ELECTRICITY RULE CHANGE PROPOSAL

DER MINIMUM TECHNICAL STANDARDS

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CONTENTS

1. SUMMARY

Challenges and benefits of DER penetration levels

By 2025, Australia is expected to have 12.34 gigawatts (GW) of rooftop solar connected to the National Electricity Market (NEM), up from 9 GW in 2019[1], and 2.3 GW connected to the Wholesale Electricity Market (WEM), up from 1.16 GW in 2019[2]. This represents a world-leading level of distributed solar penetration. The adoption of distributed PV by households and businesses across the NEM and WEM is integrating a substantial new generation source to the Australian grid, driving a decentralised two-way energy system which is having a transformative impact on the operation of the power system, presenting both opportunities and operational challenges.

For consumers, if these distributed energy resources (DER) are installed with improved minimum levels of capability this transformation can have significant benefits that will enable them to engage in new markets and services; along with providing whole-of-system benefits that deliver operational efficiencies and in turn cost savings.

As distributed PV penetrations have continued to rise, particularly in South Australia, Western Australia and Queensland, challenges are emerging within distribution systems typically related to managing voltages, thermal capacity and protection coordination. Distribution Network Service Providers (DNSPs) have expanded their capabilities and successfully implemented a range of localised management responses to the various challenges faced, which can vary from simpler export limitations to developing more technically complex feed-in and power quality management capabilities.

The Australian Energy Market Operator's (AEMO) Renewable Integration Study and Technical Integration of DER Report provide extensive and detailed technical analysis demonstrating the impacts of DER and the imperative to act. These reports are included at Appendix A and B as key supporting evidence for this proposal. In summary the reports demonstrate:

- The aggregate performance of the distributed PV fleet including its monitoring and management, is becoming increasingly critical as penetrations increase; in 2019, South Australia operated for a period where 64% of the region's demand was supplied by DPV; by 2025, all mainland NEM regions could be operating above 50% at times.
- Due to its relatively high DER levels and low load base, distributed PV is already affecting bulk system operation in South Australia today. Rooftop distributed PV connections are expected to increase from 9GW to over 12GW by 2025[3], escalating these risks in the short term. In aggregate, DER is impacting AEMO's core system operating duties including system balancing, power system stability, and recovery and restoration following major system events.
- Due to identified risks associated with unnecessary and unmanaged disconnection of DER in response to system disturbances, in some regions the continued connection of distributed PV is forecast to impact planning around contingency-size to a point where it no longer becomes manageable. Without action, the largest regional and NEM contingency sizes will increase due to distributed PV disconnection in response to major system disturbances.
- Further, continued increases in behind the meter generation may result in insufficient system demand to support minimum synchronous generation levels to deliver requisite system strength and inertia.

Given the largely unmonitored and uncoordinated nature of DER today, there is a new imperative that DER devices have the minimum capability to operate autonomously in a manner that is responsive to network

[1] AEMO 2018, Integrated System Plan
[2] AEMO 2019, Wholesale Electricity Market Electricity Statement of Opportunities

and bulk power system needs. Uniform DER technical requirements are now a necessary lever to ensure consumers can benefit from future services and markets leveraging their DER, and that network service providers and AEMO can jointly manage grid and power system operations in accordance with their roles under the National Electricity Rules (NER or the Rules), so that power supply remains secure and reliable for energy consumers. The way we think about distributed PV and other DER, the way we govern it, and the way we use its evolving technology must now change along with its expanding role and technical capabilities.

ESB work program on DER integration

The Energy Security Board (ESB) has been considering the need for the development of nationally consistent minimum technical standards for DER across Australia, and in early 2020 sought a review of governance of DER technical standards to support effective and efficient DER integration. The review found significant gaps in the current arrangements in terms of leadership, coordination and harmonisation.

On 20 March 2020, the ESB recommended to the Council of Australian Governments (COAG) Energy Council that the ESB and AEMO work together to deliver a rule change proposal to put in place minimum distributed energy resource (DER) technical standards by October 2020, which was agreed by the Energy Council. The Energy Council also agreed that ESB develop longer-term governance arrangements for the maintenance of DER technical standards. The governance arrangements to be designed would incorporate consultation with all stakeholders and bring back a proposal with the details of these arrangements for Energy Council approval in October 2020. This rule change proposal is submitted by AEMO in cooperation with the ESB and taking on board direction from the ESB in relation to its DER work program.

The ESB and AEMO are similarly working with the relevant Western Australian (WA) reform body and stakeholders to develop mirror requirements in WA. The following chapter sets out the context and need for this proposal, a summary of changes proposed, and interlinking work.

Rule change to address immediate challenges

This rule change proposal outlines the evidence base and benefits for DER to begin complying with standardised minimum technical requirements, and for those requirements to be set uniformly and applied nationally via a framework established in the Rules, so that DER can contribute to the secure and reliable supply of electricity to all consumers in the NEM, whilst providing greater value to DER owners and minimising cross-subsidies to those who cannot install these resources.

The proposal focuses on leveraging existing mechanisms within the NER and the National Energy Retail Rules (NERR) as required, to achieve its objectives and builds on recent rule changes to establish the DER information register. In summary the rule proposes the development of initial minimum DER technical standards as follows:

- AEMO must make, publish and may amend, the DER Minimum Technical Standards in accordance with the rules consultation procedures.
- DNSPs must ensure that connected DER, either by its own means or by way of a DER device, meets the DER Minimum Technical Standards (including without limitation, through the inclusion of appropriate provisions in connection agreements).

At this relatively early stage of the emergence of DER, it has been generally agreed that very tightly drafted, detailed definitions of DER risk being out of date too soon and not sufficiently flexible. For the purposes of determining the permissible coverage of DER minimum technical standards at this emerging stage of DER development, the proposal provides both a broader statement of "DER" but combined with a number of mechanisms by which the scope of these standards can be specified.

A broad statement of DER might be considered:

> *The types of resources/assets including small and medium scale distributed generation (such as solar PV), energy storage (such as small and medium-scale batteries and electric vehicles that can deliver energy from vehicle to the power system) and controllable loads (such as air conditioners, electric storage hot water systems, pool pumps, and electric vehicle supply equipment) that connect to the distribution system.*

This is intended to capture minimum requirements for connected DER (new and replacements) and DER devices including the inverters, demand response enabled devices, smart meters, gateway and other equivalent devices that determine or influence DER response to grid conditions and/or control instruction/commands. Retrospectivity is not being considered at this stage.

Consumer and system benefits

By improving the performance of DER and the predictability of DER behaviour, standardisation of minimum DER capabilities across the NEM will allow more consumers to connect DER to the grid in the future and increase the avenues available for consumers to optimise their investments in DER. For non-DER households it will improve the efficient operation of the power system by system managers, leading to more affordable power supply.

Minimum standards on technical capabilities to integrate DER with the power system will improve certainty about the behaviour, performance and contribution of DER to the power system during and following severe disturbances. This certainty and predictability enables power system operators to avoid conservative (and inefficient) operational measures in anticipation of loss of DER for a range of severe disturbances. This effectively benefits consumers through optimal operational practices and improved resilience of the power system (a key component of reliability).

