

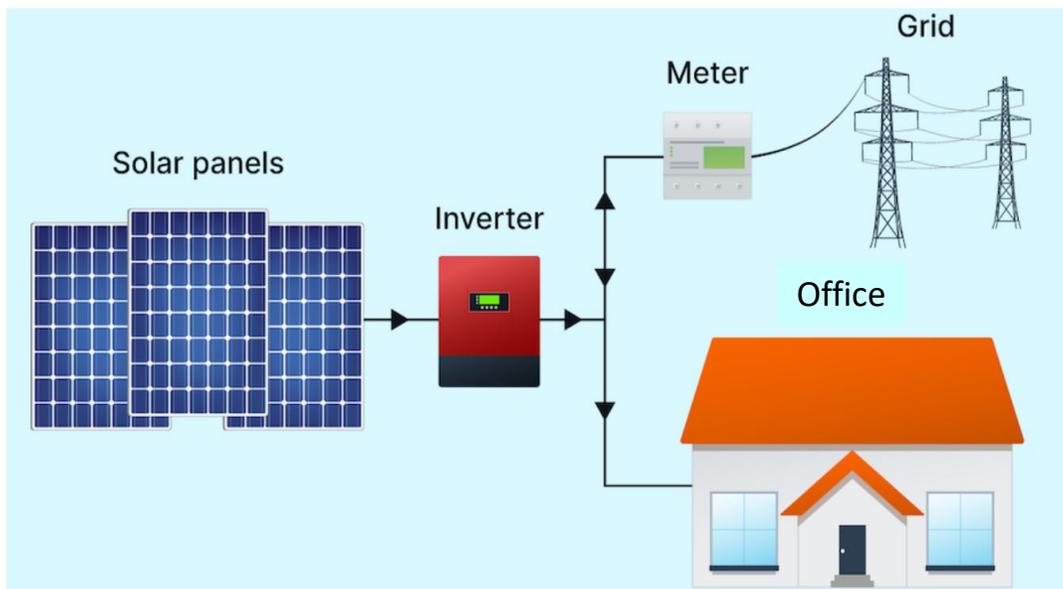
Solar system safety

Small mines roadshow 2023

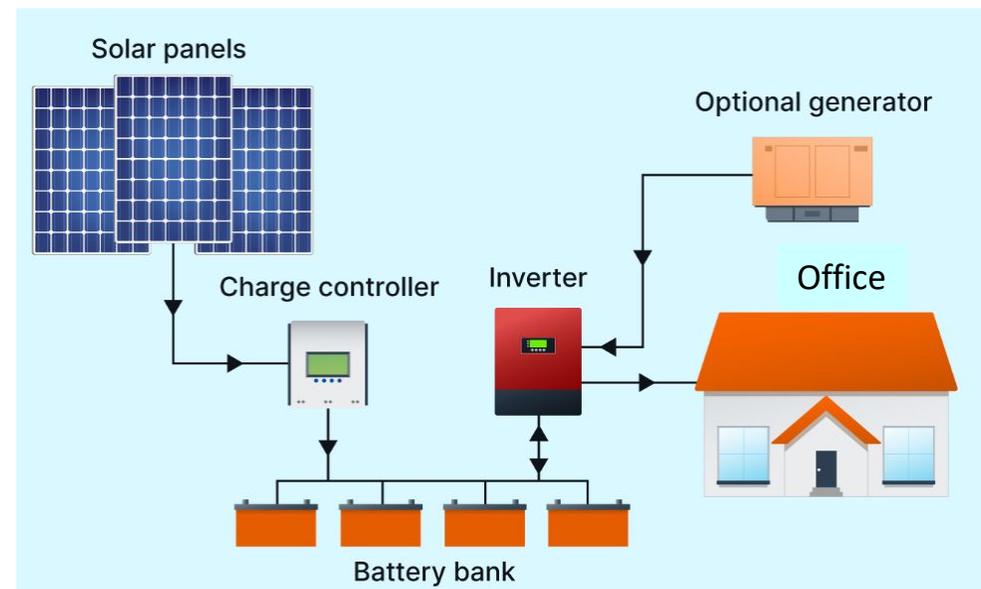
February to March 2023



Types of solar (Photo Voltaic) systems



Grid connected system



Off Grid system

Each system similar as well as different hazards

Risk Assessment & Electrical Engineering Control Plan

Each mine that has electricity MUST do a risk assessment on the hazards of electricity and have an Electrical Engineering Control Plan

Schedule 2 Section 3(1) identifies 4 items that you need to manage risks for:

- a) **lifecycle** of electrical plant and installations,
- b) **reliability** of electrical safeguards,
- c) the electrical **work practices**,
- d) the **competencies** required to work on electrical plant and equipment.

