Sustainable change through education, engineering and communication

GSES® global sustainable energy solutions

Experience with inspection of systems

Training • Consulting • Engineering • Publications

Australia - Early Inspections

- 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

© 2017 GSES P/L

Government Managed Inspections

- 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.

© 2017 GSES P/L

Early Issue

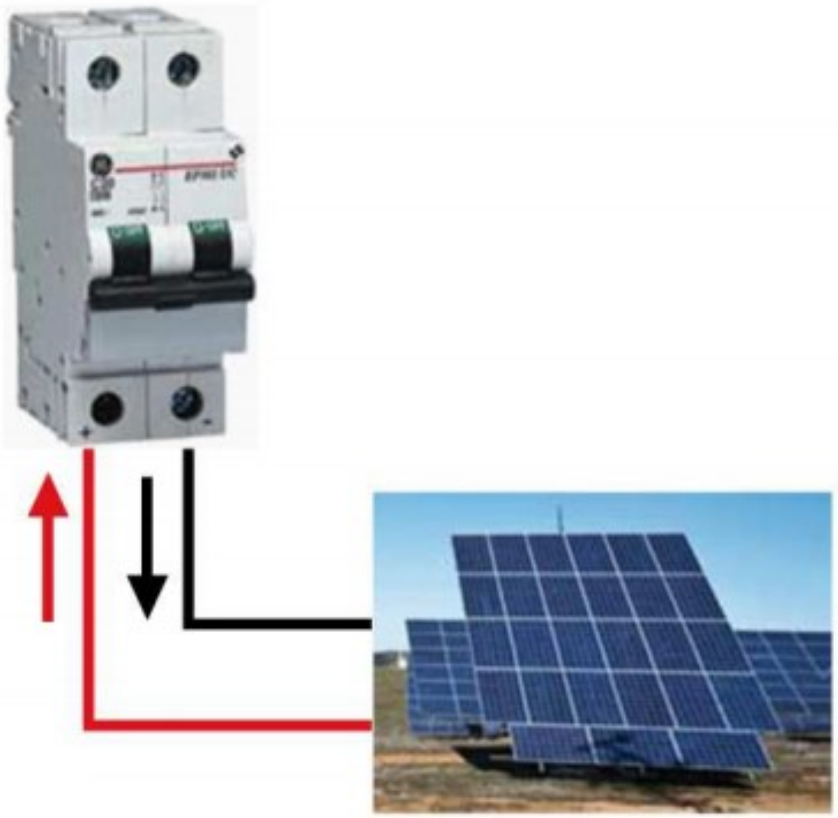
- Prior to the first round of inspections one of the issues were installers using AC rated circuit breakers instead of DC rated breakers-however publicity within the industry quickly fixed this issue.

- 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

© 2017 GSES P/L

Correct Circuit Breaker Wiring

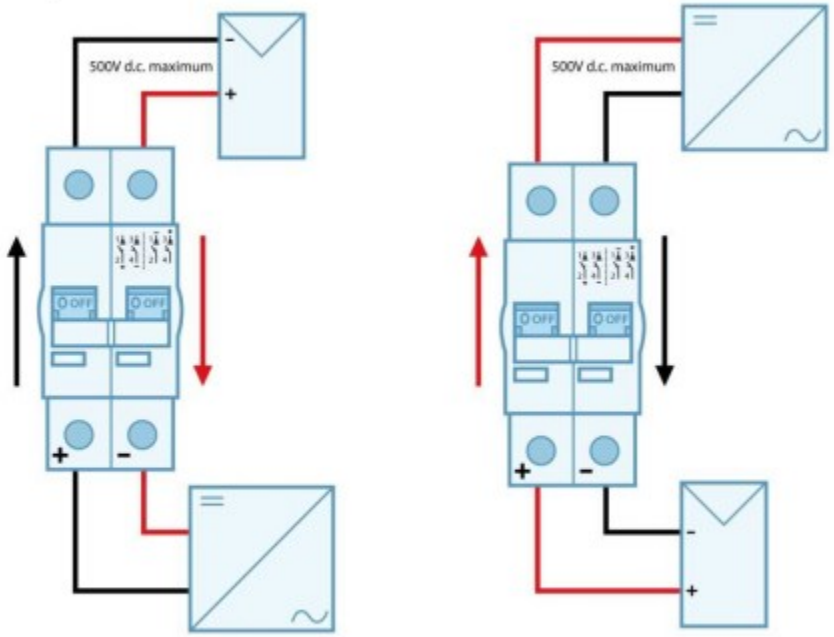


Preferred connection of array to a Polarised Double Pole DC Circuit Breaker with markings on bottom of CB

© 2017 GSES P/L

Correct Circuit Breaker Wiring

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.

