Shell ENERGY

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Submitted electronically

RE: REL 0084 - Review of the Frequency Operating Standard Draft Report

About Shell Energy in Australia

Shell Energy is Shell's renewables and energy solutions business in Australia. Shell Energy delivers business energy solutions and innovation across a portfolio of electricity, gas, environmental products and energy productivity for commercial and industrial customers. Our residential energy retailing business Powershop, acquired in 2022, serves more than 185,000 households and small business customers in Australia. 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. Further information about Shell Energy and our operations can be found on our website here.

General Comments

Shell Energy Australia thanks the Reliability Panel (the Panel) for the opportunity to review and provide comments on the draft report (the Report) of the frequency operating standard. We confirm our view as set out in previous submissions in the area of power system frequency control, that primary frequency response (PFR) is essential for maintenance of power system security. The key question is with regards to how PFR should be supplied. It is our continuing view that effective PFR requires not just response but the maintenance of adequate reserves to provide response. Absent maintenance of adequate reserves, PFR and potentially contingency frequency control ancillary services (FCAS) response will not be available when required. Such concerning outcomes have already occurred in the NEM. Shell Energy supports many of the draft determinations set out in the Report, however there are some areas where it is unclear to Shell Energy that the Panel has given adequate consideration to issues raised by participants.

We support the decision not to alter the normal operating frequency band and the normal operating frequency band excursion band. We note that no economic or technical benefit has been offered or demonstrated to alter these. We also note that these standards were continuing to be met even prior to the introduction of the mandatory narrow band primary frequency response requirements.

We are also supportive of the proposal to include a target frequency of 50.0 hertz (Hz) in the standard but it is unclear to Shell Energy as to the practical purpose of this proposed change. We believe the Final Report should provide additional guidance to AEMO regarding the intent of this addition which we interpret as requiring AEMO to procure sufficient FCAS reserves to achieve this target as well as the other frequency standards.

We support maintaining the operational frequency tolerance band at the current settings but raise concerns regarding the maintenance of the upper level of the extreme frequency excursion tolerance limit at 52.0 Hz and believe that further analysis regarding the secure operation of some generating unit types at that frequency level is warranted given the forecast retirement of a number of large rotating mass thermal generators over the next two years which currently act to stabilise power system frequency outcomes.

We support the decision to include a new rate of change of frequency (RoCoF) limit in the FOS but question the way this standard is being expressed as a converted hertz/second (Hz/sec) value and recommend these

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Hz/sec values not be included in the FOS as in our view they could be misleading and add no value in interpreting the Standard. By way of example, the requirement to maintain a RoCoF of 0.50Hz over any 500 millisecond period following any credible contingency event applicable to a mainland region is less than the implied value of 1.0Hz/sec indicated in the draft FOS. In addition, the draft limits appear set to a very high, or conservative standard for RoCoF noting the limit of 2.0 Hz/sec currently set for the South Australian region which has been in operation for many years without concern that this limit is unsatisfactory or leading to power system security issues.

We note the concerns raised in the Report that some generating unit types may have an increasing risk of tripping out of service with a RoCoF exceeding 2.0 Hz/sec and AEMO's concerns as set out in the Report that automated underfrequency load shedding (UFLS) relays may in some scenarios fail to operate as intended with a RoCoF approaching 3.0 Hz/sec. We also note acknowledgement in the Report that its technically possible to adjust RoCoF setting on UFLS relays to achieve dynamic or cascading operation which we consider would be beneficial from a power system security perspective. However, maintaining such a high safety buffer as set out in the draft limit will not be without additional costs in the form of provision of maintenance of synchronous inertia or the new contingency very fast (sub one second) frequency control ancillary services. We recommend the Panel consider if a value of 0.750Hz over any 500 millisecond period following any credible contingency event applicable to a mainland NEM region would provide sufficient power system security safeguards but at a lower cost.

Shell Energy request additional clarity as to how the Panel believes the draft RoCoF limit for a non-credible contingency event or multiple contingency event would be operationalised by AEMO. Whilst this could be interpreted as providing guidance to AEMO from a planning standard perspective, we urge the Panel to consider that there may be a wide range of control limits that could be placed on the market by AEMO in seeking to meet this standard that may have unintended consequences and increase overall costs to consumers. This may potentially be alleviated by the provision of additional clarity in the standard as to how this RoCoF limit should be operationalised by AEMO.

We support the decision to alter the name of the "supply scarcity" to "system restoration" and suggest that "consumer load restoration" would be a more appropriate definition of when this area of the FOS would apply and align with its original intent. The revised standard was put in place following the 2009 review to allow the market operator to reduce the level of contingency FCAS reserves procured during consumer load restoration periods so that this freed up headroom on generating units could be applied to restoration of consumer load earlier than would otherwise be the case. However, we consider it should also be noted that unlike contingency FCAS reserves, which notionally respond or trigger at the edge of the normal operating band, mandatory narrow band primary frequency response (MNBPFR) will result in generating units that are currently providing contingency FCAS reserves responding via MNBPFR and reducing response headroom for contingency FCAS as consumer load is restored which may result in little if any active contingency FCAS reserve capacity available to respond to a credible, non-credible or multiple contingency event which may have unintended consequences for power system security.

