AEMC

RULE

Australian Energy Market Commission

RULE DETERMINATION

NATIONAL ELECTRICITY AMENDMENT (TECHNICAL STANDARDS FOR DISTRIBUTED ENERGY RESOURCES) RULE 2021

NATIONAL ENERGY RETAIL AMENDMENT (TECHNICAL STANDARDS FOR DISTRIBUTED ENERGY RESOURCES) RULE 2021

PROPONENT
AEMO

25 FEBRUARY 2021

INQUIRIES

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ABOUT THE AEMC

The AEMC reports to the Council of Australian Governments (COAG) through the COAG Energy Council. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the COAG Energy Council.

SUMMARY

1 The Australian Energy Market Commission (Commission) has made a final rule which is a more preferable rule to introduce technical standards that will enable distribution network service providers (DNSPs) and the Australian Energy Market Operator (AEMO) to better manage the growing number of micro-embedded generators connecting across the national electricity market (NEM).

2 In making this final rule determination, the Commission recognises the importance of promptly addressing the concerns of AEMO and the Energy Security Board (ESB) regarding the impact that the significant growth in connections of distributed solar PV generation units is having on networks and the power system, particularly in the ability of DNSPs and AEMO to manage voltage disturbances.

3 The Commission's final rule determination has been made in response to a rule change request from AEMO. It is one step in implementing the ESB's priority to integrate DER effectively into the NEM.

The final rule

4 The key features of the final rule are:

- the creation of DER Technical Standards which embedded generating units connecting to a distribution network by way of a micro EG connection service must comply with
- DER Technical Standards that include the requirements set out in AS 4777.2:2020 as updated from time to time
- a requirement that model standing offers for basic connection services for embedded generating units include that embedded generating units the subject of the basic micro EG connection service must be compliant with the DER Technical Standards
- an obligation on DNSPs that the information to be provided to connection applicants in order for them to negotiate a connection contract must include the requirement that if the connection applicant is proposing to connect a new or replacement embedded generating unit by way of a basic micro EG connection service, that the micro embedded generating unit must be compliant with the requirements of the DER Technical Standards
- a requirement that the minimum content requirements of connection offers under Schedule 5A.1 to the NER must include the requirement that if the connection applicant is proposing to connect a new or replacement embedded generating unit by way of a basic micro EG connection service, that the embedded generating unit the subject of the connection application is compliant with the DER Technical Standards.
- the DER Technical Standards will apply only to new connections and replacement inverters and connection alterations (including upgrade, extension, expansion or augmentation)
- the rule will commence on 18 December 2021, approximately 10 months after it is made, to allow for the implementation of the new requirements

- transitional provisions have been included so that if before the commencement date of the rule:
  - a connection applicant in relation to a basic micro EG connection service has made a connection application but not received a connection offer, the new Chapter 5A will apply to that connection offer and connection contract
  - if a connection applicant in relation to a basic micro EG connection service has received a connection offer from the relevant DNSP but has not yet entered into a connection contract, the old Chapter 5A will apply to that connection offer and connection contract.

The rule change request

5 The rule change request submitted was prepared by the ESB and AEMO following a direction given by the COAG Energy Council in March 2020. In it, AEMO proposed the creation of a new obligation upon it to establish and maintain minimum technical standards for distributed energy resources (DER) in an instrument subordinate to the National Electricity Rules (NER). AEMO proposed that the initial minimum technical standard should encompass inverter performance and grid responsiveness; interoperability and communication interfaces; and cybersecurity measures.

6 The request also proposed the creation of a high-level definition of DER in the NER which would describe the DER devices that the proposed minimum technical standards would apply to. This descriptive definition included solar PV, batteries, electric vehicles as well as controllable loads such as air conditioners and hot water systems.

7 In addition, the rule change request sought to include compliance with the initial technical standards as a requirement in the DNSP connection processes to ensure compliance of connected DER with the standard. It also proposed that the AER be required to develop a light-touch monitoring and compliance framework, primarily for the purpose of transparency.

8 While the focus of the rule change request was to make amendments to the NER, AEMO did suggest that the NERR may also require amending.

9 In light of stakeholder views on the scope of the initial technical standards, AEMO subsequently indicated that the focus of this rule change process should be on addressing DER capability to withstand power system disturbances.

Commission's response

10 The Commission has assessed whether AEMO's proposal would, or would be likely to, contribute to the achievement of the national electricity objective and the national energy retail objective. It has concluded that the changes to the NER made by the final rule adequately address the immediate issues of concern identified by AEMO and stakeholders.

11 The following outlines the reasons for the Commission's final rule determination. Further details are set out in the relevant chapters of the final rule determination.

Scope and duration of the standard

12 The Commission recognises the particular concern of the ESB, AEMO and other stakeholders that small scale solar generation can have a detrimental impact on the operation of some distribution networks and the power system when voltage disturbances occur.

13 Accordingly, the Commission has focused on addressing these immediate concerns. As a result, the final rule establishes DER Technical Standards in regard to inverter performance and grid responsiveness. This is consistent with AEMO's recent approach to DER technical standards set out in its consultation paper on the content of the initial standard.

14 The DER Technical Standards established by the final rule include a non-static reference to an Australian Standard — AS 4777.2:2020, as updated from time to time — to minimise divergence or conflicting obligations in the instance where the standard is called up in jurisdictional instruments.[1] This will apply to new connections and replacements of inverters connecting micro-embedded generation within a distribution network.

15 The Commission considers that the more preferable final rule is likely to better achieve the national electricity objective (NEO) than the rule change proposal by AEMO because it:

- establishes technical standards in the NER that address the imminent system security threats to the power system
- uses an existing Australian Standard to provide a cost-effective and timely response that creates consistency with jurisdictional legislation and is administratively efficient
- utilises the existing framework for embedded generator connections in Chapter 5A of the NER, including the definitions of micro embedded generators and micro EG connection, which ensures that the final rule applies to the small scale solar PV generators (who are currently the primary concern for the ESB and AEMO).

16 The scope of the DER Technical Standards is focused on addressing the immediate concerns arising from the growing use of DER. However, this does not prevent more extensive DER technical standards being developed in the future to address other important DER integration issues. The Commission will continue to work on these issues arising from DER integration with industry. In light of this, the Commission has not placed any time limit on the life of the DER Technical Standards established by the final rule, enabling the standards to evolve over time as needed.

Governance arrangements

17 The rule change request sought to amend the NER to require AEMO to establish and maintain DER minimum technical standards through an instrument subordinate to the NER.

18 The Commission has considered the merits of creating a new set of DER technical standards in a subordinate instrument against using existing Australian standards that have been

1 The Australian Standard AS 4777 is a series of standards for the grid connection of energy systems via inverters. The series includes AS 4777.1, G*rid connection of energy systems via inverters, Part 1: Installation requirements* and AS 4777.2, *Grid connection of energy systems via inverters, Part 2: Inverter requirements*. This rule change is concerned with AS 4777.2 which specifies minimum performance and safety requirements for the design, construction and operation of inverter intended for grid connection of energy systems. AS 4777.2 includes requirements for withstand capabilities including in relation to voltage disturbances.

produced using a well-recognised framework of stakeholder consultation, industry and technical knowledge. This has been considered in the context of the technical standards needed to address the immediate issue identified in the rule change request. As a result, it has concluded that establishing a new process may result in duplication and potentially inefficient costs borne by consumers. In addition, confusion and additional compliance costs for industry participants are likely to arise where there are differences between the requirements included in AS 4777.2:2020 and the standards specified in a NER subordinate instrument. Further, creating a subordinate instrument would require a bespoke governance framework to also be created.

19 For these reasons, the final rule has not created a subordinate instrument for AEMO to administer. Instead, the final rule creates a definition of DER Technical Standards that incorporates AS 4777.2:2020 as in force from time to time in the NER. Consequently, the AEMC will be the responsible body for any changes to the DER Technical Standards.

20 The Commission notes that a rule change request has been submitted by Dr Kerry Schott AO, Chair of the ESB, proposing arrangements for the long term governance of DER technical standards. The rule change request on enduring governance arrangements proposes that the AEMC, with the assistance of an advisory committee, be the responsible body for overseeing the development of new DER Technical Standards.[2] The governance arrangements included in this final rule do not limit, in any way, consideration of the most suitable pathway to establish enduring governance arrangements for setting technical standards in the future.

Network connection agreements

21 AEMO proposed that the DER minimum technical standards be inserted into the minimum content requirements of connection contracts, negotiation frameworks and model standing offers, and into the model standing terms under Chapters 5 and 5A of the NER. It also suggested that the standard could be recognised in the model terms and conditions for deemed standard connection contracts prescribed in Schedule 2 to the NERR.

22 The Commission has determined that DNSPs should be obliged to ensure that connection applicants in relation to new and replacement micro embedded generators should comply with the DER Technical Standards as defined in the NER. As a result, the final rule requires DNSPs to include in their connection agreements made under Chapter 5A of the NER a requirement that all embedded generating units the subject of a connection for micro embedded generation by way of a basic micro EG connection service must comply with the DER Technical Standards.

23 The Commission considers that these arrangements are consistent with the key intent of AEMO's proposed approach.

Compliance arrangements

24 The rule change request proposed that the initial technical standards be included as a

2 The Commission anticipates that the rule change process for the Governance of DER Technical Standards will commence by mid 2021.

requirement in the connection process to ensure compliance of connected DER. It also proposed that the AER develop a light-touch monitoring and compliance framework.

25 The final rule includes new DER Technical Standards as part of the requirements for the connection of micro embedded generation. In doing so, this places an obligation on DNSPs to be satisfied that the connecting inverter meets the standard. As a result, device manufacturers and installers are obliged to show the DNSP that those requirements are met. These new arrangements are consistent with existing requirements under the NER that enable DNSPs to establish technical requirements for their networks and AEMO's proposed approach.

26 However, the final rule does not include AEMO's proposed light-touch monitoring and compliance framework for the AER. Instead, the Commission has concluded that the AER's existing compliance processes can be utilised. Placing the standard in the NER places an obligation on DNSPs to ensure the standard is met. This triggers the AER's existing capability to monitor and enforce this obligation.

27 In addition, the Commission considered the existing compliance and monitoring systems under the Clean Energy Council and the Clean Energy Regulator relating to the certification of products and installers of electricity generating systems should continue to be used by industry as they are complementary to the overall compliance arrangements. The Commission considers that this approach is consistent with achieving the NEO as this avoids imposing inefficient costs of a new, potentially duplicative compliance system on electricity consumers.

Implementation approach

28 The Commission recognises that there are a number of actions that must be undertaken by various parties, such as DNSPs and inverter manufacturers, to enable the DER Technical Standards to take effect. It also recognises the intent of the ESB and AEMO to address issues arising from the growth of small solar generation sector as promptly as possible.

29 The Commission has concluded that the requirements should come into effect on 18 December 2021, approximately 10 months from the date of the final rule is made. It considers that this timeframe is achievable as it is reasonable to expect that relevant manufacturers are already progressing towards meeting the requirements of AS 4777.2:2020.

30 The final rule also includes transitional arrangements to clarify the compliance obligations of parties involved in a connection process at the time the rule comes into effect.

CONTENTS

1 OVERVIEW OF AEMO'S RULE CHANGE REQUEST

On 5 May 2020, the AEMO submitted a rule change request to the Commission to make a rule to implement minimum technical standards for DER.

This chapter outlines:

- AEMO's rule change request
- the proposed solution and its expected outcomes
- an outline of other DER related work
- the rulemaking and consultation processes.

Details and copies of the rule change request may be found on the AEMC website at www.aemc.gov.au.

1.1 Rationale for the rule change request

AEMO's rule change request was prepared in co-operation with the ESB as requested by the COAG Energy Council in March 2020.[3] In the rule change request, AEMO stated that:[4]

- There are gaps in current technical standards for DER, which are increasingly driving system risks to unmanageable sizes across the NEM.
- Without establishing minimum technical standards, especially given the exponential growth in DER, NEM system operation may be suboptimal; increasing the reliance on inefficient interventions to manage waning system security parameters such as voltage, thermal capacity, or inertia.
- Particular minimum standards for DER are critical and need to be brought in line with network connection frameworks to integrate DER into the grid more efficiently.

According to AEMO, following the rapid growth in DER, particular system impacts at the distribution level are becoming increasingly complex and difficult to manage.[5] These issues also can impact AEMO's core system operating duties, including system balancing, power system stability and recovery and restoration following major system events.[6] AEMO recognised that DER does offer critical consumer benefits, both private and for the whole system, yielding rapid change in electricity generation toward a two-sided market. Nevertheless, the growing penetration of DER, particularly rooftop solar PV, can create critical system events like over-generation during the midday load profile.

In addition to these observations, AEMO argued that the current arrangements for DER technical standards-setting, through voluntary industry, Australian, and International

3 On 29 May 2020, the Prime Minister announced the establishment of the National Federation Reform Council and the disbanding of the COAG. New arrangements for the former COAG Energy Council will be finalised following the National Cabinet Review of COAG Councils and Ministerial Forums. The Prime Minister has advised that, while this change is being implemented, former Councils may continue meeting as a Ministerial Forum to progress critical and/or well-developed.

4 AEMO, Rule change request, pp. 3-4.

5 AEMO, Rule change request, pp. 7-8.

6 AEMO, Rule change request, p. 2.

Standards has lagged in response to DER's uptake.[7] AEMO also noted that these standards' uptake might not apply uniformly across the NEM, considering that this:[8]

> 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.

AEMO suggested that the minimum technical standard for DER should cover three technical capacities to enable more DER to integrate into the NEM and improve consumer value:[9]

- inverter performance and grid responsiveness
- interoperability and communication interfaces
- cybersecurity measures.

AEMO claimed that its proposed rule change, if made, could provide scope for addressing system operations issues such as minimum operational demand support for systems services through the key performance capabilities noted above. In AEMO's view, if the ability to set DER minimum technical standards is not incorporated into the NER, then growth in DER would necessarily be restrained, daily generation would be inefficiently curtailed, and risks of larger passive shut-downs — and in quite rare cases system black events — would be raised.[10]

AEMO considered that creating a subordinate instrument to establish the required minimum technical standards could address the gaps in current standards-setting, provide flexibility and allow for easy updating.[11] AEMO also proposed that it be obliged under the National Electricity Rules (NER) to set the minimum technical standards, capabilities, and performance of emerging DER units through a requirement to make, publish and amend this new subordinate instrument. In its view, a rule change to this effect could create a capability for better monitoring and control of DER, particularly solar PV generation, to minimise system impacts to the transmission-distribution interface and maximise integration.[12]

1.2 Solution proposed in the rule change request

AEMO proposed the following key components in its potential solution:

- an obligation on AEMO to make, publish and, if necessary, amend DER minimum technical standards that will be contained in a new subordinate instrument
- that DNSPs ensure, through their connection agreements, that connecting DER meet the DER minimum technical standards

7 AEMO, Rule change request, pp. 6, 11.
8 AEMO, Rule change request, p. 11.
9 AEMO subsequently indicated that this rule change process's focus should be on addressing DER capability to withstand power system disturbance.
10 AEMO, Rule change request, pp. 7-8.
11 AEMO, Rule change request, p. 16.
12 AEMO, Rule change request, p. 19.

- establishing a high-level definition of DER in the NER.

These are discussed in more detail in this section. As explained below, AEMO has suggested that the new rules should enable the principles of uniformity, adaptivity, and complementarity in technical standards-setting to minimise DER's negative impacts on system security.

The rule change request did not include a detailed proposed rule. However, it did include a high-level description of a proposed amending rule and description of its proposed changes.

1.2.1 Creation of a subordinate instrument

The rule change request sought to amend the NER and require AEMO to establish and maintain DER minimum technical standards through an instrument subordinate to the NER. That is, an obligation on AEMO to create, publish, and amend DER minimum technical standards on an ongoing basis, building on existing state regulatory frameworks in standards and connection setting. In its view, the development of a subordinate instrument would allow for direct and efficient setting standards.[13]

To achieve this outcome, AEMO proposed a new rule 3.7G of the NER titled "DER minimum technical standards" which would set out AEMO's obligation to make, issue, and change minimum technical standards. AEMO suggested that this new rule could also specify the purpose and requirements of the standards, as well as the considerations that it must regard when making the standards.[14] Also, AEMO proposed that new rule 3.7G of the NER also include definitions of relevant terms such as "DER device", "connected DER" and "DER minimum technical standards".[15]

AEMO considered that the amending rules and the creation of a subordinate instrument would allow it to:

- develop and publish an initial technical standard to be available with the new rules, if made.[16]
- introduce other minimum technical standards for DER over time, including the scope to incorporate relevant Australian and International Standards, where applicable
- review and update the standards on a 'needs basis' to allow response by AEMO to technological developments or critical system events, such as a cyber threat.

1.2.2 Network connection agreements

AEMO proposed that the NER obligate DNSPs include the DER minimum technical standards into the terms and conditions of their relevant connection agreements with retail customers. This obligation would have a flow-on effect of binding manufacturers and installers of DER and DER devices to the minimum technical standards; compliance with the minimum technical standards would be a condition of connection.[17]

13 AEMO, Rule change request, pp. 16, 18.

14 AEMO, Rule change request, pp. 22-23.

15 AEMO, Rule change request, p. 24.

16 AEMO noted in the request that it would undertake concurrent consultation with stakeholders to develop an initial standard focused on adverse under-voltage disconnections. AEMO, Rule change request, p. 17.

17 AEMO, Rule change request, p. 16.

AEMO noted that consequential amendments to Chapters 5 and 5A of the NER might be required so that connection contracts entered into under these chapters incorporate the DER minimum technical standards set out in the subordinate instrument. AEMO suggested that such references in the NER refer to the DER minimum technical standards and any subsequent updates so that further AER approval of the connection agreements resulting from any updates would not be triggered.[18] Also, AEMO suggested that the AEMC consider if changes to the "model terms and conditions for deemed standard connection contracts" set out in Schedule 2 of the NERR would also be required.[19]

1.2.3 Definition of DER and connected DER

AEMO proposed that a high-level definition of DER, including its scope, be included in the NER to determine the minimum technical standards' coverage. AEMO suggested the following definition:[20]

> 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.

AEMO stated that the definition of DER needed to be general enough not to preclude emerging technologies while providing enough technical detail to capture current complexities. A DER definition would be included in connection agreement terms and conditions to establish compliance,[21] and according to AEMO:[22]

> In order to avoid overreach (i.e. inadvertently covering small 'behind the meter' appliances etc.), AEMO should be required in the standard itself to specify the particular DER being covered.

According to AEMO's proposal, the DER must also be newly connected or connected within a distribution network or DER within a distribution network that has recently been upgraded, replaced, or otherwise augmented in order to be considered "connected DER" under the standard.[23]

1.2.4 Compliance arrangements

AEMO also proposed that the NER should require DNSPs to be responsible for the compliance of "connected DER" with the standards on an ongoing basis. It maintained that monitoring compliance at a distribution network level would create operational efficiencies.

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18 AEMO, Rule change request, p. 25.
19 AEMO provided no further details on this issue. AEMO, Rule change request, p. 22.
20 AEMO, Rule change request, p. 22.
21 AEMO, Rule change request, p. 16.
22 AEMO, Rule change request, p. 23.
23 AEMO, Rule change request, p. 15.

Also, on the basis that the technical standards were housed in a subordinate instrument, AEMO proposed that the new framework require the AER to develop a light-touch monitoring and compliance framework, primarily for transparency.[24]

1.3 Expected outcomes of the proposed solution

AEMO claimed that implementing its proposed solution would produce the following outcomes:[25]

- Setting minimum technical standards will eventually produce smoother NEM and distribution network operations, ultimately lowering consumer costs.
- A more consistent performance baseline and predictability of DER could be established, leading to the more efficient management of system security. This could include reducing the risk of over-generation in the middle of the day, providing certainty for minimum system service support, fewer disconnections from voltage disturbances, improving reliability, and mitigating consumers' financial losses.
- Enabling competition by reducing potential consumer or manufacturing barriers to choice, while setting a common baseline of certainty for today's market participants and future integrative grid developments, such as virtual power plants.

In its view, AEMO's proposed solution would align DER performance with NEM system needs to maintain system security, balance supply and demand, keep consumer-led DER connected, and optimise the power system.[26]

Importantly, AEMO proposed that any technical standards established due to rules made under this rule change process will not apply retrospectively to current DER. Instead, any new requirements should only be applied to assets that are newly connected, or DER within a distribution system that is newly augmented, upgraded, extended or replaced.[27] AEMO asserted that implementation of its proposal would facilitate customer choice and affordability in connecting DER while supporting the operation of the NEM.[28]

AEMO also suggested that amendments to the NER could create a device-level baseline of performance capability through which market participants, such as DER manufacturers or aggregation services, could derive value from and develop: essentially setting a consistent technical floor across the market.[29]

Also, by creating a subordinate instrument, the standards could promptly, directly, and efficiently be set and updated to respond to technological and operational necessities of DER in a more effective and consultative way.[30]

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24 AEMO suggested that this could be inserted into Chapter 3 of the NER. AEMO, Rule change request, p. 16.
25 AEMO, Rule change request, pp. 18-19.
26 AEMO, Rule change request, p. 18.
27 AEMO, Rule change request, p. 15.
28 AEMO, Rule change request, p. 18.
29 AEMO, Rule change request, p. 18.
30 AEMO, Rule change request, p. 16.

1.4 Other relevant work

The Commission recognises a number of other projects and work programs relevant to this rule change process that have progressed. These are outlined briefly below. Further details are located in Appendix C.

- Register of DER rule change

On 13 September 2018, the AEMC made a rule that established a process by which AEMO, network service providers and other parties may obtain static data on DER across the NEM. The rule provided that the DER information would be held in a register established and maintained by AEMO. The purpose of this rule was to improve the visibility of DER to enable network service providers to plan and operate their networks more efficiently.

- Integration of DER rule change requests

In July 2020, the AEMC received three rule change requests to better integrate DER into the NEM. These requests were from the Total Environment Centre and the Australian Council of Social Services; St Vincent de Paul Society of Victoria; and SA Power Networks. The Commission is currently assessing these rule change requests. A consultation paper was published on 30 July 2020 with submissions closing on 10 September 2020. The draft rule determination for these requests is expected to be published on 25 March 2021.

- AEMO's consultation on the initial DER technical standard

AEMO published its consultation paper on the content of the initial technical standard on 24 August 2020. Noting stakeholder views expressed to the AEMC on the scope of technical standards in the initial consultation phase of this rule change process, AEMO's consultation paper focused the initial standard on DER inverter capability to withstand power system disturbances as the issue to resolve. While AEMO recognised that Standards Australia is currently revising the relevant standard (AS 4777.2) concerning voltage ride-through, it recommended that it's South Australian voltage disturbance ride-through (VDRT) testing procedure be included as an initial DER technical standard for the NEM. In January 2021, AEMO informed stakeholders it would cease consultation on the initial DER technical standard.

- Rule change request on governance for DER technical standards

On 21 September 2020 the ESB Chair Dr Kerry Schott AO, submitted a rule change request proposing new governance arrangements for DER technical standards under the NER and NERR. The AEMC has not yet initiated the rule change process for this request.

- South Australian regulatory changes for smarter homes.

From 28 September 2020, a package of regulatory changes to implement new regulatory instruments for DER took effect in South Australia. Relevant to this rule change process, in particular, the new technical standard for generating systems connected via low voltage power inverters to the South Australian distribution network requires that the inverters meet ride-through standards as demonstrated by testing per testing standards in AS/NZS4777.2 and any applicable AEMO testing standard. These regulatory changes will go live 31 March 2021.

- Western Australia's DER roadmap

The DER roadmap set out by the Western Australian Energy Transformation Taskforce has set out the state's plans to transition the South West Interconnected System to optimise renewable, decentralised electricity generation and supply. Several changes are being worked through over the roadmap's five-year life, including changes to technical and functional requirements for DER inverters and greater transparency of DER within the electricity system.

- Australian Standard AS 4777 and 2020 review of AS 4777.2

The Australian Standard AS 4777 is a series of standards for the grid connection of energy systems via inverters. The series includes AS 4777.1, *Grid connection of energy systems via inverters, Part 1: Installation requirements* and AS 4777.2, *Grid connection of energy systems via inverters, Part 2: Inverter requirements.*[31] This rule change process is concerned with AS 4777.2, which specifies minimum performance and safety requirements for the design, construction and operation of inverter intended for grid connection of energy systems.

In June 2019, following investigations into the response of inverter-based DER (primarily DPV) to power system events, AEMO put forward a proposal to update AS 4777.2. This proposal aimed to deliver improved performance capabilities (required to underpin system security requirements) as well as enhanced functionality (to improve the potential for distribution networks to host increased DER capacity). The review to assess AEMO's proposed change to the standard was completed with the publication of the updated standard on 18 December 2020.

At a high level, the content of the 2020 version of AS 4777.2 includes:[32]

- **General requirements**: for electrical safety, how external connections to the inverter are made and their compatibility, and standard capabilities like detecting harmonic currents and voltage.
- **Operational modes**: demand response modes, how the inverter responds to power quality and runs multiple inverters.
- **Protective functions**: defines the inverter's automatic disconnection, active and passive anti-islanding protection, including voltage disturbance ride-through.
- **Multiple inverter combinations**: how an installation with multiple inverter systems connects to the grid through one connection point, plus how it must behave and be tested.
- **Generation control function**: soft and hard limits are predetermined at connection for active or apparent power output levels. These are disabled by default.
- **Inverter marking and documentation:** the inverter documents the equipment, ratings, ports, and external equipment and conditions.

The standard also prescribes testing requirements for each relevant clause and provision.

31 The standard can be purchased online from Standards Australia.

32 See AEMO website: https://www.aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/standards-and-connections/as-nzs-4777-2-inverter-requirements-standard

1.5 The rulemaking process

On 25 June 2020, the Commission published a notice advising its commencement of the rulemaking process and consultation regarding the rule change request.[33] A consultation paper identifying specific issues of interest for consultation was also published. Submissions closed on 23 July 2020. The Commission received 27 submissions in response to the consultation paper.

Subsequently, on 2 September 2020, the Commission extended the time to make a draft rule determination for this rule change request until 3 December 2020.[34] It considered that this extension was necessary due to the complexity of issues arising from stakeholder submissions.

On 3 December 2020, the Commission published a draft determination and made a more preferable draft rule. Submissions to the draft determination closed 14 January 2021. AEMC staff also held several meetings with stakeholders during this period. The Commission has considered all issues raised by stakeholders in submissions in the first and second rounds of consultation in making this final rule determination. Issues raised in submissions are discussed and responded to throughout this final rule determination. The issues that are not addressed in this document's body are set out and addressed in Appendix A.

