

30 – 100 KW DESIGN GUIDELINES FOR ACCREDITED INSTALLERS



GRID-CONNECT, NO BATTERY STORAGE

CLEAN ENERGY COUNCIL
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1 GENERAL

The objectives of these guidelines are to:

- improve the safety, performance and reliability of commercial solar photovoltaic power systems installed in the field
- encourage industry best practice for all design and installation work involving commercial solar photovoltaic power systems
- provide a network of competent solar photovoltaic power systems designers and installers to increase the uptake of solar photovoltaic power systems , by giving customers increased
- confidence in the design and installation work
- develop an industry-wide standardized approach to commercial photovoltaic system projects

The performance of a reliable installation that fulfils customer expectations requires both careful design and correct installation practice. Compliance with relevant state health and safety regulations is also necessary.

At this time, PV with battery storage systems is not discussed in this guideline. Guidance and advice for these systems may be added in a future revision.

This Guideline is in addition to the current CEC Design Guidelines for Accredited Installers (Grid-Connected Solar PV Systems, no battery storage), which are applicable to grid-connected systems of all sizes.

NOTE: These guidelines alone do not constitute a definitive set of rules, and shall be read in conjunction with all relevant Australian standards. Where these guidelines have additional requirements above those stated in the Australian Standards, then these guidelines should be followed.

2 DEFINITIONS

This document uses the same terminology as AS/NZS 5033:2014 - Installation and safety requirements for photovoltaic (PV) arrays. Two important general definitions are:

1. Where the word “shall” is used, this indicates that a statement is mandatory.
2. Where the word “should” is used, this indicates that a statement is a recommendation.

Note also that “PV array maximum voltage” refers to the open circuit voltage of the array, corrected for the lowest expected ambient temperature in the locality where the array is to be installed. (Minimum ambient temperature in the area can be obtained using Bureau of Meteorology historical weather data).

3 STANDARDS FOR INSTALLATION

Accredited installers shall comply with the following standards where applicable:

AS/NZS 3000	Wiring Rules
AS 4777.1	Grid connect - Installation
AS/NZS5033	Installation of Photovoltaic (PV) Arrays
AS/NZS 1768	Lightning Protection
AS/NZS 4509.2	Stand-alone Power Systems – Design
AS/NZS 3008	Selection of cables
AS 1170.2	Wind Loads

- 3.1 The grid-interactive inverter shall be tested in accordance with AS4777 (parts 2 & 3) and with IEC 62109 (parts 1 & 2).
- 3.2 The systems shall comply with the relevant electrical service and installation rules for the state where the system is installed.
(NOTE: The local electricity distributor may have additional requirements)
- 3.3 These guidelines set additional requirements to the standards. An accredited installer or supervisor is expected to follow these guidelines in addition to the requirements within the relevant standards.
- 3.4 These guidelines will become mandatory on 1 July, 2016.

4 LICENSING

4.1 Extra Low Voltage

All extra low voltage wiring shall be performed by a “competent” person, which is defined by the Australian Standard AS/NZS 4509.1 stand-alone power systems as:

“a person who has acquired through training, qualifications, experience or a combination of these, knowledge and skill enabling that person to correctly perform the task required.”

4.2 Low Voltage

All low voltage work: >120V DC or >50V AC shall be performed by a licensed electrician.

A licensed electrician is required to be responsible for the safety of the system wiring prior to connection of the system to the grid.

If the system contains ELV wiring installed by a non-licensed person, then a minimum level of inspection by the electrician prior to closing the PV array isolators would include:

- An open circuit voltage test on each PV string and on the total array.
- A visual inspection of an open PV junction box (randomly selected) and the master array junction box

These inspections / checks shall confirm:

- The array voltages and are designed and specified
- The appropriate cables (cross sectional area and insulation), junction fittings and enclosures have been used

Both the non-electrician ELV installers, as well as the licensed electrician, are expected to carry out the checks on the ELV wiring.

5 DOCUMENTATION

The designer should provide the following documentation to the installer:

- A list of equipment supplied
- A list of prescribed materials – such as cable type, including CSA
- A list of actions to be taken in the event of an earth fault alarm
- The shutdown and isolation procedure for emergency and maintenance
- An electrical schematic diagram that includes the electrical ratings of:
 - Modules
 - The PV array
 - DC & AC isolators
 - Overcurrent devices (ie. fuses, circuit breakers, etc)
- A physical layout of the solar modules.
- Site-specific system performance estimate.
- Recommended maintenance for the system.
- Maintenance procedure and timetable.
- AC voltage rise calculations (with reference to State SIR's where relevant)
- Structural certification or equivalent, confirming that the building can support the PV array.

