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Submitted electronically

RE: REL0084 - Review of the Frequency Operating Standard 2022 – Issues Paper

Shell Energy welcomes the opportunity to provide the following submission on the Review of the Frequency Operating Standard 2022 – Issues Paper (the Paper).

About Shell Energy in Australia

Shell Energy is Shell's renewables and energy solutions business in Australia, helping its customers to decarbonise and reduce their environmental footprint.

Shell Energy delivers business energy solutions and innovation across a portfolio of electricity, gas, environmental products and energy productivity for commercial and industrial customers, while our residential energy retailing business Powershop, acquired in 2022, serves more than 185,000 households and small business customers in Australia.

As the second largest electricity provider to commercial and industrial businesses in Australia[1], Shell Energy offers integrated solutions and market-leading[2] customer satisfaction, built on industry expertise and personalised relationships. The company's generation assets include 662 megawatts of gas-fired peaking power stations in Western Australia and Queensland, supporting the transition to renewables, and the 120 megawatt Gangarri solar energy development in Queensland.

Shell Energy Australia Pty Ltd and its subsidiaries trade as Shell Energy, while Powershop Australia Pty Ltd trades as Powershop. Further information about Shell Energy and our operations can be found on our website here.

Key Points

Shell Energy submits the following key points for the consideration of the Panel in its review of the Frequency Operating Standard. In our view the Reliability Panel should:

- engage with customers to assess economic impact of frequency outcomes;
- reconsider the view that tighter frequency outcomes necessarily lead to lower costs;
- consider the original market design band of 49.90 to 50.10 hertz as one of the options for frequency normal operating band as part of this review;
- engage the most experienced external consultant with the deepest technical expertise in this area to assist with the review;
- understand that the Paper misrepresents the "wide-deadband" primary frequency control band proposed by participants;
- consider the implementation of a safety net which would trigger under-frequency load-shedding;
- implement an additional standard for a maximum rate of change of frequency (RoCoF) in the NEM;
- maintain the current settings for contingency events;
- consider if a narrowing of the frequency operating standard following the triggering of a protected event is warranted;
- provide additional clarity regarding the distinction between protected events and separation events, or remove the separation event category; and
- consider empowering itself to declare a protected event independently of AEMO.

We detail the reasoning behind these considerations below.

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[1]By load, based on Shell Energy analysis of publicly available data.
[2] Utility Market Intelligence (UMI) survey of large commercial and industrial electricity customers of major electricity retailers, including ERM Power (now known as Shell Energy) by independent research company NTF Group in 2011-2021.

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General Comments

The Reliability Panel (the Panel) has been charged with reviewing the frequency operating standard for the National Electricity Market (NEM) which includes the synchronously interconnected electricity networks of Queensland, New South Wales, Victoria and South Australia as well as the separate asynchronously connected electricity network of Tasmania. In undertaking this important review, the Panel must consider the technical requirements for the maintenance of secure operation of the power systems in the NEM whilst balancing the economic costs to consumers of achieving such outcomes. In Shell Energy's view it is critical that the Panel seek good advice to understand the technical needs of the power system to ensure that the risk of over allocating resources to frequency control in minimised. This may include the separation of requirements for "ease of operation" and those technical requirements necessary for maintaining secure operation of the power system.

In considering the economic costs of frequency outcomes, we urge the Panel to engage directly with consumers to understand consumers views in this area. In particular, we recommend engaging with consumers whose operations, due to their size and the technology associated with their connection, would be highly sensitive to power system frequency outcomes and the technical and economic impacts this may have. The EUAA represents many of the larger directly connected industrial and commercial loads in the NEM which meet this criteria and is therefore well placed to provide advice to the Panel. In addition, due to cost pass through provisions, these consumers are sensitive to the costs imposed by the procurement of frequency control ancillary services to manage power system frequency. Whilst the Paper contains details of what is indicated as a period of poor frequency control from mid-2015 to mid-2020, we are unaware of any work undertaken in this area to understand the extent of any economic impact on consumer loads during that time.

Also, in considering the economic costs we understand that the Panel may consider historical power system events, such as regional electrical islanding or blackout events. Some of these events may include instances of loss of consumer load due to under frequency load shedding, or power system dynamics. If this is the case, we urge the Panel to carefully consider the detail around these historical outcomes. In particular, the Panel should consider the cause and nature of the underlying failure and its impact on network operation as well as the operational headroom on generating units and the specific location of operational headroom at the time of the historical event. Comparisons have been made between power system outcomes on 25 August 2018 and 25 May 2021 with regards to the double circuit trip of lines forming part of the Queensland to New South Wales interconnector (QNI). We also suggest the Panel consider a similar separation event which occurred on 28 February 2008 during a period of what has been indicated as excellent frequency control. Whilst review of historical events is reasonable, no two critical double circuit line trips are the same and system outcomes are dictated by underlying conditions at the time. In our view the key question for the Panel to consider is the economic impact experienced by consumers as a result of the event and what impact any proposed change to the frequency operating standard may have on this. Shell Energy is willing to discuss our detailed thoughts in this area with the Panel.

