

5 December 2017

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Submitted by email to aemc@aemc.gov.au

Project number: EPR0059

Frequency Control Frameworks Review

Snowy Hydro Limited welcomes the opportunity to comment on matters raised in the Issues Paper 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.

Snowy Hydro understands that the NEM is undergoing fundamental change which is impacting frequency variations. We however do not believe that the Commission has clearly defined the problem and provided proper analysis of the causes and the potential resolutions undertaken by frequency control. Although there is evidence that there is greater variation in operating frequencies within the NEM, Snowy Hydro notes that the frequency remains compliant with the frequency operating standard.

Hence it is imperative that the AEMC takes an objective approach to this review through:

1. Assessing whether is a material problem associated with the observed frequency distributions;
2. Determining independently what are the root causes associated with the observed frequency distributions;
 - a. Assessing whether these root causes could be rectified.
3. If there remains a material problem, assessing whether the current frequency operating standards are still fit for purpose;
4. If a new frequency operating standard is adopted an assessment needs to be done to determine how the new standard will be met. That is, market based incentives, or through regulation; and
5. With step 4, the pros and cons of each approach must be assessed against the National Electricity Objective.

Snowy Hydro firmly believes that if the AEMC determines that there is a material problem that needs to be addressed then market based or incentive based options continue to be the best way forward to incentivise tighter frequency control as opposed to the imposition of mandatory governor frequency requirements. Snowy Hydro believes that an approach that undervalues ancillary services and relies heavily on mandatory provision will result in more intervention and costs to deal with the maintenance of system security. There will also be further costs on generators who will require capital investment and plant upgrades in order to be able to provide the ancillary service.

Answers to specific questions from the Issues Paper have been provided in Attachment 1. We welcome the opportunity to discuss any of the issues raised in this submission with the Commission along with any other matters as they arise.

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

Yours sincerely,

A handwritten signature in black ink, appearing to read 'K Ly', with a stylized flourish underneath.

Kevin Ly
Head of Wholesale Regulation
Snowy Hydro



List of questions from FCF Review issues paper

1) Scope

Are there any other issues relating to frequency control that should be included within the scope of this review?

The Australian Energy Market Operator (AEMO) role in setting the regulation amount in the normal operating band has not been properly explored in the Issues Paper. With the current frequency distribution there is likely to be a larger amount of contingency service needed to be enabled in order to capture the fall in frequency. AEMO has progressively reduced the amount of enabled regulation services since Frequency Control Ancillary Services (FCAS) markets commenced in 2001. Additionally contingency services are only enabled due to a contingency event that causes the frequency to deviate outside the normal operating band. Snowy Hydro believes the likelihood of this occurring must be weighed against a tighter mandatory governor control that is continuous and will likely lead to wear and tear implications on generation plant.

2) Drivers of degradation of frequency performance in the NEM

- A. *Do stakeholders agree with the drivers of the observed long term degradation of frequency performance as identified by DlgSILENT?*
- B. *Are there any other drivers of frequency degradation in the NEM that are not mentioned here?*

Snowy Hydro disagrees with certain drivers the DlgSILENT report has observed as impacting the long term degradation of frequency. The DlgSILENT analysis has worryingly contributed the FCAS markets and the removal of compulsory provision of the governor response as having adverse impact on the performance of frequency regulation with the normal operating frequency band. Snowy Hydro considers that without a proper understanding of the cause of the problem the DlgSILENT report has pre-empted that more regulation via mandatory governor responses to arrest the wider distribution in frequency outcomes will solve the problem. The DlgSILENT report does not properly assess economic trade-offs with any changes to frequency control.