Where the installer makes any changes to the system configuration or component ratings on site, the installer shall give the designer all the necessary information to update the system documentation (including alterations to the electrical schematic, if relevant).

6 RESPONSIBILITIES OF SYSTEM DESIGNERS

System designers shall comply with the following responsibilities:

- Provide full specifications of the system including quantity, make and model number of the solar modules & inverter
- Provide a site specific full system design including all shading issues, orientation and tilt, along with the system's site-specific energy yield, including average daily performance estimate on kWh for each month of solar generation
- Ensure array design will fit on available roof space
- Ensure array mounting framing installation will comply with AS1170.2
- Ensure the installation location of the solar array(s) can support the load
- Ensure array configuration is compatible with the inverter specification
- Ensure all equipment is fit for purpose and correctly rated
- Obtain warranty information on all equipment

7 SYSTEM SIZING

Factors that influence the proposed kWp (Peak Power at Standard Test Conditions) of a commercial PV system include:

- Customer's budget
- Rooftop area (or available land area for ground mounted systems)
- Roof altitude & azimuth
- Load profile of site
- Capacity limits (such as those set by the distributor, or the existing electrical installation)
- Financial benefit (eg. Return on investment, Internal Rate of Return, etc)
- Applicable grants and incentives
- Structural limitations of buildings
- Customer preferences
- Shading losses

All of these should be discussed with the customer, so that the basis of design decisions is clearly understood.

8 ENERGY YIELD

Unlike residential PV systems, medium scale installations require a highly detailed performance estimate.

That is, the hourly output of the system should be calculated – in addition to total monthly generation. Average hourly outputs may be produced on a monthly or seasonal basis. It is also recommended that site consumption data be overlaid with production data and presented to the customer. See [Section 9.1 Site Load Profile](#) for more details.

Whilst it is beyond the scope of this document to define the methodology for determining hourly output, refer to [Appendix C](#) for more details.

9 SITE SPECIFIC DESIGN INFORMATION

9.1 Site Load Profile

Medium scale PV systems typically have little incentive for producing surplus electricity. This is largely due to the low value of exported electricity; and, the export restriction (“zero export”) in some jurisdictions.

It is recommended that medium scale PV systems are designed to maximize “self-consumption” of generated electricity.

For this reason, it is critical that system sizing is performed correctly and is customized to the specific site load profile.

As such, system designers must obtain high resolution site consumption data before determining the system size & configuration.

There are two main ways to do this:

- Obtain data from the customer’s retailer/ distributor. Often such data is available in CSV format with resolution in 15 or 30 minute intervals.
- Data measured via a logging device. Generally such systems use current transformers to measure the current of the consumer mains. It is important that data collected via this method is available for at least a 12 month period to assess the demand for each month.

There are two main ways to do this: When proposed PV systems are to be installed in new buildings historical data will, obviously, not be available. A load profile will need to be developed based upon known loads. This is a roughly similar process to determining maximum demand—however, consultation with the customer may also be necessary to determine the timing of loads.

In all cases, a system designer will need to consider any future energy demand at the site.

9.2 Electricity Billing

To estimate the energy cost savings to the customer from installing solar, the customer’s electricity bill needs to be correctly assessed.

Businesses that consume more energy than a certain threshold will be treated as “large business” customers and billed in a more complex manner. This may include network charges (such as Transmission Use of System (TUOS) and Distribution Use of System (DUOS)); and, other energy market charges calculated separately on the bill.

The threshold will vary according to the retailer. For example, Origin Energy's current criterion for a "Large Business" customer is where consumption is greater than \$30,000 of power per annum, per meter and per site.

There are several types of charges on a "large business" customer's electricity bill:

- Fixed charges that are not related to how much energy is used.
- Electricity usage charge. This may be a simple charge per kWh used, but may also include time of use charges, network charges, environmental and regulatory charges (e.g. LGC, STC, NEM charges)
- Separate demand charge. The demand charge is based on the maximum peak load that an end user places on the system (typically measured in kW or kVA).

Businesses with lower energy usage will be billed in a similar way to residential customers, with most charges rolled into a single rate per kWh, however time-of-use charges may still apply.

