



Draft National Electricity Amendment (Technical standards for distributed energy resources) Rule 2021

under the National Electricity Law to the extent applied by:

- (a) the National Electricity (South Australia) Act 1996 of South Australia;
- (b) the Electricity (National Scheme) Act 1997 of the Australian Capital Territory;
- (c) the Electricity - National Scheme (Queensland) Act 1997 of Queensland;
- (d) the Electricity - National Scheme (Tasmania) Act 1999 of Tasmania;
- (e) the National Electricity (New South Wales) Act 1997 of New South Wales;
- (f) the National Electricity (Victoria) Act 2005 of Victoria;
- (g) the National Electricity (Northern Territory) (National Uniform Legislation) Act 2015 of the Northern Territory; and
- (h) the Australian Energy Market Act 2004 of the Commonwealth.

The Australian Energy Market Commission makes the following Rule under the National Electricity Law.

Merryn York
Acting Chairperson
Australian Energy Market Commission

Draft National Electricity Amendment (Technical standards for distributed energy resources) Rule 2021

1 Title of Rule

This Rule is the *Draft National Electricity Amendment (Technical standards for distributed energy resources) Rule 2021*.

2 Commencement

This Rule commences operation on [COMMENCEMENT_DATE – 6 months from date rule is made].

3 Amendment to the National Electricity Rules

The National Electricity Rules are amended as set out in Schedule 1.

4 Amendment to the National Electricity Rules

The National Electricity Rules are amended as set out in Schedule 2.

5 Amendment to the National Electricity Rules

The National Electricity Rules are amended as set out in Schedule 3.

6 Savings and Transitional Amendment to the National Electricity Rules

The National Electricity Rules are amended as set out in Schedule 4.

Schedule 1 Amendment to the National Electricity Rules

(Clause 3)

[1] Clause 5A.B.2 Proposed model standing offer for basic connection services

In clause 5A.B.2(b)(7)(iv), omit "." and substitute "; and".

[2] Clause 5A.B.2 Proposed model standing offer for basic connection services

After clause 5A.B.2(b)(7)(iv), insert:

- (v) the requirement that the *embedded generating unit* the subject of the *basic micro EG connection service* must be compliant with the *DER Technical Standards*.

[3] Clause 5A.C.3 Negotiation framework

In clause 5A.C.3(a)(3)(iv), omit "." and substitute "; and".

[4] Clause 5A.C.3 Negotiation framework

After clause 5A.C.3(a)(3)(iv), insert:

- (v) 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 must be compliant with the *DER Technical Standards*.

[5] Schedule 5A.1 Minimum content requirements for connection contract

After paragraph (a)(7) in Part B of Schedule 5A.1, insert:

- (7a) if the *connection applicant* is proposing to connect an *embedded generating unit* by way of a *basic micro EG connection service*, a requirement that the *embedded generating unit* must be compliant with the *DER Technical Standards*.

Schedule 2 Amendment to the National Electricity Rules

(Clause 4)

[1] Schedule 5A.2 Short duration undervoltage response test requirements

After Schedule 5A.1, insert:

SCHEDULE 5A.2 – Short duration undervoltage response test requirements

S5A.2.1 General test and reporting requirements

- (a) The intention of this test procedure is to verify the behaviour of an inverter energy system during a short-duration undervoltage disturbance. This is to confirm that the inverter can meet the prescribed short duration voltage disturbance ride-through provisions as expressed in AS/NZS 4777.2:2015, see excerpts below.

Figure 1 Relevant excerpts from AS/NZS 4777.2:2015 on ride-through provisions

**TABLE 13
PASSIVE ANTI-ISLANDING SET-POINT VALUES**

Protective function	Protective function limit	Trip delay time	Maximum disconnection time
Undervoltage (V<)	180 V	1 s	2 s
Oversvoltage 1 (V>)	260 V	1 s	2 s
Oversvoltage 2 (V>>)	265 V	—	0.2 s
Under-frequency (F<)	47 Hz (Australia) 45 Hz (New Zealand)	1 s	2 s
Over-frequency (F>)	52 Hz	—	0.2 s

NOTE: When voltage falls below the undervoltage limit of Table 13 it is permissible to continue, reduce or stop the inverter output during the trip time delay and if voltage returns above the limit during the trip time delay period it may resume normal operation.

- (b) The inverter should sufficiently demonstrate the ability to remain in continuous operation through a 220 ms duration voltage dip to 50 V. This test should be applied in conjunction with existing product certification testing for compliance with AS/NZS 4777.2:2015 and has been developed as a supplementary test. All definitions throughout are according to AS/NZS 4777.2.

Where possible the undervoltage ($V<$) trip level from the original AS/NZS 4777.2:2015 certification should be noted. If this value is not available, then the undervoltage ($V<$) test as described in AS/NZS 4777.2:2015 Appendix G2.2 should be performed to determine the value.

