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Mr Anthony Englund
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Dear Mr Englund

Reliability Panel - Tasmanian Reliability and Frequency Standards
Draft Determination

The Tasmanian Jurisdiction appreciates the opportunity to provide a submission to the Australian Energy Markets Commission Reliability Panel (RP) consultation covering the above draft determination.

While the Jurisdiction does not have any particular issue with the proposals in the draft determination itself, because the Tasmanian frequency standards are different from those applied in the remainder of the NEM, it is expected that there will be some pressure in future reviews of the frequency standards to bring the Tasmanian standards into line with the NEM standards.

The purpose of this submission is therefore to draw attention to some specific features of the Tasmanian Power System, including some aspects associated with the design and operation of Basslink, which should be taken into account in the proposed future review of the Tasmanian frequency standards as well as any further subsequent reviews.

Yours sincerely

Phil Harrington
DEPUTY SECRETARY INFRASTRUCTURE

April 2006

Submission to AEMC Reliability Panel

on

Tasmanian Frequency Standards Draft Determination

1.0 Introduction:

The draft determination by the Australian Energy Market Commission (AEMC) Reliability Panel (RP) for the Tasmanian Reliability and Frequency Standards proposes that a phased in approach be used in implementing the Tasmanian Reliability and Frequency Standards.

With respect to the Reliability Standards the RP proposes to adopt the current Tasmanian reliability standard set out in the Tasmanian Reliability and Network Planning Panel (TRNPP) November 2005 determination as the standard that will apply in Tasmania from the date that this determination is finalised. In doing so, the RP noted that the current Tasmanian standard is generally consistent with the national reliability standard. The Tasmanian Jurisdiction supports this position and does not intend to comment any further on this proposal.

The remainder of this paper provides comment on the issues that will need to be addressed under the principles to be adopted by the RP for assessing the frequency standards and provides some additional information that the RP may find useful with respect to implementation of the frequency standards.

The paper also comments on the opportunities for the alignment of Tasmanian and national frequency standards, including those identified by NEMMCO in the draft determination.

2.0 Principles:

2.1 In so far as they relate to frequency, such standards must be made having regard to any existing standards in relation to frequency.

The standards determined by the TRNPP were used by the Tasmanian System Controller for the operation of the Tasmanian power system prior to Tasmania entering the NEM. In this period the frequency standards were refined to provide Tasmanian customers with frequency standards that provided a level of power system security that satisfied their requirements without putting excessive burden on ancillary service providers. To ensure that both customers and providers had the opportunity to advise the TRNPP of any issues they had experienced with the standards the TRNPP annually reviewed the frequency standards in a similar manner to the RP taking submissions from interested or affected parties.

The key difference between the NEM and Tasmanian frequency standards is that the Tasmanian frequency standard has separate bands for Load and Generation events whereas the NEM frequency standard has a single band for a generation event or load event. In the recent determination by the TRNPP this band has also been applied to rapid load changes arising due to rapid change of flow by a high voltage direct current interconnector (Basslink) starting, stopping or reversing power flow as well as identifiable increases or decreases in customer load in excess of 20 MW. In both the

Tasmanian and the NEM frequency standards these events are not necessarily contingency events.

A further difference is in the definition of sub island standards (i.e. islands that occur in part of the Tasmanian power system) due to the potential for these sub islands to occur.

In terms of actual frequency values, the Tasmanian standards are wider than the NEM standards. The band that has been identified as affecting potential generation development in Tasmania is the standard for multiple contingency events, although wider ranges are also reflected in the standard for other contingency events. The Tasmanian standard for multiple contingency events and the extreme frequency excursion band is 46 to 55 Hz compared with 47 to 52 Hz for the remainder of the NEM. These differences are important because this standard effectively determines the range of frequency over which connected generation plant and customer equipment may occasionally operate. There may be cost penalties associated with some types of plant being required to operate satisfactorily over the wider range in the Tasmanian standards.

However there are good reasons why Tasmania has had wider standards than the NEM as explained in the following.

2.2 In so far as they relate to frequency, such standards must be made having regard to the costs and benefits of any change proposed to the frequency standards.

