

Guidelines for photovoltaic installations up to 200kW connected via inverters to the ActewAGL network

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1. INTRODUCTION

Under National Electricity Rules (NER) 5.3 ActewAGL has an 'obligation to review and process applications to connect or modify a connection which are submitted to it and must enter into a connection agreement' with the applicant. This requirement applies to both customer load and embedded generation plant.

Embedded generation systems, which Photovoltaic (PV) systems come under, when connected to the ActewAGL network can impact the operating conditions, voltage profile and loading on the feeder. ActewAGL has in place specific minimum technical requirements that must be met in the design and installation of PV facilities to ensure that these impacts can be controlled to maintain safe and reliable operation of the network for operating personnel, customers and the general public.

These guidelines outline the technical requirements for the installation of PV power generation systems connecting to via inverters and operating in parallel with ActewAGL's distribution network.

There may be additional requirements over that specified in this document for installations in unique situations. These requirements will be identified by ActewAGL at the initial enquiry processing stage.

These guidelines only consider technical requirements from the utility network point of view. They do not specify requirements for the customer side of the PV system itself or any plant associated with its installation and operation.

2. SCOPE

This document covers issues specific to PV installations. It should be noted that other solar energy systems for example solar thermal and other renewable generation such as wind power generation are considered separately.

This document applies to the following inverter connected PV systems connecting to ActewAGL's low voltage (LV) network:

- **single phase installations up to 10kW**
- **three phase installations up to and including 200kW**

Installations above 200kW may use these guidelines to ascertain minimum requirements for connection but will require additional network studies to identify other requirements for connection to ensure the safety, operation and reliability of ActewAGL's network are not compromised.

This guideline does not apply to connections to the high voltage (HV) network.

3. OBJECTIVE

ActewAGL is committed to connecting renewable generation to its network while ensuring at all times that power supply to its customers is delivered in accordance to ActewAGL and industry safety and reliability standards. ActewAGL's prime directives are, in order of importance:

- a) the safety of personnel who work on the electricity network and to the general public; and
- b) to minimise asset loss-of-life, reduced performance and to prevent damage to electricity network assets; and
- c) to minimise disruption to all customers (quality of supply) inclusive of the applicants site.

The objective of this document is to outline to proponents of embedded PV power generation systems ActewAGL Distribution's requirements for the connection via inverters to, and parallel operation with, ActewAGL's distribution network.

These guideline should be read in conjunction with AS4777 parts 1 to 3, ActewAGL's service and installation rules as well as ActewAGL's guidelines for the connection of small LV generators in parallel with the ActewAGL distribution network.

ActewAGL's Guidelines for the connection of small LV generators in parallel with the ActewAGL distribution network can be found at:

<http://www.actewagl.com.au/~media/ActewAGL/ActewAGL-Files/Products-and-services/Building-and-renovation/For-professionals/guideline-for-connection-of-small-lv-generators.ashx>

ActewAGL's service and installation rules can be accessed on the ActewAGL website at the following link:

<http://www.actewagl.com.au/About-us/The-ActewAGL-network/Electricity-network/~media/ActewAGL/ActewAGL-Files/Products-and-services/Building-and-renovation/For-professionals/Service-installation-rules-for-connection-to-electricity-network.ashx>

Alternatively you can contact ActewAGL Southern Services Centre on (02) 6293 5749.

4. DEFINITIONS AND REFERENCES

4.1. Definition of terms in this document

ActewAGL

For the purpose of these guidelines "ActewAGL" refers to ActewAGL Distribution. Any reference to ActewAGL Retail will be stated as 'ActewAGL Retail'.

It is important to note the difference between ActewAGL Distribution and ActewAGL Retail. ActewAGL Distribution is the ACT's principal Distribution Network Service Provider (DNSP) and is responsible for the distribution of electricity to all distribution grid-connected customers within the ACT under a regulatory framework. ActewAGL Distribution design, install, up-grade, repair and maintain the poles, substations and wires which make up the distribution network carrying electrical energy to ACT homes and businesses.

ActewAGL Retail is the ACT's local electricity retailer and has a license to buy and sell electricity. An agreement made with ActewAGL Distribution or any other electricity retailer does not constitute an agreement with ActewAGL Retail.

Anti-islanding Protection

A protection system to detect islanded conditions and disconnect the PV inverter from the island.

Class 1, 2, 3 or 4 PV Generator

For the purposes of these guidelines PV installations have been classified according to their inverter rating as shown in the table below.

Class	Inverter Nameplate Rating
1	Up to 10kW single phase or 30 kW three phase
2	Above 30 kW up to 60 kW three phase
3	Above 61 kW up to 120 kW three phase
4	Above 121 kW up to 200 kW three phase

Embedded generating unit

A generating unit that is connected directly to the distribution network without direct access to the transmission network.

Environment and Sustainable Development Directorate (ESDD)

ESDD is the inspecting authority in the ACT and is responsible for inspecting and approving customer's electrical installation. (Previously known as ACTPLA).

External protection

For the purposes of these guidelines external protection means a protection device separate to the inverter in a PV system.

Generator Connector Cubicle (GCC)

A standardised enclosure designed to accommodate the required components to connect the PV system to ActewAGL's LV distribution network. Refer to Appendix A6 for a description of the GCC.

Gross metering

For the purpose of these guidelines gross metering means a metering arrangement in which both the total amount of energy created and the total amount of energy consumed by a customer are recorded separately.

Internal protection

For the purpose of these guidelines internal protection means a protection device that is part of the inverter in a PV system.

Inverter

Performs the conversion of the variable DC output of the photovoltaic (PV) modules into a utility frequency AC current that can be fed into the electricity network.

Islanding

Occurs when supply from the network is isolated and one or more PV generators remain connected to the isolated network and continue to supply load in this part of the network.

'Must' and 'Shall'

For the purposes of these guidelines the words 'must' and 'shall' indicate a mandatory requirement.

Maximum Power Point Tracker (MPPT)

A device, typically located within an inverter, which regulates incoming DC power to the inverter and optimises solar panel performance.

Net Metering

For the purpose of these guidelines 'net metering' shall mean a metering arrangement in which the difference between the total amount of energy created and the total amount of energy consumed by a customer is recorded.

The result can have two forms, 'net export' in which case the customer uses less energy than they generated or 'net import' in which case the customer uses more energy than they generated.

National Electricity Rules, NER

The Rules made under the National Electricity Law to control the operation of the National Electricity Market.

Network Charges

For the purpose of these guidelines 'network charges' shall refer to the costs invoked by ActewAGL for the use or augmentation of ActewAGL's network. See Appendix 3 for details.

Network Technical Study:

The connection of a PV installation to a distribution network will inevitably result in some local changes to the characteristics of the network. To evaluate the possible consequences of these changes ActewAGL will carry out a network study with the installation included in the network model. This involves the use of detailed databases describing the electrical characteristics of their networks and can be used to analyse how the networks will behave under different loading conditions or in the event of particular faults. Refer to Clause 7.2.2 and Appendix A8 for details.

SCADA (Supervisory Control and Data Acquisition):

A computer system that remotely monitors and is capable of switching the PV connection to the electricity network.

4.2. List of references

1. AS3000: Electrical Installations (known as the Australia/New Zealand Wiring Rules)
2. AS4777.1: Grid Connection of Energy Systems via Inverters Part 1 – Installation

Requirements

3. AS4777.2: Grid Connection of Energy Systems via Inverters Part 2 – Inverter Requirements
4. AS4777.3: Grid Connection of Energy Systems via Inverters Part 3 – Grid Protection Requirements
5. AS5033: Installation of Photovoltaic Arrays
6. AS6100.3.2: Electromagnetic Compatibility – Limits for Harmonic Current Emissions
7. ActewAGL's Service and Installation Rules
8. ActewAGL's Guidelines for the Connection of Small LV Generators in Parallel with the ActewAGL Distribution Network

5. GENERAL REQUIREMENTS

5.1. Regulatory

The PV installation and its connection process shall implement the regulatory requirements and recommendations of the following:

- The National Electricity Rules: Chapter 5
- The National Electricity Customer Framework: Second Exposure Draft (2009)

5.2. Renewable Energy Generator Connection Contract

In accordance with the applicable regulations listed in section 5.1, customers will be required to enter into a Renewable Energy Generator Connection Contract. The Contract sets out the terms of connection of the renewable energy generator to ActewAGL's electricity network.

Customers may also enter into a negotiated generator connection contract and may also be required to enter into a Generator Connection Agreement. ActewAGL will notify the customer if this Agreement is required.