AND

What are the issues?

Schedule 2 Section 3 identifies 5 risks to health and safety that has to have control measures for:

- a) injury to persons caused by direct or indirect contact with electricity,
- b) injury to persons caused by working on electrical plant or electrical installations,
- c) the unintended initiation of gas or dust explosions,
- d) the unintended operation of plant,
- e) the occurrence of uncontrolled fires.

What are the issues?

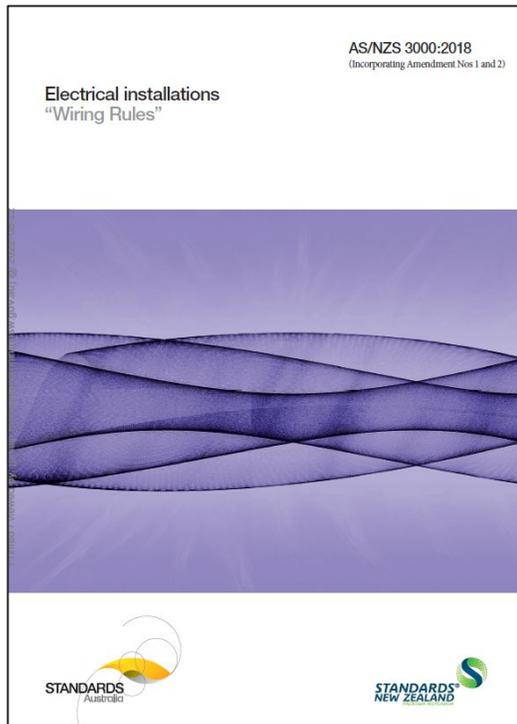
Introducing a solar system will need you to review your risk assessment for at least 3 of these 5 risks.

- a) injury to persons caused by direct or indirect contact with electricity,
- b) injury to persons caused by working on electrical plant or electrical installations,
- c) the occurrence of uncontrolled fires,
- d) the occurrence of uncontrolled fires,
- e) the occurrence of uncontrolled fires.

Wiring Rules

WHSMP SR 2022 - Section 34(2)(a) says you “must ensure electrical installation work at the surface is carried out in accordance with the Wiring Rules”

S 7.3.2 Selection and installation of ... shall comply with:



PV Cells
AS/NZS 5033



Inverters
AS/NZS 4777



Battery systems
AS 3011 & AS/NZS 5139

I am going to install a solar system

Lifecycle



Accredited

Licensed electrician & done accredited training



Documentation for safe operation and maintenance

Test certificates

Design & operational manuals

Hazards with solar systems

DIRECT CONTACT

Solar cells will still generate electricity even when disconnected. Even a little light (moonlight) can generate electricity.

Misconception that they are DC volts just like a battery – WRONG the voltages can be very high, typical roof top arrays can be 400+ volts, large industrial arrays can be over 1000 volts.

Work on cells / arrays can only be done by licensed and accredited electricians.

