FINAL REPORT FOR RELIABILITY
PANEL DRAFT DETERMINATION

Prepared for:

AEMC Reliability Panel

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Tasmanian frequency operating standards: benefit-cost analysis

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DISCLAIMER

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EXECUTIVE SUMMARY

This report provides a benefit-cost analysis of the options for possible changes to the power system frequency operating standards for the Tasmanian region of the National Electricity Market (NEM) being considered by the Reliability Panel. The report has been written to accompany a report by the Reliability Panel on this matter. Changes to the standards are being considered in the light of proposals for the construction of new thermal generating units in Tasmania.

In conducting the primary benefit-cost analysis we have needed to consider two crucial threshold matters:

- Whether it is prudent to assume additional base load generation capability in Tasmania may seek to connect to the Tasmanian network. A high-level analysis indicates that over the range of possible load growth and hydro inflow scenarios, the answer to this question is "yes"; and
- It is not possible to facilitate the connection of modern efficient CCGT plant without an effective tightening of the Tasmanian frequency standards.

CRA's analysis comes down to two basic questions:

- Is there a net benefit from making a change to the Tasmanian frequency operating standards in order to facilitate the connection of modern efficient CCGT plant?
- If the answer to the question above is "Yes", what is the best change to make?

Considerations and options

Alinta has proposed that the Tasmanian frequency operating standards (TFOS) – which differ from those that apply in the mainland NEM – be narrowed in crucial respects, given current standards do not facilitate the connection of high-efficiency CCGT (and co-generation) plant.

Before considering changes specific to Tasmania it is useful to note that it is technically possible to have different frequency standards in Tasmania to those applying in the mainland states of the NEM because Tasmania is interconnected to the NEM via a DC link (Basslink). As a result Tasmania operates asynchronously to the remainder of the NEM. It is also important to take account of the limited availability and potentially high costs of frequency control services in Tasmania relative to other regions of the NEM. A first principles analysis of appropriate frequency standards would therefore be likely to find that standards for Tasmania should allow for wider excursions of frequency than in the remainder of the NEM.

If the TFOS are narrowed and higher levels of ancillary services are required, the cost of ancillary services most likely will increase. However, the supply of FCAS in Tasmania is limited and some incumbents have expressed concern that they would be unfairly exposed to additional costs they would be unable to recover.

Policy considerations

The possibility of narrowing the frequency excursion bands or limiting the size of the maximum contingency gives rise to some important policy considerations:

- Three types of frequency control services are employed in the NEM:

    1. primary management is through market ancillary services acquired centrally by NEMMCO. Service providers are paid and costs recovered from market participants in accordance with cost allocation rules;

    2. market ancillary services are designed to manage disturbances to frequency due to “credible single contingencies”; and

    3. larger disturbances are managed through unpaid, mandatory interruptions to either demand or generation to manage under and over frequency disturbances respectively[1].

    The level at which standards for individual plant are set therefore establishes the boundary between individual participant costs and shared costs and affects the point at which mandatory interruptions may be required.

- If new entrants were required to bear the incremental costs of services required as a result of their entry, presumably they would seek to recover this cost through higher energy charges. However they could only do so to the extent that this could be passed through in competition with other generators in Tasmania and the rest of the NEM. Quantitative analysis would be necessary to identify the extent to which this would be possible but submissions to the Panel all point to increases in costs. The net benefit to the market overall is a key factor for assessment of the merits of change.

There are precedents for both allocating additional costs to new entrants and alternatively for absorbing additional costs within the market:

- The current NEM Rules imply that change in maximum unit size is automatically accommodated in the calculation of FCAS and transmission transfer limits are set to ensure frequency remains within relevant standards, thus accommodating the changes in increased shared costs.

1 Under-frequency load shedding scheme (ULFSS) and over frequency generation shedding scheme (OFGSS).

- When Basslink was connected, to ensure maintenance of system stability, it was made a condition of connection that the owners of Basslink arrange for load to be interrupted in Tasmania if Basslink trips.

Limiting contingency size

Logically, there will be a reasonable limit to the size of the contingency that should be managed by shared ancillary services and, at some further level, it may be technically impossible to accommodate very large units. But what is this limit?

Altering the balance between shared and individual participant costs in an attempt to elicit a commercial decision about the size of the contingency may simply create a transfer of wealth without changing economic cost or benefit. However, in a market, decisions by individual participants are driven by the costs they face, not the system-wide effect and hence that balance may have economic affects.

In practice, frequency standards are used as an alternative to precise allocation of cost and benefits to individual parties. Accordingly, the standards, the rules for cost allocations and the rules for price setting, must be considered as a whole. In the end, however, it is a matter of policy choice as to how the balance between the three is set. Benefit-cost analysis can inform decisions about where that balance is set.

Is there a case for changing the standards?

Subject to implementation of effective mechanisms to allocate the costs of contingencies to the owners of relevant generating units, analysis indicates that there is a strong probability that there *is* a net benefit from making a change to the Tasmanian frequency operating standards in order to facilitate the connection of high-efficiency CCGT plant.

What form of change is appropriate?

In determining the appropriate structure for amended frequency standards in Tasmania, the following decision steps were applied:

1. The case to ensure frequency standards are not a barrier to high efficiency CCGT plant has been made.

2. Typical sizes for new entrant high-efficiency CCGT plant is unable to operate below 47.0 Hz (small-sized plants can).

3. In order to prevent system collapse when typical CCGT plant is connected, the Tasmanian under-frequency load shedding scheme (UFLSS) must complete its operation at or above 47.0 Hz.

4. UFLSS requires a band of at least 1.0 Hz in which to operate and must therefore operate between 48.0 Hz and 47.0 Hz (advice from Transend and NEMMCO).

5. A basic premise of the management of security of operations in the NEM is that the UFLSS should not operate on a single credible contingency and, therefore, the lower bound of the single contingency frequency excursion band must be (effectively) 48.0 Hz.

Analysis of evidence presented in submissions leads to the conclusion that there is a case for facilitating the connection of high-efficiency CCGT by tightening the frequency standards, albeit not to the extent of alignment with the NEM, and limiting the size of the largest generator contingency. The final choice between alternative forms of change to the overall arrangements comes down to the following:

- Do not formally change existing frequency standards but allow modification of existing minimum access standards to allow new entrants to connect and meet some part of additional costs ensuring:
  - operation of their plant does not cause existing frequency standards to be breached should their own plant trip; and
  - additional services are privately procured that would prevent frequency excursions sufficient to damage their own plant.
- Formally narrowing current frequency standards, access standards and protection schemes to ensure frequency excursions are limited to ranges that would not create untenable plant lifetime degradation or maintenance costs and relying on the FCAS market to bring forward additional frequency control services.

Formally changing the standards and relying on the market to bring forward the additional FCAS required is the most direct approach but carries some risk that participants will not be prepared to present additional volume of services to the current FCAS market or will do so at significantly higher cost.

Advice from NEMMCO and Transend, and the views of stakeholders making submissions on the issue, all point to untenable costs if contingency size is unfettered. Submissions from Alinta accept the benefit of limitations on contingency size where needed.

Accordingly a package of changes that include a limitation on contingency size, and obligations for new entrants to procure additional services together with a narrowing of frequency bands within the standards, are warranted and provide a net benefit. It is a matter of regulatory and policy choice as to whether this is achieved through:

- formal narrowing of the frequency standards with some form of limitation on contingency size; or
- minimal changes to the frequency standards in conjunction with requirements for limiting contingency size and bringing interruptible load capability to market.

The economic and technical outcomes are the same. An interim arrangement to rely on tighter conditions for a period should be considered.

1. INTRODUCTION

This report provides a benefit-cost analysis of the options for possible changes the power system frequency operating standards for the Tasmanian region of the National Electricity Market (NEM) being considered by the Reliability Panel. The report has been written to accompany a report by the Reliability Panel on this matter.

1.1. TERMS OF REFERENCE

The terms of reference for this matter requires CRA to provide the Reliability Panel (RP) with a written report on the following issues:

1. *Technical assessment of any proposed changes to the Tasmanian frequency operating standards (the "standard"), including whether the proposed standards can be operationalised.*

2. *Costs of changing (tightening) the standard, including the impact on ancillary services and any changes to the Basslink control systems and Tasmanian under frequency load shedding and over frequency generator tripping schemes.*

3. *Benefits of changing (tightening) the standard, including increased competition from allowing additional types of generator technologies to be connected.*

4. *The specification of the economic framework for cost benefit analysis required of possible changes to the standard.*

5. *Assessment of any proposed changes, including modifications to the proposed changes in order to optimise the overall effectiveness of the standard both technically and economically.*

The work is to be based on qualitative analysis and informed by available quantitative material – for example, from submissions.

1.2. BROAD OPTIONS

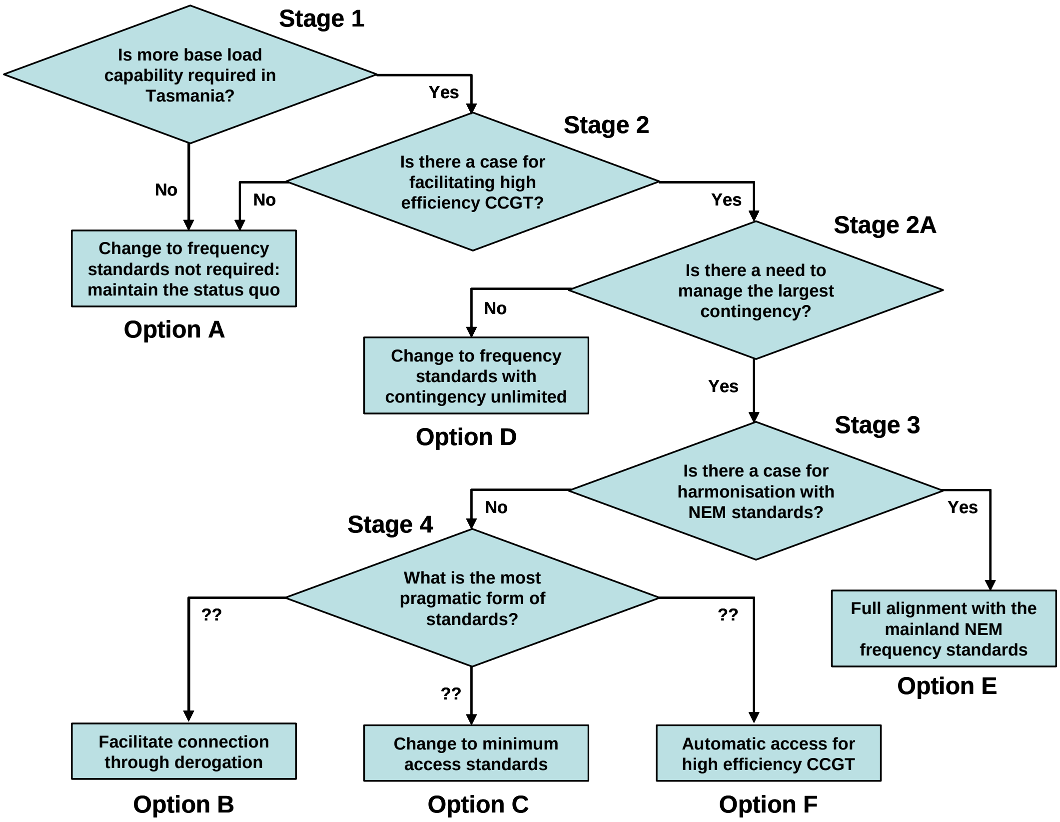
At the extremes of the options for decisions on the future Tasmanian frequency operating standards are:

- maintaining the status quo; and

- full harmonisation with the mainland NEM.

Between these extremes there is a range of options that could include those proposed by parties making submissions to the Reliability Panel's consultation, or some variant. CRA's analytical framework for the assessment of the range of options A through F is outlined in Figure 1.

