TRANSEND

Our ref: D08/62091

7th August 2008

Mr Ian Woodward
Chairman, AEMC - Reliability Panel
Australian Energy Market Commission
PO BOX A2449
Sydney South NSW 1235

Dear Mr Woodward

Review of Frequency Operating Standards for Tasmania – Supplementary Submission

Please find attached a supplementary submission from Transend Networks on a number of issues which Transend believes should be taken into account by the AEMC Reliability Panel as part of its review process.

If you have any questions on this submission please contact Peter Clark on (03) 6274 3649.

Yours faithfully

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Encl.

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REPORT

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DISCLAIMER

CONTENTS

ACRONYMS

AEMC	Australian Energy Market Commission
FCAS	Frequency Control Ancillary Services
FCSPS	Frequency Control System Protection Scheme
HT	Hydro Tasmania
MASS	Market Ancillary Service Specification
MNSP	Market Network Service Provider
NEMDE	National Electricity Market Dispatch Engine
NEMMCO	National Electricity Market Management Company (Ltd)
NER	National Electricity Rules
NOCS	Network Operations Control System
OFGSS	Over Frequency Generator Shedding Scheme
SPS	System Protection Scheme
TNSP	Transmission Network Service Provider
UFLSSS	Under Frequency Load Shedding Scheme

1 INTRODUCTION

Transend Networks in considering the AEMC Reliability Panel's review of the Tasmanian Frequency Operating Standards wishes to table this supplementary submission.

This document provides comments on a number of issues identified by Transend which it believes should be taken into account by the AEMC Reliability Panel as part of its review process. Should further information be required on any of the matters raised, Transend can be contacted and will assist wherever practical.

2 AFFECTED CONTROL SCHEMES

Transend has given additional consideration to the scope, cost and implementation time for work required to modify the following should the Frequency Operating Standards be altered:

(a) Under Frequency Load-Shedding Scheme (UFLSS);

(b) Over Frequency Generator Shedding Scheme(OFGSS); and

(c) (Basslink) Frequency Control System Protection Scheme (FCSPS)

The studies for all three systems (UFLSS, OFGSS and FCSPS) are to be conducted at the same time. Transend is currently developing a detailed technical scope for the system studies and is liaising with NEMMCO to obtain agreement on a number of issues prior to commencement (boundary operating conditions for investigation, design concepts etc).

It is expected that these studies will take about eight weeks to complete and will cost about $90,000.

While the time to undertake the studies is relatively certain, the time to implement the changes is not as clear at this point in time as the scale of required changes will not be known until the system studies are complete. Based on our current understanding, we believe the following to be a reasonable estimate.

(a) Implementation of setting changes to the UFLSS and OFGSS would require a coordinated field program and require approximately three weeks at a cost $36,000. It is expected that there will be challenges in getting the three week program incorporated into existing work schedules. While a single pass approach is considered ideal (i.e.: all setting changes are carried out concurrently while people are engaged), this may not be possible and may result in an extension to the time frame stated;

(b) If new panels are required (for either the UFLSS of OFGSS), the estimated installed cost of each will be approximately $200,000 and will take about ten months to procure, install and commission;

(c) Assuming that only parameter changes are required to the FCSPS, then the time to test and implement those changes will take up to a month. The actual cost would however be minor (say several thousand dollars);

(d) While it is considered unlikely, if significant re-engineering of the FCSPS was required, this could take up to a year to develop, test and implement and cost hundreds of thousands of dollars (the original design took two years to develop and implement).

(e) The initial studies presented by Alinta indicate that a workable, reliable UFLSS design is probable within the frequency standards as proposed in their submission. While Transend believes it is likely that a scheme can be designed, this will ultimately depend on the range of contingencies for which the scheme must satisfactorily operate. If the severity of the "design" contingencies is increased or the UFLSS is required to coordinate with another as yet unspecified tripping scheme (e.g.: Alinta SPS, Alinta UFLSS) a point may be reached where it is not possible to satisfy all requirements concurrently without some "trade-off" arrangements. This will be a combined matter for Transend and NEMMCO to address should it occur;

Given that NEMMCO is ultimately responsible for system security[1], all design work undertaken by Transend will need to be reviewed and approved by it prior to implementation. Assuming that NEMMCO will undertake their own system studies to confirm recommended settings (and any other required changes), Transend believes it prudent to allow six weeks for appropriate due diligence exercises to be completed.