33 This notice was published under s. 95 of the National Electricity Law (NEL) and s. 251 of the National Energy Retail Law (NERL).

34 This noticed was published under s. 107 of the NEL and s. 266 of the NERL.

2 FINAL RULE DETERMINATION

2.1 The Commission's final rule determination

The Commission's final rule determination is to make a rule which is a more preferable rule. The rule made by the Commission is published with this final determination. The more preferable rule addresses the urgent power system security issues identified by AEMO and stakeholders in relation to the increasing penetration of distributed solar PV generation across the NEM. This is achieved by requiring micro-embedded generators connecting to distribution networks to be compliant with the DER Technical Standards (AS 4777.2:2020).

The final rule allows for an implementation time frame of ten months and will apply to new connections or replacements of distribution network connected micro embedded inverter generating units connecting by way of a basic micro EG connection service. The Commission did not consider it necessary to mandate further compliance monitoring functions as sought by AEMO.

A description of the final rule is provided in section 2.4 below. The Commission's key reasons for making this final rule determination are set out in section 2.5.

This chapter outlines:

- the rule making test for changes to the NER and the NERR
- the more preferable rule test
- the assessment framework for considering the rule change request
- the Commission's consideration of the more preferable final rule against the national electricity objective (NEO)
- the Commission's consideration in deciding whether to make a uniform or differential rule in accordance with the Northern Territory legislation adopting the NEL.[35]
- summary of reasons for making the final rule determination.

Further information on the legal requirements for making this final rule determination is set out in Appendix B.

2.2 Rule making test

2.2.1 Achieving the NEO and the NERO

Under the NEL the Commission may only make a rule if it is satisfied that the rule will, or is likely to, contribute to the achievement of the national electricity objective (NEO).[36]

The NEO is:[37]

> to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

35 *National Electricity (Northern Territory)(National Uniform Legislation) Act 2015*.
36 Section 88 of the NEL.
37 Section 7 of the NEL.

> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system.

Under the NERL, the Commission may only make a rule if it is satisfied that the rule will, or is likely to, contribute to the achievement of the national energy retail objective (NERO).[38]

The NERO is:[39]

> to promote efficient investment in, and efficient operation and use of, energy services for the long term interests of consumers of energy with respect to price, quality, safety, reliability and security of supply of energy.

The Commission must also, where relevant, satisfy itself that the rule is "compatible with the development and application of consumer protections for small customers, including (but not limited to) protections relating to hardship customers" (the "consumer protections test").[40]

Where the consumer protections test is relevant in the making of a rule, the Commission must be satisfied that both the NERO test and the consumer protections test have been met.[41] If the Commission is satisfied that one test, but not the other, has been met, the rule cannot be made.

There may be some overlap in the application of the two tests. For example, a rule that provides a new protection for small customers may also, but will not necessarily, promote the NERO.

2.2.2 Making a more preferable rule

Under s. 91A of the NEL, the Commission may make a rule that is different (including materially different) to a proposed rule (a more preferable rule) if it is satisfied that, having regard to the issue or issues raised in the rule change request, the more preferable rule will or is likely to better contribute to the achievement of the NEO.

In this instance, the Commission has made a more preferable rule. The reasons for this are outlined below in section 2.5 and in the following chapters.

2.2.3 Making a differential rule

Under the Northern Territory legislation adopting the NEL, the Commission may make a differential rule if, having regard to any relevant Ministerial Council of Energy statement of policy principles, a different rule will, or is likely to, better contribute to the achievement of the NEO than a uniform rule. A differential rule is a rule that:

- varies in its term as between:
  - the national electricity system, and

38 Section 236(1) of the NERL.
39 Section 13 of the NERL.
40 Section 236(2)(b) of the NERL.
41 That is, the legal tests set out in s. 236(1) and (2)(b) of the NERL.

  - one or more, or all, of the Northern Territory's local electricity systems, or
- does not have effect with respect to one or more of those systems

but is not a jurisdictional derogation, participant derogation or rule that has effect with respect to an adoptive jurisdiction for the purpose of s. 91(8) of the NEL.

As the final rule relates to parts of the NER that apply in the Northern Territory, the Commission has assessed the final rule against additional elements required by the Northern Territory legislation.[42]

In making the final rule, the Commission has considered whether a uniform or differential rule should apply to the Northern Territory. The final rule determination is to make a uniform rule because the provisions in the NER which are amended by the final rule are the same in the Northern Territory version of the NER, and making a differential rule due to the different physical characteristics of the Northern Territory's network would not better achieve the NEO in this instance.

2.2.4 Application to Victoria

As indicated in AEMO's rule change request and the AEMC's draft rule determination, amendments made to the NERR must be considered in light of Victoria having not adopted the National Energy Customer Framework in its jurisdiction. This is because amendments made to the NERR may not apply unless Victoria elects to make changes to its own jurisdictional instruments.

As the final rule does not include amendments to the NERR, and the provisions in Chapter 5A of the NER that are amended by the final rule apply unamended in Victoria, the final rule is applicable to all NEM jurisdictions including Victoria.

2.3 Assessment framework

In assessing the rule change request against the NEO and NERO the Commission has considered the following principles:

- Efficient operation of the electricity system, considering if the proposed solution would reduce the probability of system security issues arising from the growing number of DER connections. In the context of minimum DER technical standards, the Commission has considered which issues are the most likely to cause imminent threats to system security.
- Efficient risk allocation, taking account of who is best placed to manage system security and reliability risk arising from an increasing number of DER connections. In general, it is desirable that the party that is allocated a risk has the incentive and ability to manage that risk because there is a clear link between that party's actions on the outcomes of the risk. For DER technical standards, it does not always seem clear that this can be

42 From 1 July 2016, the NER, as amended from time to time, apply in the NT, subject to derogations set out in regulations made under the NT legislation adopting the NEL. Under those regulations, only certain parts of the NER have been adopted in the NT. (See the AEMC website for the NER that applies in the NT.) *National Electricity (Northern Territory) (National Uniform Legislation) Act 2015*.

achieved. For example, while interoperability may provide system security benefits, it is not clear that consumers are best placed to manage this risk.

- Regulatory burden, assessing the proposed additional regulatory burden directly imposed on consumers as well as that on device manufacturers, DNSPs and the AER related to the introduction of a minimum technical standard for DER which may have consequential costs for consumers. For the purpose of minimum DER technical standards, the Commission considered any additional costs, direct and indirect which would be imposed on consumers, manufacturers, installers, DNSPs and the AER.
- Governance, examining if appropriate governance structures are or can be put in place to support AEMO's proposed role in setting an interim minimum technical standard for DER. The Commission considered additional governance requirements if the new standard would be set in a subordinate instrument.

2.4 Description of the final rule

AEMO's rule change request proposed that amendments to the NER should be made to Chapters 5 and 5A. It also raised the possibility that amendments to the NERR may also be required to implement its objective.

In making this final rule determination, the Commission has considered AEMO's proposed approach. It has concluded that to achieve the policy objective of addressing the immediate concerns arising from small scale rooftop solar generators, amendments to Chapter 5A of the NER (with transitional provisions in Chapter 11) are the only amendments to the NER that are required.

Amendments to Chapter 5 are not required because this chapter of the NER does not apply to embedded generators connected by way of a micro EG connection. In addition, the Commission has not found it necessary to make any amendments to the NERR because the model terms and conditions for deemed standard retail connection contracts are broad enough to capture the changes made to Chapter 5A of the NER in the final rule.

The more preferable final rule made by the Commission is attached to and published with this final rule determination. The key features of the more preferable final rule are:

- the creation of DER Technical Standards which embedded generating units connecting by way of a micro EG connection service must comply with
- DER Technical Standards that include the requirements set out in AS 4777.2:2020 as in force from time to time
- a requirement that model standing offers for basic connection services for embedded generating units include the requirement that all new and replacement embedded generating units the subject of a basic micro EG connection service must be compliant with the DER Technical Standards
- an obligation on DNSPs that the information to be provided to connection applicants in order for them to negotiate a connection contract must include the requirement that if the connection applicant is proposing to connect a new or replacement embedded

generating unit by way of a basic micro EG connection service, that the micro embedded generating unit must be compliant with the requirements of the DER Technical Standards

- a requirement that the minimum content requirements of connection offers under Schedule 5A.1 to the NER must include the requirement that if the connection applicant is proposing to connect a new or replacement embedded generating unit by way of a basic micro EG connection service, that the embedded generating unit the subject of the connection application is compliant with the DER Technical Standards.
- the DER Technical Standards will apply only to new connection and replacement inverters and connection alterations (including upgrade, extension, expansion or augmentation)
- the rule will commence approximately ten months after it is made on 18 December 2021 to allow for the implementation of the new requirements
- transitional provisions have been included so that if before the commencement date of the rule:
  - a connection applicant in relation to a basic micro EG connection service has made a connection application but not received a connection offer, the new Chapter 5A will apply to that connection offer and connection contract
  - if a connection applicant in relation to a basic micro EG connection service has received a connection offer from the relevant DNSP but has not yet entered into a connection contract, the old Chapter 5A will apply to that connection offer and connection contract.

Further detail on the more preferable final rule can be found in the following chapters of this final rule determination.

2.4.1 Changes from the draft rule

A limited number of changes have been made between the draft rule and the final rule. The key changes are:

- **Referring to the most recent standard — AS 4777.2:2020**: The final rule defines DER Technical Standards by reference to AS 4777.2:2020. This will simplify the implementation pathway and minimise divergence or conflicting obligations in instances where the standard is called up in jurisdictional instruments.
- **Extending the implementation timeframe**: The final rule commences on 18 December 2021. As this date is the same as when AS 4777.2:2020 comes into effect, this provides a simple and clear changeover for industry participants from one set of technical requirements to the other, avoiding confusion of what requirements are relevant in different contexts.
- **Non-static reference to AS 4777.2:2020**: The final rule refers to AS 4777.2:2020 as in force from time to time. This will enable changes made to the Australian Standard to flow through to the NEM without carrying out a rule change process. It will also prevent divergence between the NER, AS 4777.2 and other instruments where the standard is used.

2.5 Summary of reasons

The Commission has considered the rule change request submitted by AEMO which proposed an obligation be placed in the NER for it to create a subordinate instrument that would set out DER minimum technical standards. It also proposed that a high-level definition of DER be included in the NER. While the focus of the rule change request was to make amendments to the NER, AEMO did suggest that the NERR may also require amending.

In making this final rule determination, the Commission notes that AEMO has more recently indicated that, in its view, the focus of this rule change process should be on addressing DER capability to withstand power system disturbances.

The Commission has assessed whether AEMO's proposal would, or would be likely to, contribute to the achievement of the NEO and the NERO with regard to the assessment framework outlined above. It has concluded that changes to the NER adequately address the issues identified by AEMO and stakeholders. In addition, the model terms and conditions for deemed standard connection contracts in Schedule 2 to the NERR are broad enough to capture the changes made to Chapter 5A of the NER. Therefore, the Commission has determined that changes to the NERR, and consideration of the NERO, are not required.

The final rule represents one component of the ESB's work program to prioritise more effective integration of DER into the NEM.

The following outlines the reasons for the Commission's final rule determination. Further details are set out in the following chapters.

Scope and duration of the initial standard

AEMO's rule change request proposed that the initial standard should encompass inverter performance and grid responsiveness; interoperability and communication interfaces; and cyber security measures. Of these, the Commission recognises the particular concern of the ESB, AEMO and other stakeholders that small scale solar generation is having a detrimental impact on the operation of some distribution networks and the NEM.

Accordingly, the Commission has focused on addressing these immediate concerns. As a result, the final rule establishes DER Technical Standards in regard to inverter performance and grid responsiveness. This is consistent with AEMO's more recent approach to DER technical standards as set out in its consultation paper on the content of the initial standard.

The DER Technical Standards established by the final rule include a non-static reference to an Australian Standard — AS 4777.2:2020, as updated from time to time — to minimise divergence or conflicting obligations in instances where the standard is called up in jurisdictional instruments. The standard AS 4777.2:2020 has been used because it sets out requirements for inverters connecting to a distribution network, including voltage disturbance ride-through. The DER Technical Standards will apply to new connections and replacements of inverters connecting micro-embedded generation within a distribution network.

The Commission considers that the more preferable final rule is likely to better achieve the NEO than AEMO's proposal. This is because having considered the nature of the imminent threats to the NEM, and recognising the urgency required in addressing these, it has

concluded that it is unlikely to be consistent with the NEO if technical standards over and above what is currently required to address the urgent NEM-wide power system security issues are created. Other important DER integration issues will be addressed in the future.

In addition, using an existing Australian Standard is likely to be a more cost-effective and timely approach to address immediate concerns than establishing a set of new requirements with bespoke governance arrangements. This is because AS 4777.2:2020 has been produced using a well-recognised framework of stakeholder consultation, industry and technical knowledge.

The Commission has found that defining the DER Technical Standards as including AS 4777.2:2020 in the NER will address the immediate concerns arising from the increasing use of small rooftop solar generators. It does not require a broad definition of DER to be included in the NER as proposed by AEMO.

Instead, the Commission has used the current NER definition of micro embedded generators. This would mean that in terms of the devices that are within scope of the standard, the final rule applies the DER Technical Standards to inverters connecting small solar PV generation units, as well as potentially batteries and electric vehicles.

The Commission considers that the use of the existing definition of micro embedded generator has benefits that are consistent with achieving the NEO. In particular, industry familiarity of the definition should assist with clarity in the application of the new rules, supporting successful compliance.

The scope of the DER Technical Standards is focused on enabling market participants to address their immediate concerns arising from the growing use of DER. More extensive DER technical standards can be developed in the future to address other issues as they arise. The Commission will continue to work with industry to address issues arising from DER integration.

As a result, the Commission has not placed any time limit on the life of the DER Technical Standards. It considers that it is appropriate to allow the standards to evolve over time as needed.

Governance arrangements

The rule change request sought to amend the NER to require AEMO to establish and maintain DER minimum technical standards through an instrument subordinate to the NER.

The Commission has considered the merits of creating a new set of DER technical standards against using existing Australian standards that have been produced using a well-recognised framework of stakeholder consultation, industry and technical knowledge. This has been considered in the context of the technical standards needed to address the immediate issue identified in the rule change request. As a result, it has concluded that establishing a new process to establish technical standards may result in duplication and potentially inefficient costs borne by consumers. The Commission is of the view that this would not be likely to advance the NEO because it may result in technical standards over and above what is required to address NEM-wide power system security issues. In addition, confusion and

additional compliance costs for industry participants are likely to arise where there are differences between the requirements included in AS 4777.2 and the standards specified in the NER subordinate instrument.

The Commission received substantial feedback from stakeholders that raised concerns about AEMO's proposal to create a subordinate instrument. The Commission considered that creating a subordinate instrument would require a bespoke governance framework to also be created. In contrast, if the standard is housed within the NER, this could be done quickly and would also establish the AEMC as the responsible body. This approach has received broad agreement from stakeholders for the purpose of addressing the immediate system security issues for the NEM.

This more preferable final rule is likely to better achieve the NEO than the rule change request sought by AEMO because it achieves the overall outcome of creating an initial DER technical standard in a timely manner because no additional work on governance is required at this stage. This will likely result in imminent system security issues caused by DER connections to be addressed in a more timely manner than would otherwise have been possible.

The Commission notes that a rule change request has been submitted by Dr Kerry Schott AO, Chair of the ESB, proposing arrangements for the long term governance of DER technical standards. The rule change request on enduring governance arrangements proposes that the AEMC, with the assistance of an advisory committee, be the responsible body for overseeing the development of new DER Technical Standards.[43] The governance arrangements included in this final rule do not limit, in any way, consideration of the most suitable pathway to establish enduring governance arrangements for setting technical standards in the future.

Network connection agreements

AEMO proposed that the initial DER minimum technical standards be inserted into the minimum content requirements of connection contracts, negotiation frameworks and model standing offers, and into the model standing terms under Chapters 5 and 5A of the NER. It also suggested that the standard could be recognised in the deemed standard connection contracts prescribed in Schedule 2 to the NERR.

Under an approach where the DER Technical Standards are defined in the NER, the Commission has decided that DNSPs should also be obliged to ensure that connection applicants in relation to micro embedded generators should comply with the initial standard. As a result, the final rule requires DNSPs to include in their connection agreements made under Chapter 5A of the NER a requirement that all new and replacement embedded generating units the subject of a basic micro EG connection service must be compliant with the DER Technical Standards.

As the final rule only relates to the connection of micro embedded generation, only Chapter 5A and not Chapter 5 of the NER has been amended.

43 The Commission anticipates that the rule change process for the Governance of DER Technical Standards will commence by mid 2021.

The Commission considers that these arrangements to establish DER Technical Standards in the NER are consistent with the key intent of AEMO's proposed approach. In addition, the Commission considers the final rule is consistent with achieving the NEO as it clearly establishes compliance with the technical standard at the point of connection. This is achieved efficiently through the use of existing processes DNSPs have in place for the connection of embedded generation and applies across all NEM jurisdictions and the Northern Territory.

Compliance arrangements

In its rule change request, AEMO proposed that the initial technical standards be included as a requirement in the connection process to ensure compliance of connected DER. It also proposed that the AER develop a light-touch monitoring and compliance framework, primarily for the purpose of transparency.

The final rule includes new DER Technical Standards as part of the requirements for the connection of micro embedded generation. In doing so, this places an obligation on DNSPs to be satisfied that the connecting inverter meets the standard. As a result, device manufacturers and installers are obliged to show the DNSP that those requirements are met. These new arrangements are consistent with existing requirements under the NER that enable DNSPs to establish technical requirements for their networks as well as AEMO's proposed approach.

The Commission also considered AEMO's proposal to develop a light-touch monitoring and compliance framework for the AER. However, the final rule does not include such a framework. Instead, the Commission has concluded that existing compliance processes are appropriate and can be utilised. Placing the standard in the NER creates an obligation on DNSPs to ensure the standard is met. This triggers the AER's existing capability to monitor and enforce this obligation.

In addition, the existing compliance and monitoring systems under the Clean Energy Council and the Clean Energy Regulator, relating to the certification of products and installers of electricity generating systems should continue to be used by industry as they are complementary to the overall compliance arrangements. The Commission considers that this approach is consistent with achieving the NEO as it avoids imposing inefficient costs of a new, potentially duplicative compliance system on electricity consumers.

Implementation approach

The Commission recognises that there are a number of actions that must be undertaken by various parties, such as DNSPs and inverter manufacturers, to enable the initial DER Technical Standards to take effect. It also recognises the intent of the ESB and AEMO to address issues arising from the growth of small solar generation segment as promptly as possible.

The Commission has concluded that the requirements should come into effect approximately ten months from the date of the final rule is made on 18 December 2021. This date is the same as the date AS 4777.2:2020 becomes effective. The use of the same date provides a

simple and clear changeover for industry participants from one set of technical requirements to the other, avoiding confusion of what requirements are relevant in different contexts.

In addition, the Commission considers that this timeframe is achievable as it is reasonable to expect that relevant manufacturers are already progressing towards meeting the requirements of AS 4777.2:2020 and will still have time to complete any testing needed. It also provides time for the DNSPs and the AER to update the relevant network connection agreements.

The final rule also includes transitional arrangements as discussed in section 2.4 to clarify the compliance obligations of parties involved in a connection process at the time the rule comes into effect.

3 SCOPE AND DURATION OF THE DER TECHNICAL STANDARD

This chapter sets out the Commission's considerations of the issues raised by AEMO in its rule change request as well as those raised by stakeholders on the development of DER in the NEM as well as the possible amendments to the NER and NERR to address these issues. In doing so, the chapter also notes the Commission's consideration of the growth in consumer-led DER to date and how it can contribute to, or sometimes exacerbate, power quality issues in distribution networks.

This chapter also discusses the scope of a technical standard for DER. Specifically, the issues that could be best addressed by a technical standard and what particular DER devices would benefit from the requirement to comply with the DER Technical Standard. In relation to the technical matters, the Commission has concluded that the final rule should focus on the current and urgent needs of managing power quality issues as this is the primary focus of AEMO's rule change request. Consistent with the draft rule, the final rule applies only to micro embedded generating units.

This chapter also discusses the scope of a technical standard in terms of the duration, or term, of the standard. The Commission has determined to create a non-static reference to an Australian Standard — AS 4777.2, as updated from time to time — to minimise divergence or conflicting obligations in instance where the standard is called up in jurisdictional instruments. The Commission has also determined that the technical standard can be enduring; it does not require an explicit end date and can be updated or amended in the future if necessary by amendments to the NER. Therefore, the Commission does not consider it necessary to have the standard cease at a specific date or have a NER requirement that the standard is later reviewed.

Finally, this chapter discusses AEMO's and stakeholders' views on the cost of implementing a technical standard for DER. The Commission is satisfied that the final rule's implementation of the DER Technical Standards achieves the sought after benefits while minimising costs for industry participants and electricity consumers.

3.1 Growth, impact and urgency of DER in the NEM

3.1.1 AEMO's view

As set out in AEMO's rule change request, a significant number of electricity users have adopted DER across Australia. However, AEMO has observed that this rapid introduction of these new technologies has led to the need to manage emerging challenges in operating the power system. AEMO's views on these issues are set out below.

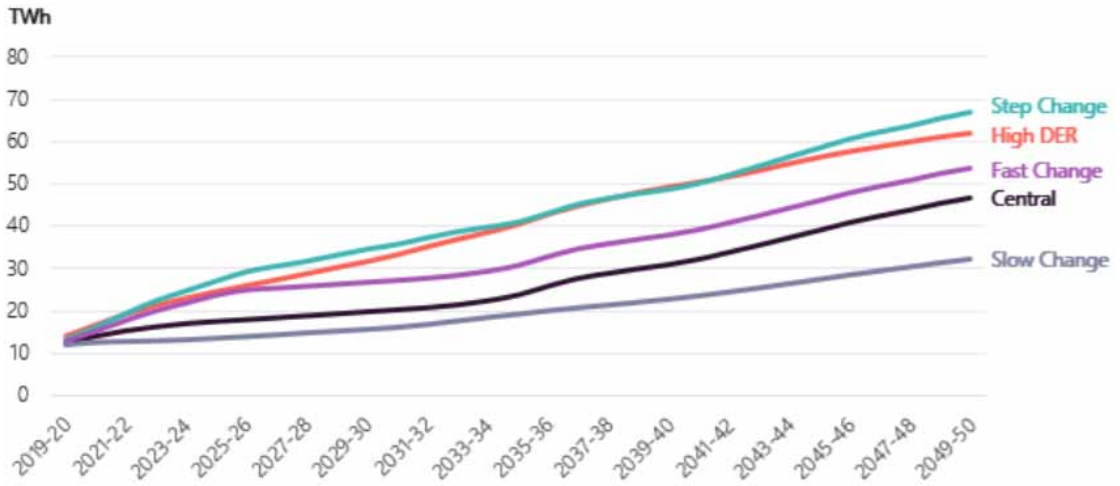
The growth of DER

Across Australia, households and small businesses are increasingly installing devices at their premises (such as rooftop solar generation, batteries and electric vehicles) and adopting

behaviours (such as demand response and the use of energy management systems) in response to developments in the electricity market and concerns about climate change.[44]

Uptake of different DER types has been growing at pace and is expected to continue for some time. However, rooftop solar generation's growth is regarded as being at the forefront of impacting the distribution networks and the broader power system's operation.[45] This is indicated in the figure below from AEMO.

Figure 3.1: Distributed PV generation, 2019-2020 to 2049-2050



AEMO, *2020 Integrated system plan*, July 2020, p. 41. Includes PV non-scheduled generation.

The impact of DER

In its rule change request, AEMO stated that DER could cause, or at least in specific instances exacerbate, power quality issues in some distribution networks that may also impact the operation of the whole system.[46] Some of these issues have been identified as more urgent than others.

AEMO stated that these DER assets' performance in aggregate can pose considerable risk to its ability to maintain key power system operational limits, like voltage and inertia, while also needing to operate under increasing uncertainty and variability.[47] In particular, AEMO stated it could be difficult to balance generation across dispatch intervals to cater to uncertain DER performance, which can cause network reliability and security issues.[48] This can adversely affect the benefits that consumer-led DER may provide.

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44 Each of these, as well as air conditioners, pool pumps, and other behind-the-meter devices, can be described as being a form of DER.

45 AEMO reports that DER could provide up to 22 per cent of annual NEM electricity consumption in the future with much of this driven by the installation of rooftop solar generation. AEMO, *2020 Integrated system plan*, July 2020, p. 41.

46 AEMO, Rule change request, pp. 6-8.

47 AEMO, Rule change request, pp. 6-8.

48 AEMO, Rule change request, pp. 6-8.

According to AEMO, the type of DER that can have the most impact is household distributed solar PV generation. To date, distributed solar generation on the low voltage network has tended to be passive. That is, it is not very controllable (nor often visible) by the relevant DNSP. As the penetration of passive solar generation grows in distribution networks, DNSPs experience more difficulty managing voltage in their networks. This, in turn, can impact the distribution-transmission interface in the event a system disturbance or contingency event occurs.

Operating the power system with considerable DER penetration in some locations has significant implications on maintaining system security and its ability to return to a steady-state following a contingency event.[49] The continued growth of passive distributed solar generation will impact AEMO's ability to manage the power system and balance load and generation.[50] AEMO has specified particular issues for the NEM arising from the growing proportion of DER generation in the power system that it would like to see addressed:[51]

- **Impact on AEMO's core power system operation** — Increased DER penetration impacts AEMO's core power system operating duties including system balancing, power system stability and recovery and restoration following major system events. Due to identified risks associated with unmanaged and unnecessary disconnection of DER in response to system disturbances, rooftop solar PV's constant connection is forecast to impact planning around contingency size in some regions. Without action, the largest contingency sizes will increase due to distributed solar PV generation disconnection following major system disturbances.
- **Managing the system load profile** — This can be difficult where aggregate small solar generation depresses operational demand load (often referred to as the 'duck-curve') when electricity demand is low and solar generation exports are high. This may lead to an underestimation of the evening ramp. It has been noted that this is exacerbated by the "invisibility" and the unpredictability of some DER assets.
- **System strength support through minimum operational demand** — Continued increases in rooftop solar PV generation may result in inefficient system demand in some regions to support the minimum levels of synchronous generation required to deliver power system services, such as inertia, frequency control or system strength, that are necessary to maintain power system security during regular operation. The limited availability of such services may also lower the resilience and the effectiveness of emergency control mechanisms available to AEMO.
- **Responding to disturbance events** — As distributed solar PV generation penetration has continued to rise, in some regions (for example, South Australia, Western Australia and Queensland) limitations have begun to be reached in distribution networks related to managing voltage, thermal capacity and protection co-ordination. While DNSPs have successfully implemented a range of responses to manage this, impacts are beginning to

49 A contingency event is an event that affects the power system in a way which would likely involve the failure or sudden and unexpected removal from operational service of a generating unit or transmission element.