Figure 1: Analytical framework



The analysis that follows is predicated on the assumption that there is a step change in efficiency between:

- base load generation plant capable of operating within the current Tasmanian frequency operating standards; and
- high-efficiency CCGT plant similar to that recently connected in mainland NEM locations but incapable of operating within the current Tasmanian frequency operating standards.

1.3. THRESHOLD QUESTIONS

Before proceeding to analyse whether there a net benefit to the market from making a change to the Tasmanian frequency operating standards, the first stage of analysis is to consider the following question:

> **Stage 1:** Is more base load generation capability required in Tasmania?

In the absence of any investment in additional generation capability in Tasmania, if any of the following were to occur:

- higher than medium economic growth; and/or

- lower than estimated long term average hydro energy inflows; and/or
- reduced energy availability (compared to recent history) from the Bell Bay Power Station or Bell Bay Three Power Station,

then energy shortfalls would have to be met by operating Basslink as (more of) a net energy importer. Therefore, on the basis of high level analysis (see Appendix A for more details) there is a *probability* that efficient development of the Tasmanian power system would involve the incorporation of additional base load plant. In undertaking an assessment to change (or not) the Tasmanian frequency operating standards, further stages of analysis are based on the high-level finding that base load plant will need to be developed in Tasmania.

In undertaking our analysis, CRA notes that it is not possible to facilitate the connection of modern efficient CCGT plant without an *effective* tightening of the Tasmanian frequency standards[2]. That is, a decision to *not* change key aspects of the frequency standards is akin to determining that future base load generation in Tasmania will need to be of a substantially different configuration to the high efficiency CCGT plant 'of choice' in the mainland NEM.

CRA's assessment of the benefits and costs of alternatives to the status quo thus proceeds on the basis of the following further stages of analysis:

Stage 2: Is there a case for facilitating the connection in Tasmania of high efficiency CCGT plant by making changes to the status quo for frequency standards, under- and over- frequency management schemes and cost allocations?

Stage 3: If the result of Stage 2 analysis is: "Yes, there is case for facilitating the connection in Tasmania of high efficiency CCGT plant", then is it warranted to harmonise the Tasmanian frequency operating standards with those of the mainland NEM?

Stage 4: If the result of Stage 3 analysis is: "No, it is *not* warranted to harmonise the Tasmanian frequency operating standards with those of the mainland NEM", then what is the nature of the set of standards between the status quo and NEM harmonisation that offers the greatest net benefit?

1.4. STRUCTURE OF THIS REPORT

The remainder of this report is structured as follows:

2 See further discussion in Section 2.1.

- Section 2 canvasses the considerations and broad options involved in developing a reasoned position on possible changes to Tasmanian frequency operating standards;

- Section 3 sets out the case for change from the status quo in order to facilitate the connection of high efficiency CCGT plant and examines the viability of the two extreme options of either doing nothing or harmonising the Tasmanian and mainland frequency standards; and

- Section 4 examines the viability of specific forms of standard that sit between the two extremes – that is, facilitating connection of high efficiency CCGT plant by either derogation to minimum access standards or adoption of amended automatic access standards; and

- Section 5 presents the case for adopting a package of measures that amend minimum access standards, while considering alternative levels of change to the Tasmanian frequency standards.

2. CONSIDERATIONS AND OPTIONS

2.1. NARROWING THE FREQUENCY EXCURSION BANDS

A proposal has been put to the Reliability Panel to narrow the Tasmanian frequency operating standards (TFOS) in crucial respects. In response to request for submissions on this matter, a number of parties have proposed alternative amendments to the TFOS, while others have proposed less far reaching changes to the TFOS that would be accompanied by an amendment to related requirements in the National Electricity Rules (NER) affecting the connection of plant to the power system. Under the NER the Reliability Panel has the authority to amend the TFOS but is unable to amend other provisions under NER – although the Reliability Panel can make recommendations to the AEMC in this regard.

Physically, it is possible to have different frequency standards in Tasmanian to those applying in the mainland states of the NEM because Tasmania is interconnected to the NEM via a DC link (Basslink) and operates asynchronously to the remainder of the NEM. The current TFOS allows excursions of frequency down to 47.5 Hz under credible single contingencies and includes an extreme frequency excursion tolerance limit of 46.0 Hz. Under clause S5.2.5.3(c) of the NER, this extreme limit is part of the minimum access standard for connection of generators. The current limit is wider for Tasmania than the NEM but narrower than the limit that applied before Tasmania's interconnection to the NEM via Basslink.

On the presumption that additional base load capability is required in Tasmania, an obvious candidate plant for installation is CCGT[3]. However, the frequency excursion ride-through capability of high-efficiency CCGTs is understood to be as follows[4]:

- indefinite operation between 47.5 Hz and 52.0 Hz;
- for under-frequency events:
  - 47.0 Hz to 47.5 HZ for 15 seconds in any single event;
  - trip at ≤ 47.0 Hz with 2 seconds delay, with output running down to 20 MW as soon as frequency falls below 47.0 Hz;
- for over-frequency events trip at 52.0 Hz with 0.1 seconds delay.

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3 See discussion in Section 1.3.

4 See p. 13, of Alinta submission available at: http://www.aemc.gov.au/pdfs/reviews/Review%20of%20Frequency%20Operating%20Standards%20for%20Tasmania/Submissions/001Alinta%20Submission%20-%20revised%2021%20May%202008.pdf

Therefore, given the existing TFOS, high-efficiency CCGT plant is *not* able to comply with the requirements to remain connected at frequencies down to the current level of the lower bound of the extreme frequency excursion tolerance limit band of 46.0 Hz.

The under-frequency limitations have three potentially significant effects:

1. high-efficiency CCGT plant potentially would be exposed to frequencies that can lead to damage to the plant due to regular excursions in frequency when other plant "trips" from the system and frequency falls below 47.5 Hz;

2. because of the size of high-efficiency CCGT plant, increased levels of ancillary service would be required to ensure frequency remains within the TFOS when the CCGT plant itself trips; and

3. high-efficiency CCGT plant does not comply with the minimum access standard under the NER.

If the TFOS are narrowed as proposed and higher levels of ancillary services are required, the cost of ancillary services most likely will increase. To the extent the additional level of ancillary service is provided by Hydro Tasmania plant, Hydro Tasmania has submitted that not only would it need to provide additional service volume but that it could only do this by operating its plant at lower efficiency, also increasing cost and consuming additional water. Hydro Tasmania has submitted that it may not be able to meet all of the additional requirement all of the time and, as a result, it may be necessary for NEMMCO to restrict flow on Basslink to ensure ancillary service can be sourced from the remainder of the NEM. It is also notable that under the NER the cost of the relevant ancillary service (raise FCAS) is recovered from generators in the relevant region. As the dominant generator in the region, Hydro Tasmania would both provide much of the additional the service and also pay for it – a zero sum game at best.

If no changes are made to either the TFOS or other provisions of the NER, high-efficiency CCGT plant will be unable to meet the minimum access standard for "Generating unit response to frequency disturbances" and, hence, not be entitled to connect.

2.2. LIMITING THE SIZE OF THE MAXIMUM CONTINGENCY

An alternative approach to narrowing the TFOS is to not amend the TFOS, but require affected plant to make arrangements to limit the size of a disturbance by purchasing additional ancillary service outside the formal market ancillary service arrangements[5]. Such an arrangement could ensure that the size of the disturbances is limited to a specified level – it may also be possible for participants with both load and generation to make this arrangement internally. This arrangement is similar to the obligation that has been placed on Basslink, which is required to arrange for "inter trip" of load in Tasmania to reduce the effect of a trip of Basslink to be equivalent to the size of the largest currently exiting unit in Tasmania, namely the 144 MW units operated by Hydro Tasmania.

However, such an arrangement is a de facto narrowing of the standard, with the incremental costs of maintaining tighter frequency control borne by the new entrant. This is because *any* plant that connects in the future and is unable to tolerate excursions beyond, say, 48Hz would also need to make similar arrangements to protect itself against the system effects of a trip of the existing 144 MW maximum effective contingency size[6]. This would apply even if the plant itself is smaller than 144 MW.

2.3. POLICY CONSIDERATIONS

The possibility of narrowing the frequency excursion bands or limiting the size of the maximum contingency gives rise to a number of policy considerations.

As a general principle, frequency standards should be set to provide a cost effective service quality and facilitate smooth operation of the primary energy market. Consistent with other technical standards in the NEM, the frequency standards set the limits on system frequency excursions that plant connecting to a transmission network can expect to be exposed to and, conversely, also set limits on the impact that individual plants that are connected to the network may have on other plants.

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5 Submissions from both Hydro Tasmania (Third Supplementary Submission) and Alinta (Second Supplementary Submission) raise this as a viable way forward. Submissions available at: http://www.aemc.gov.au/electricity.php?r=20080424.133954

6 From Hydro Tasmania units, Basslink and plant larger than 144 MW with inter trip agreements to limit the effective size to 144 MW

An implicit cost of doing business in the market is that each participant must carry the cost of meeting the standard for individual plants. But the cost of ensuring the system performs in accordance with the standard, and does not expose other connected plant to frequencies outside the plant's technical envelope, is treated as a common good. Accordingly, appropriate services are acquired centrally through market ancillary services, with costs allocated among market participants in accordance with cost sharing rules. In the NEM, the cost of controlling minor variations in frequency (regulating service) is recovered on a causer-pays basis from both generators and customers. Generators are charged for ancillary services scheduled in preparation for a major fall in frequency, and customers are charged for services scheduled to cover the risks of a major rise in frequency.

The level at which the standards are set therefore establishes the boundary between individual participant costs and shared costs. Any change in the standards unavoidably shifts the allocation between individual parties and shared costs, although the shift may be counteracted and complicated by cost allocation rules that are also open to amendment.

Of the alternatives discussed above, changing the standards would mean an increase in shared costs, as these standards facilitated the entry of large, and presumably more cost-effective, new generation. Changing frequency standards would therefore be justified if increased FCAS (and other) costs were outweighed by savings in energy costs arising through the introduction of cost-effective generation.

The alternative, which leaves the standards unchanged but requires new entrant plants to acquire ancillary services off market, results in an effective narrowing of the frequency excursions observed in Tasmania without changing the standards – a de facto change in standards – but would shift the burden of cost for the additional services to the new entrants. Presumably the new entrants would seek to recover this increase in cost through higher energy charges and could only do so to the extent that this could be passed through in competition with other generators in Tasmania and the rest of the NEM. Quantitative analysis would be necessary to identify the extent to which this would be possible.

There are precedents for allocating additional costs to new entrants and also for absorbing additional costs within the market:

- In the mainland NEM, change in maximum unit size has been automatically accommodated in the calculation of FCAS and transmission transfer limits, thus accommodating the changes via increased shared costs.
- When Basslink was connected, to ensure maintenance of system stability, it was made a condition of connection that the owners of Basslink arrange for load to be interrupted in Tasmania if Basslink trips.

The current standards recognise that it may not be cost effective to require the standards to be met if ancillary services cannot be drawn from across the entire network. For this reason, standards include provision for islanded conditions – that is *any* part of the *normally interconnected* transmission system that is separated from other parts. The question of a section of the network connected by a DC link, as is the case for Tasmania, has been implicitly accepted as a *normally islanded* condition and led to the separate and wider standards in Tasmania. Logically, therefore, there is no case to argue that the standards in Tasmania should, as a matter of principle, be aligned with the standards in other parts of the market. Further, a first principles analysis of appropriate frequency standards would be likely to find that standards for Tasmania should allow for wider excursions of frequency than in the remainder of the NEM. However, this situation still leaves open the fundamental question as to what standards should apply in Tasmania.

More generally, all frequency standards are set on the basis of a balance between:

- costs;
- historical practices for both local system operation;
- available equipment characteristics; and
- expected future conditions.

The current standards for the mainland NEM were set on the basis of the practices of the previous utility operations. These standards had been established to be consistent with the characteristics of the type of generating plant and customer equipment currently employed and expected to continue in the future. Frequency standards have since been refined but not materially changed. Previous Tasmanian frequency standards had been developed using a similar philosophy, but because of the smaller system and different characteristics of the dominant hydro plant, a different set of standards applied.