The negotiated contract and the agreement are subject to commercial negotiations between the parties and will encompass both the technical and commercial aspects of the connection, address the access standards and specify the terms and conditions including the connection charge.

The agreement also requires the Proponent to indemnify ActewAGL against any liability resulting from the Proponent's use of the distribution network in a manner prejudicial to the safety and efficiency of the network.

It is desirable that the negotiated contract and agreement (if required) be finalised and signed by the duty authorised representatives of both parties at least one month prior to the intended commissioning date.

Where required ActewAGL will prepare and forward a draft Generator Connection Agreement following the receipt of the Proponent's full and complete Connection Application.

Commissioning and connection of the PV installation will not be permitted until this agreement is in place.

5.3. Compliance with the National Electricity Rules (NER)

The National Electricity Rules (NER) regulate the access of the distribution network to generators subject to the generating unit's capacity and the amount of energy generated.

Chapter 5 of the NER provides the framework for this access and aims to:

- establish the process to be followed;
- detail the guidelines and principles governing the connection and access to a network;
- address the Proponent's reasonable expectations of the level and standard of power transfer capability; and
- establish the process to ensure ongoing future compliance with the technical requirements of the connection with the network.

6. INSTALLATION AND TECHNICAL REQUIREMENTS

6.1. General requirements

Unless otherwise specified the PV system shall comply with the requirements of AS4777. As noted in AS4777 although this Standard does not apply to systems larger than 30kW 3-phase units, similar principles can be used for the installation of such systems.

Only inverters that are either included in the list of approved inverters published by the [Clean Energy Council](#) or have been tested by an authorised testing laboratory and certified as being in compliance with AS 4777 will be accepted for connection to the ActewAGL network.

Installations greater than 200 kW will be assessed on a case-by-case basis; however this document may be used as a minimum guideline to indicate factors which may be relevant to installations of this size. Such systems may employ inverters with individual ratings greater than 30 kW. Approval to connect these inverters will be determined on a case by case basis.

Appendix A7 shows a typical connection arrangement for PV system between 30 and 200kW.

6.1.1 Wiring of the PV installation

The PV installation shall meet the wiring requirements of AS/NZS3000 (also known as the Australian/New Zealand Wiring Rules). It shall also meet the requirements of ActewAGL's Service and Installation Rules, with specific attention to sections 1.9 and 1.10 of the main document.

However, it should be noted that ActewAGL is not an inspecting authority and cannot connect a new installation to the electricity network until that work has been inspected and approved for connection by the Environment and Sustainable Development Directorate (ESDD) or other relevant inspecting authorities.

6.1.2 Labelling of the PV installation

The PV installation shall meet the labelling requirements outlined in section 5.5 of AS4777.1. It shall also meet the requirements of ActewAGL's Service and Installation Rules, with specific attention to section 5.1.5 of the main document.

6.1.3 Safety

The PV installation shall not impose a safety hazard to personnel working on the network, ActewAGL customers and members of the public.

6.1.4 Connection arrangement

The maximum value for the rating of an inverter allowed for single phase installations is 10 kW. Single phase inverters in three-phase configuration will be allowed. PV Installations with capacities greater than 10kW must be three-phase systems with generation balanced equally (maximum 10% variation between any two phases) amongst the three phases.

6.1.5 Permitted PV installation capacity

ActewAGL has limits on the maximum generation capacity that can be connected to a local LV network. This is largely driven by the thermal capacity of the feeder, distribution transformer rating and the combined effect of the connected generation plant on ActewAGL network performance, operation and safety. The network study will determine the maximum PV installation capacity that may be connected. There may also be cases where the proposed installation may be required to connect at a reduced capacity or where no connection is allowed.

In some instances, depending on the location of the proposed installation, network augmentation and or additional protection and control functions (for either or both ActewAGL network and the PV installation) may be required to ensure network safety and performance standards are not compromised. ActewAGL will identify these as part of the network study and advise the applicant if additional work is required. The cost for some or all of this work will be attributed to the applicant.

Applications will be processed strictly in the order in which they received.

For the purposes of these guidelines ActewAGL has classified PV installations by the size of the inverter. Please refer to Clause 4 'Definitions and References' for details.

6.1.6 Power supply reliability

Connection of the PV System shall not create a situation where the reliability of the supply network is degraded.

6.1.7 Power supply quality

Operation of the PV System shall not cause undue interference with the supply to other customers. In particular the installation shall comply with the requirements of

- AS4777.2 Section 4.4 for power factor
- AS4777.2 Section 4.5 for harmonic currents injected into the network
- AS4777.2 Section 4.6 for voltage fluctuations and flicker
- AS4777.2 Section 4.8 for transient voltage limits
- AS4777.2 Section 4.9 for direct current injection.

The output voltage of the PV system shall be within the range specified in ActewAGL's Service and Installation Rules, which is the average voltage over any given 10 minute period at the connection point shall be within the range of 225.6V to 254.4V. Voltages outside this range may damage or reduce the lifetime expectancy of electrical appliances.

6.1.8 Protection

The PV system shall comply with the protection requirements of AS4777.2 and AS4777.3.

Anti-islanding protection is an important requirement of PV protection systems. Islanding creates serious safety issues for personnel working on the distribution network or on an inverter during an outage. It also interferes with the quality of supply to other customers and can damage equipment. All protection equipment associated with a grid-connected PV system must be designed, installed and tested to ensure islanding does not occur.

AS4777 compliant inverters do not necessarily guarantee complete immunity against islanded operation, particularly on networks with a high penetration of PV solar systems or with multiple inverter installations. ActewAGL will carry out technical studies to assess islanded operation risk levels for all new installations and specify control measures to manage identified risks if deemed necessary. The installation may be required to connect with a reduced capacity or not at all.

PV installations must disconnect from ActewAGL's distribution network and must not connect to the network in the event that one or more phases of the distribution network is not energised. The protection system must ensure the installation is disconnected from the network within two seconds and must not reconnect for at least 60 seconds after the network supply has been restored.

Appendix A4 provides a table showing minimum protection requirements for the various classes of PV systems connected to the ActewAGL network. Additional requirements may be required for protection and monitoring under unique situations for any size of installation to address operational or safety risks. Additional protection requirements such as but not limited to neutral voltage displacement protection and intertripping will be required for PV installations greater than 200kW.

6.1.9 Control and monitoring (SCADA)

ActewAGL will require remote controlling and monitoring facility for the range of PV installations covered by these guidelines. For class 4 and in some cases, class 3 installations, information on the distributed generation (KW, KVAR, Amps and Volts) will be required to better predict impacts on ActewAGL network and to improve planning and operations thereby requiring the installation of SCADA in the Generator Control Cubicle.

Actual implementation to install the SCADA and communications hardware is not normally required by ActewAGL for class 1 to 3 installations, but is certainly required for class 4 installations. The provision for these works shall be at the applicant's cost.

Appendix A6 provides details of the Generator Connection Cubicle that will accommodate the anticipated SCADA hardware to meet control and monitoring requirements.

For units greater than 200kW additional SCADA facilities will be required.

6.1.10 Metering

There are two main metering arrangements used by metering providers.

Gross metering arrangement

Gross metering arrangement is based on the gross amount of electricity generated by a customer's PV installation. This arrangement requires a direct connection from the PV installation to the customer's switchboard. The gross amount of energy created by the customer's PV installation as well as the gross amount of electricity consumed by the customer will be metered. In order to do this ActewAGL will either install a new meter to measure the gross quantity of electricity the PV system creates or replace your existing meter with a dual register meter which performs the functions of both required meters. This metering arrangement is shown in figure 6.1.

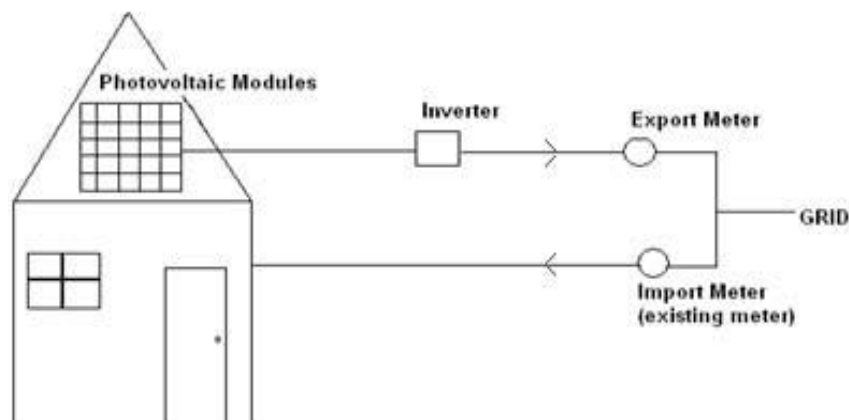


Figure 6.1: Gross Metering Arrangement

Net metering arrangement

In the net metering arrangement the net amount of energy used from ActewAGL's distribution network is metered. As this arrangement does not require a connection directly from the PV installation to customer's switchboard (unlike the gross metering arrangement) it may be used for simplicity. An example of this is a situation in which a customer's PV system is far away from the switchboard. Using this arrangement saves the customer the cost and effort of having to establish connection lines from the PV installation to the switchboard. The net metering arrangement is shown in figure 6.2 below. ActewAGL must be notified if this arrangement is to be implemented.