50 AEMO, *Renewable integration study stage 1 report, Appendix A: high penetrations of distributed solar PV*, April 2020, p. 14.

51 AEMO, Rule change request, pp. 2, 7-8.

occur at the transmission-distribution interface. During frequency or voltage disturbance, small solar generating units have acted in unison to disconnect from the power system when they should have remained connected. This has exacerbated the contingency event and has required AEMO to acquire increased frequency control ancillary services (FCAS) following transmission faults due to the potential for mass disconnection of distributed solar PV generation systems. The aggregate impact of this is significant for the safe and secure management of the power system. Because this event's size is mostly unknown or invisible, this can compound the risk of managing contingency events for AEMO. DER inverter responses to power system disturbances are an increasingly important factor in the system recovery.

Urgency of managing DER's impact

Of the impacts on the power system noted above, a key focus for AEMO has been on responding to power system disturbance events, particularly the mass disconnection of small solar generators in response to frequency or voltage disturbances and the significant exacerbation of the impact of the initial event.[52]

AEMO has indicated that in some jurisdictions, particularly South Australia and Western Australia, managing power quality and system security under increasing uncertainty and variability inclusive of potentially higher fault rates, has reached urgent levels. In particular, it has stated:[53]

> AEMO has identified through analysis of recent power system events, that a proportion of distributed PV (DPV) disconnect in response to short duration transmission undervoltage disturbances. In South Australia (SA), possible contingency sizes associated with tripping of DPV following a credible fault is estimated to exceed 500 MW (on average approximately 100,000 residential rooftop PV systems) by the end of the year, and this will grow as more DPV is installed. If this eventuates, AEMO will have very few courses of action available for secure operation of South Australia if separated from the rest of the National Electricity Market (NEM). Load shedding and resulting customer disruption may be inevitable in response to credible faults, and cascading failure may be possible.

AEMO and the South Australian Government have worked together to put in place arrangements to address the issues with small solar PV generation response to undervoltage events in South Australia. However, the problem is also expected to soon apply to other locations in the NEM.[54] For this reason, AEMO has recommended that an undervoltage disturbance ride-through capability for inverters connecting to distribution networks across the NEM through a testing procedure: this is the key focus of the current rule change process and AEMO's consultation on the content of an initial technical standard for DER.[55]

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52 AEMC, *Technical standards for DER*, consultation paper, 25 June 2020, pp. 7-9.

53 AEMO, *Short duration undervoltage disturbance ride-through: inverter conformance test procedure for South Australia*, consultation paper, June 2020, p. 3.

54 Instantaneous penetration of distributed solar generation was 31 per cent in Victoria and 30 per cent in Queensland in 2019. AEMO, *Renewable integration study: stage 1 report*, April 2020, p. 39.

55 AEMO, *Initial distributed energy resource minimum technical standards*, issues paper, 24 August 2020, pp. 4-5.

3.1.2 Stakeholder views on the request

Stakeholder views on the growth of DER

In general, stakeholders recognised the growth in consumer-led uptake of DER, inclusive of the increasing penetration of generation and load behind-the-meter.[56] Also, stakeholders appreciated that the growth of DER across the NEM presents a new frontier of two-way energy flows, seldom nationally standardised, which can impact operation and augmentation of the energy system.[57]

Stakeholder views on the impact of DER

Conversely, stakeholder views on the degree of impact that this growth in DER can cause were more varied. For example, Ausgrid stated that it 'understands' the concerns that AEMO raised that a high variable renewable energy world (that is, DER) can yield specific impacts worth of short-term actions in the immediate future.[58] Essential Energy stated that, under current and forecast levels of consumer-led DER, the system's operation could be exposed to some risks that technical standards could help address.[59]

Energy Queensland raised that these impacts, particularly concerning voltage, thermal capacity, and protection coordination, rest with jurisdictional legislation that obligates the DNSP to manage them. Energy Queensland demonstrated that Energex and Ergon have effectively managed 3 GW of installed solar PV capacity, through compliance with Standards Australia's current relevant standard in their DNSPs' connection agreements.[60] Nevertheless, Energy Queensland also commented that:[61]

> It is accepted that DPV is beginning to cause issues at a system-wide level during the day time, and it is believed that electric vehicles and batteries may either help or hinder these issues, depending on tariff incentives and how they are controlled.

In addition to this, Dr Martin Gill agreed that there is a problem that 'some' inverters unfavourably disconnect in response minor disturbances in voltage, which can pose a cascading problem of unfavourable disconnections on the local network.[62]

Stakeholder views on the urgency of managing DER

Some stakeholders shared views on the urgency and impact of DER, and whether the creation of standards now, is the most apt solution. ARENA and Endeavour Energy commented that the growth and impact of DER do require short-term and immediate action, or else DER could be restrained and curtailed, or system security and frequency issues could persist.[63] However, ARENA also commented that the urgency of standardisation could, in

56 AGL submission to the consultation paper, p. 1.
57 Intellihub submission to the consultation paper, p. 1.
58 Ausgrid submission to the consultation paper, p. 2.
59 Essential Energy submission to the consultation paper, p. 1.
60 Energy Queensland submission to the consultation paper, p. 3.
61 Energy Queensland submission to the consultation paper, p. 8.
62 Dr Martin Gill submission to the consultation paper, p. 4.
63 Submissions to the consultation paper: ARENA pp. 2-3; Endeavour Energy p. 3.

fact, stunt innovation and growth of DER in the long run; a point similarly raised by ERM Power, who "[were] keen to avoid heavy-handed requirements... thereby inhibiting the uptake of DER among large energy users."[64] Furthermore, ERM Power was not certain that heavy-handed or over-reaching standards would likely help manage evening load peaks or utility-scale solar's contribution to the duck curve.[65]

Dr Martin Gill commented that the urgency of managing DER in the proposed way was 'not essential' because an unquantified amount of inverters can meet the technical requirements AEMO proposed.[66] Similarly, the Caravan & Camping Industry Association NSW expressed that implementing NEM-wide standards would create a duplication of work seeking to manage these issues, such as localised strategies at the DNSP-level or through the South Australian Smarter Homes policies.[67] In these cases, some stakeholders found that the proposed solution to the issue was not urgently required. In contrast, others saw it as not very appropriate, due to the potential risks it could likely impose to regulatory burden or costs of new DER installations.

3.1.3 Draft rule determination assessment

In its draft rule determination, the Commission acknowledged the considerable growth in consumer-led DER behind-the-meter, with 2020 already recording up to 1.5 GW of rooftop solar PV generation. It noted that DER will continue to grow as consumers respond to jurisdictional incentives or seek to capture the value of DER, like potential bill savings or consuming less emissions-intensive generation. By 2040, AEMO has estimated "that 13% to 22% of total underlying annual NEM energy consumption" could be provided by DER across the NEM.[68] The Commission considered that the growing use of solar PV generation does provide a range of benefits, as identified by AEMO and other stakeholders as noted above. These benefits are significant for consumers integrating their DER assets with the local low voltage network, including providing benefits to non-DER consumers in the form of lower overall total system costs.

Nevertheless, the Commission also recognised that DER is one potential contributing factor to network security issues in voltage management. As noted by some stakeholders responses to the consultation paper, grid voltage, as a dynamic range, is relatively high regardless of the local DER penetration. As a result, when solar generation connects to a distribution network and subsequently exports at a higher voltage than the receiving line, it can add to the dynamic range variability. If overvoltage was to occur on a DNSP's feeder, for instance at a time of peak generation but lower relative demand, this could lead to curtailment of exporting DER generation. This behaviour indicates that DER, particularly solar PV generators, contributes to the difficulty managing voltage in some distribution networks.[69]

64 Submissions to the consultation paper: ARENA pp. 2-3; ERM Power p. 3.
65 ERM Power submission to the consultation paper, p. 2.
66 Dr Martin Gill submission to the consultation paper, p. 6.
67 Caravan & Camping Industry Association NSW submission to the consultation paper, p. 2.
68 AEMO, *2020 Integrated system plan*, July 2020, p. 41.
69 AGL submission to the consultation paper, p. 4. See also: University of New South Wales, *LV Voltage Report*, May 2020.

In its draft rule determination, the Commission acknowledged that the growth in DER to date has, or may have, contributed to power quality issues in the aggregate. The immense increase of passive rooftop solar PV generation to date appears to have exacerbated some operational problems like the 'duck curve'.[70]. Furthermore, short-duration undervoltage events are now being similarly compounded in some passive inverter-based DER locations as they do not respond to such events appropriately.

At the same time, while the volume of DER installed is understood to be significant and growing, there is limited visibility for several DNSPs and AEMO.[71] Also, there is a lack of specifications to realise the needed visibility of DER. The Commission considered that this lack of sufficient information about DER operations has created a divergence between realising the significant benefits of DER and the ability to manage its impacts on networks and the whole power system efficiently.

The Commission acknowledged that managing the high growth and potential benefits of DER (primarily small scale solar generation) with the potential for adverse network and system impacts can be addressed in many ways. Most notably, as stakeholders have commented, the balance between price signals and off-market solutions is crucial for capturing benefits at the least possible cost.

In its draft rule determination the Commission acknowledged that the growth of DER, primarily small scale solar generation, has been significant and is still expected to continue at pace over coming years. It also noted the benefits that DER owners have been able to capture and the benefits that can flow through to other electricity users. Nevertheless, some negative impacts of high DER use have begun to emerge in some power system locations as technical difficulties in operating networks become exacerbated under certain conditions. Mandating technical requirements will not always be the most appropriate response to issues relating to DER use. However, the Commission concluded that the specification of specific technical requirements is an appropriate response for the matter of particular concern for this rule change process — that of high penetration of (often passive) small scale solar generators impacting on the ability of DNSPs and AEMO to manage voltage disturbances.

3.1.4 Stakeholder views on the draft determination

Stakeholders that commented on the growth, impact and urgency of DER in the NEM, were broadly supportive of the Commission's assessment that specifying technical requirements, in this instance, was an appropriate response. For example, some stakeholders broadly affirmed that increased uptake of DER like rooftop solar PV can contribute to challenges in managing system security, while also recognising the need for inverter performance and grid responsiveness standardisation in the short term.[72]

70 Utility-scale inverter-based generation, which has begun to displace retiring synchronous generation, may also contribute to these power quality issues at a whole of system level. However, the focus of this rule change request is on DER assets

71 This can be attributed to low penetration of advanced meters or network devices which capture voltage and current between the meter and substations upstream to the transmission network connection point.

72 Submissions to the draft determination: ECA, p. 2; Citipower, Powercor, and United Energy, pp. 1-2; ERM Power, p. 2; Simply Energy, pp. 1-2.

Ausgrid expressed the view that significant change is occurring across the NEM, transitioning from a one-way large scale system to a distributed two-way system where consumers have greater power and control.[73] The AER acknowledged the challenges higher penetrations of DER present and noted that the draft rule marked an important step in supporting the "active participation [and integration] of these generation devices in the overall power system."[74]

Similarly, Tesla commented that growth in DER would continue to provide new opportunities for consumers, particularly through their active involvement in the provision of market services.[75]

3.1.5 Final rule determination assessment

Giving consideration to submissions provided by stakeholders, the Commission is satisfied that its assessment in the draft rule determination remains appropriate.

The growth of DER, primarily small scale solar generation, has been significant and is still expected to continue at pace. Accordingly, the Commission concludes that the specification of certain technical requirements in the NER is a pragmatic and timely response that will enhance the ability of DNSPs and AEMO to manage voltage disturbance.

3.2 Technical scope of the standard

3.2.1 AEMO's view

AEMO's rule change request proposed that the initial technical standard's content should reflect the critical and urgent needs of the power system, both currently and what would be reasonably required in the future, including:

- **Inverter performance and grid responsiveness**: Given the behaviour of individual DER assets, particularly solar PV generation in the aggregate, AEMO has proposed that select capabilities of Australian specific standards be adopted and nationally mandated. The initial specifications offered AS 4777.2:2015 (the then-current standard), which requires an autonomous response to voltage variations, among a raft of other inverter capabilities. AEMO proposed this requirement because without a baseline or default inverter setting a system disturbance event can be exacerbated if the inverters trip off.[76]
- **Interoperability and communication interfaces**: AEMO proposed that nationally consistent interoperability requirements should also form part of the initial technical standard. It was suggested this would include industry standards like AS 4755 and communication interfaces for data exchange, coordination, and control of DER assets. AEMO considered these requirements necessary to integrate DER further.[77]
- **Cybersecurity measures**: Noting the increasing digitisation of the energy system, especially of DER and cloud data storage, AEMO claimed that there is a need to prevent

73 Ausgrid submission to the draft determination, p. 1.
74 AER submission to the draft determination, pp. 1-2.
75 Tesla submission to the draft determination, p. 4.
76 AEMO, Rule change request, pp. 11-12.
77 AEMO, Rule change request, p. 12.

threats of a cyber attack. Currently, there is no device-level cybersecurity standard for the NEM. This, in AEMO's view, decreases the perceived reliability of the system and the security of DER customers and their data.[78] Accordingly, AEMO proposed that DER's initial technical requirements should include cybersecurity measures to future proof the NEM and protect consumers' data.

In its rule change request, AEMO also commented on the trade-off between achieving inverter performance and grid responsiveness and to a lesser extent interoperability and communications outcomes, through a market services approach compared to using a standard. AEMO stated:[79]

> 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.

In this way, AEMO believes that setting minimum technical requirements of DER does not preclude the additional development of market services or innovations. Instead, using a standard creates a technical floor that customers can rely on and make investment decisions around going forward and having a base level of performance and response for DNSPs and AEMO to rely on.[80]

AEMO subsequently commenced a consultation process on the content of the initial technical standard. The consultation paper was published on 24 August 2020; it indicated that AEMO's focus on the initial minimum technical standard's content had narrowed to inverter performance and grid responsiveness standards. Interoperability and communication interfaces and cybersecurity standards would continue to be developed as soon as practicable through a separate process, "as [the standards] are not sufficiently well prepared."[81]

3.2.2 Stakeholder views on the request

The majority of stakeholders considered that the technical outcomes, particularly concerning the content and subsequent requirements for DER, should be specified by the NER. Stakeholder responses covered the different aspects of technical details proposed by AEMO, including standards of inverter performance and grid responsiveness, interoperability and communication interfaces, and cybersecurity measures as detailed below.

Inverter performance and grid responsiveness

Firstly, there was broad support for standards to be put in place regarding inverter performance and grid responsiveness from stakeholders. Stakeholders recognised this aspect as having a significant degree of importance and/or urgency.[82] Submissions from ENA, SAPN, and Jemena expressed the view that the Commission should expressly limit this rule change

78 AEMO, Rule change request, p. 13.
79 AEMO, Rule change request, p. 13.
80 AEMO, Rule change request, p. 13.
81 AEMO, *Initial distributed energy resource minimum technical standards*, issues paper, 24 August 2020, p. 7.
82 Submissions to the consultation paper: ARENA, p. 4; Ausgrid, p. 7; Endeavour Energy, p. 3; ENA, p. 4. Jemena, p. 2; Red Energy and Lumo Energy, p. 3; Reposit Power, pp. 4-5; SAPN, p. 5; Tesla, p. 3.

to address the immediate shortcomings of the AS 4777.2 ride through capabilities by amendments made to the NER.[83]

Interoperability and communications interfaces

Secondly, and conversely, stakeholders were generally less supportive of interoperability and communications requirements as part of new minimum technical standards for DER proposed by AEMO. For example, Dr Martin Gill commented that mandating communications standards were "unnecessarily expensive". Simultaneously, the AER considered that implementing interoperability standards before system risks had eventuated NEM wide could be unnecessary.[84]

Nevertheless, some stakeholders did recognise the importance of interoperability and communications for the longer term, suggesting that these issues could be considered later.[85]

Energy Queensland stated that DNSPs should still retain their standards which could include interoperability.[86]

Cybersecurity

Finally, stakeholders were much less supportive of AEMO's proposal to include cybersecurity standards in the minimum technical standards for DER. The South Australian Department for Energy and Mining noted the importance of future cybersecurity provisions in an ever digitising NEM, yet did not support the inclusion of these provisions as proposed.[87] Other stakeholders expressed concern about shifting responsibility for determining these standards from existing instruments, like the Cyber Security Centre or the Cybersecurity Capability Maturity Model, to an AEMO instrument.[88]

In contrast, the AER and Wattwatchers, and to a lesser extent, EnergyAustralia and the CEC, supported AEMO undertaking and implementing cybersecurity standards as proposed.[89]

3.2.3 Draft rule determination assessment

In its draft rule determination, the Commission determined that the DER Technical Standard's scope should only focus on inverter performance and grid responsiveness. It was satisfied that this aspect of the proposed technical requirements for DER is urgent and should be promptly addressed. The Commission noted that while South Australia had addressed the issue through its jurisdictional mechanism, the potential for the case to arise in other jurisdictions in the near future indicated that it was essential to take action now. It was also satisfied that an appropriate response was to set the needed technical requirements through a standard to apply across the NEM. The Commission considered this approach is consistent

83 Submissions to the consultation paper: ENA, p. 4; SAPN, p. 5; Jemena, p. 5.
84 Submissions to the consultation paper: Dr Martin Gill, p. 3; AER, p. 2.
85 Submissions to the consultation paper: Jemena, p. 5; Ausgrid, p. 8; SAPN, p. 5, CEC, p. 3.
86 Energy Queensland submission to the consultation paper, p. 9.
87 South Australian Department for Energy and Mining submission to the consultation paper, p. 3.
88 Submissions to the consultation paper: Reposit Power, p. 1; Energy Queensland, pp. 9-10.
89 Submissions to the consultation paper: AER, p. 2; Wattwatchers, pp. 2-3; EnergyAustralia, pp. 2, 7; CEC, p. 2.

with the NEO as it enables a timely, cost-efficient mechanism suitable to the scope of the issue.

Similar to many stakeholders, the Commission considered that the other technical requirements identified in the rule change request do not require urgent attention in the same way as inverter performance and grid responsiveness. This was consistent with AEMO's current approach, as noted above. As stated in the draft rule determination, these issues are significant and appropriate responses to concerns about interoperability and communications, and cybersecurity (including options other than mandating standards across the industry) should be considered by all relevant parties promptly to enable timely implementation to support the integration of DER in the NEM.

In its draft rule determination, the Commission stated that the technical scope of the DER Technical Standards in the NER would be that set out in Standards Australia's AS 4777.2:2015 *Grid connection of energy systems via inverters — inverter requirements* in its entirety. For the avoidance of doubt, the text and content of AS 4777.2:2015 was not replicated in the draft rule or otherwise in a subordinate instrument. Instead, the Commission created an obligation for compliance with the standard through a reference in the NER. This approach was employed on the basis that it would prevent divergence between the requirements relevant in the NEM and the industry-standard set out in AS 4777.2.

In its draft rule determination, the Commission noted that the DER Technical Standards would only apply to assets connected after the final rule commenced, or when the assets themselves are upgraded, extended, or replaced. The Commission acknowledged that not applying the new requirements to existing devices limited the immediate impact of making the rule, as identified by several stakeholders. However, the application of new technical requirements on existing devices is significantly more complex and costly and for these reasons, the draft rule did not extend to existing devices.

Standards Australia's AS 4777.2

At the time of the draft rule determination's publication, the current national standard which established the appropriate inverter performance and grid responsiveness capabilities was Standards Australia's AS 4777.2:2015. In general, this standard describes the technical requirements and associated testing for low voltage inverters to safely and efficiently deliver electrical power to the grid. Of particular interest to this rule change process is clause 7.4 of the standard, which states that an inverter device should automatically disconnect in line with passive anti-islanding specifications of undervoltage and overvoltage protection. The particulars are set out in the table below:

Table 3.1: **Passive anti-islanding set-point values**

PROTECTIVE FUNCTION	PROTECTIVE LIMIT	TRIP DELAY	MAXIMUM DISCONNECT TIME
undervoltage	180 volts	1 second	2 seconds
overvoltage	260V	1 second	2 seconds

PROTECTIVE FUNCTION	PROTECTIVE LIMIT	TRIP DELAY	MAXIMUM DISCONNECT TIME
overvoltage	265V	—	0.2 seconds

Source: Standards Australia, *AS 4777.2:2015 Grid connection of energy systems via inverters Inverter requirements*, October 2015. p. 29, Table 13.

However, AS 47777.2:2015 did not include a testing procedure for the above protective function, used to certify the compliance of the asset's behaviour with the standard. As a result of no established testing regime, there were an undefined number of existing inverters in the NEM which can meet this capability.[90]

AEMO's short duration undervoltage response testing requirements

To meet the omission of a testing procedure required to comply with the current standard, AEMO sought to develop testing requirements to enable parties to demonstrate compliance with the protective function of the passive anti-islanding set-point values. As outlined in AEMO's consultation on the initial standard's content, it proposed incorporating a NEM-wide short duration undervoltage response procedure and AS 4777.2:2015 in its initial technical standard.[91] This proposed testing procedure is mostly the same as the testing procedure AEMO developed recently for South Australia.[92] The differences are relatively minor and reflect applying test procedures to the entire NEM rather than only to South Australia.

Also, AEMO made amendments to the testing requirements from the version it first published for consultation on 5 June 2020.[93] The amendments have been made in response to stakeholder feedback provided to AEMO as part of that consultation process.

The Commission's draft rule created a definition of DER Technical Standards which included the requirements of both AS 4777.2:2015 and the version of AEMO's short duration undervoltage response testing requirements for the NEM as referred to above.

For the avoidance of doubt, the Commission noted in the draft rule determination as well as in the draft rule that the short duration undervoltage response requirements, including the mandatory settings tables in new Schedule 5A.2 to the NER, were to be applied during testing of the performance of the (new and replacement) devices only.

90 Notably, the revised standard which was published in December 2020 (AS 4777.2:2020) corrects the test procedure's omission and builds on the technical parameters detailed in the current standard. AS 4777.2:2020 has a twelve-month implementation period. Compliance is required by December 2021.

91 AEMO, *Initial distributed energy resource minimum technical standard*, issues paper, 24 August 2020, pp. 4-5.

92 The testing procedure was included in the South Australian regulatory changes for smarter homes that took effect on 28 September 2020.

93 See: https://aemo.com.au/en/consultations/current-and-closed-consultations/short-duration-undervoltage-disturbance-ride-through-test-procedure

3.2.4 Stakeholder views on the draft determination

Use of AS 4777.2:2020

In submissions to the draft rule determination, the majority of stakeholders expressed broad support for focusing the scope of DER Technical Standards on inverter performance and grid responsiveness only.[94]

Many of these stakeholders also expressed support for including the updated version of AS 4777.2 (that is, AS 4777.2:2020) in the final rule rather than AS4777.2:2015 and AEMO's short duration undervoltage response testing requirements which were specified in the draft rule. [95] However, these stakeholders also suggested a twelve-month implementation period (from the date of AS4777.2:2020 publication, which was 18 December 2020) is necessary to enable parties to meet all the requirements of the 2020 version of the standard.

Dynamic or static reference to AS 4777.2

On the basis that AS 4777.2:2020 would be included in the final rule, some stakeholders suggested that any reference to AS 4777.2 in the NER should not be static as this would allow for any updates or changes to the Australian Standard to automatically flow through to the NER without the need for a rule change process.[96]

ECA noted the importance that the NER reflects the latest version of the standard in order to avoid a situation where rules and standards frameworks are out of sync or the change process imposes a regulatory burden at a cost to consumers.[97]

To achieve this effect, Ausgrid suggested the rule could include wording the effect of "as updated from time to time" to minimise divergence or duplication.[98] Similarly, Energex and Ergon Energy suggested that the use of "or subsequent version" may be appropriate wording to achieve an automatic flow through of updates made to the standard.[99]

Power quality settings

Some stakeholder submissions also discussed the potential application of the power quality settings, and the suitability of these settings in the context of managing voltage disturbances. Several stakeholders raised concerns with the requirement for AEMO's short duration undervoltage response test to select particular power quality response mode settings in accordance with those recommended by ENA.[100] This was on the basis that the power quality response mode settings called up in AEMO's short duration undervoltage response testing requirement were outdated. Instead, these stakeholders suggested using a reference to a

94 Submissions to the draft determination: Simply Energy, pp. 1-2; Ergon Energy and Energex, p. 1; Ausgrid, p. 2; CEC, pp. 2-3; ERM Power, pp. 1-2; Citipower, Powercor, United Energy p. 2; ENA pp. 1-2; Enphase Energy p. 1.

95 Submissions to the draft determination: ECA, p. 2; Enphase Energy p. 1; ENA p. 1; Citipower, Powercor, United Energy, p. 1; Tesla, pp. 8-9; ERM Power, p. 2; CEC, pp. 2-3; Simply, pp. 1-2; Ergon Energy and Energex, p. 1; Ausgrid, p. 1.

96 Submissions to the draft determination: AEMO, p. 2; Ausgrid, pp. 2-3; Energex and Ergon Energy, p. 2; Simply Energy, p. 1; ECA, p. 2.

97 ECA submission to the draft determination, p. 2.

98 Ausgrid submission to the draft determination, pp. 2-3.

99 Energex and Ergon Energy submission to the draft determination, p. 2.

100 Submissions to the draft determination: Ausgrid, pp. 1-2; Energex and Ergon Energy p. 1; CEC, pp. 5-6.

single set of representative settings would ensure suitable functionality and would provide sufficient flexibility to ensure the setting, which often become quickly outdated, maintain currency. To this end, some stakeholders suggested adopting the Region A settings from AS/NZS 4777.2:2020 standard as suitable representative settings.[101]

Other stakeholders opposed adopting the proposed set points for power quality settings under the 2020 standard.[102] AGL expressed support for the immediate adoption of the revised voltage ride through elements of AS 4777.2:2020. However, it recommended the deferral of the revised power quality response modes elements as contained in AS 4777.2:2020 for a period of twelve-months, during which time the AEMC could undertake a cost benefit analysis, drawing on research undertaken in that intervening period.[103] This position was supported by the AEC.[104] The suggested delay in using the AS 4777.2:2020 power quality settings stems from AGL's concern about the potential consumer impacts of those settings if they were to be adopted. In particular, whether regulating inverter power quality response modes is the right approach to addressing overvoltage issues.[105] As such, AGL suggested further analysis to ensure power quality response modes not only support voltage management practices and system security but also do not unintentionally impact customer value and therefore potentially disincentivise consumer uptake and participation in DER.[106]

Recognising other standards

The ECA suggested that the Commission consider the potential for the mutual recognition of standards in its final rule. In ECA's words:[107]

> [t]he vast majority of these technologies [inverters] are not manufactured in Australia and noting there is an IEEE standard for grid inverters and, we understand, there are also European equivalents, we strongly suggest that the AEMC specify either outcomes rather than a prescriptive standard, or allow for mutual recognition of standards.