Because the performance of the Tasmanian power system has been consistent with the Tasmanian frequency standards now for many years, existing customers have adapted to these standards and there would be no direct benefits to these customers which would be achieved by tighter standards in Tasmania.

It is possible that there could be some benefits associated with new installations in the form of lower costs for new equipment if the standards were tightened, but this would probably only apply for some types of specialised equipment. In general most consumer equipment is not sensitive to frequency variations within the ranges permitted under the existing Tasmanian standards and hence no associated benefits could be expected from tightening the standards.

As has been noted in the Alinta submission to the recent TRNPP frequency standards review, there may be cost benefits for new gas turbine and thermal generators associated with tightening of the frequency standards. These cost benefits may be associated with the need for the plant to be specifically designed for a wider range of frequencies or merely that existing designs have only been verified for a relatively narrow band of operating frequency as expected in the large power systems of Europe and America. The substance and materiality of the relevant cost benefits should be verified in this context.

However, there would be significant costs associated with further tightening of the frequency standards in Tasmania. Any changes from the existing frequency standards, in particular the standards for contingency events, would require adjustments to Basslink frequency controller settings and associated systems (e.g. Basslink SPS). Tightening of the range for multiple contingency events would require the present

UFLS scheme to be revised with a consequent tightening of the range for other contingency events including Basslink interruptions. This would require revamping of the load interruptibility arrangements associated with the Basslink SPS and an increase in the amount of fast raise and lower contingency FCAS service. The Tasmanian frequency standards currently require the ULFS scheme to be designed within a tighter band (1.5Hz) than the mainland standard (2.0Hz). This already imposes significant limitations on ULFS design.

Given the limitations on the availability of fast contingency FCAS services from hydro generators in Tasmania there is a distinct possibility that it may not be possible to achieve any significant changes without constraining the ability to transfer power across Basslink.

2.3 In so far as they relate to frequency, such standards must be made having regard to the size and characteristics of the separate systems that make up the power system.

Tasmania has always had wider frequency standards than the NEM because it is a smaller, isolated power system and the preponderance of installed hydro generation is much slower to respond to changes in output required in response to governor action than most thermal generation. Therefore, a system incident that may cause a frequency variation has a proportionately larger effect on the Tasmanian power system than a similar incident would have in the larger interconnected NEM. Furthermore, the higher relative proportion of wind generation in the Tasmania Power System has the potential to exacerbate the impact of system incidents on frequency as the wind generators currently installed do not contribute any inertia to the power system.

In Tasmania the largest generator is approximately 16% of the minimum power system demand (145 MW) and the largest single connected load is approximately 23.5% of the minimum demand (200 MW). Up to 100 MW loads (ie 11% of the minimum demand) may be switched regularly as part of a customer's normal production process. In the interconnected NEM the largest generator is approximately 5% of the minimum power system demand and for a load to be of the same proportion of minimum demand as in Tasmania it would have to be in the order of 2950MW.

If hydro generators are required to increase their output in response to governor action as a result of a frequency change, the water flow through the turbines must be increased by opening the guide vanes or control valves. However an increase in flow requires the water in the tunnels and pipelines feeding the turbines to be accelerated. The ability to accelerate this water quickly depends on the length of the water column and the required acceleration. Because of the physical arrangement of many of the hydro schemes in Tasmania (ie involving long tunnels and/or pipelines) it is physically impossible to accelerate the associated water column quickly and hence the associated generators cannot respond quickly to an increase in output in response to governor action. Hence the amount of fast contingency FCAS service available from hydro generators in Tasmania is limited.

By comparison, an increase in power output from thermal generators requires the flow of steam through the turbines to be increased and this can normally be done very quickly as the steam lines are relatively short. Hence thermal generators can normally

respond very quickly to an increase in output in response to governor action although their boiler design may limit the ability of the generators to sustain the increased output. Hence there is usually a significant amount of fast contingency FCAS service available from thermal generators in the remainder of the NEM.

As the ability to meet a particular frequency standard for a contingency event is determined directly by:

- the magnitude of the event relative to the size and inertia of the associated power system; and
- the ability of generators to respond to the frequency change following the event;

it has not been physically possible to achieve the NEM frequency standards for contingency events in the Tasmanian system, particularly for light power system loads.

