

Solar PV

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Foreword

This Specification is for the design, supply and installation of solar PV works for Sydney Water Corporation (SWC) assets.

SWC makes no warranties, express or implied, that compliance with the contents of this Specification must be sufficient to ensure safe systems or work or operation.

It is the user's sole responsibility to ensure that the copy of the Specification is the current version as in use by SWC.

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1. General

- For the purpose of this specification “Sydney Water” or “SWC” is the nominated person or organisation that has written authority and act on Sydney Water Corporation’s behalf.
- Equivalent alternative design, materials and construction methodology may be used if accepted by SWC.
- The content of this specification must not be changed without notifying the custodian of this document.
- This Specification is not intended to be a stand-alone document. Project specific documents and additional technical clauses may apply and must be considered.

1.1 Scope

The scope of this document includes, but is not limited to, the following:

- The design, supply, delivery, installation, commissioning and installation of the following types of solar PV systems:
 - Roof mounting systems
 - Ground mounting systems
 - Building integrated (BIPV) systems
- Small to medium sized solar PV systems (between 5-100 kW), which are LV connected.
- The integration of solar PV systems into the existing electrical system, including meter reconfiguration or changeover.
- The grid connection application and approval, including inspections and any witness testing of the Solar PV system as required by the DNSP.
- The design, supply and installation of permanent safe roof access hardware and fall protection in accordance with AS1657 & AS1891, to allow safe on-going operation and maintenance of the installed solar PV system.

1.2 Acronyms

Term	Definition
AC (ac)	Alternating Current
ANSI	American National Standards Institute
AS	Australian Standard
ASD	Aspirated Smoke Detector
ASP	Accredited Service Provider
AUD	Australian Dollars
BIPV	Building Integrated Photovoltaic
c/w	complete with
CEC	Clean Energy Council
DB	Distribution Board
DC (dc)	Direct Current
DNSP	Distribution Network Service Provider
GA	General Arrangement (drawing)
GHG	Green House Gas
GPO	General Purpose Outlet
H ₂ S	Hydrogen Sulphide
HD	Heavy duty
HMI	Human Machine Interface
HV	High Voltage (i.e. >1000Vac or >1500Vdc)
HVAC	Heating, ventilation, and air conditioning
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical & Electronic Engineers
IP	Ingress Protection
ISO	International Standards Organisation
ITP	Inspection and Test Plan
LGC	Large-scale generation certificates
LV	Low Voltage (i.e. greater than ELV but ≤1000Vac or ≤1500Vdc)
MAO	Manual-Off-Auto
MPPT	Maximum Power Point Tracker
MSDS	Material Safety Data Sheet
MV	Medium Voltage
NATA	National Association of Testing Authorities
NSW	New South Wales
PE	Photoelectric
PLC	Programmable Logic Controller

Term	Definition
PPE	Personal Protection Equipment
pu	per unit
PV	Photovoltaic
PVC	Poly-Vinyl Chloride
RCD	Residual Current Device
SAA	Standards Association of Australia
SCADA	Supervisory control and Data Acquisition
SLD	Single Line Diagram
TBA	To Be Advised
TBC	To Be Confirmed
TCS	Trip Circuit Supervision
UPS	Uninterruptible Power Systems
Wp	Watt peak (W)

1.3 Compliance with authorities and standards

All work performed, equipment supplied and modifications carried out to the existing equipment must comply with the appropriate latest issues of Australian Standard or, in their absence, the latest IEC Standards.

Except where the specification requires a higher standard, all work must be carried out in accordance with the latest edition of AS/NZS 3000 (SAA Wiring Rules), AS/NZS 3008.1.1, the services rules of the electricity distributor, and all relevant statutory authorities. Electrical installations operating at high voltage and earthing must be designed and installed in accordance with AS 2067.

All work must be of the best quality incorporating the best means of providing and installing all equipment including cables. All work must be subject to the inspection and approval of the electricity distributor.

Proof of compliance with a standard or specified test may be required. Where requested, such proof must comprise a test certificate from an independent testing authority.

All design work must comply with Australian Standards and codes as stated in this specification or other parts of the Contract Document. If no such Standard or code is nominated, the Works must comply with the most relevant Australian Standards and codes.

If an international or overseas standard or code is proposed in lieu of an Australian Standard, a detailed assessment to show that the proposed standard or code is equivalent to the relevant Australian standard or code must be submitted to SWC for acceptance.

If there is no Australian Standards or codes covering the subject, an international or overseas standard or code may be used if accepted by SWC.

Any design work proposing to connect a SWC installation to the electrical network (i.e. Ausgrid and/or Endeavour Energy) must be performed by an appropriate NSW Accredited Service Provider (ASP).

2. Design consideration

Solar system design must incorporate the requirements of SWC standards, in particular:

- CPDMS0023 Technical Specification – Civil
- BMIS0209 Technical Specification – Mechanical
- CPDMS0022 Technical Specification – Electrical
- HSS0009 Instrumentation and Control Standards
- DOC0016 Specification Earthing and Lightning
- DOC0014 Specification Protection Relays

2.1 System design

The following documents are to be used as the basis for the solar PV system design for all solar PV systems, even those systems which are smaller than 30 kW:

- Clean Energy Council: Design Guidelines for Accredited Installers
- Clean Energy Council: 30 – 100 kW Design Guidelines for Accredited Installers
- Where this technical specification has additional requirements above that stated in the Clean Energy Council Guidelines or Australian standards, then the requirements in this technical specification must be followed.
- The system design must include the following:
 - The “site-specific energy yield” design responsibility, as outlined in ‘Clean Energy Council: 30 – 100 kW Design Guidelines for Accredited Installers’ must be compared with the SWC business case assessment forecast to validate the results of the feasibility stage.
 - Drafting according to SWC drafting standard.

Additional design requirements are outlined below in subsequent sections for each engineering discipline.

2.2 Electrical design

The design must include, but is not limited to, the following:

- Electrical schematic diagram(s) of solar PV system integration with site main switchboard. The quantity of diagrams will depend on the site, as well as size and complexity of solar PV system.
- Any metering upgrade/replacement/alteration or any other specific requirements for each site
- Protection design
- Earthing and Lightning protection design
- DNSP – Connection application and approval
- Any grid connection studies and/or secondary network grid protection relays as required by the DNSP and Australian Standards
- Any relevant notices, arranging for inspections and testing, paying all fees to the distributor and other authorities as required in connection with the solar PV installation.

2.2.1 Generators

The design must consider the interaction of the PV system with on site or temporary generators.