Importantly, the commissioning of a PV system may affect the rates the customer is billed for their supply and usage. For example, the customer may be moved from a flat rate tariff to a time-of-use tariff, or to time-of-use tariff plus a demand charge.

Customers should be informed of potential changes to their electricity charges and encouraged to perform their own due diligence to ensure the full benefits of installing a PV system are realized.

See [Appendix B](#) for examples of commercial bills.

9.3 Solar Access & Shading Analysis

A detailed shading analysis should be conducted on the site so that system performance can be accurately estimated.

Where potential shading may arise - such as nearby buildings, parapets, flues, air conditioning units - the designer should use software modelling packages, such as 3D CAD, to assess the impact. Such modelling should be retained for future reference.

The shading estimate should be calculated over a whole year. See [Appendix A](#) for some tools that may be able to assist with this.

Where tilt frames are used, the designer shall ensure there is adequate spacing between rows of tilted modules, to avoid each row of modules shading the row behind them.

The minimum Clean Energy Council requirement states that north-facing rows shall not shade each other between 10am and 2pm on the Winter Solstice (~June 22).

Designers should ensure north-facing rows do not shade each other between 9am to 3pm on the Winter Solstice (~June 22).

Refer to the CEC Technical Bulletin “PV array row spacing” (March 2010) for more information on how to calculate this.

9.4 Network Pre-Approval

Each distribution business has its own process for connection approval of a solar generation system to their grid. It is recommended to contact the distributor early in the design phase to ensure all their connection requirements are met.

The distributor may require upfront fees to assess proposals for systems above a given size. Additionally, some distributors may require an electrical engineer’s certificate for systems over a given size.

For more general information on the pre-approval process, see our guide to [Small Scale Generation Connection](#).

Regarding the electrical characteristics of the PV installation, there may be requirements for:

- Reverse power protection relays
- Export limiting devices (e.g. zero export)
- Ramp rate
- Manual system restore
- Power factor settings other than 1.0
- Additional anti-islanding provisions for inverters.

For more information regarding this subject, refer also to the [CEC Embedded Generation Guide \(>100kW\)](#), section 3.7.2.)

The following examples in particular should be noted:

- Ergon and Energex (Queensland) have specific requirements for systems over 30kW which are connected to their networks, such as additional anti-islanding protection. Refer to their fact sheet [“Installing Generation on Major Customer Premises”](#) for further details.
- ActewAGL (ACT) currently require a “grid connection cubicle” (GCC) for systems larger than 60kW. This assembly includes provision for future protection relays, and Remote Control and Monitoring by the distributor among other things.

9.5 Inverter Location

At both the proposal and design stages, it is important to consider the proposed location of inverters, in relation to the main switchboard or sub-board where the inverter AC output is to be connected.

As the output current from the inverter(s) can be substantial, the provision of suitable AC submains to the connection point can add significant cost and complexity to the project. Existing distribution wiring in the building should be reviewed to ensure that it can carry the output current without excessive voltage drop.

9.6 Building Structural Considerations

The roof structures of commercial buildings can be quite different to those in residential buildings. For example, there may be wider spacing between trusses and purlins, different roofing materials, different structures, etc.

It is the responsibility of the system designer to verify that the structure can support the proposed PV array. This can be determined either from the original drawings and specifications or via inspection by an accredited structural engineer. For a list of suitably qualified structural engineers, contact one of the following accreditation bodies:

- Engineers Australia (NPER scheme)
- RPEng (required for Queensland – registration managed via Professionals Australia)
- Building Practitioners Board (for the NT)
- RBP (for Victoria – via the Building Commission)

Structural certification is required in some jurisdictions by State or Local government regulations (e.g. when submitting a Development Application to some municipal councils in NSW). The designer should check the requirement for this with the local authorities.

If certification is not required, it is still important to confirm that the building structure can support the additional load of the PV array and its mounting system. Reference should be made to the original structural documentation for the building wherever possible.

Ballast mounting systems may be used for flat concrete roofs, as an alternative to bolt or screw fixings. The weight of ballasts (plus the frame and array) needs to be considered when assessing the structural capacity of the roof.

If a ground mounted system is proposed, the framing system must be certified for the wind region in which it is installed – some are only certified for the less demanding Region A and/or B. Some key aspects to check are footing dimensions and spacing, concrete strength, and the specification of suitable fasteners between posts/uprights and footings.