This test is used to verify:

- (1) The undervoltage trip delay and maximum disconnection time for a short-duration undervoltage event, and
 - (2) The withstand capability for a short-duration undervoltage event that occurs within the trip delay time.
- (c) This test shall be repeated three times to confirm that the requirements in clauses S5A.2.2(d), S5A.2.2(e) and S5A.2.2(f) are met.

Test conditions

- (d) Unless otherwise specified by the test procedure, the testing conditions for each test shall be such that:
- (1) the average r.m.s. current on each phase is within ± 5 % of the intended test point; and
 - (2) the average r.m.s. voltage on each phase is within ± 1 % of the grid test voltage.
- (e) In the case of a three-phase supply, the angle between the fundamental voltages of each pair of phases shall be maintained at $120 \pm 1.5^\circ$. The average r.m.s. voltages between each pair of phases shall be maintained within ± 1 %.
- (f) The grid test voltage shall be 230 V a.c. phase to neutral, 50 ± 0.1 Hz.

Inverter setup

- (g) Each inverter that is to be tested shall have its device settings and configurations set to the default set-points required by AS/NZS 4777.2:2015, as they would be for operation in an installation. Once the default settings are selected, the power quality response mode settings should be set according to the Energy Networks Australia¹ recommended default power quality response modes for either Tables 2a to 2c, 3a to 3c, 4a to 4c, 5a to 5c or 6a to 6c (please see Schedule 5A.2.1 for full excerpts of these tables). The tables selected for testing should be noted in the test report.
- (h) If the inverter is required to be used with an external device or devices, such as external automatic disconnection devices or dedicated isolation transformers, the inverter shall be configured in combination

¹ ENA Power Quality Response Mode Settings. <https://www.energynetworks.com.au/miscellaneous/power-quality-response-mode-settings/>.

with these devices for all tests. The combinations tested shall be documented in the test report.

- (i) Before commencement of the test, all model information and specific information concerning the version of software, firmware and hardware used by the inverter shall be recorded. This information shall be provided in the test report. High speed monitoring data records shall be kept and archived; photographs taken to be included in the test report such that the model tested can be verified. The test data and information shall be made available upon request.

Grid source

- (j) Either a real grid or a simulated test grid shall be used in the testing.
- (k) Whether a real grid or simulated test grid is used, the impedance of the test point shall be rated appropriate to the rating of the inverter or combination of inverters under test. The impedance of the test point should not cause a voltage rise greater than 0.5 % of the grid test voltage at the rated current output of the device under test.

NOTE: This is to ensure that the application of the inverter in a customer installation will not adversely affect the quality of supply to the customer.

- (l) The type and impedance of the source shall be declared in the test report for each test performed.
- (m) During the tests, the steady-state voltage of the real or simulated test grid shall not vary by more than ± 1 % of the grid test voltage. The grid test voltage shall be set as required by each test.
- (n) For tests requiring step changes in voltage, the simulated test grid shall be capable of being stepped at least 0.5 times the smallest step required for testing, to determine the set-points with required accuracy.
- (o) The real grid or a simulated test grid should be free from harmonic distortion which could interfere with testing. The voltage harmonic distortions of the real or simulated test grid shall be less than the limits specified in the table below.

Harmonic order number	Limit based on percentage of fundamental
3	0.9%
5	0.4 %
7	0.3%
9	0.2%
Even harmonics 2–10	0.2%
11–50	0.1%
	5%

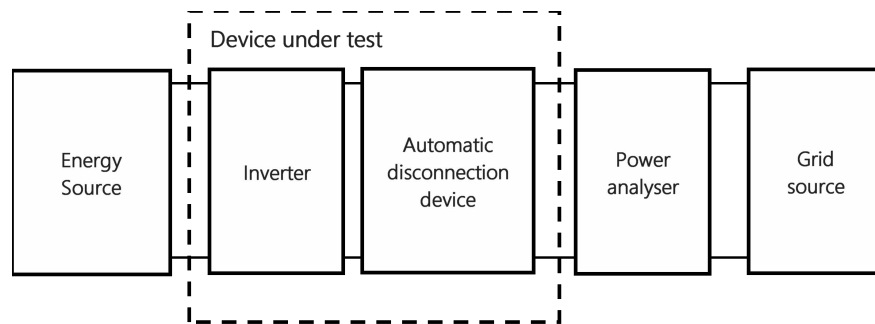
Total harmonic distortion (to the 50th harmonic)	
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S5A.2.2 Test procedure

General

- (a) The following test procedure steps should be completed sequentially. For each of these tests the inverter and automatic disconnection device shall be connected into a test circuit equivalent to that shown in Figure 1.