At temporary generator connection points signage must be added to alert personnel to the presence of an on-site PV system and the location of the isolation point(s).

Where a site has a permanent backup generator the interaction of the PV system with the generator will be considered in the design. Consideration must be given to the inclusion of an interlock to shut down the PV system if the backup generator is operating and the site is not connected to the utility.

2.2.2 DNSP connection application

Before installing or upgrading a solar PV system, the designer must submit a connection application to the responsible DNSP and receive approval to proceed.

The specific details of this connection application vary between the DNSPs and are subject to regular updates. Therefore, the designers should refer to the latest connection DNSP application procedure at the time of the project.

2.3 Instrumentation and control diagram

The design must include, but is not limited to, the following:

- List of all monitored parameters which will be available to the IICATS/SCADA system.
- Compliance with SWC – Instrumentation and Control Standards.
- Network architecture diagram clearly indicating all devices, device addresses, network type, and interface to the SWC system.

Equipment must support the Sunspec alliance communications standards and provide the SCADA system with the ability to read the mandatory data points defined in the Sunspec standard for the relevant equipment type.

2.4 Civil/structural design

The design must include, but is not limited to, the following:

- Compliance with SWC Technical Specification – Civil
- Compliance with SWC Work health and safety procedure – HSP0052 Fall Prevention
- Verification of structure/roof loading
- Any building permits application and approval
- Structural assessment as required for:
 - Roof mounting system
 - Free standing system
 - Building integrated (BIPV) system
- Safe roof access and fall arrest system
- Evaluate any potential risk to the PV system arising from external sources beyond the SWC property that could impact the system's operation and performance.

2.4.1 Recently built or assessed structures

Recently built structures are defined as less than 10 years old with reliable documentation, such as As-Built drawings.

Recently assessed structures must have had a detailed condition assessment of the structure carried out within the last five years with all relevant information to allow reliable assessment.

Where structures are recently built or assessed, then a desktop study may be conducted to ensure the structure is capable of supporting the additional PV system load, in particular the wind load. When there is any concern with the current status of the building, a detailed inspection/assessment must be undertaken.

Any variation in the roof access arrangement (if required) should be carefully assessed to ensure no section of the roof will be overloaded in particular secondary elements (i.e. roof purlins)

For reservoirs in particular, the assessment needs to consider whether the current roof structure layout is constructed in such way that there might be some vulnerability to new additional load in some segment of the roof structure. This includes roof edges and where purlins span is biggest due to radial configuration of

the roof rafters. This high-risk area should be noted and contingency plans to be developed if panels installation is problematic in certain areas, or these areas not used for the PV installation.

2.4.2 Assessment for existing aged structures

It is critical to conduct a condition assessment where the structures age is greater than 10 years and new loads such as PV panels are considered.

The assessment should include:

1. High level assessment of the structure based on its “as new” condition using the existing drawings and/or previous condition assessment. When the result of this high-level assessment indicates failure under new loading then the structure should be considered unsuitable.
2. When the structure satisfies the performance requirements for “as new” condition, a detailed condition assessment must be undertaken to assess “as is” condition of the structure. A detailed engineering assessment based on the existing condition must be undertaken. If the level of corrosion exceeds a certain level (i.e. 20% in roof rafters) no panels must be installed as it will constraint future remedial work on the roof structure.

In general:

- Structures that are expected to be part of the medium term (i.e. 10 years) remedial work program must be excluded from PV system installation.
- Detailed condition assessment must be undertaken prior to finalise the decision about panel installation unless the building age is less than 10 years or a condition assessment has been done in the last five years,
- Preference must be given to designs that minimise loading on the structure. This might be achieved by various measures including but not limited to:
 - a) Minimise the gap between the panels and the top of the roof
 - b) Avoiding installation of the panels in high risk area such as closer to the edge of the building
 - c) Keeping new loading pattern as close as possible to the original design intention (i.e. access routes)
 - d) Consider non-structural requirements such as avoiding connections/penetrations that might cause future corrosion in base material or adverse impact on the quality of water
 - e) Liaising with operations team to ensure the operational requirements and access is not impacted by the proposed panels installation

2.5 Geotechnical design

For free standing systems the design must include, but is not limited to, the following:

- Compliance with SWC Technical Specification – Civil
- Verification of geotechnical design and compliance with the PV mounting/racking manufacturers requirements.

3. Equipment selection and installation

The following document is to be used as the basis for the Solar PV system equipment selection and installation:

- Clean Energy Council: Grid-Connected Solar PV Systems: Install and Supervise Guidelines for Accredited Installers

Where this technical specification has additional requirements above that stated in the Clean Energy Council Guidelines or Australian standards, then the requirements in this technical specification must be followed. These additional installation requirements are outlined below in subsequent sections for each system.

3.1 General

The PV module must adhere to the specified temperature requirements in CPDMS0022 Technical Specification – Electrical and following requirements

Table 1: PV module environmental factors

Condition	Requirement
Maximum relative humidity for one month	90%
For daily average air humidity	95%

The Solar PV system must be suitable for installation and service up to an elevation of 1000 m above sea level or the elevation of the specific site, whichever is greater.

All fasteners must comply with the requirements in SWC Technical Specification – Mechanical, particularly in relation to dissimilar metals.

3.2 PV modules

The PV modules must have the below minimum requirements.

Table 1: PV module requirements – Certification

Condition	Requirement
PV Modules	
Monocrystalline	AS/NZS 5033, IEC 61730, IEC 61215, CEC approved PV modules list*
Multi/poly-crystalline	AS/NZS 5033, IEC 61730, IEC 61215, CEC approved PV modules list*
Thin film	AS/NZS 5033, IEC 61730, IEC 61215, CEC approved PV modules list*
PV Modules	

*at the time of installation

Table 2: PV module requirements – Environmental

Condition	Requirement
Maximum allowable temperature coefficient of maximum power	-0.45% / °C.
PV modules installed in a coastal environment or areas with high agricultural activities must be certified to the following IEC standards*	IEC 61701 IEC 62716

* Preference should be given to PV modules certified to the above IEC standard in all installations.

