AEMO Proposal to Standards Australia re AS/NZS 4777.2:2015

CEC submission and additional issues – 10 May 2019

AEMO Proposed Updates to AS/NZS4777.2

The Clean Energy Council (CEC) generally supports the proposal by AEMO for review of AS/NZS 4777.2 (issued 18 February 2019), and the intent of the proposed updates.

It is noted that the AEMO proposal includes the adoption of elements and functions from IEEE 1547-2018. However there are currently limitations that prevent the rapid implementation of this proposal, in particular:

- IEEE 1547 is a grid-interaction standard, effectively used as the "equivalent" to AS/NZS 4777.2 in some overseas jurisdictions. While some inverter manufacturers can provide products that comply with IEEE1547 through software changes, incorporating a mix of current 4777.2 and 1547 requirements would require a test process that addresses any conflicts or interactions between the two.
- Although IEEE 1547-2018 has been released, the test standard for this is still under development and is at least a year away from being finalized. Without this test standard, products cannot be certified against it. The earliest timing for compliance is likely to be mid/late 2020.
- The possible interaction between proposed IEEE 1547 requirements, and AEMO's market based grid support services needs to be examined.

Given that CEC, through its Approved Product list program, are responsible for the final "gateway" of verification, that products supplied to the installation market meet new and changed standards, we urge that these issues are explored fully, to ensure any changes can be successfully implemented.

Additional issues for inclusion

The Clean Energy Council wish to propose the following additional changes to AS/NZS 4777.2, to be incorporated into the Standards project proposal initiated by AEMO.

These issues have arisen via feedback from CEC member companies, from accredited installers, and from product manufacturers, including through the CEC's product listing program.

Each of the following issues will require more exploration to determine which elements could be addressed by an early Amendment to the current 2015 Standard, and which elements could be included in a later amendment or new edition of the Standard.

1. Move integrated DC isolator requirements from AS/NZS 5033 into AS/NZS 4777.2

AS/NZS 5033 covers installation and safety requirements for PV arrays. This includes the selection of components such as wiring, isolation and protection, as well as the method of installation to connect these components to the Power Conditioning Equipment (PCE).

An important safety feature specified in this Standard is the DC isolator (also referred to as DC switch-disconnector), which is provided to isolate the PCE from the array, such that maintenance of the PCE is possible without electrical hazards.

AS/NZS 5033:2014 Clause 4.4.1.2 gives the installer one of the following options to meet their obligations:

1. Selecting a separate DC isolator and mounting it beside the PCE; or
2. Choosing a PCE with an integrated DC isolator that meets the requirements of AS/NZS 5033.

If the installer meets their safety obligations through the second option – installing a PCE with an integrated isolator – they are relying on the product manufacturer to meet the requirements of an installation standard. Manufacturers can declare that they have met the installation standards, but they aren't required to prove it in the same way they would if it were in a product standard.

The CEC regularly meets with inverter manufacturers. In these meetings, some manufacturers have voiced frustration that others are declaring compliance with the requirements of AS/NZS 5033, without sufficient evidence.

This also creates a safety issue, because installers and electrical inspectors take official company paperwork on face value, while the product may not achieve the desired safety outcome set out in the installation standard.

CEC proposes that the requirements in AS/NZS 5033 for switch-disconnectors that are installed within PCE enclosures, be transferred into AS/NZS 4777.2.

This will ensure that product manufacturers own the responsibility of integrated DC disconnectors. In addition, it will allow integrated DC disconnectors to be assessed as part of the type-testing and certification process for inverters.

The technical content will be the same as in the recently amended AS/NZS 5033 (particularly Clauses 4.3.3.4, 4.3.3.5 and 4.3.3.6), and the CEC will work with AEMO to incorporate this information into AS/NZS 4777.2.

2. Inverter manufacturers to nominate compatible RCDs for extension of integral protection

Residual current devices (RCDs) are mentioned many times in AS/NZS 4777.2.