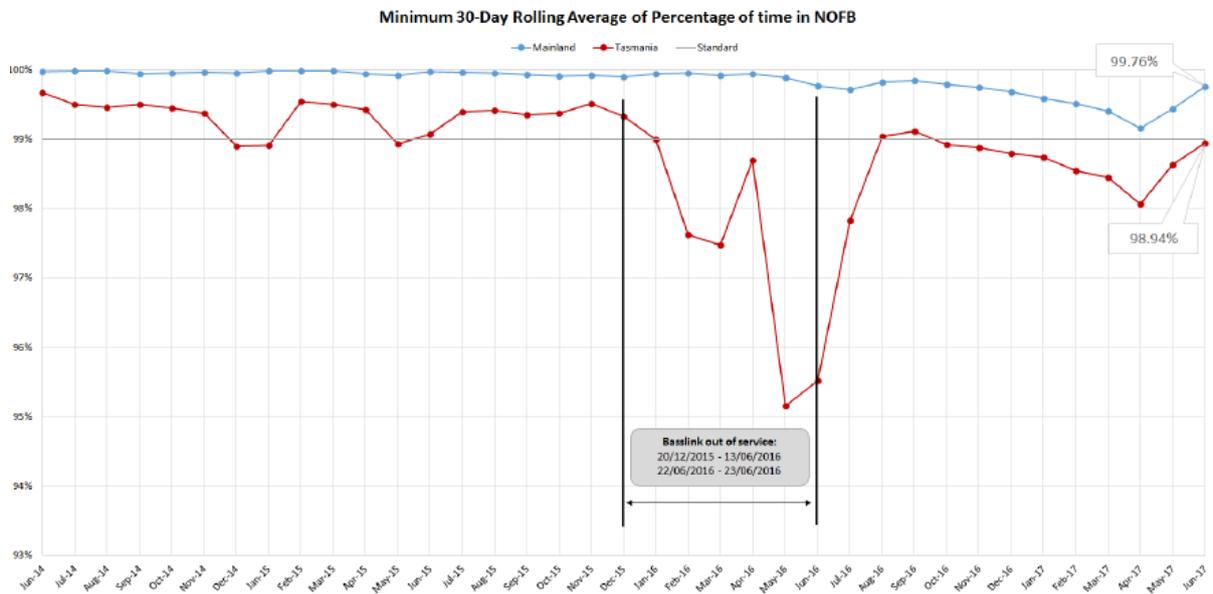
The introduction of increasing numbers of non-synchronous generators has likely had a greater contribution towards increasing frequency fluctuations and had an adverse impact on the performance of frequency regulation with the normal operating frequency band rather than pointing to the FCAS markets.

Figure 1 below from the Issues Paper shows that the NEM mainland is within the standard for the Normal Operating Frequency Band of 49.85 to 50.15 for 99% of the time in any 30 day period. The drop-off in the NEM mainland from Oct-16 is directly due to the drop-off in performance in



Tasmania. We believe more independent analysis on the effect of Tasmania and Basslink on Mainland frequency needs to be done to ensure a complete picture of all casual factors to observed frequency distributions in the NEM.

Figure 1: NEM mainland and Tasmanian frequency performance¹



Two key sources of degradation of frequency performance in the NEM which has received less attention is AEMO’s forecasting error and the level of Regulation services enabled. Figure 2 below demonstrates this point.



Figure 2. Source: AEMO.

¹ Australian Energy Market Commission, 2017, “Frequency Control Frameworks Review - Issues Paper”, pp32

Figure 2 shows the 99% Probability of exceedance values for demand forecast error (DFE) and Semi-scheduled forecast error (SSFE) over time. It shows the regulation enabled is insufficient. Snowy Hydro requests further investigation on:

1. Ways to improve AEMO's forecasting;
2. An explanation of why less Regulation services is enabled that what is required to rectify the forecast error.

Finally, AEMO's AGC system and processes are opaque. This may well be a major source contributing to the wider distribution in frequencies. Snowy Hydro requests an independent and detailed assessment of the key inputs into AEMO's AGC system, a detailed process map of how the AEMO AGC system works, and an assessment of what changes are needed to improve AEMO's AGC system to ensure that is delivering outputs which aid the management of frequency to the required frequency operating standard.

3) Materiality of frequency impacts from non-dispatchable capacity.

- A. *What are the likely impacts on frequency of increasing proportions of non-dispatchable capacity, and reducing proportions of scheduled generation?*
- B. *Are there any significant impacts on frequency that may occur from changes in output from individual large scale semi-scheduled generation (large solar and wind farms)?*
- C. *Does the analysis for wind generation above hold true for large scale solar PV? Does large scale solar PV output change more rapidly than wind output? Are changes in solar output more difficult to forecast?*

The Commission has correctly acknowledged that non-dispatchable generation and distributed energy resources will form an increasing proportion of the market which will likely complicate AEMO's forecasting processes. Snowy Hydro agrees with the Commission that the predictability of changes in power output has changed² with the concept of predictability being more *"important because it impacts the way that AEMO dispatches energy in the NEM to balance supply and demand, which has important implications for the frequency of the power system"*³.