© 2017 GSES P/L

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

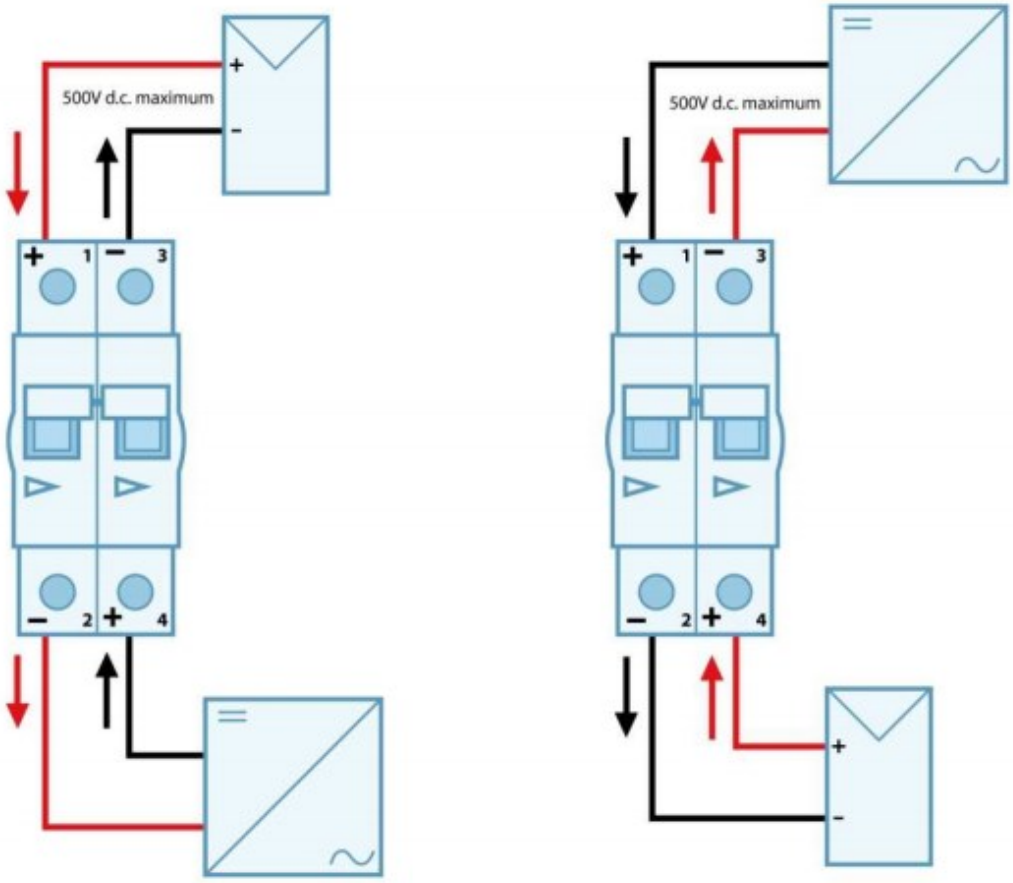
© 2017 GSES P/L

Double Marked Isolators

Polarised Breaker with markings at both ends of the breaker

© 2017 GSES P/L

Double Marked Isolators



Two Ways of Connecting to a Polarised DC Breaker with markings on both sides of breaker.

© 2017 GSES P/L

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)

© 2017 GSES P/L

Clean Energy Regulator Inspections

- The inspections were then taken by the office of the Renewable energy Regulator now known as Clean Energy Regulator
- Since 2012 over 20,0000 inspections have been undertaken throughout Australia (GSES has undertaken over 8000).

© 2017 GSES P/L

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.

© 2017 GSES P/L

Inspection Process

- Systems to be inspected selected by CER
- Inspection Companies appoint the inspectors for each particular inspection but they must declare if their 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

© 2017 GSES P/L

Inspection Process 2

- 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

© 2017 GSES P/L

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.

