Hydro Tasmania
the renewable energy business

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Dalibor Balicevic
System Operations Planning and Performance
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Via email: MASS@nemmco.com.au

Dear Dalibor,

2009 Market Ancillary Services Specification consultation

Hydro Tasmania welcomes the opportunity to provide comments regarding the 2009 Market Ancillary Services Specification (MASS) consultation process.

Hydro Tasmania understands that the objective of this first consultation is to address the changes necessary to MASS to reflect changes made to the Tasmanian Frequency Operating Standards (FOS). We don't have any objection to the two stage process provide all participants affected by the changes are treated equally. NEMMCO would be very familiar with the impacts of the new FOS as described through the consultation process and therefore know that there are two key issues that need to be considered in relation to the implementation of new FOS. These are:

1. The Tamar Valley Power Station requires the new FOS implemented to enable them to gain connection; and
2. FCAS supply/demand balance in Tasmania will become very tight during periods when global FCAS cannot be transported across Basslink (around the no-go zone and maximum limits).

As an existing participant in the region Hydro Tasmania is extremely interested in the second point and is developing some variations on traditional FCAS supply methods that are not currently easily represented against the MASS.

Our submission seeks changes to the MASS to better accommodate a higher use of switch controllers and introduce hybrid mixes of switch and proportional controllers. The introduction of hybrid mixes is to enable the registration of unprecedented FCAS delivery methods utilising the capability of our current assets. One such method is known as “tail-water depressed” mode and is currently used in New Zealand’s South Island; a power system with similar characteristics to that of Tasmania. We are particularly keen for our technical people to open up the dialogue on these new opportunities and will be seeking a meeting as soon as possible to progress this issue quickly.

To assist with achieving the best outcome for the Tasmanian region we have compiled our submission in two parts. The first part highlights issues that either affect the calculation of trapeziums, or if left to the second consultation, will delay increases in FCAS capability being achieved to offset the impacts of tightened FOS. Hydro Tasmania strongly suggests these should be included in the first round consultation in order to maximise the volume of FCAS available to the system and avoid sub-optimal market outcomes due to FCAS constraints. The remaining issues can be incorporated into the second consultation.

Please do not hesitate to contact Gerard Flack on (03) 6230 5586 if you have any queries.

Yours sincerely

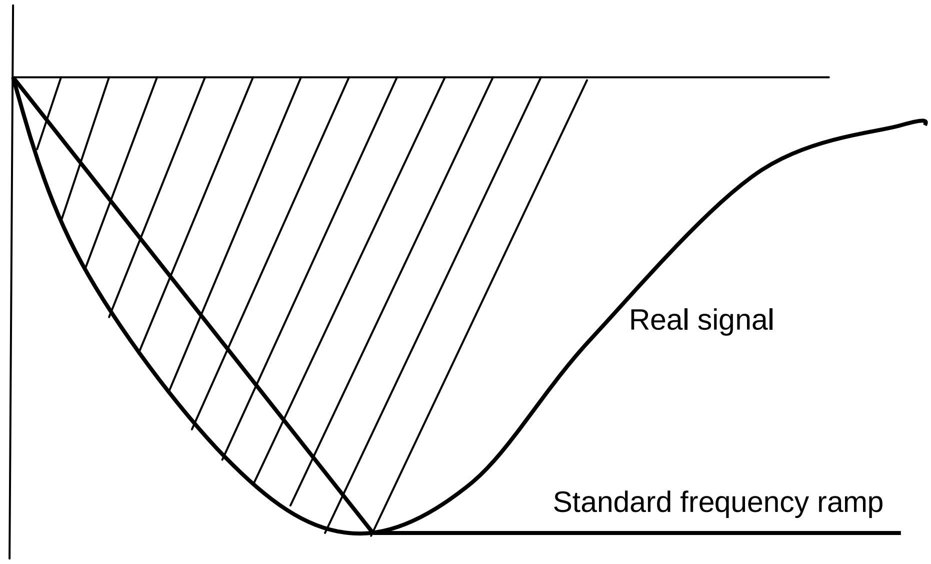
D. Bowker

David Bowker
Manager Regulatory Affairs

First MASS consultation (Tasmanian Frequency Operating Standards Change)