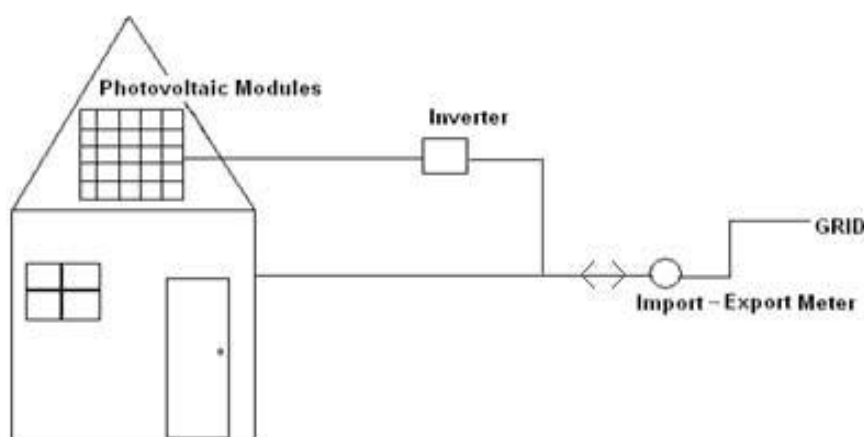


Figure 6.2: Net Metering Arrangement

For differing arrangements of supply and PV installation, various combinations of meters are used by ActewAGL. Section 6, Appendix A2 gives possible meter configurations for customers with PV installations with less than 10kW capacity.

Sites without ActewAGL provided meters

If the site of the PV installation is not an ActewAGL metering site the customer should contact their electricity retailer to arrange appropriate bi-directional metering.

NOTE: For installations with a capacity to generate above 60kW, current transformer (CT) metering will be required as per the Service and Installation Rules: Appendix 6: Current Transformer Metering

7 CUSTOMER INFORMATION

7.1 Contracts and agreements

Customers will be required to enter into contracts or agreements as described in Clause 5.2.

7.2 Business process

The business processes to be followed in installing and connecting the different classes PV installation are given below.

7.2.1 ActewAGL Class 1 PV installations

A flowchart of this process is given in figure 7.1

Step 1: Customer finds an installer

The customer must first choose an accredited installer. A current list of accredited installers is available at the [Clean Energy Council](#) website.

Step 2: Installer selects/designs a PV system

The chosen installer will select or design a PV system to meet the customer's requirements.

Step 3: Customer and installer complete ActewAGL's 'Special Connection Request' form

The customer in conjunction with the installer must fill out and return to ActewAGL a [Special Connection Request](#) form. This form contains key information about the PV installation and can be obtained from the ActewAGL website (<http://www.actewagl.com.au/~media/ActewAGL/ActewAGL-Files/About-us/Publications/SpecialElectricity-connection-request.ashx>) or by contacting the ActewAGL Southern Services Centre on (02) 6293 5749.

Step 4: Gain approval from ActewAGL

ActewAGL will ensure that the PV system complies with all relevant Australian Standards and has current test certificates. If the PV system is compatible with the network and suitable for connection approval will be given.

If approval is denied the non-compliant component of the PV system will need to be reselected or redesigned and the process recommences at Step 2.

Step 5: Customer and ActewAGL enter into a contract

If the customer decides to proceed with the connection they will be required to enter into a contract as described in Section 5.2.

Step 6: Customer contacts the Environment and Sustainable Development Directorate (ESDD)

The installer working on the PV system must advise ESDD of the electrical work taking place. At this stage the installer may commence on the installation of the PV system. However the work is not complete until ESDD has inspected and approved the installation and ActewAGL has set-up the required metering arrangement by either installing a second meter or replacing the existing meter.

Step 7: Installer completes PV installation

The installer and Electrician will complete the PV installation to a point where it is ready for the new solar meter to be fitted.

Step 8: Customer requests for an appointment

The customer's installer must submit a [Request for Service](#) form to ActewAGL for an appointment to install metering. This form can be accessed from 'http://www.actewagl.com.au/About-us/~media/ActewAGL/ActewAGL-Files/About-us/Publications/Request-for-service-electrical-works-form.ashx'.

The electrician can submit this form at any time after Step 4. It is at this point ActewAGL becomes aware that the PV installation is proceeding and that the customer will require a new meter or meter replacement soon. ActewAGL will arrange a suitable appointment date with the installer to carry out this work.

Step 9: Installation of new metering arrangement by ActewAGL

ActewAGL will meet the customer's installer on-site to install a second electricity meter, or replace the existing meter. ActewAGL will only install the meter and connect the PV system to the network if and only if Steps 1-8 are completed.

Step 10: ESDD notification*

The installer/electrician notifies that the installation is complete and is ready for inspection through filing the 'Certificate of Electrical Safety' to ESDD.

Step 11: ESDD inspection

ESDD will carry out an inspection of the wiring and other electrical work. If the installation passes the inspection ESDD will place an approval sticker adjacent to the existing metering installation or in the meter box.

Step 12: Installer commissions PV installation

The installer will then commission the PV installation and it may be connected to the electricity grid and is permitted to generate electricity.

Step 13: ActewAGL notifies Retailer of successful installation

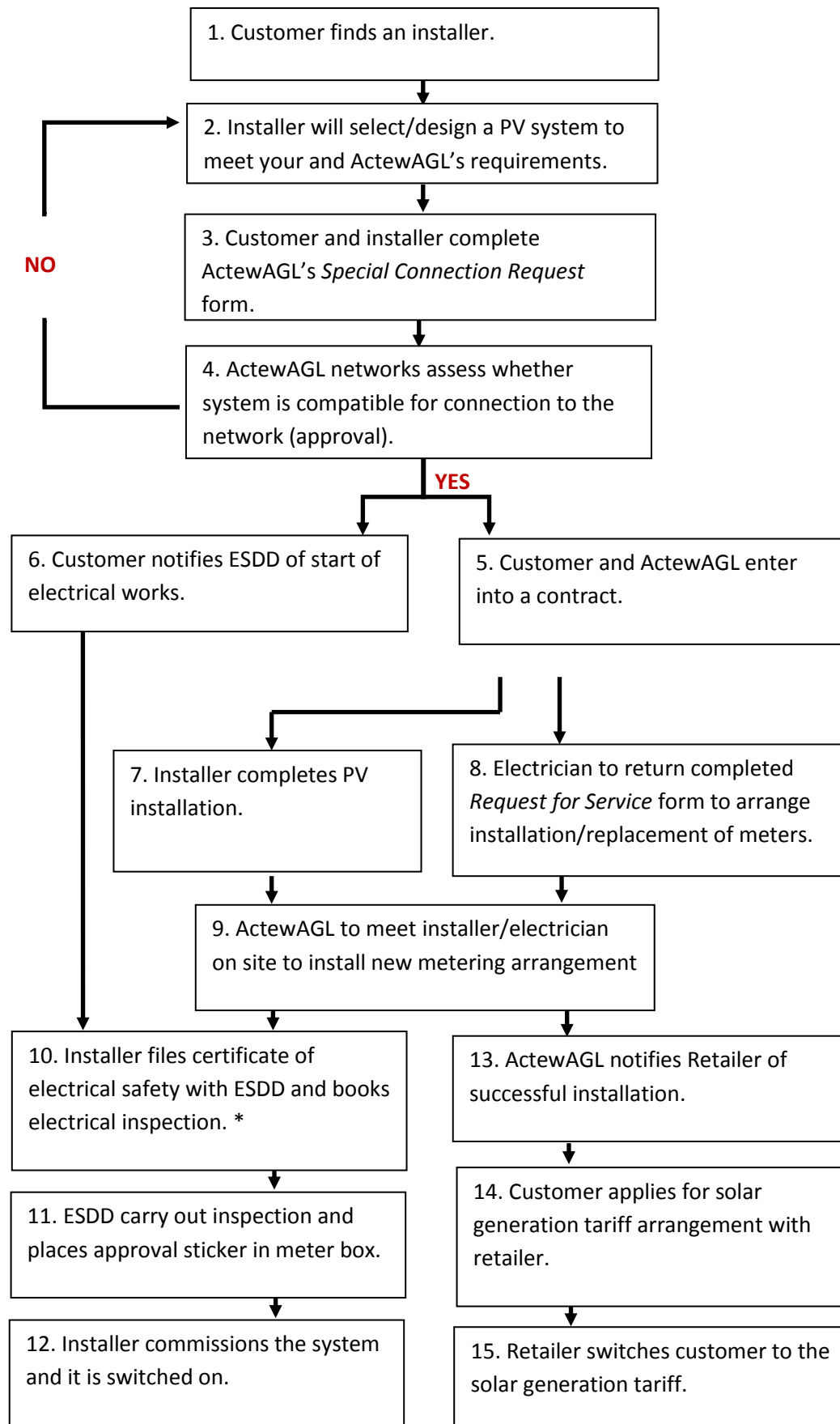
ActewAGL will notify the customer's electricity retailer of the completion of all electrical work. This is done via a national business to business process where an electronic notification is sent to the retailer informing them of the new meter, date installed and the revised default tariffs..