Inverter energy systems with PV arrays require residual current detection, in accordance with IEC 62109. Clause 9.2.5 of AS/NZS 4777.2 gives inverter manufacturers one of the following options to meet the requirement:

1. Instructing installers to install external RCDs; or
2. Making an RCMU integral to the inverter.

AS/NZS 4777.2 (Clause 9.3.5) currently only requires manufacturers to state compatible RCD type and ratings where an external RCD is required. This information is not required where the manufacturer has installed an RCMU.

However, installers following The Wiring Rules (AS/NZS 3000) may also be required to install an RCD to protect the inverter circuit cable he/she has installed, regardless of the internal protection of the inverter.

Manufacturers are not obliged to nominate the type and rating of RCDs compatible with their inverters if they have integrated an RCMU. The internal characteristics of the inverter may affect the way in which the RCD works, so the installer needs this information to meet their obligations. Installers calling the CEC's technical hotline have asked the CEC to help get manufacturers to pass on this information, so that they can choose the correct RCD for the job.

The CEC proposes that AS/NZS 4777.2 requires manufacturers to nominate compatible RCD types and ratings for all inverters, so that installers who use additional RCDs to meet AS3000 requirements can select types that will operate with the inverter.

CEC can work with AEMO to achieve this. We can also take guidance from the Inverter Listing Working Group if required.

It should be noted that there are some circumstances (esp. for multi-mode devices) where AS/NZS 4777.1 does not support the use of external RCDs as a substitute for mechanical protection. Relevant clauses will need to be drafted in a way that does not contradict, or conflict with existing requirements.

3. Tracking of software and firmware versions and updates

Software and firmware version tracking and updates are a key area of non-compliance with the current standards, due to inadequate requirements in IEC 62109.

From the results of the CEC in-market test program so far, 9 out of 14 inverters tested (64%) failed the passive anti-islanding requirements of AS 4777.2.

In all cases of non-compliance, there has been a failure to adequately track version changes to software. Likewise, there has been inadequate evaluation of the consequences of changes made. In a number of cases, the inverter does not display a true version number, but shows a "shell" version number.

Changes to software have the ability to completely alter the compliance of an inverter, and uncontrolled changes should be made easy to track to ensure compliance.

CEC recommend the following specific measures:

1. The Standard should include clear definitions of the following terms:
    a. "Software Version" or (firmware version) to capture all changes which may affect compliance to the Standard.
    b. A "Software changelog" document which maintains a record of relevant software changes, and associated date and version number.

2. New clause(s) under General Requirements specifying the requirements for evaluation, tracking and reporting of changes to software. Software version to be specified on the test report. An accurate changelog to be maintained by manufacturer. Reporting may be via screen display &/or through the normal inverter communications protocol.

3. Clause 7.8 “Security of Protection Settings” requires a subclause dealing with manufacturer changes to protection settings.

4. Clause 7.8 also requires a subclause dealing with changes to AS 4777.2 settings which may be required by a Distribution Network operator (DNSP).

It is acknowledged that manufacturers apply many software and / or firmware changes to inverter products for functions such as monitoring, data gathering or control, which do not affect the product’s compliance. Hence, for this topic we will also seek to incorporate further feedback from the Inverter Listing Working Group on how to implement this measure successfully.

4. Improve inverter documentation requirements

CEC propose the following corrections and additions to documentation requirements, based upon experience from the approved inverter listing scheme and the test program:

1. Table 16 “Inverter Ratings Documentation Requirements” has an error. The last 6 lines have been incorrectly placed under the heading “d.c. output ratings”. Therefore some manufacturers claim that they do not need to comply with these critical documentation requirements if the unit does not have a d.c. output. These 6 items should be placed under a sub-heading such as “General” in the first column.

2. Clause 7.3 “Active anti-islanding protection” should require all inverters to be tested in accordance with IEC 62116, removing the Appendix F test.

3. If the Appendix F test option is retained, there should be new requirements for reporting which test has been used, both in the test report, and on the inverter display or communications.

4. Add a requirement for documentation to specify the make and model of quick-connect DC connectors used on PV inputs, and the requirement that only connectors from the same manufacturer shall be used to connect.

5. Add a requirement for the documentation to specify any external equipment which may be required to achieve compliance with DRM0, and how this is to be installed and configured.