9.7 Array Installation Methods

Rooftop PV array mounting methods may require approval from the roofing material manufacturer and/ or installer, to ensure that warranties are not voided (for leakage and weatherproofing etc.). This is particularly relevant for new or recently completed buildings.

Newer commercial buildings often also use roof products with concealed-fastener fixing systems. Solar mounting frames should be fixed to this type of roofing using non-penetrative clamps, rather than fixing into the purlins. Limit strength ratings for these clamps must be noted, and directions for installation must be carefully followed.

As always, the array mounting system shall be installed to the manufacturer's instructions, so that the whole assembly meets the structural wind loading standard (AS/NZS 1170.2). Check for any assumptions and limitations in the installation manual (such as minimum thickness of roof battens or purlins, gauge of fasteners to be used, etc.).

9.8 PV Array Installations over 600VDC & Restricted Access

According to AS/NZS 5033:2014, PV installations with maximum array voltages above 600VDC (adjusted for minimum ambient temperature) are only permitted in buildings which are not "domestic dwellings".

"Domestic dwelling" is defined by the building classifications in the National Construction Code. The following types of buildings are considered "domestic dwellings:"

- Class 1 (e.g. a freestanding house)
- Class 2 (e.g. an apartment block)
- Class 3 (e.g. a hotel/motel)
- Class 4 (e.g. a private garage, carport, or shed)

In systems where the PV array maximum voltage is greater than 600V DC, AS5033 requires that the array, inverter connections and associated isolators are in a "restricted access" area. The intent of these requirements is to ensure that only adequately trained personnel can access the system.

The designer shall ensure that equipment can be installed or located in a way that satisfies the "restricted access" requirements.

Restricted access can be achieved by:

- a barrier (e.g. a perimeter fence or barrier with access only via a padlocked or equivalently secured gate or door); or

- location (e.g. a commercial rooftop where there is no fixed ladder or other ready means of access).

Suitable solutions to this include installing the inverters in a cage or locked room, or an area that can only be accessed by those with authorization; or having the isolator enclosures padlocked or caged, and all cabling up to and into the inverter casing enclosed in conduit.

Note that simply being “inside a business premises” may not be sufficient, as the inverters may then be accessible to a variety of staff and visitors on the premises.

Additional signage is required when installing systems are greater than 600VDC. The label (below) is required on the access door, hatch or gate used to access the equipment.

Refer to [Section 9.15 Labelling and Signage](#) and the provisions of AS5033 for other signage requirements.



9.9 Overcurrent Protection (PV Array)

Where multiple parallel PV strings exist, there may be a requirement to install overcurrent protection (e.g. string fusing).

Overcurrent protection shall be located in accordance with AS5033:2014 clause 3.3.6.

Clause 3.3.4 from AS 5033 determines whether overcurrent protection is needed in an array with parallel strings:

3.3.4 String overcurrent protection

String overcurrent protection shall be required if—

$$((S_A - 1) \times I_{SC\ MOD}) > I_{MOD\ MAX\ OCPR}$$

Where:

SA = total number of parallel-connected strings in the PV array

ISC MOD = the short circuit current of a single panel at STC (as specified by the manufacturer)

IMOD MAX OCPR = maximum overcurrent protection rating of the panel. (This is usually specified by module manufacturers as the “Maximum Series Fuse Rating”.)

This formula considers the situation where there is a major fault in the array cabling – e.g. the insulation of a string cable on the negative side of the array is damaged, and makes contact with a metal roof surface, leading to current being “back fed” through one string of panels in the array, from all the other parallel strings. This can result in current passing through the panels and string cables that is much higher than during normal operation.

The Maximum Series Fuse Rating of the panels should be listed on the panel’s spec sheet. Maximum Series Fuse Rating is equivalent to the maximum current that a panel can safely handle being “back fed” during a fault condition.

Refer to Clause 3.3.5 of AS 5033 for fuse protection requirements and selection of fuses.

Note: Where an inverter has multiple maximum power point trackers (MPPT), the section of the array connected to each individual MPPT is treated as a separate PV array.

9.10 DC Cable Selection & Voltage Drop

The designer must ensure that all DC cables specified are rated to handle the PV array maximum voltage.

Array cables shall also be sized to carry a current of $1.25 \times \text{ISC ARRAY}$ at the expected operating temperature. The location and method of installation of cables (e.g. enclosed, clipped, buried), along with the cable manufacturer’s recommendations, shall be taken into account when calculating the cable rating.