Table 3: PV module requirements – Mechanical

Condition	Requirement
Equipment class	Class A as defined by AS/NZS 5033
Fire Class according to MST-23, as part of the IEC 61730-2 testing and IEC 61730 certification	A
Minimum permissible wind load rating	2.4 kPa
Minimum permissible snow/mechanical load	5.4 kPa
Frame material for panels installed >10° above horizontal	Anodized aluminium alloy or equivalent OR Frameless glass
Ingress protection of PV module junction boxes installed in an outdoor environment	IP65, in accordance with AS 60529
UV resistance of PV module junction boxes installed in an outdoor environment	UV resistant
All cabling	PV1-F

Table 4: PV module requirements – Electrical

Condition	Requirement
Module efficiency Crystalline	>20%
Power tolerance:	Positive
Maximum System Voltage	1500 V DC (IEC)
Minimum cable size	-Refer to AS/NZS 5033

Table 5: PV module requirements – Warranty

Condition	Requirement
Minimum manufacturer's workmanship warranty	10 years
Minimum manufacturer's power warranty	10 years at 90% power output and 25 years at 80% power output (or better)

The following conditions must also be met in the selection of PV modules:

- All PV modules proposed in a single MPPT should have the same manufacturer and model.
- The PV modules proposed must have a minimum of 10 year remaining of its product manufacturing lifecycle

Table 6: PV module requirements – Installation

Condition	Requirement
Edge zone avoidance installation methodology	According to AS/NZS 1170.2
Minimum PV module incline angle to ensure self-cleaning by rainfall	10°
Allowable PV module installation azimuth range	270° (W) and 90° (E)

The following conditions must also be met in the installation of the PV modules:

- Parallel strings, connected to the same MPPT input at the inverter, must be installed with the same number of panels and of the same make and model.
- A string of PV modules must be connected such that all modules in the string have the same tilt and the same orientation. This does not include micro-inverters and DC power optimisers connected to individual modules.
- PV Module Attachment to Ra-I - A PV module's ability to withstand wind and static load is affected by the attachment area. Manufacturers will specify the clamping area of the module. Clamping of PV modules onto rails must fall within the modules' specified clamping area to ensure that the modules can withstand loads up to the rated pressure.

3.3 PV mounting systems

All PV mounting system types must have the below requirements or better.

Table 7: PV mounting system requirement– - Certification

Condition	Requirement
PV mounting system	AS/NZS 1170.2

Table 8: PV mounting system requirement– - Mechanical

Condition	Requirement
Equipment class	Class A as defined by AS/NZS 5033
Material	Weatherproof and corrosion resistant, such as anodized aluminium, stainless steel or similar.

Table 9: PV mounting system requirement– - Warranty

Condition	Requirement
Design life	25 years
Minimum product warranty	10 years
Minimum finish warranty	5 years

The following conditions must also be met in the selection of PV mounting systems:

- The mounting frame and associated parts, including but not limited to parts such as bolts, splices, etc. must be a suitable proprietary made product. Custom made products are not acceptable. Durability assessment must be performed to ensure the design life can be achieved in the installation location.
- The PV mounting system documentation must include:

- Certification of the product’s compliance with AS/NZS 1170.2
- Installation methods that are compliant with AS/NZS 1170.2 for the terrain category and wind region applicable to the installation site.
- Panel arrays must be located to ensure ease of access for maintenance and repair of the solar system
- All panels must be able to be safely and easily accessed, with any one panel able to be accessed by removed only one other panel
- The mounting system manufacturer’s installation specification, including but not limited to maximum fixing width for wind regions and roof zones, maximum building height and roof mounting requirements, must be followed.

The subsequent sections outline additional requirements for each PV mounting system type.

3.3.1 Roof mounting system

Table 10: PV mounting system requirements - Roof mounting systems

Condition	Requirement
Installation type	Fixed tilt (if roof has <10° pitch) Flush or fixed tilt (if roof has >10° pitch)

Table 11: PV mounting system requirements - Installation - Roof mounting systems

Condition	Requirement
Certification	AS/NZS 1170.2*
Minimum clearance around significant plant items that require ongoing maintenance, such as chillers or heating, ventilation, and air conditioning (HVAC) systems	1200 mm
Minimum clearance around fixed minor plant items, such as fans and vents	600 mm
Minimum distance between the PV module and the edge of the roof sheeting	650 mm
Flush to roof installations	
Air gap distance between rear of the PV module and the roof material	60-100 mm

*Mounting systems will only be compliant to AS/NZS 1170.2 if the manufacturer has supplied installation instructions certified to AS/NZS 1170.2 and these instructions are followed.

The following conditions must also be met in the installation of roof mounting PV systems:

- Panel arrays must be located to ensure ease of access to all roof areas including all existing roof plant, anchor points and guttering
- Minimum gap between PV modules to allow for thermal expansion must be considered
- Flush mounted (non-tilted) panels must provide maintenance access of 600 mm width every four rows of panels as a minimum or maintenance access of 300 mm width every two rows of panels
- PV modules must be installed square to the roof line in an orderly and visibly appealing fashion
- PV modules must be located to minimise the effects of shade from surrounding infrastructure and vegetation
- If excess roof space is available, large arrays should be installed as follows so that adequate access is provided for maintenance of the array:
 - 500 mm clearance around the perimeter of the PV array

- For flush mounted arrays, every fourth row is spaced at least 600mm to provide a maintenance access way.
- Care must be taken to ensure the manufacturer’s installation requirements for the specific wind region and terrain category are met, especially:
 - Maximum allowed rail end overhang
 - Maximum rail support spacing
 - Extra rail support spacing requirement in roof edge zones
 - Method of installing fixings to roof, such as screw type, gauge and quantity per fixing point.
- If an installation configuration is not covered by the mounting system manufacturer’s specification, a structural engineer’s certificate must be obtained for the proposed installation configuration, stating the compliance of the proposed installation method with AS/NZS 1170.2.
- Easily removable mounting frame must be installed to facilitate roof repair and overhauls.
- Engineering efforts must be undertaken (and presented to SWC) to minimize the penetration work for securing mounting frames and installed in a way that ensure protection against water ingress, vermin, and dust.
- Manufacturer’s installation instructions and corresponding engineer’s certificate must be provided as part of the system documentation.
-
- If a ballasted racking system is to be installed, signed engineering certification must be obtained: both for the roof’s ability to support the ballast system and array components and for the ballast requirements to adequately secure the array.
- All roof penetrations for cabling must use a fit for purpose roof collar flashing (such as a Dektite). Collar flashing installed must have a minimum warranty of 15 years.

3.3.2 Free standing system

Table 12: PV mounting system requirements - Free standing systems

Condition	Requirement
Installation type	Fixed tilt

Free standing systems must be installed in accordance with manufacturers guidelines and with the ground conditions verified in the civil design.

