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1 August 2017

Mr Neville Henderson
Commissioner & Reliability Panel Chairman
Australian Energy Market Commission (AEMC)

Via electronic submission - REL0065 Issues Paper

Dear Mr Henderson,

Review of Frequency Operating Standards – TasNetworks Submission to First Issues Paper

Tasmanian Networks Pty Ltd (TasNetworks) is pleased to provide our initial response to the *Issues Paper – Review of the Frequency Operating Standards* that was published by the Reliability Panel on 11 July 2017.

As the Transmission Network Service Provider (TNSP) and Distribution Network Service Provider (DNSP) in Tasmania, TasNetworks is focused on delivering safe and reliable electricity network services while achieving the lowest sustainable electricity prices for Tasmanian customers. We are committed to providing fair and equitable network access to a broad range of generation and customer based technologies with the intent of promoting competition and efficiency within the National Electricity Market (NEM).

In conjunction with the Australian Energy Market Operator (AEMO), TasNetworks has demonstrated its commitment to national electricity objectives by designing and implementing several innovative frequency control and protection schemes. The schemes have helped extend the capability of the Tasmanian power system while managing power system security.

As a result, TasNetworks has a significant interest in the ongoing refinement of the Tasmanian Frequency Operating Standard (TFOS) for the benefit of Tasmanian customers. We welcome the opportunity to discuss this submission further with the Reliability Panel and suggest a collaborative round table with stakeholders in Tasmania would be beneficial.

Should you have any queries in relation to our submission, please contact Andrew Halley (Principal Operations Engineer) on (03) 6271 6759 or via email, andrew.halley@tasnetworks.com.au.

Yours Sincerely

BESClark

Bess Clark

General Manager Strategy and Stakeholder Relations

1. Format of this submission

The AEMC has opted for a two stage review of the Frequency Operating Standards (FOS) recognising that interrelationships exist between a number of ongoing reviews of market and regulatory arrangements and the Standards themselves. TasNetworks is broadly supportive of this approach. We have representatives participating in the *Ancillary Services Technical Advisory Group* (AS-TAG) being convened by AEMO and are therefore aware of the overlaps which exist.

Section Two of this submission describes the key issues of concern for TasNetworks relating to the Tasmanian Frequency Operating Standard (TFOS). To preserve the intent, the submission segregates discussion items into stage one and stage two as outlined in the Issues Paper [1]. Section Three of the submission provides more general commentary on questions raised throughout the Issues Paper where these have not already been adequately addressed in Section Two.

2. Core issues that require review

2.1. Scope of stage one

2.1.1. Application of the 144 MW contingency cap in the TFOS and definition of *generator event.*

Background

A key element of the revised TFOS published by the Reliability Panel in December 2008 [2] was the introduction of a 144 MW limit on single generator events. The Panel determined that such a limit was necessary to satisfy the NEO recognising that substantially increased Frequency Control Ancillary Services (FCAS) requirements would be necessary to control larger contingency sizes which would "*cause costs that are likely to exceed the benefits and would likely lead to regular interventions by NEMMCO in order to maintain power system security*"[1].

The contingency size limit is defined in Clause (h) of Section B of the current standard. The exact wording of the clause is as follows:

> "The size of the largest single generator event is limited to 144 MW, which can be implemented for any *generating system* with a capacity that is greater than 144 MW by the automatic tripping of load".

Importantly, the term 'generator event' is explicitly defined in the TFOS and is described in Section D of the Standard as follows:

> "Means a *synchronisation* of a *generating unit* of more than 50 MW or a *credible contingency event* in respect of either a single *generating unit* or a *transmission element* solely providing *connection* to a single *generating unit*, not arising from a *network event*, *a separation event* or a part of a *multiple contingency event"*.

The definition has been interpreted and applied in a practical sense as follows since its enactment in 2008:

(a) The system impact that results from the unexpected disconnection of a *generating unit* due to a *credible contingency event* that is not a *network event,* will not exceed the equivalent of 144 MW.

[1] Refer Section 4.4.2 of "Tasmanian Frequency Operating Standard Review – Final Report", 18 December 2008

(b) In the case of a wind farm where multiple small *generating units* are aggregated to form a *generating system*, the impact of any *credible contingency event* affecting the *generating system* that is not a *network event* will not exceed the equivalent of 144 MW.