For cables installed near, or in contact with PV modules, the operating temperature should be considered to be equal to 80°C.

String, sub-array and array cables, shall also be sized to avoid excessive voltage drop under load. For LV PV arrays, under peak output conditions, the voltage drop from the most remote module in the array to the input of the inverter should not exceed 3% of the V_{mp} voltage (at STC).

9.11 DC Isolator Requirements

As for domestic PV systems, the designer should consider several factors when selecting or specifying DC isolators. Commercial systems may run at high DC voltages, including above 600VDC for non-domestic buildings.

Most inverters currently in use for commercial PV systems are the transformerless type, hence each “leg” of the DC isolator (positive or negative conductor) must be rated to break the full PV array maximum voltage. This voltage rating may be achieved by using an isolator with 4 or more poles, with 2 or more switch poles connected in series in each leg.

DC isolators shall also be adequately rated to break the full load current, or potential fault currents from the array. (PV arrays connected to systems without battery storage are typically current limited sources by nature).

If the isolator is exposed to the sun (i.e. rooftop use) then it shall be rated for the required current at a temperature equal to the maximum ambient temperature in the region, plus 40°C. The effect of derating due to temperature shall also be considered for isolators that are installed in other locations, such as outdoor walls or in a rooftop plant room.

For a more detailed explanation, see the presentation “PV Array DC Isolator Ratings” (<https://www.solaraccreditation.com.au/installer-area/technical-information/dc-isolator-ratings.html>)

Appendix B of AS/NZS 5033 shows examples of the possible earth fault conditions that could occur in a solar array, and the voltage that the DC isolator will have to break.

9.12 AC Voltage Rise

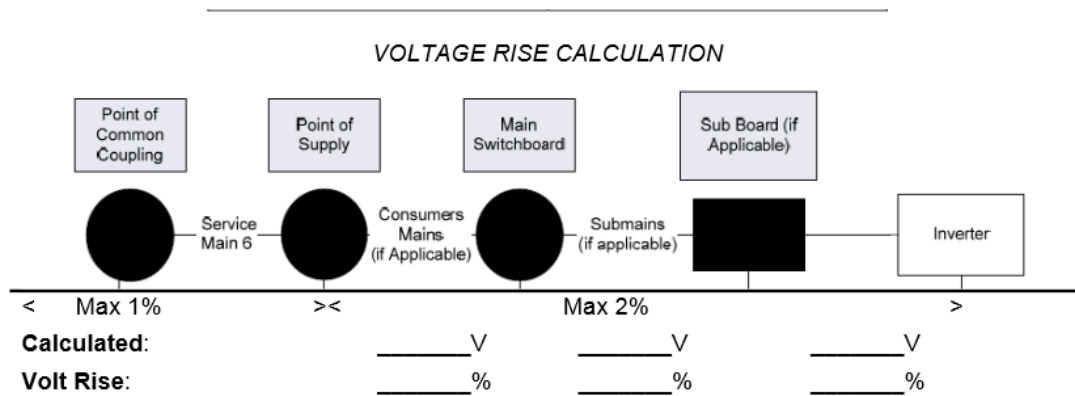
The system designer should check the size of AC cables between the proposed inverter and the electricity distributor’s point of supply to avoid excessive voltage rise within the installation when the PV system is generating at its peak output.

This includes the existing cabling between switchboards or distribution boards where an inverter is connected, and the point of supply (street pole, pit, etc).

It is recommended that the total voltage drop/rise between the inverter and the point of supply should be kept below 2%. This will avoid problems with inverter disconnection at times of peak generation, especially where the supply voltage in the area is high.

Designers should consider best practice as a voltage drop/rise of 1% from point of attachment to the main switchboard; and, 1% from the main switchboard to inverter terminal (including via any distribution boards).

Some distribution businesses require the installer to provide this calculation as part of the pre-approval application for connection. On the following page is an example from Ergon / Energex.



Check this is the latest version before use.

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EX BMS4286 Ver 2
EE STNW1170 Ver 2

Joint Standard Document between ENERGEX and Ergon Energy
ENERGEX Limited ABN 40 078 849 055 ■ Ergon Energy Corporation Limited ABN 50 087 646 062

Some states (particularly NSW) also have specific requirements listed in their “Service and Installation Rules” relating to voltage rise.

For complex installations, the designer may need to consult with a qualified electrical engineer, to ensure that there are no adverse side effects on the existing electrical services from the installation of solar.

