Shell ENERGY

7 August 2025

Energy Policy WA
Level 1
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Perth WA 6000

Lodged email: energymarkets@dmirs.wa.gov.au

Dear Energy Policy WA,

RE: Power System Security and Reliability Standards Review – Stage 3

Shell Energy Australia Pty Ltd (Shell Energy) welcomes the opportunity to provide feedback to Energy Policy WA (EPWA) on the Consultation Paper for Stage 3 of the Power System Security and Reliability (PSSR) Standards Review. We understand that feedback from this Consultation Paper will inform the draft rules at Stage 4 which will implement the proposals outlined in the Consultation 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 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.

[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

Shell Energy appreciates the opportunity to provide feedback on the Consultation Paper which sets out reforms to the PSSR Standards and their governance framework to ensure the efficient and effective decision making around planning, upgrading and operating the power system as the South West Interconnected System (SWIS) moves through the energy transition. We understand that the intention of this review is to bring together a consistent, single end-to-end standard for the SWIS under a centralised governance framework, to be implemented through the Electricity System and Market (ESM) Rules.

Shell Energy are broadly supportive of the proposals that relate to network planning standards, the user facility standards framework, and governance arrangements and mostly agree with the rationale outlined in the Consultation Paper for these proposals. We do however, have concerns with the proposals related to technical requirements for new technologies, system strength framework and relevant definitions, and have provided detailed feedback below.

We would also like to take this opportunity to express our concern around increasing costs in the SWIS and to Market Participants (MPs) in the WEM and the impact this has on existing operations and investment in new projects. We strongly urge EPWA to consider the proposals outlined in this review and the cost impact they will have on the market in the future by undertaking a cost benefits analysis which includes implementation costs by both Western Power and AEMO, which are eventually absorbed by MPs such as through increases to AEMO market fees.

Our feedback is outlined in the table below and contains attachments for more detailed responses.

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Table – Responses to Consultation Questions

Proposal	Consultation Question	Shell Energy Response
1	Do stakeholders agree with the proposed framework? Do stakeholders consider that the deterministic standards should be mandatory, requiring an exemption from the ERA to deviate from them, or implemented as a guide for the Network Operator? What indicators do stakeholders consider should be used for the customer outcome standards?	Shell Energy considers that the planning regime for the network operator should transition to a customer outcome standards approach based on probabilistic modelling as commercial software is now available which allows this to be carried out in a semi-autonomous and consistent manner. The expected benefits of this approach include: • A focus on system reliability outcomes • The ability to provide a flexible approach to improving system reliability which deterministic methods often rule out • A consistent framework by which diverse engineering solutions can be assessed The key parameters used in probabilistic modelling are "mean time to failure" and "mean time to repair" from which Markov and/or Monte Carlo modelling is carried out to derive an overall reliability metric (which can be easily cross checked by observing actual operational experience). In the past this approach was very labour intensive and could be subjective, but the relatively recent introduction of modelling software has greatly assisted. By contrast, the deterministic approach based on N-0, N-1, N-x terminologies often leads to non-optimal engineering solutions (typically in the form of unnecessary equipment duplication) which place large cost burdens on all stakeholders. Whilst this was traditionally a pragmatic and easily applied approach which has underpinned the design of the transmission and distribution systems to date; it is clearly non-optimum due to the large amount of duplication of substations, transformers, lines, protection and control systems, with consequent large capital and operational costs that result.
2	Do stakeholders agree with the proposed categorisation framework?	Shell Energy supports the proposal to provide a tiered approach for generator and load performance standards.

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3	Do stakeholders support the adoption of the proposed User Facility categorisation and User Facility Standards?	Shell Energy supports the proposal to provide a tiered approach for generator and load performance standards.
4	Do stakeholders support the proposal to continue to allow compliance to be assessed at individual components behind the Connection Point if guidance is provided on when this requirement will be imposed?	Shell Energy supports this proposal.
5	Do stakeholders support the proposed governance framework?	Shell Energy supports the general evolution of the WEM and NEM with the aim of allowing harmonised regulatory regimes which provide a stable environment for investment. This proposal seems to reflect some provisions that already exist in the NEM which aids the harmonisation between the two markets which will encourage cross fertilisation and innovation.
6	Do stakeholders agree with the above proposed provisions/standards? Should corresponding changes be made to the equivalent provisions, which will apply to Medium Energy Producing Systems (inc. ESR) ≤10MVA connected to high voltage and medium voltage network?	Shell Energy does not agree with the proposed standards. Our reasoning is given below: The short circuit ratio is a poor metric to use – particularly if there is a possibility of interactions with other inverter-based resources or traditional synchronous plants in neighbouring regions of the system. As an example of where this approach could fail, consider the situation where two grid following plants are connected at neighbouring nodes. Individually their withstand SCR's may be 3.0 and hence can connect. However, if they were considered as a combined plant – the withstand SCR could be calculated to be 1.5, and they would not be able to connect. In theory, grid forming plant should be able to operate down to an SCR of zero – however in situations where the SCR is very high (say > 20) – grid forming plant may become unstable. This potential situation is not covered in the proposal.