3.2.5 Final rule determination assessment

Use of AS 4777.2:2020

The Commission's final rule in respect of the technical scope of the DER Technical Standards is consistent with the position put forward in the draft rule to focus on inverter performance and grid responsiveness. Consistent with the draft rule determination, the basis for the DER Technical Standard is Standards Australia's AS 4777.2. A revised version of AS 4777.2, in which short duration undervoltage response testing requirements are included, was published on 18 December 2020. In light of this and stakeholder feedback, the Commission concludes

101 Submissions to the draft determination: Ergon Energy and Energex, p. 1; Ausgrid, p. 1; CEC, pp. 5-6.
102 Submissions to the draft determination: AGL, p. 3; AEC, p. 1.
103 AGL submission to the draft determination p. 4.
104 AEC submission to the draft determination, p. 1.
105 AGL submission to the draft determination, pp. 4-5.
106 AGL submission to the draft determination, pp. 4-5.
107 ECA submission to the draft determination, p. 2.

that it is appropriate to include the most up to date version of AS 4777.2 (that is, AS 4777.2:2020) in the NER.

The final rule maintains consistency with the principles that underpinned the draft rule. As such, AS 4777.2:2020 will be included in the NER in its entirety by a reference. That is, the text and content of AS 4777.2:2020 will not be replicated in the NER.

Dynamic or static reference to AS 4777.2

Using a reference to AS 4777.2:2020 as in force from time to time in the NER has the benefit of preventing divergence between the requirements relevant in the NEM and the industry-standard set out in AS 4777.2. To achieve this outcome, the reference of AS 4777.2 includes the phrase "as in force from time to time" and is therefore not a static reference.[108] This will allow for any updates made to AS 4777.2 to automatically flow through and assists in avoiding a situation where rules and standards frameworks are out of sync. As such, the Commission considers this approach balances stakeholder feedback with regard to the need to maintain consistency in the use of AS 4777.2 with the need to limit the regulatory burden required to make changes to update the standard.

Power quality settings

The Commission acknowledges the concerns of stakeholders in respect of the application of the power quality response modes as set out in AS 4777.2:2020. It also recognises the possibility, at least in the short term as the provision of market services to manage voltage issues continue to emerge, that technical difficulties in operating networks will become exacerbated under certain conditions. To this end, there is likely to be merit in specifying technical requirements, applicable to certain forms of DER. This route would support the ability of DNSPs and AEMO to manage voltage disturbances and the Commission expects that this would provide both direct and indirect benefits to both DER owners and other electricity users.

In addition to concerns around the application of the power quality response modes established under AS 4777.2:2020, some stakeholders considered that the additional features of the 2020 standard are not well enough understood to be made mandatory in the NER. These stakeholders were generally of the view that only the undervoltage disturbance ride through component of the AS 4777.2:2020 standard should be incorporated into the NER. This would provide the opportunity for further consideration of the other elements included in the updated AS 4777.2.

The Commission has considered the merits of this approach closely, seeking technical input from Standards Australia, AEMO and other stakeholders. Ultimately, it does not agree that an approach that includes the undervoltage disturbance ride through requirements from AS 4777.2:2020 in isolation would be the most appropriate option. The Commission is concerned that such an approach presents timing challenges in terms of coordinating with technical experts to develop this solution. In addition, there is significant doubt that the undervoltage disturbance ride through requirements from AS 4777.2 can be separated from other

108 NER Chapter 10.

requirements in the 2020 standard. Therefore, in line with the preference expressed by many stakeholders, the Commission's final rule includes AS 4777.2:2020 in its entirety.

In addition, the Commission understands that the Standards Australia committee that undertook the review and update of AS 4777.2 involved a broad balance of representation of parties impacted by updates to the standard. As part of this process, committee members are provided a range of opportunities to provide comment, input and technical information to aid the development of the standard prior to its finalisation. As such, the Commission is satisfied that the differences between AS 4777.2:2020 and AS 4777.2:2015 have been adequately considered and agreed through consensus by committee members.

Recognising other standards

As noted above, the ECA suggested the Commission consider the mutual recognition of standards when making the final rule. The Commission has discussed this matter further with stakeholders and has concluded that the existing standards arrangements adequately address the issue. In particular, the Commission understands that mutual recognition arrangements work through recognising and accepting the technical competence of each country's conformity assessment bodies to test and certify products for compliance with the standards and regulatory requirements of the other party. This is different to ECA's suggestion to allow for products not manufactured to Australian Standards but meeting other international standards for grid inverters to be recognised in Australia.

However, it is important to note that AS 4777.2 draws on information and guidance by other international bodies involved in developing standards for inverters to ensure the features of the AS 4777.2 are aligned with international developments. In addition, managing the adoption of international standards or particular elements of international standards requires, in many instances, a process of conversion to ensure that the requirements meet the safety and market arrangements in Australia. In light of this, it is the Commission view that AS 4777.2 remains the most appropriate standard to apply to inverters in the NEM through the final rule.

3.3 Devices to be covered by the standard

3.3.1 AEMO's view

In its rule change request, AEMO proposed that the initial technical standard should apply to the DER devices included in its proposed DER definition. That is:[109]

> 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.

109 AEMO, Rule change request, p. 22.

AEMO stated that the scope of this definition 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.[110]

In addition, AEMO proposed that only new and replacement devices would be covered, the requirements would not apply retrospectively to existing DER devices.[111]

3.3.2 Stakeholder views on the request

Stakeholders provided numerous comments regarding what the proposed technical standards should cover devices. These are outlined in the table below.

Table 3.2: **Stakeholders' views on what devices should be covered by a standard**

STAKEHOLDER VIEWS ON OUTCOMES AND SERVICES	STAKEHOLDER VIEWS ON DEVICES
AGL stated that the technical standard should "consider the nature of the services provided" as a means to DER integration, instead of device-centric integration (p. 3).	AGL asserted that self-consumption specific DER should not be covered by the DER Technical Standard (p. 3).
ARENA suggested that market-based approaches, inclusive of incentives to contribute to power system security, should not be " lost in the consideration of technical standards" (p. 3).	ARENA suggested that the standard recognise a full range of technologies, such as large scale and small scale generating inverters, especially to withstand short-term voltage disturbances. Also, the definition should align with the DER register (pp. 1, 4).
Plus ES considered that outcomes should be the focus, as well as solution agnostic. Also, developing a standard on current technical solutions could discourage innovative solutions (p. 3).	Plus ES stated that "[the standard] should apply to any devices which can provide measurement and/or control of electrical power flowing through that device" except where power and control capabilities should be separate (p. 3).
Tesla considered that market interaction with DER and standards should be "fully technology agnostic", more focused on removing barriers to entry (p. 8).	Tesla stated that it did not support a DER definition that included or excluded systems from different markets and services (p. 7).
Energy Queensland opined that consideration on customers' value of controllable load and	Energy Queensland commented that exempt generation (>200 kW, <5 MW) poses

110 AEMO, Rule change request, p. 22.
111 AEMO, Rule change request, p. 15.

STAKEHOLDER VIEWS ON OUTCOMES AND SERVICES	STAKEHOLDER VIEWS ON DEVICES
giving control of load should be made with price signals (p. 8).	particular risks to power quality and impact the system which could be considered under the technical standard (p. 8).
Intellihub stated that standards should, under best endeavours, specify outcomes at the connection point, not technology-centric solutions for individual devices, like generator performance standards (p. 4).	Solar Analytics stated that "[the standard] should include all large loads including hot water and air conditioners" (p. 2).
Wattwatchers considered that describing the nature of services rather than describing devices that can provide services would likely better integrate DER with future market services (p. 3).	
The AER did not object to the proposed definition of DER but noted the risks of creating a definition when technology is evolving rapidly. It urged that any definition should be capable of extension to new technologies that may become available (p. 3).	
AEMO noted that, while its rule change request could progress without a definition of DER, as technical standards typically set out technical requirements for assets such as electrical equipment, plant and devices, a definition that refers to assets may be more suitable than one that focuses on services (p. 4).	
Vector supported a high-level definition of DER based on service standards of service levels, rather than on minimum technical standards or specifications. This is because standards may limit the potential for innovation by narrowing the potential outputs that technologies can deliver (p. 5).	

Source: Submissions to the consultation paper.

While acknowledging it is appropriate to consider the type of service or function that a DER device provides, other stakeholders believed that a DER definition in the NER was unnecessary.[112]

Jemena commented that the standard does not need to apply to all DER but rather the device that controls the DER between the power system.[113] Ausgrid observed that the NER currently has definitions for small generating units and different classifications of embedded generators in Chapter 5A, including micro embedded generators as defined by the scope of AS 4777. In its view, these definitions could be used to cover the minimum technical standards required for the significant area of concern such as the voltage disturbance ride through capability of inverter energy systems.[114]

3.3.3 Draft rule determination assessment

The Commission's draft rule determination stated that the DER Technical Standards would apply to new connections and replacements of inverters connecting micro embedded generation within a distribution network by way of a basic micro EG connection service. Micro embedded generation connection as defined in Chapter 5A of the NER includes the connection of an embedded generating unit of the kind contemplated by Australian Standard AS 4777 (Grid connection of energy systems via inverters) currently up to 200kVA and connected to a distribution network.[115] The draft rule did not apply DER Technical Standards to existing installed equipment.

As the intent of the DER Technical Standard is primarily to address the potential impacts that household (or small) solar PV generation has on the grid, the Commission considered it appropriate that the requirement to meet the DER Technical Standard should be focused on solar PV systems connected via an inverter to a distribution network. As previously noted, such systems are treated as micro-embedded generating units under existing rules.[116] While the term micro-embedded generation covers solar PV inverters, it may also apply to other devices such as residential batteries and electric vehicles. As these devices are also capable of generating energy that can be exported to the distribution network, the Commission considered that where batteries and electric vehicles do use a basic micro EG connection service, there is no reason to exclude these inverters the requirements of the DER Technical Standards.

The Commission considered that using the term micro embedded generator is appropriate to determine the devices to which the DER Technical Standards will apply. It considered this a more preferable approach than developing a new definition of DER as proposed by AEMO. Using micro embedded generators as the basis for the DER Technical Standards devices would best address this rule change's particular immediate issues. Also, it does not

112 Submissions to the consultation paper: Reposit, p. 2; Jemena, p. 2; Ausgrid, p. 4; ENA, p. 4.
113 Jemena submission to the consultation paper, pp. 4-5.
114 Ausgrid submission to the consultation paper, p. 7.
115 ENA, *Distributed energy resources grid connection guidelines*, May 2018, p. 2.
116 NER clause 5A.A.1.

unnecessarily confine the development of DER or the future scope of the DER Technical Standards in the Australian electricity system.

Further, the Commission noted in the draft rule determination that the class of asset that is most relevant to the key issue raised (inverter performance and grid responsiveness) in the rule change request is micro embedded generation.

As a result, the draft rule utilised the existing definitions in the NER, forgoing the need to create a new definition of broader "connected DER". The local definition in Chapter 5A of the NER of a *micro embedded generator* is:

> means a *retail customer* who operates, or proposes to operate, an *embedded generating unit* for which a *micro EG connection* is appropriate.

Where an *embedded generating unit* is defined in Chapter 10 as:

> A *generating unit* connected within a *distribution network* and not having direct access to the *transmission network*.

And where a *micro EG connection* is defined in Chapter 5A as:

> a *connection* between an *embedded generating unit* and a *distribution network* of the kind contemplated by *Australian Standard* AS 4777 (Grid connection of energy systems via inverters).

In the draft rule determination, the Commission determined that these definitions sufficiently covered the DER assets, contributing to power quality issues on low voltage distribution networks. Applying the DER Technical Standard to a new connection and replacement devices' inverters and connection alterations (including upgrade, extension, expansion or augmentation) devices was considered to be consistent with the purpose of the Australian Standard for low voltage inverters that deliver electrical power to the grid.

In its draft rule determination, the Commission concluded that utilising an already defined and recognised type of asset best specifies the DER Technical Standards' technical scope and addresses the issue AEMO proposed to resolve. It noted that this definition does not preclude the future inclusion or exclusion of other assets specifically. The approach would also allow for the inclusion of new devices that fall within the definitions above as they are developed and become available to electricity consumers. Accordingly, the Commission considered the draft rule fit for purpose, meeting the issues raised by the rule change request and that if made, it would be likely to achieve the NEO.

3.3.4 Stakeholder views on the draft determination

Submissions to the draft rule determination were broadly supportive of the application of the DER Technical Standards to new connections and replacements of inverters connecting micro

embedded generation by way of a micro EG connection service.[117] However, a number of stakeholders sought clarification with regard to three points.

First, both Citipower, Power and United Energy and Ergon and Energex sought clarity as to the size limit that the DER Technical Standards would apply to based on the use of the existing NER definition of micro EG connection.[118]

Second, some stakeholders also sought clarity about the treatment of replacement of inverters which are replaced on a 'like-for-like' basis under warranty. The CEC suggested that the Commission clarify in its final rule determination that the DER Technical Standard does not apply to the like-for-like replacement of inverters under warranty. The CEC stated that this approach would be "necessary to ensure [that] customers continue to enjoy their existing rights and that no unnecessary additional costs are incurred if there is a need to replace an inverter under warranty".[119] Similarly, Citipower, Powercor and United Energy noted that suppliers may seek to provide replacements under warranty that are compliant under the previous standards. As such, they suggested that the Commission's final rule should make clear whether this is allowed.[120]

Third, Ergon Energy and Energex noted that the requirement for all micro embedded generation connecting by way of a micro EG connection service to meet the DER Technical Standard may require further consideration with regard to its application of the standard to standalone power systems (SAPS). These stakeholders considered that flexibility around SAPS connections is required as those inverters will not necessarily comply with AS 4777.2. For this reason, the final rule should clarify that the DER Technical Standard does not apply to SAPS.[121]

3.3.5 Final rule determination assessment

Application of DER Technical Standards to micro embedded generation connecting by way of a micro EG connection service

The draft rule applied the DER Technical Standards to new connections and replacements of inverters connecting micro embedded generation within a distribution network. As stated in the draft rule determination, the Commission considers that using the term micro embedded generator is appropriate to determine the devices to which the DER Technical Standards will apply. With regard to providing clarity as to the size limit of generation system that the DER Technical Standards apply to, the Commission relies on the existing definition of micro EG connection as set out in Chapter 5A of the NER. This definition necessarily includes the connection of an embedded generating unit of the kind contemplated by Australian Standard AS 4777 (Grid connection of energy systems via inverters) currently up to 200kVA and connected to a distribution network. Using this definition, rather than specifying 200kVA,

117 Submissions to the draft determination: ERM Power, p. 1; Citipower, Powercor and United Energy, pp. 1-2; Ergon Energy and Energex, p. 2.

118 Submissions to the draft determination: Citipower, Powercor and United Energy, pp. 1-2; Ergon Energy and Energex, p. 2.

119 CEC submission to the draft determination, p. 5.

120 Citipower, Powercor and United Energy submission to the draft determination, p. 2.

121 Ergon Energy and Energex submission to the draft determination, p. 2.

enables the application of the final rule to change without the need for a rule change if the size recognised by AS 4777 changes in the future.

Application of DER Technical Standards to all new and replacement inverters

The Commission's final rule on the application of the DER Technical Standard to new and replacement inverters (which necessarily includes like-for-like replacements under warranty) is consistent with the draft rule.

The Commission notes that under the South Australian Smarter Homes program, like-for-like replacements under warranty are permitted. On this, it acknowledges the unique circumstances and time constraints faced in the implementation of short duration undervoltage ride through requirements for inverters in South Australia. These requirements were implemented in conjunction with other more costly technical requirements for inverters as part of the Smarter Homes program. The policy decision to permit like-for-like warranty replacements and limit the financial impact of replacing an inverter that would otherwise fall on the consumer, should be viewed in this context.

The Commission notes that the new Smarter Homes requirements for manufacturers supplying inverters into the South Australian market have been in place since September 2020. The majority of these manufacturers, who also sell inverters in other NEM jurisdictions, will have been manufacturing inverters with short duration undervoltage ride through capability for a period of almost 15 months by the time the Commission's final rule comes into effect. Consequently, the Commission considers that the majority of manufacturers and installers that currently hold inverter stock that does not comply with AS 4777.2:2020 will have had sufficient time to use this stock by December 2021. As a result, there should be limited stock of inverters not compliant with undervoltage disturbance ride through capability held.

In terms of customer impacts, the Commission has consulted relevant stakeholders on their views. As a result, it is the Commission's expectation that consumers connecting micro embedded generation to a distribution network will not see significant price increases as a result of manufacturers uplifting inverters to meet the requirements of AS4777.2:2020. Thus, any financial impact on a consumer requiring an inverter replacement under warranty should be limited.

On this basis, the Commission does not consider it necessary to exempt like-for-like replacements under warranty from the requirement to comply with AS 4777.2:2020. The Commission is satisfied that this approach is consistent with the NEO as it provides a clear, workable requirement that limits compliance complications while meeting the primary objective of the rule: to address ride through issues with inverters connected in the distribution networks.

Clarification that the DER Technical Standard does not apply to SAPS

The Commission notes Ergon Energy and Energex's position that the DER Technical Standard should not apply to SAPS. In the *Updating the regulatory framework for distributor-led stand-*

alone power systems review 2019, proposed drafting established a requirement that each DNSP proposing to develop a regulated SAPS must publish applicable technical standards.[122] The purpose of having DNSPs determine technical and performance standards in this context is to give DNSPs the flexibility to develop appropriate standards for nascent SAPS technologies and operation, particularly in instances where existing NER technical standards are not directly applicable to SAPS.

The Commission continues to consider that this approach is appropriate for SAPS. The Commission also considers that the proposed drafting for distributor-led SAPS do not present any conflict with the rules amended to give the DER Technical Standard effect.[123]

3.4 Duration of the standard

3.4.1 AEMO's views

Although positioned expressly to create an "initial" technical standard for DER, the AEMO rule change request detailed that there is a need for:

- developing standards in the future — consistent with the COAG Energy Council's direction to the ESB in developing a future governance arrangement
- a flexible framework to enable easy updating of standards when necessary.

As a result, the rule change request proposed a rules-based structure to introduce an initial minimum technical standard for DER, a base-level standard as a starting point, while allowing for subsequent standards over time. Nevertheless, the AEMC's consultation paper did seek stakeholder feedback on whether the role of AEMO in setting DER minimum technical standards (the subordinate instrument) should be limited in time.

3.4.2 Stakeholder views on the request

There was broad stakeholder support to review the technical standard, if made, in the future. However, there was no consensus on the detail of the review, for instance, the timing, trigger, or responsible party.

For example, Ausgrid and EnergyAustralia pointed to "a future date", while Citipower, Powercor and United Energy suggested a date agreed by all stakeholders. ERM Power and Reposit Power suggested a periodic or scheduled review if one was to be carried out at all.[124]

Stakeholders also held different views on why the review should be established. For example, Ausgrid considered that a review would provide a back-stop in case future arrangements did not eventuate. At the same time, Reposit Power suggested regular reviews would manage stakeholders' investment risk or concerns.[125]

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122 AEMC, *Updating the regulatory framework for distributor-led stand-alone power systems review*, 2019, p. 67.

123 The rules for SAPS have not yet been made. They will be implemented by way of a SA Minister made rule and are expected to be consulted on in the first quarter of 2021.

124 Submissions to the consultation paper: Ausgrid, p. 8; EnergyAustralia, p. 6; CitiPower, Powercor and United Energy, p. 2; ERM Power, p. 2; Reposit Power, pp. 3-4.

125 Submissions to the consultation paper: Ausgrid, p. 8; Reposit Power, pp. 3-4.

Furthermore, some stakeholders suggested a review was required due to the proposed rule's intent, including how relevant participants would be obligated to comply with (potentially) overlapping standards, governance, or clear roles and responsibilities down the supply chain.[126]

Conversely, ARENA questioned the intention of the proposed rule to prescribe standards, instead of minimum service levels or non-standards-based outcomes, as was argued would make more sense to be limited by the NER or by review.[127]

A common theme concerning reviewing the proposed technical standards' scope was the involvement or importance of a longer-term governance body. Some stakeholders suggested that the suggested long-term responsible body undertake a review. However, others maintained that deciding whether to carry out a review should be deferred to this body. For example, Energy Queensland stated that a long-term governance body should undertake a review of the standard. However, Wattwatchers suggested that a "considered approach" would defer the decision until an appropriate governance structure is established.[128]

In addition to this, there was reasonable consensus across submissions that limiting the proposed standard in the NER would best account for alignment with a future governance mechanism, consistency with the NEO, or to address barriers or challenges imposed by the rule.[129] A review of the technical standard, as suggested by PIAC, could establish if the standards are, and remain, fit for purpose.[130]

Limiting the life of the standard

A wide range of feedback was received on whether the proposed standard (located in a subordinate instrument as proposed) should have a limited lifespan.

Some stakeholders commented that, given the impending ESB governance arrangement review process, the decision to limit the standard should be an outcome of the ESB review. Alternatively, the standard should cease to continue when the longer-term governance arrangement comes into effect. For example, AGL suggested a sunset clause. In contrast, Jemena suggested establishing a future governance body would allow that body to decide on an appropriate time to review the initial standard.[131]

Submissions by ERM Power and Intellihub suggested limiting the role of AEMO to "urgently required standards" and that it "makes sense" to limit the time this role is in effect. Also, these stakeholders commented that the standards should be periodically reviewed and amended as needed.[132] Further, SAPN explained that limiting the standard's duration without limiting its scope could lead to perverse outcomes, like rushed standards on minimal

126 Submissions to the consultation paper: CEC, p. 4; Tesla, p. 8; AER, p. 2.
127 ARENA submission to the consultation paper, pp. 2-3, 5.
128 Submissions to the consultation paper: Energy Queensland, p. 12; Wattwatchers, p. 3.
129 Submissions to the consultation paper: Intellihub, p. 5; Plus ES, pp. 4-5.
130 PIAC submission to the consultation paper, p. 2.
131 Submissions to the consultation paper: AGL, p. 7; Jemena, p. 6.
132 Submissions to the consultation paper: ERM Power, p. 2; Intellihub, p. 5.

consultation.[133] Similarly, Ausgrid suggested that a limit on duration could provide cause to limit by other means, such as per jurisdiction.[134]

3.4.3 Draft rule determination assessment

The draft rule determination noted that stakeholders appeared to value a framework that enables the reviewing and updating technical standards as circumstances change over time. In principle, this is consistent with Standards Australia's approach to standard-setting and updating.

The Commission considered this particular issue in light of its decision to establish DER Technical Standards through the NER. In this context, it noted the DER Technical Standards could evolve as Standards Australia updates AS 4777.2. In addition, under the draft rule the DER Technical Standards could also be amended by amending the new Schedule 5A.2 of the NER through a rule change process.

The Commission acknowledged stakeholder concern about using a rule change process to update requirements like the DER Technical Standards. To this point, it noted:

- amendments which do not have a significant impact on the NEM may satisfy the criteria to be considered as an expedited rule change request, a process which usually takes eight weeks
- that appropriate and relevant public consultation carried out before the lodgement of a rule change request may enable the request to be considered through a fast track rule change process
- a standard rule change process takes over about six months.

With these public consultation processes available to any party, the Commission considered that it was not necessary or desirable to create a bespoke change mechanism for the DER Technical Standards. It was satisfied that the cost and time in creating a bespoke process for the draft rule would duplicate functions and outweigh any potential benefits.

The draft rule approach to managing the DER Technical Standards does not pre-empt future governance arrangements that may be put in place. The Commission noted that the rule change request lodged by Dr Kerry Schott AO (Chair of the ESB) on long-term governance arrangements for the DER Technical Standards could result in a change to the arrangements set out in the draft rule.

In the draft rule determination, the Commission stated that it had decided not to limit the life of those standards by specifying an end date. Nor did the Commission include a review mechanism in the draft rule as stakeholders could submit a rule change request any time to initiate consideration of a change to the standards.

133 SAPN submission to the consultation paper, p. 5.

134 Ausgrid submission to the consultation paper, p. 8.

3.4.4 Stakeholder views on the draft determination

The Commission did not receive any comments to the draft rule determination that concerned the standard's duration, except where discussing potential changes to the draft implementation approaches. These are discussed in Chapter 7.

3.4.5 Final rule determination assessment

The Commission's final rule is consistent with that expressed in its draft rule determination. That is, it is not necessary to specify an end date for the standard nor establish a new bespoke review mechanism for the standard. Importantly, this position does not in any way limit the development of any future governance arrangements for DER Technical Standards.

On balance, the Commission considers that this approach is appropriate and consistent with achieving the NEO. It enables changes to the DER Technical Standards to occur through a public consultation process without the cost, or potential duplication, of establishing a new bespoke process.

3.5 Cost of establishing the standard

3.5.1 AEMO's view

AEMO, both in the rule change request and its subsequent consultation on the content of the initial standard, noted the costs of establishing technical standards for DER in terms of the revised AS 4777.2, which holds additional functionalities, that manufacturers would bear.

In terms of benefits from technical standards, AEMO focused on the individual benefits, such as enabling access to new markets and benefits and whole-of-system benefits, such as cost mitigation, and the operational efficiencies that a baseline technical capability could provide.[135]

3.5.2 Stakeholder views on the request

The majority of stakeholders provided feedback on the potential costs of the initial standard. Some stakeholders identified where additional costs could occur, such as implementing and increasing testing or compliance requirements.[136] Moreover, stakeholders provided feedback on the need to balance benefits to power system security and the costs across the supply chain, to prevent against stifling innovation.[137]

The CEC noted that given the very open-ended nature of the AEMO proposal, it was difficult to conceive how the costs and benefits would be rigorously assessed.[138] Ausgrid expressed concern that:[139]

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135 AEMO, Rule change request, pp. 2, 13; AEMO, *Initial distributed energy resource minimum technical standards*, issues paper, 24 August 2020, p. 18.