Step 14: Customer applies for Solar Generation Tariff

The customer applies to the Retailer for the Solar Generation Tariff. A higher than default tariff may be available through Government legislation or through a program of the Retailer.

Step 15: Customer switched to the Solar Generation Tariff

The customer's retailer will make the necessary changes to their account.



*ESDD may require additional approval processes such as BA or DA before approving the installation

Figure 7.1: Flowchart of business process for class 1 grid-connected PV system installations

7.2.2 ActewAGL Class 2 to 4 PV Installations

A flowchart of this process is given in figure 7.2

Step 1: Customer advises ActewAGL of intent to connect (connection enquiry)

The customer must advise ActewAGL of the proposed connection by submitting a completed [Special Connection Request](#) form. This shall be done prior to undertaking any detailed design or committing to expenditure or material and resources. ActewAGL will meet any reasonable request for information on its network that would enable the customer to prepare a connection application that best meets the customer's technical and commercial considerations. Requests for information on network layout and ratings for a specific section of the network are considered reasonable by ActewAGL.

Appendix A3 shows the charge for processing this connection enquiry. Payment of this charge must be included when submitting the Special Connection Request form.

The customer should also notify ESDD of the intention to connect.

Step 2: Response from ActewAGL

ActewAGL will process the connection enquiry and respond to the connection enquiry within 4 weeks. This will include advice to the customer on:

- Technical feasibility of the proposed connection based on the preliminary information provided
- Network studies required to determine the impact of the installation on the distribution network
- Additional information required from the customer for ActewAGL to carry out the above studies
- Preliminary program of works to make the connection; provided that the customer has informed ActewAGL of their schedule to connect
- 'Network Technical Study' charge payable by the customer. This will cover costs for ActewAGL to carry out network technical studies and to investigate and recommend appropriate measures to address any issues identified. Appendix A3 shows the charges for Network Technical Study for various PV classes.

Step 3: Customer requests ActewAGL to conduct network technical study

The customer must confirm intent to take the connection enquiry to the next stage by submitting to ActewAGL a written confirmation to proceed with the Network Technical Study and provide the following information.

- Confirmed location (suburb, block and section or address) of the proposed installation.
- Details of PV inverter – manufacturer, type and model, number, technical datasheets including rated kW, Volts and PF, details of integrated protection functions and features and Clean Energy Council (CEC) approval. If inverter does not have CEC approval ActewAGL will require additional information such as, but not limited to compliance standards and manufacture's certification stating inverter has been tested and passed requirements of AS4777.2 and 3.

- Details of PV installation contractor. Note that the installer will need to be CEC accredited. A current list of accredited installers is available at the [Clean Energy Council](#) website.
- Typical generation/load profile over a 24 hour period at point of connection.
- Any specific requirements for supply service levels and connection arrangement
- Additional information specific to the proposed installation as requested by ActewAGL in order for it to complete the assessment.
- Required timing for connection.
- Single line diagram showing proposed connection arrangement.

Upon receipt of the written confirmation ActewAGL will raise a quote/invoice and submit to the customer. Once payment is received ActewAGL will commence the study.

Step 4: Network technical study and preliminary offer to connect by ActewAGL

ActewAGL will conduct a detailed assessment of the connection application to determine its impact on the safety and operation of the network. Network technical studies and connected plant reviews are part of this assessment and include the following:

- Load flow studies to check effect on voltage profiles and thermal loading on feeders and transformers.
- Fault level study to confirm equipment fault ratings are not exceeded.
- Protection co-ordination study, if required, to check effect of PV generation on operation of ActewAGL protection system.
- Review of connected generation type and capacity, load type and capacity and inverter specification to evaluate risk of islanded operation.
- Review of inverter specification and checks for compliance to standards.

The outcome of the above studies and reviews will provide the basis for ActewAGL's preparation of a Preliminary Offer to Connect for submission to the customer. The Preliminary Offer to Connect will include the following:

- Advice on the maximum PV generation capacity and details of connection arrangement that can be accepted at the proposed location without incurring augmentation or modification costs.
- Details of network augmentation or modification, if required, to enable the proposed connection.
- A schedule of itemised costs to be funded by the customer including network augmentation or modification costs if required.
- Program of works to complete the connection including, if required, augmentation or modification work.
- Applicable service standards.

Appendix A8 contains the scope of the study.

Step 5: Customer to notify ActewAGL if connection conditions are acceptable

On receiving the Preliminary Offer to Connect the customer must decide if the connection conditions are acceptable and if so the customer must lodge a formal application to connect to the network in accordance with the Electricity Network Capital Contribution Code:

http://www.icrc.act.gov.au/_data/assets/pdf_file/0005/150179/Electricity_Network_Capital_Contributions_Code_August_2007.pdf

On receipt of the application to connect ActewAGL will prepare the connection plans which include the cost to augment the electricity network to enable a connection to occur. ActewAGL will require a non-refundable design charge with the application which will be offset against the cost should the customer choose to accept the offer to proceed with the construction.

ActewAGL will proceed with the construction once payment of the customer contribution where required is received.

Step 6: Customer and ActewAGL enter into a contract

If the customer decides to proceed with the connection they will be required to enter into a contract as described in Section 5.2.

Step 7: Customer contacts the Environment and Sustainable Development Directorate (ESDD)

The installer working on the PV system must advise ESDD of the electrical work taking place. At this stage the installer may commence on the installation of the PV system. However the work is not complete until ESDD has inspected and approved the installation and ActewAGL has set-up the required metering arrangement by either installing a second meter or replacing the existing meter.

Step 8: Installer completes PV installation

The installer and Electrician will complete the PV installation to a point where it is ready for the new solar meter to be fitted.

Step 9: Customer requests for an appointment

The customer's installer must submit a [Request for Service](#) form to ActewAGL for an appointment to install metering. This form can be accessed from 'http://www.actewagl.com.au/About-us/~~/media/ActewAGL/ActewAGL-Files/About-us/Publications/Request-for-service-electrical-works-form.ashx' .

The electrician can submit this form at any time after Step 4. It is at this point ActewAGL becomes aware that the PV installation is proceeding and that the customer will require a new meter or meter replacement soon. ActewAGL will arrange a suitable appointment date with the installer to carry out this work.

Step 10: Installation of new metering arrangement by ActewAGL

ActewAGL will meet the customer's installer on-site to install a second electricity meter, or replace the existing meter. ActewAGL will only install the meter and connect the PV system to the network if and only if Steps 1 to 9 are completed.

Step 11: ESDD notification*

The installer / electrician notifies that the installation is complete and is ready for inspection through filing the 'Certificate of Electrical Safety' to ESDD.

Step 12: ESDD inspection

ESDD will carry out an inspection of the wiring and other electrical work. If the installation passes the inspection ESDD will place an approval sticker adjacent to the existing metering installation or in the meter box.

Step 13: Installer commissions PV installation

The installer will then commission the PV installation and it may be connected to the electricity grid and is permitted to generate electricity.