		Sub-synchronous and super-synchronous oscillations have been experienced for inverter connected plants which have been found to be due to power system resonances which are unrelated to the short circuit ratio. There is no provision in the proposal to address these issues. Shell Energy propose that a range of fault levels at the connection point be considered based on the forward-looking fault level estimates; and the plant be proved to be viable across the range by simulation. Simulations should use frequency scans at the point of connection to rule out possible resonant oscillatory behaviour. Shell Energy supports the clause that requires settings to not be different to settings required for compliance with other Technical Requirements unless otherwise agreed with AEMO and the Network Operator. Shell Energy supports the clarification that continuous uninterrupted operation is not required when the SCR falls below the withstand SCR but believe this should apply only to grid following inverters. For Grid forming inverters an upper limit to the SCR should be defined – above which continuous uninterrupted operation is not required. In theory grid forming inverters should be operable down to a withstand SCR of zero.
7	Do stakeholders agree with the above proposed provisions/standards? Should corresponding changes be made to the equivalent provisions, which will apply to Medium Energy Producing Systems (inc. ESR) ≤10MVA connected to high voltage and medium voltage network?	Whilst Shell Energy is in general agreement with the intent of this proposal, we would like to see the reasoning for the proposed limits of 25 degrees and 60 degrees, and we believe the necessity for a 20 ms response time to be questionable particularly for weak systems. In practice, the sudden change in angle that occurs will depend on the system event and the prior operating point of the system. The requirement of a 20 ms response time appears to us to be onerous for some locations on the system, and possibly easily achieved at other locations. Regardless, in our view the requirement should not be based on a specific response time metric but rather whether the response of the plant has a material impact on the power system.
8	Do stakeholders agree with the above proposed provisions/standards?	See detailed response – attachment 1.

	What is an appropriate rise time for the Minimum User Performance Standard for grid-forming IBRs? With regard to the Fault Ride Through Activation Threshold for reactive current response during contingencies: is the use of voltage as an activation threshold appropriate for gridforming IBR? If so, can the same numerical values used for grid following IBR be applied? Are there any additional performance metrics that should only apply to grid-forming IBR? What is an appropriate level of active power to specify in A12.9.2.5(b) for grid forming inverters? Should corresponding changes be made to the equivalent provisions, which will apply to Medium Energy Producing Systems (inc. ESR) ≤10MVA connected to high voltage and medium voltage network?	
9	Do stakeholders agree with the above proposed provisions/standards? Should corresponding changes be made to the equivalent provisions, which will apply to	Shell Energy does not support this clause except in the form in which an OEM should warrant that their protection and control systems are not modified by a sequence of disturbances in a short period of time. Specifically, the OEM should warrant that the ride through performance of the plant should not be degraded by having several disturbances occurring in close succession.

	Medium Energy Producing Systems (inc. ESR) ≤10MVA connected to high voltage and medium voltage network?	The current practice in the NEM, which requires simulation of multiple disturbances, is in our view extremely wasteful of consulting labour and computing time – and adds no additional insight into the behaviour of the plant. The simulation of multiple disturbances after the previous event is allowed to settle is equivalent to simulating a single event multiple times.
10	Do stakeholders agree with the above proposed provisions/standards? Should corresponding changes be made to the equivalent provisions, which will apply to Medium Energy Producing Systems (inc. ESR) ≤10MVA connected to high voltage and medium voltage network?	The term "power system stabiliser" was historically applied to filtering on the automatic voltage regulator control loop of a traditional synchronous generator. Such filters were designed to respond to very low frequency oscillations (< ~ 10 Hz), and limits were used to remove them from the control loop in the event of large disturbances. To avoid confusion with this prior usage, we do not believe that the term "Power system stabiliser" should be used in this context. Instead, we propose that the term be removed from the clause – which can remain largely unchanged with the emphasis on the desired outcome rather than the means to achieve it. The proposed upper frequency limit of 300 Hz is too low, as we are aware of installations which have experienced higher frequency oscillations. We suggest that the upper frequency be defined to be half the switching frequency of the inverters (using the Nyquist criteria) – above which the control system will have no impact in theory. Medium Energy producing systems should also comply – but again the guiding principle should be the impact of the installation on system security/reliability and power quality. This may allow relaxation of requirements for medium energy installations.
11	Do stakeholders agree with the above proposed provisions/standards? Should corresponding changes be made to the equivalent provisions, which will apply to Medium Energy Producing Systems (inc. ESR) ≤10MVA connected to high voltage and medium voltage network?	Shell Energy supports this proposal.

12	Do stakeholders agree with the proposed definition?	Shell Energy does not agree with the proposed definition. The concept of "system strength" has been applied in the NEM and it has resulted in the confusion of several distinct technical issues and often non optimum, poorly targeted and non-economic responses to emerging technical issues. It should be recognised that loose terminology that has been traditionally used in the industry such as "weak "or "strong" systems and "system strength" are imprecise and hence serve as a poor foundation for defining and solving engineering issues. The term "system strength" is a descriptive term which lacks quantitative precision and while useful for elucidating various concepts, should not be used to develop technical solutions which must be based on electrical engineering design, theory and calculations. Attempts to define "system strength" in terms of voltage waveforms may cause further confusion by attempting to retrofit an academic definition to what was traditionally merely a shorthand method of providing descriptive language to technical concepts. By combining several distinct concepts such as "fault level", "inertia", "voltage control", "harmonic distortion", "flicker" etc under the umbrella term "system strength", the issues become confused with each other, and the individual technical solutions become more difficult to design and negotiate between parties. Precise terminology already exists for traditional electrical engineering concepts which can often be expressed as quantities (e.g. fault level of x MVA , inertia as y MWs/MVA etc). Use of this more precise terminology rather than an umbrella term is more appropriate for use in developing technical solutions.
13	Do stakeholders agree with the proposed forecasting approach?	Knowledge of the system fault level at various transmission nodes is necessary to ensure equipment is operated within its fault rupture levels, that protection system systems operate correctly and control systems remain stable. Accordingly, it is necessary to plan for changes in system fault level which will occur as the mix of generation changes and changes to network topology occur.

