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Government of South Australia
Department for Energy and Mining

Consultation on the Proposed New Low Voltage Ride-Through Requirements for Smart Inverters in South Australia

Glossary

AEMO	The Australian Energy Market Operator
AS/NZS	Australian/New Zealand Standard
CER	The Clean Energy Regulator
CEC	The Clean Energy Council
DER	Distributed Energy Resources
PV	Photovoltaic
SAPN	SA Power Networks
UFLS	The automatic Under Frequency Load Shedding scheme
UNSW	The University of New South Wales

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1. Background

The Australian Energy Market Operator (AEMO) has reported disconnection of large portions of the grid connected power inverter fleet in South Australia during disturbances which resulted in brief low voltage excursions [1]. This appears to be due to some models of inverters disconnecting immediately upon measuring a grid voltage below the minimum set by Australian Standards.

The contingency size associated with tripping of inverters is forecast to become very large – in the range of 240-500 MW by late 2020 [2], growing to 400-700 MW by late 2023.

During a disturbance, if net loss of photovoltaic (PV) generation and load exceed approximately 150 MW it is likely that grid frequency will fall below 49 Hz and UFLS will operate. During periods where PV generation is high, there may however be very little net load available to shed to allow UFLS to arrest the decline in frequency.

If net loss of PV and load exceed 300 MW then grid frequency may fall out of the 47-52 Hz range, which could potentially lead to cascading trips and major supply interruption.

AS/NZS 4777.2:2015 Table 13 [2] defines undervoltage withstand capabilities for inverters which require an inverter to withstand a fault with a duration of less than one second. The testing procedure specified for this capability found in Appendix G however only tests inverter response to slow voltage sag and not to short duration voltage step. This test does also not sufficiently test whether an inverter can remain connected for faults with a duration of less than one second.

A revised AS/NZS 4777.2 is targeted for publication in early 2021 with full adoption by early 2022. Even with full adoption of the updated Standard by this date, South Australia may still face operational challenges – particularly if operating separate to the NEM in an islanded state.

Laboratory testing conducted by the University of NSW (UNSW) [3] has shown that many inverters which were developed against AS/NZS 4777:2015 are already capable of riding through short duration undervoltage steps.

Due to the extent of penetration of domestic rooftop solar PV in South Australia, there is an immediate need to investigate alternative pathways to manage new installations. This would pave the way for a well-managed power system in South Australia which can operate safely even when reliant on rooftop solar generation and would support increasing installations of rooftop solar PV systems

New requirements for inverters are proposed in South Australia to manage this issue. It is proposed that new installs of inverters in South Australia are restricted to those models which demonstrate the capability to ride through voltage disturbances.

The testing Standard for this purpose will be any relevant testing Standard published by AEMO or included in Australian Standards.

2. Proposed Technical Standard

It is being proposed that a new voltage ride-through technical standard apply to power inverters connected to the SA Power Networks (SAPN) distribution network. The technical standard will require that low voltage inverters must meet voltage ride-through standards as demonstrated by testing in accordance with testing standards in AS/NZS4777.2 and any applicable AEMO testing standard.

The Australian Standard AS/NZS4777.2:2015 defines the capability of low voltage inverters for grid connection of energy sources, and specifically defines the undervoltage fault withstand parameters.

The current specifications require that an inverter has a trip delay time of greater than 1 second if the voltage falls below 180 V (as per Table 13 of AS/NZS4777.2:2015), with the intent to provide anti-islanding for distribution networks beyond 1 second, and ride-through for transmission under 1 second. An additional note in Section 7.4 specifies that any change in voltage should not result in the inverter activating the automatic disconnection device and that it should return to operating power following a fault.

The current testing procedure in Appendix G.2 of AS/NZS4777.2:2015 tests to confirm that an inverter trips after one second for incremental voltage reductions (in steps of less than 1 V from 182.5 V to 177.5 V, with a dwell time of 5 seconds for each voltage step).

AEMO is proposing to define a compliance test that specifically determines whether an inverter can meet the existing defined voltage ride-through provisions in AS/NZS 4777.2:2015.