With our current level of knowledge, initial studies indicate that the most probable outcome is that only parameter and setting changes will be required. Taking into account all considerations outlined above, it is Transend's opinion that up to six months should be allowed for design and implementation activities at a cost of approximately $130,000. However, until Transend knows what the proposed standard is, and the detail of any new load tripping schemes, it is not possible to provide a definitive answer.

Transend cannot comment on the studies that may be required by Basslink to effect changes within their plant. Issues such as changes to the Basslink frequency controller objective function are matters for Basslink Pty Ltd to address.

3 DEFINITION OF AN ISLAND WITHIN TASMANIA

In its initial submission, Transend stated that consideration should be given to what Frequency Operating Standard should be applied when electrical islands form *within* Tasmania.

The current Tasmanian Frequency Operating Standards are not consistent with the mainland Frequency Operating Standards in regard to how an island is defined. The Tasmanian definition of an island excludes the separation of Tasmania from the mainland.

The existing arrangement was developed principally to deal with the islanding of the West Coast and Strathgordon. However, the outcome was to place obligations on all generators wishing to connect in Tasmania. There is also a lack of clarity with respect to which frequency standard should be applied if the system were to split into two roughly equal islands[2].

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[1] NER refer 4.3.1 (k)

[2] For example the Palmerston split

Transend's proposal states that consideration should be given to alternative solutions for the management of sub-islands within Tasmania. An option for deliberation is whether the term "island" can be explicitly defined for specific areas of the Tasmanian system. Only areas which may form viable islands need be considered on the assumption that all other pockets will not remain energised. With an appropriate definition, it may then become possible to legitimately reduce the technical requirements on new market entrants not connecting within those defined islands.

4 ISSUES AFFECTING FREQUENCY CONTROL

4.1 SYSTEM INERTIA

The impact of inertia on system operating constraints is an emerging issue in Tasmania and while it is not formally part of the Reliability Panel review, it is an important factor to consider. The availability of sufficient inertia can greatly impact on the performance of the power system and its ability to be operated within the frequency standards. This is turn affects the ability of some forms of generation to be connected and be dispatched to optimum (or desired) outputs.

Low inertia systems are typified by:

(a) High rates of frequency change for a given MW imbalance (brought about by the disconnection of load or generation); which leads to,

(b) Magnified FCAS requirements (given that the rate of frequency change reduces the effective time available to supply such services prior to the standards being breached);

FCAS issues for low inertia dispatch scenarios will be significantly impacted upon by a tightening of the frequency standards. This issue is of particular relevance to Tasmania given the high proportion of hydro generating units and their characteristically slow governing responses.

The follow on effect that needs to be considered is the impact of increasing wind penetrations. Wind turbine technologies currently seen in Australia do not lend themselves to significant inertial contributions and thus may effectively lower the overall system inertia depending on what and how much generation is displaced as a result of their operation.

An issue being explored at present is the impact on the maximum wind generation that could be practically dispatched in Tasmania if the frequency standards were tightened. This is a technically complex question involving a number of factors[3] of which system inertia is only one.

While a tightening of the frequency standards does not create the issues as such (they exist in one form or another regardless of the standard being applied), it is probable that it will reduce the volume of low inertia energy sources that could be practically dispatched within the Tasmanian power system under particular operating conditions.