The Paper suggests that maintaining a more stable power system at 50 hertz may result in lower maintenance and operational costs for thermal generators and battery energy storage systems (BESS). However, the provision of such an outcome may require significant work in the form of frequent and variable output deviations, the costs of which may only emerge over time. These costs may result in the earlier retirement of plant due to accelerated wear and tear or degradation of BESS storage modules. Simply because the power system frequency is stable does not necessarily mean that generators are not performing costly operations to achieve this outcome.

Normal Operating Band

The Paper sets out four alternatives to the current frequency normal operating band (FNOB). We consider that the Panel should also consider a return to the original NEM market design band of 49.90 to 50.10 hertz as part of this review. This recognises that the original FNOB of 49.90 to 50.10 hertz had been in active use in the NEM for a lengthy period and was originally set based on strong technical reasoning. In contrast, the proposed addition of a normal operating primary frequency band (NOPFB) is based solely on observed historical "good frequency control" outcomes and is not clearly supported by strong technical reasoning. It may be the case that the proposed introduction of the additional NOPFB will deliver additional benefit from a consumer's perspective, but this need to be demonstrated.

The parameters for the FNOB were last changed in 2001 at the request of the market operator. This change increased the FNOB from 49.90 to 50.10 Hertz to 49.85 to 50.15 hertz for 99 % of the time and an absolute limit of 49.75 to 50.25 hertz absent a contingency event. This change was made on the basis that the FNOB at the time was overly tight compared to comparable international systems and not required for maintenance of power system security. The main argument in support of the change was that the economic costs of maintaining power system frequency within the FNOB of 49.90 to 50.10 hertz was not technically justified.

Shell Energy notes that the Paper contains no details of frequency standards currently used in international electricity systems. Stable operation of power system frequency is a feature of all electricity power systems, many of which are undergoing transformation to new generation and load types. We understand that the normal operational limit for the power grid in the United Kingdom is 49.80 to 50.20 hertz, we also note that this is currently under review. The

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interconnected electricity systems in Europe are managed to maintain frequency normally within a range of 49.90 to 50.10 hertz but we note that this is based on the following complementary settings:

> *Steady state frequency alarm level:* system frequency of 50.05Hz or 49.95Hz is exceeded for a time interval longer than 15 minutes, and system frequency of 50.1Hz or 49.9Hz is exceeded for a time interval longer than 5 minutes.
>
> *Emergency frequency reserve (up to 1,000 MW) dispatched*: system frequency of 50.05Hz or 49.95Hz is exceeded for a time interval longer than 20 minutes system frequency of 50.1 Hz or 49.9Hz is exceeded for a time interval longer than 10 minutes.

We recommend that the Panel consider and provide details in the draft report of international frequency standards for comparison as part of this review.

We note that the Panel has also raised consideration of a separate FNOB for the Tasmanian region based on its smaller consumer demand, as well as the fact it is not synchronously connected to the Mainland and therefore receives no synchronous frequency support, which results in power system frequency in Tasmania being more sensitive to supply/demand imbalances. Basslink operation through its very quick change in transfer associated with its "no go" zone often results in a significant change in frequency outcomes in Tasmania and should be considered by the Panel as part of this review. We recommend discussion with larger consumers connected in the Tasmanian region as well as network service providers in Tasmania regarding the technical and economic impact of having a different FNOB in Tasmania.

Primary Frequency Control Band

Shell Energy views the setting of a new primary frequency control band (PFCB) as the critical required component of this review. The original form of the PFCB at the time of NEM start was +/- 0.050 hertz with most generators operating with an effective PFCB of +/- 0.030 to 0.050 hertz. This Code requirement at NEM start has often been misrepresented as only a "capability" rather than an "operational requirement" setting. The original wording of the Code makes it clear that it was an "operational requirement" for all generators. This original wording was replaced by the market operator following the commencement of the Frequency Control Ancillary Services (FCAS) markets. Shell Energy notes that generators in a number of international markets are required to operate with an equivalent to the PFCB of +/- 0.035 to 0.050 hertz. Shell Energy observes that the current PFCB applied in the NEM is very narrow compared to the equivalent requirements that have been adopted in other electricity systems.