Tighter frequency standards would require significant additional plant to be dispatched to provide the required FCAS and, even now Tasmanian generation being predominately hydro can have difficulty providing sufficient FCAS to meet the current frequency standards particularly during drought and very wet periods.

This deficiency has lead to spot prices for ancillary services being set to VoLL for some dispatch intervals and/or constraints on generation dispatch through the co-optimisation process. Significant costs may be imposed on customers through these occurrences.

Nevertheless the Tasmanian frequency standards have been tightened since the original determination by the TRNPP in 1999. For example the standard for a multiple contingency event has been narrowed from 44.8 - 55.0 Hz to 46.0 – 55.0 Hz.

2.4 Where the network or networks located in a particular area or region in Tasmania is or are only connected to other areas or regions by means of an asynchronous link, the power system security and reliability standards, in so far as they relate to frequency, may incorporate different standards for the first area or region to those applying elsewhere in the power system.

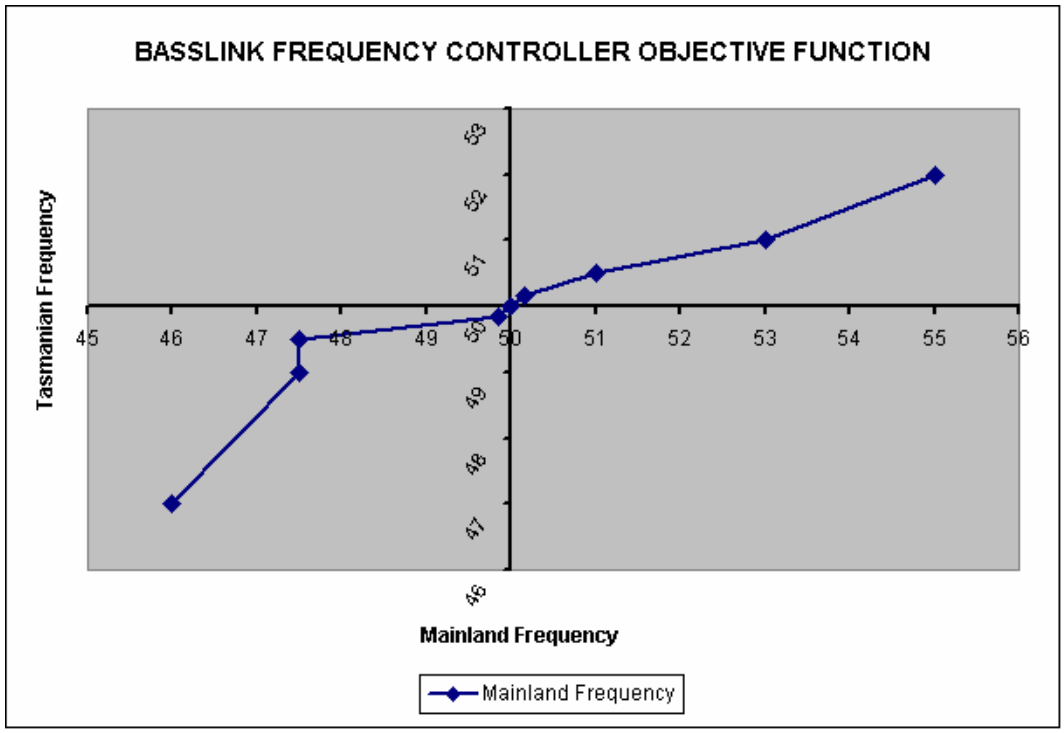
The design of Basslink and the systems associated with Basslink and Tasmania's entry to the NEM (for example the Basslink System Protection Scheme (SPS) and Frequency Controller as well as Tasmania's Under Frequency Load Shedding (UFLS) Scheme) have been based on the present frequency standards existing in Tasmania and the NEM.

2.4.1 Basslink SPS - The Basslink SPS has been designed so that if an interruption to the import of power to Tasmania via Basslink occurs, the combination of load tripping initiated by the SPS and fast contingency FCAS (raise) services will ensure that the Tasmanian frequency will not fall beyond 47.5 Hz (ie the standard for a network event). If the frequency did fall below 47.5 Hz, under frequency load shedding is likely to be initiated by the UFLS System on the basis that a non-credible contingency event had occurred such as a failure of the Basslink SPS.