Snowy Hydro is concerned that this comes after the Commission decided not to make a rule change in response to the proposed *Non-scheduled Generation and Load in Central Dispatch*⁴ rule change to allow more generation and load visibility. The rules obligation required operators and agents of non-scheduled generation and price sensitive non-scheduled load to inform the market of their intentions which Snowy Hydro firmly believes would have improved price discovery and ensured an overall more efficient utilisation of resources for the NEM. The Commission however concluded that it would not make the rule change reporting that AEMO's forecasts were generally accurate.

² Australian Energy Market Commission, 2017, "Frequency Control Frameworks Review - Issues Paper", pp42

³ Australian Energy Market Commission, 2017, "Frequency Control Frameworks Review - Issues Paper", pp42

⁴ Australian Energy Market Commission, 2017, "Non-scheduled Generation and Load in Central Dispatch"

The Commission asserts that *“for any five-minute dispatch interval throughout the day, the average ramping capacity available to be dispatched is substantial when compared with the average ramping needs expected out to 2035-36”*⁵. Ramping capacity is an important issue and with additional intermittent energy entering the market, Snowy Hydro submits with the Five Minute Settlement rule there will be less plant available to meet the power system’s ramping requirements as conventional fast-start plant will be unable to respond within the five minute settlement period will impact market responsiveness. To meet the expected shortfall, it is important that markets are established to provide the necessary capacity as economically efficient as possible.

4) Drivers of change.

Are there other drivers of change affecting frequency control that are not set out in this section? If so, how material are they?

The Commission has adequately highlighted the drivers of change affecting frequency control.

5) Assessment principles

- A. *Do stakeholders agree with the Commission's proposed assessment principles?*
- B. *Are there any other relevant principles that should be included in the assessment framework?*

Snowy Hydro agrees with the Commission’s proposed assessment principles which include appropriate risk allocation, efficient investment to promote a secure supply, technology neutral, flexibility and transparent, predictable and simple.

6) Assessment approach.

Are there any comments, or suggestions, on the Commission's proposed assessment approach?

- A. *Are stakeholders aware of any other costs or impacts linked to the degradation of frequency control performance in the NEM?*
- B. *Are there any other risks that stakeholders are aware of with respect to degradation of frequency control as represented by the flattened frequency distribution within the normal operating frequency band shown in Figure 5.1?*
- C. *Are stakeholders aware of any other international experience in relation to primary frequency control that is relevant for this review of frequency control frameworks in the NEM*

Snowy Hydro acknowledges the Commission’s listed risks of reduced frequency performance and recommends further analysis to assess the scale of the economic and security impacts of such risks, while being mindful of the fact that frequency remains within the frequency operating standard. Any changes to the frequency control framework must also ensure that existing generation does not suffer additional costs which 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

⁵ Australian Energy Market Commission, 2017, “Frequency Control Frameworks Review - Issues Paper”, p47

met. The market's ability to provide frequency control services should not be compromised and additional costs not be borne by consumers. It is important that the Commission considers the outcomes it is seeking to achieve, and identifies the most economically efficient means of doing so.

The international experiences highlighted by the Commission outline the diversity of mechanisms across other countries although there would be significant value added if the analysis included the impact the different mechanisms have on existing generation and the impact on consumers. Snowy Hydro is concerned that the Issues Paper attempts to falsely assert that it is unusual for the NEM to have FCAS markets as those with FCAS market such as Germany, France and the western interconnection in the USA have "*more stable frequencies than smaller power systems with relatively limited interconnection*"⁶. We believe a more extensive analysis is required of the FCAS markets.