Whilst the Panel has indicated that changes to the PFCB may be non-trivial, such changes would in general be able to be easily implemented, at little cost, via adjustments in a generator's digital control system. We agree that AEMO would need to co-ordinate these changes but expect the impact of this would be less than the change required to implement and verify the original very narrow PFCB setting.

With reference to Figure 2.2 of the Paper, we note that the current shape and form of the frequency distribution is significantly different to that recorded prior to 2015. The period prior to 2015 is a period acknowledged by all to be one of "good frequency control". The current recorded frequency outcomes have a noticeably defined flat top area on the frequency distribution areas close to 50 hertz. We are concerned that this may be occurring due to the very narrow setting of the PFCB. The current tight setting of the PFCB may be leading to unintended consequences where generators with different reaction speeds, control systems and rates of wear and tear in governor and control valve linkages are counteracting each other.

Noting the complex technical challenges and historical developments associated with the issues under considerations, Shell Energy recommends that the Panel seek advice from an independent consultant with the most experience and deepest expertise in the areas of complex modulating and co-ordinated control systems for power stations, ideally with intimate knowledge of the Australian power system. Shell Energy has had past associations with independent consultants who we believe have the depth of experience and knowledge of the NEM to provide valuable insights to these issues. Shell Energy would be happy to put these recommendations forward for the panel's consideration. The question in our view is not if a narrow band PFR is required, but what is the most effective PFCB setting and the framework by which narrow band PFR is provided.

We acknowledge the work undertaken by AEMO to date as identified in the Paper. However, there is one area where participant's concerns and suggestions regarding the PFCB have been misrepresented in the Paper. With regards to what is referred to as "Wide Deadband (+/- 0.50 hertz)", participants never proposed that such an outcome would be introduced by itself. Such a setting for the mandatory PFCB was only intended to provide an additional safety net response by all generators. This would have been provided in the case where a narrow band primary frequency response at the PFCB was to be provided via a market based (as opposed to mandatory) narrow band response outcome. Figure 2.1 in the Paper clearly demonstrates that good frequency control outcomes had been achieved with only approx. 30% of the larger generators providing mandatory narrow band PFR. This indicates that narrow band PFR could have been achieved via market based as opposed to mandatory provision. We believe what is set out in the Paper is a significant misrepresentation of what participants proposed and should be corrected for Panel members.

In addition to the PFCB for generating systems, we recommend that the Panel consider if a safety net setting for scheduled load or registered wholesale demand response providers should be considered. Such an outcome would trigger under frequency load shedding (UFLS) of scheduled load or wholesale demand response inside the current settings for automated and more widespread UFLS. Such an outcome in our view could add to the general resilience of the NEM in the area of frequency response to non-credible contingency events and could form part of the requirements for loads which participate in any capacity mechanism framework, should this be introduced.

Proposed Additional Rate of Change of Frequency Standard

Shell Energy is supportive of the proposal to include an additional standard for a maximum rate of change of frequency (RoCoF) in the NEM. However, we are concerned that the example provided for this change fails to represent the framework for managing frequency response, post a contingency event, following the introduction of the new very fast contingency frequency control ancillary services markets. As the purpose of this review is to set the future FOS for the NEM we consider this example should have been based on outcomes post-implementation of the very fast contingency FCAS markets.

We support the view that separate RoCoF standards would be required under different contingency events, in addition we request the Panel to consider if separate RoCoF standards would need to apply for system normal, prior outage of critical network elements or at times of electrical islanding of a region or part region. We also agree that the RoCoF standard would need to consider the operational needs of the electricity network, in particular with regards to the operation of UFLS and other emergency frequency control schemes, and the capabilities of existing and future generating units.

In addition to understanding the ability of generating units to withstand a RoCoF event, we consider that the Panel must also understand the ability of large loads to continue to operate post a contingency event. Loss of a large load could also lead to a cascading event which impacted secure generating unit operation. Engagement with the EUAA and its members may also be beneficial in this area.

Frequency Settings for Contingency Events

The current FOS settings for generation, load and network events have served the NEM well for a very long period of time. The Paper provides no technical evidence to suggest that under most normal system operation scenarios any change to the frequency settings is warranted. We support the continuation of the current settings for contingency events.

The Paper also raises the issue of the appropriateness of the operational frequency tolerance band during periods of supply scarcity which is currently set at 48.0 – 52.0 Hz. This setting was introduced to allow the market operator to reduce procurement levels of FCAS to facilitate higher levels of dispatch in the energy market for the purpose of load restoration at times of supply scarcity. The current setting of the operational frequency tolerance band during periods of supply scarcity seems at odds with the overall objective with regards to improving operational resilience in the NEM. Whilst we acknowledge that a change in this area could result in potential for increased costs to consumers, potentially through a delay to restoration of consumer load following an UFLS event, we consider that the Panel should examine the economic trade-off obtained through an increase in system resilience which could be obtained by a small adjustment. This could be in the range of 0.25 to 0.5 Hz in this area of the FOS. The outcome of this assessment could be that no change is justified.

