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Australian Energy Market Commission
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Frequency Control Frameworks Review – Draft Report

Snowy Hydro Limited welcomes the opportunity to comment on matters raised in the Draft Report from the Australian Energy Market Commission (the Commission) on the Frequency Control Frameworks Review.

Snowy Hydro Limited is a producer, supplier, trader and retailer of energy in the National Electricity Market ('NEM') and a leading provider of risk management financial hedge contracts. We are an integrated energy company with more than 5,500 megawatts (MW) of generating capacity. We are one of Australia's largest renewable generators, the third largest generator by capacity and the fourth largest retailer in the NEM through our award-winning retail energy companies - Red Energy and Lumo Energy.

Executive Summary

Snowy Hydro understands the potential implications for the management of power system frequency through the imbalance between electricity demand and supply. Appropriately structured incentives that align with existing market structures however continue to be the most cost effective and efficient means of supporting the provision of primary regulating response and addressing the current concerns with frequency performance in the NEM. We commend the Commission's comprehensive review of frequency control in the NEM and strongly support their incentive based approach to addressing any material deficiencies identified in the current frequency control frameworks.

The Generator Group consisting of Snowy Hydro, Stanwell Corporation, Engie, Origin Energy, AGL, Alinta Energy, Delta Electricity, and Intergen commissioned SW Advisory Pty Ltd and DIgSILENT Pacific Pty to address related issues identified in the Commission's frequency control frameworks review. The Consultant concluded that:

- The NEM does have some frequency control issues but the way to address these is not via mandatory requirements but by adapting market processes and incentives for the new environment of greater variable renewable energy penetration

- Market solutions to frequency control should recognise the changing nature of the power system, especially the acute changes in sub-regions of the NEM. Revised FCAS arrangements should take into consideration the projected technical and performance capabilities of new technologies and not hold onto historical systems and structures that will be inappropriate in the future.

- The solution to the frequency control issues is to fix up the market arrangements and to avoid regulation requiring compulsory capabilities and provision of services. Regulation is a costly and economically inefficient approach that does not satisfy the NEO.

The market arrangements that the Consultants are suggesting is through efficient market arrangements that value services correctly and provide appropriate incentives for behaviour that assists with managing frequency. This approach provides a vision of how an effective FCAS market could operate in the future. The suggestions will require more detailed analysis and testing and some refinements before they are suitable to be implemented as operational systems in the NEM. The consultants report has been formally submitted to the consultation process.

Snowy Hydro is generally supportive of the AEMC's draft recommendations. We agree with the approach of dividing the recommendations into immediate priorities and emerging needs. We highlight in particular:

Priority Issue	**Draft recommendation**	**Snowy Hydro comment**
Immediate priority 2 - to address frequency control performance under normal operating conditions	That the providers of a primary regulating response should be remunerated for the costs of providing the service. Further work is required to investigate Option F and describe the potential arrangements for the implementation, and the associated costs and benefits of these arrangements.	A new FCAS be created which would supply a linear response to frequency deviations in the NOFB. This service should be seen as a complementary primary control service to the secondary control service of regulation which is managed via AGC[1] Further improvements within the NOFB could be achieved by increased amounts of regulation FCAS being enabled at different times based on a proper and transparent statistical analysis of the sources variation which require generation units to

[1] Refer to chapter 5 of the Generator Group's consultant report, "Frequency Control Frameworks Review, Market-based Solutions, 27 February 2018".