Minimum standards for interoperability will help coordinate the emergence of new DER markets and services including Virtual Power Plants (VPPs), ultimately enabling consumers to individualise and optimise the benefits of their DER investments. Supporting cyber security standards will improve the reliability of DER and protect consumer investments, physical safety and privacy. The interoperability capabilities can also be leveraged by market participants and VPPs to enable customer churn and to offer services that improve the cost and efficiency of delivery of electricity to consumers.

Next steps

AEMO is committed to working with the Australian Energy Market Commission and industry to seek to achieve the introduction of this proposed rule change, and on further reforms to the governance of DER technical standards that result from the ESB review.

2. RELEVANT BACKGROUND

2.1 High and growing distributed PV levels

Australia's 9GW of rooftop solar is predicted to rise to over 12GW by 2025 under AEMO's Draft 2020 Integrated System Plan (ISP) Central projections. In 2019 DPV was already at times supply 25% of underlying demand in the NEM[4]. By 2025, the Draft 2020 SIP Central scenario forecast assumes enough

[4] AEMO 2020, Renewable Integration Study

distributed PV that it could reach 41% of NEM demand. It is increasingly evident as this contribution grows that the performance and capabilities of this fleet must be uniformly uplifted to meet the reliable and secure power supply outcomes of the NEO.

In addition to a growing proportion of DER, Australia's generating mix is increasingly supplied from variable renewable energy sources such as wind and solar farms, replacing traditional generation and increasing the proportion of non-synchronous generation in the NEM. Wind and solar generation (including DER), because of its inverter-based characteristics change the way the power system responds to disturbances, and drives increasing variability and uncertainty into balancing of supply and demand[5]. This requires careful management and balancing of the system.

2.2 Technology innovation in DER

While there are technical challenges surfacing in the power system, rapid changes in technology are at the same time expanding DER capabilities and creating opportunities for industry participants and consumers to use DER in new ways. Smart inverters are now internet connected with communication and software interface capabilities. This enables the aggregation of DER by third parties, increasing their utility to both consumers and the power system. New markets and services are beginning to emerge to monetise these capabilities and today DER is already supporting system security[6] and can and must play a greater role in the future as its portion of instantaneous energy in the system continues to increase.

Technology innovation is also combining with digitalisation to cause a step change in energy data capabilities. For DER, this means a future with fleets of automated and remotely controlled active DER that is tailored to customer needs and to operate with the power system through the internet. The digitalisation of energy presents new challenges in the form of cyber or digital disruption risk through the connection of utility devices and control systems with internet connected DER. The sector's attractiveness to cyber-attack is growing as complexity, interconnectivity and innovation increases system vulnerability. Cyber security incidents in the power system are rising in number, impact and sophistication[7] and internet connected DER increase the attack surface of our power system creating new vulnerabilities routes for intrusion.

2.3 DER integration work program

The ESB has developed a DER Integration workplan of priority actions to integrate high levels of DER into the NEM, focused on technical, regulatory and market actions. Technical integration is one of the ESB's workplan priorities with work focused on uplifting technical standards across the NEM. The Distributed Energy Integration Program (DEIP), a collaboration of the NEM's market authorities, industry and consumer associations is coordinating a number of market and technical working groups designed to share information and collaboratively develop options to efficiently integrate DER into the power system.

AEMO has commenced a program of work to better utilise DER for individual consumers, communities and the grid. AEMO is working in partnership with a range of parties to make this happen in the most effective way to deliver consumer outcomes. One key stream of AEMO's DER program, is the enhancement of DER technical standards, which is the primary focus of this paper. AEMO commenced a review of Australian Standard AS/NZS 4777.2 (grid connection via inverters) and is on the committee for AS 4755.2 (demand response).

It is noted there are many other specific trials, research programs and practical DER integration measures being undertaken across DNSPs, research institutes and market bodies.

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[5] AEMO 2020, Renewable Integration Study

[6] Examples include in South Australia where third parties are aggregating distributed PV, battery systems and demand response capabilities into VPPs and are providing a range of electricity and related energy services (FCAS).

[7] World Energy Council 2019, Cyber challenges to the energy transition

2.4 ESB governance review

To support effective and efficient DER integration, the ESB sought a review of governance of DER technical standards in early 2020. The review[8] recommended that substantive changes are needed to the overall governance of DER technical standards. The review found:

- Governance of DER technical standards has been fragmented, lacking clarity of roles and coordination.
- Resourcing is inadequate, and the pace of change in standards setting is slower than required to manage the emerging issues resulting from rapid deployment of DER across Australia. The result is that DER systems deployed today are not able to deliver the performance levels and services required to support system security, efficient and effective distribution network management and the optimisation of DER benefits for all electricity system users.
- There are critical gaps and weaknesses in the current governance system, including leadership, coordination, alignment with the NEO and weaknesses in existing process in terms of speed, transparency and a lack of harmonisation across DNSPs.

In response to these findings, in March 2020 COAG Energy Council agreed that in parallel with this rule change process, the ESB develop longer-term governance arrangements for the maintenance of DER technical standards. The governance arrangements to be designed would incorporate consultation with all stakeholders and bring back a proposal with the details of these arrangements for Energy Council approval in October 2020.

AEMO and ESB have identified, as a result of developing this rule change proposal, that there needs to be additional enhancements to DNSP obligations in relation to the management of DER including for network planning and power system security. The ESB proposes that further work to examine DNSP obligations is undertaken as part of the governance review due in October 2020.

2.5 WA Roadmap

In May 2019, The WA government, announced an Energy Transformation Strategy and established an Energy Transformation Taskforce to implement it. Delivery of the Strategy involved developing a Roadmap for a transition to a decentralised, democratised, and highly data driven power system – the WA DER Roadmap. The DER Roadmap was released in April 2020 and proposes a suite of actions for DER to be fully integrated into the power system. The report acknowledges that levels of DER growth mean that is now becoming a central player in the power system and therefore needs to be subjected to similar discipline as traditional generation and contribute to, rather than detract from, the security of the overall power system, whilst providing a return to DER owners.

3. STATEMENT OF ISSUE

There are technology capabilities that must be harnessed for the benefit of all consumers and that can assist to meet network and power system challenges of secure and reliable electricity supply. This requires industry and market bodies to work together to put in place a world-first DER enabled operating system, built on uniform underlying technical capabilities.