The Basslink SPS has also been designed so that if an interruption to the export of power from Tasmania via Basslink occurs, the combination of generator tripping initiated by the SPS and fast contingency FCAS (lower) services will ensure that the Tasmanian frequency will not rise above 53.0 Hz (ie the standard for a network event). If the frequency did go above 53.0 Hz (ie the standard for a network event), over frequency generator tripping is likely to be initiated on the basis that a non-credible contingency event had probably occurred.

2.4.2 Basslink Frequency Controller - The Basslink Frequency Controller will adjust the scheduled transfers of power across Basslink whenever the frequencies in Tasmania or the Victorian region of the NEM depart from the nominal frequency level of 50 Hz.

The Frequency Controller has been designed so that it maps the respective frequency bands in the Tasmanian and NEM standards.

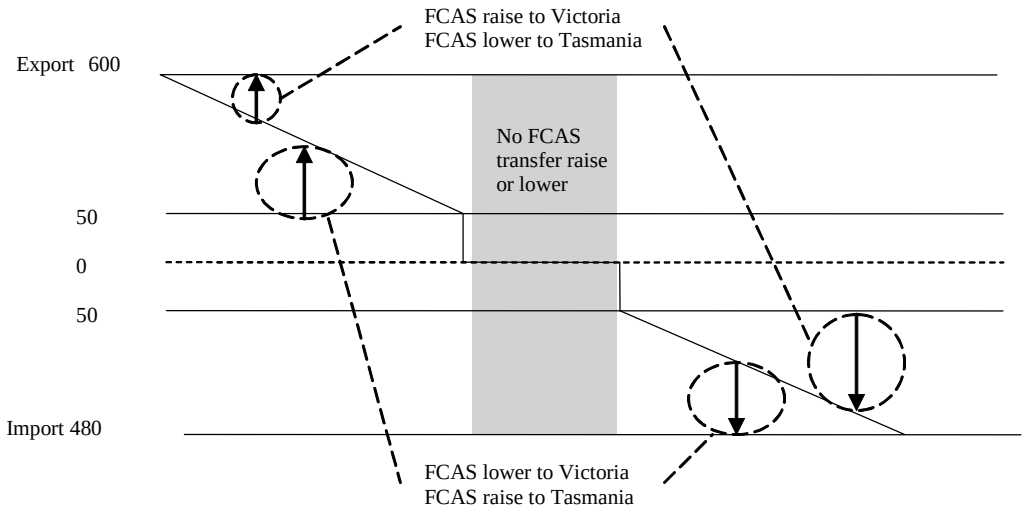


For example if the frequency in Victoria should fall to 49.5 Hz (corresponding to the NEM standard for a generation event) the Basslink flow to Victoria would increase until the frequency in Tasmania fell to 47.5 Hz (corresponding to the Tasmanian standard for a generation event) or Basslink reached an operational limit. This implies that multiple contingency events on the Mainland and in Tasmania would both require UFLS operation together (thus sharing the pain for such events).

The Basslink Frequency Controller thus allows the transfer of Frequency Control Ancillary Services (FCAS) across Basslink, whilst, at the same time, accounting for the different frequency standards existing between the two interconnected regions.

2.4.3 FCAS Dispatch & Basslink - The frequency controller on Basslink will allow FCAS to be scheduled in Tasmania to meet requirements in the remainder of the NEM as well as FCAS to be scheduled in the remainder of the NEM to meet requirements in Tasmania. However Basslink is not intended to operate beyond 600 MW export to Victoria and 480 MW import to Tasmania and there is effectively a "no go" zone between + and – 50 MW transfer in which Basslink cannot operate. These limitations impose constraints on the amounts of FCAS which can be transferred depending on the actual transfers on Basslink.

The constraints on FCAS are achieved through the constraint equations used by NEMMCO for dispatch as outlined in the NEMMCO Report "Basslink Energy and FCAS Equations". The constraints are complex but in general terms are illustrated in the diagram below.



As Basslink power transfer approaches its export limit of 600 MW, or the 50 MW import "no go zone", the amount of FCAS lower services which can be supplied from Victoria to meet the Tasmanian requirements reduces.