Issue 1: Shape of the standard frequency ramp

In Tasmania, fast FCAS is in short supply. Any under estimation of the fast FCAS capability of machines leads to sub-optimal dispatch. The shape of the standard frequency ramp does not reflect the shape of the frequency trace following a disturbance. In Tasmania the shape of the frequency trace is basically that of a half sinusoid. The time to reach the peak varies typically in the range 5-7s. The current standard frequency ramp for raise reaches its peak at 4.9 s which is at the low end of the time to reach the peak frequency excursion, however it under-predicts the “area under the curve”, leading to an under-prediction of the fast FCAS capability as illustrated below:



The FCAS capability is assessed according to a time average. The results will therefore be sensitive to the area under the frequency trace. Two suggestions for improving the accuracy of the capability assessment would be:

1) Change the shape of the test signal to better match the real frequency trace; or
2) Select the ramp rate such that the area under curve is similar to the real frequency trace.

The same applies to the lower test signal.

Issue 2: Trigger to initiate switching control action

The switching control triggers on a frequency threshold alone. For the delivery of fast FCAS, this can result in a significant delay before the FCAS response initiated, reducing the potential for fast FCAS delivery. For example, if Tasmania has a raise reference frequency of 49.0 Hz, this would result in a 2.3 s delay from frequency disturbance time till the trigger of a fast raise switching controller is issued. In effect, if a 10 MW switching load was used to provide this service, it would only deliver 12.3 MW of this service (ignoring delays) compared to up to 20MW if it is triggered immediately. Having triggers based on frequency plus rate of change of frequency would allow the switching control action to be triggered earlier, increasing its effectiveness. An effective trigger could be based on the following formula:

$$\Delta f + \alpha \frac{\delta f}{\delta t} \geq \beta$$

The values of α and β would be chosen to suit the raise/lower frequency settings to minimise the switching delay time.

Issue 3: Switching control frequency settings for Tasmania

The following issues are related to the switching control frequency settings listed in Table 3 for Tasmania:

- With the proposed changes to the Frequency Operating Standards in Tasmania contingency band being 48 – 52 Hz, it would seem that the data in column 4 and column 5 could be more aligned.

- The default setting for the raise service (column 4) for the default setting (level 3) for a switching controller not allocated a frequency setting under 6.2(a), will have a significant delay before triggering a switching controller.

- If issue 2 is considered, then it may be appropriate for α and β values to be listed in this table.

- In Tasmania, during a Basslink import/export transition, the frequency excursion that occurs could trigger the operation of a switching controller under the low level settings (1 & 2) in Table 3. To date only one switching controller has been registered, but in the future following the allocation procedure listed under 6.2(a) this should be taken into consideration.

Issue 4: Combined linear and switching control action

It is unclear from the current MASS whether it is allowable to have FCAS services delivered from a combination of linear (“proportional”) and switching control action from a single unit or aggregated units. This could be technically possible, and some details could be included to indicate whether this is allowed and the verification method for this.

Second MASS Consultation (General Review)

Issue 1: Definition of a proportional controller

The meaning of “proportional controller” is defined in Table 1 of the MASS:

proportional controller	means a *control system* that controls the amount of service delivery essentially in proportion to the difference between *local frequency* and 50 Hz.

Proportional control has particular meaning in control systems terminology as distinct from integral and derivative control. Typically hydro machines have the equivalent of either proportional plus integral control or proportional plus integral plus derivative control. Only steam turbines tend to have purely proportional control. Hydro Tasmania has treated the hydro governors as proportional controllers for the assessment of FCAS capability.

It may be more suitable to have this as a class called “linear controllers”. This covers the range of governor control functions provided for the various turbine types (P, PI, PID or other compensation method).

Currently the definition in MASS for proportional control does not account for the presence of frequency dead-band. There is no requirement to provide contingency FCAS while frequency is within the normal operating band. Rather, the machine should remain on the dispatch target. The above definition if taken literally does not allow for the use of dead-band.

It would appear that a hydro governor fall into the category of “proportional controllers” and that dead-band is allowed. However the definition should be changed to avoid confusion for new entrants and those not familiar with FCAS.