14	Do stakeholders agree with the proposed approach to managing minimum fault levels for network protection?	Yes. The minimum fault level has an impact on power quality, reactive power management, and control system stability. Accordingly, the minimum expected fault level should be tracked and tabulated in a similar manner to the way maximum fault levels are. We believe this activity should not be confused with the ill-defined system strength terminology as discussed in proposal 12. Fault level is a well-defined concept in electrical engineering design, and it causes confusion whenever it is linked with less defined terminology.
15	Do stakeholders agree that the Network Operator should be obliged to make proactive investments to maintain system strength sufficient to host the expected fleet in a region?	See detailed response – attachment 2.
16	Do stakeholders consider a collaborative approach will bring about the necessary consistency in forecasting?	Shell Energy agrees that a collaborative approach will tend to bring about consistency among the various parties responsible for forecasting. However, we note that the primary aim is to produce accurate forecasts and appropriate scenarios which capture possible outliers. For the purpose of determining potential outliers and scenarios, some diversity amongst the participants may be desirable as it guards against collective dogmas. For this reason, whilst we support common and verifiable inputs to be shared between the parties, we believe that if each party has the freedom to prepare their own forecasts which can be compared at the end of the process – this approach is more likely to produce a realistic range of forecasts which can be used for planning purposes.
17	Do stakeholders support the proposal to require network elements to ride through disturbances?	Shell Energy is supportive of this proposal and agree that ride-through requirements for network elements should be similar to the ride-through requirements for generation plants, subject to clarifications associated with load shedding, fault clearance and specific trip designs.

18	Do stakeholders agree that the framework to improve clarity and transparency?	Shell Energy agrees that the provision of better clarity is desirable as to which customer outcome standards can be modified.
19	Do stakeholders have any specific concerns with the allocation of roles and responsibilities in the proposed governance framework for PSSR?	Shell Energy believes the ultimate structure of the governance framework of the PSSR Standards should transition to a similar structure that is currently evolving in the NEM, subject to the special requirements pertaining to the WEM. However, it is understood that this is not practical in the short term due to the significant differences that currently exist between the two systems. The proposed structure is suitable as a starting point for the evolution of the system governance arrangements.
20	Do stakeholders support the proposal to accept the subset of the Western Power proposed amendments to the relevant Technical Rules requirements?	See detailed response – attachment 3.

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Attachment 1

Proposal 8 - detailed response

Appropriate Rise time

A fast voltage rise time after a system fault has cleared is generally considered desirable for system security because it quickly re-establishes the prior fault system conditions and allows the system to continue operating normally. However, very fast voltage rise times can also lead to system instabilities due to excessive effective gain in control systems. For Grid Forming inverters (which act similarly to ideal voltage sources), instabilities are more likely to occur at high fault level points of connection because their current limits may be exceeded – which may induce mode switching of their controls between current-limiting and normal operation. The inverse situation occurs for Grid Following inverters (which act similarly to ideal current sources) – which are known to be more likely to experience instability for low system fault level conditions.

In practice, tuning of the control systems is carried out to ensure an adequate response for the existing system fault level and future prospective fault levels. A limit on the rise time of voltages after a fault can often be achieved for a specific fault level but fail if the projected future fault level is significantly different.

Shell Energy propose a pragmatic approach which recognises the system physics pertaining to a specific connection point, and the voltage rise time to be agreed between the parties having due consideration to the existing and potential changes in system fault level.

Reactive power activation threshold

The reactive power activation threshold which switches the mode of control to prioritize reactive power control over power control when the connection voltage is outside a pre-specified range can only be triggered by a change in voltage. This is the case regardless of whether grid following or grid forming technology is employed. The threshold settings must be determined during the system connection studies and typically vary from connection point to connection point, and the interactions with other factors in the system. A change of technology from grid following to grid forming may cause the setpoints to change depending on the results of the studies.

Additional performance metrics for Grid forming IBR

Shell Energy believe that any performance metrics introduced should be done only with respect to ensuring power system reliability and power quality.

Appropriate level of Active Power in A12.9.2.5(b)

Shell Energy believe the guiding principle for the performance metric of meeting x% of the pre-disturbance power level after 100 ms (5 cycles) should be the effect it could have on power system reliability and power system power quality. For grid following inverters x% is set to 95% which is usually easily achieved with this technology - depending on the fault level at the point of connection.

Grid forming inverters might struggle to achieve this because the method of changing power output is similar to a traditional synchronous generator whereby the phase angle of their output voltage is modified. Accordingly, grid forming inverters may experience similar power swings as occur for traditional synchronous machines.

These power swings will likely be low frequency and lightly damped which implies a possibly longer time to settle than 100 ms. If this does not cause a power system security issue or a power quality issue, this should not be a cause for concern. System studies are required to confirm this. Therefore, we believe there is no

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appropriate specific value of x% which can be defined for all cases. The power response should be assessed based on the power system reliability, security and quality of supply considerations.

Medium Energy Installations

Shell Energy believe the requirements for medium energy installations should follow what is required for large scale plants, but the technical requirements may be relaxed if they have no material impact on power system reliability and quality of supply.

Technical commentary on detailed requirements

Behaviour at current limitation

Shell Energy supports the proposed wording which specifies the requirements of GFM Inverters when operating at or above its maximum rated current.

Injection ratio

Shell Energy does not support mandated requirements for the injection ratio on a "one size fits all approach", rather the ratio should be chosen based on the system needs at the point of connection and the wider implications for the power system. The recent black-out event (28th April 2025) of the Iberian Peninsula highlighted some of the risks involved in mandating specific reactive power injection for a large amount of plant. One of the contributing causes of that event was the operation of plant (in accordance with their regulatory requirements) which did not reduce reactive power output despite high system voltages appearing on the system.