Logically, there will be a reasonable limit to the size of the contingency that should be managed by shared ancillary services and, at some further level, it may be technically impossible to accommodate very large units. For example, consider a hypothetical proposal to install a very large generator in Tasmania. At some point there would simply not be sufficient customer load to manage the effect of a trip of this unit without complete blackout – the implied cost to the community would be so great that the proposed generating unit could not be viably accommodated. However, at intermediate sizes the costs and risks would be less and, at some point, the benefits of major sales of energy at (presumably) cost-effective prices would outweigh the risk of blackout and cost of additional ancillary services. The problem is that unless the proponent of the plant is exposed to all of the relevant costs it would not be in a position to make the call about how large is too large. Other than for Basslink, nowhere has the NEM had to consider a proposal to install significantly larger plant than has previously existed, leading to a *material* shift in availability and cost of shared services. As noted previously, Basslink has been required to purchase what is, in effect, a private ancillary service.

We have noted that one approach to this dilemma is limiting the size of contingencies, and, by default, requiring new entrants who cannot tolerate the current frequency standards to acquire private ancillary services. However, if the frequency standards were narrowed but the costs of ancillary services shared in a more cost reflective manner, market participants would see market incentives to either decide to pay increased FCAS costs or to acquire private ancillary services (by limiting the size of their contribution). “Runway” pricing has been discussed in the past as a means to refine the cost allocation and is used in other markets including New Zealand and Singapore.

Altering the balance between shared and private costs may be a question of wealth transfer without changing economic cost or benefit but, in a market, decisions by individual participants are driven by the costs they face, not the net effect. In a real world market standards such as the frequency standards are used as an alternative to precise allocation of cost and benefits to individual parties. Accordingly, the standards, the rules for cost allocations and the rules for price setting must be considered as a whole, but in the end it is a matter of policy as to how the balance between the three is set. Benefit-cost analysis can inform decisions about where that balance is set.

3. THE CASE FOR CHANGE

3.1. POSSIBLE EXTREMES

In Stage 1 of this analysis (Section 1) we concluded that there was a sufficient probability that efficient development of the Tasmanian power system would include additional base load generating plant for analysis of the frequency standards to presume this was the case. Only smaller and inherently less efficient new entrant base load plant can meet the current standards and this begs the question as to whether the standards should be changed to facilitate entry of larger and potentially higher efficiency plant. This question is examined in Stage 2 of our analysis. Stage 3 considers if the result of Stage 2 analysis is: "Yes (there is case for facilitating the connection in Tasmania of high efficiency CCGT plant)", then is it warranted to harmonise the Tasmanian frequency operating standards with those of the mainland NEM? Stage 4 considers alternative changes that lie between the two extremes.

3.2. STAGE 2: SHOULD WE SHIFT FROM THE STATUS QUO?

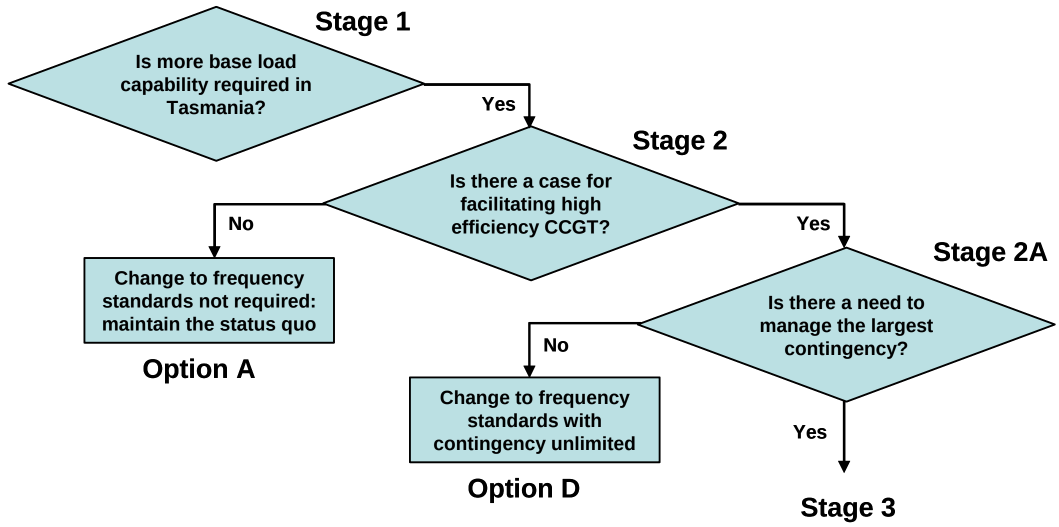
This section analyses:

- whether there is a case for changing from the status quo standards and facilitating the connection in Tasmania of high efficiency CCGT plant

and, if so:

- whether the size of the maximum generator contingency should be limited.

Figure 2: Analytical framework – Stages 2 and 2A



The status quo arrangements (**Option A**) were established to suit the size of the Tasmanian power system and the nature of the generating plant that was suited to it including the existing thermal and hydro units.

Submissions to the Reliability Panel have confirmed that although it is possible to acquire new plant that can meet the status quo, such plant is generally more expensive and limited in size. Therefore in order to allow for a broad range of plants typically utilised in power systems it would be necessary to narrow the frequency standards. Such a change would increase costs of frequency management and require changes to associated protection schemes but would, in turn, also deliver a reduced energy price.

The key elements of the answer to Stage 2 analysis will be a function of:

- the energy cost saving to Tasmanian customers arising from:
  - having relatively high cost new marginal base load plant in a system with unchanged frequency standards;

  compared to:

  - having relatively low cost new marginal CCGT plant in a system with amended frequency standards; and
- FCAS cost that is carried by the market as a result of tighter frequency standards and greater single contingency size;
- other relevant costs and benefits carried by the market as a result of tighter frequency standards and greater single contingency size; and

In conducting such an analysis, it should be carefully noted that how much of an energy cost saving finally emerges would be a function of:

- the percentage of time the new plant was the marginal generator and thus setting the price in Tasmania; and
- the opportunity the generator has to pass-on (in higher prices) any additional costs the generator may face in terms of higher FCAS or contingency management costs.

For the purposes of this analysis we have not been asked to undertake independent quantitative analysis and have relied on advice and submissions from stakeholders and market authorities including NEMMCO and Transend.

3.2.1. The minimum change

If any change to TFOS were to be made to facilitate a high efficiency CCGT, before an assessment of the value of change can be made, there is a need to identify the minimum change that is necessary in order to establish a benchmark for benefits and costs.

A necessary requirement of a sustainable environment in which a high efficiency CCGT operates is that the system must be capable of withstanding the shocks created by a range of plausible multiple contingency events. Plausible multiple contingency events that trigger operation of the UFLSS should therefore be capable of being contained before the UFLSS completes its operation. The lower bound of a UFLSS (currently set at 46.0 Hz) that is consistent with preventing system collapse would thus be a critical parameter.

In an environment in which a high efficiency CCGT operates, a chain of logic establishes the operation of the UFLSS operation between 48.0 Hz and 47.0 Hz and the lower bound of frequency excursions created by single credible contingencies as no lower than 48.0 Hz. The logic is as follows:

- A high efficiency CCGT would trip at 47.0 Hz with approximately 2 seconds delay, the UFLSS and associated protection schemes must be robust to such an eventuality.
- Advice from Transend is that under feasible multiple contingencies, should frequency be falling on a trajectory towards 46.0 Hz – as per the current lower limit of the multiple contingency band – voltage instability is such that loss of load to mask the trip of CCGT at 47.0 Hz is likely to send the Tasmanian system black through extreme under- or over-voltage.
- The UFLSS must complete its operation by 47.0 Hz to avoid the extreme under- or over-voltage that would occur through loss of high efficiency CCGT and additional load at 47.0 Hz.
- Advice from Transend and NEMMCO is that the UFLSS could not operate in a band tighter than 1.0 Hz and must, therefore, operate in a band no lower than between 48.0 Hz and 47.0 Hz.
- As a single credible contingency should not cause the operation of the UFLSS, the lower bound of frequency excursions created by single credible contingencies can be no lower than 48.0 Hz.

Accordingly, any proposal to assess the value of changing the frequency standards in order to facilitate the connection of a high efficiency CCGT is constrained to one where frequency excursions created by single credible contingencies are no lower than 48.0 Hz.

Table 1 outlines the requirements for FCAS R6 for a range of system demands / inertia:

- under existing arrangements; and
- with a lower bound on the single contingency band of 48.0 Hz with:
  - a maximum contingency size of 144 MW; and
  - a maximum contingency size of210 MW.

Table 1: Typical Tasmanian FCAS R6 requirements

Tasmanian demand (MW)	900	1,000	1,400	1,800
47.5 Hz & 144 MW contingency (existing requirements)	95.2	89.9	66.7	47.0
48.0 Hz & 144 MW contingency	125.7	116.8	81.5	64.5
48.0 Hz & 210 MW contingency	306.5	290.5	159.8	129.4
Tasmanian inertia	4,500	4,600	7,300	9,700

Source: NEMMCO advice to the Reliability Panel, 23 May 2008[7].

3.2.2. Evidence of material incremental costs from Hydro Tasmania

Hydro Tasmania provides information in its submissions that provide some insights into possible energy cost savings and incremental FCAS costs that would arise should frequency standards be changed to allow the entry of modern CCGT plant.

Potential energy cost savings

A key aspect of the benefits that would arise from facilitating connection of high efficiency CCGT plant is that this new entry plant would have a lower long run marginal cost (LRMC) than would otherwise be the case, with the expectation that lower LRMC would translate into energy cost savings.

Hydro Tasmania, in a presentation to the Reliability Panel, indicated that robust gas-fired units capable of operating under current Tasmanian frequency standards have a capital cost 12% higher than high efficiency CCGT plant, and a SRMC 3% higher than high efficiency CCGT plant[8].

An estimate of the LRMC differential between high efficiency CCGT plant and robust gas-fired units capable of operating under current Tasmanian frequency standards can be developed:

- using the Hydro Tasmania estimates of the capital cost and SRMC differential;

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7 Available at: http://www.aemc.gov.au/pdfs/reviews/Review%20of%20Frequency%20Operating%20Standards%20for%20Tasmania/panel/002NEMMCO%20advice%20to%20Reliability%20Panel.pdf

8 Refer slide 9 of: http://www.aemc.gov.au/pdfs/reviews/Review%20of%20Frequency%20Operating%20Standards%20for%20Tasmania/Submissions/017Hydro%20Tasmania%20supplementary%20submission.pdf

- using published data on the costs of relevant CCGT plant operating cost and parameters for high efficiency CCGT plant[9] as follows:
  - capital cost of $1.1 million / MW;
  - fixed operating and maintenance (FOM) costs of $12,800 / MW / year;
  - variable operating and maintenance (VOM) costs of $4.85 / MWh;
  - heat rate 6.96 GJ / MWh;
  - fuel cost $3.75 / GJ; and.
- assuming a 20 year project life, (real, post-tax) WACC of 9.75% and 80% plant utilisation rate.

On the basis of the foregoing data and assumptions:

- the LRMC for (small) high efficiency CCGT plant is $50.68 / MWh; and
- the LRMC for robust gas-fired units capable of operating under current Tasmanian frequency standards is $53.77 / MWh,

there is a $3.09 / MWh LRMC advantage to the high efficiency CCGT plant.

Allowing for possible variation in key parameters[10], the LRMC differential probably lies somewhere in the range of $3.00 to $3.50 / MWh.

Incremental FCAS costs

Given the FCAS requirements outlined in Table 1, in advice to the Reliability Panel Secretariat, Hydro Tasmania reports incremental costs for locally sourced FCAS under a range of scenarios as outlined in Table 2.