(c) Due to practicalities, the unexpected loss of one transformer within the *generating system* that interconnects the generating unit/s to the *transmission network* has been treated as a *generator event* rather than a *network event*.

The reasoning to exclude *network events* from the 144 MW cap was explicitly addressed in Section 4.4.3 of the Reliability Panel's 2008 determination. The explanation given was as follows:

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

As will be outlined below, operational experience now exists which demonstrates that the original assumptions applied by the Reliability Panel were optimistic. The current definitions applied within the TFOS have and will continue to impact operation of the Tasmanian power system, if not addressed as part of the current review.

Contingency sizes in Tasmania from 2014 onward

Musselroe Wind Farm (MRWF) entered commercial service late in 2013 and is the largest in Tasmania (installed capacity of 168 MW). Musselroe Wind Farm (MRWF) entered commercial service late in 2013 and is the largest wind farm in Tasmania (installed capacity of 168 MW). It is connected via a single radial transmission circuit which means that a single credible network contingency event must be mitigated via the dispatch of sufficient FCAS. It can be noted that Studland Bay and Bluff Point Wind Farms also connect to the Tasmanian transmission network via a single 110 kV circuit and are in aggregate rated at 140 MW.

TasNetworks has undertaken a review of all operating periods from January 2014 to December 2016 to assess when wind generation was capable of setting the FCAS raise requirements in the Tasmanian region[2]. The results of the analysis are provided in Table 1.

Table 1: Impact of wind generation on FCAS requirements in Tasmania.

Year	Column A	Column B	Column C
	Wind generation exceeded synchronous generator contingency size.	Contingency size was above 144 MW when wind was setting FCAS requirements.	Percentage of time that MRWF was generating above 144 MW.
	% of total time	% of Column A	% of total time
2014	29.1%	45.5%	13.2%
2015	35.4%	39.9%	14.1%
2016	34.8%	62.3%	21.7%
Average	**33.1%**	**49.2%**	**16.3%**

[2] The simplified analysis compared the generation output of all large hydro generating units with the equivalent generation loss that would have resulted from a *network event* causing disconnection of either Musselroe or Woolnorth Wind Farms.

The analysis clearly demonstrates that large wind farms exposed to single credible contingency events have the potential to set the FCAS requirements in Tasmania for significant periods of time. Furthermore, it is evident that a wind farm of 168 MW installed capacity can operate above 144 MW for one day per week (approximately).

As wind turbine technology continues to improve, allowing more energy to be extracted at lower wind speeds, TasNetworks believes that it is reasonable to assume even higher utilisation levels for new generation developments. This will also result in greater lengths of time spent operating at or near maximum capacity.

TasNetworks agrees with the original Reliability Panel determination to cap the generator contingency size in Tasmania to 144 MW, and considers that the Panel should now reflect on the appropriateness of the same constraint being applied to network events.

Relevance for new wind and solar developments in Tasmania

Like other states, Tasmania is currently seeing a renewed interest in developing wind and solar generation at both transmission and distribution voltage levels. The prospect of large scale transmission developments in excess of 144 MW are credible and need to be appropriately managed in the context of FCAS imposts going forward. This is especially relevant given reducing system inertia that will accompany such projects as the network is reduced to a minimum level of synchronous machine support for increasing periods of time.

Proposal for consideration by the Reliability Panel

TasNetworks proposes that the following arrangements be considered and refined by the Reliability Panel:

(a) The existing 144 MW limit be applied to all categories of single credible contingency events affecting individual *generating units* or *generating systems*. Network contingency events should be included to prevent large (>144 MW) *generating systems* connecting to the network via single radial transmission circuits without the provision of load shedding facilities that can appropriately limit the resulting FCAS requirements.

(b) The requirement should be applied for normal 'intact' network operating conditions, i.e. with all transmission elements initially in service, as is the situation for the vast majority of the time.

(c) TasNetworks is of the view that forced or planned network outages that then expose a larger amount of generation (>144 MW) to a subsequent single contingency event can be managed by the application of interim (short term) constraints that reflect an economic and practical trade-off between resulting FCAS requirements (and subsequent costs to the market), FCAS availability and a desire to minimise operational constraints for affected generators. TasNetworks is of the understanding that AEMO utilises a similar approach to this already, with a maximum contingency size of approximately 250 MW being applied during abnormal system operating conditions.