Step 14: ActewAGL notifies Retailer of successful installation

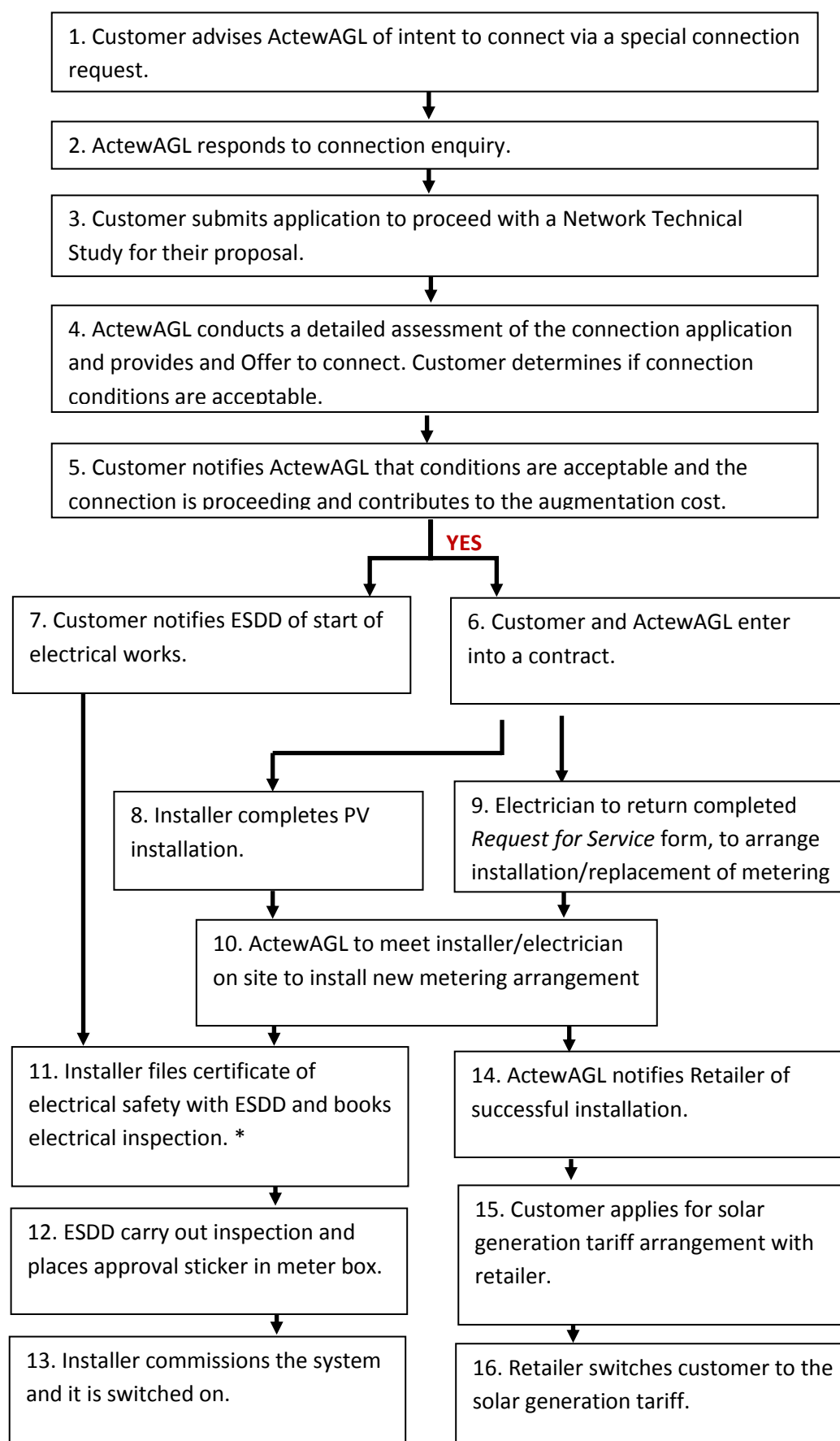
ActewAGL will notify the customer's electricity retailer of the completion of all electrical work. This is done via a national business to business process where an electronic notification is sent to the retailer informing them of the new meter, date installed and the revised default tariffs. .

Step 15: Customer applies for Solar Generation Tariff

The customer applies to the Retailer for the Solar Generation Tariff. A higher than default tariff may be available through Government legislation or through a program of the Retailer.

Step 16: Customer switched to the Solar Generation Tariff

The customer's retailer will make the necessary changes to their account.



*ESDD may require additional approval processes such as BA or DA before approving the installation

Figure 7.2: Flowchart of business process for class 2 to 4 grid-connected PV system installations

8 OPERATION AND MAINTENANCE

8.1 Testing

All protection, control systems and equipment associated with the PV system and its connection to the ActewAGL distribution network shall be tested by the installer completing the electrical work to demonstrate full and correct functionality and compliance to these guidelines prior to connection to the network.

An approved test procedure is outlined in Appendix B of AS 4777.3. Tests shall be carried out on both the primary protection and external protection where provided.

ActewAGL may wish to attend and witness the final commissioning tests of the PV system's control, network connection and protection systems to verify compliance with the requirements outlined in this document. The proponent shall provide at least seven days of notice of such final commissioning tests to facilitate ActewAGL personnel attendance.

Following the successful commissioning of the PV installation, the proponent must keep records of the final commissioning test results verifying compliance with the requirements outlined in this document and must provide ActewAGL with a certified copy of the final commissioning test results if requested by ActewAGL.

For Class 2 to 4 PV installations the test results must be provided to ActewAGL.

Failure to comply with the testing requirements may result in ActewAGL disconnecting the PV installation from the network.

8.2 Periodic maintenance

All protection, control systems and equipment associated with the PV system and its connection to the ActewAGL distribution network shall be periodically tested to demonstrate operation. For class 1 systems, the period is at least once every 5 years. For classes 2 to 4, annual testing periods will apply. Refer to Appendix A5 for test procedure.

The owner of the PV system must keep records of all such tests and provide ActewAGL with a certified copy of the test results.

Failure to comply with the testing requirements may result in ActewAGL disconnecting the PV installation from the network.

8.3 Alteration to approved design

The owner of the embedded generation facility must not modify the approved design of the PV system without informing ESDD and receiving prior written authorisation from ActewAGL.

Settings of the protection relays and control equipment must not be modified without informing

ESDD and receiving prior written authorisation from ActewAGL.

Upon receipt of a written request to modify the approved design and/or settings, ActewAGL will advise the proponent if it is considered necessary to undertake a new assessment on the impact on ActewAGL's network, the associated costs involved and the timeframe expected to complete the study and associated report.

Appendix A1: Frequently asked questions

A1.1 Questions

- What are solar panels?
- Can I have solar panels on my roof?
- What does a typical home grid-connected solar power system consist of?
- Who will be involved in the installation and connection of my solar system?
- Will I need a new meter, and if so who pays for it?
- Will my meter box need to be modified?
- What happens to the electricity in my house?
- How much energy will I be able to produce?
- How much money will I need to spend?
- What incentive schemes are available?
- What electricity tariffs can I participate in?
- What agreements do I need to enter into?
- How long does the whole process take?
- Where can I get more information?
- I want solar panels installed, what are the steps I need to follow to do this?

A1.2 Answers

In these questions and answers any reference to 'ActewAGL' will mean ActewAGL Distribution.

It is important to note the difference between ActewAGL Distribution and ActewAGL Retail.

ActewAGL Distribution is ACT's principal Distribution Network Service Provider (DNSP), and is responsible for the distribution of electricity to all distribution grid-connected customers within the ACT under a regulatory framework. ActewAGL Distribution design, install, upgrade, repair and maintain the poles, substations and wires which make up the distribution network carrying the electrical energy to ACT homes and businesses.

ActewAGL Retail is the ACT's local electricity retailer, and has a license to buy and sell electricity.

An agreement made with ActewAGL Distribution does not constitute an agreement with ActewAGL Retail.

Although the information provided here is primarily aimed at domestic Class 1 PV installations the underlying principles apply to other PV Classes.

What are solar panels?

A 'solar panel' is an interconnected assembly of solar cells which convert energy from sun light into electricity. Solar panels are often referred to as a photovoltaic (PV) panel. The term 'photovoltaic' is simply a combination of the prefix 'photo', meaning from light, and the word 'voltaic', which means to produce a voltage or electric current.

Most PV panels in domestic applications are approximately 0.8 metres wide by 1.6 metres long. A module this size will generate approximately 200 Watts of power under full sunlight.

However, as PV technology matures, increasing quantities of output power per cell are being produced.

An installation of multiple PV panels is known as a PV array. For cost and practicality reasons the PV cells in a PV panel are connected electrically, while PV panels are simply connected mechanically to form a field-installable PV array unit. Usually glass covers the array to provide protection from the local elements.

Can I have PV panels on my roof?