Speed of response

Whilst Shell Energy support clarifying the terminology – the proposed allocation of specific timings may not be appropriate for some network locations or may not be achievable for very high or very low fault levels. Accordingly, we recommend the required response times be informed by appropriate system studies and the reliability/power quality needs of the system.

Total current

Shell Energy supports the change in terminology from "reactive current" to "total current" when injecting into a system fault. However, as discussed below, we do not support attempts to overtly control the negative phase sequence behaviour of the inverter plant. Rather, as is currently the case for traditional generation, the inverter plant should always output a positive sequence (i.e. balanced) voltage at its terminals, and unbalanced faults will induce positive, negative and zero sequence current as the impedance to fault requires. To do otherwise, would be to purposely induce an unbalanced output voltage which would be contrary to traditional power system operation and possibly lead to control system instabilities.

Negative Sequence Current Control

Shell Energy believe it is not necessary – nor desirable to have specific negative phase sequence current injection specified in the generator performance standards. There are two main reasons for this:

- Traditional synchronous generation does not have specific negative phase sequence control but nevertheless can and does inject negative sequence current into unbalanced system faults. At a fundamental level, the only difference between rotating machines and inverters is that one uses a rotating mass of iron and copper to create a rotating voltage vector – the other uses fast switching of electronic devices to achieve the same end. The common factor between each is a rotating voltage vector in the positive sequence domain (i.e. a balanced 3-phase voltage output).

- The introduction of an additional negative sequence control loop creates another possible mode of control system instability.

Drawing the sequence network of the measured fault location explains visually why negative sequence control is not required.

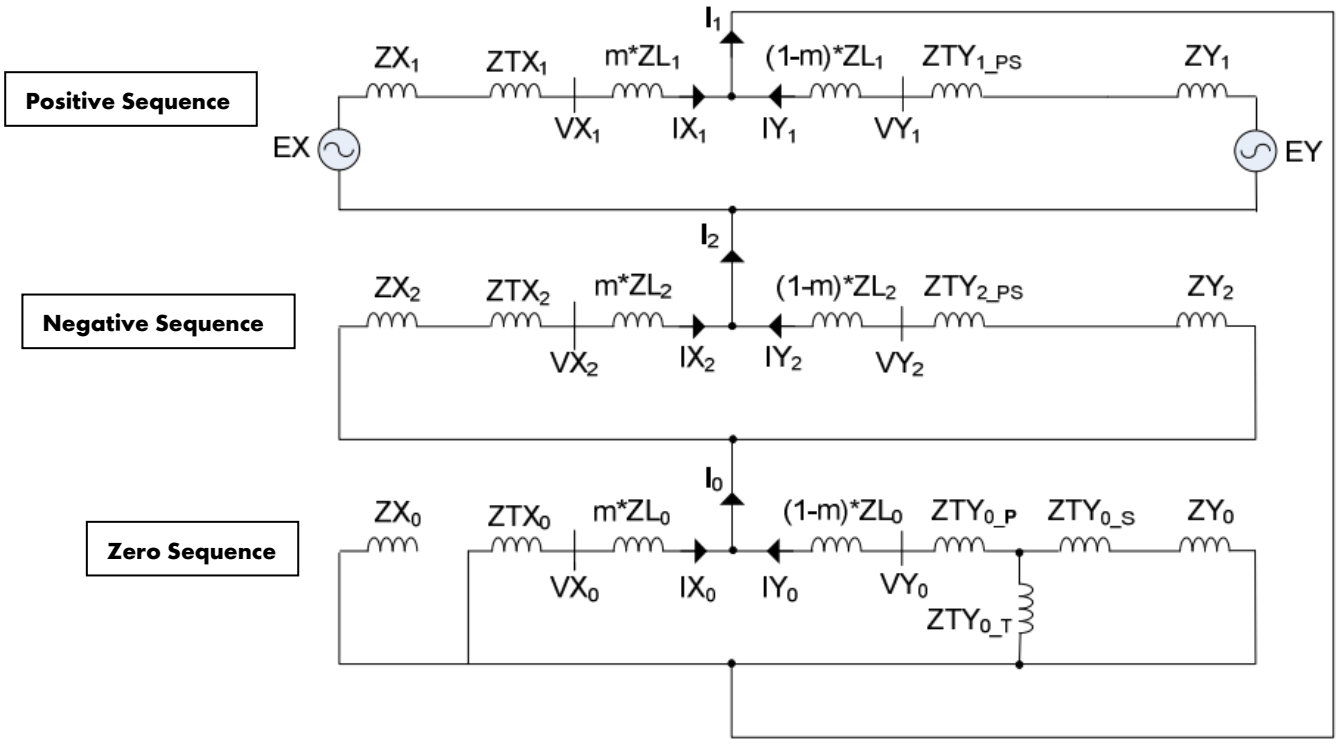

Figure 1 Typical Sequence network diagram used to calculate fault current flows during an unbalanced Phase to Earth fault.

For unbalanced faults, only the positive sequence network has sources. As can be seen in the figure above the negative and zero sequence networks have no source – but because the networks are connected – zero and negative sequence currents will still flow, but they are driven by sources in the positive sequence portion of the circuit.

This principle applies for all unbalanced faults and underpins the usefulness of using sequence networks to calculate unbalanced fault currents.

In theory, for traditional generation to produce a negative sequence voltage source it would have to either run backwards or produce an unbalanced voltage across each of its phases.

Frequency of current injection

Shell Energy supports the requirement for the frequency of current injection to match the system frequency.

Fault ride through activation threshold

Shell Energy does not support pre-defined levels for the activation thresholds because different locations on the power system may necessitate different threshold levels.

Long duration faults

Shell Energy supports the proposal to lower the fault duration for which the response must be sustained and held near constant from 2 seconds to 450 ms – if the protection systems are suitably designed to ensure the fault can be cleared in this period.