136 Submissions to the consultation paper: Jemena, p. 8; SAPN, p. 6 which also raised that any additional new costs are not covered under the five-year regulatory revenue allowance; Tesla, p. 8 which also raised that additional costs would likely be incurred from overlapping standards or specific standard to jurisdictions or DNSPs; Essential Energy, pp. 1-4; AGL, pp. 2, 8.

137 Submissions to the consultation paper: Jemena, p. 8; Red Energy and Lumo Energy, p. 2; Vector, pp. 1-2, 7.

138 CEC submission to the consultation paper, p. 6.

139 Ausgrid submission to the consultation paper, p. 3.

> The proposal does not appear to have adequately considered the potential cost impacts on all customers... In the short-term, if a rule is to be made, we would prefer a rule that is limited in time, scope and potentially jurisdiction to immediate, short-term system security needs.

Stakeholders also expressed concern for the costs and impact on future DER consumers. These concerns included how additional costs to devices would impinge on the falling cost curve of household DER and how that compares to DER and non-DER consumers.[140]

Energy Queensland also raised concerns on the recovery of compliance costs — whether that is as incurred or smeared across all consumers — and whether consumer losses would be considered.[141] Furthermore, the AER noted that any high additional costs to manufacturers or in compliance and monitoring are ultimately borne by consumers, which ought to be ascertained through a regulatory impact statement.[142]

Stakeholders expressed significant concern that AEMO did not provide any cost-benefit analysis on the scope of its proposed technical standards in its rule change request. Vector submitted that it would be consistent with good regulatory practice for AEMO's proposal to be subject to a cost-benefit analysis.[143] Red Energy and Lumo Energy raised concerns about the impact of AEMO's proposed scope of the standard on the cost to consumers:[144]

> Consumers will inevitably bear the cost of the proposed changes (through increased costs for their solar systems and potentially increased network charges owing to new responsibilities for managing ongoing compliance with the standards). Regulation must therefore be fit for purpose and pass an adequate cost benefit analysis to ensure that consumers do not face unnecessary increased costs.

Accordingly, many stakeholders indicated an interest in the proposed technical standards being subject to a cost-benefit analysis.[145] Stakeholders suggested some variables which could be critical in valuing the costs and benefits such as comparing the standard to a non-standard alternative, valuing reductions in wholesale price from additional DER, identifying the direct costs to new DER installations and the indirect costs of compliance and monitoring, and importantly the cost impact to consumers.[146]

Other stakeholders noted the absence of a holistic cost-benefit analysis in AEMO's rule change request. They attempted to identify stakeholder groups likely to bear the costs of the proposed technical standard. For example, Reposit identified 11 areas of potential costs, both direct and indirect, linked to AEMO's proposed standard scope. These included that system

140 Submissions to the consultation paper: Dr Martin Gill, p. 1; Energy Australia, p. 1; Solar Analytics, p. 1.

141 Energy Queensland submission to the consultation paper, pp. 5, 11.

142 AER submission to the consultation paper, p. 3.

143 Vector submission to the consultation paper, p. 1.

144 Red Energy and Lumo Energy submission to the consultation paper, p. 3.

145 Submissions to the consultation paper: AER, p. 3; Energy Queensland, p. 11; Vector, p. 7; Tesla, p. 8; SAPN, p. 6; AGL, p. 8; ARENA, p. 4; Ausgrid, pp. 2-4; ENA, p. 6; Solar Analytics, p. 1.

146 Submissions to the consultation paper: ARENA, p. 4; Ausgrid, pp. 2-4; ENA, p. 6; Solar Analytics, p. 1.

strength and inertia should be paid for by the market, rather than categorising some MWh as "overgeneration" and that minimum technical standards for DER may:[147]

- inhibit revenue-generating and cost-saving functionality of DER now and into the future
- have the potential to exclude DER from large portions of wholesale market value.

3.5.3 Draft rule determination assessment

In its draft rule determination, the Commission acknowledged stakeholders' views that there could be high costs in establishing a technical standards framework for DER as outlined in the rule change request.

However, the Commission's approach to establishing DER Technical Standards in the draft rule focused on the critical issue identified by the rule change request while also seeking to limit the costs of implementing a standards framework. Central to this was establishing requirements around the DER Technical Standard within existing governance and compliance arrangements. Thus, limiting the need to create bespoke compliance arrangements for the AER or an additional governance framework to update the standards over time.

Overall, the Commission was satisfied that the draft rule achieved the sought-after benefits while minimising the costs of creating an obligation to comply with a technical standard for DER.

3.5.4 Stakeholder views on the draft determination

Stakeholders who provided comments on the cost of implementing the draft rule were generally positive. These stakeholders acknowledged that the Commission put forward an approach, relative to the rule change request, with low implementation costs and administrative burden.[148]

However, some stakeholders noted the challenges of assessing the costs and benefits, impacts on business, and impacts on customers where new standards and regulations related to electrical regulation are introduced.[149] Tesla considered this is a critical gap that should be further considered in the DER Technical Standards Governance rule change request.[150]

QEUN also sought clarity from the AEMC on how the number of changes in AS4777.2:2020, which go beyond voltage disturbance ride through, would be treated in the final rule. This question was raised on the basis that the technical detail of those additional features of the standard are not widely accessible or understood, particularly by consumers who will purchase or replace inverters prior to the new standard becoming mandatory.[151]

147 Reposit Power submission to the consultation paper, pp. 6-7.
148 Submissions to the draft determination: Simply Energy, p. 1; AER, p. 2.
149 Submissions to the draft determination: CEC, p. 3; Tesla, p. 4.
150 Tesla submissions to the draft determination, p. 8.
151 QEUN submission to the draft determination, p. 1.

3.5.5 Final rule determination assessment

Specific comments were made by Tesla and QEUN on whether the AEMC would assess costs and benefits of adopting AS 4777.2:2020 (or particular parts of the standard) in the NEM. The Commission understands stakeholders' desire to seek surety that a decision to introduce new requirements into the NEM is beneficial. However, not all potential impacts of a decision can be described by a monetary value. The Commission makes its assessment through considering the rule change request, submissions from stakeholders and other relevant information in the context of the framework of the NEO.

In this case, the Commission's conclusion is consistent with that expressed in its draft rule determination. That is, the final rule is likely to contribute to achieving the NEO because it creates arrangements that enable DNSPs and AEMO to address and manage the negative impacts of significant levels of small scale solar generation within distribution networks that may arise on occasions.

The cost impact of the final rule has been limited by the Commission by not extending the final rule beyond the identified critical issue of inverters' voltage ride through capability. Nevertheless, the rule also enables the arrangements to develop and update over time as needed without limiting the possibility of cost effective market-based solutions to emerge. In addition, the Commission has made a final rule that addresses the issue without creating additional regulatory requirements or processes that may duplicate existing, established practices. The Commission has also been mindful to provide sufficient time for industry participants to adjust to the new requirements.

3.6 Commission's final rule determination assessment on the scope and duration of the DER Technical Standard

The growth of DER in the NEM to date has been rapid as more and more consumers make investments into these assets. The Commission recognises that this appears likely to continue for some time with a growth in the breadth of devices which could be classified as DER. Integration of consumer-led DER is critical to enable consumers to benefit from their investments directly while also providing benefits to electricity consumers more generally as well as the power system.

However, DER can also exacerbate, or in some instances cause, power quality issues in a distribution network which can impact on the efficient integration of DER as well as result in challenges in the operation of distribution networks and the whole power system. As indicated by the ESB, AEMO and stakeholders, of particular importance to this issue is the degree to which DER inverters in the aggregate perform and respond to the power system to a standard that manages their response to voltage disturbances.

In this way, the Commission has determined that, proportionate to the impact and urgency of the issue, the technical scope of the DER Technical Standard set out in the final rule is AS4777.2:2020.

The devices which will be required to meet this technical standard will be micro embedded generating units because this class of asset is recognised as delivering electrical power to the

grid through low voltage inverters. The DER Technical Standards that apply to these devices will not have an explicit end date nor has a predefined review been specified in the final rule.

Noting the consumer-led growth of DER, the Commission has been conscious to limit the cost of the final rule and has not required the creation of new regulatory requirements and processes, the cost of which could be passed onto consumers. It has also provided a transition time of ten months for industry to prepare for compliance with the DER Technical Standards.

4 GOVERNANCE ARRANGEMENTS

This chapter sets out AEMO's proposed governance arrangements for the DER Technical Standards, stakeholder views and the Commission's assessment; and outlines the Commission's final rule determination to establish DER Technical Standards in the NER rather than creating an instrument subordinate to the NER in which to house the standard.

4.1 AEMO's views

AEMO's rule change request did not include a proposed rule but set out a framework outlining how initial minimum technical standards could be introduced. It proposed that a new rule be inserted into Chapter 3 of the NER that set an obligation on AEMO to make, publish and, if necessary, amend initial DER minimum technical standards. AEMO would be required to create these initial technical standards in an instrument that was subordinate to the NER.[152]

AEMO anticipated that it would carry out a consultation process to develop the content of the initial technical standard at the same time that the AEMC would carry out this rule change process. This would enable an initial technical standard to be published at the time the final rule would be made, consistent with the COAG Energy Council's plans.[153]

AEMO asserted that developing a framework to allow for the implementation of DER minimum technical standards through a subordinate instrument would provide flexibility and allow for the technical standards to be easily updated to reflect the evolution of technology.[154] In addition, AEMO considered that establishing a subordinate instrument would enable technical requirements to be introduced over time with consultation.[155]

4.2 Stakeholder views on the request

4.2.1 Proposed introduction of a subordinate instrument

In general, stakeholders did not support establishing a subordinate instrument to enable AEMO to set initial minimum technical standards for DER.[156] In many cases, this was on the basis of in-principle support for the existing Australian Standard's standard development process and a preference to see the finalisation of the ESB's review on governance of DER standards prior to establishing any form of enduring governance arrangement.[157]

In fact, a number of stakeholders explicitly stated that if the Commission considered that there was merit in establishing technical standards for DER to meet immediate short-term outcomes, then these would be best achieved by setting the initial standards in the NER with

152 AEMO, Rule change request, p. 16.

153 AEMO, Rule change request, p. 17.

154 AEMO, Rule change request, p. 16.

155 AEMO, Rule change request, p. 18.

156 Submissions to the consultation paper: AGL, p. 2; Ausgrid, p. 5; Tesla, p. 7; ENA, p. 2; CEC, p. 2; Vector, p. 3; Dr Martin Gill, p. 1; EnergyAustralia, p. 1; Caravan and Camping Industry Association NSW (CCIA NSW), p. 3; CitiPower, Powercor and United Energy, p. 2; Reposit, p. 3; Energy Queensland, p. 3; Wattwatchers, p. 2.

157 ESB, *Governance of DER technical standards*, consultation paper, July 2020, p. i.

a clear end date and by limiting the scope of the initial standards to addressing immediate concerns.[158]

Wattwatchers, Vector, Energy Australia, Dr Martin Gill, the AER and ARENA urged consideration with regard to the potential market impacts of introducing an initial standard such as, risks and costs to manufacturers and industry, impacts on future opportunities for innovation (that is, new markets for services) and cost to consumers.[159] In particular, Dr Martin Gill considered that AEMO's proposal may limit the potential for future market services to develop by restricting how solar loads are able torespond (for instance, the development of demand response services may be hampered if technical specifications are enforced).[160] Similarly, ARENA noted that it is important that the need to enhance the underlying incentives for market participants to contribute to power system security is not lost in the consideration of DER Technical Standards.[161]

In contrast to these views, Landis+Gyr and ERM Power expressed support for the introduction of minimum technical standards through a subordinate instrument. They considered that a subordinate instrument would allow for future flexibility in resetting standards as technologies and markets develop.[162]

Jemena also expressed support for the creation of a subordinate instrument in the NER, provided an end date is specified for the initial standard.[163] The South Australian Department for Energy and Mining supported the development of a subordinate instrument by AEMO in order to support the continued integration of DER.[164]

4.2.2 Appropriate body for the management of the standards

Many stakeholders expressed concern with the proposal for AEMO setting the initial DER technical standard in the absence of any enduring and clear governance arrangements to support comprehensive consultative processes in the development of technical standards.

While AGL supported AEMO's role in contributing towards the development of appropriate technical standards for DER with insights on system security and market operation, it did not consider AEMO to be the appropriate body to manage technical standards for DER. AGL considered Standards Australia, as an independent body skilled in standards setting, continues to be best placed to develop and adopt technical standards that reflect international best practice through broad stakeholder engagement and with the support of relevant industry expertise.[165]

158 Submissions to the consultation paper: Ausgrid, p. 5; ENA, p. 2; CCIA NSW, p. 3; CitiPower, Powercor and United Energy, p. 2; Reposit, p. 3.

159 Submissions to the consultation paper: AER, p. 1; Vector, pp. 4-5; Dr Martin Gill, p. 1; Energy Australia, p. 6; Reposit, p. 3; Wattwatchers, p. 2; ARENA, p. 3.

160 Dr Martin Gill submission to the consultation paper, p. 1.

161 ARENA submission to the consultation paper, p. 3.

162 Submissions to the consultation paper: Landis+Gyr, p. 1; ERM Power, p. 2.

163 Jemena submission to the consultation paper, p. 1.

164 South Australian Department for Energy and Mining submission to the consultation paper, pp. 1-2.

165 AGL submission to the consultation paper, p. 4.

Reposit Power suggested that a number of other technical regulatory bodies are better placed than AEMO to set technical standards for DER. These included Standards Australia, the Australian Cyber Security Centre (ACSC), DNSPs, the AEMC's Reliability Panel, and state and territory technical regulators.[166]

The CEC, EnergyAustralia and ARENA, for example, considered that AEMO should only have responsibilities for technical standards that relate to its specific set of functions relevant to power system security.[167] Similarly, Intellihub suggested that AEMO's role should be limited to any issues that urgently require new standards to address system security risks before a longer-term governance model is implemented.[168]

Endeavour Energy suggested that the development of the DER technical standard, AEMO-led or otherwise, should account for the views of network service providers who are well placed to establish (or identify) minimum standards required to support effective network operation.[169] Solar Analytics considered that the development of a DER technical standard should be guided by a technical reference group.[170]

A number of stakeholders expressed support for improvements to AEMO's proposed governance arrangements for initial minimum DER technical standards to ensure decisions with regard to the standards remain customer-focused, evidence-based and contemplate other crucial matters, including safety, economic efficiency and innovation.[171] These stakeholders generally considered that the ESB's review of governance arrangements would be the most suitable pathway to establish arrangements for the setting of technical standards, including the relevant body, safeguards and consultative requirements.

4.3 Draft rule determination assessment

4.3.1 Locating the initial standard in the NER

In its draft rule determination, the Commission concluded that the DER Technical Standards to regulate inverter performance should be established in the NER. The Commission noted this was a simplified approach to address the immediate issues raised by AEMO compared to the proposal set out in AEMO's rule change request. This simpler approach would mitigate the system security risks presented by short-duration undervoltage ride-through promptly. It would also allow for the long-term governance of the DER Technical Standards to be subject to appropriate consideration in the future.

For the introduction of the DER Technical Standards to be effective, the Commission noted it is important that the appropriate structures are in place to support transparent governance and timely implementation. Subsequently, the Commission did not consider it would be practical or appropriate for DER Technical Standards to be prescribed by AEMO through a

166 Reposit Power submission to the consultation paper, p. 1.
167 Submissions to the consultation paper: CEC, p. 2; ARENA, p. 1; EnergyAustralia, p. 1; Intellihuib, p. 5.
168 Intellihub submission to consultation paper, p. 5.
169 Endeavour Energy, submission to the consultation paper, p. 2.
170 Solar Analytics submission to the consultation paper, p. 1.
171 Submissions to consultation paper: AGL, p. 5; Tesla, p. 4; Ausgrid, p. 4; ARENA, p. 3; Energy Queensland, p. 2; Jemena, p. 1.

subordinate instrument. This was largely consistent with the feedback provided by stakeholders in submissions to the consultation paper.

In its draft rule determination, the Commission acknowledged that there is merit in establishing DER Technical Standards to meet the immediate system security concerns. However, it also noted that it is important that the approach taken to address the urgent inverter performance issues is proportional and able to be implemented quickly. The draft rule determination therefore established the DER Technical Standards in the NER. In doing so, the DER Technical Standard would not require any additional governance arrangement to be established at this time.[172] This approach balanced feedback from industry in submissions to the consultation paper regarding the potential market impacts and risks of implementing the suite of standards proposed by AEMO with the need for standards to be in place as soon as practicable.

Accordingly, the Commission's draft rule determination concluded that establishing the DER Technical Standards in the NER with a focus on inverter performance is proportional to the scope and urgency of the issues raised by AEMO. It is consistent with the key intent of AEMO's proposed approach.

The Commission considered that the draft rule would be likely to better contribute to the achievement of the NEO than AEMO's proposed approach as it will allow for the efficient and timely implementation of technical standards for DER without the risk of implementing technical standards beyond what is currently required, or with the need to establish additional governance arrangements.

4.3.2 AEMC as the body responsible for the standards

As the draft rule determination established the DER Technical Standards in the NER, the AEMC would be the body responsible for the management of the DER Technical Standards.

The Commission considered that this approach would materially reduce the impact of the rule change on industry by allowing existing governance structures to be utilised. The Commission considered it appropriate that the standard is housed in the NER and that it be the responsible body for setting the initial standard. This was considered preferable to requiring a new process to establish a subordinate instrument with new governance processes for that new instrument.

Importantly, the Commission's draft rule determination noted that to establish the initial DER Technical Standards to meet immediate issues does not limit any future governance structures that may be put in place.

4.4 Stakeholder views on the draft rule determination

In submissions to the Commission's draft rule determination, most stakeholders expressed strong support for the inclusion of the DER Technical Standards in the NER. [173] Some

172 Draft NER rule S5A.2.

173 Submissions to the draft determination: Solar Analytics, p. 1; Ausgrid, p. 1; Energy Queensland, p. 1; Simply Energy, p. 1; AGL, p. 1; AEC, p. 1; CEC, pp. 2-3; ERM Power; Tesla, pp. 1- 2; Citipower/Powercor/United Energy. p. 1; ENA, pp. 1-2; AGL, p. 3.

stakeholders however, identified the potential for conflicting obligations, such as between the NER and state and territory electricity Acts. [174] Moreover, stakeholders provided feedback on the need to be considerate of and consistent with any new national arrangements for the governance of DER Technical Standard being proposed by the ESB as part of its rule change request. [175]

The CEC and Tesla noted that an important issue that should be considered for the final rule is how locating the DER Technical Standard in the NER would interact with the existing jurisdictional regulatory frameworks. [176] Both submissions noted that AS 4777.2 is currently referenced in AS3000 (the 'wiring rules') and therefore gains legal force through state and territory electrical regulations. As such, these stakeholders suggested that the Commission should consider how to avoid any conflicting obligations between the NER and state and territory regulations. In particular, Tesla suggested the Commission should focus on ensuring that the inclusion of AS 4777.2 in the NER does not create an additional compliance pathway inconsistent with existing compliance arrangements under state and territory regulations.[177]

In addition, Tesla expressed the view that there is a current lack of a body that has adjudicative authority for responding to queries on ambiguities, and/or consumer complaints for Australian Standards.[178] Tesla suggested that an adjudicative body will be particularly important if there are ever any conflicts across national or state and territory compliance pathways. While Tesla acknowledged that this is a broader issue, it suggested it is an issue that needs to be addressed due to the introduction of AS 4777.2 in the NER.

ECA sought clarity with regard to how future updates to the standards would be handled. ECA suggested that it is important that the NER reflects the latest version of the standard to avoid a situation where rules and standards frameworks are out of sync or the change process imposes a regulatory burden at a cost to consumers.[179]

Simply Energy, ECA, AEMO and Tesla expressed strong support for new national arrangements for the governance of DER Technical Standards to be prioritised.[180]

AEMO noted that the draft rule is an important first step in putting in place measures necessary to ensure the ongoing safe and secure operation of the NEM.[181] It also noted that further work beyond this immediate rule change, including Dr Kerry Schott's rule change request to establish a new governance framework for the development of additional DER Technical Standards, needs to be prioritised. [182] AEMO considered it is critical that this further work progresses urgently as the risks presenting from rooftop solar continue to emerge across the NEM. [183]

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174 Submissions to the draft determination, CEC, p. 3; Tesla, p. 6.
175 Submissions to the draft determination, ECA, p. 2; Tesla, pp. 5-7; Simply Energy, p. 1.
176 Submissions to the draft determination, CEC, p. 3; Tesla, p. 6.
177 Tesla submission to the draft determination, p. 6.
178 Tesla submission to the draft determination, p. 6.
179 ECA submission to the draft determination, p. 2.
180 Submissions to the draft determination: ECA, p. 2; Tesla, pp. 5-7; Simply Energy, p. 1; AEMO, p. 1.
181 AEMO submission to the draft determination, p. 1.
182 AEMO submission to the draft determination, p. 1.
183 AEMO submission to the draft determination, p. 2.

Simply Energy expressed support for the AEMC to be responsible for the management of the DER Technical Standards in the interim until the governance arrangements are resolved.[184] However, Tesla reiterated (although generally supportive of the draft rule determination) that the draft rule ought to have been postponed until the governance framework was made.[185]

The ECA also reiterated its earlier comment on whether a national rule change is needed at this time given the arrangements that have been established to address the priority issues in South Australia.[186]

4.5 Final rule determination assessment

The Commission's final rule determination remains the same as that made in the draft rule determination. Consistent with the draft rule, the key aspects of the final rule include:

- locating the initial standard in the NER
- establishing the AEMC as the body responsible for the management of the DER Technical Standards.

4.5.1 Locating the initial standard in the NER

The Commission acknowledges that some stakeholders are concerned about the potential for conflicting obligations as a result of AS 4777.2 being called up in the NER and jurisdictional regulations. However, the Commission's decision to require compliance with AS 4777.2 as amended from time to time, without reference to a particular version or component of the standard, assists in maintaining consistency between national and jurisdictional requirements. As stated in Chapter 3, the version of AS 4777.2 introduced into the NER will automatically include any future updates to the standard, as is the case in jurisdictional instruments.

The Commission expects that introducing AS 4777.2 into the NER in this way allows for any changes to the standard to flow through and will allow for alignment with how the standard is typically used in jurisdictional regulations. This limits the risk of establishing multiple compliance pathways and the potential for any conflicts to arise as a result of duplicate compliance requirements. On this basis, the Commission does not consider it appropriate or necessary in this rule change process to establish an adjudicative body to manage and respond to queries about AS 4777.2 due to the limited potential for misalignment across compliance requirements.

The Commission considers that the final rule's inclusion of AS 4777.2 in the NER is likely to better achieve the NEO than AEMO's proposed approach as it will allow for the efficient and timely implementation of technical standards for DER without the risk of implementing technical standards beyond what is currently required, or with the need to establish additional governance arrangements.

184 Simply Energy submission to the draft determination, p. 1.
185 Tesla submission to the draft determination, pp. 5-7.
186 ECA submission to the draft determination, p. 4.

4.5.2 AEMC as the body responsible for the standards

Given the final rule establishes the DER Technical Standards in the NER, the AEMC will be the body responsible for the management of the DER Technical Standards for the NEM. As set out above and in the draft rule determination, this approach has the benefit of quickly establishing effective oversight of the DER Technical Standards without significant cost. The Commission considers this is important in the context of the urgency to address DER capability to withstand power system disturbances. However, it is important to stress that this final rule to establish the initial DER Technical Standards to meet immediate issues does not limit any future governance structures that may be put in place.

The ESB undertook a review into what arrangements could be put in place for the long-term governance framework for DER technical standards.[187] This review resulted in the submission of a rule change request proposing different governance arrangements to those put forward by AEMO in its rule change request.[188] The rule change request on enduring governance arrangements proposes that the AEMC, with the assistance of an advisory committee, be the responsible body for setting DER Technical Standards. The Commission anticipates that the rule change process for the Governance of DER Technical Standards will commence by mid 2021.

187 ESB, *Governance of DER technical standards,* consultation paper, July 2020.

188 Dr Kerry Schott AO, Governance of distributed energy resources technical standards rule change request, 21 September 2020.

5 NETWORK CONNECTION AGREEMENTS

This chapter outlines the Commission's final rule determination and the requirements established within the NER to give effect to the initial DER Technical Standards through DNSPs' network connection agreements.

The final rule requires DNSPs to include in the terms and conditions of their model standing offers, if the connection service is a basic micro EG connection service, a requirement that all newly connected or replacement micro embedded generators must comply with the DER technical standards.

This requirement also applies to negotiated connection contracts for micro EG connection services and is a mandatory requirement to be included in connection offers.

Other than expression of general support, the Commission received limited stakeholder feedback on the draft rule's requirement for DNSPs to include the DER Technical Standards in connection agreements made under Chapter 5A. Consequently, the Commission's policy on network connection agreements outlined in the draft rule determination have been retained and included in the final rule.

This chapter provides an overview of the current connection framework in the NER and discusses the treatment of grid connected generation in the NEM. Stakeholders' views on including technical standards in DNSPs' connection agreements and the Commission's assessment in respect of this issue are provided in this chapter.

5.1 Connection arrangements and technical standards in the NEM

5.1.1 Current connection arrangements in the NEM

Obligation to provide connection services

The current connection framework, governing electricity connections for small and large customers as well as embedded generators (that are not registered participants) in the NEM, consists of components related to (i) offers for new connections and connection alterations and (ii) connection service charges. It is the first of these components that is more directly relevant to establishing initial technical standards for DER — for example, offers for new connections or alterations may impose specific requirements such as safety and technical requirements.

In jurisdictions that have adopted the National Energy Customer Framework (NECF), the obligation to provide connection services is imposed on DNSPs under the NERL.[189] The relationship between DNSPs and retail customers in relation to the provision of connection services is set out in detail in Part 4 of the NERR. Under Part 4, Division 3 of the NERR, a DNSP is obliged to provide a deemed standard connection contract for a new connection or a connection alteration within its distribution network. The connection contract commences on acceptance by the customer of the distributor's connection offer for a new connection or

189 NERL ss. 66(1) and (2). No consumers in Victoria are covered by the NECF. However, they are covered by protections under the Victorian Energy Retail Code which applies protections similar to many of those in the NECF.

connection alteration in accordance with the requirements under Chapter 5A of the NER. At the same time as the contract for a new connection commences (discussed in the following section), a deemed standard connection contract is also formed. The deemed standard connection contract establishes the terms and conditions upon which the DNSP will provide ongoing connection services once a new connection is established.