Based on historical performance of existing wind farms and the prospect of large wind and solar farms seeking connection in the Tasmanian region of the NEM, this change is likely to be necessary to ensure system security and to achieve the National Electricity Objective (NEO).

Potential mechanism to manage legacy issue associated with MRWF

As confirmed by the statistical analysis provided in Table 1, MRWF will continue to set the FCAS requirements in Tasmania above 144 MW for not-insignificant periods of time. TasNetworks does not support retrospective application of the 144 MW limit to MRWF as this would immediately require the installation of load shedding schemes by Woolnorth Holdings Pty Ltd to maintain current levels of generation output (and energy yield).

TasNetworks is of the view that several options exist to manage this legacy issue. Any one of the following may be appropriate depending on what is desired by the Reliability Panel:

(a) Limit new network connections to 144 MW (in the absence of load shedding schemes) and accept that MRWF will at times exceed this value with a corresponding increase in FCAS requirements.

(b) Recognise that the transmission losses between MRWF and its registered *connection point* at Derby substation are substantial at high wind farm outputs and use the power flow through the *connection point* for FCAS calculation purposes. At the present time, it is understood that AEMO applies a consistent methodology of using power as measured at the terminals of the *generating unit* or *generating system*[3] for such calculations.

    TasNetworks estimates that this would reduce the assessed contingency size to approximately 155 MW.

    Subsequent options then become:

    i. Apply this approach as a 'once off' for MRWF and maintain the 144 MW limit for all new connections.

       TasNetworks does not support the inclusion of transmission loss variations as part of the broader FCAS requirement calculations due to the complexity this would create in practice. However, the fact that significant transmission losses are incurred behind the registered *connection point* provides an opportunity to consider this option for MRWF using a simplified approach.

    ii. Standardise the maximum contingency limit to 155 MW for all new network connections, albeit that in doing so, new developments that do not have a generation profile strongly correlated with MRWF (due to geographical diversity) will increase the overall percentage of time that FCAS raise requirement are increased. In simple terms, more FCAS will be needed more often.

In considering these changes, it is recommended that the definition of 'generator event' be reworded. A possible definition for consideration could be:

> "Means the *synchronisation* of a *generating unit* of more than 50 MW or a *credible contingency event* which results in the disconnection of *generation* from the *network".*

The advantage of this definition is that the contingency event need not electrically isolate generation that is included as part of the event, i.e. a 'generator event' could include sympathetic tripping of electrically remote units as may have occurred during the South Australian blackout. The same principle applies to any embedded (distributed) generation that is assessed as being at risk.

2.1.2. Operationalising *Emergency Frequency Control Schemes* Rule change in Tasmania

While TasNetworks has not finalised the implementation of changes arising from the Emergency Frequency Control Schemes Rule change, we are of the view that existing emergency frequency control schemes installed in the Tasmanian region satisfy the second last paragraph of NER S5.1.8 (Stability) and have been designed and implemented with intent that is broadly consistent with the Rule change. As an example, TasNetworks is of the view that at least one protected event could be

[3] Being the summation of all individual *generating units* that form the aggregated *generating system*.

defined which is already mitigated by existing emergency frequency control schemes (for both under and over frequency events).

In regards to the questions raised in Box 4.1 and 4.2 of the Issues Paper:

(a) The FOS that applies for protected events should leverage off the capability of existing frequency control and protection schemes as far as is possible to prevent unnecessary duplication and operational complexity. The potential for multiple different schemes interacting in unforeseen ways (during an actual system event) could potentially represent a bigger risk to the power system than the initial event.

(b) In the Tasmanian region, application of frequency limits and restoration times equivalent to those already defined for multiple contingency events is considered appropriate and satisfies the basic principle described in (a). Application of the islanded frequency standard provides scope for the definition of a protected event that causes the formation of a viable electrical island within the Tasmanian region.

At this stage, TasNetworks is supportive of the interim frequency operating standard defined for protected events being retained subject to more rigorous analysis being undertaken.

(c) In terms of regional specific issues, the potential generation mix that remains post contingency will have a significant bearing on the ability to restore satisfactory operation, especially if an electrical island is produced. Regions with a high penetration of intermittent generation would require very detailed analysis to determine if a viable island can be established under all circumstances, and whether pre-contingency operating constraints are required in unison with the application of emergency frequency control schemes.