Active Current Response During and After Contingencies

Shell Energy support the change in wording from '' after clearance of the fault'' with '' after the end of the disturbance'', but do not support the 100 ms limit on determining the time required to return to close to pre-disturbance levels for reasons stated above.

Oppose fast changes in voltage magnitude

Shell Energy supports the proposal which will require that the response time is expected to be a few ms up to an AC cycle (i.e. 20ms).

Attachment 2

Proposal 15 – detailed response

Shell Energy believe the use of "system strength" as an umbrella metric is not suitable for designing power systems. We believe it is more appropriate to consider individual specific requirements and design the most cost-effective solution going forward.

Some examples of potential emerging issues and possible solutions are tabled below:

Potential Emerging issue	Possible solution or mitigation
Harmonic voltage distortion	Harmonic filter
Voltage disturbances or Flicker	StatCon or SVC
Voltage or Reactive power management	Transformer tapping Switched capacitors and/or reactors Dynamic reactive power injection using StatCons, SVCs, Inverters or rotating machines
Poor Fault ride through of Grid following inverters	Modify inverter control system Install Grid forming inverters nearby Increase fault level via transmission augmentation
Poor Fault ride through of grid forming inverters	Modify inverter control system Install Grid following inverters nearby Decrease fault level via transmission augmentation
Insufficient power transfer capability	Install additional transmission infrastructure
Fault level above equipment rupture rating	Install fault limiting equipment
High rate of change of frequency due to loss of generation or load	Control system tuning Fast power injection by batteries

	Spinning machine inertia

The table highlights the wide diversity of potential emerging issues and potential solutions, which could lead to a varying range of costs. It is this diversity which strictly limits the usefulness of generic terminology such as "system strength". A "one-sized fits all approach" inherent in using a derived system strength metric will not provide a cost-effective solution. Instead, it will cause confusion in determining the most appropriate response as we have already observed on the NEM.

Instead, we favour the network operator making investment decisions based on the various emerging needs of the system and adopting the most cost-effective approach going forward. The justification for each investment decision should be based to the specific technical issue that has been identified and the benefits that would accrue.

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Attachment 3

Proposal 20 – Detailed response

Transmission and distribution system performance

Frequency Operating Standards

The proposal appears to move the setting of frequency band limits out of the rules which is similar to the process that is currently followed in the NEM. Shell Energy does not consider this to be a material change to the existing arrangement in practice.

Transmission voltage limits

Shell Energy supports the separation of Transmission and Distribution voltage limits and agrees with the proposed limits.

Distribution voltage limits

As above.

Transient stability

Shell Energy agrees that asynchronous generation cannot experience angle instability in the same way that traditional synchronous plant can. However, there are other modes of instability that need to be addressed, some of which are still the subject of research. Shell Energy recognise the complexities in this area and recommend that the various forms of instability be addressed separately. The guiding principle in assessing stability issues should be the degree to which they can affect system security/reliability/operability and power quality.
For the purposes of providing a working definition, we suggest that the term "transient stability" should be reserved for situations where the plant cannot maintain synchronism with the system.

Oscillatory stability and damping

Shell Energy favours an approach whereby the damping ratio requirements are dropped entirely, and emphasis is placed on the oscillation halving time as the appropriate figure of merit. This focuses attention on the system security issue of avoiding the possibility of extended oscillations on the power system, whilst not unfairly penalizing smaller generation plant which typically oscillate at higher frequencies and consequent lower damping ratio – but which still have acceptable overall damping.
The" halving-time" metric can also be applied to multimodal oscillations, whereas the "damping ratio" metric is in theory strictly only applicable to second order systems.

Voltage stability

To clarify that this subject is about voltage magnitude stability rather than voltage angle stability, Shell Energy suggests it be renamed to "Voltage magnitude stability" to avoid the possibility of confusion with "voltage angle stability".

Network Service Provider obligations – stability and modelling

Shell Energy consider that the stability and modelling that is carried out by NSPs on the NEM and is proposed to be carried out by Western Power for the WEM can often be a source of project delays and uncertainty. This

can be exacerbated when difficult network technical issues are discovered but not openly shared with the project developers.
Shell Energy believes that a collaborative approach to the modelling process should be established whereby all stakeholders carry out various modelling tasks and fully share the data, results and reports of the various analyses. This will encourage the appropriate design which is fit for purpose and meet the needs of the system in the most cost-effective manner.

Network Service Provider obligations – transfer limits

Clause 2.3.6 requires the Network Service Provider to determine the power transfer limits which Shell Energy believes should be shared with the project proponents and the market participants.

Network Service Provider obligations – power system performance

Shell Energy supports the proposed changes to allow the addition of monitoring equipment (as required) to track the power system performance. For significant events the data gathered by such devices should be openly shared with stakeholders to assist analysis.
Oscillography (suitably triggered) should also be added to Table 2-9 of the technical rules as a necessary power system performance monitoring activity.

Network Service Provider obligations – system restart

Shell Energy considers that system restart obligations to be a responsibility of AEMO and they should procure restart capabilities from the various market participants in accordance with the system restart plan and the requirements of the market.

Under-frequency load shedding requirements

Shell Energy consider that the prescriptive approach that currently exists in the technical rules is no longer fit for purpose as the mix of generation changes. In particular, the fast response of BESS, the overall reduction in system inertia and the replacement of synchronous plant with asynchronous plant all affect the frequency response of the system. This changes with system dispatch which ideally should also be reflected in the underfrequency load shedding scheme. Accordingly, we support the proposal to allow the UFLS schemes to evolve into a more sophisticated design.