7) Mandatory primary frequency control

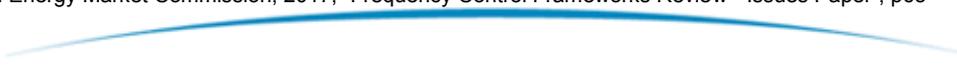
- A. *What are the advantages and disadvantages of mandating primary control for all generators in order to improve frequency control during normal power system operation?*
- B. *What factors should be considered in the specification of a mandatory primary frequency control response?*
- C. *Are there any regional issues that should be considered in assessing whether primary frequency response should be a mandatory obligation for registered generators in the NEM?*
- D. *Should an obligation for generators to be responsive to changes in system frequency outside a pre-defined dead band include a required availability reserve, such as 3 per cent of a generators registered capacity, as is the case in Argentina?*
- E. *What are the advantages and disadvantages of procuring primary control through bilateral contracting as a means to improve frequency control during normal power system operation?*

Snowy Hydro does not support mandating primary control for all generators in order to improve frequency control during normal power system operation. We need to consider if the current FCAS markets are the best way from a frequency control perspective, or if an alternative may exist before looking to improve the frequency control through a mandatory approach.

Snowy Hydro believes that the disadvantages associated with a mandatory approach far outweigh the advantages. Tighter mandatory governor controls will have a tear and wear implications for generation plant that will flow through to end prices to consumers.

An approach that undervalues ancillary services and that relies heavily on mandatory provision will result in more intervention and intervention costs to deal with the maintenance of system security. In a mandatory approach there will be further costs on generators who will require capital investment and plant upgrades in order to be able to provide such functionality. Many of the commercial conditions including testing, liability and default will be weighed against the generator.

⁶ Australian Energy Market Commission, 2017, "Frequency Control Frameworks Review - Issues Paper", p63



Failure to pay a fair price for ancillary services required at peak times will tend to exacerbate the problem. Snowy Hydro believes that the relevant services should be recompensed according to their opportunity cost and, if possible, this should be done by incorporating these services directly into the market arrangements. The mandatory approach option comes at a time when ancillary service costs continue to increase leading to further cost pressures on generators.

The FCAS markets were introduced to the NEM in September 2001 and provide simpler, more dynamic and transparent arrangements that have further increased competition and contributed to improved overall market efficiency. NEMMCO's (AEMO) reasons for FCAS to be sourced on a commercial basis and removing mandatory requirements continue to apply today.⁷

Mandating services was found to have implications for long run dynamic efficiency leading to a lack of income by generators for the provision of such services which would raise the threshold of investment for new plant, especially peaking and emergency plant.

Snowy Hydro notes that in 2001 none of the parties most involved in the mandatory arrangements found them satisfactory. Generators felt they were unfairly and unreasonably required to provide too many services for free under the mandatory requirements of the Code and connection agreements. Retailers felt they were unfairly and unreasonably required to pay for all services, when they consider that they are not the cause of the requirement (although their customers may be). Many of these real or perceived problems are inherent to the central procurement of ancillary services overlaying a competitive energy market.⁸

Under the mandatory method prior to 2001 retailers were paying for these services on a cost-as-incurred basis which represented a very significant financial management problem for retailers. This is especially so if the costs turn out to be volatile and if, as at present, the arrangements are not conducive to hedging or other risk management measures⁹. The Commission should choose the option that is the least cost to consumers and not add further cost pressures to industry.

The requirement to have a governor or a certain reactive capability in a generator does not in general guarantee that the facility will be available for use by AEMO. Specifically, a unit may be off-line, even though its presence on line might be of great value. If direction is to be avoided wherever possible, some means must be found to ensure that the service is willingly made available if needed. A market based approach provides the required incentives for this to occur.

8) Market based options for primary frequency control

What are the advantages and disadvantages associated with the two options presented for earlier provision of primary frequency control:

⁷ NEMMCO, 1999, "Ancillary Service Review - NEMMCO recommendations"

⁸ NEMMCO, 1999, "Ancillary Service Review - NEMMCO recommendations"

⁹ NEMMCO, 1999, "Ancillary Service Review - NEMMCO recommendations"

- A. *Using the existing contingency FCAS for provision of primary frequency control and narrow the normal operating frequency band to trigger a primary frequency response closer to 50 Hz.*
- B. *The establishment of a new primary regulating service to provide primary frequency control within the normal operating frequency band, separate from contingency FCAS.*

Are there any aspects of the existing Causer pays procedure that stakeholders believe are acting to discourage the voluntary provision of primary frequency response?

Snowy Hydro supports primary frequency control market based options over tighter mandatory governor requirements. The current FCAS markets are the best way from a frequency control perspective, although if an alternative may exist, then it is important that generators are compensated to have a prescribed governor setting and operating in frequency bias mode.