Issue 2: Scaling factor in verification methods for "proportional control"

In the verification methods for contingency services, the change in mechanical power is first calculated, and then compensated with a scaling factor. The scaling factor is intended to "scale-up" disturbances that are less severe than the test disturbance used to calculate the capability. However, the present method for calculating the scaling factor can produce very large errors. The scaling factor is:

$$\mathrm{MAX}\ (1, \mathrm{ABS}(50 - f_{ref})/\mathrm{ABS}(50 - f_{local}))$$

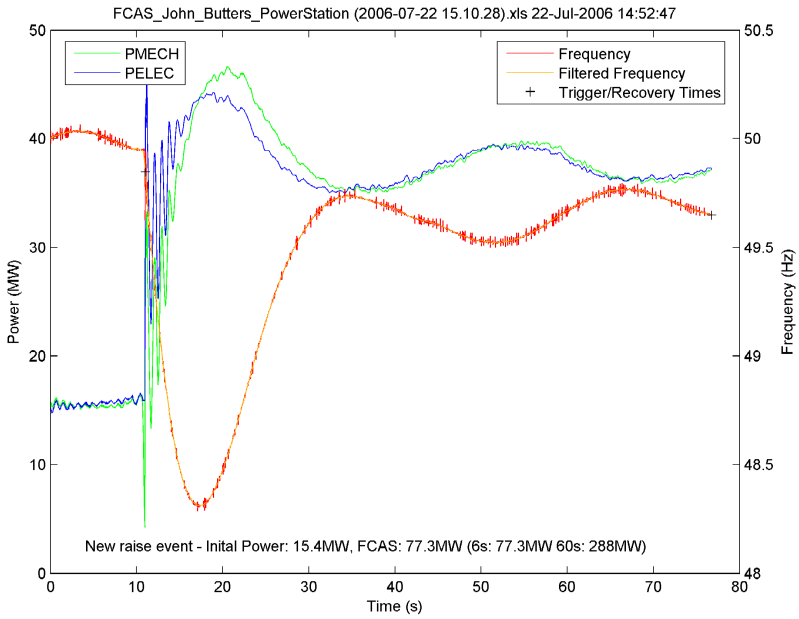
where f_{local} is the *local frequency* measurement coincident with the basic response measurement being compensated,

f_{ref} is the relevant *raise reference frequency* or *lower reference frequency*

The scaling factor is calculated and applied to each sample point.

The main problem with the scaling factor as it stands is the large scaling that is applied at the start of disturbances as frequency exits the normal operating band. In Tasmania, the scaling factor for raise and lower services, will be initially 13.3 (2 Hz/0.15Hz under the new Tasmanian Frequency Standards).

Generally with lower disturbances the errors produced by the scaling factor are not obvious in the results because the initial response is normally in the wrong direction, somewhat balancing the over scaling later on. For raise disturbances there is normally a large over estimation of the delivered FCAS. See the example below:



The delivered FCAS was calculated to be 77MW even though the actual change in output was only about 25MW up to 6s.

Another issue with the scaling factor is that it is applied to individual samples and it changes from one sample to the next. This means that noise and the effect of rotor angle oscillations are not averaged to zero in the calculations. The frequency is normally metered at the connection point which means that the rotor angle oscillations are not removed from the PELEC response when calculating the PMECH response. With the scaling factor varying, they don’t average to zero.

To reduce the effect of noise on the frequency signal, it could be worthwhile applying a bi-directional filter (which does not introduce time delay) and it removes “noise” that is above the bandwidth of any frequency changes that could occur from system disturbances. If frequency measurements are taken at a sample rate higher than the minimum 50 ms (say 20 ms), perhaps there could be some scope to filter the results to an equivalent 50 ms rate?

The scaling factor could be revised by:

- Basing it on the difference between the test signal and the measured frequency, not the reference frequency and the measured frequency. Scaling to the reference frequency produces a roughly 2x over-scale.

- Applying it to the overall result and not the individual samples so that noise and the rotor angle oscillations average to zero.

Issue 3 Verification methods for switching control

The assessment of fast FCAS delivery from switching control is based on a standard test signal. However during a real system event, the delivered FCAS will be highly dependant on the time taken to reach the trigger frequency. No compensation factor is taken into account to allow for this (apart from when two or more ancillary service providers share a common connection point).

Issue 4 Verification methods for slow and delayed services

The verification method for slow services differs depending on whether the equivalent fast service was enabled. For slow services, the amount of service delivered is reduced by the amount of fast service that was enabled. There is no allowance for this reduction in the calculation methods for determining capability leading to a discrepancy between the capability and verification assessments. The delivery of fast service is not mutually exclusive to the delivery of slow service, as the verification suggests.

A similar comment can be made for the verification of the delayed service which is reduced depending on the amount of slow service enabled.