In order to install PV panels on the roof of your home, business, etc. there are a few things you need to consider.

- Space – is there sufficient space available to site your panels?
- Strength – is your roof strong enough to support the panels? Roof strength is generally not an issue but still needs to be considered.
- Permission – local authorities such as ESDD may insist on planning permission, especially in conservation areas or on heritage listed buildings.

Once these matters have been negotiated, there are several other considerations to be made before installation can begin. These include aspects of fitting such as the orientation and tilt of the system.

What does a typical home grid-connected PV system consist of?

A typical home grid-connected PV system chiefly consists of PV panels. However some additional parts are required to ensure correctness of output power and metering. An inverter is required in the system as PV panels provide a direct current (DC) output which is not compatible with the alternating current (AC) that the national grid operates on.

Domestic PV systems use an approved inverter to convert the DC electricity from the panels into standard 240 volt, 50 hertz, AC electricity suitable for use both in the home and exported to the network.

An additional meter is also required to record the output from your PV array.

Who will be involved in the installation and connection of my PV system?

Apart from yourself, there are four main parties involved in the processes for installation and connection of your PV system in the ACT.

1. ActewAGL Distribution

ActewAGL Distribution is ACT's principal Distribution Network Service Provider (DNSP), and is responsible for the distribution of electricity to all distribution grid-connected customers within the ACT under a regulatory framework. ActewAGL Distribution design, install, up-grade, repair and maintain the 'poles, substations and wires' which make up the distribution network carrying the electrical energy to ACT homes and businesses. Because of this ActewAGL have established technical guidelines that the PV system must adhere to. These guidelines are in place to ensure that the PV installation does not pose any safety issues for ActewAGL's employees or have detrimental effects on ActewAGL's network, and hence other customers. ActewAGL's role in the installation and connection process is to ensure these guidelines are met and that the PV system is suitable for network connection.

2. Installer

Your chosen installer will be designing and installing your PV system. They must ensure that the PV system and installation work meets the standard required by authorities such as ActewAGL, ESDD and the Clean Energy Council.

3. Electricity retailer

Your chosen electricity retailer will be the one who 'buys' the energy your PV system creates. You must contact them in order to find out more information on the available tariffs, or your eligibility for the ACT Feed-in Tariff scheme.

3. ESDD

ESDD is responsible for inspecting and approving the PV installation.

Will I need a new meter, and if so who pays for it?

Two meter readings are required for a grid-connected PV system. The first meter reading measures electricity supplied from ActewAGL's distribution network to your home (this is your existing meter). The second meter reading will measure the quantity of electricity your PV array exports back into the distribution network. In order to take this second meter reading ActewAGL or your metering provider will need to change your metering arrangement. This will be done in one of two ways.

1. a second meter will be added to work in conjunction with your existing meter, or
2. your old meter will be replaced with a new dual register meter which performs the functions of both required meters.

ActewAGL currently charges a nominal fee for installation of the new meter – see appendix A3 for details.

Will my meter box need to be modified?

Customers are responsible for ensuring adequate space to accommodate the new metering arrangement in their meter box. Your installer/electrician will be able to tell you whether your meter box will need an upgrade. This is not a problem for most new meter boxes where the common size is usually 600 millimetres by 600 millimetres for connecting Class 1 PV. Smaller boxes may need to be modified. A special cubicle is required for PV installations above Class 1 – see Appendix 6 for typical details. Supply and installation of the cubicle and any meter box upgrade work are to be carried out by an installer at the customer's expense.

What happens to the electricity in my house?

During the day, when the sun is shining, your PV array is producing and supplying electricity into ActewAGL's distribution network. Your house is supplied from ActewAGL's distribution network during the day as well as at night when the sun is no longer shining. If you have signed up for green energy with your chosen retailer, then the percentage of your energy you have nominated to make "Green" is being accessed only from the renewable energy in the network (e.g. solar and wind power).

How much energy will I be able to produce?

This depends on a number of factors. The most significant factor is the size of your PV system, referred to as the installed capacity. Other important factors that affect the power output include the location of the PV array, its orientation and how well it is maintained (dirt on the PV cells is heavily detrimental to power output).

A typical energy efficient family home in Canberra uses between 15 and 20 kilowatt-hours (kWh) per day, or 5,500 to 7,500kWh per year. Modest homes using natural gas for hot water, heating and cooking tend to use even less (around 4,000 kWh per year).

In the table below is the expected annual output from a range of PV systems varying in size, situated in the ACT, under good conditions.

Peak Installed capacity (kW)	Expected Oupput Per Annum (kW hours)
1	1,533
2	3,066
3	4,599
4	6,132
5	7,665
6	9,198
7	10,731
8	12,264

* The figures above are appropriate for a north facing system located in the ACT

These figures represent the PV system operating in ideal conditions and are by no means exact. Each installation will vary.

How much money will I need to spend?

While the running costs of PV generation are extremely low, arrays do have significant set up costs

There may also be several other costs:

Installation costs charged by your installer/electrician

This is the labour and installation cost of your PV system.

Potential metering costs

Customers are responsible for ensuring adequate space to accommodate the new metering arrangement in their meter box. Any meter box upgrade will be carried out by the installer at the customer's expense.

Potential network upgrades

In some cases, connection of a PV system to the network can only occur after a network upgrade has been performed. An upgrade will be necessary if the connection of the PV system will potentially affect the quality of supply of other customers. This will most likely occur in situations where the distribution network is deemed to be unable to operate adequately with the added capacity of your PV system unless an upgrade is performed. In this event, ActewAGL will notify you of the required work and the associated costs.

Are there any incentive schemes available?

As of July 1, 2009 the new incentive scheme available to those with domestic grid-connected PV systems is the Australian Solar Panel Credits program. This program works on the

exchange of Renewable Energy Credits (or RECs) instead of a directly cash rebate funded by the government. To read more about RECs please visit the Australian Government's Office of the Renewable Energy Regulator by clicking [here](#). More information about the Australia Solar Panel Credits program may be obtained [here](#).

What electricity tariffs can I participate in?

A solar tariff, higher than default, may be available through Government legislation or through a program of the Retailer, please contact your Retailer and/or the Government for details of these schemes.

What agreements do I need to enter into?

There are several agreements that you are required to enter into.

Customers will be required to enter into a contract with ActewAGL Distribution which will outline mutual obligations and technical requirements. Commissioning and connection of your PV installation will not be permitted until this agreement is in place.

In addition to this your chosen electricity retailer may also have an agreement which you will need to enter into. It is important to note that this is a different agreement to the one you will need to enter into with ActewAGL Distribution.

How long does the whole process take?

The time for the whole process to be completed is variable. It depends mostly upon the workload of your installer and when ESDD can inspect your PV installation.

After your installer has designed your PV system and initiated the approval process, they must contact ActewAGL or your chosen metering provider in order to arrange an on-site meeting to reconfigure the metering arrangement.

ActewAGL endeavours to set this meeting date to carry out the necessary work within two weeks of being contacted by your installer, or on whatever date they nominate. However, the final connection to the network of your PV system will not take place until ESDD has completed an inspection.

The earlier the installer contacts ActewAGL and ESDD, then all parties can coordinate the onsite work around the days of the actual installation of the PV system on your roof.

Where can I get more information?

Given below are some links to useful sites where you can get more information on domestic PV power generation.

- [Office of the Renewable Energy Regulator \(ORER\)](#).
- [Clean Energy Council](#).

I want PV panels installed, what are the steps I need to follow to do this?

There are several steps to follow in getting your PV power system approved and installed. The full process is outlined in Clause 7,2 of this guideline.

Appendix A2: Possible meter configuration for customers with PV installations less than 10kW capacity

Combinations of Meters for a 600mm x 600mm Meter Board		Meter 1	Meter 2	Meter 3
1	Single phase energy + PV	2 element SECURE	N/A	N/A
2	Single phase energy with off-peak hot water + PV	1 element Secure	2 element Secure	N/A
3	Single phase energy with single phase off-peak slab heating + PV	1 element SECURE	2 element SECURE	N/A
4	Single phase energy with off-peak hot water and single phase off-peak slab heating + PV	1 element SECURE	2 element SECURE	N/A
5	Single phase energy with three phase off-peak hot water + PV	2 element SECURE	SPRINT 200	N/A
6	Single phase energy with three phase off-peak slab heating and single phase off-peak hot water + PV	2 element SECURE	SPRINT 200	N/A
7	Three phase energy + PV	SPRINT 200	1 element SECURE	N/A
8	Three phase energy with single phase off-peak hot water + PV	SPRINT 200	2 element SECURE	N/A
9	Three phase energy with three phase off-peak slab heating + PV	SPRINT 200	SPRINT 200	1 element SECURE
10	Three phase energy with three phase off-peak slab heating and single phase off-peak hot water+ PV	SPRINT 200	SPRINT 200	1 element SECURE

Table A2.1: Possible Meter Configuration for customer's with PV Installations

NOTE: SPRINT 200 use Internal Clock to Control Load Contactor

Appendix A3: Schedule of charges

A3.1 Connection enquiry processing charge

Class 1:

Nil

Class 2 to 4:

\$550 (incl GST) per installation.