The market based option approach is the best way to provide a positive contribution to the ongoing development of the market processes in the NEM. In the FCAS market buyers and sellers would trade small deviations of energy relative to their energy dispatch targets. Those who cause frequency deviations and those who act to correct them would pay and receive accordingly. While there is evidence that there is greater variation in operating frequencies within the NEM it is important to note that the Frequency Operating Standard has not been breached.

Mandatory provision of any ancillary service is an unsatisfactory and inefficient solution. The service, if provided, must be provided to a satisfactory and agreed standard. Generally part of generation equipment but extra facilities as well as operation and maintenance costs may be incurred.

FCAS market payments and recovery are competitive. For the purpose of recovery, participants are treated equally, regardless of region. Under a mandatory scheme the cost of providing the service is difficult to interpret. The need for compensation is important as it covers the assessed opportunity cost of providing the service when it might otherwise have been used profitably for energy or other production. The need to demonstrate the provision of a capability will continue to act as a barrier to entry such time as until actual provision can be easily measured or assured.

The dead band is a key variable for primary frequency control services. Snowy Hydro believe that the increasing use of contingency services if deadbands are tightened would result in increased wear and tear on units, potentially increasing costs in the FCAS market.

There needs to be further analysis undertaken before a determination is made on which two options presented for earlier provision of primary frequency control is the preferred option.

The DigSILENT report notes that the causer pays procedure could incentivise the wrong behaviour although it is unclear in the report what the measure is and objective of the causer pays procedure and what impact improvements in this procedure would have on frequency. It is important before any solution to causer pays procedures (CPP) is proposed that there is a clear statement of the problem that is being solved. The current discussion around frequency control has identified a wide



range of potential issues with inertia, governors, forecast errors, CPP all being mentioned. Snowy Hydro however would support the improvement of the CPP further.

9) Frequency monitoring and reporting

- A. *What are the potential benefits or costs associated with a requirement for AEMO to produce regular frequency monitoring reports?*
- B. *What metrics should such frequency monitoring reports include?*

Snowy Hydro acknowledges the importance AEMO's desire to anticipate and prevent possible system problems which may cause reliability issues. However we consider that AEMO must initially clearly understand the operation of system frequency control and what is important. Only then can work progress towards determining the impact of the current arrangements and potential solutions.

Snowy Hydro supports AEMO managing the frequency within the Frequency Operating Standard in a manner that is least cost to consumers. AEMO should look at various aspects to effective control of frequency including the interaction between primary frequency control, automatic generation control, regulation and contingency services, demand forecasting, inertia, causer pays and other systems and settings. If AEMO proceeds with producing regular frequency monitoring reports then it should not be onerous on generators who already undertake a significant amount of reporting.

AEMO's role in setting the Regulation amount in the normal operating band has not been explored over the years and they have progressively reduced the amount of enabled Regulation Services since FCAS markets commenced in 2001. We consider AEMO's involvement important.

10) Defining FFR.

What are your views on AEMO's advice on how and when FFR might emerge in the NEM?

Snowy Hydro supports AEMO's advice on how might the FFR emerge in the NEM. We agree that emergency response FFR is being implemented immediately, contingency FFR and frequency control show promise in the near term, fast response regulation may become important and is technically feasible at present and simulated inertia and grid forming technologies are not yet commercially demonstrated.

Snowy Hydro submits however that AEMO should look at the interconnector flows being dispatched, that settings are being reviewed when there are major settings being reviewed following major retirements.

11) Potential options for making changes to FCAS frameworks.



What are your views on the above indicative approaches to varying the design of FCAS services, and on other potential changes?

The current FCAS markets are the best way from a frequency control perspective. Snowy Hydro however agrees if the Commission is to look at innovative approaches that the “*development of new FCAS market or markets is likely to be complex and time consuming*”¹⁰.

The Commission notes that “*to a large extent, the structure of current markets reflects the nature of the generating fleet existence at the start of the NEM*”¹¹. With the introduction of increasing numbers of non-synchronous generators since the start of the NEM contributing towards increasing frequency fluctuations a different framework the Commission could look at is the theory of externalities. This would involve the cost of market externalities being corrected by imposing a tax on the causers of the externality, in this case the generator that caused the significant change in frequency.