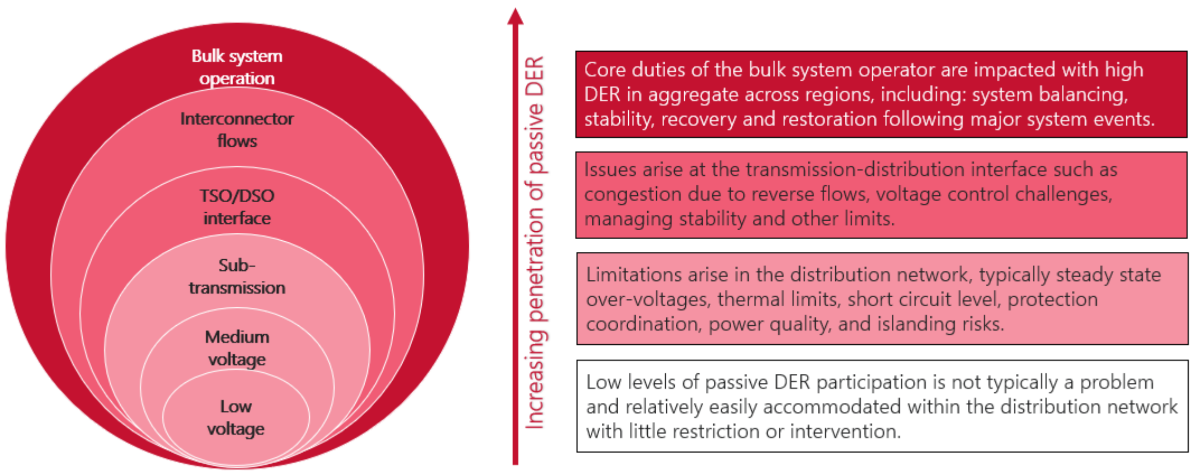
[8] Sapere and CultlerMerz (2020) Review of governance of Distributed Energy Resource (DER) technical standards for the Energy Security Board, Available at: http://coagenergycouncil.gov.au/sites/prod.energycouncil/files/ESB%20Governance%20of%20DER%20Technical%20Standards.pdf

3.1 The system impacts of DER

As distributed PV penetrations have continued to rise, particularly in SA, WA and QLD, limitations have begun to be reached in distribution systems related to managing voltages, thermal capacity and protection coordination. DNSPs have successfully implemented a range of management responses such as inverter and export limits on individual systems, adjusting transformer taps, and refining performance standards and inverter capabilities required to connect to the distribution network. As network impacts are location specific, technical requirements for connection differ based on the network characteristics, load and the level and nature of challenges faced. As DNSPs continue to improve their management of DER, this has allowed them to continue hosting PV in their networks.

Where local clusters of DER grow in size, impacts begin to occur at the distribution-transmission interface, for example, in the form of reverse power flows which require time and resources to manage. As penetration continues to grow, DER in aggregate sums to a utility scale plant, and impacts become significant across the operation of the power system (see Figure 1), manifesting in real time challenges to balancing supply and demand required to maintain security and restore the system after major events[9].

Figure 1. Trajectory of system challenges with increasing penetrations of uncontrolled DER



Source, AEMO 2019, Maintaining Power System Security with High Penetrations of Wind and Solar Generation

Bulk power system operational challenges from aggregate DER are becoming more urgent and significant as penetration rises in two main respects:

1. Inverter performance is not aligned with the needs of the power system; at present in relation to withstand capability and grid support modes.
2. The ability of operators to see and actively manage the DER fleet is impacting core system operating duties including system balancing, power system stability, and recovery and restoration following major system events.

Inverter performance

In 2019 AEMO[10] published evidence about the challenges that fleets of uncontrolled rooftop PV present during disturbance and separation events including:

[9] 2019 AEMO, Maintaining Power System Security with High Penetrations of Wind and Solar Generation
[10] AEMO 2019, Technical integration of distributed energy resources

- Performance settings in inverters causing large amounts of rooftop PV to act in unison during disturbances or system events in ways that are detrimental to maintaining or restoring power system security.
- Several incidents of fleets of rooftop PV (in excess of one hundred megawatts) unfavourably disconnecting in response to disturbances (e.g. under-voltage events) in the power grid, in turn exacerbating the event.
- The potential for moderate disturbances to escalate into severe disturbances and affect large geographical areas, decreasing the robustness of the power system.
- In aggregate this behaviour is already large enough to exacerbate disturbances to an operationally significant degree.
- Improved inverter performance settings and capabilities between 2015 and 2017 did in turn improve the resilience of those inverters to ride through systems events.

DER inverter responses to disturbances are an increasingly important factor in system recovery. The AEMO report indicates that left unchecked this distributed PV behaviour could lead to costly interventions and conservative, inefficient operation of the power system. However, there are technical solutions to these issues. In particular uniform technical performance standards can assist in managing these identified challenges.

System operation impacts of aggregated PV

AEMO's recently released Renewable Integration Study[11] found the following impacts of aggregated PV:

- The need for increasing Frequency Control Ancillary Service provisions following transmission faults due to the potential mass-disconnection of PV systems. This is occurring because this growing proportion of generation in the NEM is not subject to similar bulk system disturbance withstand requirements as utility-scale generation.
- The ongoing reduction in the daytime system load profile due to continued growth in distributed solar generation is contributing to the reduction of stable load blocks, reducing their availability for the effective operation of mechanisms such as emergency frequency control schemes and system restart.
- Eventually reducing system demand can reach the point of insufficient load to support minimum synchronous generation levels necessary for system strength, inertia, frequency control and other services required for system security during system normal[12].

DNSPs are actively working to mitigate these challenges as detailed in section 3Error! Reference source not found..

Due to its relatively high penetration and low load base, distributed PV is already affecting system operation in South Australia today. Under current distributed solar uptake projections, these issues will also be increasingly prevalent in other NEM regions by 2025[13]. Technical studies of power system events demonstrate that DER can influence the power system in a similar manner to utility scale generators[14]. These impacts necessitate national DER standards that align the performance of DER with the needs of the power system to ensure it can be operated in emergency conditions and continue to supply security and reliable power to consumers.

[11] AEMO 2020, Renewable Integration Study
[12] AEMO 2020, Renewable Integration Study
[13] AEMO 2020, Renewable Integration Study
[14] AEMO 2019, Technical integration of Distributed Energy Resources

3.2 Demand response of loads

Emergency situations can occur when a change in supply and demand balance is experienced like when a large amount of generation resources are removed from the system or as network plant is tripped. There are emergency methods for rebalancing the system, which has been traditionally achieved with emergency load shedding schemes such as Under Frequency Load Shedding, and rotational shedding (the disconnection of thousands of customers). As generation becomes more diverse and distributed through DER such as distributed PV there has been reduction of the amount of load which can be reduced or increased to balance the system.

DNSPs have traditionally managed loads by dropping distribution feeders, effectively turning off the power to entire suburbs, as the assets for performing this function were only available at the network level. With the advent smart meters and DER, these functions can now be operated at a lower level in the system where the device itself incorporates certain minimum technical functionality and capability. The flexibilities available within DER can assist in restoring the balance of supply and demand just as the system has used supply resources. If standardised in devices, these capabilities can lead to more effective load shedding operations and improved experiences for consumers through targeted responses at the household level. This means that where load shedding that must occur for system security purposes today requires total disconnection of tens of thousands of customers for hours at a time, demand side response of DER will instead enable the turning off of discretionary loads without impacting customer amenity (electric storage hot water heaters and pool pumps) instead.