A3.2 New meter installation

\$169 (inc GST)

A3.3 Network technical study charges by installed PV class

PV Class	Network Technical Study Charge (incl GST)
1	Nil
2	\$3960
3	\$5170
4	\$8470

Note that higher charges will apply for installations greater than 200kW. The charge will be determined on a case by case basis.

A3.4 Augmentation charges

These charges will be advised by ActewAGL after receipt of the application to connect.

Appendix A4: Minimum protection, control and monitoring requirements for grid connection of PV systems

Class	1	2	3	4
Protection Requirement				
Phase and Neutral lockable or sealable Isolation Switch at Customer Connection Point	Required	Required	Required	Required
Compliance to protection requirements of AS 4777.3	Required	Required	Required	Required
Generator Connection Cubicle with circuit breaker and provision for future protection relay and Remote Control and Monitoring	Not Required	Required	Required	Required
External Protection: Micom P142 Relay + Circuit Breaker at Customer Connection Point	Not Required	Not Required	Required	Required
Remote Control and Monitoring (SCADA)	Not Required	Not Required	Not Required	Required

(Note: These are minimum requirements. In unique situations additional protection and or control/monitoring may be required for any class of installation to manage performance or safety issues determined by network studies and system checks).

Appendix A5: Periodic PV inverter test procedure

A5.1 Process for anti-Islanding testing of PV installations

This document outlines a simple testing process to confirm the operation of the AC solar main switch and testing of the Anti-Islanding protection of the installation.

Testing methodology

WARNING: Carrying out these tests involves dealing with live 240 volt terminals and must only be carried out by a licensed electrician who possesses a CEC accreditation.

The tests must be conducted at a time of day when the prevailing weather conditions allow the PV system to be producing at least a minimum power output. This must be greater than 20% of the rated output of the PV array or the Inverter (whichever is less).

Test 1: Inverter must cease supplying power within two seconds of a loss of mains

The PV array main switch is to be turned OFF. The time taken for the inverter to cease supplying power is to be measured with a timing device and recorded. A voltage probe placed on the installation side of the main solar switch is to be used to determine when the inverter has ceased attempting to export power.

The DC supply from the solar array is to remain connected to the inverter for the duration of this test.

Test 2: Inverter must not resume supplying power until mains has been present for more than sixty seconds

The time taken for the inverter to resume power supply after installation has been re-energised is to be measured and recorded. A current probe is to be placed on the installation side of the main switch to determine when the inverter recommences exporting power.

The DC supply from the solar array is to remain connected to the inverter for the duration of this test.

Records

The tester must make copies of the test record: the original shall be kept by the tester, a copy shall be provided to the owner of the installation, a third copy must be emailed to ActewAGL on

networkServicing@actewagl.com.au.

For more information please call ActewAGL on (02) 6293 5749.

A5.2 PV anti-Islanding test records

Array Details: Array # _____ of _____
(number) (total arrays in installation)

Identical to first Array <input type="checkbox"/>	Inverter Make	
	Inverter Model	
	Inverter Nominal AC power	Watts
	Power of array connected to this inverter	Watts

Test 1: Anti-islanding operation	Measurement	Result (circle one)
AC power fed being supplied by inverter prior to test commencing. Is this greater than 20%? of the rated output of the PV array or the Inverter (whichever is the lesser)*	Watts	Yes / No
Time for inverter to disconnect: Must be < 2 seconds to pass	Seconds	Pass / Fail

Test 2: Reconnection	Measurement	Result (circle one)
Time for inverter to reconnect: Must be > 60 seconds to pass	Seconds	Pass / Fail

*If not, you must wait until a time when this condition is fulfilled before you can conduct valid testing

A5.3 PV anti-Islanding test declaration

Date:
Installation Address:
Installation owner name:
Installation owner contact number:
Installation owner contact email:
Electrician Name:
Company:
Licence Number:
CEC Accreditation Number:
Electrician Contact phone:
Contact email:

Did all the inverters in the installation pass the Anti islanding tests	Pass / Fail
---	-------------

If one or more tests failed, the defect must be rectified and the tests carried out again. A test record giving evidence that the rectified installation passes this testing regime must then be sent to ActewAGL.

Signature of tester: _____ date: _____

Email this document and test records to ActewAGL on

networkServicing@actewagl.com.au.

Appendix A6: PV Generator connection cubicle

The connection of all new PV systems greater than 30kW to the electricity network will require the applicant to install a generator connection cubicle (GCC). The primary purpose of this GCC is to assure ActewAGL that PV installations that are connected to the low voltage electricity network do not operate as islanded generators and to provide SCADA facility to PV units generally greater than 121kW. That is, the GCC is a backup protective device to the PV inverter's existing active anti-islanding circuitry. This backup arrangement will provide ActewAGL with assurance that reasonable steps have been taken to provide for the following:

- a) The safety of personnel who work on the electricity network and to the general public; and
- b) To minimise asset loss-of-life, reduced performance and to prevent damage to electricity network assets; and
- c) Minimise disruption to all customers (quality of supply) inclusive of the applicants site

The applicant has the choice of either forwarding a design proposal to ActewAGL for a GCC that offers anti-islanding backup protection and SCADA facility or to install a GCC that has been approved by ActewAGL. If the applicant wishes to design their own GCC then the design needs to comply with the Performance Specification as outlined below.

PERFORMANCE SPECIFICATION - PV GENERATOR CONNECTION CUBICLE (GCC)

INTRODUCTION

The increased penetration of embedded generation in ActewAGL's LV network, particularly in the 30 to 200kW range, has created the need now for added scrutiny of every new connection to assess its impact on network operation and safety.

ActewAGL requires a GCC to be installed by the applicant. The performance specification of the GCC is as follows:

METHODOLGY

The installation shall be located in a prominent position near the MSB and be shall be clearly labelled and accessible 24/7 to ActewAGL and Emergency Service personnel.

There are three (3) classes of interface installations:

- Class 2: typically 30kW to 60kW (Cubicle and Circuit Breaker only)
- Class 3: typically 61kW to 120kW (Class 2 + Protection Relay + UPS)
- Class 4, typically 121kW to 200kW (Class 3 + SCADA + Communication)

These classes serve only as a guide. ActewAGL will determine the appropriate installation interface for each Special Connection Request application. However, it is important that provision be made to install all options in an installation so as to accommodate for future generation augmentation.

The installations comprise six (6) main components as follows:

1. The cubicle - required

The cubicle shall be designed to include the following:

- Constructed of steel and have a lockable hinged door. Locking shall be accessible by ActewAGL staff and property facility manager.
- Wall mounted (preferred) or free standing.
- Overall internal and external dimensions to be fit for purpose.
- Vermin proof, weather proof and secure to IP66.
- Contents must not exceed their normal operating temperature range. May require double skinned walls, anti-condensation heater and cooling fans.
- Opening the door will automatically activate a light that will enable the internal components and schematic diagram to be viewed clearly.
- An internally mounted GPO.
- Labeled externally to identify the purpose of the installation and show a unique location number to be provided by ActewAGL (the authorization number). Label shall be visible in low light conditions.
- Labeled internally to identify the purpose of all internal components, number secondary wiring and include a generator shutdown procedure. A schematic diagram will be shown on the inside of the hinged door.
- All secondary components including wiring shall be dead front (i.e. no exposed live metal).
- An externally mounted light to indicate the generator is energised.
- An externally mounted emergency manual trip button (lockable) to be located at the Fire Control Panel, Main Switchboard and Generator Control Panel.
- Provision for the attachment and safe housing of ActewAGL load survey equipment.

2. Circuit breaker (CBG) - required

The circuit breaker CBG shall be designed to include the following:

- Rated to disconnect a three phase continuous load of up to 200kW.
- Ganged four pole operation (load break fault make, neutral to be switched)
- Manually tripped.
- Manually closed (only by an Authorised Person, label required).
- Optional electrically tripped (by the protection relay under local fault detection conditions or remotely by SCADA when fitted).
- Optional electrically closed (by the protection relay under local fault-free conditions or remotely by SCADA subject to local fault-free conditions when fitted).
- Optional Electrical interlocking (to prevent closing until protection relay status is in-service when fitted).