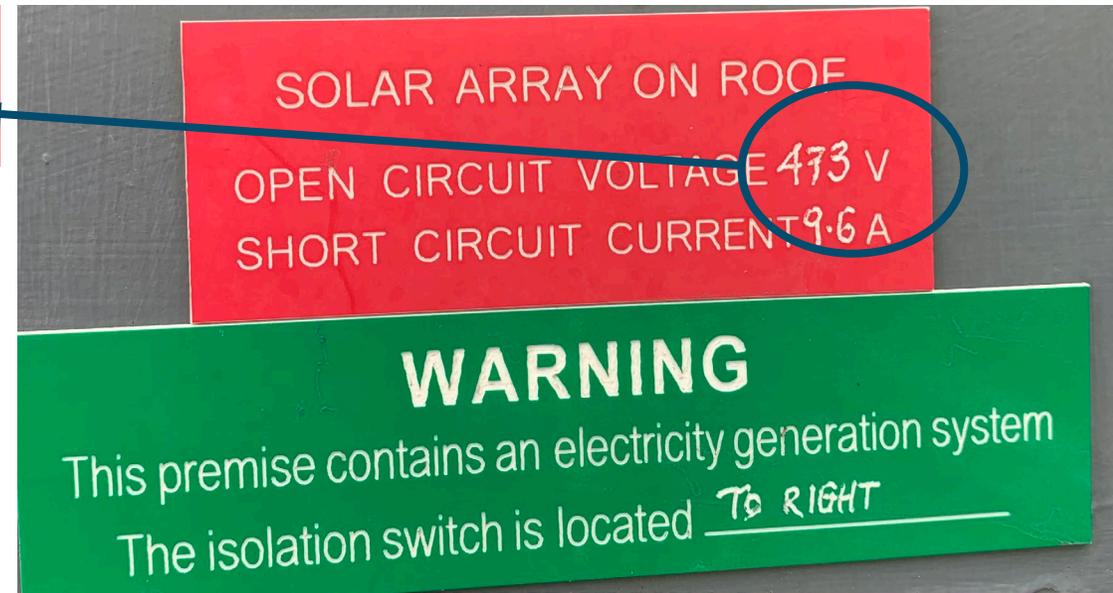


EXAMPLE

Home solar system

Your home runs normally on 240 volt ac

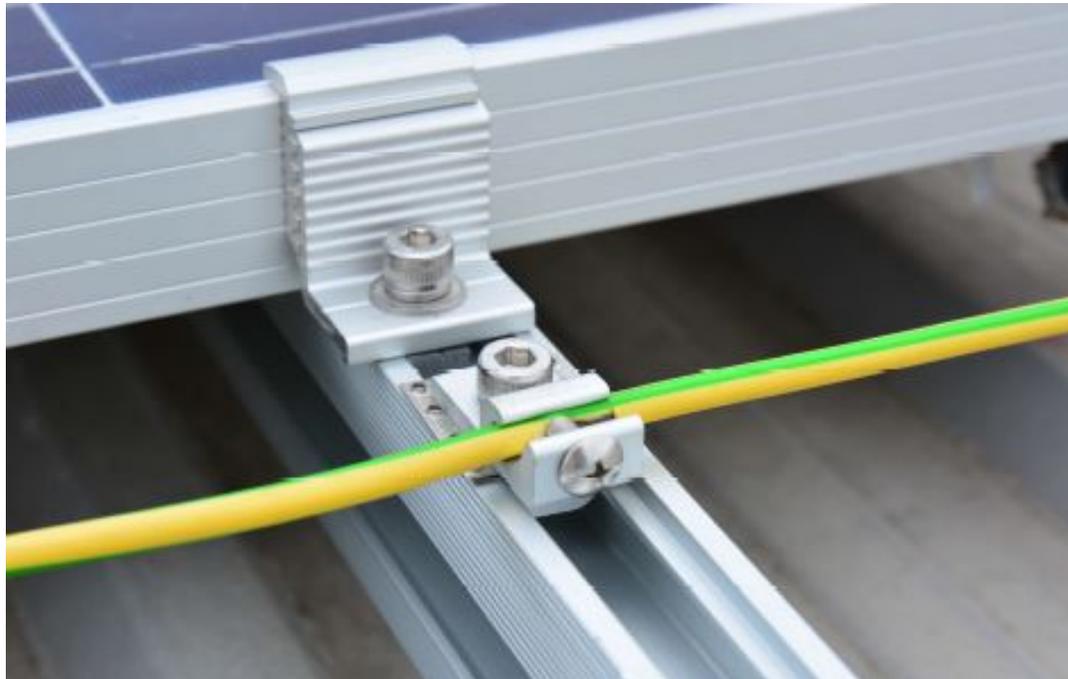
This solar system is **473 volts dc**



Hazards with solar systems

INDIRECT CONTACT

Earthing of solar systems is very important to prevent unwanted stray voltages in fault situations, and lightning strikes.