Figure 1 Test circuit for voltage limits



NOTE: The above test circuit applies to a single-phase system. To test a three-phase system, an equivalent three-phase circuit is required.

Undervoltage (V<) disconnection test in response to event duration exceeding trip delay time

- (b) The disconnection time for the protective function undervoltage (180 V) for a voltage step shall be confirmed. The procedure shall be as follows:
- (1) Set the grid source equal to the grid test voltage. Vary the energy source until the a.c. output of the device under test equals $50 \pm 5\%$ of its rated current output.

NOTE: For three-phase inverters or inverter combinations, the required inverter output is based on the per phase inverter current rating.

- (2) Step the grid source voltage down to 177.5 V (2.5 V below 180 V) with the step change completed within 2 ms and occurring at the zero crossing of the grid source voltage. Record the time interval between the start of the voltage step and the device under test disconnecting from the grid source.

NOTE: For three-phase systems, the test shall be conducted at the zero-crossing for each phase individually, and additionally for all three phases stepped together at the zero-crossing for one of the phases.

- (3) Adjust the grid source to return the voltage to the grid test voltage. Record the reconnection time (the time taken for the device under test to reconnect to the grid source).

Undervoltage ($V <$) withstand test in response to event duration of less than trip delay time

- (c) The trip delay requirement for the protective function undervoltage 1 ($V <$) of 180 V for a voltage step shall be confirmed. The procedure shall be as follows:

- (1) Set the grid source equal to the grid test voltage. Vary the energy source until the a.c. output of the device under test equals $50 \pm 5 \%$ of its rated current output.

NOTE: For three-phase inverters or inverter combinations, the required inverter output is based on the per phase inverter current rating.

- (2) Record the stabilised active power output.
- (3) Step the grid source voltage down to 50 V with the step change completed within 2 ms and occurring at the zero crossing of the grid source voltage, remain at 50 V for 220 ms. Increase the grid source voltage to the grid test voltage with the step change completed within 2 ms and occurring at the zero crossing of the grid source voltage. Record the time interval between each voltage step passing through 180 V (i.e. the duration for which voltage lies below 180 V).

NOTE: For three-phase systems, the test shall be conducted at the zero-crossing for each phase individually, and additionally for all three phases stepped together at the zero-crossing for one of the phases.

- (4) After 1 second, record the active power output, and confirm it is equal to that recorded under paragraph (2) $\pm 4 \%$.

NOTE: There is no defined behaviour of the inverter during the simulated fault. Monitor and recording at this stage is to better understand the anticipated inverter response.

Criteria for acceptance

- (d) The disconnection time recorded at paragraph (b)(3) shall be greater than the trip delay time of AS4777.2:2015 of 1 s and less than the disconnection time of AS4777.2:2015 of 2 s.
- (e) The device under test shall remain connected for the duration under paragraph (c)(3).
- (f) Under paragraph (c)(4) the device under test shall have recovered its active power output to that recorded under paragraph (c)(2) $\pm 4 \%$ within 1 second.

Test report specifications

- (g) For each test performed, the results specified in the test procedure and criteria for acceptance shall be recorded and displayed in the test report. The report shall include time-series plots that shows the instantaneous and RMS voltage waveform and the power output of the device under test over the duration of each test (A1.5.2 and A1.5.3 in Schedule 5A.2.1). The presented waveforms shall demonstrate that the inverter appropriately disconnected after 1 second, and that the inverter remained connected and recovered to a stable output for a disturbance of less than 1 second. The test report should clearly indicate whether the inverter met or failed each acceptance criteria.

S5A.2.3 Accreditation

- (a) The testing facility must have the technical competence to undertake the test and be accredited by either:
- (1) The Australian National Association of Testing Authorities (NATA), or
 - (2) The International Accreditation New Zealand (IANZ); or
 - (3) By accreditation bodies that are signatories to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangements (ILAC MRA).

S5A.2.4 Conformance

Once the testing is complete, the test report is to be provided to the CEC for conformance approval and listed on to CEC Approved Inverter Listing.

Schedule 5A.2.1 Power quality settings to be applied during testing

NOTE: The settings in the following tables are to be applied during testing.

Tables 2a to 2c – Mandatory settings for Victorian DNSPs**Table 2a: Mandatory volt-var response mode settings**

Reference	Voltage (V)	Var (% rated VA)
V1	208	44% leading (exporting vars)
V2	220 (default)	0%
V3	241	0%
V4	253	44% lagging (sinking vars)

Table 2b: Mandatory volt-var response mode settings

Reference	Voltage (V)	Power (% rated Power)
V1	207 (default)	100% (default)
V2	220 (default)	100% (default)
V3	253	100% (default)
V4	259	20% (default)

Table 2c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 3a to 3c – Mandatory settings for Queensland DNSPs and Essential Energy (NSW)**Table 3a: Mandatory volt-var response mode settings**