3.3.3 Building integrated (BIPV) systems

Building integrated systems such as car parks must be designed similarly to free standing systems with consideration for the impact on the building or use under the array.

3.4 Fall arrest system requirements

Systems installed on roofs or other areas that represent a fall from height risk must provide fall arrest systems for installation and maintenance.

Table 13: Fall arrest system requirements

Condition	Requirement
Sydney Water Requirement	Technical Guidance Note TG 505 Fall Prevention Guide

Condition	Requirement
Fall arrest system standards	AS 1657 AS 5532 AS 1170.2.2 AS/NZS 1891 AS/NZS 4488

The following conditions must also be met in the selection of the fall arrest system:

- The roof safety hardware system must be designed by a competent person who is trained in height safety to AS/NZ 1891 and has the experience, knowledge and skills to ensure the pendulum effect is eliminated to the greatest possible level
- The following conditions must also be met in the installation of the fall arrest system:
 - The system must be installed by competent height safety installers using National Association of Testing Authorities (NATA) approved products which comply with the loads for one and two person fall arrest applications. The height safety system will consist of safe access and egress to the roof ensuring the end user is restrained when at a height of 2 m and within 2 m of the roof edge. Each component installed on a roof for height safety purposes must meet all current load ratings as stipulated in AS 1891:2009. Test Certificates must be provided.
 - The installer must provide a statement of the systems compliance and must install in accordance to the manufacturer's instructions. The installer cannot use 'mix & match' hardware and must use proprietary hardware to comply with the Australian Standards.
 - Where existing roof safety hardware is removed, not accessible due to the solar installation, or restricts the current intended purpose of the hardware following solar installation; the designer and installer must design and supply replacement safe roof hardware to ensure safe roof access is maintained and the original purpose of the safe roof hardware is achieved.

The relocation of anchor points/safe roof hardware is prohibited. New and relocated anchor points/safe roof hardware must include certification of compliance, a new rigging plan, the same load bearing ratings to the existing anchor systems and comply with all appropriate Australian Standards.

There is a strong preference to maintain the existing safe roof hardware by providing appropriate solar PV designs and installation to allow the ongoing safe usage of the equipment.

The design of panel arrays should provide sufficient access to be achieved while tethered with a safety harness to the new or existing anchors. The rope arc must not be inhibited, and there must be access to walk back to the anchor, detach from the anchor, then move safely to the next anchor, tether and move to the gutter or area required to be accessed.

- Anchors, static lines and fall arrest systems must:
 - be located to allow safe access to any panels which are located within 2 m of an unprotected vertical edge
 - be located to comply with the requirements for safe use, safe access, the pendulum effect and signage, as stipulated in clause 3.2 of AS 1891.4
 - be supported by a structural support that is assessed separately by a suitably qualified engineer (as stipulated in AS 1891.4, clause 3.1.2.) or by a competent person, as appropriate, and the assessment documented
 - must be inspected for compliance with the requirements in clause 9.3.3 of AS 1891.4 and the inspection documents. The documentation should specify any ongoing requirement to carry out testing of anchor points
 - be properly labelled as per the Australian standards
 - include instructions for safe use and appropriate rigging plans.

- include roof plan showing locations of all new equipment
- provide information on the fixing method of the anchor/fall arrest system
- provide a list of components serial numbers.

3.5 Inverters

3.5.1 Technical requirements

The inverters and power conversion equipment must have the below requirements or better.

Table 14: Inverter requirements - Certification

Condition	Requirement
Inverter(s)	AS 4777 AS/NZS 5033 AS/NZS 3100 IEC 62109-1 IEC 62109-2 IEC 61727 CEC approved inverters and power conversion equipment list*

*at the time of installation

Table 15: Inverter requirements - Mechanical

Condition	Requirement
Ingress protection of inverters installed in an outdoor environment	IP54 or greater, in accordance with AS 60529
Ingress protection of inverters installed indoors	IP50 or greater, in accordance with AS 60529

Table 16: Inverter requirements - Electrical

Condition	Requirement
Voltage regulation	as directed by DNSP
Total harmonic distortion of output current	< 5%
Grid voltage synchronisation	The inverter must be capable of autonomously synchronising with the existing grid voltage
Anti-Islanding protection	Active and passive protection required
Over/under voltage and frequency protection settings	Must adhere to limits specified by the DNSP, and AS 4777.
Voltage and Frequency protection	AS 4777.1: requirements
Inverter transient voltage limit	AS 4777.2 requirements
Earth fault alarm system*	Must be provided to IEC 62109-2 ed. 1 13.9 fault indication requirements.
Demand response mode	Must meet any DNSP and AS 4777 requirements
Load balancing of three phase inverters	Phases must be balanced within 20 A or to the approval of the DNSP.

Condition	Requirement
Load balancing protection of three phase inverters	Protection must isolate the inverter if: Current imbalance is >20 A, or Voltage imbalance is > 2%.
Efficiency	>96.5% European weighted inverter efficiency factor or equivalent >96.5% Peak efficiency

*The earth fault alarm should be installed such that any fault indication is detectable by SWC according to the SWC - Emergency Stops Policy.

Table 17: Inverter requirements - Communication / interfaces

Condition	Requirement
Ethernet connection	Must have capability of wired connection to a monitoring system (application interface must be available to SWC)
Protocols supported	Modbus RTU, Modbus TCP, Profibus, IEC61850

Note that protocol converters may be needed to convert to the SWC required Modbus RTU/Profibus serial at the interface point.

Table 18: Inverter requirements – Warranty

Condition	Requirement
Minimum manufacturer warranty	10 years
Warranty support	Inverter must have an Australian based warranty support team and systems
Manufacturing history	Inverter manufacturers must have a minimum of seven years inverter manufacturing history
Australian presence	Inverter manufacturers must have an Australian office and Australian based employees
Servicing	Inverters must have an in-house Australian based servicing team, or team of certified NSW licensed electrician servicing partners

The following conditions must also be met in the selection of inverters:

- Transformerless inverters are not to be used if the PV module selected requires functional earthing (i.e. connection of one of the PV array conductors to earth)
- Integrated three phase inverters must be used for PV systems connecting to three phase power supply unless micro-inverters are used
- DC connectors between the inverter and PV array DC input must be of the same manufacturer and model.

3.5.2 Inverter installation

The area surrounding the inverter and all associated protective devices such as PV array DC isolator, inverter AC isolators, and wiring is known as the inverter station.