The governance around such arrangements will require development but a mechanism to implement the technical capabilities when required is a necessary step. National DER standards will bring the option to modernise an historically blunt instrument for power system operation that currently has serious impact upon consumers; by mitigating full load shedding and instead allowing customers to still have power to much of their home, that in the absence of nationally consistent DER standards could be completely disconnected (under existing processes for security load shedding).

4. ADDRESSING THE PROBLEM THROUGH TECHNICAL STANDARDS

4.1 Role of technical standards in supporting secure power system

Power system security refers to maintaining the power system in a secure and safe operating state to manage the risk of major supply disruptions to consumers. It deals with the technical parameters of the power system such as voltage, frequency, the rate at which these might change and the ability of the system to withstand transient faults. AEMO is required under the National Electricity Law and the Rules to operate and maintain the power system in a secure operating state. For this to occur, there are a number of physical parameters that must be maintained within a defined operating range. An electricity system that operates outside of these parameters may become unstable, jeopardise the safety of individuals, risk damage to equipment, and produce the possibility of blackouts. Power system reliability is about the likelihood of supplying all consumer needs with the existing generation and demand response capacity and network capability. System security is necessary for the efficient functioning of the NEM and both security and reliability are core to achieving the National Electricity Objectives (NEO).

Systems and network operators use a suite of complementary operational and regulatory tools to operate the distribution and power system. The performance and behaviour of equipment connected to the system including aggregated equipment fundamentally impacts these duties. To the extent that technical standards determine the behaviour of the connected equipment they are an important input or control relevant to system management.

Detailed performance requirements for connected large scale generators (5MW and above but typically over 30MW) are defined in the Rules and stipulate the range of capabilities that are needed to support system stability and assist in maintaining and restoring a secure power system. Historically, AEMO has had a limited role in technical requirements for smaller generating units and provides a standing exemption from registration for generating systems with a nameplate rating less than 5 MW[15], acknowledging that these systems "are unlikely to have such an impact or cause a material degradation in the quality of supply to other Network Users". While there is no thought of registering individual systems below existing thresholds, the evidence base on the power system impacts of aggregated DER has changed, giving rise to new thinking about how these systems should be governed.

4.2 Gaps in the current DER technical standards framework

The current approach to technical requirements for interconnected DER in Australia is achieved largely through a suite of voluntary interlinking Australian and International Standards enforced on a network-by-network basis through regulatory obligations on DNSP with respect to their delivery of connection services and to maintain network safety, power quality and reliability. This section discusses areas of concern with the current framework for DER technical standards and the gaps that this rule change seeks to address.

Network connection requirements

DNSPs determine the technical requirements for basic, standard and negotiated connection services for connection of embedded generation to the distribution network. Chapter 5A of the Rules sets out terms and conditions which are to be included by DNSPs in their contracts with retail customers (or their representatives) for the connection of generation to the distribution network. For both basic and standard connection services the Rules (5A.B.2(4) and 5A.B.4(4)) stipulate that DNSP connection contracts must set out the technical requirements for the connection and the statutory basis under which those requirements are imposed. For negotiated connections, DNSPS must as part of the negotiating framework, determine the technical requirements for a proposed new connection or alteration (5A.C.3(5)). These provisions allow DNSPs to impart technical obligations on the manufacturers and installers of connected embedded generation, via customer connection contracts.

In determining the technical requirements for connection, DNSPs are bound by legal obligations set out in state electricity and electrical safety legislation and codes, and the conditions of their distribution licences. DNSPs base their requirements on the objectives determined in regulatory frameworks and according to the operating needs of their networks. It is important to note that the decision-making autonomy and flexibility DNSPs have to determine their technical requirements has been critical to managing the localised network impacts of DER and in particular large penetrations of distributed PV across a diversity of network typologies and conditions. In many cases the efficient management of local network conditions relies on this flexibility.

Voluntary national connection guidelines

In order to better harmonise the technical requirements to connect to the distribution network, in March 2019 the Energy Network Association (ENA) published a national DER grid connection guidelines for Basic

[15] AEMO 2020, Guide to Generator Exemptions and Classification of Generating Units

and LV embedded generator connections[16]. It is voluntary for DNSPs to adopt the guidelines although they were developed with a high level of commitment across DNSPs.

Australian Standards

Australian Standards set through Standards Australia processes document technical norms and are useful when many parties need to agree on the details of a technology, process, or practice. Setting an Australian Standard typically requires wide industry consultation and Australian Standards are ratified via a consensus process that requires the approval of a governing technical committee. Consensus is considered to have been achieved when stipulated consensus voting thresholds are met. From first proposal to final publication, developing a Standard usually takes 2 to 3 years.

Australian and International Standards are voluntary until called up in legal instrument. There are a range of different ways in Australian Standards that apply to DER are implemented, including via State incentive schemes, by reference in Commonwealth or State legislation, and through network connection standards and contracts (discussed above).

4.3 Assessment of status quo

The current 'patchwork' approach to standards of DER connected to the NEM is not capable of delivering the consumer outcomes needed in the context of the rapid uptake of DER by consumers. It fails to deliver adequate support for power systems at a technical level and will inhibit the future development of markets and services in the NEM to provide benefit to consumers. There is an immediate need for these issues to be addressed through the introduction of minimum technical capabilities for all new connected DER.

5. TECHNICAL CAPABILITY REQUIREMENTS OF DER TO SUPPORT A SECURE POWER SYSTEM

This section describes the types of minimum technical capabilities required to integrate DER into the power system and improve its value to consumers.

5.1 Foundational technical capabilities and their benefits

The following describes the foundational technical capabilities that the minimum DER technical standards will likely cover during the first two years of development, and their benefits.

Inverter performance and grid responsiveness

To address the network and power system challenges in Section 3.1, AEMO has been and will continue to work closely with DNSPs, industry bodies and stakeholders to standardise the use of enhanced grid response modes in inverters, including:

- Improved disturbance withstand capability
- Enhanced grid response functions for voltage and reactive power, and frequency response.
- Improving the accuracy and stability of measurement systems used in these inverters to improve reliable performance characteristics for a range of grid disturbances.

[16] ENA 2019, National Distributed Energy Resources Grid Connection Guidelines Technical Guidelines for Basic Micro EG Connections.

- Standardising suitable testing procedures for these areas of enhanced performance.

It is important to note AEMO expects the select capabilities will mirror those currently being developed within the AS/NZ 4777.2 review.

A national DER standard that allows the majority of systems to include these capabilities and stay connected during power system disturbances will improve the overall reliability and security of the network and less tripping of systems brings greater financial benefits to DER customers. With this improved certainty AEMO will be better positioned to optimise power system operations, so that conservative and more costly operational practices can be avoided. These benefits combined support delivery of more affordable energy to consumers.

DER systems with advanced functionality providing autonomous reactive power response to voltage variations (often due to variability in PV output) also enhances the hosting capacity of distribution feeders. This has two significant benefits for consumers in that it allows more DER to be installed including without export limits and does so at a lower cost to the network (which would otherwise flow through to consumers).