Types of connection offers

Connection offers set out both the applicant's and DNSP's obligations and form the basis of the connection contract once accepted by the applicant. The types of connection services for new and altered connections for NEM retailer customers are specified in Chapter 5A of the NER. These are:

Basic connection services: apply where the provision of connection services between a distribution network and a retail customer's premises involves minimal or no augmentation to the distribution network, and a model standing offer has been approved by the AER for providing that service as a basic connection service.[190] In general, these services cover the majority of simple connections by NEM retailer customers, including those customers that are micro embedded generator connections (for example, residential rooftop solar systems).

A DNSP must submit to the AER for approval and publish a model standing offer for basic connection services. A DNSP can publish different model standing offers for different subclasses of basic connections, for example, one offer for a basic connection with only load and one offer for a basic connection including micro embedded generation.[191] A DNSP's model standing offer must specify terms and conditions, such as a description of the connection, including a statement of its maximum capacity, or if the service is connection of a micro embedded generator, the particular requirements regarding the export of electricity into the distribution network.[192] The terms and conditions may also refer to jurisdictional or other legislation and statutory instruments that impose specific requirements (such as qualifications of the service provider, and safety and technical requirements) to be complied with by the provider of a contestable service, in jurisdictions where contestability in connection services exists.

Standard connection services: apply where the provision of connection services involves augmentation of the distribution network. Offers for standard connection services typically apply to larger developments and embedded generators (including non-registered embedded generators) that are not micro-embedded generators.[193]

Negotiated connection services: apply where a connection service sought by a connection applicant is neither a basic nor a standard connection service, or the connection

190 Part B, Division 1 of Chapter 5A of the NER.

191 A micro-embedded generator is defined in cl. 5A.A.1 as a retail customer who operates, or proposes to operate, an embedded generating unit for which a micro embedded generator connection (of the kind contemplated by AS 4777: Grid connection of energy systems via inverters) is appropriate. In essence, a micro-embedded generator is a retail customer who has small, inverter-based generating equipment, such as a rooftop solar PV system.

192 NER clause 5A.B.2(b).

193 A non-registered embedded generator is an embedded generator who is neither a micro-embedded generator or a Registered Participant. Non-registered embedded generators that fall under the NER Chapter 5A connection process can elect to use the connection process under Chapter 5, which applies to registered embedded generators and represents are more detailed process.

applicant elects to negotiate the terms and conditions on which the connection service is to be provided. The negotiations between a DNSP and a connection applicant are governed by the rules set out in Part C of Chapter 5A of the NER.

Chapter 5A also applies to embedded generator proponents seeking to connect a generating system of less than the standing exemption from the requirement to register as a Registered Participant with AEMO (currently 5 MW), or who hold an exemption from the requirement to register with AEMO. These are known as:

- micro embedded generators (embedded generator connections that comply with Australian Standard AS 4777)
- non-registered embedded generators (a system of less than 5 MW but larger than a micro-embedded generator, or a system of 5 MW or greater that holds an exemption from the requirement to register with AEMO).

5.1.2 NEM technical standards and the treatment of grid-connected generation devices

DNSPs are required to meet a range of technical regulations and design and performance standards when supplying customers and designing their networks. These are imposed at both national and jurisdictional levels. Technical standards applicable in the NEM are set out in Schedules 5.1a to 5.3a of the NER. These schedules define the level of performance required of the equipment that makes up, and is connected to, the power system. The overall power system is operated to these standards and this allows the power system operator, AEMO, to effectively manage power system security. These system standards are also important as the level of technical performance standards that are provided by DNSPs to customers have implications for the power quality, reliability and safety outcomes received by these customers. Therefore, they are also important tools for managing power quality, reliability and safety obligations for distribution networks.

In order to manage a customer's impact on network power quality, reliability and safety, a DNSP can impose conditions on entities and individuals connecting to its network through connection agreements. These operate in tandem with jurisdictional requirements, such as the Service and Installation Rules (or similar) established in and by each jurisdiction.[194] Service and Installation Rules are primarily designed to define and co-ordinate the relationship between a licensed distributor and its customers.

5.2 AEMO's views

AEMO's rule change request did not include a proposed rule but set out a framework on how minimum technical standards could be introduced. It proposed that a new rule be inserted into Chapter 3 of the NER that sets two key obligations. Firstly, an obligation on AEMO to make, publish and, if necessary, amend DER minimum technical standards. Secondly, an obligation on DNSPs to ensure that connected DER, either by its own means or by way of a

194 For example, the Service and Installation Rules of New South Wales is the recognised industry code in NSW outlining the requirements of electrical distributors when connecting a customer to the distribution systems of NSW. They reflect the requirements outlined in the *Electricity Supply Act 1995* and Chapter 5A of the NER.

DER device, meet the DER minimum technical standards (including without limitation, through the inclusion of appropriate provisions in connection agreements).

AEMO proposed that initial DER minimum technical standards be inserted into the minimum content requirements of connection contracts, negotiation frameworks and model standing offers, and into the model standing terms under Chapters 5 and 5A of the NER.[195] It also suggested that the standard could be recognised in the deemed standard connection contracts prescribed in Schedule 2 to the NERR. AEMO suggested that if these changes were put in place in the NER and NERR, they should allow for:[196]

- the introduction of an initial standard to be published alongside the proposed new rule
- 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 of the standards to occur, on an as needs basis in response to developments in technology or, for example, new cyber threats.

AEMO proposed that the minimum technical standards apply to newly connected DER devices (and replacements) for which the DNSP has visibility (and not existing connections).[197]

5.3 Stakeholder views on the request

The majority of stakeholders conditionally supported including the minimum technical standards in DNSPs' minimum content requirements of connection contracts, negotiation frameworks and model standing offers.

Jemena considered this could be achieved through supplementing obligations in Chapters 5 and 5A of the NER for connection of embedded generators to ensure DER meet minimum technical standards.[198] Reposit Power suggested that placing minimum standards in connection contracts would be suitable and noted that in present arrangements AS 4777 is often referenced in inverter energy system connection contracts.[199]

Energy Queensland expressed concern that requirements for customers' technical standards to be maintained via the network connection agreement with the relevant DNSP may create conflict with jurisdictional obligations.[200]

However, a number of stakeholders did not support the approach to including minimum standards in connection agreements. For example, Wattwatchers considered minimum standards should be published in the NER to improve the accessibility and transparency of the minimum standards.[201]

195 AEMO, Rule change request, p. 25.
196 AEMO, Rule change request, pp. 16-17.
197 AEMO, Rule change request, p. 15.
198 Jemena submission to the consultation paper, p. 2.
199 Reposit Power submission to the consultation paper, p. 4.
200 Energy Queensland submission to the consultation paper, p. 3.
201 Wattwatchers submission to the consultation paper, p. 2.

Similarly, Ausgrid considered that minimum standards are more appropriately set out in either the NER or AS 4777.2 to ensure transparency and accessibility.[202] While SAPN agreed that minimum technical standards should be reflected in DNSPs' connection contracts, it suggested that this reference should be based on the applicable Australian Standards.[203]

Some stakeholders supported the proposal that any initial standards should only apply to new or replacement devices, noting that applying the standards to installed devices would be challenging and costly.[204]

5.4 Draft rule determination assessment

In its draft rule determination, the Commission concluded that DNSPs should be obliged to ensure in their connection offers and connection contracts that new or replacement embedded generating units the subject of a basic micro EG connection service must be compliant with DER Technical Standards. The draft rule required DNSPs to include in their connection contracts made under Chapter 5A of the NER a requirement that all connections for micro embedded generation by way of a basic micro EG connection service must comply with the DER Technical Standards.

To give effect to the policy intent, the draft rule required DNSPs to:

- include in model standing offers for basic connection services for retail customers who are seeking to connect micro embedded generators by way of a basic micro EG connection service the requirement that the relevant embedded generating unit complies with the DER Technical Standard[205]
- include in the information that the applicant requires in order to negotiate a connection contract on an informed basis, the requirement that if the connection applicant is proposing to connect an embedded generating unit by way of a basic micro EG connection service, that the micro embedded generating unit must be compliant with the requirements of the DER Technical Standards[206]
- include in the minimum content requirements of connection offers under Schedule 5A.1 to the NER a requirement that if the connection applicant is proposing to connect an embedded generating unit by way of a basic micro EG connection service, that the embedded generating unit that is subject of the connection application is compliant with the DER Technical Standards.[207]

The Commission considered that this approach would materially reduce the impact of introducing technical standards by utilising the existing contractual arrangements for connection contracts. It also considered that DNSPs hold the necessary skills, resources and

202 Ausgrid submission to the consultation paper, p. 5.
203 SAPN submission to the consultation paper, p. 4.
204 Submissions to the consultation paper: CEC, p. 3; Wattwatchers, p. 2; AGL, p. 2; Plus ES, p. 2; Solar Analytics, p. 2; Essential Energy, p. 3.
205 Draft NER clause 5A.B.2.
206 Draft NER clause 5A.C.3.
207 Draft NER clause S5A.B(a)(7a).

processes in place to meet the obligations set out in the draft rule and arising from increasing numbers of embedded generator connections.

In addition, the Commission considered that it is practical and appropriate for DNSPs to incorporate the DER Technical Standards into model standing offers, negotiation frameworks and minimum content requirements for connection offers applying to new or replacement micro embedded generation. This was on the basis that establishing an obligation to ensure compliance at the point of connection approval relies on the processes DNSPs have in place for the connection of embedded generation, including the requirements of Chapter 5A of the NER.[208] The Commission considered that in general, these arrangements to establish technical standards in the NER are consistent with the key intent of AEMO's proposed approach.

In the draft rule determination, the Commission commented that, consistent with the current provisions of Chapter 5A of the NER, the AER would continue to approve model standing offers for connection contracts and assess that they are reasonable and comply with the requirements of the NER.

It was also noted that as the draft rule would only relate to the connection of micro embedded generation, only Chapter 5A and not Chapter 5 of the NER was amended.

The Commission also considered how changes to the clauses in Chapter 5A of the NER may have implications for the application of the rule in the Northern Territory. It concluded that the clauses in Chapter 5A of the NER that are modified will not affect the application of the rule in the Northern Territory. Accordingly, the draft rule was applied as a uniform rule in the Northern Territory.

Further, the Commission noted that as no draft rule is being made for the NERR (the reasons for the Commission's decision are set out in section 2.5 of Chapter 2) there is no need to consider the implications for Victorian customers that may arise because the NECF does not apply in that jurisdiction. The draft rule, because it only makes changes to the NER, would apply in the same manner in Victoria as it would in other NEM jurisdictions.

On balance, the Commission considered that the implementation of the DER Technical Standards through DNSPs' connection agreements was a necessary and proportionate response because it would allow for identified system security issues caused by increasing small scale solar generation connections to be addressed in an efficient and timely manner.

5.5 Stakeholder views on the draft rule determination

Stakeholders who commented on the proposed requirement for DNSPs to include the DER Technical Standards in connection agreements made under Chapter 5A were broadly supportive of this change.[209]

208 The compliance arrangements for the initial standard are discussed further in Chapter 6.

209 Submissions to the draft determination: CEC, p. 1; ENA, p. 2; Ausgrid, p. 2; AER, p. 2.

ENA and Ausgrid noted that it has been a long-standing requirement that all DNSP connection agreements require inverters be compliant with the latest AS 4777 standard. [210] Therefore, these stakeholders do not foresee any significant issues in incorporating the latest standard in future connection agreements. The ENA also stated its intention to work with members to update its basic and LV connection guidelines once this rule change process is finalised.[211]

While supportive of the approach to using existing processes for network connection agreements, Simply Energy noted that placing any additional requirements on DNSPs may result in higher network charges for all customers. [212]

The AER noted that its expectation is that once the new rules are in place, it will work closely with DNSPs to update their connection agreements, including where possible by (i) the submission of early draft changes to connection agreements and (ii) limiting amendments to these agreements to implement compliance. [213]

5.6 Final rule determination assessment

In light of submissions and other feedback provided by stakeholders, the Commission is satisfied that its assessment made in the draft rule determination remains appropriate.

The use of existing processes for network connection agreements and compliance arrangements limits the impact of any additional requirements placed on DNSPs. Accordingly, the Commission does not consider that the proposed requirements on DNSPs would result in increases in network charges for customers.

As a result, the final rule requires DNSPs to include in their connection agreements made under Chapter 5A of the NER a requirement that all new and replacement embedded generating units the subject of a basic micro EG connection service must be compliant with DER Technical Standards. This is given effect through the final rule which requires DNSPs to include a requirement for new and replacement embedded generating units connecting by way of a basic micro EG connection service to meet the DER Technical Standard:

- in model standing offers for basic connection services[214]
- in the information that the applicant requires in order to negotiate a connection contract on an informed basis[215]
- in the minimum content requirements of connection offers under Schedule 5A.1 to the NER.[216]

210 Submissions to the draft determination: ENA, p. 2; Ausgrid, p. 2.
211 ENA submission to the draft determination, p. 2.
212 Simply Energy submission to the draft determination, p. 2.
213 AER submission to the draft determination, p. 2.
214 NER clause 5A.B.2.
215 NER clause 5A.C.3.
216 NER clause S5A.B(a)(7a).

Consistent with the current provisions of Chapter 5A of the NER, under the final rule the AER will continue to approve model standing offers for connection contracts and assess that they are reasonable and comply with the requirements of the NER.

The Commission is satisfied that this rule change is consistent with the NEO as it avoids imposing a significant regulatory burden on DNSPs and inefficient costs of a new, potentially duplicative compliance system on electricity consumers.

6 COMPLIANCE ARRANGEMENTS

This chapter sets out the Commission's final rule determination in relation to the compliance arrangements for the DER Technical Standards. Specifically, that the management of compliance through DNSPs' connection agreements will meet the need for effective compliance on the required inverter functionality.

In addition, the Commission continues to consider that the existing compliance and monitoring systems under the Clean Energy Council (CEC) and the Clean Energy Regulator (CER), relating to the certification of products and installers of inverter-based electricity generating systems, are complementary to the overall compliance arrangements.

This chapter sets out the current arrangements in place for technical requirements of DER, stakeholder comments on AEMO's proposed approach and then the Commission's final determination and reasons. This chapter also describes the operation of compliance arrangements managed through connection agreements, product testing to meet AS 4777.2, and the certification and monitoring of inverter products and installers through CEC and CER processes.

6.1 Existing technical requirements and compliance and monitoring arrangements

6.1.1 Network connection agreements

DNSPs determine the technical requirements for basic, standard and negotiated connection services for connection of embedded generation to the distribution networks.[217] Chapter 5A of the NER sets out terms and conditions which are to be included by DNSPs in their contracts with retail customers for the connection of small scale generation to the distribution networks. Relevantly, for both basic and standard connection services, the NER requires that DNSPs must set the "safety and technical requirements (including jurisdictional and other legislation and statutory instruments under which the requirements are imposed)".[218] For negotiated connections, DNSPs are required to determine the technical requirements for a proposed new connection or alteration.[219] Through the use of customer connection contracts, the NER requires DNSPs to establish technical obligations for networks which device manufacturers and installers of connected embedded generation are required to meet.

DNSPs are also bound by legal obligations set out in state electricity and electrical safety legislation and codes, and the conditions of their distribution licenses.[220] In determining technical requirements for a connection contract, DNSPs are to consider these regulatory obligations and the operating needs of their network.[221]

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217 See Chapter 5 of this final rule determination for a detailed discussion of DNSPs' obligations to provide connection services and the types of connection offers.

218 For connection requirements set out in the NER, see clause 5A.B.2(4) in relation to basic connection services, clause 5A.B.4(4) for standard connection services and 5A.C.3(5) for negotiated connection services.

219 Clauses 5A.b.4(4) and 5A.C.3(5) of the NER.

220 For example, in Queensland jurisdictional legislation, including the *Electricity Act 1994* and *Electricity Regulation 2006*, places network performance obligations on DNSPs Energex and Ergon Energy.

221 For example, under Ausgrid's model standing offer, the electrical installation and the premises' connection assets must comply

6.1.2 Australian Standard AS 4777 performance testing

Australian and international standards are voluntary until called up in a legal instrument. In the NER, AS 4777 is referenced in Chapter 5A in the definition of micro embedded generation connection to refer to a type of inverter-based generation.[222] In doing so, this reference to the standard has the effect of requiring that all micro embedded generating units connected to a distribution network are of the kind contemplated by AS 4777. However, managing adherence to the standard remains a challenge.

At the product level, the existing process for achieving compliance with AS 4777.2 relies on devices undergoing relevant testing from a Standards Australia recognised testing facility. If the device has demonstrated the appropriate capabilities and receives a testing certificate of approval, the device is deemed to meet the standard. This is characteristic of a performance-based approach to standard setting which requires the devices of manufacturers to undergo an initial testing process and treats the behaviour of the tested sample devices as indicative of the function of all devices of that type once installed. An outcome of this approach is that devices not meeting AS 4777.2 in the field (for example, due to malfunction or installation fault) are difficult to detect.

6.1.3 Compliance and monitoring arrangements for the production and installation of inverters

Currently, inverter compliance with AS 4777.2 is governed at the product testing level and also at the installation level by random inspections. Solar energy system suppliers, inverter suppliers and electrical contractors are required to supply and install only AS 4777.2 compliant inverters.

Compliance through the connection approval process relies on the processes DNSPs have in place for the connection of embedded generation, including the requirements of Chapter 5A of the NER. Various DNSPs also validate inverter energy system applications against the CEC's list of compliant inverters and power conversion equipment that are approved under the Small-Scale Renewable Energy Scheme (SRES).[223] A number of state government programs also require installed products to be approved by the CEC in order to participate.[224]

The equipment listed by the CEC is equipment that has demonstrated sufficient evidence that it meets the required safety standards for use in Australia. In order to be approved by the CEC, the inverter must be independently certified by a Joint Accreditation System of Australia and New Zealand (JAS-NZ) accredited certification agency, or by a state electrical safety regulator. Test reports must be submitted to the CEC along with the certificate and a fee. The process of application for inclusion in the CEC's approved product list is outlined in Box 1.

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with the requirements of (as applicable) the *NSW Service and Installation Rules*, any requirements specified by Ausgrid under the *Electricity Supply Act 1995, the Electricity Supply (General) Regulation 2014, the Electricity Supply (Safety and Network Management) Regulation 2014, the Electricity (Consumer Safety) Act 2004* or the *Electricity (Consumer Safety) Regulation 2015.*

222 NER clause 5A.A.1.

223 https://www.cleanenergycouncil.org.au/industry/products/inverters/approved-inverters

224 For example, the Victorian Solar Homes Program and the NSW Empowering Homes Program both establish the use of equipment on the CEC approved lists as a conditional requirement for the installation of solar system under the respective programs.

BOX 1: CEC APPROVED PRODUCT LIST APPLICATION PROCESS

To apply for inclusion on the CEC's approved products list, applicants are required to:

- Ensure product is tested to the Australian and/or IEC standards by an accredited testing laboratory
- Ensure product is independently certified by a Joint Accreditation System of Australia and New Zealand (JAS-ANZ) accredited certifying bodies or state electrical regulators
- Ensure all importers or manufacturers of the product register with the Electrical Regulatory Authorities Council (ERAC) (this is a product identification record)
- Application fees associated with applying to have an inverter listed with the CEC cost $5000 + GST.

Source: https://www.cleanenergycouncil.org.au/industry/products, viewed 23 November 2020.

In conjunction with the product approval lists, the CEC also carries out a testing and compliance program. This involves CEC internal audits of inverters included in its database of approved products and their relevant certifications and targeted product testing. The CEC purchases selected devices from the Australian market (either based on risk-based profiling or random selection) and has them tested at multiple certified testing laboratories. The CEC can reject an application to list a product and to de-list a product that ceases to comply with the relevant terms and conditions of listing.

DNSPs do not have a direct ability to manage the installation of inverters.[225] As a result, DNSPs rely on the CER administered schemes for the certification of installers and the monitoring of installed generating units under the SRES. As part of the scheme, the CER is required to conduct random inspections of small scale generation units which have had small-scale technology certificates created against them. Inspections are conducted to confirm that the selected systems meet all the installation requirements of the SRES. This includes the system including components that are listed on the CEC's list of approved products.[226] As a result of such inspections, the CER can identify installations that do not meet the electrical and building standards of Australia, and installers that have breached the CEC accreditation guidelines. The CER has also recently indicated its intention for and additional component to its inspection program that focuses on inverter settings.

6.1.4 Roles and responsibilities in installing or replacing inverters for micro embedded generation

Roles and responsibilities

A number of parties are involved in the process for small customers seeking to install a micro embedded generating unit. Each of these parties has different roles, responsibilities and

225 Note that individual DNSPs may have additional requirements above and beyond the CEC's list requirements.

226 To be eligible to create small scale technology certificates, the small generation unit's solar panels and inverter must be on the CEC's list of approved components, and the system must be installed by a CEC accredited electrician.

obligations in managing the installation, replacement and compliance of inverters used as part of installing a micro embedded generating unit.

- **Customer**: customers are responsible for making arrangements with an installer and their energy retailer to submit a connection application to the DNSP and arrange any necessary metering work. Typically, the solar or battery storage installer will work with the customer to guide them through these processes.
- **Retailer**: retailers are responsible for organising and coordinating all metering work.
- **Installer**: installers are responsible for performing the installation in accordance with network connection agreements and jurisdictional safety and technical licensing arrangements. The installer is required to install the system, conduct a test to ensure its functionality, and collect information about what is installed on site. This information, treated as a certificate of completion and assurance that the inverter operates in accordance with the requirements of Australian Standards, is then provided to the customer, the DNSP and the retailer. Installers are also required to collect and provide information to AEMO to include in the DER Register.[227]
- **DNSP**: DNSPs are responsible for processing applications for connections and authorising network connections. In some instances, DNSPs perform connection inspections and system audits.

The responsibilities of each party differ slightly depending on whether the inverter installation is for a new connection or is a replacement under warranty. This is because the installation steps are different for each scenario, including the number of parties involved in the installation process.

Installing or replacing inverters

The different scenarios for installing or replacing an inverter can broadly be grouped into two categories:

1. **Customer initiated installation or upgrade**: These include inverter installations as part of newly connected embedded generation or to upgrade a larger unit to the network.
2. **Replacement of malfunctioning inverter:** These include the replacement of faulty or malfunctioning inverters.

Before installing solar PV panels and batteries at a business or residence, the customer (or their agent, typically the installer) must gain permission from their local DNSP to connect to the network by making a network connection application.[228] Once submitted, the DNSP will conduct a network technical assessment to determine the impact of the solar power installation on the network, and the size of the system the applicant may connect. Only once a connection application has been approved and accepted by the DNSP, in the form of a connection offer, can any physical work commence for the connection.

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227 The NEM's DER Register launched on 1 March 2020. It is a database of information about DER devices installed across the NEM at residential or business locations. This information will be requested by network services providers from qualified electrical contractors and solar installers at the time of the DER installation. The DER Register is maintained by AEMO and further information can be found at: https://aemo.com.au/energy-systems/electricity/der-register/about-the-der-register

228 The regulatory framework for small loads and generating systems connecting to a distribution network is set out in Chapter 5A of the NER.

As the NERR specifies that all new meters must be advanced, customers (or their agents) are required to contact their retailer to organise any required metering work.[229]

To install a solar power or battery storage system at a customer's premise, installers are required to hold an electrical licence and accreditation for their relevant jurisdiction of operation to carry out any work on customer's electrical installations. Licensing requirements can differ by jurisdiction.

Jurisdictional electrical safety regulations also require installers to provide a certificate of completion of their electrical work at a property. Certificates of completion provide assurance that the work performed has been installed and tested to the appropriate standards while confining the electrician's responsibility to the work actually done. In NSW, for example, electricians have to provide a completed Certificate of Compliance for Electrical Work (CCEW) to NSW Fair Trading, within seven days of completing any safety and compliance test, on an electrical installation.[230] A copy of the CCEW form also needs to be submitted to the consumer, the DNSP and the retailer. Similar requirements apply in other jurisdictions.

Once a certificate of completion is received by the DNSP, the DNSP may choose to inspect the system. In certain circumstances systems energised and connected to the distribution network may be deemed unsafe if they do not comply with Australian Standards.

If the inverter requires replacement due to fault, this work must be performed by an electrician and/or solar installer as relevant who is qualified to do such work. Notice of such work must also be submitted to the relevant DNSP once it is carried out. This provides up to date information on inverter-based installations to the DNSP. The visibility of installed DER devices is increasingly important as, at times, the electricity grid and AEMO are more dependent on these assets than ever before. As this continues, the need for up to date information on the size and capabilities of connected DER is crucial to allow DNSPs and AEMO to plan and operate the electricity grid and ensure reliable, secure and affordable energy.

In accordance with its usual compliance monitoring and enforcement role under the NEL, the AER has responsibility for enforcing DNSPs' compliance with all requirements in the NER. This includes ensuring that DNSPs comply with requirements related to the DER Technical Standard.[231]

6.2 AEMO's views

6.2.1 AEMO's rule change request

Managing compliance through connection agreements

AEMO's rule change request proposed that DNSPs ensure that connected DER, either by its own means or by way of a DER device, meets the minimum technical standards (including without limitation, through the inclusion of appropriate provisions in connection agreements).

229 NERR rule 59A.

230 See *Electricity (Consumer Safety) Act 2004* and Electricity (Consumer Safety) Regulation 2015.

231 NEL s. 15.

AEMO proposed that this be achieved by including minimum technical standards into the minimum content requirements of connection contracts, negotiation frameworks and model standing offers, and into the model standing terms under Chapters 5 and 5A of the NER. AEMO also suggested that the standard could be recognised in the deemed standard connection contracts prescribed in Schedule 2 to the NERR.

It was anticipated by AEMO that such obligations for DNSP contracts would have a flow-on effect of binding manufacturers and installers of DER devices to the minimum technical standards.[232]

Light-touch monitoring and compliance framework

To support the obligations on DNSPs, AEMO proposed that the AER develop a light-touch monitoring and compliance framework, primarily for the purpose of transparency around adherence to the standards. It suggested that this could be achieved through a minimalist periodic reporting framework (possibly a light touch version of the AER's Electricity Distribution Ring Fencing reporting framework).[233]

While AEMO has suggested that the AER monitor DER device compliance with the new technical standards, it did not suggest that the standards be enforced through penalties (by civil penalty or conduct provisions in the NER or NERR).