We recommend the Panel consider that in addition to the standard to achieve 49.5 – 50.5 within 5 minutes, that further clarity in the area is provided to AEMO via an additional requirement to achieve 49.85 to 50.15 within 15 minutes for the mainland NEM and 20 minutes for Tasmania is warranted. This should ensure that an appropriate level of contingency and regulation FCAS reserves is maintained by AEMO even during a load restoration process. Consistent with our previous comment regarding the extreme frequency excursion tolerance limit at 52.0 Hz, we recommend for this area of the FOS that further analysis regarding the secure operation of some generating unit types at that frequency level is warranted.

We support the Panel's decision not to specify a maximum generation event limit for the mainland NEM in the FOS and agree there is not sufficient technical justification to introduce such a limit in the FOS for the mainland NEM at the current time.

Shell Energy notes the work undertaken by the Panel and its consultants as well as the technical advice provided by AEMO, however we consider that incomplete and insufficient analysis has been applied by the Panel in considering the appropriate level of the primary frequency control band (PFCB) to be applied to all generating units in the provision of mandatory narrow band primary frequency response (MNBPFR). We are also unclear on why the Panel has determined such a very narrow primary frequency control band (PFCB) is warranted, given the settings of the normal operating frequency band, which results in an overly conservative and costly maintenance of power system frequency well below that specified in the standard.

In considering the modelling undertaken by GHD we note that the analysis is based on synthetic frequency outcomes assumptions which are based on a stylised power system with theoretical primary frequency response outcomes from nominal selected generation resources. We are concerned that these synthesised frequency outcomes do not align with outcomes observed in the NEM, in particular they don't include the transient 50 to 100 millihertz wander with a double camel hump distribution in system frequency currently inherent to the NEM. In addition, the synthesised frequency outcomes histogram provided by GHD in Figure 1.1 in the Report for a 49.95 to 50.05 Hz PFCB is inconsistent with the historical frequencies up until 2016 when the NEM operated with what was in effect a voluntary effective PFCB of 49.95 to 50.05Hz. In our view this misalignment between the purely theoretical outcomes synthesised by GHD and actual historical and current NEM power system frequency outcomes observable in Figure 4.1 in the Report calls into question the economic conclusion that a wider PFCB would be more expensive for consumers provided by the consultant GHD upon which the Panel relies.

In addition, a key question in Shell Energy's submission to the consultation paper regarding the technical consideration of the interaction of generating units with different response times, plant wear and governor and control system response on the causes of the inherent frequency wander in the NEM appears to have been ignored in GHD's analysis. We note again this inherent frequency wander was not apparent with an effective voluntary PFCB of 49.95 to 50.05 Hz. In fact, the two sharp peaks currently observable in actual power system frequency either side of 50Hz were not evident prior to the introduction of MNBPFR and in our view is therefore considered to be occurring due to excess uncoordinated PFR reactivity and inappropriate rigid adoption of an unnecessarily narrow deadband set in large numbers of generating units.

Whilst it is often reported that the current narrow PFCB in the NEM is comparable to that implemented in other markets in some cases the overseas standard has not been accurately represented. We note that the ERCOT (Texas) market has been quoted as having a PFCB standard of 59.983 to 60.017 Hz for all generating units. Whilst this is correct for some generating units, steam, gas and hydro units with mechanical governors, which would comprise the majority of the schedule generating capacity in Texas, have an allowable PFCB of 59.966 to 60.034 Hz[1]. We understand this makes allowance for the fact there is a natural deadband in mechanical governors due to hysteresis (backlash) and the requirement to consistently provide PFR needs to begin outside that natural deadband.

Given these factors, it's unclear that the current very tight PFCB of 49.985 to 50.015 Hz is technically warranted and that a slight relaxation of the PFCB back towards the original NEM PFCB setting of 49.950 to 50.050 Hz has the potential to result in a reduction in the current inherent frequency wander and an improvement in overall power system frequency outcomes. This difference in frequency distribution around 50 Hz between the original voluntary PFCB (49.950 to 50.050 Hz) and the current narrower mandatory PFCB (49.985 to 50.015 Hz) is

[1] ERCOT, Nodal Operating Guide – Table1, March 2021

clearly observable in Figure 4.1 in the Report. In our view the original voluntary PFCB provides a superior distribution to that provided by the current mandatory and very narrow PFCB. This observable outcome questions the conclusion determined by the Panel that the current PFCB setting delivers value to consumers via the provision of additional system resilience. We also note that no modelling was undertaken using a 49.970 to 50.030 Hz PFCB setting in GHD's analysis even though this was a suggested level for analysis in submissions to the consultation paper.