Note: Designers should ensure that electrical installations maintain the electrical installation tolerances listed in AS/NZS 3000 (+10%/ -6%) of 230/400V.

9.13 Potential Induced Degradation

Voltage related or potential induced degradation refers to irreversible power loss in a module due to high voltage, high humidity and high temperatures. For systems above 600V DC this is a critical design consideration. Losses of up to 50% have been reported from overseas commercial installations.

While there is currently no official standard for testing, two tests are widely accepted. The designer should ensure that the modules and technology used in the system are appropriate for the system voltage and installation location. It may be necessary to contact the module manufacturer to ensure that the modules have been tested for PID.

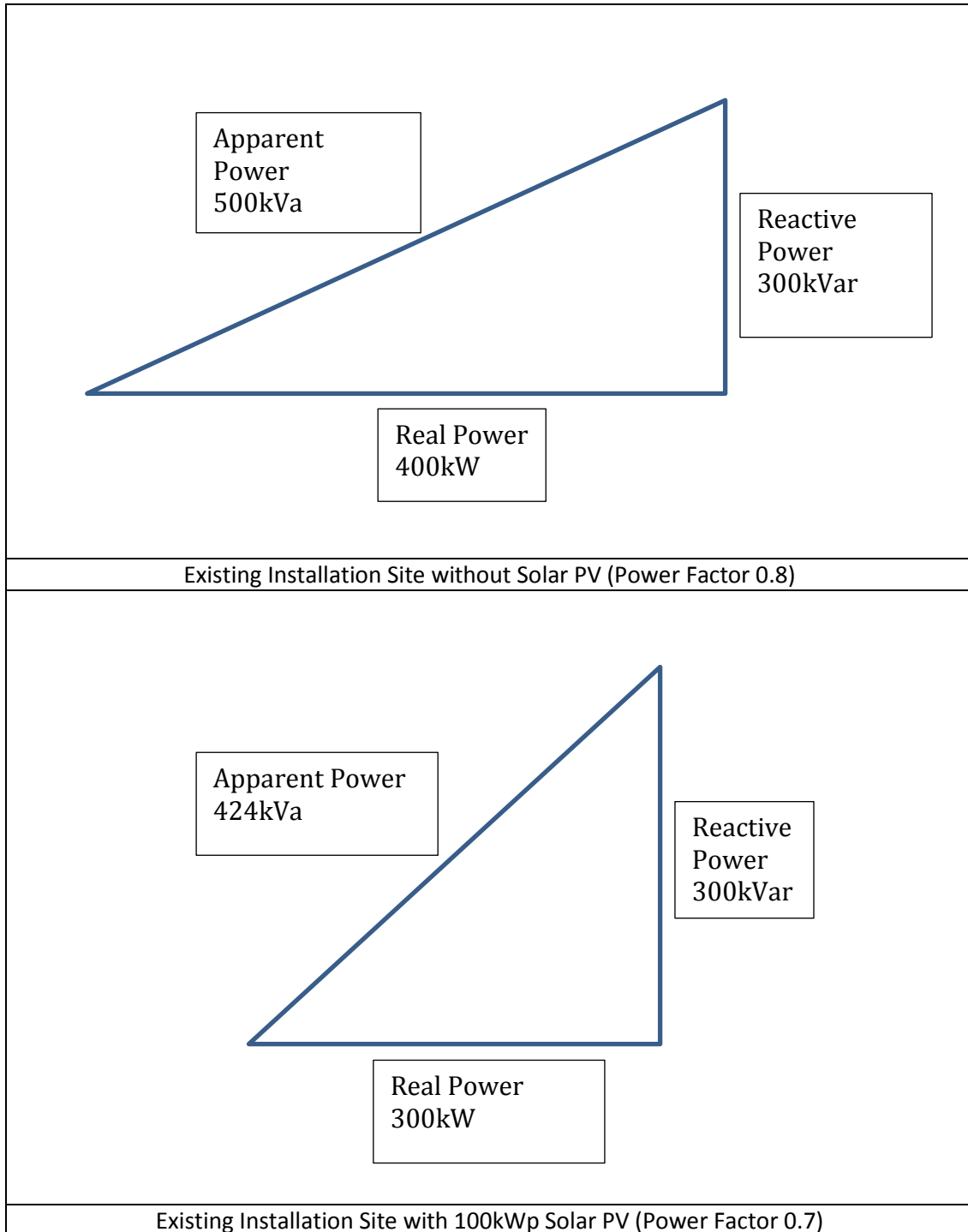
For more information see [GSES's guide to Potential Induced Degradation](#).