6.3 Stakeholder views on the request

Although generally supportive of an obligation on the DNSPs to achieve compliance of "connected DER" with technical standards through the connection process, stakeholders suggested that it was not clear what additional compliance expectations should be. This stakeholder uncertainty was on the basis that at the time of writing submissions AEMO had not yet published its proposed content for the initial minimum technical standard for consultation. In addition to these concerns expressed by industry participants, the AER noted a lack of detail provided by AEMO about its proposed compliance role.[234]

Generally, stakeholders acknowledged that compliance, monitoring and enforcement arrangements for minimum DER technical standards would be likely to be within scope of the ESB's DER standards governance review.[235] In particular, SAPN advocated for any ongoing compliance arrangements to be considered, consulted on and implemented through the ESB's review.[236] The CEC also stated that it was important for the development of device requirements to include consideration of the compliance and enforcement approach in the ESB's review.[237]

AGL expressed the view that AEMO's proposed compliance framework would create additional complexity for industry by duplicating the current compliance framework for technical

232 AEMO, Rule change request, p. 16.
233 AEMO, Rule change request, p. 25.
234 AER submission to the consultation paper, p. 3.
235 ESB, *Governance of DER technical standards,* consultation paper, July 2020.
236 SAPN submission to the consultation paper, p. 6.
237 CEC submission to the consultation paper, p. 1.

standards that is largely enforced through state-based legislative technical and safety requirements. To avoid this overlap, AGL recommended leveraging the existing compliance framework, including state-based legislative technical and safety requirements to deliver improved compliance.[238]

Tesla and the CEC noted that there is a significant risk of redundancy in establishing additional testing and compliance requirements, raising the concern that the outcomes may lead to multiple and overlapping compliance requirement for the new-technology sector.[239]

Endeavour Energy noted that DNSP-led enforcement is particularly an issue in New South Wales due to the Accredited Service Provider (ASP) scheme. Endeavour Energy commented that while ASPs provide connection services in NSW direct to customers with oversight and monitoring from networks, ASPs may not necessarily be involved in DER device installation. For this reason, Endeavour Energy suggested consideration be given to a compliance approach based on the existing CEC and CER processes to certify products and installers of PV systems.[240]

Plus ES advocated for a light-touch compliance monitoring approach during the initial implementation of the standard, subject to market evolvement, before applying more stringent compliance monitoring program.[241]

However, Reposit expressed the view that "given that the majority of DER is a consumer or small/medium enterprise product, compliance should be enforced under Australian Consumer Law". It considered that if the standard exists and is mandatory and a device is non-compliant then the consumer is protected by the warranties in that Act [*Competition and Consumer Act 2010*].[242]

Ausgrid suggested that the level of compliance monitoring should be proportional to the risk being faced and that any potential obligation requiring inspection regimes will need to be rigorously tested to ensure that the benefits outweigh the expected costs.[243]

Energy Queensland, Essential Energy, CEC and Endeavour Energy all noted that DNSPs are not currently funded or resourced to perform compliance on system security issues, and it is unclear what implications the introduction of such activities would have on customers and costs.[244]

Nevertheless, other stakeholders indicated some support for compliance activity on DER technical standards. For example, CitiPower, Powercor and United Energy considered that installers need to have greater accountability and the CEC should have greater involvement with a wider group of stakeholders to facilitate training to installers.[245]

238 AGL submission to the consultation paper, pp. 6-7.
239 Submissions to the consultation paper: Telsa, p. 1; CEC, p. 4.
240 Endeavour Energy submission to the consultation paper, pp. 2-3.
241 Plus ES submission to the consultation paper, p. 5.
242 Reposit submission to the consultation paper, p. 5.
243 Ausgrid submission to the consultation paper, p. 9.
244 Submissions to the consultation paper: Energy Queensland, p. 10; Essential Energy, p. 4; CEC, p. 5; Endeavour Energy, p. 2.
245 CitiPower, Powercor and United Energy submission to the consultation paper, p. 1.

6.4 Draft rule determination assessment

In its draft rule determination, the Commission considered that existing compliance and monitoring arrangements could be leveraged to support the DER Technical Standards. The Commission noted:

- The requirement for newly connected rooftop solar inverters to comply with the DER Technical Standards (AS 4777.2) will arise by the NER requiring DNSPs to include such a requirement in the relevant connection contracts.
- The need for DNSPs to be satisfied that the relevant connecting inverters are compliant with the standards will enable them to enquire and seek confirmation of this from installers and/or manufacturers. This can leverage off the existing compliance programs on the certification of products and installers carried out by the CEC and CER.

In addition, the Commission noted that the obligation on DNSPs to be responsible for connecting compliant inverters triggers the ability of the AER to enquire as to the DNSPs' approach and actions to satisfy this requirement as part of its DNSP performance reporting program.

6.4.1 DNSPs to ensure connecting equipment meets technical standards

Central to the Commission's compliance approach in the draft rule determination was a requirement for new or replacement embedded generating units the subject of a basic micro EG connection service to be compliant with the DER Technical Standards to be included in DNSPs' connection contracts.[246]

The Commission's draft rule therefore required DNSPs to be satisfied that the equipment connected to their networks operates in a manner that complies with the applicable initial standard. To support this, the Commission considered it a necessary condition to ensure compliance with technical standard at the time of connection.

An outcome of including this requirement in the NER is that this places an obligation on DNSPs to confirm, during the connection process, that the standard is met. The Commission acknowledged in the draft rule determination that this obligation is consistent with DNSP's existing obligations under the NER which allow DNSPs to establish technical obligations for their networks based on operating needs. As a result of the obligation on DNSPs, device manufacturers and installers of connected inverter-based embedded generation are obliged to satisfy the DNSP that those requirements are met.

The Commission observed that the compliance arrangements described in the draft rule determination are supported by the AER's ability to enforce DNSPs' compliance with the above requirement. This may include confirming that DNSPs comply with the DER Technical Standard [247] through the use of its compliance monitoring and enforcement role.[248]

246 See Chapter 5 for a more detailed discussion of connection arrangements under the draft rule.
247 NER Chapter 10.
248 NEL s. 15.

In the draft rule determination, the Commission commented that placing the responsibility for connecting inverters to comply with AS 4777.2 on DNSPs was consistent with the NEO because DNSPs are best placed to deal with this additional responsibility through their existing processes.

6.4.2 Establishing testing requirements for the initial standard in the NER

The draft rule introduced mandatory test requirements into the NER.[249] This amendment to the NER was made on the basis that equipment manufacturers could test against the test requirements and ensure compliance with the provisions in AS 4777.2:2015 that require all inverters to have under voltage disturbance ride-through capability. The test requirements, developed by AEMO, were to test for inverter performance that is already captured in AS 4777.2:2015 but not already explicitly tested for.

In the draft rule determination, the Commission noted that these test requirements had already been introduced into South Australia through changes to the Electricity (General) Regulations 2012. The Commission also noted that the testing requirements included in the draft rule were the same as that used in South Australia with the only significant difference between the two being the conformance provisions.[250]

The Commission observed that the existing process for devices to achieve compliance with AS 4777.2:2015 relies on relevant testing from a recognised testing facility. AEMO had proposed that such an approach would be appropriate. In the draft rule determination, the Commission considered this approach and concluded that the applicable testing bodies and accreditation and conformance processes set out in AEMO's test procedure were suitable for meeting the objective of the draft rule determination and addressing the most pressing concerns on the impact of rooftop solar generation on the power system.

On this basis, the Commission noted that to be able to test inverters for short duration under voltage disturbance ride-through capability the testing facility must have the technical competence to undertake the test and be accredited by either:

- The Australian National Association of Testing Authorities (NATA),
- the International Accreditation New Zealand (IANZ), or
- by accreditation bodies that are signatories to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangements (ILAC MRA).

Under this approach to product testing and conformance, inverter manufacturers were expected to have adequate on-going access to accredited testing facilities. The Commission concluded that this should provide installers (and consumers) with choice in compliant inverters available for connection.

249 Draft rule Schedule 5A.2.

250 The South Australian conformance requirements give certain responsibilities to the Office of the Technical Regulator of South Australia. This includes maintaining a publicly available register of designated inverters and processing test reports from inverter manufactures to ensure they meet the appropriate requirements.

Consistent with current arrangements, the Commission's draft rule determination supported that the test report is to be provided to the CEC for approval and listing on the CEC Approved Inverter Listing Register once testing is complete.[251]

6.4.3 Suitability of existing compliance and monitoring arrangements

In the draft rule determination, the Commission also considered the arrangements for the ongoing monitoring and oversight of the DER Technical Standard to ensure inverters for embedded generators support and operate with the desired short duration under voltage disturbance ride-through functionality.

The Commission concluded that revisions to existing compliance arrangements as proposed by AEMO would be overly complex.[252] In addition, the creation of a new compliance approach for an initial standard in the NER would create duplicative compliance regimes at a time when the broader enduring governance arrangements for technical standards in the NEM are yet to be finalised.[253]

The Commission noted that while it considered it is reasonable for DNSPs to manage compliance with the DER Technical Standards through the application of connection policies, it recognised that there are established compliance and monitoring processes in place that also support compliance with AS 4777.2.

Application of CEC inverter listing, compliance processes and CER monitoring processes

In its draft rule determination, the Commission expressed the view that the CEC's approval and listing processes should be undertaken once manufacturers have completed testing.[254] This is necessary to demonstrate that their inverters can meet the prescribed short duration voltage disturbance ride-through provisions. In order to be included on the product listing register by the CEC, both product and business certification requirements need to be satisfied, such as submitting product testing reports and ensuring businesses meet manufacturer warranty obligations under Australian Consumer Law.[255]

Under this general approach to inverter compliance and monitoring, the Commission observed in the draft rule determination that inverters will continue to be subject to the CEC's targeted inverter testing program, with inverter selection based on risk analysis and on a log of failure reports from the market under the draft rule.[256]

In addition to the work carried out by the CEC, the CER's inspection program to ensure that inverter and solar systems meet all the installation requirements of the SRES—including compliance with AS/NZS4777.2—would also continue to apply under the draft rule.

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251 CEC, *approved inverter listing* reigster, See ttps://www.cleanenergycouncil.org.au/industry/products/inverters/approved-inverters

252 AEMO, Rule change request, p. 25.

253 See ESB, *Governance of DER technical standards,* consultation paper, July 2020; Dr Kerry Schott AO, Governance of DER technical standards rule change request, 21 September 2020.

254 See section 6.1.3 for a more detailed overview of the CEC product listing and approval process.

255 https://www.cleanenergycouncil.org.au/industry/products

256 https://www.cleanenergycouncil.org.au/industry/products/product-faults-and-testing

Having considered the systems put in place by the CEC and CER, as well as comments from industry participants, the Commission's draft rule determination considered that the application of existing compliance and monitoring arrangements was appropriate. It considered that the arrangements would be consistent with the draft rule. It also noted that the arrangements are likely to contribute to limiting the regulatory burden placed on industry and the AER, as well as not unnecessarily increasing costs to electricity consumers.

6.5 Stakeholder views on the draft rule determination

Stakeholders that commented on this aspect of the draft rule determination provided general support for utilising existing compliance and monitoring systems under the CEC and CER, relating to the certification of products and installers of electricity generating systems.[257] This was on the basis that the compliance arrangements provide a workable and streamlined process that will minimise the total cost to industry and customers.[258]

A number of stakeholders, including Tesla, AGL and the CEC, while generally supporting the proposed compliance approach, noted that it may duplicate existing compliance frameworks.[259] This was because compliance with AS4777.2 would be enforced through both the NER and through jurisdictional regulatory requirements.

Another issue identified in submissions by stakeholders was the role of DNSPs in compliance and enforcement, and the suitability of the compliance process to ensure compliance with the standard at the point at which inverters are installed. The CEC sought further clarification on whether the compliance approach outlined in the draft rule determination would change the responsibilities of DNSPs (if at all) with respect to their compliance and enforcement role. In particular, the CEC sought to understand whether the compliance approach set out any obligations on DNSPs to check if the inverter installation is in accordance with the application to connect.[260] ENA expressed the view that compliance arrangements should continue to be considered as part of this and future processes, suggesting that compliance by the CEC and CER may not drive the desired outcomes without stronger enforcement.[261] ENA noted that despite regulated responsibility to maintain network safety and voltage requirements, which involves providing connections and specifying the standards they must meet, adherence to AS4777 is still not guaranteed and is a challenge for DNSPs. It also noted that DNSPs are not currently funded to undertake enforcement activities.

Tesla expressed strong support for a centralised portal that inverter manufacturers list with and that the CEC inverter product list should be a key feature of the compliance arrangement.[262]

In contrast, Enphase Energy proposed that product listing should not be carried out by the CEC on the basis that product approval times are lengthy and the cost associated with

257 Submissions to the draft determination: CEC, p. 4; Simply, p. 1; AER, p. 2; Tesla, p. 7; AGL, p. 6.
258 Submissions to the draft determination: CEC, p. 4; Simply, p. 1; AER, p. 2.
259 Submissions to the draft determination: CEC, p. 3; Tesla, p. 6; AGL, p. 6.
260 CEC submission to the draft determination, p. 4.
261 ENA submission to the draft determination, pp. 1-2.
262 Tesla submission to the draft determination, p. 5.

accreditation through the CEC is high.[263] Enphase Energy suggested another organisation or a DNSP could be responsible for this role, citing the role of the Office of the Technical Regulator of South Australia to maintain a register of designated inverters.

6.6 Final rule determination assessment

6.6.1 DNSPs to ensure connecting equipment meets technical standards

As detailed in the draft rule determination, the Commission considers that placing an obligation on DNSPs to confirm that the standard is met during the connection process is appropriate. This obligation is consistent with DNSP's existing processes as is detailed above in section 6.1.4. As a result of the obligation on DNSPs, device manufacturers and installers of connected inverter-based embedded generation are obliged to satisfy the DNSP that those requirements are met. Existing arrangements provide for this through the connection process as well as the exchange of certificates of completion between the installers of inverters and DNSPs. Stakeholders provided general support for DNSP's to be responsible for compliance with the standard at the point at which inverters are installed.

As a result, the final rule is the same as the draft rule and does not change the responsibilities of DNSPs in ensuring connecting equipment meets the DER Technical Standard. The Commission is satisfied that this approach is consistent with achieving the NEO as it utilises existing regulatory arrangements and avoids imposing inefficient costs of a new, potentially duplicative compliance system on electricity consumers.

6.6.2 Testing requirements for the initial standard in the NER

In the draft rule the Commission introduced mandatory test requirements in the NER.[264] This was on the basis that the test requirements to ensure compliance with the provisions in AS 4777.2:2015 that require all inverters to have under voltage disturbance ride-through capability needed to be included in addition to AS 4777.2:2015. However, the Commission also noted in the draft rule determination that if the updated version of AS 4777.2 (that is, AS 4777.2:2020) was released before the publication of the final rule determination, then the final rule may refer to AS 4777.2:2020 alone rather than AS 4777.2:2015 and the short duration undervoltage response testing requirements (because the test requirements are incorporated in the new version of the Australian Standard).

Consistent with this position, the Commission's final rule determination is to include the updated version of AS 4777.2 in the NER which includes short duration undervoltage response testing requirements. In addition, the Commission has concluded that the existing process for devices to achieve compliance with AS 4777.2 through relevant testing from recognised testing facilities remains appropriate.

On this basis, manufacturers will be able to test inverters for short duration under voltage disturbance ride-through capability at testing facilities that have the technical competence to undertake the test and be accredited by either:

263 Enphase Energy submission to the draft determination, p. 1.

264 Draft NER s. 5A.2

- the Australian National Association of Testing Authorities (NATA),
- the International Accreditation New Zealand (IANZ), or
- by accreditation bodies that are signatories to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangements (ILAC MRA).

6.6.3 Utilising existing compliance and monitoring arrangements

The Commission acknowledges Enphase Energy's concerns regarding the cost and time constraints associated with accreditation of products to the CEC's approved products list. The Commission notes that the changes made in South Australia, including designating the South Australian Office of the Technical Regulator as the appropriate a body to maintain a register of designated inverters, are established through jurisdictional regulations. This arrangement reflects the circumstances facing South Australia at the time.

In line with Enphase Energy's suggestion, an alternative to using the CEC, would be to require the relevant technical body in each NEM jurisdiction to carry out similar activities. However, this approach could easily result in different requirements emerging in different jurisdictions which would be likely to lead to greater compliance complexity and costs for manufacturers, installers and DNSPs. In addition, a benefit of continuing with the CEC's system is that it is also relevant for Western Australia and the Northern Territory. While these are not NEM jurisdictions, the Commission considers consistent national coverage is preferable.

As the Commission's final rule will have a NEM-wide application, it continues to consider that listing of inverters through the CEC remains the most appropriate arrangement and avoids any potential duplication that may result from having multiple bodies, either jurisdictional regulators or DNSPs, having individual responsibility for managing a register of compliant inverters.

As such, the Commission considers the final rule determination is likely to contribute to limiting the regulatory burden placed on industry, as well as not unnecessarily increasing costs to electricity consumers. Accordingly, it considers this approach is consistent with achieving the NEO.

7 IMPLEMENTATION APPROACH

In developing the final rule, the Commission has considered the appropriate measures required for the implementation of the DER Technical Standards in the NEM.

The Commission recognises that there are a number of actions that must be undertaken by various parties, such as DNSPs and inverter manufacturers, to enable the DER Technical Standards to take effect. It also recognises the intent of the ESB and AEMO to address issues arising from the growth of the small solar generation segment as promptly as possible. On balance, the Commission has concluded that the requirements should come into effect on 18 December 2021 — approximately 10 months from the date the final rule is made.

This chapter sets out AEMO's proposed implementation plan, the views expressed by stakeholders, the Commission's implementation approach in the final rule; and the steps that the Commission considers will need to be undertaken by DNSPs, market institutions, inverter manufacturers and suppliers before the DER Technical Standards commence.

7.1 AEMO's views

On 20 March 2020, the ESB recommended to the COAG Energy Council that the ESB and AEMO work together to deliver a rule change proposal to put in place initial minimum DER technical standards by October 2020. This was agreed by the COAG Energy Council.

In terms of implementation, AEMO noted that interoperability and cyber security standards may not be sufficiently developed to be considered in time to develop a minimum DER technical standard by the proposed implementation date of October 2020. As a result, AEMO noted that the initial standard will be likely to focus on addressing adverse under-voltage disconnections.[265]

AEMO considered that the publication and application dates for the new rules and initial standard should take into account appropriate transitional arrangements to accommodate:

- A reasonable timeframe for DNSPs to update relevant connection contracts or agreements to comply with the new rule. AEMO considered three months from the date the rule is made would be appropriate.[266]
- The practical steps that need to occur before DER owners can reasonably be expected to comply with the initial standard.
- The extent to which implementation of particular capabilities in the minimum DER technical standard may be dependent on specific network requirements, and whether such capability is required on specific networks at that specific point in time.

AEMO also proposed that DER technical standards would be developed and published with their own application dates and bespoke transition arrangements, following appropriate consultation with relevant parties.

265 AEMO, Rule change request, p. 17.
266 AEMO, Rule change request, p. 17.

7.2 Stakeholder views on the request

7.2.1 Time needed for industry to meet the required specifications

Broadly, stakeholders considered that any application of an initial technical standard for DER should take into consideration implementation lead times required for industry to meet the proposed specifications. No stakeholders supported AEMO's proposed three month implementation timeframe.

AGL considered that adequate notice for industry would be needed to make the necessary changes and mitigate any impact to consumers who have already contracted for the installation of new DER. Further, AGL noted that for the development of technical standards, manufacturers may require between 15 and 24 months to achieve compliance through appropriate testing.[267]

Given the potential impacts on manufacturers and suppliers, Plus ES suggested that the commencement date and the implementation dates need to allow for a minimum period of six months.[268] Ausgrid considered that as long a timeframe as possible is required in order to allow for appropriate design, specification, testing, manufacturing, distribution and sales processes to occur, while ERM Power noted the importance of certainty across industry and the allowance of appropriate lead times for the introduction of new standards.[269]

Tesla raised concerns that AEMO's proposed timeframes for industry compliance with the initial standard were unrealistic. It noted that industry participants will be required to seek internal approvals, undertake the relevant tests and go through the CEC's product re-listing approach. Tesla also noted that there are limited JAS-ANZ testing facilities in Australia, making it practically challenging for industry participants to meet the proposed timeframes. Instead, it suggested a minimum of six to 12 months would be a more realistic period for the introduction and testing of new performance standards.[270]

7.2.2 Specifying a date

Stakeholders commented on AEMO's proposal that each specific requirement in the standard could have its own start date.

Both EnergyAustralia and Jemena agreed with AEMO. They stated that the overall technical standards could have an implementation date specified in the NER and then individual requirements within the standard could be set in the standard itself.[271] Vector also expressed this view.[272]

Reposit suggested that in considering the start dates for standards, the standards needed to resolve the most urgent issues should be commenced earlier.[273]

267 AGL submission to the consultation paper, p. 6.
268 Plus ES submission to the consultation paper, p. 5.
269 Submissions to the consultation paper: Ausgrid, p. 9; ERM Power, p. 2.
270 Tesla submission to the consultation paper, p. 4.
271 Submissions to the consultation paper: EnergyAustralia, p. 7; Jemena, p. 6.
272 Vector submission to the consultation paper, p. 7.
273 Reposit submission to the consultation paper, p. 5.

While not making a specific suggestion on the implementation date, the CEC noted that the key to setting a date should be that it is achievable and practical.[274]

Energy Queensland commented that without knowing the contents of the technical standard, it could not assess what the commencement date of the standard should be.[275]

7.3 Draft determination assessment

7.3.1 Implementation and key dates

In its draft rule determination, the Commission determined that the DER Technical Standards would come into effect six months from the date the rule is made. It was noted that AEMO, DNSPs, the AER and inverter manufacturers and suppliers would need to begin the development and consultation on the proposed changes in order to give them effect. The Commission considered that a commencement date of six months after the rule is made was sufficient time to make the required changes.

7.3.2 Key changes to implement the initial standard

In its draft rule determination, the Commission outlined two key requirements to implement the DER Technical Standards if a final rule were to be made in a form like the draft rule.

DNSP amendments to model standing offers and minimum content requirements

The Commission considered that DNSPs would need to make amendments to their model standing offers and minimum content requirements for connection offers under Chapter 5A of the NER.[276] These changes to model standing offers would need to be approved by the AER.

The Commission noted that the AER indicated its support for this approach. The AER also considered it would be an effective, low-cost option to ensure that DNSPs require that connecting parties are complying with the standards.[277]

In its draft rule determination, the Commission provided further guidance on when the new requirements apply to connection agreements that are still in the process of being entered into on the commencement date of the rule. These transitional provisions specified that if at the commencement date of the rule:

- a connection applicant in relation to a basic micro EG connection service has made a connection application but not received a connection offer, the new Chapter 5A will apply to that connection offer and connection contract (draft rule clause 11.[XXX].2)
- if a connection applicant in relation to a basic micro EG connection service has received a connection offer from the relevant DNSP but has not yet entered into a connection contract, the old Chapter 5A will apply to that connection offer and connection contract (draft rule clause 11.[XXX].2).

274 CEC submission to the consultation paper, p. 5.
275 Energy Queensland submission to the consultation paper, p. 10.
276 NER clauses 5A.B.3 and 5A.B.6.
277 AER submission to the consultation paper, p. 4.

The new rules would not apply to existing connection contracts unless there is a connection alteration (that is, the connection is amended, augmented or upgraded) (clause 11.XXX.4 of the NER).

Inverter compliance through testing and certification

The Commission acknowledged that to meet the specifications set out in the DER Technical Standards, manufacturers would be required to demonstrate inverter compliance through testing at a recognised testing facility and certification through the CEC's list of compliant inverters.

In the draft rule determination, the Commission noted its expectation that once product manufacturers have achieved product testing and conformance with the DER Technical Standards (as presented in the draft rule determination) with an accredited testing body,[278] the test report will be provided to the CEC for approval and listing on the CEC Approved Inverter Listing Register.[279]

The Commission suggested that any changes required to inverters to meet the DER Technical Standards and achieve CEC certification be implemented by the effective date of the standard.

The Commission noted a six-month time frame for manufacturers is less than the 12-month period often provided by Standards Australia when implementing new requirements. It also noted concern by some stakeholders that the limited number of testing facilities may impact on the ability of manufacturers to complete testing quickly. However, the Commission considered that it was reasonable to expect that the relevant manufacturers were already progressing towards meeting the requirements of AS 4777.2:2015 as well as the short duration under voltage disturbance ride-through requirement because:

- these requirements were already in place and compliance may already be required in some jurisdictions
- the development of AS 4777.2:2020, which incorporates requirements for short duration under voltage disturbance ride-through, had been underway since September 2019 and so industry participants are aware of the changes that will come into effect through Standards Australia
- the recent South Australian regulatory changes for smarter homes also require compliance with these requirements and so to participate in South Australia, industry participants must satisfy the South Australian Office of the Technical Regulator, through the same short duration under voltage disturbance ride-through testing requirements as included in the draft rule, that they meet the requirements.

278 See Chapter 6, section 6.5.

279 The CEC list can be found at: https://www.cleanenergycouncil.org.au/industry/products/inverters/approved-inverters

7.4 Stakeholder views on the draft rule determination

In submissions to the draft rule determination, a number of stakeholders expressed general support for a twelve-month implementation approach in the instance that AS4777.2:2020 was the version of the standard to be included in the final rule.[280]

Of these stakeholders, some suggested that the Commission could introduce AS 4777.2:2015 and AEMO's VDRT requirements in the interim period. In particular, the CEC suggested implementation of AS 4777.2:2015 by 31 March 2021 prior to bringing in AS 4777.2:2020 in December 2021.[281] Tesla noted that the twelve-month industry compliance period for Australian Standards is industry standard and reflects the timelines that will need to go into firmware development and system upgrades to comply with new AS 4777.2:2020 requirements, as well as the timelines for testing and approval.[282] However, Tesla also considered that a six-month implementation of AS 4777.2:2015 would be feasible given that many manufacturers are already meeting these requirements in South Australia.[283]

Similarly, Enphase Energy suggested the implementation of AS 4777.2:2020 by September 2021 and that a six-month implementation timeframe is acceptable and similar to that achieved internationally.[284]

However, QEUN expressed that six-months may not be sufficient time for sufficient stock of inverters to be available and that the AEMC should be guided by manufacturers on what time is needed to transition to compliant inverters, especially in light of supply constraints caused by COVID-19.[285]

AGL suggested a commencement date of twelve-months following the final rule determination to enable compliance with AS 4777.2:2020 and mitigate any impact to consumers.[286] It also suggested that the AEMC defer for twelve-months the revised power quality response modes elements as contained in AS 4777.2:2020.[287] On this basis, AGL supported only the immediate adoption of the revised voltage ride-through elements of AS 4777.2:2020. Similarly, the AEC considered that the AEMC should defer the application of the power quality requirements by twelve-months while conducting a formal cost-benefit analysis drawing upon research undertaken in that intervening period.[288]

7.5 Final rule determination assessment

The Commission has determined that the final rule will commence on 18 December 2021. The final rule extends the implementation period in the draft rule to meet the requirements

280 Submissions to the draft determination: Tesla, p. 5; AGL, p. 3; Ausgrid, p. 2; CitiPower, Powercor, United Energy, p. 1; Queensland Energy Users Association, p. 1.
281 CEC submission to the draft determination, pp. 2-3.
282 Tesla submission to the draft determination, p. 4.
283 Tesla submission to the draft determination, p. 5.
284 Enphase Energy submission to the draft determination, p. 1.
285 QEUN submission to the draft determination, p. 2.
286 AGL submission to the draft determination, p. 6.
287 AGL submission to the draft determination, p. 3.
288 AEC submission to the draft determination, p. 1.

of the DER Technical Standards by approximately four months. This change has been made after considering stakeholder feedback on the time that is necessary to meet the requirements of the updated AS 4777.2:2020 and the implementation burden on various parties.