3. Protection relay - optional

The protection relay shall be designed to include the following:

- Provision shall be made to include a protection relay that is optional.
- Make and model shall be approved by ActewAGL (presently MiComm P142).
- The protection relay will have settings approved by ActewAGL.
- The primary purpose of the protection relay is to monitor for a generator fault event and when “true” to isolate the generator by electrically tripping CBG. The protection relay shall have a self test capability (in-service or failed). A relay failure shall also trip CBG. The status of the protection relay shall also be made available to the building BMS system.
- Easily installed and removed (i.e. easily replaced).
- Located in a prominent position such that the display is readable by a person of normal height (range 1.5m to 2m).
- Typical settings required for the P142 relay are:
 - $f < 49.8\text{Hz}$ $f > 50.2\text{Hz}$
 - Δf 0.2Hz in 10mins
 - $U <$ $U >$. 240volts volts $\pm 6\%$ outside range for more than 10 mins
 - ΔU outside range above for more than 10 mins
 - Rapid $< U$
 - $\text{Cos } \Theta$ (Lagging) Range 0.9 – Unity is acceptable.
 - Odd Harmonics 3rd and 9th
 - UPS stability – self test failure, Battery impedance out of range – alarm only
 - C/B operation

4. Power supply - optional

The power supply (UPS) shall be designed to include the following:

- Provision shall be made to include a UPS that is optional. The UPS shall be installed if a protection relay is installed.
- Rated to provide an uninterruptable supply of energy to the protection relay, SCADA and communication equipment. There shall be sufficient battery capacity for a minimum of two (2) hours without supply from the distribution electricity network.
- Easily installed and removed (i.e. easily replaced).
- Self test functionality and status reporting.

5. SCADA - optional

The SCADA system shall be designed to include the following:

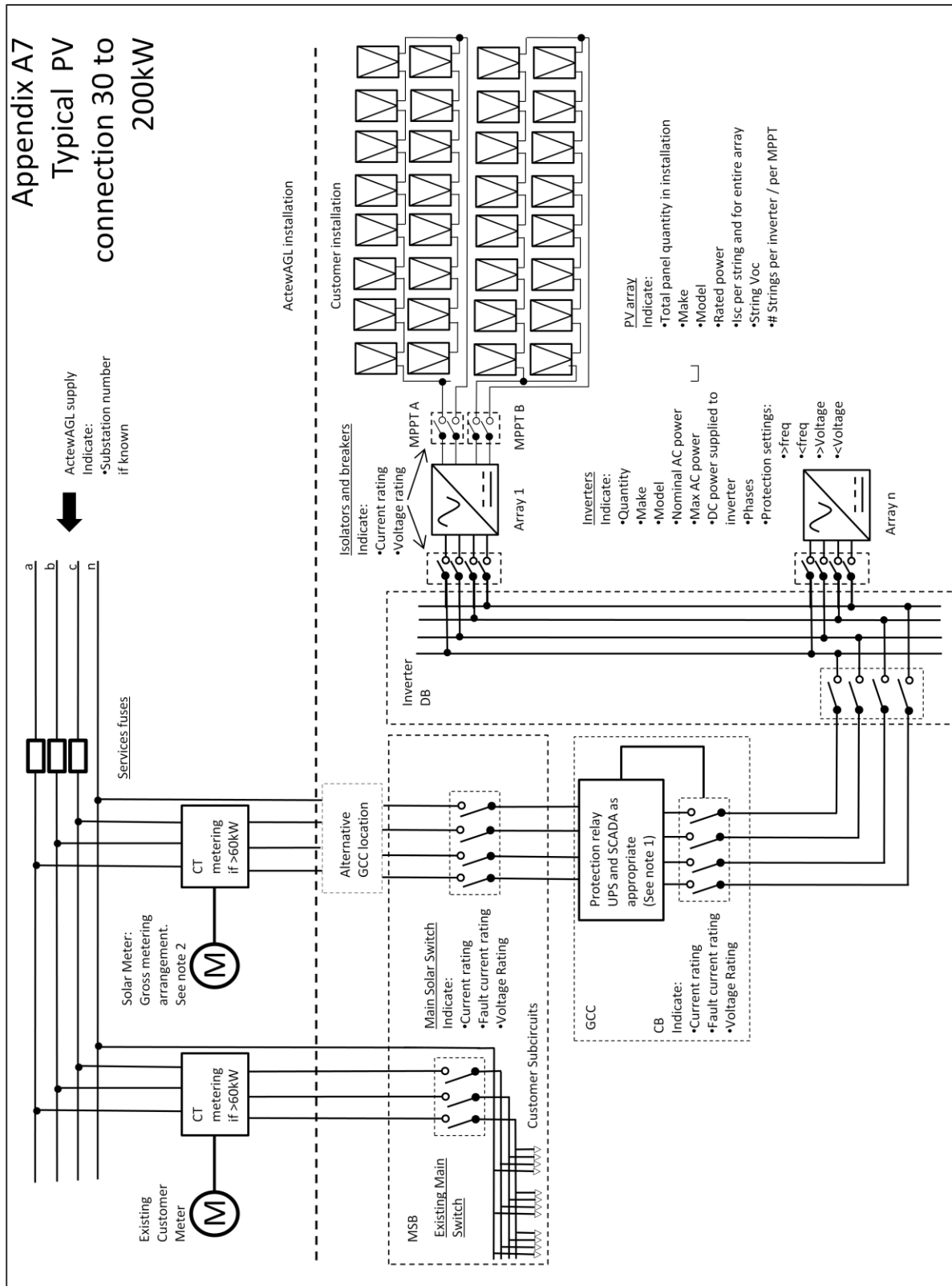
- Provision shall be made to include SCADA equipment that is optional.
- The primary purpose of the SCADA system is remote tripping of the circuit breaker CBG via the protection relay. The trip command will be initiated by ActewAGL.
- The secondary purpose of the SCADA system is to monitor the status of the circuit breaker CBG (open or close), protection relay (in-service or failed) and UPS (in-service or fail). This information shall also be made available to the building BMS system.
- The other purpose of the SCADA system is to report the status of selected protection relay fault registers.
- Easily installed and removed (i.e. easily replaced).

6. Communications (optional)

The communications system shall be designed to include the following:

- The communications equipment shall be installed when a SCADA system is installed.
- Make and model shall be approved by ActewAGL.
- Easily installed and removed (i.e. easily replaced).
- Self test functionality and status reporting.

Appendix A7: Typical PV connection 30 to 200kW



A7.1 Notes to drawings

Note 1:

PV Generator Connection Cubicle (GCC)			
Required functionality	Size category (kW)*		
	60 30 -	61 - 120	121 - 200
• Circuit breaker	X	X	X
• Protection Relay		X	X
• UPS		X	X
SCADA			X
*Indicative only, exact level of functionality will be determined by the Network Technical Study			

Refer to Appendix A6 for the GCC details.

Note 2:

Existing site metering may be located in the MSB or on a separate meter panel. New solar meter shall be located at the same location as the existing site meter.

Appendix A8: Network technical study scope

The scope of the network technical study is as follows:

Task	Description	Procedure	Activity
1	Review Application Form	1	Location, capacity, voltage, connection and timing details provided?
2	Check inverter compliance to AS4777	1	CEC Compliance
		2	Manufacturer's certificate available
		3	AS4777.2 & 3 compliance
		4	Witnessed Testing if required
3	Model LV Network	1	Obtain data on connected load - minimum, maximum estimates OR
		2	Confirm network data - feeder and service type, length, substation details
		3	Model LV network including new connection downstream of distribution transformer
4	Network Studies	1	Check 11kV feeder loading level (% thermal rating) under minimum local load demand conditions
		2	Check LV feeder loading level (% thermal rating) under minimum local load demand conditions
		3	Check distribution transformer loading level (% thermal rating) under maximum and minimum local load demand conditions
		4	Check voltage (% Vn) under minimum load at PCC
		5	Check voltage (%Vn) under maximum load at PCC
		6	Check Fault Level, kA
5	Assess risk level of islanded operation. Increased risk if at least one of checks 1 to 4 are not met.	1	Check load generation match (Sinv: Sload <0.7)
		2	Check [Pinv]:[Pload] <0.8 or >1.2
		3	Check [Qinv]:[Qload] <0.8 or >1.2
		4	Number of 3-ph Inverters on LV feeder