One method of reducing PID is to ground (functionally earth) the negative leg of the array.

Note: Functional earthing can only occur on separated (“transformer” based) inverters.

9.14 Power Factor

The installation of a commercial PV system may have a negative effect on the power factor of an electrical installation. This can occur where the inverter is operating with a power factor approaching unity, thereby reducing the amount of real power on the electrical installation and increasing the amount of apparent power.



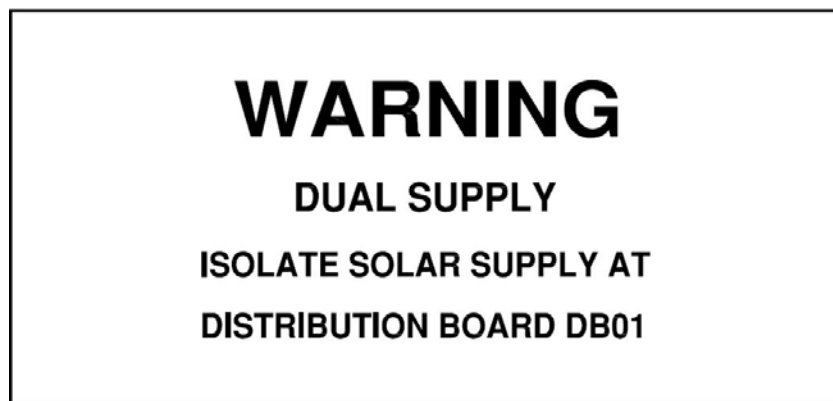
9.15 Labelling and signage

All AC and DC isolating switches need to be appropriately identified, in particular for larger systems with many strings and multiple inverters. Customized labels may be required for the System Shutdown Procedure, and numbered labels for the DC isolators, AC isolators and inverters.

Where there are multiple sub arrays connected to an inverter, and there are several DC isolators adjacent to the input, the isolators need to be suitably grouped to allow for isolation of the inverter, and labelled with a warning notice to indicate the need to shut off multiple supplies to isolate the equipment. (Refer to Clause 4.4.1.4 from AS 5033).

Designers and installers shall also be aware of the requirements of AS 4777.1 – Grid connection of energy systems via inverters: Installation requirements. This standard defines the labelling required on the AC switchboard side of the inverters.

In particular, if an inverter is connected to a distribution board or sub-board, signs shall be installed in prominent positions on the main switchboard and all intermediate distribution boards (see below). This ensures that personnel working on other parts of the electrical installation will be aware that the system has multiple supplies, and how to isolate parts of the system safely.



Example sign for a main switchboard or intermediate distribution switchboard when Inverter Energy System (IES) is connected to a subsequent distribution switchboard

9.16 System and Site Monitoring

It is recommended that automatic monitoring be provided for 30-100kW systems. This monitoring has two main purposes:

- Recording energy generation data to confirm that the system performance is in line with the performance estimate. (DNS meters, which usually only record exported energy, do not provide suitable information for this purpose.)
- Collecting diagnostic data and fault notification from the inverter(s), so that system faults can be rectified as quickly as possible.

The designer shall ensure that the monitoring equipment is compatible with the PV system equipment and, if required, any existing equipment (e.g. existing electrical meters).

The designer should provide appropriate information to the installers so that the monitoring system can be installed, configured and tested.

The following physical requirements should be considered:

- Network access – wired, wireless or mobile (e.g. passwords, network IDs, etc.)
- Physical network connection
- Power supply requirements for monitoring devices
- Physical wiring to sensor devices (e.g. irradiance, wind, temperature, string / panel monitoring).

Options for presentation of monitoring data to the customer, e.g. through a proprietary web portal or Building Management System (BMS) — such as Cbus — should be discussed before installation of the system.

10 ADDITIONAL INSTALLATION CONSIDERATIONS

10.1 OH&S

Ensure OH&S practices are consistent with AS4801. Specific OH&S considerations include:

- Detailed, site specific Health and Safety Plan
- Signed Safe Work Method Statements covering all work activities and for all contractors
- Detailed site specific risk assessments, signed by all personnel
- Hazard, Risk and Control Measure Register
- Incident Reporting procedure
- Insurance Documentation
- Site Induction Procedure
- Site Rules
- Emergency Response Plan
- Rescue Plan
- Corrective Action Procedure
- Contractor Documents Folder
- Material Safety Data Sheets
- Work Safely at Heights accreditation

10.2 Lifting Equipment and Roof Loading

Mechanized lifting equipment (cranes, scissor lifts etc.) will generally be required for getting PV system components onto the rooftop, or for moving heavy components.