Including the entire 2020 version of AS 4777.2 in the NER with a commencement date of 18 December 2021, avoids the need for transitional requirements that would be necessary if the final rule was made with the earlier 2015 version of the standard in a form like the draft rule commencing prior to this date and then updated four months later to the 2020 version. As such, adopting AS 4777.2:2020 provides a simpler implementation pathway that avoids additional complications and transaction costs that would likely arise from taking a staggered approach to implementing AS 4777.2. This includes avoiding the duplication of requirements to be tested against two different standards and model standing offers needing to be updated and approved as part of meeting initial requirements of AS 4777.2:2015, and then again as part of transitioning to the 2020 version of AS 4777.2.

On balance, the Commission considers that this approach is appropriate and consistent with achieving the NEO. It allows sufficient time for industry to make the changes to give the DER Technical Standard effect while limiting the potential regulatory burden faced by industry, which would be passed onto consumers, in doing so.

7.5.1 Implementation and key dates

The Commission has determined that the DER Technical Standards will come into effect approximately ten months from the date the rule is made on 18 December 2021. This is also the date that AS 4777.2:2020 comes into effect (being 12 months from its publication).

AEMO, DNSPs, the AER and inverter manufacturers and suppliers will need to begin the development and consultation on the proposed changes in order to give them effect. The Commission considers that a commencement date of 18 December 2021 is sufficient time to make the required changes. An overview of the approach to implementation of the initial minimum standard is set out in Figure 7.1. Additional information on this approach is set out below.

Figure 7.1: Implementation approach

Source: AEMC

7.5.2 Key changes to implement the DER Technical Standards

This section outlines how the Commission anticipates the new requirements of the DER Technical Standards will be implemented. In developing this approach, the Commission is satisfied that the approach outlined in the draft rule determination remains appropriate. However, the Commission notes that the implementation period for these changes has been extended by approximately three months for the final rule.

DNSP amendments to model standing offers and minimum content requirements

DNSPs will need to make amendments to their model standing offers and minimum content requirements for connection offers under Chapter 5A of the NER. These changes to model standing offers will need to be approved by the AER.

Under Chapter 5A of the NER, the AER currently approves the model standing offers for basic connection services between DNSPs and customers if the AER is satisfied that these are fair and reasonable and comply with the requirements of the section.[289] The AER may also approve amendments to model standing offers under clause 5A.B.6 of the NER. This is an established activity for the AER that has been effective in confirming that model standing offers meet the appropriate standards.

DNSPs would be required to resubmit model standing offers to the AER that include the requirement for embedded generating units connecting by way of a basic micro embedded generation connection service to comply with the DER Technical Standards. This would utilise an established AER process to assess a minor change to the model standing offer requirements. The AER has indicated its support for this approach. It has noted it would be

289 NER clause 5A.B.3.

an effective, low-cost option to ensure that DNSPs require that connecting parties are complying with the standards.[290]

The Commission acknowledges that in setting a date for the DER Technical Standards to take effect, there will always be some parties that are partly through a connection process. To provide clarity to these parties, the Commission has provided further guidance on when the new requirements apply to connection agreements that are still in the process of being entered into on the commencement date of the rule. These transitional provisions specify that if at the commencement date of the rule (18 December 2021):

- a connection applicant in relation to a basic micro EG connection service has made a connection application but not received a connection offer, the new Chapter 5A will apply to that connection offer and connection contract (final rule clause 11.135.2)
- if a connection applicant in relation to a basic micro EG connection service has received a connection offer from the relevant DNSP but has not yet entered into a connection contract, the old Chapter 5A will apply to that connection offer and connection contract (final rule clause 11.135.2).

The new rules do not apply to existing connection contracts unless there is a connection alteration (that is, the connection is amended, augmented or upgraded) (clause 11.135.4 of the NER).

Inverter compliance through testing and certification

The Commission continues to consider that to meet the specifications set out in the DER Technical Standards, manufacturers will be required to demonstrate inverter compliance through testing at a recognised testing facility and certification through the CEC's list of compliant inverters.

It is the Commission's expectation that once product manufacturers have achieved product testing and conformance with the DER Technical Standards with an accredited testing body,[291] the test report will be provided to the CEC for approval and listing on the CEC Approved Inverter Listing Register.[292]

The Commission suggests that any changes required to inverters to meet the DER Technical Standards and achieve CEC certification be implemented by the effective date of the standard (that is, 18 December 2020).

The Commission notes that the effective date of the DER Technical Standard has been aligned with the twelve-month period typically provided by Standards Australia when implementing new requirements. It also notes concern by some stakeholders that a shorter time frame would impact on the ability of manufacturers to complete testing for AS 4777.2:2020. However, the Commission considers that it is reasonable to expect that manufacturers are already progressing towards meeting the requirements of AS 4777.2:2020 and that inverters may be available to the market prior the 18 December 2021 effective date.

290 AER submission to the consultation paper, p. 4.

291 See Chapter 6, section 6.5.

292 The CEC list can be found at: https://www.cleanenergycouncil.org.au/industry/products/inverters/approved-inverters

ABBREVIATIONS

ABN	Australian Business Number
ACSC	Australian Cyber Security Centre
AEMC (or Commission)	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AS	Australian Standard
ASP	Accredited service provider
CCEW	Certificate of Compliance for Electrical Work
COAG	Council of Australian Governments
CEC	Clean Energy Council
CER	Clean Energy Regulator
DER	Distributed energy resources
DNSP(s)	Distribution network service provider(s)
DVP	Distributed photovoltaic
ENA	Energy Networks Australia
ENSP	Embedded network service provider
ERAC	Electrical Regulatory Authorities Council
ESB	Energy Security Board
EV(s)	Electric vehicle(s)
FCAS	Frequency Control Ancillary Services
IANZ	The International Accreditation New Zealand
ILAC MRA	International Laboratory Accreditation Cooperation Mutual Recognition Arrangements
JAS-ANZ	Joint Accreditation System of Australia and New Zealand
MCE	Ministerial Council on Energy
NATA	The Australian National Association of Testing Authorities
NECF	National Energy Customer Framework
NEL	National Electricity Law
NEM	National electricity market
NEO	National electricity objective
NER	National Electricity Rules
NERL	National Energy Retail Law
NERO	National energy retail objective
NERR	National Energy Retail Rules

PV	Photovoltaic
SAPN	South Australian Power Networks
SAPS	Standalone power systems
SRES	Small-Scale Renewable Energy Scheme
VDRT	Voltage disturbance ride-through

A SUMMARY OF OTHER ISSUES RAISED IN SUBMISSIONS

This appendix sets out the issues raised in the first and second round of consultation of this rule change process. It includes the AEMC's response to each issue. If an issue raised by a submission has been discussed in this document's main body, it has not been included in this appendix.

Table A.1: Summary of other issues raised in submissions to the rule change request

STAKEHOLDER(S)	ISSUE	AEMC RESPONSE
The Caravan, Camping & Tourism Industry & Manufactured Housing Industry Association of NSW Ltd., pp. 3-4.	The AEMC should consider the effect of the DER technical standards on assets located in embedded networks, particularly those residential customers living within residential land lease communities.	The AEMC's *Updating the frameworks for embedded networks review* recommended an obligation that embedded network service providers (ENSPs) be required to notify the DNSP of the relevant network about any generation or load being connected under Chapter 5A. This is intended to provide DNSPs with the relevant information necessary for managing network security issues that may arise as a result of small scale generation and larger load connecting to an embedded network. The recommendations are currently under consideration by the Senior Committee of Official's Embedded Network and Stand-alone Power System working group. With regard to the existing framework, DNSPs may impose requirements through their connection agreements with ENSPs.
Red Energy and Lumo Energy, p. 1.	It is necessary to place clear limitations on the application of the DER technical standards, and the standard should not include standalone generation sites connected directly to the network or transmission system.	As noted in section 3.3 of the draft determination, the draft rule sets out that the DER Technical Standards will only apply to devices categorised as micro-embedded generation units.
Reposit Power, pp. 2-3.	Implementing a technical standard for new and replacement devices ignores the existing 4 GW of existing capacity and potentially disadvantages	The AEMC notes stakeholder concerns regarding the application of DER Technical Standards to new and replacement devices only. However, there are significant issues in requiring existing DER to

STAKEHOLDER(S)	ISSUE	AEMC RESPONSE
	new buyers of DER when compared to owners of existing DER. A price signal is a fairer and more efficient means of operating the system than a technical standard for new and replacement devices.	comply with new technical requirements. While the draft rule will impact some customers more than others, the AEMC considers there are overall benefits to customers in addressing the immediate system security concerns presented by VDRT. In the longer term, both technical standards and price signals will play an important role in the operation of the grid as DER continues to be integrated.
Tesla, p. 3; Wattwatchers, pp. 1-2; Reposit Power, p. 4.	Consideration is required with regard to the relationship between technical standards, tariff reform and market development. Standards shape market behaviour and the potential for ongoing innovation needs to be protected. Engagement with "new energy" sector participants is encouraged.	The AEMC's *2019 Economic regulatory framework review* identified there is a significant risk that the regulatory framework will not continue to promote efficient investment in, and operation and use of, energy services without reforms to accommodate the changes in the industry. The AEMC is cognisant of the links between the development of DER technical standards and the broader program of work underway on distribution access and pricing reforms. It has been working to expand its engagement of all parts of industry when considering reforms to integrate DER.
Solar Analytics, pp. 1-2.	Include in relation to DER technical standards, the requirement for AEMO to value greenhouse gas emissions and implement standards consistent with Australia's commitments under the Paris accords	In order to make decisions that promote the NEO and NERO, the AEMC considers whether its decisions are robust to any impacts of climate change, or climate change mitigation or adaptation measures, on the price, quality, safety, reliability and security of supply of energy or energy services.
Energy Australia, p.3; Vector, pp.4-5.	An alternate option for the control of DER is through the customers meter. Additional capabilities could be set to enable or disable DER technology through the meter. This would require barriers to the accelerated deployment of meters	The application of DER Technical Standards to micro embedded generation focuses on the capability of voltage ride-through. Any additional capabilities, including those that relate to interoperability or the control of DER devices, are not dealt with in this rule change process.

STAKEHOLDER(S)	ISSUE	AEMC RESPONSE
	to be addressed.	The scope of the forthcoming *Review of the regulatory framework for metering services* will include enabling services through the meter.
ARENA, pp. 1 and 4.	In the case of EV and charging infrastructure (acting as a generator or a load) it is important that any requirement of EVs providing vehicle-to-grid services need to be internationally consistent where possible to ensure that it does not disrupt EV market development.	Connections to which the DER Technical Standards will apply include new connections in relation to micro EG systems or modifications to existing basic micro EG services, where the basic micro EG system consists of inverter energy system, energy storage system or a combination of both. This includes EVs where the on-board battery storage system is capable of exporting to the network. The introduction of the DER Technical Standards is intended as an interim measure until an updated AS 4777.2 is published. This updated version is anticipated to include updates specifically to incorporate EVs. Additionally, AS4777.2 maintains international consistency through reference to International Electrotechnical Commission (IEC) standards.

Table A.2: **Summary of other issues raised in submissions to the draft rule determination**

STAKEHOLDER	ISSUE	AEMC RESPONSE
Simply Energy, p. 2.	Propose that the AEMC set out a timeframe for reviewing other important DER integration issues.	There is a significant program of work underway to integrate DER into the electricity system. The three market bodies are working together with the ESB to identify and address current and future challenges and opportunities associated with efficiently DER into the electricity system.

STAKEHOLDER	ISSUE	AEMC RESPONSE
		The ESB Chair, Dr Kerry Schott AO, submitted a rule change request proposing new governance arrangements for DER technical standards under the NER and NERR on 21 September 2020. The rule change process is expected to commence soon.
QEUN, p. 1.	The AEMC should give consideration to the potential for arrangements to allow for the independent testing of existing inverters, either those that are installed or are waiting in stock, to meet any new voltage ride through testing requirements under the final rule.	The AEMC's final rule will not apply the DER Technical Standard to existing installed equipment. The cost in applying the standard retrospectively would likely outweigh the benefits seen by customers and the DNSP.

B LEGAL REQUIREMENTS UNDER THE NEL

This appendix sets out the relevant legal requirements under the NEL for the AEMC to make this final rule determination.

B.1 Final rule determination

In accordance with ss. 102 and 103 of the NEL the Commission has made this final rule determination in relation to the rule proposed by AEMO.

The Commission's reasons for making this final rule determination are set out in section 2.5 and Chapters three to seven of this final determination.

A copy of the more preferable final rule is attached to and published with this final rule determination. Its key features are described in section 2.4.

B.2 Power to make the rule

The Commission is satisfied that the more preferable final rule falls within the subject matter about which the Commission may make rules. The more preferable final rule falls within s. 34 of the NEL as it relates to:

- the operation of the national electricity system for the purposes of the safety, security and reliability of that system[293]
- the provision of connection services to retail customers.[294]

Further, the more preferable final rule falls within the matters set out in Schedule 1 to the NEL as it relates to the operation of generating systems, transmission systems, distribution systems or other facilities.[295]

B.3 Commission's considerations

In assessing the rule change request the Commission considered:

- it's powers under the NEL to make the rule
- the rule change request
- submissions and other information received during the first and second rounds of consultation
- the Commission's analysis as to the ways in which the proposed rule will or is likely to, contribute to the NEO.

293 Section 34(1)(a)(ii) of the NEL.
294 Section 34(1)(a)(iv) of the NEL.
295 Clause 11 of Schedule 1 to the NEL.

There is no relevant Ministerial Council on Energy (MCE) statement of policy principles for this rule change request.[296]

The Commission may only make a rule that has effect with respect to an adoptive jurisdiction if satisfied that the proposed rule is compatible with the proper performance of the Australian Energy Market Operator's (AEMO) declared system functions.[297] The more preferable final rule is compatible with AEMO's declared system functions because it does not affect AEMO's performance of those functions.

B.4 Civil penalties

The Commission cannot create new civil penalty provisions. However, it may recommend to the COAG Energy Council that new or existing provisions of the NER be classified as civil penalty provisions.

The final rule does not amend any clauses that are currently classified as civil penalty provisions under the NEL or National Electricity (South Australia) Regulations. The Commission does not propose to recommend to the COAG Energy Council that any of the proposed amendments made by the final rule be classified as civil penalty provisions.

B.5 Conduct provisions

The Commission cannot create new conduct provisions. However, it may recommend to the COAG Energy Council that new or existing provisions of the NER be classified as conduct provisions.

The final rule does not amend any rules that are currently classified as conduct provisions under the NEL or National Electricity (South Australia) Regulations. The Commission does not propose to recommend to the COAG Energy Council that any of the proposed amendments made by the final rule be classified as conduct provisions.

296 Under s. 33 of the NEL the AEMC must have regard to any relevant MCE statement of policy principles in making a rule. The MCE is referenced in the AEMC's governing legislation and is a legally enduring body comprising the Federal, State and Territory Ministers responsible for energy. On 1 July 2011, the MCE was amalgamated with the Ministerial Council on Mineral and Petroleum Resources. The amalgamated council is now called the COAG Energy Council.

297 Section 91(8) of the NEL.

C OTHER DER REFORMS

This appendix outlines reforms and projects, carried out by the AEMC and others, relevant to the introduction of a minimum technical standard for DER.

The ESB plays an important role in coordinating reforms undertaken by all parts of the electricity industry to make reforms to successfully integrate DER into the sector. Its objective is to "optimise the benefits of DER for all electricity system users, regardless of whether they own DER or not".[298] Part of the ESB's work plan to meet this objective is the technical integration of DER. This includes technical standards, governance of those standards, and improving DNSPs' systems to integrate DER into their networks. The current rule change process is one project in this work stream. Other relevant projects are outlined below and include:

- register of DER rule change
- long term governance arrangements of DER technical standards
- rule change processes on the integration of DER into the NEM
- AEMO's consultation on the content of the initial DER technical standard
- South Australia's regulatory changes for smarter homes
- Western Australia's DER roadmap.

C.1 Register of DER rule change

On 13 September 2018, the AEMC made a rule that established a process by which AEMO, networks service providers and other parties may obtain static data on DER across the NEM.[299] The rule provided that the information on DER would be held in a register established and maintained by AEMO. It also required network service providers to provide information about DER within their network to AEMO for the register.

In addition, AEMO is required to provide disaggregated data on the location and technical characteristics of DER devices to network service providers. The new rules also require AEMO to publish aggregated data periodically and publish, at least annually, information on its use of the DER information it has received under this rule.

The purpose of this rule was to improve the visibility of DER to enable network service providers to plan, invest in, and operate their networks for efficiently. In making this rule, the AEMC also anticipated that greater visibility of DER would assist AEMO in improving its load forecasting and modelling as well as its operations.

C.2 Long term governance of DER technical standards

In 16 July 2020, the ESB commenced a consultative process to determine the long term governance arrangements that could be implemented for DER technical standards.

298 ESB, *DER integration roadmap and workplan*, September 2020, p. 4.

299 AEMC, *Register of distributed energy resources*, rule determination, 13 September 2018.

The ESB's consultation paper was based on a review carried out by consultant firms Sapere and CutlerMerz on the current standards setting arrangements. The ESB reported that the consultants had highlighted:[300]

> ... to date the governance of DER technical standards has been fragmented and uncoordinated. The pace of change in the governance area is slower than needed and more resources need to be dedicated to the setting of standards given the rapid deployment of DER, across the National Electricity Market (NEM) and the Wholesale Electricity Market (WEM) in Western Australia.

The ESB consultation paper put forward a governance arrangement that featured a new governance committee that would oversee the development of DER technical standards that are coordinated to meet electrical system security requirements and support DNSPs in managing their networks. In addition, it was recommended that the new committee be convened by the AEMC, who would provide a secretariat to the committee and appoint members.

Following a round of consultation, on 21 September 2020 the ESB Chair Dr Kerry Schott AO, submitted a rule change request with the AEMC proposing new governance arrangements for DER technical standards under the NER and NERR.

The rule change request proposed: [301]

> ...changes to create 'DER Technical Standards' in the Rules or subordinate instrument, provide for the compliance enforcement of those standards and establish the Australian Energy Market Commission (AEMC) as the responsible decision maker for creating DER technical standards.

The AEMC expects to initiate the rule change process for this request by mid 2021.

C.3 Integration of DER rule change requests

In July 2020, the AEMC received three rule change requests that sought to better integrate DER into the NEM. These requests were:

- The Total Environment Centre and the Australian Council of Social Services together submitted a rule change request to the AEMC on 7 July 2020. This request seeks to enable DNSPs to efficiently manage the integration of DER and meet consumer needs by: requiring DNSPs to offer export services and support efficient investment; and establishing principles to guide DNSP decisions on the allocation of DER hosting capacity within a distribution network.[302]
- St Vincent de Paul Society of Victoria submitted a rule change request seeking to remove impediments in the NER that prevent DNSPs from recovering the costs incurred in

300 ESB, *Governance of DER technical standards*, consultation paper, July 2020, p. 1.

301 Dr Kerry Schott AO, Governance of DER technical standards rule change request, 21 September 2020, p. 1.

302 Total Environment Centre and Australian Council of Social Services, Network planning and access for DER rule change request, 7 July 2020.

supporting the export of electricity from those users of the network that export electricity.[303]

- SA Power Networks submitted a rule change request to enable DNSPs to efficiently manage DER integration and meet consumer preferences. This is to be achieved by: updating the regulatory framework to recognise export services; encouraging efficient DNSP investment in DER to provide the services sought by customers; and enable DNSPs to propose tariffs for export services.[304]

On 12 November 2020, these rule change requests were consolidated, and are being assessed as one rule change request by the AEMC. A draft rule determination for this consolidated rule change request is expected to be published on 25 March 2021.

Further information is available from the AEMC website under the project codes ERC0309, ERC0310 and ERC0311 respectively.

C.4 AEMO consultation on the initial standard

AEMO published its consultation paper on the content of the initial technical standard on 24 August 2020. The submission period to this paper closed on 29 September 2020. As this consultation was conducted alongside the AEMC's rule change consultation, AEMO worked with the AEMC and industry to define the focus of its consultation paper regarding the contents of the initial technical standard. In its consultation paper, AEMO focused the initial standard on DER inverter capability to withstand power system disturbances.[305] It noted that:[306]

> AS/NZS has a provision requiring that all inverters have VDRT capability. However, the current standard does not have a test procedure which equipment manufacturers can test against and ensure compliance.

AEMO stated that it had drafted a voltage disturbance ride-through (VDRT) test procedure for the South Australian Government in relation to its DER action plan. While AEMO recognised that Standards Australia is currently revising the relevant standard (AS/NZS 4777.2) in relation to voltage ride-through, it recommended that its VDRT testing procedure be included as an initial DER technical standard for the NEM. AEMO also commented that:[307]

> Improvements to VDRT and other disturbance ride-through requirements are also proposed in the current revision to AS/NZ 4777.2... This revision will not be finalised until early 2021 with manufacturers provided a 12-month transitional period before inverters must be compliant to the new standard.

303 St Vincent de Paul Society of Victoria, Allowing DNSPs to charge for exports to the network rule change request, 2 July 2020.

304 SAPN, Access, pricing and incentive arrangements for DER rule change request, 7 July 2020.

305 AEMO also noted the importance of interoperability capabilities for DER and sought feedback in the consultation paper from stakeholders for future development. AEMO, *Initial distributed energy resource minimum technical standard*, issues paper, August 2020, p. 7.

306 AEMO, *Initial distributed energy resource minimum technical standard*, issues paper, August 2020, p. 4.

307 AEMO, *Initial distributed energy resource minimum technical standard*, issues paper, August 2020, p. 5.

AEMO recommended that AS/NZ 4777.2:2015 be included as an initial technical standard for DER with an accelerated implementation time frame for the VDRT test procedure of six, rather than 12 months.[308]

Following the Commission's draft determination on DER Technical Standards, AEMO announced that its concurrent consultation process for developing DER minimum technical standards would be closed as it was no longer required.[309]

C.5 South Australian regulatory changes for smarter homes

In June 2020, the Department for Energy and Mining, South Australia consulted on a proposed package of regulatory changes to seek to implement new technical standards to support the orderly transition and incentive structures for customers to be rewarded for managing their energy use.

This consultation resulted in a number of new technical standards and requirements for new and replacement smaller generating systems, such as rooftop solar, that were made effective on 28 September 2020. These included:

- voltage ride-through standards for generating systems connected via an inverter
- remote disconnection and reconnection requirements
- export limit requirements
- smart meter minimum technical standards
- tariffs to incentivise energy use in low demand periods.

Of relevance to this current rule change process, the new technical standard for generating systems connected by low voltage power inverters to the South Australian distribution network specifies that the inverters meet Australian Standards ride-through requirements set out in AS 4777.2. Satisfying this requirement was to be demonstrated by successful completion of the test specified in the testing procedure developed by AEMO for this purpose.[310] This requirement was designed to mitigate the impacts of large scale disconnection of DER inverters on the South Australian power system that may otherwise occur during disturbances.[311] An up to date list of approved inverters is maintained on the department's website.[312]

C.6 Western Australia's DER roadmap

The Western Australian Energy Transformation Taskforce was established in 2019 to implement the government's strategy to transition the South West Interconnected System

308 AEMO, *Initial distributed energy resource minimum technical standard*, issues paper, August 2020, p. 5.

309 AEMO, *Distributed Energy Resources — Initial Standard*. See https://aemo.com.au/en/consultations/current-and-closed-consultations/der-initial-standard

310 AEMO, *Short duration undervoltage response test*, 28 July 2020.

311 South Australian Department for Energy and Mining, *Regulatory Changes for Smarter Homes*. https://www.energymining.sa.gov.au/energy_and_technical_regulation/energy_resources_and_supply/regulatory_changes_for_smarter_homes

312 South Australian Department for Energy and Mining, *VDRT approved inverter list*. See https://www.energymining.sa.gov.au/__data/assets/pdf_file/0005/370868/VDRT_approved_inverter_list.pdf

(SWIS) to one that optimises renewable, decentralised electricity generation and supply. One aspect of this is making improvements to inverters to enable more successful management of the distribution network.[313] The DER roadmap is to be implemented over 2020-2024.

Relevant to the technical requirements of DER inverters, in August 2019 Western Power updated its guideline for inverter-based embedded generators to specify new requirements consistent with AS 4777.2:2015. Following this, further changes are to be made to improve the autonomous functions of inverters as set out in the Australian standard. It is also anticipated that AEMO and Western Power will work on the development of inverter communication functions with the aim of further enhancing the ability of the DNSP to manage its network.[314]

More recently, on 1 July 2020, rules governing the wholesale electricity market (WEM) were amended to implement a register of DER devices. AEMO and Western Power are working to establish the register.[315]

The Energy Transformation Taskforce also recently carried out consultation on the work to implement the DER roadmap. The work consulted upon included the development of the new roles of distribution system operator and distribution market operator, the creation of DER aggregators, and the impact of DER on customers.[316]

313 WA Energy Transformation Taskforce, *DER roadmap*, December 2019, p. 4.

314 WA Energy Transformation Taskforce, *DER roadmap*, December 2019, p. 54.

315 WA Energy Transformation Taskforce, *A brighter energy future*, newsletter issue 8, August 2020, p. 4.

316 WA Energy Transformation Taskforce, *Issues paper DER roadmap: Distributed energy resources orchestration role and responsibilities*, 14 August 2020.