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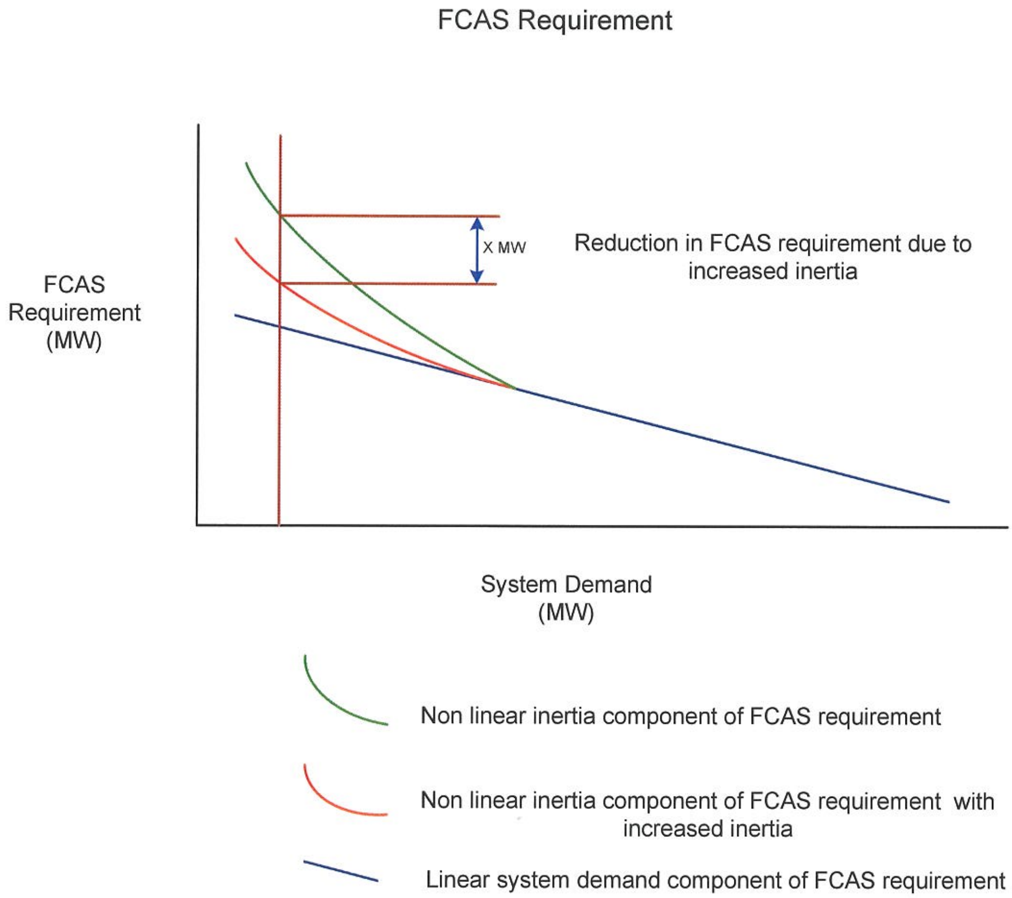
[3] Such as FCAS requirements, fault ride through capabilities, system voltage control, network thermal limitations, Basslink effective short circuit ratio requirements, system wide fault levels and resulting impacts on protection systems etc.

A mitigation measure for consideration is the development of an incentive scheme which financially compensates other forms of generation to provide the inertia in parallel (e.g.: operation of hydro generation at low, inefficient outputs, dispatch of synchronous condensers etc). Existing market and dispatch mechanisms do not cater for such options[4]. The introduction of such a "market" could have the combined effect of increasing maximum wind penetration and/or reducing FCAS requirements. Valuation of the service could be based on the effective FCAS which the additional inertia displaces as shown in Figure 1.



Value of inertia = X MW x $/MW for FCAS service

Figure 1: FCAS requirements as a function of system demand for a given contingency

The value of inertia may in practice be greater than that given by the formula above, as reducing the FCAS requirement may also reduce the cost of the FCAS service.

From a combined inertia / wind penetration perspective, the likely impact of tightening the frequency standards will be:

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[4] Existing dispatch systems do not take into consideration the inertia being provided by generation selected from the dispatch pool. Inclusion of such variables, in addition to the creation of separate ancillary service market arrangements, may also be beneficial.

(a) No restriction on the volume of wind generation that can be *installed*;

(b) Real time restrictions imposed on wind generation *output* as a function of available system inertia, i.e.: unless sufficient inertia is available in some other form, wind generation will only be allowed to displace "heavier" generation sources up to a certain point;

It should be noted that following the introduction of "semi-scheduled generating units" into the NEM, mechanisms now exist to control the maximum output of wind farms for the purposes of maintaining power system security.

(c) Increased drivers to explore the deliberate dispatch of inertia as a form of network ancillary service;

This is a highly simplistic view point as a range of other technical issues may well be more limiting than inertia. The exact limitations on wind will depend on where the generation is to be connected and the capability of the technology actually being installed to assist with the issues aforementioned. The second point is particularly relevant given that the Federal Governments carbon reduction policies may well drive technological advancements in various renewable energies, including wind.