Conversely as the Basslink power transfer approaches its import limit of 480 MW, or the 50 MW export "no go zone" the amount of FCAS raise services which can be supplied from Victoria to meet the Tasmanian requirements reduces.

Furthermore if Basslink is scheduled to reverse its power flow, no transfer of FCAS services is possible between Tasmania and the remainder of the NEM. However it is important to remember that FCAS transfer across Basslink does not provide for the local requirement to manage the contingent loss of Basslink.

In normal dispatch the dispatch engine will co-optimise the dispatch of energy and market ancillary services, in doing this co-optimisation Basslink energy transfer may be constrained to enable the provision of FCAS for regional or global requirements to meet the least cost market objective.

2.4.4 Starting, Stopping & Reversing Flow - As indicated above there is a "no go zone" for Basslink operation between + and – 50 MW transfer. This means that when Basslink is starting or stopping there will be a 50 MW step change in the load on the Tasmanian system and if it is reversing the direction of flow there will be two 50 MW step changes spread over two dispatch intervals. As Basslink cannot transfer FCAS services while it is in the "no go zone", the FCAS services needed to meet these changes in Tasmanian demand must be sourced in Tasmania at those times. As Basslink reversing flow is likely to be a regular feature of its operation, occurring at least once or twice a day, this situation must be addressed without imposing unreasonable requirements on the ancillary services required to achieve the relevant frequency standard.

In the current Tasmanian frequency standards this issue has been addressed through the classification of such changes as load events, and therefore subject to the relevant standard (49.0 - 51.0 Hz).

2.4.5 Impact of Limitations - As indicated earlier, the key impact of the above limitations is that, even though the exchange of FCAS services is possible via Basslink there are conditions when the exchange of these services is constrained and hence some (or in some instances all) of these services must be scheduled in Tasmania in order to meet the relevant Tasmanian frequency standards.

For example, referring to the above diagram, as Basslink power transfer approaches its export limit of 600 MW, or the 50 MW import "no go zone", the amount of FCAS lower services which must be scheduled in Tasmania increases. When Basslink is at its export limit of 600 MW, all FCAS lower services necessary to achieve the relevant Tasmanian frequency standards must be scheduled in Tasmania.

Similarly, as Basslink power transfer approaches its import limit of 480 MW, or the 50 MW export no go zone, the amount of FCAS raise services which must be scheduled in Tasmania to meet the local requirement increases. When Basslink is at its import limit of 480 MW, all FCAS raise services necessary to achieve the relevant Tasmanian frequency standards must be scheduled in Tasmania.

Furthermore, if Basslink is scheduled to reverse its power flow, all the FCAS services needed to meet the local requirements (including the + or – 50 MW changes imposed by Basslink itself) must be scheduled in Tasmania.

The above limitations are compounded by the fact that generators which are included amongst those selected for tripping by the Basslink SPS cannot also be scheduled to supply FCAS services. As some of these generators are capable of providing fast contingency FCAS services this further reduces the amount of these services which may be available at any particular time.

When there are insufficient FCAS services available in a region to meet the requirements which must be supplied locally and this will be reflected in the spot prices for the relevant service(s) which will be set to VoLL. The dispatch process will attempt to co-optimise the dispatch for that dispatch interval and this may result in the transfers across Basslink being adjusted from the values determined through the dispatch of electrical energy alone.

2.5 The power system security and reliability standards, in so far as they relate to frequency, must allow less stringent standards for the frequency of a network or networks located in a particular area or region in Tasmania when that area or region is isolated from the remainder of the power system.

In 2002 the frequency standards excluded parts of the Tasmanian power system that became "islanded" in so far that the standards would not apply to electrical "islands". At that time the System Controller was to use reasonable endeavours to maintain stability of the islanded system and restore a satisfactory operating state to the islanded system as soon as practicable.