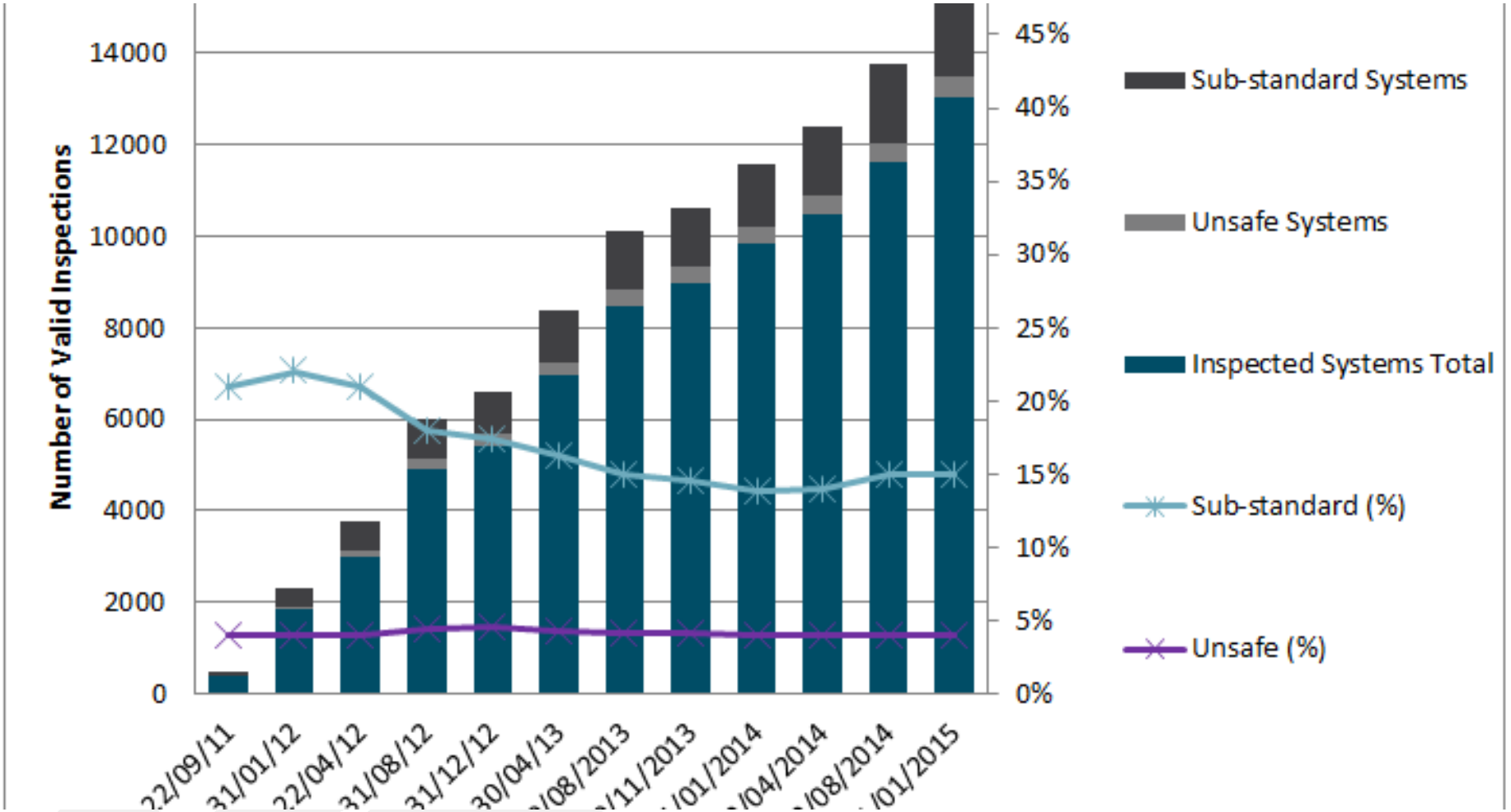
© 2017 GSES P/L

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.