(d) TasNetworks agrees with the notion that it is not possible to guarantee a return to a satisfactory operating state for every multiple contingency event and recognition of such practical limitations is a necessary consideration as part of the FOS review. The principle of 'reasonable' or 'best endeavours' is worthwhile to explore. It should be recognised that Network Service Providers have an existing obligation under S5.1.8 of the *Rules* and the possibility of increasing AEMO's responsibility/accountability in the last two paragraphs of this clause would be beneficial in TasNetworks' view.

A general concept for re-consideration is:

Protected event → Power system must transition to a satisfactory operating state.

Multiple contingency event → Power system may transition to a satisfactory operating state depending on the severity of the event and must otherwise be managed to significantly reduce the probability of cascading failure of the entire network.

This is essentially TasNetworks design philosophy for it's under frequency load shedding (UFLS) and over frequency generator shedding (OFGS) schemes. The philosophy is to control wherever possible, but otherwise aim to maintain a portion of the network in an energised state to enable faster restoration of the entire network than would be the case if a black system was to occur.

2.1.3. Practical application of the 'electrical island' definition in Tasmania

An island in the context of the Tasmanian power system is a sub-section of the main network which has become electrically isolated. For the avoidance of doubt, the loss of the Basslink HVDC interconnector is managed as a credible contingency event on a continuous basis and is not classified as an islanding event in terms of the TFOS.

TasNetworks is supportive of the principle that the TFOS should contain more guidance on what constitutes a viable electrical island. Combining this with an agreed list of protected events would provide the basic framework for TasNetworks to design and implement countermeasures that ensure a satisfactory operating state can be achieved following such an event. Alternatively, where a viable island cannot be reasonably achieved in accordance with agreed criteria, this would provide TasNetworks with the necessary mandate to ensure all energy sources are disconnected and the island is de-energised. Such clarity would be of assistance when negotiating new generation connection agreements, specifically in regards to the application of NER S5.2.5.8(c).

TasNetworks would like to offer the following contributions to questions raised in Box 4.3 of the Issues Paper.

The basic characteristics of a viable electrical island are considered the same as for intact operating conditions and revolve around the need for stable frequency and voltage control as well as the continued operability of protection systems that ensure the safety of people, plant and network equipment. This also inherently manages the risks to which customer equipment may be exposed.

What is less clear is as follows:

(a) Should a viable electrical island have the capability to withstand an (N-1) event and return to a satisfactory operating state rather than becoming unviable at that point and collapsing? The need for (N-1) resilience is inferred in Table A2 of the existing TFOS however the practicality of this is questioned for small islands. Clarification of expectations should be included in the TFOS.

(b) This is potentially one difference between an electrical island created as a result of a protected contingency event and some other mechanism. An island that results from a protected contingency event should possibly have greater levels of resilience and robustness than one involving a small sub-section of a single NEM region.

(c) It is unclear whether AEMO has the ability to maintain control of scheduled generating units via its market systems for an island that forms *within* the Tasmanian power system. It is also unclear what processes exist to manage generating unit commitment and dispatch under such circumstances? TasNetworks suggests that this issue be considered and potentially factored into the requirements of the viability test. The impact of increasing levels of semi-scheduled generation is another related consideration (and applicable to all NEM regions).

(d) If an island is deemed unviable for reasons other than voltage or frequency stability, can it be retained in service for a period of time to allow network customers to transition to alternate energy supplies, e.g. local backup generating systems if required? This may be particularly relevant for underground mining operations or other such sites where immediate loss of power supply may be a significant impost.

TasNetworks is keen to engage with both the Reliability Panel as well as AEMO to clarify these and related issues as part of the current frequency standards review. A driver to understand the criteria applicable to electrical islands is a number of generator control system upgrades are being planned by Hydro Tasmania for units located on Tasmania's west coast. If required, the need for continuous, uninterrupted, stable operation of generators during islanded conditions would likely form part of the design criteria, especially for governor control system replacements.

2.1.4. Time error control in Tasmania

TasNetworks is of the view that time error remains a worthwhile metric for assessing the overall performance of a synchronous 50 Hz power system, from the perspective of 'good electricity industry practice'.