Hazards with solar systems

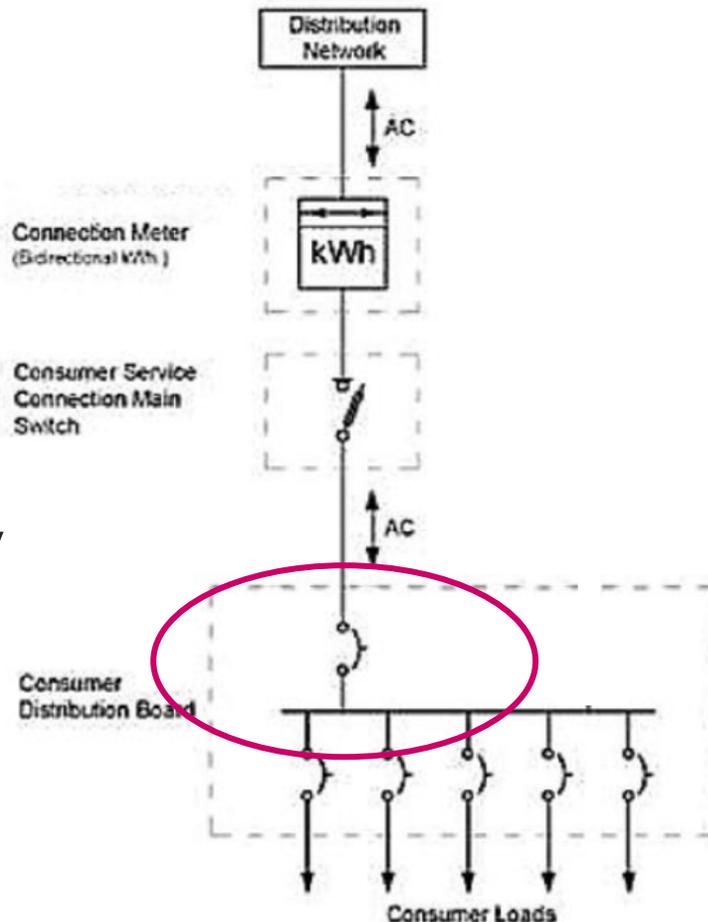
ISOLATION PROCEDURES

Any isolation procedures you have that say how to isolate electricity will need to be reviewed.

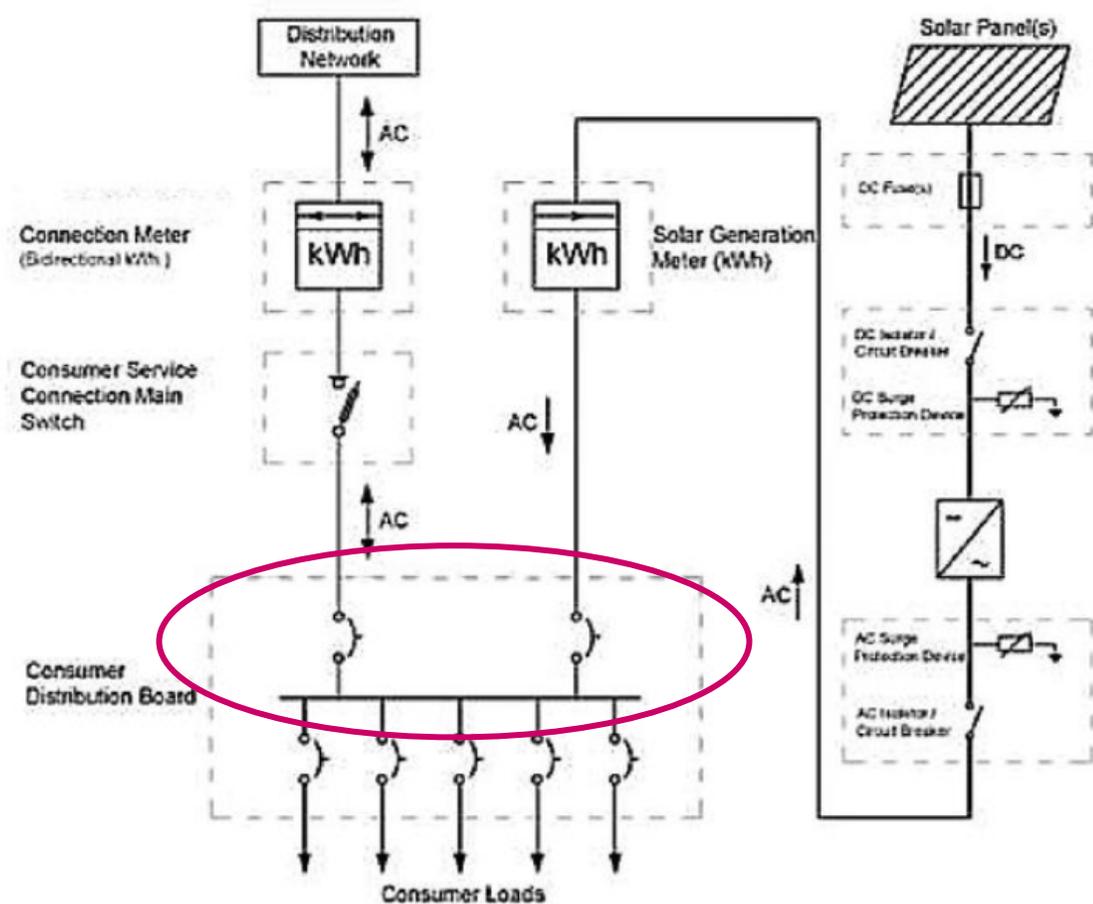
Your mine will have 2 sources of electricity – Mains Power & Solar Power.