© 2017 GSES P/L

CER Report No 12 – Early 2015



© 2017 GSES P/L

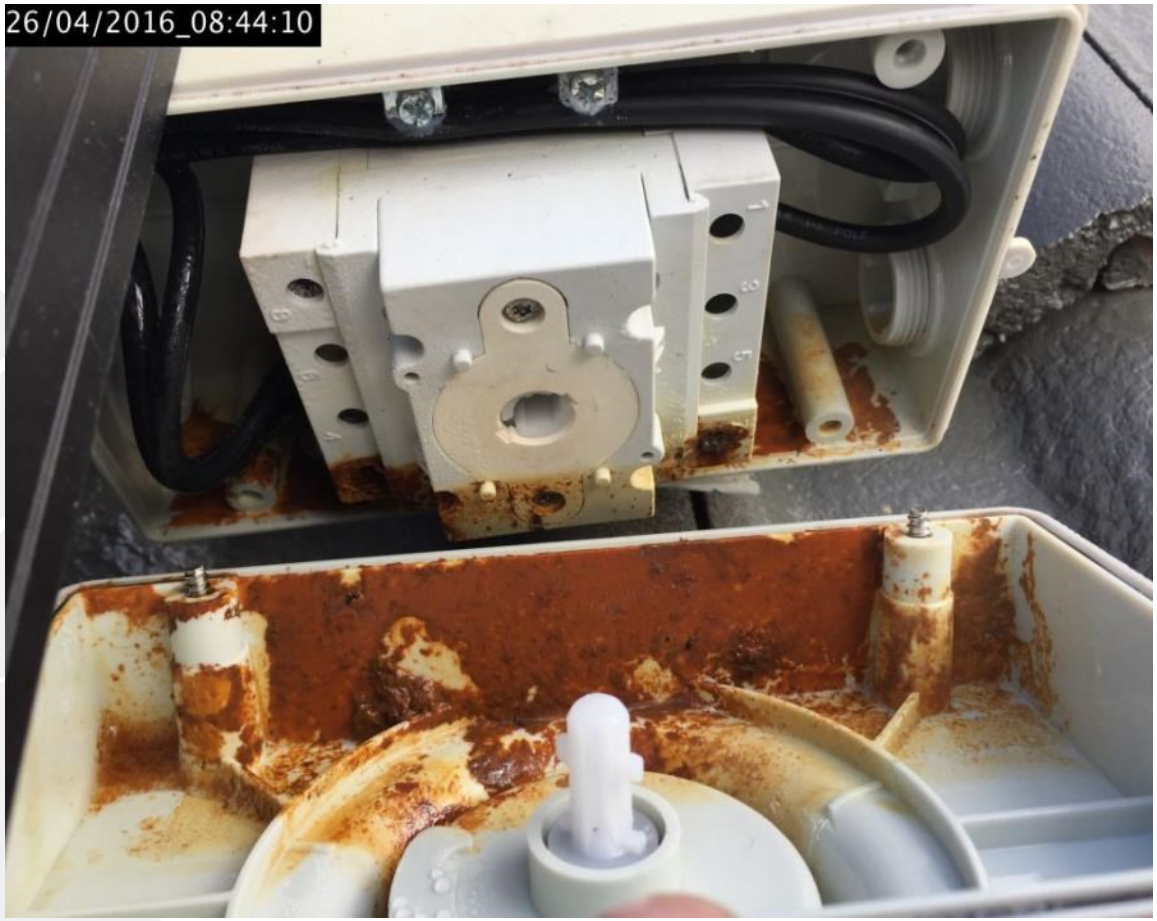
Unsafe Systems

- 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

© 2017 GSES P/L

Isolators on Roofs

- Not Required in PPA/SEIAPI Guidelines.
- Not required in New Zealand in accordance with AS/NZS5033
- RECOMMEND DO NOT INSTALL IN THE PACIFIC



© 2017 GSES P/L

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.

© 2017 GSES P/L

DC ARCS

© 2017 GSES P/L

DC ARCS

© 2017 GSES P/L

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

© 2017 GSES P/L

Isolator Recall

- There has been recall of 5 isolators in Australia due to safety concerns

© 2017 GSES P/L

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.