Recognising that many time keeping applications are now independent of power system frequency (removing what was once a significant justification for time error management), TasNetworks would like to propose the following pragmatic approach for consideration by the Reliability Panel.

(a) A reduced dependence on time error likely justifies the removal of a formal, accumulated time error standard.

(b) The fact that time error control is already embedded within AEMO's Automatic Generation Control (AGC) system suggests that its ongoing application (using regulation FCAS already procured for other reasons) is delivered at little or no marginal cost. As such, managing time error could occur using a 'best endeavours' approach, removing the need to procure additional regulation FCAS specifically for time error control (as would occur at present based on comments provided on page 43 of the Issues Paper).

(c) The ongoing use of time error as a metric to monitor power system performance still justifies that it be calculated and reported as part of AEMO's functions as the market operator.

TasNetworks view is that control of frequency within the limits of the *normal operating frequency band* will be of more concern (and importance) going forward, as opposed to time error. The recent degradation of frequency control across the NEM is now a well-documented and notably included in Section 2.4 of the Issues Paper. While Figure 2.8 of the Issues Paper shows a decline of frequency performance for both the mainland and Tasmanian power systems, time error control has remained relatively consistent for the Tasmanian region as shown below in Table 2.

Table 2: Indicators of time error management in Tasmania based on 5 minute resolution GPS time error.

Year	Column A	Column B	Column C	Column D	Comments
	Median time error	Standard deviation	Minimum error	Maximum error	
	[seconds]	[seconds]	[seconds]	[seconds]	
2013	-1.242	2.965	-14.8	12.3	The majority of operation outside the standard of 15 seconds occurred during May 2016 when Basslink was out of service and Tasmania was operating with a reduced fleet of hydro generators due to record low water storage levels.
2014	-0.569	3.580	-13.7	13.1	
2015	-0.895	2.812	-12.3	10.3	
2016	-0.242	2.877	**-16.3**	**16.1**	
2017	0.034	2.710	-13.3	10.8	

2.2. Scope of stage two

2.2.1. Specification of rate of change of frequency (ROCOF) limits within the Frequency Standards

As part of Stage Two, TasNetworks proposes that a rate of change of frequency (ROCOF) minimum standard be defined in the FOS and TFOS to provide a fixed reference for future network operation, planning and connection design processes. As management of ROCOF will only become more important as the generation mix continues to evolve, it would seem an appropriate time to consider how and where the limits/standards around this metric are defined.

The basis of the proposal is as follows:

(a) At present, the TFOS (and FOS) is silent on what ROCOF is acceptable.

(b) The withstand capability for generators is defined in Schedule 5.2.5.3 of the *Rules* (Generating unit response to frequency disturbances). The performance requirements are defined in terms of a *minimum* (MAS) and *automatic access standard* (AAS).

   i. The AAS is $\pm$4 Hz/s for not more than 250 ms.

   ii. The MAS is $\pm$1 Hz/s for not more than 1 s.

(c) In reality, as soon as one generator is connected at the *minimum access standard* (or close to it) this effectively sets the pseudo standard for the entire power system, i.e. all credible contingency events would need to be managed within the limits set by the 'least capable' generating unit to prevent simultaneous generator disconnections (with resulting impacts on FCAS dispatch).

The question then becomes, how do other network service providers know what *access standards* have been agreed to across the NEM?

TasNetworks would like to encourage discussion on the following:

(a) What ROCOF should the industry be working to as a preferred design standard for the mainland and Tasmanian power systems? For the Tasmanian power system, TasNetworks has been applying $\pm$3 Hz/s as its benchmark.

(b) It is recommended that existing access standards be reviewed to ascertain what agreements already limit operation of the mainland network. If scope exists to set a benchmark ROCOF above the existing *minimum access standard*, this should be discussed and embedded in the mainland FOS.

(c) Once benchmark ROCOF limits are defined, consideration should be given to the cost effectiveness of enforcing higher access standards on future participants when the network could not be operated at such levels anyway. An understanding of the distribution of agreed access standards would be useful in this regard, to determine whether the NEM could transition to a higher ROCOF limit over time (if relatively small numbers of changes were made).

(d) Consideration should be given to removing the existing ROCOF requirements from Schedule 5.2 in preference to having limits embedded within the FOS and TFOS. This potential change links to AEMO's current activity to develop amendments to Schedule 5.2.5 of the *Rules*.