Table 2: Hydro Tasmania estimates of incremental FCAS costs relative to the status quo*

Lower bound of single contingency band	Largest single contingency	FCAS cost ($ million p.a.)
48.0 Hz	144 MW	3.5
48.0 Hz	210 MW	14.6

* Impact per annum on Hydro Tasmania.

9 ACIL Tasman, *Energy costs for Queensland electricity tariffs in 2007/08 and 2008/09*, March 2008. Available at: http://www.qca.org.au/files/E-NEP0809-AGL-BRCISub-Add.pdf

10 With a price of $5.00 / GJ for gas, the LRMC differential becomes $3.35 / MWh.

Inefficient operation of Basslink

Hydro Tasmania claims that with additional FCAS requirements (as per Table 1), Basslink would be required to operate less efficiently – at lower transfer levels – than is currently the case. Hydro Tasmania has valued the efficiency loss to itself under various scenarios as summarised in Table 3.

Table 3: Hydro Tasmania advice of Basslink reversal inefficiency

Lower bound of single contingency band	Largest single contingency	Basslink reversal inefficiency ($ million p.a.)
48.0 Hz	144 MW	1.2
48.0 Hz	210 MW	6.8

* Hydro Tasmania estimates of Basslink efficiency costs to Hydro Tasmania relative to the status quo.

3.2.3. Evidence of material incremental benefits and costs from Alinta

Alinta has presented modelling results to the Reliability Panel indicating changes in energy and FCAS costs based on a comparison of results from the following scenarios:

- facilitation of the connection of TVPS CCGT and Gunns co-generation plants; and
- no additional base load generation in Tasmania.

Alinta suggests that in comparing the results from these scenarios, savings in the sum of annual energy and FCAS R6 costs is in the order of $50+ million per annum[11].

3.2.4. Evidence of material incremental costs from other respondents

Other respondents to the Reliability Panel's consultation have provided qualitative evidence of costs that would arise as a result of the need to change operation of:

- the under-frequency load shedding scheme;
- the over-frequency generator shedding scheme;
- the Basslink frequency control special protection scheme; and
- the Basslink frequency controller.

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11 Refer slides 11 – 15 of AETV presentation to the Reliability Panel, 30 July 2008. Available at: http://www.aemc.gov.au/pdfs/reviews/Review%20of%20Frequency%20Operating%20Standards%20for%20Tasmania/Submissions/016Alinta%20-%20supplementary%20submission.pdf

None of the evidence presented indicates any more than modest cost involved in making the necessary once-off changes to these facilities. Anecdotal evidence indicates that the combined cost of the above changes would be less than $1 million.

Roaring 40s has submitted that its operations would be affected if it were to be exposed to substantial increases in FCAS costs, to the extent that it may be encouraged to invest in other regions of the NEM. However, no cost estimates of this effect has been provided.

3.2.5. Assessment of the evidence of the case for change from the status quo

In order to use the evidence presented by respondents to the Reliability Panel consultation to develop a clear case for or against a change from the status quo, the limitations of the evidence needs to be understood. The long term interests of consumers of electricity would be served if the benefits of change to consumers outweigh the costs of change to consumers.

However, none of the evidence presented by respondents directly addresses the benchmark case for change adopted by CRA that seeks to compare:

- a future with status quo frequency standards and new relatively high costs generation entry;

to

- a future with tighter frequency standards and high efficiency CCGT entry.

The Alinta market outcomes modelling compares:

- a future with status quo frequency standards and no new generation entry;

to

- a future with tighter frequency standards and high efficiency CCGT and co-generation entry.

The Hydro Tasmania evidence reports the impact on Hydro Tasmania of incremental FCAS charges and Basslink efficiency losses comparing:

- the current environment with status quo frequency standards and no new generation entry;

to

- a future with tighter frequency standards and high efficiency CCGT and co-generation entry.

Deriving conservative estimates of market-wide benefits and costs

Notwithstanding the different bases on which evidence is presented, CRA believes it is possible to develop plausible conclusions using aspects of available evidence. The basic elements of the analysis would be putting together conservative estimates of whole of market impacts on the three key factors as follows:

- **Energy cost savings**

  On the basis of information from Hydro Tasmania on incremental SRMC and capital costs, CRA estimates a $3.25 / MWh LRMC advantage to the high efficiency CCGT plant. If, in a market situation the new entry gas-fired base load plant was marginal in Tasmania for, say 50% of the time, then with a 10,000 GWh annual energy load – and assuming the price at all other times was unchanged – Market Customers would save:

  *$3.25 / MWh x 10,000 GWh x 50% = **$16 million per annum***

- **Incremental FCAS costs**

  In the foreseeable future it is likely that even with relatively low hydrological inflows and entry of new base load plant, Hydro Tasmania would provide at least 75% of energy in Tasmania, therefore making it liable for around 25% of local FCAS R6 costs. On this basis, a conservatively high estimate of total market FCAS costs could be derived by inflating the Hydro Tasmania FCAS R6 costs by around 30% to yield costs as outlined in Table 4.

Table 4: Incremental (conservatively high) market impact of FCAS costs

Lower bound of single contingency band	Largest single contingency	FCAS cost ($ million p.a.)
48.0 Hz	144 MW	5
48.0 Hz	210 MW	19

- **Basslink efficiency costs**

  Basslink reversal inefficiency would result in costs to parties both in Tasmania and in the mainland NEM. In the absence of detailed market modelling it is very difficult to estimate the level of impact to parties on both sides of Basslink. However, an arguably conservatively high estimate could be produced by doubling the Hydro Tasmania impact to yield a market wide impact as outlined in Table 5.

Table 5: Incremental (conservatively high) market impact of Basslink reversal inefficiency

Lower bound of single contingency band	Largest single contingency	Basslink reversal inefficiency ($ million p.a.)
48.0 Hz	144 MW	3
48.0 Hz	210 MW	13

Conclusion

A summary of the evidence available to CRA via examination of material presented in submissions to the Reliability Panel yields conservatively estimated benefits and costs as outlined in Table 6. CRA is not aware of any other material non-quantifiable costs. A point for further consultation would be whether there are any *material* costs that have not been accounted for in the above analysis.

Table 6: Benefits and costs relative to the base case

Scenario	Energy cost savings ($ million p.a.)	FCAS cost ($ million p.a.)	Basslink reversal inefficiency ($ million p.a.)	Net benefit ($ million p.a.)
high efficiency CCGT … 48.0 Hz … 144 MW	16	5	3	8
high efficiency CCGT … 48.0 Hz … 210 MW	16	19	13	-16

On the basis of the above, provided some mitigants were adopted to limit the size if the maximum generator contingency, a case could be made to change the frequency standards – by at least raising the lower bound of the single contingency band to 48.0 Hz – to facilitate the connection of high efficiency CCGT[12].

The status quo (**Option A** in Figure 2) would be recommended only if Table 6 was unable to identify an option with a positive net benefit. Given a scenario requiring limitation of frequency excursions to 48.0 Hz following a single contingency event has a net benefit ($8 million p.a.) *provided* the size of the largest generator contingency is limited to 144 MW, then the status quo (**Option A**) is ruled out.

Note also that the scenario whereby limitation of frequency excursions to 48.0 Hz following a single contingency event has a net cost ($16 million p.a.) if the size of the largest generator contingency is 210 MW. Accordingly, changing the frequency standards without placing a limitation on the size of the largest generator contingency (**Option D**) can also be ruled out.

12 It is notable that no submissions to the Reliability Panel were opposed to facilitating entry but were divided on how this occurs.

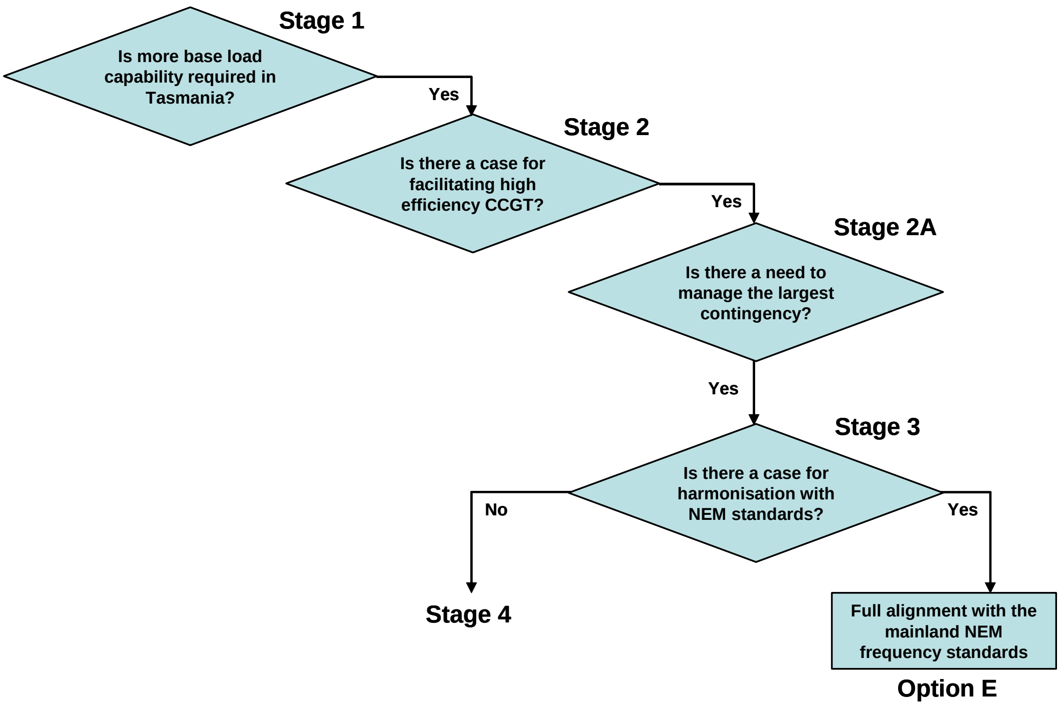
Qualifications to this assessment would be that:

- any other changes ultimately adopted did not introduce material additional costs; and
- the energy cost savings were not eroded through the introduction of measures to limit the size of the maximum generator contingency by parties seeking to recover the costs of those measures through higher market prices.

3.3. Stage 3: Should Tasmanian standards align to the mainland NEM?

Having assumed that more base load capability is required in Tasmania and that there is a case for facilitating the connection of high efficiency CCGT plant – provided appropriate mitigants to limit the size of the largest generator contingency are put in place – attention now turns to analysis of whether or not there is a case for Tasmanian frequency standards to be fully harmonised with those of the mainland NEM (**Option E**). The option is considered but ultimately ruled out.

Figure 3: Analytical framework – Stage 3



If frequency standards in Tasmania were to be set on the basis of a first principles analysis involving assessment of:

- system size;
- plant currently connected to the system;
- plant likely to be required to be connected to the system in the foreseeable future; and

- the costs of maintaining a given frequency performance,

frequency standards as tight as those applying in the NEM would not be applied. The principal reason for this conclusion is that the costs of FCAS raise and lower services necessary to maintain frequency excursions under single generator and load contingencies to a range of 49.5 Hz to 50.5 Hz would be prohibitive[13].

As noted in Section 2.1, physically, it is possible to have different frequency standards in Tasmania to those applying in the mainland states of the NEM because Tasmania is interconnected to the NEM via a DC link (Basslink) and operates asynchronously to the remainder of the NEM. Accordingly, the case for dismissing the need to harmonise the Tasmanian frequency standards with those of the mainland NEM is straightforward.

Full alignment of Tasmanian frequency standards with those of the mainland NEM (**Option E** in Figure 3) is thus ruled out as being non-viable and analysis will proceed to Stage 4.