4.2 FCAS AVAILABILITY AND REQUIREMENTS

The following observations are considered relevant:

(a) While tightening of the frequency standards removes a barrier to the connection of some forms of thermal generation, the connection of such generation may not necessarily reduce the shortage of fast FCAS services available in Tasmania. There is no obligation on new entrant generators to bid their plant into the FCAS markets;

(b) While it is recognised that there is a current shortage of Fast FCAS from existing service providers in Tasmania, there are other potential sources that are currently untapped. An obvious example is the participation of network loads, especially for the provision of fast raise;

(c) As the calculation of FCAS requirements by NEMMCO takes into account system inertia, the connection of some forms of thermal generation will have the effect of reducing FCAS requirements even if the units offer no FCAS to the market as such. Combined cycle gas turbines and steam turbines are traditionally excellent sources of inertia, small open cycle gas turbines less so;

(d) The current assumptions applied to Basslink in respect to FCAS capability underestimate Basslinks' actual contribution to frequency control in Tasmania. Transend believes that the very fast response characteristics of the Basslink frequency controller result in an effective transfer of mainland inertia as well as FCAS. It should be noted that the FCAS component is comprised of both mainland generator responses as well as a significant amount of load relief;

The effect of this in practice is most easily described as follows:

i. For a given system inertia, the calculated Fast Raise FCAS requirement to manage the loss of a 200 MW generator may be 250 MW. The required FCAS is larger than the size of the actual contingency due to the rate of change of frequency that would occur for such an event;

ii. The current dispatching arrangements for Basslink equate 1 MW of spare transfer capability to 1 MW of available FCAS. For the purposes of this example, assume that Basslink is the only source of FCAS available to Tasmania, i.e.: Tasmanian based generation provides no FCAS at all;

iii. Under import conditions, it is Transend's understanding that Basslink power transfer would be constrained by 250 MW to meet the calculated FCAS requirements;

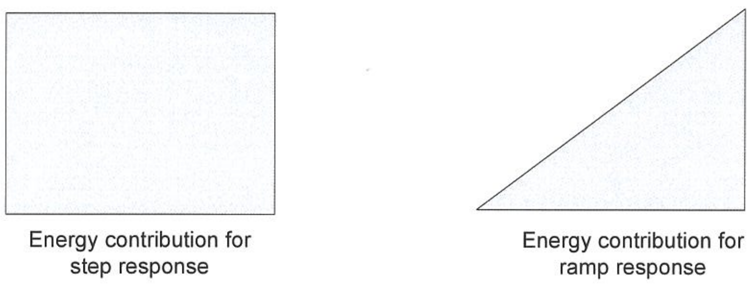
iv. It is Transend's opinion that frequency could be adequately controlled if Basslink was only constrained by 200 MW, rather than the 250 MW as initially calculated. Given that Basslink represents an "energy source with no inertia", the rate of response is virtually unlimited allowing the 200 MW imbalance to be controlled without the need for over compensation.

With respect to initial comments made by Transend equating 1 MW of Basslink spare capacity with 2 MW of Fast Raise FCAS capability, it should be realised that this is a theoretical maximum as allowed for by the current definitions documented in the NEMMCO publication "*Market Ancillary Services Specification (MASS), Version 1.5*".

It is Transend's interpretation of the MASS that an FCAS provider capable of instantaneously changing its output by X MW can legitimately claim 2X MW of capability. This is based on the fact that the mathematics used for calculation of FCAS capability assume a linear response as shown below. Application of the equations to a step change will result in a doubling of capability.

While Basslink will not step change its power transfer via the response of the frequency controller, the response is significantly faster than a six second linear ramp resulting in a higher effective FCAS contribution.

For example consider the diagrams below:



10 MW change delivered as a ramp = 10 MW of Fast FCAS

10 MW change delivered as a step = 20 MW of Fast FCAS

Figure 2: Equivalent FCAS contribution of a step response

4.3 OVER FREQUENCY TRIPPING OF GENERATING UNITS

In Transend's initial submission, the issue of over frequency tripping of generating units above 52 Hz was raised. The concern was the potential for "congestion" immediately above 52 Hz and an inability to connect all thermal generation just because it may be capable of satisfying a *minimum access standard.*

This issue is not strictly related to the tighter frequency standards. It was raised so that potential proponents wishing to connect thermal generation plant did not immediately assume that just because their plant could remain connected for frequencies up to and including 52 Hz that connection was immediately guaranteed. Transend sights the requirements of NER S5.2.5.3 (d)(2) which effectively limits the connection of generation under a negotiated access standard so as to prevent severe under frequency events in response to over frequency tripping of generating units.