Table 19: Inverter requirements – Installation

Condition	Requirement
Certification	AS 4777.1, Section 8

The following conditions must also be met in the installation of the inverter:

- Where multiple inverters are installed connecting to the same switchboard, the inverters must be installed grouped in a common location. Each inverter must be provided with an AC isolation switch at an electrical distribution board.
- A main switch (inverter supply) must be provided to isolate all inverters installed on the distribution board
- Conduits enclosing PV array DC cables must be installed to AS 5033 requirements
- Cables leading up to the inverter must be secured by saddles so they cannot be inadvertently unplugged from the inverter
- Cable penetration through walls into isolator enclosures must be sealed to AS 3000 requirements to prevent the spread of fire, water, and vermin
- Equipment at the inverter station should be arranged as follows:
 - Provide AC isolators at the inverters if the inverters are not within 3 metres and in line of sight of switchboard to which they are directly connected
 - Install all switching devices and inverters no lower than 0.5 metres and no more than 2.0 metres above the ground, floor or platform
 - Allow a minimum of 0.6 metres access clearance in front of all switching devices and inverters.
- The inverter station location selection must satisfy the following:
 - The inverter station location must have restricted access. Staff or general public must not be able to gain unauthorised access
 - Keying arrangements must be approved by SWC
 - Inverter station equipment must be installed meeting manufacturers specified minimum clearance to maintain inverter efficiency and rated lifetime. Where objects are installed within the clearance zone, system owners must be made aware of the effects of having reduced clearance around inverters and an inverter manufacturer declaration, stating that this installation configuration is permitted, must be included in the system documentation.
 - No inverter is exposed to excessive heat, dust or moisture, it is preferred to install the inverter in the indoor environment.
 - No inverter is exposed to direct sunlight or rain
 - DC & AC losses must be minimized by proper selection of inverter location and conductor sizes
 - Access to the inverter station components and cabling is restricted as described by AS/NZS 5033 regardless of system voltage
 - No flammable liquids or gasses must be stored at the inverter station location.
- The inverter installation must be installed as per section 8 of the Clean Energy Council Installation Guidelines, and the Design Guidelines
- For string inverters:
 - Inverters must be located where they can receive adequate ventilation to not compromise inverter efficiency
 - Inverters are to be accessible to maintenance staff via a safe access point
 - Inverters must be protected by a vandal resistant steel cage/ventilated box or similar where the inverter is accessible to the public
 - Inverter must have appropriate restricted access of the inverters where the system maximum voltage exceeds 1500 V DC

- Inverters must be installed as per the manufacturer’s guidelines
- All proposed locations for inverters are subject to approval by the client and site tenant.

3.6 Micro-inverters

Micro-inverters must meet all inverter requirements as listed for inverters and all requirements set out by AS/NZS 5033 4.3.12 Small micro-inverter installations.

Systems with micro inverters must have AC isolators installed at the array. If the system is installed in multiple locations or spread over different roof surfaces, then an AC isolator must be provided at each group of modules.

3.7 Micro-inverters

The DC optimisers must have the below requirements or better:

Table 20: DC optimiser requirements - Certification

Condition	Requirement
DC optimisers	AS/NZS 5033 for strings constructed using DC conditioning units

Table 21: DC optimiser requirements - Warranty

Condition	Requirement
Minimum manufacturer warranty	25 years

DC optimisers should be considered where there are shading issues or modules are replaced with mismatching panels.

3.8 Monitoring system requirements

The monitoring system must have the below requirements or better:

- Compliance with SWC - Instrumentation and Control Standards
- Supported protocols: Sunspec Alliance (mandatory), Modbus TCP/RTU, Profibus, IEC61850(optional)
- A multiple inverter system may have in internal network. The design must include the network layout, technology and device addresses. The network may use a RS485 or TCP/IP and may use industry standard or proprietary protocols provided that a suitable interface converter is provided at the SWC interface point.
- New distribution boards for multiple inverter connections must be provided with a power meter that provides aggregated system power parameters
- There must be sufficient monitoring to measure the total output of all inverters for the purposes of greenhouse gas (GHG) accounting (e.g. evaluating large-scale generation certificates (LGCs)).

3.8.1 Inverter installation

- Must comply with the current version of the SWC Instrumentation and Control Standards
- Communications interface to SWC system must be Modbus RTU serial interface over RS485. If a PV system uses an IP network, it must not be directly connected to any other network without specific approval of SWC.
- At Network sites the interface must be to the IICATS RTU using Modbus RTU over serial unless otherwise stated

- For treatment sites the interface will be to the IICATS RTU using Modbus RTU over serial unless otherwise stated. Where this is not possible and subject to specific approval of SWC, the interface will be to the Plant PLC using either Modbus RTU over serial or Profibus DP.
- Where Modbus RTU over serial is used it must be:
 - Modbus RTU at the application layer and be fully compliant with the latest version of the Modbus Application Protocol Specification
 - Modbus master-slave/RS485 2-Wire (EIA/TIA-485) RTU transmission mode at the data link/physical layer and be fully compliant with the latest version of the Modbus over Serial Line Specification.
- The network design, including cyber security requirements, must be reviewed for acceptance by the SWC SCADA Services Manager.

3.9 Balance of system components

All other balance of system components which are not mentioned in this document must comply with SWC Technical Specification - Electrical.

The following conditions must also be met in the selection of the monitoring system:

- All balance of system components installed on the DC side of the system must be rated for DC application
- All equipment, including any conduit and ducting, exposed to the outdoor environment must be a minimum of IP55 compliant and must be UV resistant.

Table 22: Balance of system component requirements - DC cables

Condition	Requirement
Certification	AS/NZS 5033
Voltage drop from furthestmost PV module to the inverter	< 3%

Table 23: Balance of system component requirements - DC isolators*

Condition	Requirement
Certification	AS/NZS 5033
Component installation location	According to AS/NZS 5033
Type	Rotary type lockable DC isolator
Enclosure material**	Metal
Ingress protection***	IP66NW, in accordance with AS 60529
UV resistance of DC isolators installed in an outdoor environment	UV resistant
Temperature derating	80 °C
Voltage rating	Must be above the required voltage rating
Current rating	Must be above the required current rating, however AS/NZS 5033:2014 Table 4.2 must be used to confirm the required current rating
Polarity sensitive	No

*The DC isolator documentation must include:

- Single pole voltage and current rating
- Wiring diagram

**Metallic enclosure must be equipotential bonded to earth

***DC isolator enclosures must be installed according to manufacturer's specifications to ensure IP rating is maintained.