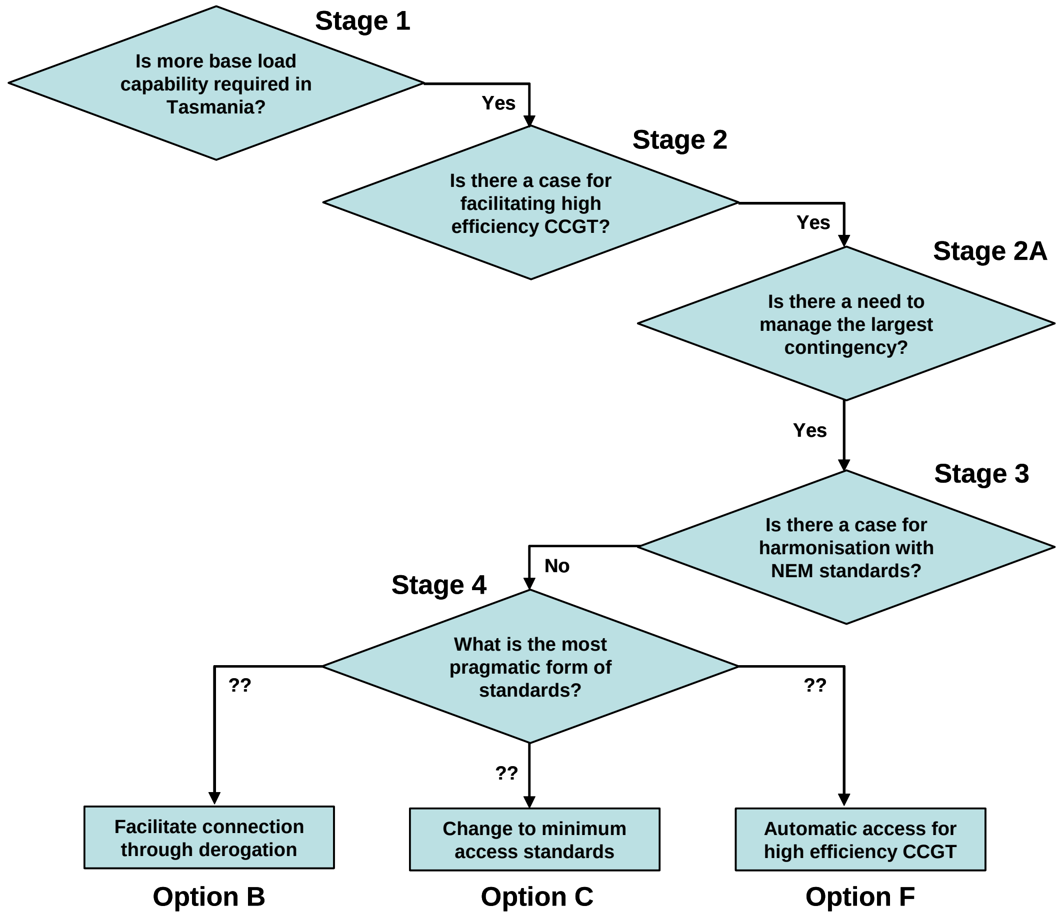
13 A conclusion reached by extrapolation of NEMMCO advice in relation to the FCAS requirements arising from tightening the lower limit of the single contingency band to just 48.0 Hz.

4. DEROGATION OR AUTOMATIC ACCESS

Section 3 outlines a case for change to the Tasmanian frequency standards that does not involve harmonisation with standards applying in the mainland NEM. Attention thus turns to Stage 4 assessment of the form of standard that would produce the greatest net benefit.

Stage 4 assessment develops three options for amended frequency control requirements. Initial assessment is of: i) use of regulatory derogation (**Option B**); and ii) changes to the TFOS such that high-efficiency CCGT plant would meet automatic access standards (**Option F**). These options are both ruled out. A third option to make targeted amendment is considered in Section 5.

Figure 4: Analytical framework – Stage 4



4.1. DEROGATION

The argument behind a proposal to support connection of high efficiency CCGT through derogation is premised on an assumption that elements of the existing frequency standards could be maintained. Key elements of this proposal would be retention of the lower bound of the single contingency band being 47.5 Hz, with minimum access standards not being met by CCGT, but connection would be allowed as a result of:

- derogation from minimum access standards for specific plant; and
- connection being subject to agreement to:
  - meet any incremental FCAS costs that emerge as a result of:
    - changed maximum contingency size;
    - need to maintain frequency within tolerable bounds for newly connected plant in the event of existing credible single contingencies;
  - ensure operation of the UFLSS was not compromised through a need to trip newly connected generating plant midway through operation of the UFLSS[14].

Section 3.2.1 presented analysis to the effect that connection of high efficiency CCGT plant could only be technically viable if:

- the UFLSS operated in a band between 48.0 Hz and 47.0 Hz; and
- the lower bound of frequency excursions created by single credible contingencies were no lower than 48.0 Hz.

Consequential to changes of the operation of the UFLSS, the minimum access standards with respect to “Generating unit response to frequency disturbances” [NER cl. S5.2.5.3] would also change such that high efficiency CCGT plant would then meet the minimum access standards (on the low side), thereby obviating the need for a derogation.

Facilitating connection of high-efficiency CCGT plant through derogation of the minimum access standards (**Option B** in Figure 4) is thus ruled out as a viable option.

14 Hydro Tasmania has submitted that alternative arrangements be established to modify the UFLSS and allow for additional customer load to be tripped in the (rare) event that frequency did fall below 47.0 Hz, as well as providing an exemption or derogation for any non compliant thermal. The objective of tripping additional load at 47.0 Hz would be to offset the inevitable loss of a (potentially) 210 MW of generation from proposed high-efficiency CCGT plant. However, advice from Transend is that under feasible multiple contingencies, should frequency be falling on a trajectory towards 46.0 Hz – as per the current (and Hydro Tasmania proposed) lower limit of the multiple contingency band – voltage instability is such that loss of load to mask the trip of CCGT at 47.0 Hz is likely to send the Tasmanian system black through extreme under- or over-voltage. (See Section 3.2.1.)

4.2. AUTOMATIC ACCESS

One means of facilitating connection of high efficiency CCGT would be to make changes to the frequency standard, access standard and associated control systems such that connection would be automatically granted. Given the known characteristics of high efficiency CCGT, this would require (at least):

- narrowing the range for the multiple contingency bands to be 47.0 Hz to 55.0 Hz;
- narrowing the range for the single contingency bands to be 48.0 Hz to 52.0 Hz;
- changing the ride-through requirements such that:
    - in low frequency events plant is only required to maintain continuous operation between 47.0 Hz and 47.5 Hz for 15 seconds; and
    - in high frequency events CCGT plant is permitted to trip instantaneously at 52.0 Hz

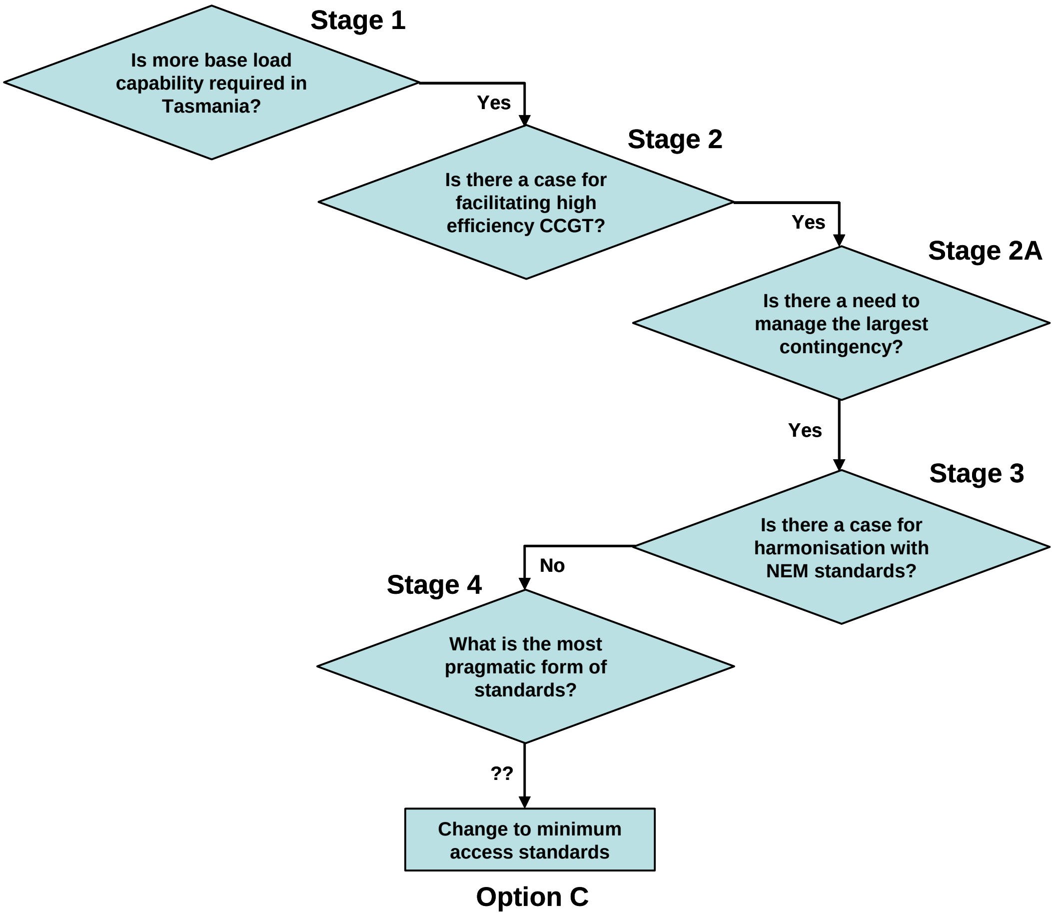
Advice from Transend indicates that the OFGSS is likely to become congested at the 52.0 Hz mark and, as such, the prospect of having multiple plant tripping at that frequency level creates risks for secure system management. Having an automatic access standard that high efficiency plant is able to meet thus creates a risk that could, instead, be managed through negotiation if high efficiency CCGT plant was capable of meeting a minimum rather than an automatic access standard.

Facilitating connection of high-efficiency CCGT plant through adjustment to the automatic access standards (**Option F** in Figure 4) is thus ruled out on the basis that having CCGT plant being able to meet a minimum access standard is to be preferred.

5. PRAGMATIC STANDARDS: MINIMUM ACCESS

Analysis to this point has eliminated options A, B, D ,E and F. The preferred Option C in Figure 5 is now developed.

Figure 5: Analytical framework – Stage 4, Option C



The objective of this section is to describe a set of arrangements that facilitate the connection of high efficiency CCGT, such that the plant would meet an appropriate set of minimum access standards, consistent with redefined frequency excursion bands and protection system settings.

5.1. MINIMUM ACCESS STANDARDS

5.1.1. Tolerance of under-frequency events

A recap of the analysis in Section 3.2.1 is valuable at this point.

In an environment in which a high efficiency CCGT operates, a chain of logic establishes the operation of the UFLSS operation between 48.0 Hz and 47.0 Hz and the lower bound of frequency excursions created by single credible contingencies as no lower than 48.0 Hz. The logic is as follows:

- A high efficiency CCGT would trip at 47.0 Hz with approximately 2 seconds delay, the UFLSS and associated protection schemes must be robust to such an eventuality.
- Advice from Transend is that under feasible multiple contingencies, should frequency be falling on a trajectory towards 46.0 Hz – as per the current lower limit of the multiple contingency band – controlled interruption of (more) load to mask the trip of CCGT at 47.0 Hz is likely to send the Tasmanian system black through extreme under- or over-voltage.
- The UFLSS must complete its operation by 47.0 Hz to avoid the extreme under- or over-voltage that would occur through loss of high efficiency CCGT and additional load at 47.0 Hz.
- Advice from Transend and NEMMCO is that the UFLSS could not operate in a band tighter than 1.0 Hz and must, therefore, operate in a band no lower than between 48.0 Hz and 47.0 Hz.
- As a single credible contingency should not cause the operation of the UFLSS, the lower bound of frequency excursions created by single credible contingencies can be no lower than 48.0 Hz.