Network Service Provider Obligation - system strength

Shell Energy consider that the term "system strength" should not be used in the network planning process or in network operations. Our main objection is that it is vague terminology that can mean different things in different contexts. Instead, we favour the traditional approach which addresses the various concepts individually. Specifically, the following concepts are often confusingly lumped with the umbrella term "system strength"

- System frequency control
- Rate of change of voltage phase angle
- Control system stability issues – sub and super-synchronous oscillations
- System fault level
- Ensuring reliable protection system operation
- Reactive Power Management
- Harmonic distortion management

The technical solutions/mitigations for each of these issues are complex and varied and sometimes require engineering compromises. The single term "system strength" implies that one simplistic solution exists for all issues – which is demonstrably not the case. It is much more cost effective to treat each issue individually and apply the appropriate engineering solution.

Transmission and Distribution system planning criteria

The traditional transmission and distribution system planning criteria relied on deterministic methods such as N-0, N-1, N-x as metrics of increasing reliability. Shell Energy note that in the WEM various schemes have been implemented for rural and Zone substations and Perth metro regions.

Whilst these deterministic measures are relatively easy to understand and implement, they are also somewhat arbitrary and fail to cater for the wide variety of system topologies, line lengths and equipment ratings/ages across the system. These schemes do not easily translate into actual reliability outcomes for the system.

Applying a probabilistic approach to the system which considers the likelihood of equipment faults based on parameters such as line length, voltage level, series/parallel configurations etc. is known to be a more systematic approach to the issue. Before the advent of reliability software based on equipment failure statistics was available this approach was impractical. However, as this software is now readily available, it is straightforward to adopt a probabilistic approach to power system reliability planning.

Shell Energy favours probabilistic modelling of the network to inform network planning as this is a consistent methodology that is applicable to all topologies and can be used to take account of variations in equipment types, ratings and ages. We believe this will result in significant cost benefits for the system going forward.

This approach is customer outcome focused but does not directly rely on the customer outcome statistical measures - rather the statistical knowledge (derived from Worldwide sources) embedded in the commercial software is used to determine the optimum customer outcome.

Probabilistic modelling avoids the need to create specific terminology to distinguish between various contingency scenarios, except when determining what level is a material risk, and what level of risk can be considered immaterial.

Transmission and distribution system protection

Shell Energy supports the proposed changes to the technical rules pertaining to transmission and distribution protection. The proposed changes slightly relax the design requirements relating to duplication of protection and required diversity of supply vendor. Shell Energy supports a customer outcome focused approach.

User requirements

Power system performance standards - Fault contribution

Shell Energy supports the proposed approach outlined in the new clauses 3.2.1(f)(4) and (5) that express the requirements for all generating systems to manage their contribution to fault currents.

Main switch requirements

Shell Energy supports the current arrangements within the technical rules pertaining to the main switch for generating installations which appear to cover both synchronous and inverter installations.

Modelling data for power system simulation studies

Shell Energy considers that the provisions currently listed in clause 3.3.11 of the proposed Technical Rules are vague and open ended which makes it difficult for project developers to properly assess what the modelling requirements are.

In addition, it is noted that the requirements are subject to change which makes project planning difficult. It is understood that to design a safe and fit for purpose system that detailed modelling is required but it is noted that it is not practicable to insist on perfect modelling accuracy when dealing with equipment which is manufactured with physical tolerances.

Shell Energy proposes that the modelling requirements should be specified by a suitable neutral industry body (e.g. the ESAA, EA, Standards Australia or similar) which all industry participants have representation at. This should consider the needs of all parties to determine a standard approach that can applied across the industry.

Extend technical matters to be coordinated to include generator performance standards

Shell Energy supports an approach which coordinates the GPS processes associated with the WEM with the equivalent processes in the NEM. This should include harmonising of terminology and applying similar requirements for connection.

User performance register

Shell Energy supports the proposal for Western Power to create a Generator Performance register which captures the information provided by generation plant associated with their connections.

Review of User control and protection settings

Shell Energy supports the provision to allow review and if necessary, make changes to a generation plant control and protection settings to improve power system security, reliability or quality of supply to other Users.

System design and construction standards

Shell Energy supports the proposal to include system design and construction standards in the rules to clarify the requirements that already exist.

Large generators

Generator performance standards framework

Shell Energy supports the proposal to introduce a GPS framework which allows for some negotiation between parties on performance standards over connection and registration.

Exemptions for generators with GPS by the WEM Rules

Shell Energy supports this proposal which seems to allow for existing generation plant to be "grandfathered" according to its existing registration requirements.

Treatment of relevant generator modifications

Shell Energy has no comment on the proposed changes associated with this sub-section.

Remote control and monitoring

Shell Energy is generally supportive of the proposal described in this sub-section but would like to see the details of the proposal. For key generation parameters (e.g. Voltage, Current, Power, Reactive Power and frequency) this data is generally already provided.

Shell Energy consider that the point of connection should be considered the interface between the Network Service Provider and the plant owner and that remote monitoring of physical quantities referenced to this point is adequate.

Protection requirements

Shell Energy has no comment on the proposed changes associated with this sub-section.

Accommodating distribution connected large generating systems

Shell Energy has no comment on the proposed changes associated with this sub-section.

Small generators connected to the transmission or high voltage distribution system

Appropriate technical requirements for small generating systems connected to the transmission or distribution system

Shell Energy supports this proposal, specifically:

a) Revise the technical requirements in section 3.6 of the Technical Rules to implement technical requirements for small generating systems that are equivalent to those specified for large generating systems, requiring negotiation of generator performance standards for all small generating systems.

b) Where appropriate, align the technical requirements for small generating systems with minimum performance standards specified for larger generating systems.

c) In addition to (b), incorporate revisions into the technical requirements that leverage capability available in AS/NZS compliant inverters.