With regards to claimed positive impacts on system resilience, Shell Energy considers that the events of 25 August 2018 clearly demonstrate the critical nature of not just reserves to respond to a significant system event but also the location of these reserves. We note the GHD analysis in the area of load shedding in addition to using the synthesised frequency outcomes relied on a NEM wide distribution of PFR reserves. It is worth the Panel considering that following the trip of the Queensland New South Wales (NSW) Interconnector on 25 August 2018, frequency response did occur as expected in most regions, however, the super majority of reserves able to respond (voluntary PFR and contingency FCAS) to the low frequency signal were located in the South Australian region which due to their response led to a trip of the Heywood assets of the Victorian to South Australia interconnector, only after which did under frequency load shedding in NSW and Victoria occur. Most generating units in NSW and Victoria at the time of the event were operating at or near reported capacity where MNBPFR would not have occurred. The current MNBPFR rule or PFR incentives rule provides no certainty that either reserves will be available to respond, or that reserves will be located in the required location to effectively respond, to claim that a narrow PFCB enhances system resilience. It is unclear to Shell Energy if the exact same event and circumstances as that which occurred on that day was repeated would MNBPFR at the current PFCB setting result in a different outcome.

In noting the analysis undertaken by GHD regarding the benefit of a narrow PFCB in facilitating the reconnection of an electrical islanded region(s), we again note that the analysis is based on the synthesised theoretical frequency trace which fails to match the observable current NEM outcomes, as such we question the value of the conclusions from the analysis. We also note that no analysis was undertaken with respect to a 49.95 to 50.05 Hz PFCB in this area. Similarly, when considering the analysis regarding the ability of distributed MBNPFR with a narrow PFCB to provide control during a period of central dispatch failure, whilst this may be achievable during a period of falling demand with sufficient and distributed reserves, it is less clear the same outcome would be achieved under tight demand/supply conditions or if reserves were primarily in a single region.

We recommend the Panel review and consider the frequency outcomes from 17:19 to 17:30 on 17 June as well where despite the narrow PFCB for MNBPFR system frequency fell for an extended period within the normal operating frequency band excursion band 49.85 to 49.75Hz. Whilst it can be argued that the FOS was technically met, the drift in system frequency remained effectively outside the normal operating band absent a contingency event for a period of over 7 minutes in that 11 minute period. Shell Energy also questions statements in AEMO Frequency and Time Error Monitoring – Quarter 2 2022[2] report which indicates some concerns that frequency triggered (switched) contingency FCAS reserves had not activated to prevent the decline in power system frequency where the frequency trigger level for response had not been achieved. Whilst this would have prevented the ultimate level of decline in power system frequency, it would have exposed the NEM to having zero active contingency raise reserves, (as the other proportional response contingency FCAS reserves had already responded via MNBPFR), able to respond to a credible, non-credible or multiple contingency event. We question if such an outcome is satisfactory from a power system security perspective. There were also a number of low frequency events which occurred during the recent South Australian electrical islanding event (12 to 25 November) which are worthy of further analysis and consideration as part of this review.

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[2] frequency-and-time-error-monitoring-q2-2022.pdf (aemo.com.au)

Shell Energy has been afforded the opportunity to read Provecta Consulting's (Provecta) review of aspects of the GHD analysis. This brief analysis was prepared for the Australian Energy Council by Mr Don Parker, a world renowned expert in the area of electrical power systems integrated controls. Provecta's review identifies that;

- There are physical and economic costs placed on synchronous generators that were not fully identified by GHD; and
- System-wide frequency skew and wobble appears to be worsened by the current very narrow PFCB.

Provecta consider these costs may materially reduce with even a very slight PFCB widening, to say +/ 30mHz (49.970 to 50.030 Hz).

The Provecta report then goes on to provide further details regarding the significant, but not exhaustive list of physical costs that the current very narrow PFCB places on synchronous generating units. The report notes that the very narrow PFCB has resulted in an increased frequency of adjustments on generating units to maintain frequency in a tight band resulting in increased wear and tear on the synchronous generating units. In Provecta's view these costs, including the resulting economic costs, were insufficiently considered and analysed by GHD. We are concerned that allowing a continuation of these physical costs to the schedulable generation fleet due to maintaining the current very narrow PFCB may result in an increase in required maintenance outages, a decrease in generating unit reliability, due to unplanned or forced outages, and an increase in costs that has the potential to impact generating unit commitment and decommitment or mothballing/retirement decisions.

Lastly, Shell Energy considers that the proposal to not review the FOS until 2027/28 is too long a time period. Instead, we recommend that the Panel as part of this review adjust the PFCB to 49.970 to 50.030 Hz in the Final Report with a view to commencing a further review twelve months following the implementation of this change to determine if further adjustment is permissable which may result in a relaxation of the PFCB to the original NEM settings of 49.050 to 50.050 Hz. It is Shell Energy's view, supported by the considered views outlined in the Provecta report that a slight relaxation of the PFCB will improve power system frequency outcomes and reduce the physical and economic costs being imposed on synchronous generators in meeting what is an unnecessarily narrow PFCB.

Shell Energy would appreciate the opportunity to discuss the issues raised in this submission with Panel members if this could be arranged.

For further detail or questions regarding this submission please contact Peter Wormald (peter.wormald@shellenergy.com.au).

Yours sincerely,

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