Note that the NER requires [at clause 3.46.3]:

> … Market Customers *must provide their* interruptible load *in respect of* connection points *located in Tasmania in manageable blocks spread over a number of steps within under-*frequency *bands down to the lower limit of the "extreme frequency excursion tolerance limits" …*

Therefore, consequential to changes of the operation of the UFLSS, the lower bound of both the *extreme frequency excursion tolerance limits*[15] and the multiple contingency event band would have to be changed to 47.0 Hz. Given these changes, and the fact that the minimum access standard requires generating units to be capable of remaining on line for 9 seconds at the lower bound of the extreme frequency tolerance band, the minimum access standard with respect to ride-through capability for under-frequency events then becomes:

- 9 seconds between 47.0 Hz and 47.5 Hz; and

15 A defining element of the access standards with respect to "Generating unit response to frequency disturbances" [NER cl. S5.2.5.3].

- 2 minutes between the *transient frequency limit*[16] (currently 47.5 Hz) and the lower bound of the *operational frequency tolerance band* (currently also 47.5 Hz); and
- 10 minutes between the lower bound of the *operational frequency tolerance band* (currently 47.5 Hz) and the lower bound of the *normal operating frequency band* (currently 49.85 Hz);.

It is understood that high efficiency CCGT can meet these ride-through requirements[17].

Note that the current lower bound of the *operational frequency tolerance band* is set with reference to the lower bound of the current generation and network event band. While it would be technically possible to leave the lower bound of the *operational frequency tolerance band* at 47.5 Hz, it would render redundant the 2 minute ride-through capability component of the minimum access standard. Complication in frequency management could also arise because of the disconnect between:

- the lower bound of the *operational frequency tolerance band* at 47.5 Hz; and
- the requirement that the lower bound of frequency excursions created by single credible contingencies can be no lower than 48.0 Hz, given such contingencies should not cause the operation of the UFLSS.

These complicating factors will be discussed further in Section 5.2.1, sub-section *Minimally amended frequency excursion bands*.

5.1.2. Tolerance of over-frequency events

Given the inability of CCGT plant to ride-through frequency excursions above 52.0 Hz, the OFGSS would need to be modified to take account of the tripping of CCGT plant at 52.0 Hz (and co-generation plant at 51.6 Hz). Transend does not rule out such change although it does indicate that challenges could arise if there were multiple thermal units connected to the Tasmanian power system each seeking to trip on over-frequency at 52.0 Hz[18]. It is understood that the minimum access standard already provides discretion for NEMMCO and TNSPs to accept tripping of generation units on over-frequency in accordance with clause S5.2.5.3(c) of the NER. Hence, no change to the minimum access standard with respect to over-frequency ride-through is necessarily required in order to facilitate connection of high efficiency CCGT plant.

16 Refer NER clause S5.2.5.3(c).

17 See Section 2.1.

18 See Transend – Second Supplementary Submission, p.10. Available at: http://www.aemc.gov.au/electricity.php?r=20080424.133954

However, due to widespread agreement that the upper limit of the single contingency bands be set no higher than 52.0 Hz[19], the upper limit of the *operational frequency tolerance band* can also be set at 52.0 Hz. The change to the upper limit of the *operational frequency tolerance* band reflects an element of the minimum access standard that sets a ride-through capability able to be met by high efficiency CCGT plant.

5.2. CHANGES TO EXCURSION BANDS AND CONTROL SCHEMES

CRA has identified two potentially viable variants for definition of frequency excursion bands and incentives to manage the costs of additional FCAS that have consequential impact on the design of control schemes:

- **Option C1** – minimal change to frequency excursion bands that places responsibility for all incremental FCAS costs on the operators of plant that create the requirement for additional FCAS; and
- **Option C2** – comprehensive change to frequency excursion bands that places responsibility on:
  - the market to fund incremental FCAS arising from the need to tighten frequency excursion bands;
  - the operators of plant to either fund or limit the need for incremental FCAS arising as a result of larger maximum contingency size.

5.2.1. Option C1: Minimal change to frequency excursion bands

One approach to facilitating the connection of the high efficiency CCGT plant is to make changes to the frequency standards / protection schemes sufficient only to facilitate connection of high efficiency CCGT plant. A further requirement would be for newly connected plant that creates the need for incremental ancillary service to pay the costs of that service directly via private procurement.

Specific elements of this minimalist approach are:

- private procurement incremental frequency control services;
- changes to the UFLSS so that it operates between 48.0 Hz and 47.0 Hz (as discussed in Section 3.2.1);
- modification to the lower bound of both the *extreme frequency excursion tolerance limits* and the multiple contingency event band to 47.0 Hz (as discussed in Section 3.2.1);

19 See Section 5.2.1, sub-section *Minimally amended frequency excursion bands*.

- modification to the upper bound of the multiple contingency event band under islanded conditions to 55.0 Hz;
- modification to the upper bound of "single contingency event bands"[20] under both interconnected and islanded conditions to no more than 52.0 Hz; and
- changes to Basslink associated control schemes.

The intent of proposing only minimalist changes to frequency standards is to create an environment where the costs of incrementally required service can be sheeted home to the parties creating the need for the service. These changes are discussed in further detail below.

Private procurement incremental frequency control services

As a condition of connection, the operators of new entrant high efficiency CCGT plant would be required to fund incremental frequency raise services because the UFLSS should not be forced to operate on the occurrence of a single credible contingency – and no change to the lower limit of the single credible contingency is proposed.

There are two separate factors that give rise to the need to procure incremental frequency raise services[21]:

- the need to contain frequency excursions within a tighter band under largest (current) single credible contingencies to avoid operation of the UFLSS; and
- the need to contain frequency excursions within the same (or tighter band) with larger single credible contingencies.

Given the connection of high efficiency CCGT plant requires both of these needs to be met, reflecting the costs of this requirement means the operators of the CCGT plant either:

- avoid the cost of additional FCAS R6 by operational restrictions on its plant at times of relatively low system inertia; or
- procure an inter-trip service to avoid it presenting a contingency of larger than the current maximum; or
- privately fund sufficient incremental FCAS R6 over and above existing requirements to prevent a 210 MW contingency causing frequency to dip below 48.0 Hz.

20 All single contingency event bands would encompass the load event band, the generation event band and the network event band.

21 The extent of the increased FCAS required under different frequency standards, contingency sizes and inertia levels was outlined in Table 1.

The proposal to allow CCGT plant to trip at 52.0 Hz has a consequential effect on modification to the OFGSS and, hence, the need to procure incremental FCAS lower services to prevent the operation of the OFGSS on the occurrence of a credible network contingency.

Minimally amended frequency excursion bands

Under Option C1, changes to the lower bound of the separation event bands and the multiple contingency event bands are consequential to changes necessary to support operation of the UFLSS so that it operates between 48.0 Hz and 47.0 Hz. Changes to the upper bound of the separation event band and the multiple contingency event band are proposed on the basis:

- that NEMMCO has no objection to this provided that it is accepted that such a change would mean that over frequency generator shedding schemes are less able to effectively manage islanding events within the Tasmanian region where an island is formed with a substantial excess of generation[22];
- of the wide support for such changes as expressed by respondents to the Reliability Panel's consultation[23].

Table 7: Changes to frequency excursion bands consistent with Option C1

	Acceptable containment frequency range	**Comparison to current standard**
Interconnected operation		
Network event band	47.5 to 52.0 Hz	Containment frequency tightened on high side.
Separation event band	47.0 to 55.0 Hz	Containment frequency tightened on low side.
Multiple contingency event band	47.0 to 55.0 Hz	Containment frequency tightened on low side.
Islanded operation		
Load event band	47.5 to 52.0 Hz	Containment frequency tightened on high side.
Generation event band	47.5 to 52.0 Hz	Containment frequency tightened on high side.
Network event band	47.5 to 52.0 Hz	Containment frequency tightened on high side.
Separation event band	47.0 to 55.0 Hz	Containment frequency tightened on low & high sides.

22 NEMMCO submission to the Reliability Panel, 8 August 2008 (see Section 9). Available at: http://www.aemc.gov.au/electricity.php?r=20080424.133954

23 Alinta, Gunns, and Hydro Tasmania have each proposed changes of this nature to the relevant bands. NEMMCO supports changes to the upper bound of the separation event bands and the multiple contingency event bands subject to arrangements to deal with management of small electrical islands.

	Acceptable containment frequency range	Comparison to current standard
Multiple contingency event band	47.0 to 55.0 Hz	Containment frequency tightened on low & high sides.

Changes to the upper bound of the load event band, the generation event band and the network event band are proposed on the basis that:

- it would represent a more simplified regime for FCAS procurement and frequency management compared to the currently diverse requirements of the generation, load and network event frequency excursion bands; and
- Tasmanian Market Participants have not indicated any concern about the availability of required FCAS L6 services and have expressed the wide support for such changes in response to the Reliability Panel's consultation[24].

However, CRA notes NEMMCO's advice that significant additional amounts of FCAS L6 would be required with a reduction of the upper bound of the network event band to 52.0 Hz. Parties to the consultation supporting this change have not raised any concern as to the availability of this services and it is therefore assumed that adequate FCAS L6 service would be available and that its cost would not significantly skew any benefit-cost analysis of the change. Should evidence emerge to the effect that the adequacy of supply of FCAS L6 service is questioned, or the cost of the service is likely to be sufficient to skew any benefit-cost analysis of the change alternative arrangements would have to be considered[25].

Notwithstanding the fact that the UFLSS would operate between 48.0 Hz and 47.0 Hz, the lower bound of the single credible contingency bands would be nominally maintained at 47.5 Hz. Yet, as noted above, high efficiency CCGT plant would be required to fund incremental frequency raise services because the UFLSS would be set to operate from 48.0 HZ but should not be forced to operate on the occurrence of a single credible contingency. Although these arrangements could be seen as a *de facto* change in the lower limit of the single credible contingency band, the actual frequency standards could be maintained notwithstanding their overlap with the operation of the UFLSS.

These arrangements help to create an environment where the costs of incrementally required service can be sheeted home to the parties creating the need for the service:

24 Alinta, Hydro Tasmania and Aurora each support such a change.

25 An alternative might be to not change the upper bound of the network event bang and to leave it at 53.0 Hz. This would remove the need for NEMMCO to acquire additional FCAS L6 service, but would create a an overlap in that the OFGSS could operate on the occurrence of a single credible contingency unless some mitigant was introduced, such as the operators of the CCGT that would trip at 52.0 Hz directly funding FCAS L6-type service to prevent frequency rising above 52.0 Hz on the occurrence of any single credible contingency.

- *De facto* raising of the standard leaves the responsibility for recruiting the necessary ancillary service to ensure frequency does not fall below 48.0 Hz with the parties creating the need for tighter frequency control, where these parties also accept all costs associated with the incremental increase.

- Leaving the frequency standard itself unchanged, but making the acquisition and presentation of additional FCAS R6 a responsibility of the relevant parties, would mean NEMMCO is obligated to acquire no additional FCAS[26]. However, the operators of high efficiency CCGT then need to contract for the necessary additional FCAS and thus the additional response would be more assured and without risk of increased cost[27]. It is likely that the costs for FCAS would rise because there would be additional private competition for existing market procured services.

Changes to Basslink associated control schemes

In order to support (de facto) tighter frequency standards, there may be a requirement to modify the operation of the Basslink frequency controller. Basslink has not yet provided any estimates of the once-off cost of such modification, but it is understood that the modifications are feasible and unlikely to be material in the context of a benefit-cost analysis.

5.2.2. Option C2: Comprehensive change to frequency standard

Rather than being constrained by having to minimise the changes made to facilitate the entry of CCGT and co-generation plant, given a (largely) clean slate – in addition to the changes to the minimum access standard discussed in Section 5.1 – the following changes to the existing environment could be made:

- comprehensive (formal) changes could be made to frequency excursion bands;

- management of the factors that create a need for additional FCAS – designed to ensure that system security issues do not arise, should FCAS supply become a problem as a result of tighter frequency standards and/or larger contingency size; and

- adjustment to Basslink control schemes.