© 2017 GSES P/L

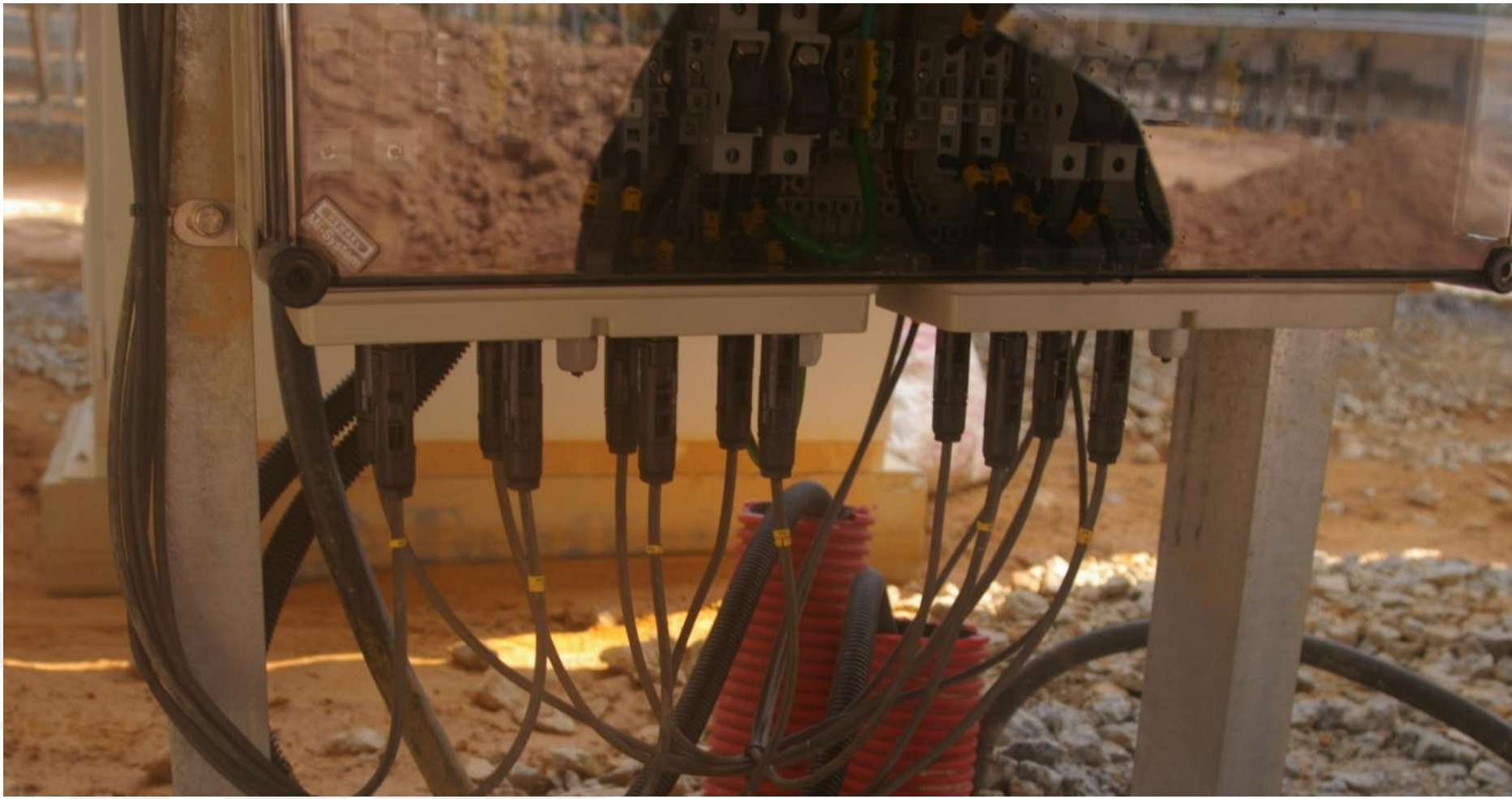
Poorly protected cables and damaged enclosure