2.2.2. Frequency operating bands defined by the TFOS

TasNetworks would caution making changes to the existing frequency operating bands unless compelling evidence exists to do so. As a minimum, the following control and protection systems would need to be reviewed and potentially updated to accommodate any changes to the *operational frequency tolerance band* or *extreme frequency excursion tolerance limit*.

(a) Tasmanian Under Frequency Load Shedding (UFLS) Scheme.

(b) Tasmanian Over Frequency Generator Shedding (OFGS) Scheme.

(c) Tamar Valley Generator Contingency Scheme (GCS) – this scheme was commissioned in 2008 as part of facilitating the connection of the combined cycle gas turbine (CCGT) unit. The 208 MW CCGT required automatic load shedding capabilities to be installed to comply with the technical requirements of the TFOS at the time.

(d) The Adaptive Under Frequency Load Shedding Scheme (AUFLS) that has been commissioned by Hydro Tasmania to provide switching controller based fast raise FCAS. TasNetworks is currently in a detailed design phase and will implement this centrally controlled switching scheme in the second half of 2017.

(e) Frequency Control System Protection Scheme (FCSPS) associated with Basslink.

(f) Basslink Frequency Controller.

(g) All registered FCAS trapeziums (for generating units) as well as associated FCAS constraint equations managed by AEMO.

Needless to say, the time and cost to undertake the necessary reviews and make any subsequent changes would be significant.

It is TasNetwork's view that changes to the frequency bands are unlikely to be justified at this time given that the principle drivers which underpinned the 2008 modifications still remain valid.

2.2.3. Impact of *Demand Response Mechanism and Ancillary Services Unbundling* Rule Change

The Reliability Panel has asked whether there are any other issues that it should be aware of in this review of the FOS.

TasNetworks suggests that the Demand Response Mechanism and Ancillary Services Unbundling Rule change (Rule 2016) is a relevant consideration. The potential increase of switching controller based FCAS that is made available to the market is the observation of note.

It must be recognised that the technical characteristics of switching controllers are not directly comparable to the continuously variable FCAS response that is delivered from generators. The coordination of multiple switching controller responses is not a trivial task, especially when the initiating contingency event is of variable size. Maintaining appropriate discrimination between discrete blocks of armed load so as to avoid frequency overshoot is an important design consideration. The issue described above pertains to the provision of fast raise FCAS in particular.

TasNetworks would like to encourage discussion on the following issues:

(a) We believe that there is a minimum ratio of fast FCAS that should be sourced from 'analogue controllers' (delivered via generator governor systems or other equipment capable of dynamically varying its FCAS response) so as to ensure appropriate frequency control in line with the intent of the FOS. TasNetworks has significant reservations about the prospect of all fast FCAS enabled by AEMO's market systems being in the form of switching controller action.

(b) It should be noted that any FCAS switching controller that is enabled between the limits of 49.0 and 51.0 Hz could not be reset while the islanded frequency standard is in effect in Tasmania as this becomes the *normal operating frequency band*. Repetitive operation of switching controllers could lead to frequency instability.

    TasNetworks recommends that switching controller based FCAS providers in the Tasmanian region should have trigger levels set outside the range of 49.0 Hz to 51.0 Hz to prevent potentially undesirable operation during islanding events.

(c) It is recommended that load and generation events in the TFOS be separated to more clearly define what is an acceptable level of frequency overshoot following either an under or over frequency event that is subsequently controlled by switching controller action.

    i. At present, the load and generation events are lumped together and have a common frequency range of 48.0 Hz to 52.0 Hz.

    ii. If an under frequency event mitigated by switching controller action then causes frequency to overshoot to 51.5 Hz, TasNetworks would not consider this acceptable given that switching controllers providing fast lower FCAS would then also be activated for the same event.

In relation to (c), TasNetworks initially proposes the following modifications to the interconnected system standards defined in the TFOS, with a right to withdraw subject to further consideration:

- Load event: 49.0 Hz to 52.0 Hz
- Generation event: 48.0 Hz to 51.0 Hz
- Network event should be defined in such a way that mimics the outcomes of the above changes depending on whether load or generation is disconnected.