5. Transfer Export control requirements from AS/NZS 4777.1 to AS/NZS 4777.2

AS/NZS 4777.1:2016 “Grid connection of inverters – installation requirements”, introduced requirements for “Export control of an IES” (Section 3.4.8).

The export control function may be integrated into the inverter, or provided by an external device.

The sub-clauses of 3.4.8 describe particular performance requirements for export control, such as reaction times and measurement methods. If the export control is supplied as an integrated part of an inverter product, or a manufactured ancillary device, then the installer is dependent upon the manufacturer to provide a compliant product.

However, as AS/NZS 4777.1 is an installation standard, it is difficult to verify the compliance of a product with these requirements, other than at the commissioning stage.

In a similar manner to the requirements for integrated DC isolators (above), we recommend that these requirements be moved or duplicated in AS/NZS 4777.2.

This change would achieve the following objectives:

1. Allow export control functions to be assessed for a given product, as part of the type-testing and certification process.
2. Provide a standardised test process for the export control requirements.
3. Simplify the verification process for DNSPs, by allowing the use of pre-approved products.

It should be noted that some distribution network operators have written their own test procedures for export control of installed systems. CEC proposes to work with distributors through our the Inverter Listing Working Group, as well as with AEMO, to maximise the value of existing work done in this area.

6. Voltage-watt response modes

AS/NZS 4777.2:2015 uses voltage to limit the production of solar power at the inverter. This was a good solution to the problem of high voltage on the grid in 2015. However, it is a blunt instrument that at times, results in unnecessary loss of solar generation.

For example, PV inverter systems only impact the voltage on the network if they are exporting power. However, increases in grid voltage due to external influences, will cause a PV inverter to ramp down energy production, even on a solar system that is exporting nothing due to local self-consumption. The means customers could result in losses with no net gain to the voltage stability of the grid.

This situation affects people selling solar, installing solar, NSPs and electricity retailers, who all need to explain to the owner of the solar system, the result of the voltage rise rule.

Also, a solar installer can comply with his obligations of 2% voltage rise on the cable between the PCE and the point of attachment at the same time as the DNSP meeting their grid voltage obligations, but the customers' solar generation can still be reduced.

CEC recommends that Volt-watt responses should not be imposed at the inverter level where possible. With new developments in inverter technology and better understandings of the way solar systems react with the grid, volt-watt responses should be reviewed and changed where more sophisticated solutions are found to solve the same problems.

7. Reference to IEC 62477-1 for storage inverters in lieu of AS 62040.1.1.

Clause 5.1 of AS/NZS 4777.2 requires inverters that have batteries as the only possible energy source, to comply with the electrical safety requirements of AS 62040.1.1.

Manufacturers and certification agencies have provided feedback that IEC 62477-1 is a more appropriate standard for verifying the electrical safety of storage inverter products.

The advantages of adopting this would include:

- Alignment with international requirements
- Consistency with the existing 4777.2 requirements for PV inverters, as IEC 62477-1 and IEC 62109 are derived from the same source.

As part of an interim Amendment, compliance with IEC 62477-1 could be offered as an alternative pathway to demonstrate general electrical safety of the product.

Later, when a full revision of AS/NZS 4777.2 is published, it could transition to mandatory use of the IEC 62477-1 pathway.

8. Scope exemption for auxiliary AC ports for charging devices.

Some stand-alone inverters are provided with a separate port for auxiliary AC power input. In many cases the manufacturer offers this such that grid power can be connected as a back-up charging supply for the system batteries, e.g. in fringe-of-grid locations.

Currently, the Scope of AS/NZS 4777.2:2015 (Section 1) states that the Standard "applies to inverters that have power flow in either direction between the energy source and the grid".

This potentially brings stand-alone inverter products such as those described above into the scope of 4777.2, even where there is no interaction between the stand-alone inverter's AC output and the auxiliary AC power input. E.g. where the auxiliary AC port is permanently wired through a rectifier within the product.

CEC recommend that a test or inspection procedure be developed, to provide a clear confirmation of situations where an auxiliary AC input port is not considered grid-interactive, and where the requirements of this Standard are not applicable.