In November 2004, during the consultation process, NEMMCO indicated that it strongly preferred that the TRNPP determine standards for electrical islands. There are many contingency events in the Tasmanian power system that could result in the formation of an electrical island. Not all of these involve a large number of customers, for example, loss of the double circuit Gordon – Chapel Street 220 kV transmission line during maximum output from Gordon Power Station would create an electrical island at Strathgordon. As the load at Strathgordon is extremely small in relation to the maximum output of the power station, the frequency would rise dramatically, and it would be impossible to control frequency to within realistic frequency standards. Therefore it was necessary to define which electrical islands were to be covered by any frequency operating standards for islands. For the purpose of setting frequency operating standards, an electrical island is defined as a significant part of the power system that becomes separated from the remainder of the system due to loss of a connecting element. Consequently, for the first time, the TRNPP set frequency standards for electrical islands.

The TRNPP also noted that the standards determined in 2003 could not be implemented practically until the new Under Frequency Load Shedding Scheme (UFLSS) and Over Frequency Generator Shedding Scheme (OFGSS) were commissioned. Subsequently the UFLSS has been commissioned and the OFGSS is likely to be commissioned by May 2006.

The present frequency standards provide for a less stringent frequency standard for an electrical island. However, islanding events are rare, the possible islanding scenarios within Tasmania are numerous and varied in nature, and a standard to cover all scenarios is difficult to prescribe. Implementation of the present standards relies on NEMMCO adopting a pragmatic approach to managing the islanding situation and it is recognised that due to the definition of an "island" that following a separation event causing the Tasmanian power system to form two or more islands, the broader frequency standard could be applied to all such parts of the Tasmanian power system.

3.0 Alignment of the Frequency Standards

In principle, the jurisdiction supports convergence of the Tasmanian and national frequency standards. However, from the viewpoint of the operation of the NEM and the impacts on participants in other regions, there is no reason why the frequency standards in Tasmania should be the same as the national standards.

Due to the physical characteristics of the Tasmanian system (as detailed in the preceding sections), significant tightening of the Tasmanian frequency standard has the potential to come at significant cost. It is noted that NEMMCO also accepts that the full alignment of the Tasmanian and national standards is not presently practicable.

Relaxation of some of the frequency bands in the present Tasmanian standards could even be justified on the basis that it would facilitate the dispatch of Basslink, (particularly during reversal of power flows) and this should also be considered during the proposed cost benefit analysis in the light of operating experience with Basslink.

In any event tightening of the Tasmanian frequency standards should only proceed if it can be shown positively that the benefits of the change will exceed the additional cost (noting that quantification of cost, particularly to customer equipment will be challenging). It is also quite possible that this cost/benefit relationship will vary over time. For instance, any costs associated with large new generation plant will only become material at a point in time when this plant is likely to be constructed.

The provisional changes suggested by NEMMCO are noted but further comment, aside from the general principles outlined above, is not possible at this time. The costs and benefits of these changes will need to be evaluated during the proposed review of the Tasmanian frequency standards to be carried out in by the RP in the next twelve months.

As noted above, this review should be informed by adequate operating experience with Basslink. It should also take account of any prospects for changes to or rationalisation of the national standards proposed or contemplated by the RP.

In the meantime it is worth noting that:

- the Basslink frequency controller allows the frequency standards to be different in Tasmania from the remainder of the NEM; and
- any significant changes to the Tasmanian frequency standards (including the changes suggested by NEMMCO) will require resetting the Basslink frequency controller and probably also adjustments to the Basslink SPS.

4.0 Conclusion

The jurisdiction supports the RP proposal to follow a phased approach to determining the Tasmanian frequency standards based on the adoption of the current Tasmanian frequency standards set out in the TRNPP's March 2006 determination to apply in Tasmania from 30 May 2007 and then considering the opportunities for further alignment of the Tasmanian frequency standards with the National Electricity Market standards in an additional review to be undertaken within the next twelve months.

The RP's intent that this review;

- will include a full cost benefit analysis of any proposed changes;
- will benefit from experience of the Tasmanian market once Basslink has commenced operation;
- is expected to parallel work to be undertaken by NEMMCO in relation to the Tasmanian automated frequency management schemes; and
- will be conducted according to the principles under the Rules that apply to the current review;

provides the Tasmanian Jurisdiction with comfort that the outcome will consider what is best for both Tasmania as a region and the Market as a whole.

This review should consider the possibility of relaxation of some of the frequency bands and not just tightening them, particularly in light of the operating experience with Basslink.

The review should also take account of any rationalisation or changes to the national frequency standards proposed or contemplated by the RP.