When lifting materials onto the rooftop, the condensed weight of the load needs to be considered, e.g. pallets of panels, or containers of framing parts. The proposed loading locations need to be checked against the structural capacity of the roof. It is recommended that this should be done by a registered structural engineer.

Temporary walkways on the rooftop may also be needed for the safety of installers, and to prevent damage to roof sheeting. This is particularly important on rooftops that include areas of translucent roof sheet (e.g. "Laserlite"). If the roof has skylights, bollards and barrier tape or other suitable markers should be used to mark out areas to avoid.

10.3 Electrical Shutdown

A shutdown of the site's electrical supply system (or part of it) will be required to connect the inverters to the electricity system. The designer and/or installer should inform the building owner/manager in advance of the shutdown requirements, likely duration, and areas which will be affected. Shutdown timing should be co-ordinated with building management, especially for premises such as hospitals, nursing homes, etc.

10.4 Backup generators

If the site contains a backup generator, the designer shall ensure that the installation of the solar system does not interfere with the backup system. In these cases, the designer should consult with the generator supplier and/or original installer. Refer to AS 4777.1 for general guidance on connection to systems that include UPS; and AS3000 for systems including generators and other sources of supply.

11 POST-INSTALLATION CONSIDERATIONS

11.1 Operation and Maintenance Manuals

Compared with domestic installations, a more detailed standard of system documentation is necessary for larger systems, so that safe operation and maintenance can be carried out throughout the life of the system. Operation and Maintenance manuals shall include information such as the following:

- The location of all rooftop/array isolators and applicable arrays/sub-arrays they serve.
- Identifying all distribution boards or sub-boards that the inverters are connected to, and their location.
- Full site-specific single-line schematic diagrams for the PV installation.
- Contact details for suppliers of specialist mounting hardware and components.
- If necessary, site plans to show the location of the site meter, main switchboard and distribution boards which are connected to the solar PV installation.

11.2 Maintenance requirements

Factors that can influence maintenance requirements include:

- Panel tilt angle (shallow tilt angles may require more frequent cleaning)
- Environmental factors (leaf litter, dust, salt spray, etc.)
- Fauna (birds, possums, rodents, etc.)

The designer and installer shall document all maintenance actions that are required by the equipment manufacturers, and ensure any site specific maintenance actions are included.

The intervals between these maintenance actions shall also be included in this documentation.

11.3 Warranty information

The designer and installer shall provide detailed warranty information.

If the PV system makes use of design or installation methods that are different from the manufacturer's standard instructions, written approval from the manufacturer for this alternative method shall be provided with the warranty information.

APPENDIX A: SOLAR TOOLS

- [Solar Pathfinder](#)
The Solar Pathfinder has been the standard in the solar industry for solar site analysis for decades. Its panoramic reflection of the site instantly provides a full year of accurate solar/shade data, making it the instrument of choice.
- [SunEye – The Solmetric SunEye](#)
Although this product is no longer available, for those that have access, the SunEye is a hand held electronic device that allows users to instantly assess total potential solar energy given the shading of a particular site. Identifying the shading pattern early in the process reduces the expense of system and home design and improves the efficiency of the final system or house.
- [HORlcatcher](#)
HORlcatcher is an easy and fast tool to take outdoor pictures of the horizon. The pictures can be used to determine the solar energy input, sunshine duration and sun exposure reduced by obstacles like trees, houses or mountains. HORlcatcher is supplied with a digital camera.
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APPENDIX B: EXAMPLES OF COMMERCIAL BILLS

- [The Energy Efficiency Exchange](#)
An explanation of basic billing requirements.
- [EnergyAustralia](#)
Examples of commercial bills, including “large business.” Includes a description of charges.
- [Origin Energy](#)
Understanding commercial electricity bills
- [Aurora Energy](#)
Understanding electricity bills - particularly relevant to Tasmanian customers.

APPENDIX C: SYSTEM PERFORMANCE ESTIMATE TOOLS

- [PVWatts](#)
Basic system energy output
- [PV Sell](#)
Detailed hourly generation and consumption data. Also perform Return on Investment calculations