Snowy Hydro believes that whichever potential option the Commission reviews that it is important that generators under a mandatory approach are adequately compensated to have a prescribed governor setting and operating in frequency bias mode.

12) Technical characteristics of emerging sources of FCAS.

What other emerging sources of FCAS should the Commission be aware of?

There are no other emerging sources of FCAS that Snowy Hydro can suggest at this stage.

13) Managing the frequency impacts of non-dispatchable capacity.

- A. *Is the existing FCAS framework sufficient to maintain frequency as greater proportions of non-dispatchable capacity enter the power system?*
- B. *Would it be more efficient to improve the forecasting of non-dispatchable capacity to reduce imbalances in supply and demand, or to rely on higher levels of regulating FCAS to manage those imbalances?*
- C. *What other efficient options are there to manage imbalances in supply and demand resulting from the variability of non-dispatchable capacity within the five minute dispatch interval?*

There is greater variation in operating frequencies within the NEM as a greater proportion of non-dispatchable capacity enter the power system. Snowy Hydro believes the FCAS framework is currently sufficient although a range of potential issues such as inertia, forecast errors, CPP need to be solved.

As mentioned in question 3, Snowy Hydro believes it would be more efficient to improve the forecasting of non-dispatchable capacity and is concerned that the proposed Non-scheduled

¹⁰ Australian Energy Market Commission, 2017, “Frequency Control Frameworks Review - Issues Paper”, p87

¹¹ Australian Energy Market Commission, 2017, “Frequency Control Frameworks Review - Issues Paper”, p88

Generation and Load in Central Dispatch rule change to allow more generation and load visibility was not seen as not improving forecasting. We also note that AEMO recently cited demand forecast errors as major source of frequency problems.

14) Cost recovery arrangements.

Do you consider existing cost recovery arrangements for contingency FCAS to be appropriate? If not, how should cost recovery arrangements be changed?

Snowy Hydro considers that the cost recovery arrangements which provides a price signal that incentivise market participants to act in a way that minimises the need to procure these services is the most appropriate mechanism. In regards to the causer pays procedure Snowy Hydro will wait for the review from AEMO's public consultation.

15) Co-optimisation with other markets

- A. *Are there other system services, such as inertia, system strength or system stability, that should be co-optimised with FCAS markets?*
- B. *If so, can one service (such as inertia) be optimised first and, if so, why?*
- C. *Would co-optimisation impact on cost recovery and, if so, how?*

No comment to this question at this stage of the consultation process.

16) Consistency in the provision of system security services

- A. *To what extent is it important that the NER arrangements for the provision of system security services are consistent between providers of such services, e.g. large, transmission-connected generators and distributed energy resources?*
- B. *Frameworks for the connection and operation of distributed energy resources.*
- C. *Do the existing connection frameworks inhibit the ability of the owners of distributed energy resources to provide system security services?*
- D. *If distributed energy resources are to play a bigger role in supporting power system security, would it be more appropriate for the distributed energy resources to be required to provide system security services, or to be incentivised to provide them?*
- E. *Are there any other regulatory barriers or opportunities relevant to the provision of system services via distributed energy resources that are not discussed in this section?*

Snowy Hydro understands that distributed energy resources could be utilised to provide ancillary services rather than purely providing traditional distribution services. The challenge will be ensuring that market mechanisms are allowed to flourish where they are able to do so with an effective framework reinforcing competitive neutrality on all Service Providers providing the same service. It is important that distributed energy resources that provide the same service or product that generators have been providing for consumers are also subjected to the same consumer protection and service obligations.



17) Frameworks for distributed energy resources to participate in the NEM

Are there any other regulatory barriers or opportunities relevant to the provision of system services via distributed energy resources that are not discussed in this section?

(Refer to question 16)

18) Technical challenges

- A. *Is the aggregated capability of distributed energy resources sufficiently 'firm' for aggregators to provide the system security services that AEMO needs?*
- B. *Are there any other technical challenges relevant to the provision of system services via distributed energy resources that are not discussed in this section?*

(Refer to question 16)

19) Commercial challenges

Are there any other commercial challenges relevant to the provision of system services via distributed energy resources that are not discussed in this section?

Snowy Hydro does not see any other commercial challenges that have not been discussed at this stage.