Interoperability

Interoperability describes the communication capabilities, data exchanges, and controllability / coordination that will need to exist between DER devices and actors to dynamically dispatch and manage DER services. Data and communication capabilities are a prerequisite of coordinated and optimised two-way energy systems, with system and device operators managing complex energy flows between multiple participants. Data and interoperability device standards are a prerequisite for DER communications "platforms" to operate, and for DER to be coordinated and optimised with each other, with interconnected operating systems (e.g. across installation sites, equipment manufacturers, networks, energy suppliers), and with the wider power system (including the system for dispatching generation to meet demand operated by AEMO)[17] . Controls may be exercised technically through DER devices such as inverters, smart meters or DRED / gateway devices.

Relatively course technical capabilities exist now at the device level to manage inverter-based DER. While these can be improved, there is currently no uniform requirement for devices such as inverters to incorporate minimum levels of remote communication and management functionality. For consumers to maximise the value of their investments, their devices need to be able to communicate and receive and respond to control signals so that they can participate in new markets where aggregators and Virtual Power Plant (VPP) operators leverage these capabilities to dispatch DER services. Interoperability also brings alternative options to manage more DER into the grid, in place of zero export constraints on new DER which is creating a two-tired, inequitable energy market made up of customers that can export and engage in new markets and services and maximise the value of their system, and those that cannot. Minimum interoperability standards can be designed to encourage new markets that enable consumers to individualise and optimise their energy services at their choice.

For the system and markets of the future to operate efficiently, this minimum level of control functionality in platforms and devices must be consistent from the DER to the DNSP and AEMO, and ultimately once markets mature, to and from the VPP and DER aggregators. Unless the millions of devices respond in a consistent manner, and critically are tested to deliver this response, then the operation of this fleet is not secure, and customers may be locked into control platforms and providers without the ability to easily churn and take advantage of market competition.

[17] Energy Security Board 2020, Review of the Governance of Distributed Energy Resource (DER) technical standards

Cyber security

Remote monitoring and control of DER requires local devices and sensors to communicate operational status and receive commands from the remote systems, via public or private communication networks. This inherently exposes DER devices to the threat of cyber interference, threatening the reliability of the Australia's energy system. As DER comes to play a larger role in energy markets and services, technical requirements to protect the power system from cyber-attack become critical. There are no Australian Standards or other similar instruments in place to govern cyber security at the device level. More robust cyber security increases the reliability of DER, and mandatory requirements are needed to protect the power system from cyber-attack through interconnected DER devices or third-party control systems and protect the data and privacy of DER owners.

In 2018, following independent review[18] recommendations that stronger cyber security measures be put in place for the energy system, AEMO was tasked by the ESB to lead the uplift of cyber security across the energy sector and this process is underway.

However, this broader work program does not negate the need for immediate measures to enable cyber security in the DER ecosystem where device level capabilities are required. Current provisions in the NER imposing obligations on Registered Participants or Metering Coordinators which relate to the security of communications do not apply at the level of DER. There is a need to implement minimum DER cyber security requirements to protect the power system with growing levels of internet connected DER. This proposal represents as minor step that is complementary to the broader reform but limited to ensuring that DER devices are not posing undue security risk to the power system.

5.2 Minimum requirements versus market services

It is important to note that the DER technical standards contemplated by this rule change proposal aim to set out minimum capabilities for DER in the same way that large generators must meet minimum access standards to connect to the transmission network. Standards will typically set out a lesser level of technical requirement than the full operating capability possible to deliver DER services into future markets. The benefit of minimum standards is that they can provide a uniform technical foundation for DER markets to develop more efficiently and enable full-service offerings to be valued by the market. Minimum levels of technical requirements also provide significant market benefits to customers, by mitigating costs and stimulating competition where new market entrants can readily enter by connecting via established standards embedded in the DER. Establishing minimum capabilities does not prevent the market from developing innovative capabilities and services that function in addition to a minimum requirements.

6. KEY PRINCIPLES

The following sets out key principles to guide the approach to a new enabling framework in the Rules for DER minimum technical standards.

Uniformity

It is the consistent and uniform national uplift of foundation minimum capabilities via a regulation that will deliver benefits for consumers in terms of power system operation, protection of the grid from cyber-attack and laying the technical foundations for open DER markets and services. A NEM-wide approach is expected to allow devices to be deployed and integrated efficiently across jurisdictional boundaries.

[18] Dr Alan Finkel AO, Chief Scientist, Chair of the Expert Panel, 2017, Independent Review into the Future Security of the National Electricity Market

Nationally applicable standards can also be expected to generate economies of scale for installers working across jurisdictional boundaries, potentially resulting in cost savings to consumers.

Minimum technical requirements

A key principle of the proposal is to establish the minimum technical capabilities required to capture the broader market, system and consumer benefit, particularly where parties determining the technical standards for connection may not have an incentive to coordinate those requirements or provide services that are of value to others.

Adaptivity

Australia is at the forefront of high DER integration worldwide and in some instances, there are no international standards in place to address challenges unique to the Australian context. Unknown future operating scenarios may also arise and create further needs for urgent new technical capabilities from a system perspective. The type of capabilities available in DER are also changing to include new software and internet-based capabilities such as application programming interfaces (APIs) that can evolve very quickly[19]. To operate the power system of the future, and optimise the use of DER, AEMO, DNSPs, industry and consumers will need flexibility to update or introduce technical standards within months. Successful adaptation relies on the flexibly to develop standards that can capture lessons learned and address new areas of risk. The ability to introduce or amend standards to keep pace with rapid technology and market change is paramount.

Complementarity

This proposal acknowledges the importance of retaining the body of electrical standards currently in operation and covering much of the lifecycle of DER including Australian Standards and DNSP technical standards. DNSPs own and operate network assets that need to be planned and managed within technical limits to meet power quality requirements and to maintain the integrity of plant. They also have regulatory obligations to manage the safety of the public and their workers and must have the protection systems suitable to manage those obligations and risks. Due to the complexity of the systems involved, an appropriate balance is needed between uniform standards and sufficient flexibility for network operators to manage native conditions or challenges. This proposal seeks to achieve this balance through Rules framework that produces a coordinated set of interlinked and complementary standards instruments including formal Australian and International Standards, DNSP technical standards and the proposed national DER minimum standards.

7. DESCRIPTION OF THE PROPOSED RULE

We attach a high-level description of a proposed Amending Rule at Appendix C. The high-level description covers key elements of a proposed new framework in the Rules for mandatory DER minimum technical standards, including the scope of DER, the structure of the proposed rule and governance arrangements.

7.1 Scope of DER

At this relatively early stage of the emergence of DER, it has been generally agreed that very tightly drafted, detailed definitions of DER risk being out of date too soon and not sufficiently flexible. Rather, AEMO proposes a high-level characterisation of DER, developed to incorporate all types of DER, that can evolve in line with technological evolution. AEMO's objective, by establishing a framework for governance

[19] World Energy Council 2019, Cyber challenges to the energy transition

of minimum DER technical standards, is to facilitate consumer access to distribution systems and provide for network security and reliability.

To achieve the objectives set out, the proposal below seeks to provide both a broader statement of "DER" but combined with a number of mechanisms by which the scope of these standards can be specified.