Table 24: Balance of system component requirements - AC cables

Condition	Requirement
Voltage rise between inverter and main switchboard	<1%
Voltage rise between main switchboard and consumer main	<1%
Cable segregation	All AC and DC wiring and components must be installed in separate enclosures and run in separate conduit.

Table 25: Balance of system component requirements - AC circuit breakers

Condition	Requirement
Main circuit breaker (inverter supply) rating	Must protect supply cable according to AS/NZS 3000
Circuit breaker ratings	> inverter maximum AC current output rating

Table 26: Balance of system component requirements – PV string protection

Condition	Requirement
Overcurrent protection sizing and location requirements*	According to AS/NZS 3000

*Circuit breakers should not be used for string overcurrent protection.

Table 27: Balance of system component requirements - Plugs, sockets and connectors

Condition	Requirement
Certification	AS/NZS 5033
Ingress protection of plugs, sockets and connectors installed in an outdoor environment	IP55, in accordance with AS 60529
UV resistance of plugs, sockets and connectors installed in an outdoor environment	UV resistant
Mating*	Must use the same type from the same manufacturer

*It must be ensured that PV module and/or inverter warranty will not be voided in the event that pre-installed connectors need to be replaced. To avoid the need to replace pre-installed connectors, it is recommended to only use PV modules and inverters for which matching connectors can be sourced.

3.9.1 Installation

The following conditions must also be met in the installation of DC isolators:

- Installing load breaking DC isolators adjacent to the array is a requirement under AS/NZS 5033. In addition to this, load breaking DC isolators are also required at the inverter unless the inverter is within 3 metres of the array and visible from the array.
- Enclosures must be installed to the manufacturer's instructions to maintain their IP rating
- Unless otherwise specified by the manufacturer the following installation methods must be followed:
 - Enclosures must be readily available as defined by AS/NZS 5033
 - All penetrations must be made on the lower entry face
 - Enclosure openings/lids should not be upwards facing
 - Any penetrations made during installation, such as for screwing the enclosure to the mounting rail, should be waterproofed using an appropriate gland or gasket
 - Enclosures should not shade the array. If some shading is unavoidable, there should be no shading between 9am and 3pm
 - All conduit entries and connections must be glued and made water tight unless not required by the manufacturer
 - Any cable glands used must be appropriate for the number of cables installed. Single cable glands used for multiple cables is not acceptable
 - All unused cable entry bungs or caps should be tightened and if no gasket is provided then they should be glued or adequately sealed with silicone and made water tight
 - Ensure enclosure openings/lids are not obstructed by module frames or other objects and can open fully
 - Mounting holes provided by the manufacturer must be used to mount the enclosure. Where applicable caps/pips will be used to seal the screws. Any screws inside the enclosure that are not covered with a cap/pip will be covered with silicone to provide galvanic insulation.

3.10 Metering requirements

The metering must have the below requirements or better:

- Bi-directional metering to the requirements of the DNSP and retailer
- LGC metering for LGCs purpose.

Attention must be given to engaging Power Utility and metering provider early to identify the scope of required changes.

3.11 Cable management/wiring requirements

Table 28: Cable management / wiring requirements - Installation

Condition	Requirement
Certification	Clean Energy Council installation guidelines. AS/NZS 3000 & AS/NZS 5033 or equivalent

The following conditions must also be met in the installation of cables/wires:

- Regardless of system voltage, the entire PV installation, including the PV array, inverters, associated wiring and protection, must have restricted access as described by AS/NZS 5033
- Conduits must be installed up to and including the cables at the inverter input. The conduits must be supported in such a way that it cannot be subjected to mechanical strain.

- All DC cabling from the inverters to the PV array DC isolators adjacent to the array must be installed in metal or heavy duty (HD) conduit. This conduit must also be UV resistant (marked 'T'). The conduit must be labelled "Solar" every 2 metres, with the labelling clearly visible when installed. 'HD' and 'T' markings on the conduit should also be visible.
- Cable installation must not be susceptible to damage by vermin or birds
- Cables must be installed to AS 5033 and AS 3000 requirements, in particular:
 - Cables must not lay on roofs or floors without adequate enclosure
 - Plastic cable ties must not be used
 - DC connections must not be hanging under tension
- Cables entering junction boxes must comply with AS/NZS 5033
- Install all PV wiring and components to minimize exposure to detrimental environmental effects where they are protected from ultraviolet radiation, corrosion, abrasion, tension, compression & cutting forces. Plastic cable ties are not to be used as a primary means of support for cables and wiring.
- All electrical wiring must be installed in accordance with the requirements of the Distribution Company and the current version of the AS 3000 and AS 5033
- Unless otherwise specified, wiring must be carried out in thermoplastic insulated and sheathed cables. Cables should be concealed wherever practical in false ceilings, under floors, in wall or block work cavities, etc. Wiring must be enclosed by PVC or steel conduit, and it must not be directly embedded in concrete, plaster, sandwich panels, etc
- Main generator cables must be sheathed cable enclosed in heavy duty insulating conduit, in accordance to AS 2053, or on cable tray with adequate mechanical protection. Refer to Energy Safe Victoria document dated July 2011 for specific recommendations.
- Normal AC cable must be of type 0.6/1 kV X-90 insulated, PVC sheathed to AS/NZS 5000.1 and TPE sheathed to AS 3191 and where applicable AS/NZS 5000.1
- DC cabling must be fine stranded tinned copper conductors
- Installation of cabling must be grouped together, parallel to each other, parallel to the building structure and penetration in accordance with AS/NZS 3006 and to minimise magnetic fields
- Installation in a logical and reasonable way such that cables are easily accessible and not subject to damage
- Any cabling subject to rain, UV, or the like must be designed for that location
- Wiring through cavity walls must protect against moisture bridging and vermin
- Do not run wiring through damp course or flashing
- Installation of cables within walls must be run vertically
- Installation of cables within solid walls must use conduit.

3.12 Earthing requirements

The following conditions must also be met in the installation of earthing:

- All exposed conductive parts of the PV system, including PV module frame and mounting rails, must be bonded to earth (equipotential bonding) in accordance with AS/NZS 5033
- Both mounting rails on every row of PV modules must be bonded to earth
- The removal of any one module must not affect the bonding of the system. To ensure that bonding is maintained across rail joins, earthing straps must be installed across rail splices unless the manufacturer confirms (in documentation) that the splices maintain continuity.
- Earthing lugs at the array must be sprayed with corrosion resistant paint.