The proposed changes do not impact on the issues alluded to in Section 2.2.2 as they are changes contained *within* the existing frequency bands and do not alter the outer limits of operation. The changes would provide greater clarity for the implementation of switching controller based schemes (in terms of acceptable overshoot) and place appropriate onus on AEMO to implement the aforementioned *Rule* change in a way that does not impact frequency stability.

The proposed changes also address issues outlined in (b) if FCAS switching controller trigger levels are set outside of the range 49.0 Hz to 51.0 Hz in the Tasmanian region. TasNetworks proposes that FCAS switching controllers not be enabled within this frequency range.

TasNetworks notes that similar considerations are likely to be relevant for the mainland FOS.

3. Responses to specific questions raised by the Reliability Panel

In relation to the definitions provided as part of the FOS and TFOS, TasNetworks recommends that the following be considered to assist with the application of both documents.

The issue of solar PV ramping (as a result of cloud cover) and high wind speed cut-out of wind turbines will be, if not already, issues that have a practical impact on network frequency control. Both types of event can have a significant impact on network frequency, especially in power systems the size of Tasmania.

At present, neither the FOS nor TFOS attempts to classify such events. It is therefore unclear whether they should be treated as regulation or contingency events for the purposes of FCAS dispatch. If classified as regulation events, the volume of regulation FCAS that may be required to satisfy the relatively narrow *normal operating frequency band* could be significant. Such an outcome may be uneconomic depending on the availability of services in some regions. In contrast, classifying such events as contingencies may not be appropriate either given that power variations may occur regularly for PV (and perhaps less so for wind farms due to geographical diversity effects). Application of the *operational frequency tolerance band* would appear most appropriate however this should be formally clarified in the standards.

Given the increasing levels of installed capacity of both wind and solar, with the viability of large scale transmission connected solar also improving, it is considered necessary that the FOS and TFOS address the specific frequency control issues introduced by intermittent generation.

While outside of the immediate scope of the FOS review, TasNetworks also encourages the Reliability Panel to monitor the emergence of new network technologies that could make a material difference to network frequency control.

While frequency control has traditionally been the domain of generators and to a much lesser extent switchable loads, the potential mechanisms to control frequency are expanding to include demand side aggregators, various forms of energy storage at transmission and distribution voltage levels and embedded generators which are largely invisible to network operators, but could and will provide a frequency control response going forward, e.g. AS4777 compliant inverters. The latter may drive a more probabilistic approach to frequency control when the exact volumes of frequency control capability may not be known, but would be too significant to ignore. How to capture increasing levels of uncertainty without introducing unacceptable risks to the power system is an issue for future consideration.

TasNetworks expects that the issues affecting frequency control will continue to get more complicated. In this context, TasNetworks encourages the Reliability Panel to consider more flexibility in its framework to enable more regular reviews of the FOS to ensure its ongoing applicability and suitability in what is a dynamic industry environment.

Please note that the definition of *generator event* could include sympathetic tripping of electrically remote units as may have occurred during the South Australian blackout. The same principle applies to any embedded (distributed) generation that is assessed as being at risk. This is an important consideration as part of this review and has is described in Section Two of this submission.

4. Conclusion

TasNetworks has demonstrated its commitment to national electricity objectives by designing and implementing several innovative frequency control and protection schemes. The schemes have helped extend the capability of the Tasmanian power system while managing power system security. As a result, TasNetworks has a significant interest in the ongoing refinement of the Tasmanian Frequency Operating Standard (TFOS) for the benefit of Tasmanian customers.

While this submission documents our key concerns for this stage of the consultation process, as the review process expands into Stage Two, we consider it would be important to consider any implications holistically on the basis that interdependencies exist between some issues.

TasNetworks has a significant interest in the ongoing refinement of the Tasmanian Frequency Operating Standard (TFOS) for the benefit of Tasmanian customers. We welcome the opportunity to discuss this submission further with the Reliability Panel and suggest a collaborative round table with stakeholders in Tasmania would be beneficial.

5. References

[1] AEMC Reliability Panel; "*Issues Paper – Review of the Frequency Operating Standards*", 11 July 2017.

[2] AEMC Reliability Panel; "*Tasmanian Frequency Operating Standards Review – Final Report*", 18 December 2008.

[3] AEMC; "*Rule Determination – National Electricity Amendment (Emergency frequency control schemes) Rule 2017*", 30 March 2017