AEMO proposes that a general definition of "Distributed Energy Resources" that covers resources and assets including small and medium scale distributed generation (such as solar PV), energy storage (such as small and medium-scale batteries and electric vehicles that can deliver energy from the vehicle to the power system) and controllable loads (such as air conditioners, electric storage hot water systems, pool pumps, and electric vehicle supply equipment) that connect to the distribution system.

For the purposes of developing a Rule based framework to enable DER minimum technical standards at this point in time, and ahead of a full governance framework, AEMO proposes that DER captured by this rule should be limited to assets or resources to which the DNSP has visibility.

'Visibility' to the DNSP could be explicated either:

- by way of a linkage to process requirements for connection to the distribution system of the DNSP (ie: a connection application process made in accordance with the NER and NERR or in accordance with the relevant jurisdictional framework,
- by way of a term or condition of a DNSP connection contract or DNSP connection standard, protocol or specification, or
- by way of the retail customer (or their representative, including, but not limited to, their retailer, metering provider or installer) contacting, or being required to contact, the DNSP, under an applicable regulatory instrument (either under the NER, NERR or jurisdictional regulatory framework).

Further, the DER that is to be subject to DER minimum technical standards may include assets such as air conditioners, electric storage hot water systems, pool pumps, electric slab heaters, energy storage and electric vehicle supply equipment. But these controllable load assets and resources are only to be covered by DER minimum technical standards in relation to and to the extent that they are capable of responding to (distribution) network requirements by adjusting load. This may either by their own means, or by way of a "DER device". In order to avoid overreach (ie inadvertently covering small 'behind the meter' appliances etc), AEMO should be required in the standard itself to specify the particular DER being covered.

Finally, AEMO proposes that the DER Minimum Technical Standards will only apply to DER that is newly connected or to be connected within a distribution system, and DER within a distribution system that is newly augmented, upgraded, extended or replaced – that is, when a customer (or their representative) contacts the DNSP, or when a requirement on a customer (or their representative) to contact the DNSP is triggered. To this end, AEMO proposes a definition – "connected DER".

Connected DER may satisfy the DER Minimum Technical Standards by way of the connected DER itself (that is, the DER will itself contain a device that can meet the requirements in the DER Minimum Technical Standards), or by way of a device (designed to facilitate connectivity between DER and the power system such as an inverter , smart meter, DRED or other gateway device – a "DER device") that is connected to the connected DER.

AEMO proposes initial DER Minimum Technical Standards will set, amongst other things, technical performance capabilities to integrate and support the power system.

AEMO proposes that future DER Minimum Technical Standards will set, amongst other things:

- Interoperability requirements, including data monitoring, communications capabilities, data exchange, and controllability/coordination.

- Cyber security and technical requirements to protect the security of the connected DER and/or DER device, the data in and communications from the connected DER and/or the DER device to protect

7.2 Rule structure

To achieve the objectives articulated above, this rule change proposal establishes a framework for setting DER minimum technical standards that operates within current structures in the NER and NERR (most notably, Chapter 5A of the NER) and operates consistently with existing Australian and International Standards.

AEMO proposes that a rule be inserted into Chapter 3 that sets two key obligations. Firstly, the rule change proposal establishes an obligation on AEMO to make, publish and, if necessary, amend DER Minimum Technical Standards. Secondly, the rule change proposal requires that DNSPs must ensure that connected DER, either by its own means or by way of a DER device, meets the DER Minimum Technical Standards (including without limitation, through the inclusion of appropriate provisions in connection agreements).

AEMO proposes that the DER Minimum Technical Standards be inserted into the minimum content requirements of Chapter 5 and Chapter 5A connection contracts, negotiation frameworks and model standing offers, and into the model standing terms and conditions for deemed standard connection contracts prescribed in Schedule 2 to the National Energy Retail Rules. For example, Chapter 5A sets out requirements that DNSP model standing offers and negotiation frameworks for connection contracts include specified terms and conditions to be approved by the AER under a propose and respond model. In order to allow for the DER Minimum Technical Standards (and any subsequent updates) to be incorporated into connection agreement model standing offers and negotiation frameworks, without triggering the need for further AER approval if the DER minimum technical standards are updated, we propose a requirement be included that the connection application meet the DER Minimum Technical Standards as made and updated from time-to-time. AEMO notes that unique regulatory arrangements are in place in Victoria and appreciates that the Victorian Government and Essential Services Commission of Victoria may need to consider how best to design the regulatory framework to implement the DER Minimum Technical Standards in Victoria.

The obligations set in the rule change proposal are imposed on AEMO and the DNSPs. However, by requiring that the DER Minimum Technical Standards are inserted into the terms and conditions that DNSPs are to include in their connection agreements with retail customers (or their representatives) in accordance with the NER and NERR, the DER Minimum Technical Standards will also bind the manufacturers and installers of DER and DER devices. The result will be nationally consistent settings.

To support the obligations, AEMO recommends that the AER develop light-touch monitoring and compliance framework, primarily for the purpose of transparency. This could be done through a minimalist periodic reporting framework (possibly a light touch version of the AER's Electricity Distribution Ring Fencing reporting framework). This could be integrated within an existing DNSP reporting framework, including jurisdictional network management plans.

The rule change proposal has deliberately been developed as a framework that will facilitate the implementation of DER Minimum Technical Standards that are set in a subordinate instrument. The reason for this approach is to provide flexibility and allow for easy updating of the DER Minimum Technical Standards, to reflect the evolution of DER technology and progress towards a truly two-sided electricity marketplace. To this end, the DER Minimum Technical Standards set under the framework can be amended from time to time, as necessary.

The structures put in place in the Rules should allow for:

- The introduction of an initial standard to be published alongside the proposed rule change.
- The introduction of subsequent standards over time.

- The ability to call up in the standards any relevant Australian and International Standards, or parts thereof.
- Review, and update to occur, on an as needs basis in response to developments in technology or, for example, new cyber threats.

Consultation processes

The DER Minimum Technical Standards would be made in close partnership with the DNSPs, consumer groups and across industry including Original Equipment Manufacturers and operators of Virtual Power Plants, consistent with the Rules consultation procedures. This includes in collaboration with exiting reforms to DER standards currently underway such as the review of AS/NZ 4777.2 and the existing industry DER API Working Group. It is proposed that the Rules consultation procedures are utilised for the setting of technical requirements and standards. The arrangements put in place through the AEMC's recent Rule change to implement the DER register (see Rule 3.7E) are an example of such arrangements. This process would provide a mechanism for relevant parties to resolve technical issues.

Transitional arrangements

The Energy Council requires the publication of an initial DER technical standard (initial standard) on matters covered in AS/NZ 4777.2, to coincide with any Rule change. To achieve this, AEMO will conduct parallel consultation and engagement with stakeholders in accordance with NER Chapter 8 consultation procedures on an initial standard to be published as a transitional measure alongside a final Rule determination. The initial standard will likely focus on adverse under-voltage disconnections, (noting that AEMO expects the select capabilities will mirror those currently being developed within the AS/NZ 4777.2 review).