		deviate from their linear trajectory energy targets to maintain frequency at 50 Hz.
Immediate priority 3 - There is currently a lack of transparency regarding the frequency performance of the power system and the performance of FCAS markets.	That a rule change request be submitted to amend the NER to require: (a)Australian Energy Market Operator (AEMO) to monitor, and publish reports on, frequency outcomes (b) AEMO to provide information to the Australian Energy Regulator (AER) on the performance of FCAS markets and for the AER to monitor, and report on, the performance of FCAS markets.	We note the AER in their Wholesale Market Monitoring statement of approach intends to monitor more generally the performance of the FCAS markets. Hence we advocate for an approach that does not duplicate processes between the NEM institutions. Stakeholders believe there is a general lack of clarity of key processes relating to frequency control in the NEM. We strongly support a recommendation in the AEMC's Final Report requiring AEMO to publish a comprehensive technical guide on the operation of the AGC system. This would provide greater transparency to market participants and result in more efficient outcomes.
Emerging needs priority 8 - The existing frameworks for frequency control may be inadequate to address the future needs of the power system	That, in the medium term: (a) AEMO conduct a broader review of the MASS to recognise the capability, and more accurately value the response profile, of new technologies that are capable of providing frequency control services (b) the AEMC and AEMO refine the time frames and develop a work program for making any substantive changes to FCAS frameworks.	The AEMC notes the conceptual proposal for markets for management of contingency events and large frequency deviations as outlined in Chapter 7 of the SW Advisory and DIgSILENT report.

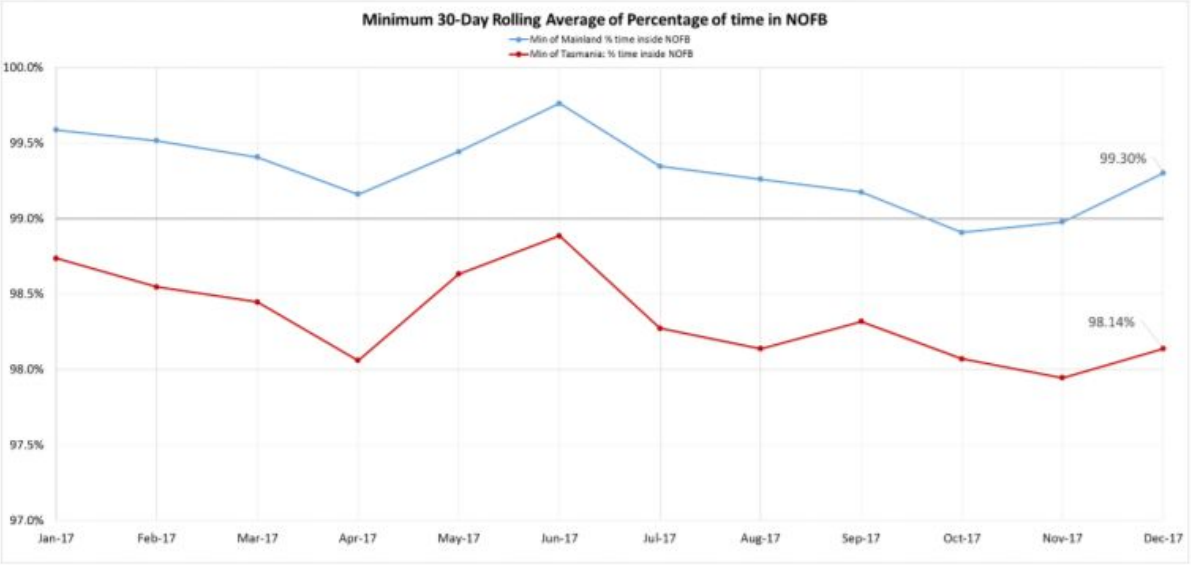
Finally, Snowy Hydro draws attention to consideration of chapter 8 and 9 of the SW Advisory and DIgSILENT report which highlights improvements to "Causer Pays" and general NEM Improvements.

Resolution of these issues and implementation of improvements identified in the Consultant's report through changes to existing FCAS arrangements would provide benefits to the NEM irrespective of the recent decline in power system frequency performance during normal operation.

Performance Frequency Operating Standard

Recent results have shown that the Frequency Operating Standard has not been breached. The AEMO recently released a report on the frequency and time error performance in the NEM for the period between October to December 2017 inclusive. Mainland frequencies exceeded the Normal Operating Frequency Band (NOFB) for more than 1 per cent of the time only twice over the 30-day periods from January 2017 to December 2017. The minimum daily values in the last 30 days of the rolling average percentage of time shows that the frequency was inside the NOFB are shown in Figure 1[2].