© 2017 GSES P/L

Poor wiring installation

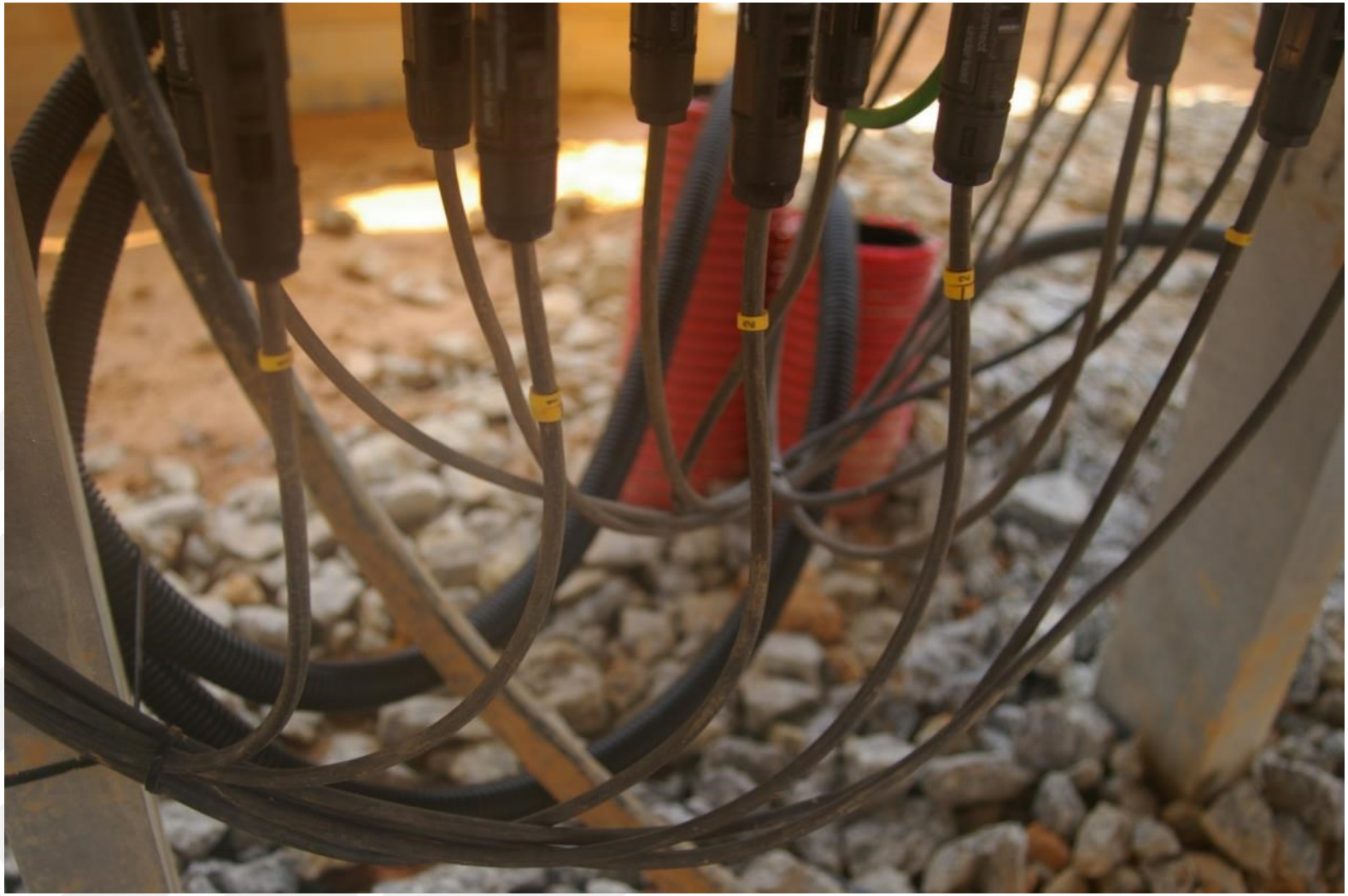
© 2017 GSES P/L

Poor wiring installation



© 2017 GSES P/L

Poor wiring Installation

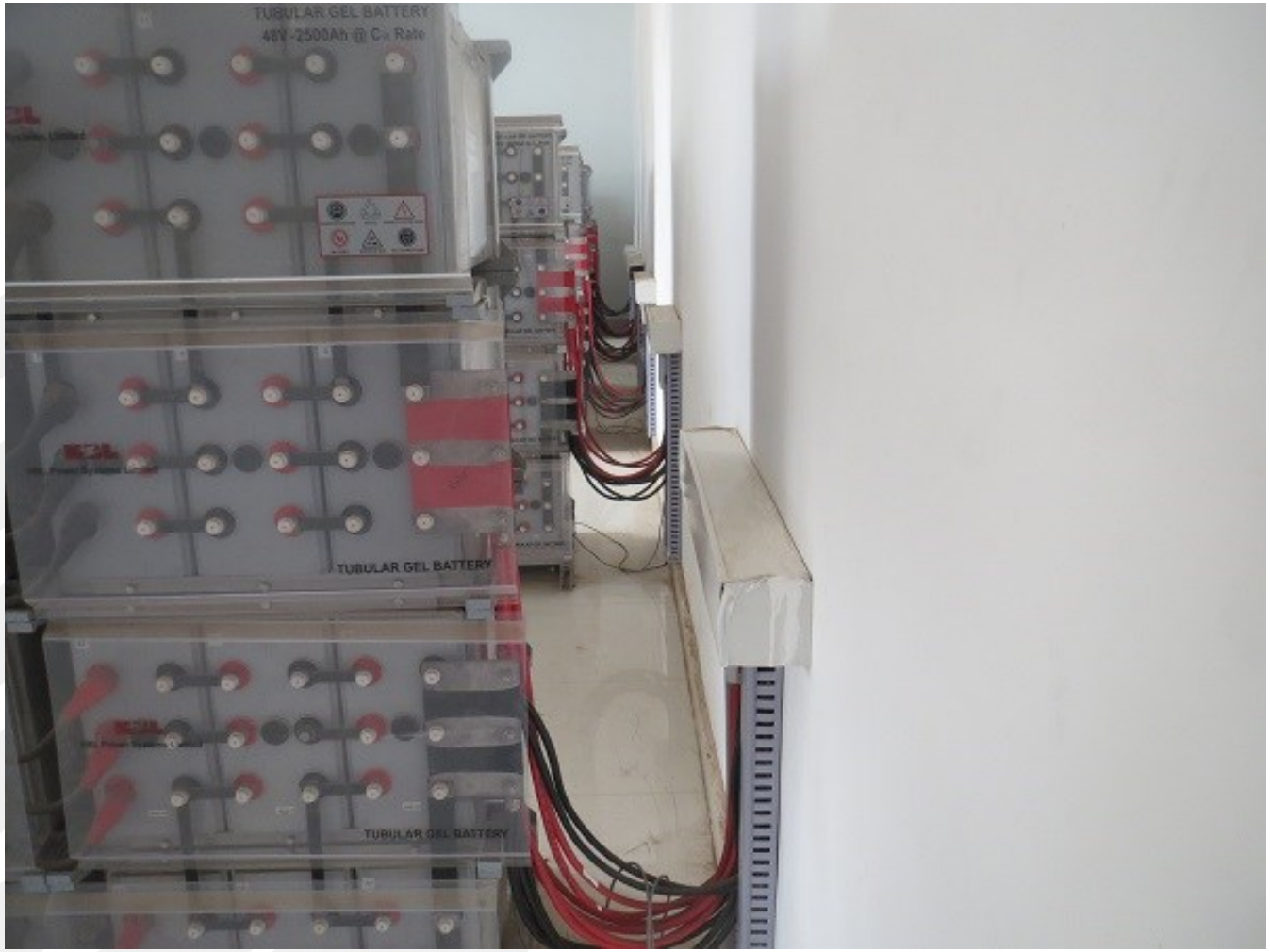