Publication and application dates for the Rule and initial standard should take into account appropriate transitional arrangements to accommodate the following:

- A reasonable timeframe for DNSPs to update relevant connection contracts / agreements to comply with the Rule. Three months from the date the Rule is made.
- The practical steps that need to occur before DER owners can reasonably be expected to comply with the initial standard.
- The implementation of particular capabilities in the minimum DER Technical standard may be dependent on specific network requirements, and whether or not such capability is indeed required on specific networks at that specific point in time. This will be explored during consultation.

AEMO notes that interoperability and cyber security standards may not be sufficiently developed to be considered in time to develop a minimum DER technical standard by October 2020 but anticipates standards on these matters would be developed during 2021. It is intended that DER technical standards will be developed and published with their own application dates and bespoke transition arrangements, following appropriate consultation with relevant parties.

8. HOW THE PROPOSAL WILL ADDRESS THE ISSUE

A regulatory approach that sets a framework for national DER minimum technical standards will facilitate a nationally coordinated and consistent uplift of DER technical capabilities across the NEM. It this national approach that benefits consumers through more efficiently integrating DER into the power system leading to more reliable and security supply outcomes, and more timely development of new DER market and service.

- Minimum capabilities that align DER performance with power system needs will help AEMO maintain power system security and the supply demand balance with an increasing complex generation mix. More DER will stay connected during power system disturbances, improving the overall reliability and security of electricity supply. Greater certainty regarding the performance of DER systems will position AEMO to better optimise power system operations, so that conservative and more costly operational practices can be avoided.
- Minimum capabilities in interoperability across the NEM, with requisite cyber security protections, is expected to underpin the development of new DER services and lower barriers to entry for participants and provide market opportunities to increase the value of DER for energy consumers.

Setting requirements in subordinate instruments will enable technical requirements to be put in place over time so that proper consultation can occur. It will also allow the minimum DER technical standards to be updated responsively outside of a rule change proposal as challenges arise in the power system and leverage technology development. These outcomes are in the best interests of customers in terms of the efficient operation of electricity supply and support customer choice in energy services.

Checks and balances in place within the Rules will help coordinate proper input across industry and consumers, help manage the risks in interacting system and network technical requirements and control and protection systems and improve alignment of DER technical standards with the NEO.

9. CONSISTENCY WITH AND CONTRIBUTION TO THE NEO

The proposed rule change is consistent with and contributes to the achievement of the NEO. The objective of this proposal is to establish a framework for minimum DER technical standards. The intended outcome of regulation is to standardise certain minimum DER capabilities nationally, so that they align with the needs and efficient operation of the power system, distribution operator needs and facilitate consumer choice in energy supply. The uplift of the technical capabilities will not only improve the efficient operation of electricity services for consumers, but also provide a technical foundation on which to build new market services and create new consumer value from DER. The outcomes of the proposal will contribute to the NEO by:

- Enabling greater efficiency in the operation of the power system on the back of more predictable DER behaviour and performance to support the grid.
- Laying the foundational device capabilities to integrate DER with the secure operation of the power system, distribution operator needs and options for DER owners to participate in the sale of DER services.
- Facilitating continued customer choice and affordability in connecting DER as without new NEM-wide capabilities, limits to DER hosting are anticipated 20.
- Enabling more efficient technical and market investment through consistent and national uniform technical standardisation.

10. EXPECTED BENEFITS AND COSTS

The current patchwork approach to DER technical requirements is expected to delay and may even prevent the implementation of required capabilities in time to address the challenges emerging, leading to higher than efficient costs for customers and lower reliability and security. DER minimum technical capabilities,

[20] AEMO 2020, Renewable Integration Study

where utilised, are expected to lower costs to consumers as AEMO and network operators can plan and operate the system more efficiently with them in place. The benefits of the rule change include:

- Provide a device level foundation on which to build the technical infrastructure for efficient new markets and services enabling customers to derive more value from their DER. Consistent device level capabilities are a first step in realising new aggregated DER services through VPPs and providing options to improve the economics of active DER investments for customers and market participants.
- Faster, more efficient and comprehensive implementation of key technical integration capabilities needed by the power system as a result of a mandatory approach.
- More consistent performance and predictability of DER, which in turn is expected to
  - improve the hosting capacity of distribution networks without the need for additional augmentation investment, facilitating ongoing consumer choice of energy services.
  - position AEMO to better optimise power system operations, so that conservative and more costly operational practices can be avoided. These benefits combined, support delivery of more affordable energy to consumers including non-DER customers.
- Result in more DER able to stay connected during power system disturbances, mitigating financial losses for customers and improving the overall reliability and security of the network.
- Provide for the expedient take up of technical device level capabilities under development and available now, in place of a network by network approach.
- Potentially reduce barriers to choice / customer switching: in future customers can change VPPs without additional hardware cost as minimum capabilities are embedded in the device.
- Enable competition: this is fundamental to developing a rich DER ecosystem of technology vendors, VPP operators and networks all using common communication and data frameworks.
- Generate greater certainty for manufacturers who can supply to a single standard.
- Consistent standards can strengthen overall outcomes by reducing compliance complexity and improving the likelihood of compliant devices.
- Enable timely, efficient and effective response to transformational technology change.
- Reduces the need for new customers to be placed on zero export creating inequities or for DNSPs to augment their networks to enable export (a cost that is passed through to non-DER customers).

11. NEXT STEPS

AEMO is committed to working with the AEMC and industry to seek to achieve the introduction of this proposed rule change, together with an initial minimum DER technical standard, by October 2020. To facilitate this timeframe, which has been endorsed by the ESB, AEMO will work closely with industry to undertake concurrent consultation to garner support amongst industry for an initial technical standard which could form the basis of a transitional standard to be published alongside any potential Rule by the AEMC. AEMO notes that these concurrent consultations are subject to, and not intended to pre-empt, the outcomes of AEMC's deliberations on this Rule change proposal in accordance with its roles and responsibilities under the NEL. ESB and AEMO are also working with WA reform bodies and stakeholders to adopt mirror requirements to ensure a national approach is taken to minimum DER technical standards.

These developments will occur cognisant of ESB developing longer-term governance arrangements for the maintenance of DER technical standards. The governance arrangements to be designed will incorporate consultation with all stakeholders and bring back a proposal with the details of these arrangements for Energy Council approval in October 2020.

12. APPENDICES

12.1 Appendix A - Renewable Integration Study

12.2 Appendix B - Technical Integration of DER Report

12.3 High level description of proposed Amending Rule for drafting purposes

Introductory

Location: AEMO considers this new rule could be inserted in Chapter 3 of the National Electricity Rules, after current Rule 3.7F (Generation Information).

The heading of the new rule 3.7G could be along the following lines: "DER minimum technical standards"

Consequential changes

AEMO recommend consequential amendments be made to Chapter 5 (Network Connection, Access, Planning and Expansion) and Chapter 5A (Electricity connection for retail customers) of the National Electricity Rules, in order to ensure that connections under those Chapters in relation to DER meet any relevant standards.