Reference	Voltage (V)	Var % rated VA	Power factor
V1	207	44%	0.9 leading
V2	220	0%	1
V3	240	0%	1
V4	258	60%	0.8 lagging

Table 3b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Max value (P/P _{rated}), %
V1	207	100%
V2	220	100%
V3	253	100%
V4	260	20%

Table 3c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 4a to 4c – Mandatory settings for SA Power Networks

Table 4a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207 (default)	31% leading (sourcing vars, 2.4% per Volt)
V2	220 (default)	0%
V3	248	0%
V4	253	44% lagging (sinking vars, 8.8% per volt)

Table 4b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207 (default)	100% (default)
V2	220 (default)	100% (default)
V3	250 (default)	100% (default)
V4	265 (default)	20% (default, 5.3% per volt)

Table 4c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 5a to 5c – Mandatory settings for the Ausgrid network**Table 5a: Mandatory volt-var response mode settings**

Reference	Voltage (V)	Var % rated VA	Power factor
V1	207	60% leading	0.8 leading
V2	220	0%	1
V3	248	0%	1
V4	258	60% lagging	0.8 lagging

Table 5b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Max value (P/P _{rated}), %
V1	207	100%
V2	220	100%

Reference	Voltage (V)	Max value (P/P _{rated}), %
V3	248	100%
V4	258	20%

Table 5c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 6a to 6c – Mandatory settings for the Endeavour Energy network

Table 6a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	60% export
V2	220	0%
V3	248	0%
V4	260	60% import

Table 6b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	100%
V2	220	100%
V3	255	100%
V4	265	20%

Table 6c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Schedule 3 Amendment to the National Electricity Rules

(Clause 5)

[1] Chapter 10 New definition

In Chapter 10, insert the following new definition in alphabetical order:

DER Technical Standards

means the requirements for *embedded generating units* under both:

- (a) *Australian Standard AS4777.2:2015*; and
- (b) Schedule 5A.2

Schedule 4 Savings and Transitional Amendment to the National Electricity Rules

(Clause 6)

[1] Chapter 11 Savings and Transitional Amendment to the National Electricity Rules

After Part ZZZZ[X], insert:

Part ZZZZ[X] Technical standards for Distributed Energy Resources

11.[XXX] Rules consequential on the making of the National Electricity Amendment (Technical standards for Distributed Energy Resources) Rule 2021

11.[XXX].1 Definitions

For the purposes of this rule 11.[xxx]:

Amending Rule means the National Electricity Amendment (Technical standards for Distributed Energy Resources) Rule 2021.

commencement date means [the date of commencement of the Amending Rule].

existing connection application has the meaning given in clause 11.[XXX].2(a)(1).

existing connection offer has the meaning given in clause 11.[XXX].3(a)(1).

existing connection contract means a *connection contract* entered into before the commencement date.

new Chapter 5A means Chapter 5A of the *Rules* as will be in force on and from the commencement date.

old Chapter 5A means Chapter 5A of the *Rules*, and all related definitions in the *Rules*, as in force immediately prior to the commencement date.

11.[XXX].2 Application of the Amending Rule to existing connection applications

(a) This clause 11.[XXX].2 applies where, before the commencement date, a *Connection Applicant* has, in respect of an *embedded generating unit* that the *Connection Applicant* proposes to *connect* by way of a *basic micro EG connection service*:

- (1) made a *connection application* to a *Distribution Network Service Provider* in accordance with clause 5A.D.3 (**existing connection application**); and

- (2) not received a *connection offer* from the relevant *Distribution Network Service Provider* in respect of the existing *connection application*.
- (b) New Chapter 5A applies to any *connection offer* made, or formation of a *connection contract* occurring, on or after the commencement date in respect of the existing *connection application*.

11.[XXX].3 Application of the Amending Rule to existing connection offers

- (a) This clause 11.[XXX].3 applies where, before the commencement date, a *Connection Applicant* has, in respect of an *embedded generating unit* that the *Connection Applicant* proposes to *connect* by way of a *basic micro EG connection service*:
 - (1) received a valid *connection offer* from the relevant *Distribution Network Service Provider* in respect of a *connection application (existing offer)*; and
 - (2) not entered into a *connection contract* with the relevant *Distribution Network Service Provider* in respect of that *connection application*.
- (b) Old Chapter 5A applies to the formation of a *connection contract* occurring on or after the commencement date in respect of the existing offer.

11.[XXX].4 Application of the Amending Rule to existing connection contracts

- (a) The Amending Rule is neither intended to, nor to be read or construed as having, the effect of:
 - (1) altering the terms of an existing *connection contract*;
 - (2) altering the contractual rights or obligations of any of the parties under an existing *connection contract*; or
 - (3) relieving the parties under any such existing *connection contract* of their contractual obligations under such a contract.