We are concerned that the Panel has included the potential for reclassification of an indistinct event to be considered as a normal contingency event for the purpose of the FOS. If that is to be the case, then we consider that the FOS should set a standalone standard to be applied by AEMO following the declaration of an indistinct event. In our view this standard should align with the standard adopted for a protected event.

Frequency Settings for Non-Credible Contingency Events

Shell Energy considers that the FOS in relation to non-credible contingency events in general remains appropriate. The gaps identified by AEMO as set out in the Paper have largely been removed via the implementation of the indistinct events framework. We do however have some concerns with the current protected event frequency standard as well as the overall framework for the declaration of a protected events. We are concerned that the standard to be applied following activation of a protected event period by AEMO may be inconsistent with the level of system resilience that may be required in a world of low synchronous generation operation. In this regard we ask that the Panel consider if a narrowing of the FOS with regards to outcomes post triggering of a protected event is warranted.

We note that a separation event could be a non-credible event including a protected event which results in the electrical islanding of a region or part region for which a significantly tighter standard applies. In our view this may lead to confusion as to which standard applies when a separation event occurs. The only existing protected event is for the loss of the Victoria to South Australia (Heywood) interconnector which under the current standard could also be a separation event, or a network event if the double circuit trip had been reclassified. In this case it is not clear if separation or network event categories still apply if AEMO has activated the protected event classification. Currently the separation of Queensland and

NSW could be a separation event or a network event. The Panel should provide additional clarity in this area of the FOS which could be to simply remove the separation event category.

We consider the framework for declaration of protected events in the NEM could also be improved by allowing the Panel, independent of AEMO, to consider and declare a protected event. We consider that the Panel should consider as part of this review if the loss of the largest group of generating units, ie a whole power station, to be a protected event. Whilst infrequent, there have been a number of events where a whole power station has tripped and whilst historically the power system has been somewhat resilient to this type of outcome, this has to a degree been dependent on an outcome where sufficient headroom has existed on other generating units and UFLS has responded effectively. Similarly, should all double circuit flow paths be declared as protected events where such an event would lead to the formation of an electrical island, ie a separation event. Alternatively, if it is considered that the Panel should not be allowed to declare a protected event independently from AEMO, the Panel could consider if a defined frequency standard, similar to that adopted for a protected event, should apply to specific non-credible events of the type set out above in the FOS.

Maximum Allowable Credible Contingency Event Size

When considering the implications of adding an additional standard specifying the maximum allowable contingency size for both generation and load, we question if this limit would apply to credible contingencies under system normal conditions. Is it possible that it could apply to non-credible contingencies which have been reclassified, non-credible contingencies more generally or protected events? Would different levels apply for system normal conditions, specified network outages or electrical islanding conditions? There are a significant number of unanswered questions with regards to this proposal.

Alternatively, as argued in the previous section, should the Panel set a frequency standard to be applied to specific non-credible contingency events or alternatively, should the Panel be allowed to consider and declare protected events independent form AEMO.

Overall, we consider that allowing the Panel to consider and declare a protected event independently from AEMO would be preferable to the Panel setting a maximum contingency event size for the NEM. Such a protected event could consider the reduction of output from a defined geographical area of renewable energy supply side resources where frequency would be allowed to deviate to a lower value than a discretely defined credible generation or network event.

Accumulated Time Error

Monitoring of time error is a useful tool to understand overall management of power system frequency with regards to secure operation of the power system. Time error also shows the level of mismatch between generation and load with regards to efficient market dispatch. As noted in the Paper;

> *The costs and impact of the accumulated time error may include unforeseen impacts on large and small consumers whose appliances or equipment may still rely on synchronous clocks to tell accurate time.*

In addition, AEMO suggested at the Public Forum that time error correction ensures that the NEM dispatch system continues to function correctly.

The Paper is unclear as to what work has been undertaken, including engagement with consumers to better understand the potential impacts in this area. At the Public Forum it was suggested that many clocks in the mass retail consumer area remain based on “grid time”. There may be other consumer processes in the business mass market or agricultural area which remain based on “grid time”. No details are contained in the Paper regarding the FCAS market costs of time error correction, so it is unclear that any form of economic trade-off has been undertaken. Shell Energy considers that prior to making any further change with regards to time error correction, that the Panel should be better informed regarding potential impacts.

For any question regarding this submission please contact Peter Wormald (peter.wormald@shellenergy.com.au).

Yours sincerely

[signed]

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