The test will demonstrate that an inverter's default settings ensure that it remains connected and in sustained, continuous operation for a short duration, transmission undervoltage step reduction (50 V or 20% retained voltage for a duration of 80-220 ms). The values selected are based on the distribution clearance times and potential transmission level events.

The proposed test report seeks to confirm two aspects of the inverter's behaviour:

- The Inverter remains connected during an event where the voltage reduces to below 180 V and consequently returns above 180V within one second; and
- The Inverter disconnects after 1 second following a sudden event where the voltage remains below 180 V.

AEMO is currently conducting consultation with stakeholders on the proposed test procedure https://aemo.com.au/consultations/current-and-closed-consultations/short-duration-undervoltage-disturbance-ride-through-test-procedure.

3. Application of the Technical Standard

It is proposed that the technical standard will apply to new solar generating plant and for existing generating plant if the inverter is being replaced.

The obligation will apply to the:

- owner/operator of the low voltage inverter – to take reasonable steps to ensure it complies with the technical standard.
- installer of the low voltage inverter – must only carry out work of connecting an electricity installation if it complies with the technical standard.

- owner of distribution network – must only allow solar generating plant to connect to their distribution network if it meets the technical standard.

4. Proposed Implementation Pathway

It is proposed that the Electricity (General) Regulations 2012 will be amended to provide that a low voltage inverter which forms part of a generating plant (such as solar or battery storage) must meet voltage ride-through standards and have passed any testing procedures for voltage ride through published by the Australian Energy Market Operator and published in AS/NZS 4777.2.

The requirement will apply to generation plant that is connected to the distribution network, including generating plant which is exempt from the requirement to hold a licence.

The requirement will apply to new generating plant connected to the distribution network and existing generating plant connected to the distribution network where the inverter is being replaced.

The owner/operator of the distribution network will not be allowed to connect any new generating plant to the network if the low voltage inverter forming part of the installation has not passed the required voltage ride through testing procedures.

The relevant compliance and enforcement provisions that will apply to this technical standard are:

- Section 60(1) of the *Electricity Act 1996* (the Act) requires a person who owns or operates electricity infrastructure must take reasonable steps to ensure the infrastructure complies with, and is operated in accordance with, technical and safety requirements imposed under the *Electricity (General) Regulations 2012* (the Regulations).
- Section 60(1b) of the Act requires that the owner or operator of an electrical installation must take reasonable steps to ensure the installation is compliant with technical and safety requirements imposed under the Regulations.
- Section 61 of the Act requires that persons carrying out work on an electrical installation must ensure that the work is carried out as required under the Regulations.
- The maximum penalty for noncompliance with either section 60 or 61 is $50,000 for a body corporate or $10,000 in other cases. An expiation fee of $315 is applicable.

In accordance with Section 60(2), an owner or operator of an electrical installation may rely on a certificate of compliance as evidence that the installation complies with the safety and technical requirements.

5. Proposed Timeline

The new requirement is proposed to commence in September 2020. It will have immediate effect, meaning a low voltage inverter which forms part of a solar generating plant which does not meet the technical standard must not be installed after the commencement date.

6. Consultation Timeline

The Department for Energy and Mining invites comments on the proposed regulatory change from stakeholders and interested parties by close of business, Friday 10 July 2020.

7. References

1. AEMO Technical Integration of Distributed Energy Resources

   https://www.aemo.com.au/-/media/Files/Electricity/NEM/DER/2019/Technical-Integration/Technical-Integration-of-DER-Report.pdf

2. AEMO Renewable Integration Study

   https://www.aemo.com.au/-/media/files/major-publications/ris/2020/renewable-integration-study-stage-1.pdf

3. AEMO Short Duration Voltage Ride Through, A memo and consultation paper.

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

4. AS/NZS 4777.2:2015

   https://infostore.saiglobal.com/en-us/standards/as-nzs-4777-2-2015-101208_saig_as_as_212627/

5. UNSW Sydney, Addressing Barriers to Efficient Renewable Integration – Inverter Bench Testing Results

   http://pvinverters.ee.unsw.edu.au/