3.13 Lightning protection requirements

Table 29: Lightning protection requirements - Electrical

Condition	Requirement
Connection type	shunt diverter
Nominal voltage	> PV system operating DC voltage
Maximum continuous voltage	1000 V DC
Maximum continuous current rating	PV system short-circuit current
Response time	< 5nS
Maximum surge current (8/20 μ S):	> 20 kA
Earth leakage current	<10 μ A

The following conditions must also be met in the installation of lightning protection:

- The metal portions of the photovoltaic array should be bonded to the existing lightning protection system if available as per AS/NZS 1768 and AS 3000
- Systems larger than 30kW must be provided with a lightning protection system to AS 1768 Level 3
- SPDs installed on the DC side of the PV system must be explicitly designed and manufactured for DC PV application
- Surge protection should be installed for each inverter. Surge protection to meet the following requirements outlined in section 3.12.
- To reduce the magnitude of lightning-induced over voltages, the PV array wiring should be laid in such a way that the area of conductive loops is minimized. See AS/NZS 5033 for examples with minimum loop area.

3.14 Signage requirements

Signs are installed to warn emergency crews and tradespeople of the presence of a PV system. Correct signage is required to convey certain system information, to warn of potential electrical danger, and to provide the correct procedure for switching the system off.

Table 30: Signage requirements - Installation

Condition	Requirement
Certification	AS/NZS 5033 and AS 4777

The following conditions must also be met in the installation of signage:

- All PV system components must be labelled, as required by AS/NZS 5033 and AS 4777. Signs installed should be engraved plastic or metallic labels. In addition:
 - Provide a plan view of PV system. The plan view should show the location of the PV modules, DC isolators, inverter, point of connection and data logger.
 - Install a label “Do not switch off power supply” on power outlet for the PV monitoring devices
 - Label terminology must be identical to the terminology used in the system’s shutdown procedure and other required documentation
 - A list of action/s to be taken if the earth fault alarm is activated should be placed next to the earth fault alarm and/or given to those who will receive earth fault notifications (the building’s administration office or SWC Corporate Services); where the PV system contains multiple PV arrays and/or inverters, provide labelling on all isolators, inverters and arrays, identifying

corresponding system components. For example, “Array - A” is connected to the rooftop “PV Array DC isolator - A”, inverter “PV Array DC isolator - A”, “Inverter - A” and so on.

- Signage must comply with the PV system specific signage required according to AS 4777.1
- All labelling of the system must be of trifoliate engraved type, adequately secured and screwed where exposed, and comply with the requirements in the CEC installation guidelines.

3.15 Installer requirements

The system provider must install the photovoltaic system to meet all relevant standards, building codes and local council requirements and in such a way that the manufacturers’ warranties on all system equipment remains valid.

The System Provider should provide an installation workmanship warranty for a minimum of 12 months.

All electrical site work including the installation of meters, solar PV panels and inverters must be performed by electricians licensed to carry out such work at the particular locality.

All installation work must be performed by accredited CEC installers and documentation proving such accreditation must be submitted to SWC.

3.16 Site operations/access requirements

Site access requirements must be confirmed for each installation. This includes, and is not limited to, inductions, permits, hours of access and, competency requirements.

The installer will ensure prior to accessing the Site, that it has discussed and agreed with SWC a designated location(s) for storage of materials, components, equipment and all other related items associated with the installation or other processed associated with delivery of the Works.

The installer will provide SWC with a site access plan which details the method the installer is seeking to employ in accessing the site both for personnel of the installer and equipment/supplies; particularly where it may be impeded the operations of the facility or access to SWC facilities.

Site access will be subject to:

- The provision of a Site access plan
- Approval by SWC or site representative in writing.

The installer will be entirely responsible for the security and storage of its plant, equipment and any related materials; as well as protection from damage or theft.

The installer will ensure that all items, components or equipment that form the photovoltaic system must be stored in such a way so as to protect the items from damage or excessive exposure to the elements prior to installation.

The installer will only deliver components of the system on and as needs basis so that excessive quantities of the components are not left on site unnecessarily.

3.16.1 Electrical isolation

The installer must co-ordinate with site operators isolations for the work and provide a minimum of two weeks’ notice to SWC prior to electrical isolation shutdown and conducted at a convenient time to the site operators. Additional time is required for outages outside of normal plant operating hours.

Any disconnection event will require the presence of SWC.

The installer is responsible for ensuring that all electrical plant and comms are in operation following electrical shutdown, and that normal operation of the facility is ensured following shutdown.

4. Commissioning requirements

The commissioning must be completed and signed-off by the following persons:

- Competent SWC person
- Clean Energy Council accredited installer, according to the Clean Energy Council Accreditation Code of Conduct
- The following document is to be used as the basis for the Solar PV system design:
 - Clean Energy Council: Grid-Connected Solar PV Systems: Install and Supervise Guidelines for Accredited Installers

Where this technical specification has additional requirements above that stated in the Clean Energy Council Guidelines or Australian standards, then the requirements in this technical specification must be followed.

The commissioning must include the following:

- Testing and associated documentation of all the communication parameters
- Testing and associated documentation of meter changeover or re-configuration.

After installation, the PV system must be commissioned according to AS/NZS 5033 as a minimum. Note that if the PV system has a rated capacity greater than 10 kW, AS/NZS 5033 includes additional commissioning tests that must also be carried out.

At the completion of commissioning tests, the completed copy of the commissioning documents must be included in the system documentation provided to SWC.

The PV system installer must commission the grid-connected PV system once installation has been completed. The documented results of the system commissioning will confirm that the system meets the system design and is structurally and electrically compliant with the relevant standards and guidelines.

As part of system commissioning, the installer will verify that the system is installed correctly using an installation checklist to document this process. The installer will then test the system and record the results in a test record document. The installation checklist and test records together form the system commissioning sheets. Australian standards AS/NZS 5033 requires the PV system's completed commissioning sheets are to be included in the system documentation given to the PV system owner.

The commissioning should be completed according to AS 4509.1 and the Clean Energy Council installation guidelines.

Installers are to comply with all OHS standards and guidelines when performing system commissioning and must ensure that all test procedures will not negatively impact the systems operation.

The installation must be deemed to be completed when it has passed all necessary tests and has been approved to the satisfaction of the distribution company.

All necessary facilities including all necessary instruments and test equipment and labour for carrying out tests must be provided by the installer.