An important outcome is to ensure that DER proponents are not able to circumvent DER minimum technical standards by electing to connect under Chapter5 rather than under Chapter 5A. These consequential amendments are only outlined below, as the detailed drafting is dependent on the approach taken more generally.

AEMO also suggests that AEMC may consider whether changes are needed to the "Model terms and conditions for deemed standard connection contracts" prescribed in Schedule 2 to the National Energy Retail Rules.

Definitional challenges associated with drafting rules for DER

At this relatively early stage of the emergence of DER, it has been generally agreed that very tightly drafted, detailed definitions of DER risk being out of date too soon and not sufficiently flexible.

For the purposes of determining the permissible coverage of DER minimum technical standards at this emerging stage of DER development, the proposal below seeks to provide both a broader statement of "DER" but combined with a number of mechanisms by which the scope of these standards can be specified.

The DER assets are also the subject of a range of jurisdictional technical and safety regulations under consumer safety and network management requirements.

AEMO notes the following in relation to the definition and scope of DER:

A general definition of "Distributed Energy Resources" might be considered:

> *The types of resources/assets including small and medium scale distributed generation (such as solar PV), energy storage (such as small and medium-scale batteries and electric vehicles that can deliver energy from the vehicle to the power system) and controllable loads (such as air conditioners, electric storage hot water systems, pool pumps, and electric vehicle supply equipment) that connect to the distribution system.*

For the purposes of developing a Rule based framework to enable DER minimum technical standards at this point in time, and ahead of a full governance framework, AEMO proposes that DER that is to be subject to a minimum standard by this new rule should be limited by a criteria that relates "visibility" to the relevant DNSP.

'Visibility' to the DNSP could be explicated either:

- by way of a linkage to process requirements for connection to the distribution system of the DNSP (ie a connection application process made in accordance with the NER and NERR or (for Victoria) in accordance with the relevant jurisdictional framework,
- by way of a term or condition of a DNSP *connection contract* or DNSP connection standard, protocol or specification, or
- by way of the retail customer (or their representative, including, but not limited to, their retailer, metering provider or installer) contacting, or being required to contact, the DNSP, under an *applicable regulatory instrument* (maybe *jurisdictional scheme obligation*).

Controllable load assets

Further, the DER that is to be subject to DER minimum technical standards may include assets such as air conditioners, electric storage hot water systems, pool pumps, electric slab heaters, energy storage and electric vehicle supply equipment.

But these are only to be covered by DER minimum technical standards in relation to and to the extent that they are capable of responding to (distribution) network requirements by adjusting load. This may either by their own means, or by way of a "DER device".

In order to avoid overreach (ie inadvertently covering small 'behind the meter' appliances etc), AEMO should be required in the standard itself to specify the particular DER being covered (see paragraph (d) below).

The terms used below therefore are about "connected DER" for AEMC consideration (see proposed definition of "connected DER" below).

Amendments to Chapter 3 National Electricity Rules

New rule 3.7G - DER minimum technical standards

AEMO obligation to make minimum technical standards

(a) AEMO must make, publish and may amend, the *DER minimum technical standards* in accordance with the Rules consultation procedures.

Notes:

1. These are minimum standards, and nothing prevents a DNSP from setting further complementary connection standards, protocols or specifications for DER for their network provided they are not inconsistent with the minimum requirements.
2. This standard making power is intended to be for 'initial' standards to be set by AEMO pending the fuller governance framework which is to be agreed by The Energy Council in October 2020.

Purpose

(b) The purpose of the *DER Minimum Technical Standards* is to support power system security and to enable consumer outcomes for *connected DER* for the long-term interests of consumers.

Requirements of DER minimum technical standards

(c) The DER minimum technical standards may specify:

i. Technical performance capabilities to integrate with and support the *power system*;
ii. Interoperability requirements, including data monitoring, communications capabilities, data exchange, and controllability/coordination;
iii. technical requirements for cyber security to protect the security of the power system, connected DER and DER devices, the data in and communications from the connected DER and the DER device.

(d) The DER Minimum Technical Standards must specify assets and resources to which the *DER Minimum Technical Standards* apply.

<u>Considerations for AEMO in making the DER minimum technical standards</u>

(e) In making the *DER minimum technical standards*, AEMO must have regard to the following factors:
i. the efficient costs of compliance with the *DER minimum technical standards*;
ii. the need for effective interaction between these *DER minimum technical standards*, DNSP connection standards, applicable Australian Standards and International Standards;
iii. the obligations on DNSPs to manage their network safety, power quality and reliability;
iv. changes in DER and *DER device* technology and capability;
v. changes in technology and capability of Registered Participants' *facilities* and *plant* with regard to DER;
vi. stakeholder input from the *Rules consultation procedures* in developing the *standards*; and
vii. any other matter AEMO considers relevant.

(f) AEMO may make minor or administrative amendments to the *DER Minimum Technical Standards* without complying with the *Rules Consultation Procedures.*

'Connected DER' to meet DER minimum technical standards

(g) DNSPs must ensure that *connected DER*, either by its own means or by way of a *DER device*, meets the *DER minimum technical standards* (including without limitation, through the inclusion of appropriate provisions in *connection agreements*).

<u>Meaning of terms used</u>

(h) In this rule 3.7G:
i. DER device – is a device that facilitates connectivity between DER and the *power system*, and may include, for example inverters, demand response enabled devices, meters, gateway devices) and necessary connection arrangements, that facilitate connection of DER to a distribution system, and that, amongst other things, can be used to control DER or establish a technical response

ii. 'connected DER' – means DER that connected or to be connected to a distribution system, and DER connected to a *distribution system* that is newly augmented, upgraded, extended or replaced.

Note: The new requirements will not apply to already installed DER. This may require an express statement in the clause or a transitional statement.

iii. 'DER minimum technical standards' means the minimum technical standards, protocols or specifications for DER made by AEMO under clause 3.7Gxx.

Consequential amendments to Chapters 5 & 5A:

The reference to "DER Minimum Technical Standards" could be inserted in a number of places in Chapter 5 (eg 5.3A) and Chapter 5A retail customer connection contracts, negotiation frameworks and model standing offers.

AEMO notes, for example, that Chapter 5A sets out requirements that DNSP model standing offers and negotiation frameworks for connection contracts include specified terms and conditions to be approved by the AER under a propose and respond model.

In order to allow for the DER Minimum Technical Standards (and any subsequent updates) to be incorporated into connection agreement model standing offers and negotiation frameworks, without triggering the need for further AER approval if the DER minimum technical standards are updated, we propose a requirement be included that the connection application meet the DER Minimum Technical Standards as made and updated from time-to-time.

Applying this approach, a provision along the following lines could be added to cl 5A.B.2(b), cl 5A.B.4(c), cl 5A.C.3(a) and cl S5A.1(a)

(x) All 'connected DER' to be connected as part of the proposed *new connection* or *connection alteration* must meet the *DER Minimum Technical Standards*, as made and amended from time-to-time, such that the DNSP may comply with their obligations under clause x.x.2 (the DNSP obligation to ensure connected DER meets DER minimum technical standards)