Export limits for transmission and distribution connected small generating systems & Export and generation limit controls

Shell Energy understands the concern and believes that export and generation limit controls may be required as the network evolves. However, there should also be consideration given to the owners of small generation plant and the potential economic impact such limits could cause. Accordingly, we recommend that appropriate market designs be implemented to address the potential emerging technical challenges.

Accommodating transmission and distribution connected small generating systems

Shell Energy supports this proposal, specifically:

For the following technical requirements, additional clauses were added where it was necessary to vary the requirements for a transmission or distribution connection:

1. Clause 3.6.2(c) of the proposed Technical Rules was revised to list applicable voltage level for the transmission and high voltage distribution system.
2. Clause 3.6.8(a) of the proposed Technical Rules was revised to remove references to the low voltage distribution system.

Communication system requirements for small generating systems & Remote Monitoring and Control

Shell Energy consider that remote monitoring and control of small generation plant by the Network Service Provider is impractical due to the large number of Solar PV installations at the domestic level and would result in unnecessary complexity if it were attempted to be implemented. There are also issues associated with potential economic impacts on owners that have not been addressed.

Shell Energy consider that the point of connection should be considered the interface between the Network Service Provider and the plant owner and that remote monitoring can be carried out by the network operator if deemed necessary at the point of connection.

Reconfirmation of correct operation

Shell Energy support this proposal in principle but consider issues of right of appeal and economic impact have not been addressed which should be set out before making changes to the rules.

Small generators connected to the low voltage distribution system

Unique requirements for small systems connected to the low voltage distribution systems

Shell Energy support this proposal in principle, which currently categorises small generation according to its connection voltage.

Export and generation limit controls

Shell Energy understands the concern and believes that export and generation limit controls may be required as the network evolves. However, there should also be consideration given to the owners of small generation plant and the potential economic impact such limits could cause. Accordingly, we recommend that appropriate market designs be implemented to address the emerging technical challenges.

Remote monitoring and control

Shell Energy consider that remote monitoring and control of small generation plant by the Network Service Provider is impractical due to the large number of Solar PV installations at the domestic level and would result in unnecessary complexity if it were attempted to be implemented. Shell Energy is concerned that there are also issues associated with potential economic impacts on owners that have not been addressed.

Reconfirmation of correct operation

Shell Energy has no comment on the proposed changes associated with this sub-section.

Inverter energy systems connected to the low voltage distribution system via a standard connection service

Shell Energy supports the proposed changes associated with this sub-section, to:

a) Introduce a new section 3.8 to identify the requirements for inverter energy system connected via a standard connection service.

b) In addition to option a) remove information that is best specified via a connection standard maintained by the Network Service Provider.

c) In addition to option b) implement revisions to clauses that recognise the capability that is provided by inverters that comply with AS/NZS 4777.2.

Loads

Protection requirements

Shell Energy has no comment on the proposed changes associated with this sub-section.

Load shedding facilities

Shell Energy believes the proposed changes appear too general and arbitrary in their current form and may require some additional consideration before implementing changes. Load shedding schemes have traditionally been implemented using staged under frequency relaying, but this approach is possibly now inadequate in situations where a high penetration of Solar PV occurs on distribution networks. To change from prior schemes operating on under frequency may be expensive in some situations, and relatively straightforward in other cases.

To avoid excessive cost of upgrades to legacy systems, a staged approach is required.

User protection

Revised Structure

Shell Energy has no comment on the proposed changes associated with this sub-section.

Approval for changes to User protection systems

Shell Energy has no comment on the proposed changes associated with this sub-section.

Cooperative design of protection systems

Shell Energy supports the proposed changes associated with this sub-section, i.e. to:

a) Revise clause 3.5.1(d) to include a specific provision requiring the coordination of the functionality of protection systems required as a condition of the User's connection to the transmission or distribution system

Clarify scope of protection requirements for large generating systems

Shell Energy supports the proposed changes associated with this sub-section, i.e. to:

a) Amend sub-clause 3.5.2(b) to remove the statement which could be interpreted as extending the scope to all protection systems necessary to protect the generating system.

Acceptable anti-islanding for transmission connected generating systems

Shell Energy supports the proposed changes associated with this sub-section, i.e. to:Revise clause 3.5.2 to include:

1. a requirement for an appropriate anti-islanding scheme which is consistent with guidelines produced by the Network Service Provider, and
2. a requirement for the Network Service Provider to develop the anti-islanding guideline for large generating systems connected to the transmission system.

Aligning protection and disturbance ride-through requirements

Shell Energy supports the proposed changes associated with this sub-section.

Relaxing location of protection function for small generating systems connected to the distribution system

Shell Energy supports the proposed changes associated with this sub-section.

Back-up protection provided by inverter protection functions

Shell Energy has no comment on the proposed changes associated with this sub-section.

Combined earth fault and anti-islanding protection

Shell Energy has no comment on the proposed changes associated with this sub-section.

Anti-islanding protection requirements for distribution connected generating systems

Shell Energy has no comment on the proposed changes associated with this sub-section.

Protection requirements for loads

Shell Energy has no comment on the proposed changes associated with this sub-section.

Inspection, testing, commissioning and decommissioning

Right of Entry and Inspection

Shell Energy has no comment on the proposed changes associated with this sub-section.

Testing by qualified persons

Shell Energy has no comment on the proposed changes associated with this sub-section.

Notification of power system tests

Shell Energy considers that for some testing scenarios the proposed notice of at least two months may be too long, and if only Western Power and the affected generator are the only parties impacted could excessively delay project schedules. Shell Energy believe that testing schedules should be jointly agreed upon between the affected parties to allow each to plan their resourcing.