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26 Formally raising the lower limit of the single credible contingency band to 48.0 Hz would place an obligation on NEMMCO to acquire sufficient FCAS to meet it, with the risk that the full amount will not be available at all times. Should the full FCAS requirement amount not be forthcoming through the market, NEMMCO may need to direct parties to provide it and/or reduce flows on Basslink to allow for import of FCAS from Victoria and the rest of the NEM.

27 Assuming contracted FCAS does not reduce the amount available to NEMMCO in the FCAS market.

Comprehensively modified frequency standards

Should the frequency standards be comprehensively modified to ensure that the high efficiency CCGT plants meet at least minimum access standards, CRA can also see an opportunity to refine the frequency bands in a way that is likely to meet with general support. Refinement of frequency excursion bands could also be achieved in a way that represents a degree of alignment with the structure of the frequency excursion bands as applies on the mainland for the remainder of the NEM.

A comprehensive form of the frequency standard that meets the above requirements is outlined in Table 8.

Table 8: Comprehensively modified frequency standards

	Containment	**Stabilisation**	**Recovery**	**Comparison to current standard**
Interconnected operation				
Normal band	49.75 to 50.25 Hz 49.85 to 50.15 Hz 99% of the time			Unchanged.
Load and generation event band	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 mins		Merge of separate bands. *Load event:* containment frequency slackened on low & high sides; recovery time unchanged. *Generation event:* containment frequency tightened on low side & slackened on high side; recovery time out from 5 mins.
Network event band	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 mins		Containment frequency tightened on low side & high side; stabilisation frequency & time removed; recovery time out from 5 mins.
Separation event band	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 mins	49.85 to 50.15 Hz within 10 mins	Containment frequency tightened on low side; stabilisation frequency tightened on low side & slackened on high side; recovery time unchanged.
Multiple contingency event band	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 mins	49.85 to 50.15 Hz within 10 mins	Containment frequency tightened on low side; stabilisation frequency tightened on low side & slackened on high side; recovery time unchanged.

	Containment	Stabilisation	Recovery	Comparison to current standard
Islanded operation*				
Normal band	49.0 to 51.0 Hz			Unchanged.
Load and generation event band	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 mins		Merge of separate bands. *Load event:* containment frequency tightened on low & high sides; recovery time unchanged. *Generation event:* containment frequency tightened on low & high sides; recovery time out from 5 mins.
Network event band	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 mins		Containment frequency tightened on low & high sides; recovery time out from 5 mins.
Multiple contingency event band	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 mins	49.0 to 51.0 Hz within 10 mins	*Separation event:* band removed. *Multiple contingency event:* containment frequency tightened on low & high sides; recovery frequency tightened on low & high sides; recovery time out from 5 mins.

Changes in the frequency excursion bands would have consequential effect on aspects of the automatic and minimum access standards [outlined in S5.2.5.3 of the Rules] as follows:

- *operational frequency tolerance band* to change to 48.0 Hz to 52.0 Hz; and
- *extreme frequency tolerance limits* to change to 47.0 Hz to 55.0 Hz.

These changes would not affect the aspects of the minimum access standards discussed in Section 5.1.

The rationale for the changes to current standards is as follows:

- **Combination of load and generation event bands:** Alignment with band structure that applies for the mainland NEM.
- **Setting recovery time to 10 minutes for all event bands:** Consistency and simplicity has regulatory appeal. Network event and load event recovery times were at 5 minutes for both interconnected and islanded operation – all other recovery times were 10 minutes. On the basis that 10 minutes recovery is necessary under some load event circumstances in Tasmania, a combined load and generation event band may require 10 minutes recovery. Given that the largest network event in Tasmania involves loss of load, it seems logical that network event recovery should also be 10 minutes.

- **Tighter frequency containment requirements for generation and network events:** On the basis of evidence presented, modern thermal base load plant is unable to withstand regular frequency excursions below 48 Hz or above 52 Hz without substantial increase in maintenance costs or degradation to plant life. Under the proposed standards, modern thermal plant may not qualify for connection under the automatic access standards in clause S5.2.5.3(b) "*Generating unit response to frequency disturbances*", but could exceed the minimum access standard in clause S5.2.5.3(c).

- **Tighter frequency containment requirements for separation and multiple contingency events:** Transend advises that it is feasible to reconfigure UFLSS and OFGSS to support tighter frequency containment requirements for separation and multiple contingency events without risk to power system security.

- **Removal of separation event band under islanded operation:** Should further electrical islands form following an initial *separation event*, the system would be considered to be being maintained under islanded operation within the *multiple contingency event* band.

- **Tighter frequency standards also establish minimum access standards that the high efficiency CCGT plants are capable of exceeding:** Proposals by Alinta and Gunns for thermal units to be allowed trip at 52.0 Hz and 51.6 Hz are not necessary because candidate plant capability would be in excess of minimum access standard.

Managing the availability of FCAS

Although tightening the frequency excursion bands, modifying access standards and the ULFS / OFGS are necessary conditions to support the connection of modern thermal plant, it is not sufficient to ensure either short- or long-term power system security.

Some question remains as to the availability of suitable volumes of FCAS R6, particularly in light loading conditions with Basslink on import and significant volumes of wind generation.

As outlined in the introduction to Section 3.2 (Table 1), there are two aspects of the changes to the power system operating conditions that given rise to additional FCAS requirements:

- tighter frequency excursion bands; and

- larger maximum generation contingency.

Regardless of which party has created the need for the change or which party would pay for the increased requirement, tightening the frequency excursion bands does *not* guarantee that:

- required incremental FCAS will be made available; or

- if the incremental service were available, the price for the additional FCAS would be reasonable (however defined).

As noted in the conclusion to Section 3.2.5, it is necessary to provide some mitigants to limit the size of the maximum generator contingency in order to make a case to change the frequency standards to facilitate connection of high efficiency CCGT plant that increases the size of the maximum generation contingency. Accordingly, CRA believes that, if frequency standards are to be tightened, it would be appropriate to put in place mechanisms that assist in the management of FCAS. Different measures are likely to be required in the short-term and the long-term.

- **Short-term measures**

  In the short-term, management of FCAS availability would be assisted by placing restrictions on the size of the maximum generator contingency, particularly at times of low system loading and low inertia – perhaps by placing some form of cap on generation under certain market conditions. In the absence of such a requirement, failure of the market to bring forward sufficient FCAS could result in NEMMCO having to place constraints on the dispatch of Tasmanian infrastructure to ensure power system security would be maintained[28]. Although operational constraints of this nature could be considered acceptable if they were only rarely used, lack of an incentive on the part of CCGT plant to limit its output in particular conditions may result in such operational constraints becoming a regular feature of the Tasmanian market.

- **Long-term measures**

  Placing an express restriction on the size of the maximum generator contingency may not, however, be a desirable long-term solution. For example, if market conditions led to high energy prices in Tasmania under conditions where output of the CCGT plant was subject to restriction under such an arrangement, but there was additional FCAS available (at a cost effective price) it would be inefficient to not enlist that additional service.

28 For example, in light loading conditions with: Basslink on import; significant volumes of wind generation; and high-efficiency CCGT plant seeking dispatch towards the upper range of its capability, FCAS R6 requirements would be at a maximum.

An arrangement that optimises the output of large CCGT plant and FCAS dispatch and assigns costs to the relevant parties is likely to be more efficient. For example runway pricing for FCAS[29] is likely to prove to be an effective means of dealing with a potential shortage of FCAS. If there is runway pricing for FCAS and FCAS R6 turns out to be in short supply, the FCAS R6 price will head towards the market price cap (currently $10,000/MWh). With FCAS R6 priced at $10,000/MWh it becomes a simple decision for the largest generator to either contract for an inter-trip service to reduce its apparent size or, alternatively, limit its operation to prevent itself from being exposed to FCAS R6 prices at $10,000/MWh.

CRA notes that it is beyond the remit of the RP to change the Rules to implement runway pricing, although the RP could consider imposing a restriction on the size of the maximum generator contingency and revisit that elements of the standard should appropriate Rule changes be made in the future.

Changes to Basslink associated control schemes

In order to support formally tighter frequency standards, there would be a requirement to modify the operation of the Basslink frequency controller. Basslink has not yet provided any estimates of the one-off cost of such modification, but it is understood that the modifications are feasible and unlikely to be material in the context of a benefit-cost analysis – certainly not sufficient to reverse the case for some change to the standards.

5.3. BENEFIT-COST ASSESSMENT OF OPTIONS C1 AND C2 – DISCUSSION

Having reached a position where change to frequency standards is warranted and connection of high efficiency CCGT plant should be facilitated by a change to minimum access standards, the remaining question is how should this change be made on the basis of the relative merits of Option C1 and Option C2[30].

The key differences between Option C1 and Option C2 are summarised in Table 9.

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29 “Runway pricing” refers to an arrangement whereby the party who causes the requirement for the latter elements of a service, pay for those latter elements.

All aircraft use the first part of a runway and should therefore share the costs of the first part of the runway with all runway users. However, only larger aircraft use the latter parts of the runway. Arguably, equity is served where only the larger aircraft are required to pay for the part of the runway that exists only because the larger aircraft created the need for its construction.

30 Appendix B provides a comparison of the benefits and costs of Option C1 and Option C2 compared to the status quo.

Table 9: Differences between Option C1 and Option C2

Impact on …	Option C1: incorporating minimal change to frequency standard	Option C2: incorporating comprehensive change to frequency standard
Additional FCAS requirement (compared to status quo) to maintain frequency above 48.0 HZ on a singe contingency (see Table 1*)*	• Funded by operators of new entrant CCGT plant. • If additional FCAS not available, operation of CCGT plant would be in breach of condition of connection.	• Funded by the market. • If additional FCAS not available, NEMMCO may need to impose operational constraints to ensure maintenance of power system security: – limitations placed on output of large CCGT plant; – Basslink may have to be backed off.
Limiting the size of the maximum contingency	• Operators of large CCGT plant fund inter-trip service to make maximum contingency ≤ 144 MW.	• **Short-term** – either: – express requirement that large CCGT plant output limited according to system inertia; or – operators of large CCGT plant fund inter-trip service to make contingency ≤ 144 MW. • **Long term** – runway pricing and market required to source additional FCAS to cope with larger contingency but large CCGT plant has choice to procure inter-trip if this is more cost effective than paying for FCAS runway charges.
Transparency of technical operational requirements	• Problematic management of technical requirements to maintain the links between frequency excursion bands and FCAS procurement.	

It has also been established that the broad role of Tasmanian frequency standards and the technical characteristics of the power system are sufficiently different to the other regions of the NEM that it would not be surprising if cost effective frequency standards for Tasmania were wider than in the other regions. This has been the case to date.

Submissions to the Reliability Panel's consultation have indicated that, if the frequency standards were changed in line consistent with the characteristics of a broad range of new entrant generation plant, and only the minimum necessary changes made to access and protection schemes, FCAS costs could potentially rise very significantly. In some circumstances the increased FCAS costs could outweigh the benefit of lower energy costs expected from the changes.

Together, these factors suggest that it may be appropriate for the structure of a “package” of frequency standards and associated protection schemes and commercial aspects of the Rules to be different from the overall arrangement elsewhere in the NEM. This would be consistent with the requirement for Basslink to acquire the ability to interrupt load in the event of a failure as a condition of access. In addition, customers are the primary beneficiaries of a change to the standards through lower energy costs but, under the current arrangements for allocating costs for FCAS, generators will be charged for the incremental increase in FCAS costs.