Your isolation procedure needs to cover this.

Mains power only



Mains power AND Solar power



Hazards with solar systems

FIRE

Incorrect cable installations can lead to short circuits.

Solar cells are “constant current” devices, they will continue to supply power into a fault situation. They do not perform like an AC system.

If fire occurs on the cell side of an isolator you cannot isolate the power (so having good installation standards can reduce the risk of a fire).

You need to risk assess the source and fuel for a fire.

Consider the location and nearby important assets and infrastructure.

How will you fight the fire

Talk to your local fire brigade.

Hazards with solar systems

There was a fire at a mine last year on an isolator at a solar installation:

- Site had suffered damage during floods
- An inverter was replaced
- Switches were inspected and were OK
- Long stretch of very sunny days, long periods of electricity production
- Fire occurred in one of three DC isolators
- That isolator isolated 2 x strings of cells. (Other isolators isolated 1 string each)
- Isolator was rated for the load.
- DCP fire extinguisher used but the power could not be isolated easily.



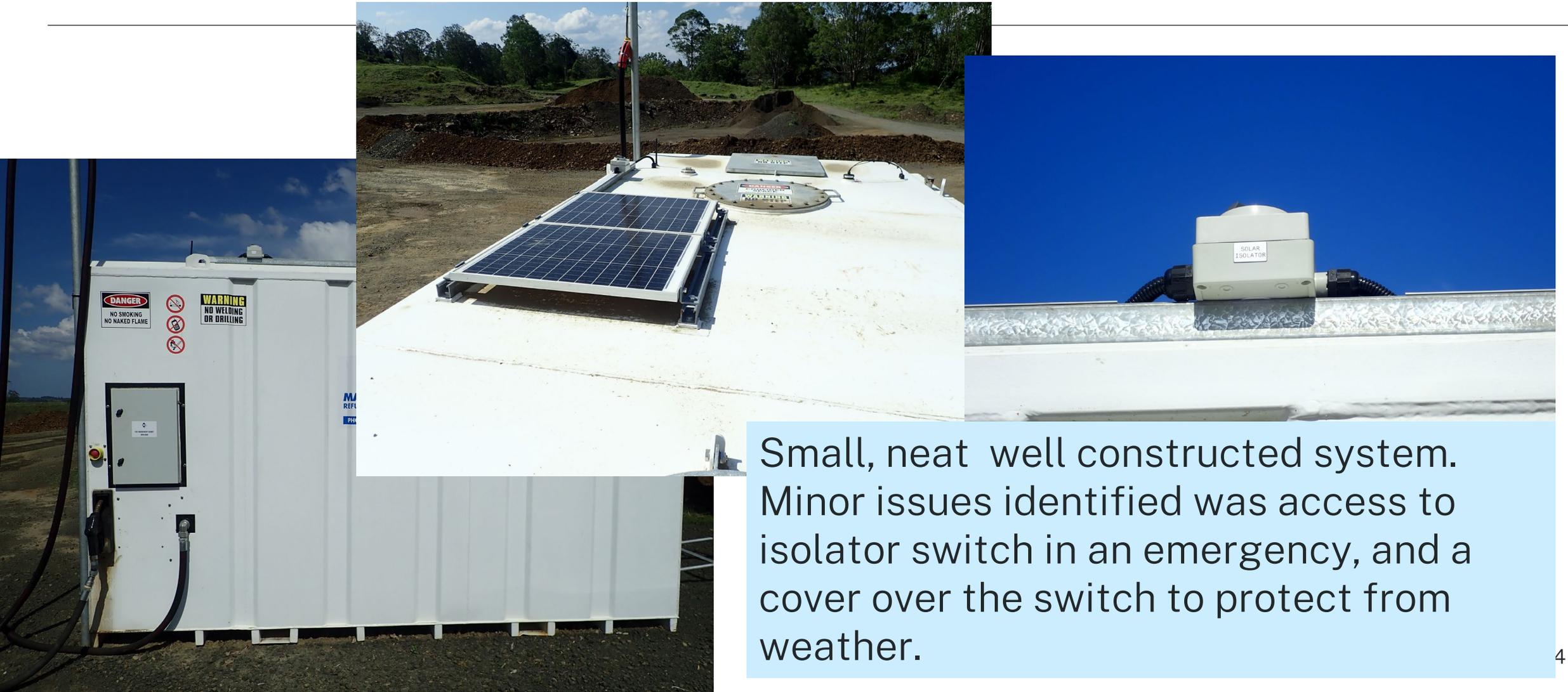
more

Hazards with solar systems

- A fire extinguisher extinguished the flames but the arcing continued
- Could not isolate the other strings, they were back feeding power into the fault.
- Fire watch established as the arcing continued.
- Electrician then disconnected the solar cells at the MC 4 connectors



Installation standards - examples



Small, neat well constructed system. Minor issues identified was access to isolator switch in an emergency, and a cover over the switch to protect from weather.

Installation standards - examples



DC Cable installation non-compliant to AS/NZS 5033 resting & rubbing on roof



DC Cable installation to compliant to AS/NZS 5033 stainless clips & out of sunlight