Aligning GPS compliance with the WEM Rules

Shell Energy has no comment on the proposed changes associated with this sub-section.

Option to renegotiate GPS where non-compliance is detected

Shell Energy favour option a) of the proposed options which is:

For large generators, extend clauses covering the review of test results to allow for the potential to renegotiate GPS for larger generators. Where a renegotiation is required, the clauses in Chapter 4 should reference the relevant process in Chapter 3 of the Technical Rules.

The reason being that it is possible for testing to uncover a minor non-compliance in the GPS which has no material impact on the operation of the plant or system security, but to fully rectify may require taking the plant off-line for long periods of time or result in excessive cost.

An example could be the partial failure of a single inverter on a BESS or Solar installation, or a single turbine on a windfarm which results in derated output capability. Technically the plants would be non-compliant with the GPS, but no system security or plant operational issue would be of concern.

Another example could be a generator AVR being unable to provide full rated output which limits a generators reactive power capability. The ability to renegotiate the GPS may be the most appropriate option if components to restore the AVR cannot be sourced, prior to replacing the AVR with modern supported equipment (which may require redesign and long lead items to be procured).

Rectification of non-compliance

Shell Energy believes that this proposal is unnecessary as it is already adequately covered in clause 3.3.3 Provision of Information.

Compliance provisions for small generators

Shell Energy has no comment on the proposed changes associated with this sub-section.

Obligation for Users to update computer models and associated parameters

Shell Energy believes that this proposal is unnecessary as it is already adequately covered in clause 3.3.3 Provision of Information.

Right to request information

Shell Energy believes that this proposal is unnecessary as it is already adequately covered in clause 3.3.3 Provision of Information.

Interim and final approval processes

Shell Energy supports the proposed changes associated with this sub-section, specifically:

Amend clause 4.2.2 of the Technical Rules to add clauses implementing interim approval to operate and final approval to operate arrangements similar to those in the WEM Rules.

Transmission and distribution system operation and coordination

Clarifying Network Operator roles and responsibilities

Shell Energy supports the proposed changes associated with this sub-section but the details of how this is to be achieved remain unclear to us.

Application

Shell Energy supports the proposed changes associated with this sub-section, specifically:

Refining clause 5.1 to note that all WEM participants must comply with the relevant operational requirements in the WEM Rules and to clarify the requirements for the operation and coordination between the Network Service Provider and AEMO are described in the WEM Rules and not included in chapter 5 of the Technical Rules.

Alignment with revisions to network planning criteria and Network Service Provider obligations

Shell Energy has no comment on the proposed changes associated with this sub-section.

Addressing technologies bias

Shell Energy supports the proposed changes associated with this sub-section, specifically:

Delete the clause and revise adjacent clauses to avoid the need to include a list of technologies.

Clarifying arrangements for planning network outages

Shell Energy supports the proposed changes associated with this sub-section, specifically:

Introduce a new clause 5.4.5 that specifies:

1. An obligation for the Network Service Provider to develop an outage assessment guideline;
2. A requirement for the Transmission Network Operator to follow those guidelines when planning outages;
3. High-level principles that should be reflected in an outage assessment guideline including the need to consider the transmission planning criteria when assessing outages, and
4. As required by the WEM Rules, provide transmission equipment outage requests to AEMO.

Consistency with revised User requirements

Shell Energy supports the proposed changes associated with this sub-section, specifically:

Introduce revisions to appropriate clauses that:

1. Clarify that the Transmission Network Operator or Distribution Network Operator is required to operate those parts of the transmission or distribution system that are not under the control of AEMO to ensure that the power system performance standards as specified in clause 2.2 or clause 6.2 are met, and
2. Recognise that to achieve the above may require a User to operate its equipment as necessary to maintain and restore secure and reliable operation of the power system.

and

Revise the existing clause in chapter 5 addressing remote control and monitoring devices to clarify that:

1. Those devices must be installed, operated and maintained by a User in accordance with the standards and protocols determined by the Network Service Provider or AEMO, and

2. The Network Service Provider must publish a 'Generating system control and monitoring guideline', describing the signals that a User may need to monitor and make available to the Network Service Provider or AEMO. In developing the guideline, the Network Service Provider must consider the procedure developed in accordance with clause 2.35.4 of the WEM Rules.

On the latter point, Shell Energy reiterate that a clean interface point for any signals should be at the point of connection.

Clarifying the role of User operating protocols

Shell Energy supports the proposed changes associated with this sub-section, specifically:

Revise chapters 3 and 5 of the Technical Rules to include:

1. Requirements for Users, when required by the Network Service Provider, to negotiate a User Operating Protocol consistent with template maintained by the Network Service Provider,
2. A requirement for the Network Service Provider to maintain a template for User Operating Protocols,
3. A requirement for Users to operate their facilities in accordance with any relevant User Operating Protocol, and
4. A requirement for Users to maintain the User Operating Protocol to ensure it continues to accurately record relevant operating arrangements for their facility.

Clarifying system security obligations for the DNO and TNO

Shell Energy considers that the proposed changes do not appear to adequately address the identified concern of clarifying the respective roles of AEMO and Western Power. We suggest the proposed changes be redrafted and resubmitted to stakeholders for review and comment.

Clarifying acceptable timeframes for protection outages

Shell Energy has no comment on the proposed changes associated with this sub-section.

Adequate consideration of all expected load conditions

Shell Energy supports the proposed changes associated with this sub-section.

Conclusion

We welcome the opportunity to discuss our submission further. Please contact Tessa Liddelow at tessa.liddelow@shellenergy.com.au for any queries regarding this submission.

Yours sincerely

Libby Hawker

General Manager – Regulatory Affairs & Compliance

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