Figure 1: Minimum 30-Day rolling average of percentage of time mainland and Tasmania frequencies remained within NOFB from January 2017 to December 2017[3]



Immediate priorities and Emerging Issues

Existing FCAS arrangements have been designed around the plant mix where high inertia coal, gas and hydro predominated. The FCAS market was designed around the characteristics of the power system at the time and have worked well. As the NEM continues to change, we understand that the frequency performance under the normal operating conditions has been deteriorating with the Commission considering that this degradation has near term implications for power system security.

[2] AEMO, 2018, "*Frequency and Time Error Monitoring – 4th Quarter 2017 for the NEM"*
[3] AEMO, 2018, "*Frequency and Time Error Monitoring – 4th Quarter 2017 for the NEM*"

Snowy Hydro believes that although the current arrangements may not reflect the reality of the evolving power system the benefit of having a market-based approach to security and reliability services is that the participants best able to provide the services are appropriately incentivised. Markets encourage innovation, as opposed to prescriptive approaches which can become obsolete as technology changes. A mandatory approach that will look at historic system characteristics to define mandatory requirements for inertia and governor responses is unlikely to deliver the most efficient outcome compared to creating appropriate market arrangements.

We agree with the Commission which "*considers that intervention-based approaches, however well designed, are likely to be a second-best alternative to well-functioning markets at promoting economic efficiency in the long-term interests of consumers."*[4] Further to this the Commission correctly notes that *"it is possible that enhanced frequency control, delivered through a greater volume of ancillary services or stricter requirements on market participants, will involve an additional cost, which may increase the price of electricity to consumers."*[5] FCAS markets enable the delivery of enhanced frequency control at no additional cost or even with a cost reduction.

Drivers of degradation of frequency performance in the NEM

Better modelling of frequency response characteristics will improve AEMO's confidence that the frequency standard and security will be met. It is vitally important that AEMO improves the automatic generation control (AGC), system NEM dispatch engine (NEMDE) and forecasting systems.

The increasing numbers of non-synchronous generators will lead to a greater contribution towards increasing frequency fluctuations and have an adverse impact on the performance of frequency regulation with the normal operating frequency band.

Snowy Hydro welcomes the Commission's recognition that *"current regulatory arrangements do not adequately incentivise the provision of primary frequency control response to assist in frequency regulation during normal power system operation."*[6] We welcome AEMO's improvements which relate to the publication of AGC functionality, improvements to AGC and varying the base and additional variable quantity of regulating FCAS.

The proposed publication by AEMO of a technical guide on the operation of the AGC system would likely provide greater clarity to market participants and result in more efficient outcomes.

Principles

In our previous submission we noted that any changes to the existing frequency control framework must ensure that existing generation does not suffer additional costs that were not anticipated at the time of commissioning of the plant, or forced to retire prematurely by the imposition of a mandatory framework that physically cannot be met. Snowy Hydro therefore welcomes the

[4] AEMC, 2018, "*Frequency Control Frameworks Review – Draft Report*", pp33
[5] AEMC, 2018, "*Frequency Control Frameworks Review – Draft Report*", pp32
[6] AEMC, 2018, "*Frequency Control Frameworks Review – Draft Report*", pp61

Commission set of principles to guide the development of recommendations on potential changes to the market and regulatory frameworks that affect security in the NEM.

Our concerns have been addressed in the Commission's appropriate risk allocation and technology neutral principles. The appropriate risk allocation principle notes that regulatory and market arrangements should be designed to explicitly take into consideration the trade-off between the risks and costs of providing a secure supply of electricity while the technology neutral approach is designed to take into account the full range of potential market and network solutions.

Options for provision of primary regulating response

Snowy Hydro supports the development of market based options for the purpose of delivering the frequency services necessary to support adequate frequency control as a preference to any mandatory mechanism. A market based approach allows the participant best able to provide the services while being appropriately incentivised. Market encourages innovation as opposed to mandatory prescriptive approaches which can become obsolete as technology changes.

The Commission correctly notes that the mandatory approach can be easily administered but the opportunity costs associated with the provision of response and headroom are likely to be substantial which will not likely be economically efficient and hence not consistent with the NEO. Mandating governor control also has the potential to overlap with the existing contingency FCAS, changing volumes in an uncontrolled manner.