© 2017 GSES P/L

Poor wiring installation

© 2017 GSES P/L

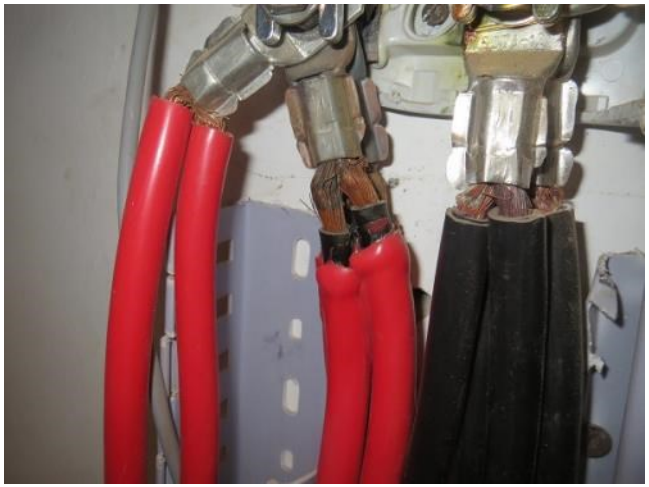
Poor battery Installation 1



© 2017 GSES P/L

Poor battery Installation 2

© 2017 GSES P/L



© 2017 GSES P/L