Submissions have also shown that it would be feasible to make changes to the frequency standards in association with measures to ensure that extreme FCAS costs are not incurred. However, this would require changes to more than the size of the bands in the frequency standards – for example, changes to protection schemes would also be required and limitations on the effective size of disturbance may be warranted. Option C1 and Option C2 provide two alternatives to achieve this. The packages can be structured to achieve essentially identical physical outcomes, although the packages do differ in terms of:

- cost allocations between new entrants and market participants generally;
- whether market price signals or mandated operating limits and preconditions are employed to manage the risks of inefficiently high FCAS prices. Properly structured, price signals offer the chance for cost effective trade-offs by either NEMMCO (within NEMDE) or by participants through their bids and offers. However, this may also require NEMMCO to source specified amounts of FCAS in the same way as in other regions – that is, at rates up to the market price limit (currently $10,000 / MWh). Measures to limit contingency size, for example, would limit the extent of potential for extreme prices. However it is important to note that changing the standards and limiting the contingency size to, say, 144MW would still require additional FCAS, albeit a relatively modest increase.
- Mandated arrangements – for example, to require new entrants to contract for specified amounts of FCAS (similar to the existing obligation on Basslink) – would provide greater assurance that the additional FCAS would be present, although there is a risk that a formulaic requirement will be sub-optimal and thus inefficient;
- the implications for sound regulatory practice – for example, the risk of a perception of ad hoc responses and whether changes within the ambit of the Reliability Panel would only be viable if accompanied by changes to the NER or the exercise of discretion by bodies such as NEMMCO and Transend; and
- transition and transaction costs.

In large part these are matters of judgement, our assessment of the advantages and disadvantages of each are as follows.

In our view, changing the standards and relying on the market to bring forward the additional FCAS required is the most direct and robust from a regulatory perspective but carries some risk. Even if contingency size is limited to 144MW, this would still require some increase in the amount of FCAS to be sourced by NEMMCO. In an environment where there was ample FCAS this would not be of concern, but this is not the case in Tasmania where FCAS supplies are limited.

Adopting a market approach, where incremental FCAS is a shared responsibility and cost, would therefore carry some risk that availability and price will be stretched. Hydro Tasmania has presented a plausible case that it is very difficult for them to recover additional FCAS costs in the limited time that their plant would be the marginal FCAS supplier. Thus it may not be commercially viable for Hydro Tasmania to present additional FCAS capacity, especially as FCAS raise costs are paid by generators pro-rated on dispatched generation levels. However, if the standards were changed in conjunction with an amended approach to cost allocation either by changing the formal cost allocation in the rules or imposing requirements for additional private costs[31] to be borne by new entrants, incentives may be altered.

As noted, mandated provisions for different parties (new entrants) to bring reserve to the market can provide greater assurance that FCAS would be available. Such a provision more directly shifts the cost to the new entrants. However, mandated provisions that do not formally narrow the standard would be considerably more complex to design and administer. In advice to the Reliability Panel, NEMMCO has noted the potential for an arrangement whereby additional interruptible load is acquired in this way[32], although NEMMCO is silent on the regulatory and commercial mechanism by which the additional interruptible load is arranged. We note that if such an arrangement were to be introduced generally within the NEM, there is a risk of distorting the current FCAS market. We therefore have a preference for additional interruptible load to be considered only in special circumstances and potentially for a limited, but renewable, period.

Extreme prices that are not based on demonstrable costs would have an intangible detrimental effect on investment perceptions and should therefore be avoided. On balance, we consider that the risk of extreme unintended FCAS outcomes is sufficiently uncertain and undesirable that measures should be included to ensure any increased level of FCAS required is provided cost effectively.

31 See discussion of shared and private costs in Section 2.3.

32 NEMMCO submission to the Reliability Panel, 8 August 2008 (see Section 2D). Available at: http://www.aemc.gov.au/electricity.php?r=20080424.133954

APPENDIX A: TASMANIAN RELIABILITY ISSUES

Energy projections

Table 10 provides projections of energy required to be met from scheduled generators[33] in Tasmania to 20017-18.

Table 10: Tasmanian scheduled energy projections (GWh)

Financial Year	Medium***	High	Low
2005/06	9,891*	-	-
2006/07	10,200*	-	-
2007/08	10,020**	-	-
2008/09	10,202	10,536	9,769
2009/10	10,483	11,037	9,826
2010/11	10,179	10,826	9,427
2011/12	10,440	11,262	9,441
2012/13	10,592	11,509	9,494
2013/14	10,493	11,546	9,332
2014/15	10,409	11,741	9,031
2015/16	10,103	11,445	8,560
2016/17	10,218	11,667	8,592
2017/18	10,362	11,928	8,649

* Actual. ** Estimate. *** Scenario assumes the Gunns pulp mill development proceeds with a 210 MW co-generation plant to offset 150 MW internal plant load. If it is the Gunns development did not proceed, the equivalent scheduled load projections would be in the order of 400 GWh *higher* than indicated[34].

Source: NEMMCO, *Australia's National Electricity Market, 2008 Energy & Maximum Demand Projections, Summary Report* (July 2008).

33 That is, excluding wind. Non-scheduled wind generation is treated as an offset to demand, so scheduled energy is total energy demand in Tasmania less energy met by non-scheduled generation such as wind.

34 That is, assuming an additional 60 MW load at 80% loading factor.

The long term energy inflow potential of the Tasmanian hydro schemes has recently been downgraded to 9,000 GWh / annum[35]. The past two financial years have had energy inflows of 7,000 GWh.

On the presumption that Basslink is expected to be energy neutral in its effect on the supply situation in Tasmania, even if annual energy inflows return to long term average in 2008-09 and stay there for the remainder of the 10 year outlook period, under the medium economic growth scenario there is a requirement for an additional 1,200 to 1,300 GWh of energy each year. Under a high economic growth scenario there is a requirement for almost 3,000 GWh of energy each year. Only under low economic growth scenarios and better than average energy inflow would there be no requirement for anything other than hydro energy in Tasmania over the outlook period.

Scheduled energy alternatives to hydro in Tasmania

Tasmania's current non-hydro scheduled energy sources are:

- Bell Bay Power Station – a facility with 2 x 120 MW (40 year old) gas turbines. These units have been used to supplement the base load capability of the energy constrained hydro system. Over the twelve months, these units have produced a combined output of 1,150 GWh of electricity. Hydro Tasmania has indicated that these units are not highly reliable.

- Bell Bay Three Power Station – 3 x 37 MW open-cycle gas turbines which are about to be supplemented by a single 60 MW open-cycle gas turbines. Over the past 12 months, these OCGT units have produced a combined output of 32 GWh of electricity.

Proposals for new sources of energy in Tasmania are:

- Tamar Valley Power Station – a high efficiency 203 MW CCGT (135 MW gas turbine plus 68 MW steam turbine) plus a separate 60 MW OCGT plant.

- Gunns cogeneration plant – a modern 210 MW steam turbine fired by black liquor and wood waste. Expected to use 150 MW on site and export 60 MW to the grid. The facility is not yet committed and is dependent on a go-ahead for the associated pulp mill project.

Although there are known plans for additional wind generation in Tasmania, it is understood that, for the purposes of producing scheduled energy forecasts, future wind generation is assumed to be non-scheduled and has been treated as a demand offset.

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35 Submission to AEMC from Director, Office of Energy Planning and Conservation (Tasmanian Government), 5 June 2008. Available at: http://www.aemc.gov.au/pdfs/reviews/Review%20of%20Frequency%20Operating%20Standards%20for%20Tasmania/presentations/006Office%20of%20Energy%20Planning%20and%20Conservation%20-%20Tony%20van%20de%20Vusse.pdf

Risk of unserved energy in Tasmania

Factors that determine whether or not there is a risk of unserved energy in Tasmania are:

- economic growth assumptions;
- long-term energy capability of hydro storages and the probability of return to average or above average energy inflows;
- the ability of existing gas-fired generation to continue to provide energy at levels commensurate with the past 12 months;
- whether or not Basslink is to be treated as being a net importer or exporter of energy; and
- whether or not new generation capability is delivered in Tasmania.

The requirements for additional on-island energy capability beyond that already in place is could be assessed via variations from a base case outcome. Although CRA makes no judgements as to the probability of particular outcomes, a reasonably conservative (low incremental energy requirement) base case scenario could be postulated as follows:

- medium economic growth, with scheduled energy demand of around 10,300 GWh by 2017-18;
- hydro storages return to long-term average energy inflows of 9,000 GWh / annum;
- Basslink operating as a neutral contributor to net energy supplies (import GWh equals export GWh);
- maintenance of Bell Bay Power Station output of around 1,100 GWh / annum; and
- continuation of operation of Bell Bay Three Power Station as a peaking facility only, contributing in the order of 50 GWh / annum.

Under this scenario, energy availability closely matches energy demand and there may be no need to facilitate entry of new generation plant, provided Basslink could be relied upon to meet any energy shortfall that might arise as a result of:

- higher economic growth; and/or
- lower than estimated long term average hydro energy inflows; and/or
- reduced energy availability from the Bell Bay Power Station or Bell Bay Three Power Station.

APPENDIX B: ALTERNATIVE PACKAGES COMPARED TO STATUS QUO

Table 11: Option C1 changes compared to status quo

<table>
<tr><th>Impact on …</th><th>Benefits</th><th>Costs</th></tr>
<tr><td>System control and FCAS availability</td><td>• Greater assurance over short- and long-term reliability:
– short-term improvement because high efficiency CCGT would replace less reliable 40yo Bell Bay Power Station;
– long-term improvement because new entrant plant will be lower capital cost and therefore require a lower market price in order for investment to be justified.
• Incrementally more cost-effective local voltage control capability.
• Potentially increased FCAS capability from modern thermal plant.</td><td>• Additional AS required to prevent frequency falling below 48.0 Hz on loss of Hydro Tasmania unit [funded by operators of high efficiency CCGT]
• Inter-trip service to make large CCGT contingency ≤ 144 MW [funded by the operators of large CCGT plant]
• Modification to UFLSS, OFGSS, FCSPS and Basslink frequency controller
• Problematic management of technical requirements to maintain the links between frequency excursion bands and FCAS procurement.
• Subject to similar conditional access for future modern thermal plant, new entry of such plant would be no problem.</td></tr>
<tr><td>Market outcomes</td><td>• Probable reduction in wholesale cost, due to:
– entry of lower cost CCGT plant – new entrant’s LRMC in the order of $3.50 / MWh less than alternative currently compliant CCGT;
– increased competition for generation dispatch;
– increased liquidity (for contracts) in the market.
Only short-term benefits for competition and contract liquidity.</td><td></td></tr>
<tr><td>Policy goals</td><td>• Assurance of co-generation would facilitate achievement towards renewable energy targets, as there is no guarantee that co-generation would emerge under the status quo.</td><td>• Potentially problematic regulatory precedent, complex administration of de facto standard due to discrepancy between formal frequency excursion band and practical operation of power system.</td></tr>
</table>

Table 12: Option C2 changes compared to status quo

Impact on …	Benefits	Costs
System control and FCAS availability	• Greater assurance over short- and long-term reliability: – short-term improvement because high efficiency CCGT plant would replace less reliable 40yo Bell Bay Power Station; – long-term improvement because new entrant plant will be lower capital cost and therefore require a lower market price in order for investment to be justified. • Incrementally more cost-effective local voltage control capability. • Potentially increased FCAS capability from modern thermal plant.	• Market required to source additional FCAS to cope with tighter frequency bands. • There is no guarantee that the incremental FCAS requirement will be available at all times via spot market mechanisms, with the risk that Basslink will have to be backed off should FCAS shortages emerge. • Either: – *if contingency size limited:* large CCGT plant required to source inter-trip to cope with larger contingency; – *if runway pricing:* market required to source additional FCAS to cope with larger contingency but large CCGT has choice to procure inter-trip if more cost effective than paying for FCAS runway charges. • Modification to UFLSS, OFGSS, FCSPS and Basslink frequency controller • Subject to similar conditional access for future modern thermal plant, new entry of such plant would be no problem.
Market outcomes	• Probable reduction in wholesale cost, due to: – entry of lower cost CCGT plant – new entrant's LRMC in the order of \$3.50 / MWh less than alternative currently compliant CCGT; – increased competition for generation dispatch; – increased liquidity (for contracts) in the market. Only short-term benefits for competition and contract liquidity.	
Policy goals	• Assurance of co-generation would facilitate achievement towards renewable energy targets, as there is no guarantee that co-generation would emerge under the status quo.	•