The demonstrated deterioration in frequency control in the normal operating frequency band can be addressed by a market-based approach and does not require the economically inefficient approach of mandating equipment upgrades.

Of the options considered in the Draft Report, Snowy Hydro supports the Commission's view that option F - the introduction of an incentive payments system for primary frequency regulation through causer pays arrangements is an option with the lowest cost approach. We agree that this preferred option will *"be highly flexible and adaptive to changes in the power system as they happen and is likely to encourage innovative technical and financial arrangements to support frequency control."*[7]

Our assessment suggests Option A suffers from a number of deficiencies such as confusing two different services into the one service provision and by bundling two different functions into one service may not result in the most efficient and cost effective outcome. There would also be difficult boundary considerations between local and AGC service provision.

Option F with the introduction of incentive payments for primary regulating response through changes to causer pays arrangements would allow generators to develop innovative predictive tools to take advantage of times where frequency performance is likely to be poor and therefore frequency response more valuable. This mechanism is "*likely to be relatively simple and low cost to implement, possibly only requiring a rule change in relation to the goal of the contribution factor*

[7] AEMC, 2018, "*Frequency Control Frameworks Review – Draft Report*", pp87

procedure to allow valuation of positive factors, followed by subsequent changes to AEMO's causer pays procedure".[8] We support further investigation into the implementation of Option F.

Of the other options considered by the Commission they are least preferred and are likely to:

- Not provide a natural incentive for a universal distribution of primary response throughout the power system
- Provide some challenges in specifying the performance criteria for the mandatory response. Some generators would be able to meet the requirements at lower cost than others.
- Lead to issues with implementing a change to minimum access standards for existing generators
- Lead to generators bearing the risk of providing the required frequency response
- Involve the specification of a minimum performance requirement for all generators to meet, which would not support innovative approaches to improve frequency response capability
- Not provide a natural incentive for a universal distribution of primary response throughout the power system. Any regional requirements for response would need to be dealt with via regional constraints, as is the case for existing FCAS.

Alternative Market Solution to NOFB Frequency Control

We support further investigations into Option F to create incentives and/or market arrangements to encourage a level of primary frequency response that is active within the normal operating frequency band, between 49.85Hz and 50.15Hz.

We believe an alternative option identified in Chapter 5 of the SW Advisory and DIgSILENT report should be investigated in conjunction with Option F in the AEMC's Draft Report. The desired output of a NOFB frequency control market solution is an automatic corrective response to frequency deviations within the +/- 0.15 Hz band around 50 Hz. This service should operate in parallel with the Regulation Service. The NOFB primary control service market, with automatic response to frequency deviations, would complement the Regulation Service by providing good control of the fast frequency deviations.

AEMO's supply/demand forecasting arrangements

Accurate forecasting is important to help manage the frequency impacts of the variability of non-dispatchable capacity within the five minute dispatch interval. The accuracy of AEMO's supply/demand balance will keep frequency within the requirements of the frequency operating standard. Snowy Hydro agrees with the Commission's view that the following events are likely leading to the number of minor imbalances between supply and demand. These include:

- Errors in the five minute demand forecasts that are used in the dispatch process
- Errors in the five minute forecasts of variable intermittent generation, such as wind or solar, that are used in the dispatch process generating systems not following their dispatch targets

[8] AEMC, 2018, "*Frequency Control Frameworks Review – Draft Report*", pp88

- Smaller generating systems or loads partially changing their output or consumption, or tripping altogether.[9]

These changes are presenting challenges for AEMO in managing power system security.

Snowy Hydro believes that improved forecasting will both reduce the dispatch interval forecast error and the amount of regulation required. Although we understand that AEMO are working on improved approaches, the Generators group consultation paper has suggested some plausible alternatives. The consultation refers to the Dyson and Mackenzie work that suggests the use of satellite images and sky cameras for short term solar generation forecasting which will allow for much improved forecasting performance for solar farms leading to both reduced FCAS costs for the generators and improved system security outcomes for AEMO. Short term wind farm generation forecasting is a much more difficult problem, but recent advances in using sophisticated machine learning approaches have produced promising results and will potentially lead to better outcomes for both the individual generators and the system operator.[10] It is important that AEMO continue to review its short term forecasting approach with the increase in penetration of rooftop solar and wind.