Transend can visualise future situations whereby thermal generators with limited over frequency capability may still not be "connectable" even after changes to the frequency standards. A mechanism was discussed in the original submission whereby this situation could be managed via formulation of constraint equations and is not repeated here.

5 ADDITIONAL SPS SCHEMES

Transend is aware that there has been discussion of using Special Protection Schemes similar to the Basslink Frequency Control System Protection Scheme (FCSPS), to help mitigate the effects of large generator contingencies.

In this discussion it is important to remember that the Basslink FCSPS does not manage severe under frequency events. Its purpose is to *reduce* the Tasmanian FCAS requirement for Basslink contingencies so that frequency may be controlled within the *operational frequency tolerance band.* Only the UFLSS manages severe under frequencies by shedding *uncontracted* load.

Currently there is no impediment to a load which is participating in the UFLSS from also providing a service to other parties, e.g.: for FCAS lower or SPS type services. Consequently all of the Basslink FCSPS loads are also tripped by the UFLSS if so required.

If it is assumed that any new SPS would operate in a similar manner to the Basslink FCSPS (that is, it would only operate for the loss of one specific generator), then provided that the scheme is completely independent of the UFLSS scheme and is appropriately coordinated, then it is technically feasible to have the same load in both the UFLSS and the new SPS.

Prior to allowing the load to participate in both the Basslink FCSPS and any possible new SPS, it would have to be proven that for all system conditions, tripping of the generator[5] could not lead to the tripping of Basslink and visa versa. The issue to be managed is that the same load cannot be tripped twice and hence one initiating event cannot result in both SPS controls being activated.

[5] That is the generator associated with the new SPS.

Modelling of the operation (and mal-operation) of such a scheme would have to be carried out over a wide range of demand and generation scenarios to ensure that its operation did not compromise system security. An important consideration would be the result of it failing to operate as intended and what possible design implications may exist for the UFLSS acting as its backup.

It would not be possible to commence these studies until after the conceptual design of the new SPS was complete. The current review being undertaken Transend does not take into account any new SPS type schemes.

6 HYDRO TASMANIA PROPOSAL

Hydro Tasmania is proposing that the combined cycle gas turbine (CCGT) being proposed by Babcock and Brown not be required to operate continuously for low frequencies. Rather it would be allowed to trip and be required to shed up to 209 MW of contracted load in a similar fashion to the Basslink SPS.

This approach differs from discussions in Section Five in that disconnection of the generating unit would occur when the system is already heavily stressed and in need of emergency control actions to remain viable. This is very different to the disconnection of contracted loads following a trip of the CCGT during normal operating conditions, with the intent only to reduce the FCAS burden.

Transend believes that:

(a) It would be very difficult to coordinate this scheme with the UFLSS unless dedicated loads were fitted with remote tripping systems to respond only to disconnection of the CCGT (as per discussions in Section 5). Extension of the UFLSS scheme to incorporate *potential* disconnection of the CCGT is not considered viable;

(b) It would be difficult to find an additional 209 MW of non critical load in north eastern Tasmania to participate in the Alinta UFLSS. Such a load block would most probably comprise a large amount of retail feeders which would be expensive to include in a tripping scheme;

(c) It would be extremely difficult (if not impossible) to connect other thermal plant on a similar basis.

7 REFERENCES

[1] Australian Energy Market Commission, AEMC Reliability Panel; "*Tasmanian Reliability and Frequency Standards – Determination*", 28th May 2006;

[2] NECA Reliability Panel; "*Frequency Operating Standards – Determination*", September 2001;

[3] NEMMCO; "*Market Ancillary Service Specification – Version 1.5*", 27th February 2004;

[4] NEMMCO; "*Reliability and Frequency Operating Standards for Tasmania – NEMMCO's Advice to the Reliability Panel*", 24th January 2006;

[5] Hill Michael, Transend Networks; "*Frequency Standards Development – Final Report to Alinta Power*", 10th December 2007;

[6] Hydro Tasmania submission; *Review of Tasmanian Frequency Operating Standards*", 23rd May 2008.