The installer must carry out commissioning and final acceptance tests as required by SWC and as specified. Commissioning tests must be performed in accordance with AS/NZS 5033:2014 Appendix I to ensure all the solar equipment are operating correctly including solar panels, panel strings, inverters, meter, data logger and electrical protection devices. Final acceptance tests must be done in the presence of the project manager and must conform to AS/NZS 3000 and AS/NZS 3017 standards.

The installer must provide a Certificate of Electrical Safety for the installation and include a copy in the manuals. The installer must also provide a report that includes voltage and temperature measurements, the current and irradiance measurements, the earth fault protection test and also states the conditions of the PV array wiring after the test, including any repairs and corrections carried out as a result of the inspections.

Prior to practical completion, the installer must submit test reports from manufacturers or suppliers, verifying the performance of safety and control functions of each system. Prior to final completion, records of yield proof (validation period in accordance with the project requirements) to be provided to SWC.

The commissioning sheets as per the Clean Energy Council Guidelines must be filled in and provided to the client as the Clean Energy Council guidelines.

All appropriate signage must be provided as per section 12 of the Clean Energy Council Guidelines.

Commissioning records

The installer must keep the PV system installation information for a minimum period of five years including installation and commissioning photographs. A copy must be provided to SWC as a part of the manuals handed over to SWC. The installer must also submit photographs showing:

- 1) The position of the PV array relative to the building on which it is installed
- 2) Mounting and external cabling
- 3) Inverter station layout
- 4) Key equipment, such as, isolators, junction boxes and system protection
- 5) Electricity board showing inverter system isolation switches and relevant signage
- 6) Meter switchover (where applicable).

5. Handover and training requirements

The installer must handover the solar PV system after a certificate electrical safety has been issued and meter changer over/re-configuration had been completed. The installer is responsible for switching on the system at handover. This is a requirement for practical completion.

The project manager must advise if the system is sufficiently new to SWC or complex to require training of SWC personnel.

SWC has the following training requirements that must be performed:

- On-site training
- Audience to include onsite operations and maintenance staff, project manager and the building occupiers. The training must be organised in advance and conducted at a convenient time for all stakeholders. Multiple sessions may be required to ensure key personnel are able to attend.
- The training topics must include, but are not limited to:
 - Solar PV operation
 - Inverter operation
 - System isolation
 - System monitoring
 - Fault diagnosis
 - Safety and emergency shutdown procedure
 - User manuals and drawings explanation.

A maintenance plan is to be provided to SWC with recommended maintenance actions, clearly stating instructions to complete the task and the frequency of which the tasks should be completed. The maintenance plan must be included in the manuals.

6. Defects liability period

Unless stipulated otherwise under the project preliminaries, the defects liability period must be twelve months following practical completion of the system.

The following activities must be carried out during the Defects Liability Maintenance Period:

- a) The system provider must provide a minimum of 12 months operations and maintenance service during the defect liability period
- b) Thermo-graphic inspections of switchboards
- c) Fault rectification and replacement of faulty materials, equipment and accessories with new
- d) Prompt emergency response when required.

At the end of the maintenance period, the installer must make a final service visit to certify the installation is operating correctly. SWC must accept and sign off all documents for all site visits and maintenance.

7. Example tender schedule

(This section to be part of tender specification requirements)

Equipment ratings and details

Pricing breakdown

8. Reference documents and standards

The Solar PV system and all associated equipment and materials must be designed, constructed, manufactured, installed and tested in accordance with the latest revisions of the Federal and State statutory requirements, applicable Australian and IEC Standards, as well as the SWC standard specifications:

Document type	Title
Legislation	Latest edition of the Work Health and Safety Act Latest edition of the Service and Installation Rules of New South Wales
Policies and procedures	
Other documents	PAM-HV SPEC-SWGR005: Specification Earthing and Lightning SWC D0000833 Engineering Competency Standard SWC Technical Specification - Civil SWC Technical Specification - Mechanical SWC Technical Specification - Electrical SWC Work health and safety procedure - Fall Prevention SWC - Emergency Stops Policy SWC Instrumentation and Control Standards

Standards

The following standards are applicable for all Solar PV systems:

- AS/NZS 1170.2 Structural Design Actions - Wind Actions
- AS/NZS 2053 Conduits and fittings for electrical installations General requirements
- AS/NZS 3000 Wiring Rules
- AS/NZS 3017 Electrical installations - Verification guidelines
- AS/NZS 3008 Electrical Installation - Selection of Cables
- AS/NZS 3100 Approval and test specification - General requirements for electrical equipment
- AS 4777 Grid connection of energy systems via inverters
- AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays
- AS 60529 Degrees of protection provided by enclosures (IP Code)
- AS 1768 Lightning Protection
- AS 1664.1 Aluminium Structures
- AS 2159 Piling Design and Installation
- AS 1657 Fixed platforms, walkways, stairways and ladders - Design, construction and installation
- AS 5532 Manufacturing requirements for single-point anchor device used for harness-based work at height
- AS/NZS 1891 Industrial fall-arrest systems and devices
- AS/NZS 4488 Industrial rope access systems
- IEC 61215 Terrestrial photovoltaic (PV) modules - Design qualification and type approval
- IEC 61646 Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval
- IEC 61727 Photovoltaic (PV) systems Characteristics of the utility interface
- IEC 61730 Photovoltaic (PV) module safety qualification
- IEC 61701 Salt mist corrosion testing of photovoltaic (PV) modules
- IEC 62109 Safety of power converters for use in photovoltaic power systems
- IEC 62716 Photovoltaic (PV) modules - Ammonia corrosion testing
- EN 50521 Connectors for photovoltaic systems - Safety requirements and tests

Electricity Distributor Service and Installation Rules
Clean Energy Council: Design Guidelines for Accredited Installers

Clean Energy Council: 30 - 100 kW Design Guidelines for Accredited Installers

Clean Energy Council: Grid-Connected Solar PV Systems: Install and Supervise Guidelines for Accredited Installers

Australian Building Codes Board Building Code of Australia

The following standards are applicable for all grid-connected Solar PV systems with energy storage (including batteries):

AS 2676 Guide to the Installation, Maintenance, Testing and Replacement of Secondary Batteries in Buildings

AS 4086.1 Secondary Batteries for Use with Stand-Alone Power Systems - General Requirement

AS 4086.2 Secondary Batteries for Use with Stand-Alone Power Systems - Installation and maintenance

AS/NZS 4509.1 Stand-Alone Power Systems - Safety and installation

AS/NZS 4509.2 Stand-Alone Power Systems - System Design

AS 62040 (All Parts) Uninterruptible Power Systems (UPS)