We support the Commission undertaking more analysis on the accuracy of forecasts and investigating potential reforms that are likely to contribute to improvements in the accuracy of supply and demand forecasting.

Causer pays contribution factors

The Generators group consultation paper noted that *"the "causer pays" mechanism for recovery of regulation costs has discouraged generators from providing governor control and encouraged them just to follow their energy targets*."[11] Snowy Hydro supports the approach noted by the consultation report which highlights that current "causer pays" approach could be adapted to provide an efficient cost recovery mechanism for the Primary NOFB FCAS and a new "causer pays" methodology based on the statistical analyses used to determine the regulation requirements could be developed to recover the costs of the regulation FCAS. This would allow participants who are not enable for either Primary NOFB FCAS or regulation FCAS who contribute to the size of the regulation amount.

It is important that the causer pays procedure is properly understood and reflects a participant's contribution to any frequency excursion at the time of that excursion.

Frequency monitoring, reporting and forecasting arrangements

The Draft Paper supports the benefits of frequency monitoring and reporting which would provide a transparent means by which all affected parties can understand the frequency performance of the system. Although Snowy Hydro understand that there may be benefits of more accessible

[9] AEMC, 2018, "*Frequency Control Frameworks Review – Draft Report*",

[10] Dyson, J., and Mackenzie, H.,2017, October, Short term forecasting of wind power plant generation for system stability and provision of ancillary services, 16th Wind Integration Forum, Berlin.

[11] SW Advisory and DIgSILENT, 2018, *"Frequency Control Frameworks Review", pp v*

information about the performance of FCAS markets we continue to be concerned that increased monitoring and reporting could be onerous on generators who are already undertaking a significant amount of reporting.

Snowy Hydro believes that any FCAS reporting or monitoring should be rationalised and not duplicated across the NEM regulatory institutions. Any duplication would increase costs due to the substantial administrative burden. For instance, recently the AER announced that it expected to undertake regular assessments of the performance of wholesale electricity markets assessing competition and efficiency in the Frequency Control Ancillary Services (FCAS). This is expected to start in December 2018[12].

If AEMO already holds data about FCAS prices and providers then we support the Commission's note that this information could be collated and published in way that is accessible to all stakeholders which could help identify trends about the number of providers in each of the FCAS markets, the total enablement costs and the amount of each service that is actually required.

Future FCAS frameworks

As we move towards more non-synchronous and variable sources of electricity generation the difficulties in predicting this variability are likely to increase the potential for imbalances between supply and demand that can cause frequency disturbances. Snowy Hydro understand that there are likely to be further substantive changes to FCAS frameworks that may be required overtime to address the appropriate valuation of inertia and FFR services along with the participation of emerging technologies in the provision of frequency response services.

On the spectrum of frequency control frameworks we believe there needs to be a balance between higher levels of certainty and confidence in the maintenance of system security with increased efficiency and flexibility in the provision of services. In the future any new approaches need to maintain the effectiveness of the existing available resources. We agree with the Commission that "*any substantive changes to FCAS frameworks should wait until any revisions to frequency control in the normal operating frequency band are implemented and consequential impacts understood*." Market-based solutions and incentives however will continue to address any material shortcomings in the frequency control in the NEM. We draw the Commission's attention to chapter 7 of the SW Advisory and DIgSILENT report which highlights conceptually an emerging priority to investigate fundamental changes into markets for management of contingency events and large frequency deviations (contingency FCAS).

Conclusion

We commend the Commission for uptaking a comprehensive review of frequency control in the NEM. Snowy Hydro strongly supports the Commission's market/incentive based approach to addressing any material deficiencies identified in the current frequency control frameworks.

[12] AER, 2018, "Wholesale electricity market performance monitoring – 2018 Focus", pg4

Snowy Hydro appreciates the opportunity to respond to the Draft Report. Any questions about this submission should be addressed to Panos Priftakis, Regulation Manager, by e-mail to panos.priftakis@snowyhydro.com.au.

Yours sincerely,

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