Installation standards - examples



Poor installation

Cells on sloping roof overhanging the roof creating wind lift issues.

Rack cells not on proper frames, cable lying across the metal roof

Installation standards - examples



Off grid system – 120 cells (3 phase system with batteries and a generator back up)
No access possible up the roof along the edges (but accessible by EWP).

Documentation

The Australian Standards dictate what documentation has to be provide (much more in stds)

- A list of the equipment supplied
- Actions to be done when the inverter shows “earth fault”
- **Shutdown and isolation procedure for emergency and maintenance**
- **Electrical connection diagram showing ratings, overcurrent devices and switches**
- System performance estimate
- **Recommended maintenance**
- **Maintenance procedures and timetable**
- Commissioning and installation checklist
- Array mounting structural certificate for both wind and mechanical loading
- Installers and designers declaration of compliance for mechanical design issues.

Signs and labelling

Standards specify labelling required

These are just a few that are required



Example of a sign indicating a roof top switch disconnecter



Example of sign indicating multiple supplies in the switchboard



Example of sign indicating a high DC voltage



Example of sign indicating that PV is present at the site

Solar systems – Summary

- ✓ Use reputable and accredited designer
- ✓ Use qualified and accredited electrician
- ✓ Ensure you receive your documentation from the designer AND electrician

- ✓ Undertake a review of your risk assessments for electricity and fire
- ✓ Modify your electrical engineering control plan where required
- ✓ Review your isolation procedures

- ✓ Train workers in the hazards of the solar system
- ✓ Carry out the recommended maintenance (using licensed and accredited electricians)



Any questions?