Experience with inspection of systems
• GSES managed the first Government funded inspection program on behalf of the BCSE (industry association) back in 2003-04

• 190 systems were inspected Australian wide and that project led to amendments in the AS/NZS4509 – Stand Alone Power System Standard

• The industry association continued to undertake inspections (randomly) of systems that were receiving subsidy under the PVRP program
• In 2009, GSES was approached by the then Department of Environment Water Heritage and the Arts- to develop the Inspection Framework and in Particular the Inspection Checklist for Inspections.

• GSES was selected as one of 3 inspection companies to undertake inspections of systems that had received funding under the PVRP subsidy program.

• GSES inspected over 600 systems in next 12 months.
• Prior to the first round of inspections one of the issues were installers using AC rated circuit breakers instead of DC rated breakers-however publicity within the industry quickly fixed this issue.

• However in the early rounds of inspection the big issue was incorrectly wired polarised DC breakers.

• Over 20% of system were wired incorrectly which led to Industry association requiring all installer to recheck every system over a 6 month period
Preferred connection of array to a Polarised Double Pole DC Circuit Breaker with markings on bottom of CB
NOTE: For all connections, the direction of the current flow is to be the same whether the array is connected to the top or the bottom.

Two Ways of Connecting to a Polarised DC Breaker with markings only on bottom side.
Double Marked Isolators

- Both terminals of each breaker are labelled positive or negative to indicate the required direction of current flow.
- Positive and negative outputs of array connect to the respective breaker terminals.
Double Marked Isolators

Polarised Breaker with markings at both ends of the breaker
Two Ways of Connecting to a Polarised DC Breaker with markings on both sides of breaker.
Non-polarised Isolators

• Non-polarised isolators operate safely breaking current flow in both directions through the device.

• There are no positive or negative terminals

• End result was that AS/NZS5033 now only allows non-Polarised breakers however industry is mainly using DC switch disconnectors (isolators)
The inspections were then taken by the office of the Renewable energy Regulator now known as Clean Energy Regulator.

Since 2012 over 20,000 inspections have been undertaken throughout Australia (GSES has undertaken over 8000).
Who are the Inspectors

- Nominated by inspection company but appointed by CER
- Be licensed electricians with Clean Energy Council accreditation for design and installation of grid connected PV systems.
- Receive initial training and ongoing training.
Inspection Process

• Systems to be inspected selected by CER
• Inspection Companies appoint the inspectors for each particular inspection but they must declare if there is conflict of interest.
• All owners are written to and then phone to organise the inspection. They do have opportunity to decline the inspection.
• Inspectors then make final visit arrangement and the inspection involves:
  – Completing a checklist on exactly what has been installed against what should have been installed.
  – Completing a technical checklist which is based on all the key clauses from standards such as AS/NZS3000, AS/NZS5033, and AS/NZS4777 and the CEC guidelines.
• A report is prepared and it is sent to the installer for comment.

• The inspections are rated: best industry practice, compliant, adequate sub-standard and unsafe.

• The CEC apply demerit points on an installer’s accreditation if their system is found to be sub-standard or unsafe. Disciplinary action is taken on installers with 20 or more demerit points.

• Report is sent to system owner- CER and CEC
Unsafe System

Actions taken as a result of the systems being classified as unsafe:

• The system was shut down or otherwise rendered safe by the inspector.

• The owner and/or occupier of the premises were advised by the inspector of the nature and extent of the safety risk.

• The relevant state or territory regulation authorities and energy network provider were advised by the inspector of the nature and extent of the safety risk.
Sub-standard systems

- A system that is assessed as substandard requires work to rectify the installation.

- A substandard system is defined as one that:
  - does not meet key clauses in the standards and requirements for installation and may lead to premature equipment failure or other issues,
  - does not pose an imminent safety risk, or
  - the installation work and/or the equipment should be improved to meet relevant standards and industry guidelines.
Examples of an unsafe system is one that has been assessed as having either; direct current isolator enclosures, or junction boxes, that were not suitably installed to prevent water ingress, or had signs of water damage present; issues with the panel mounting, or; exposed live parts.
• Not Required in PPA/SEIAPI Guidelines.

• Not required in New Zealand in accordance with AS/NZS5033

• RECOMMEND DO NOT INSTALL IN THE PACIFIC
Protection of String and Array cables

• Currently there is no electrical protection for these cables.

• Their cross sectional area is selected to carry the maximum short circuit current with a margin (40%)—hence if a fault—ARC will occur and there is no electrical device to stop the arc and fire.

• The arc could also occur within a module if there is a break in the wiring or a poor quality module or poor quality connectors.

• AS/NZS5033 does require all cables within building cavities to be within heavy duty conduit.
Connectors

- An additional safety requirement for the string and array cables is that cable connectors need to be mated with those of the same type and from the same manufacturer.
• There has been recall of 5 isolators in Australia due to safety concerns
Other Inspections

- GSES has been involved with system larger system inspection- both grid and off-grid throughout the Pacific, Australia, Africa and India.

- Inspection checksheets based on relevant standards are developed.
Poorly protected cables and damaged enclosure
Poor wiring installation
Poor wiring installation
Poor wiring Installation
Poor wiring installation
Poor battery Installation 1