Safety Alert

Safety Alert No. SA-15-23

Effective Date: 21/11/2023
Version: 2.0

Incident response to Industrial Solar Farms Fires

Purpose

To advise all operational Rural Fire Service (RFS) and Fire and Rescue Service (FRS) staff and volunteers of the potential risks associated with responding to an incident at industrial solar farms and large scale Battery Energy Storage Systems (BESS) and the mandatory actions that must be taken to ensure health and safety.

Issues

There are currently about 43 operational Industrial Solar Farms located in Queensland with another 88 proposed or under construction. A number of these industrial solar farms are located in areas where RFS are the primary responder.

Significant incidents on large scale industrial solar farms include catastrophic inverter failures which can result in doors being blown off and fires external to the inverters.

When responding to incidents (i.e. fires, including bushfires and disaster recovery efforts etc) at solar farms, there are several factors contributing to electrical contact risks which must be kept in mind:

- There are various components at each stage of solar energy production which have potential to be live such as:
    - Inverters (converting direct current (DC) to alternating current (AC)
    - Switch boards
    - Electrical wiring and connection terminals
    - Battery energy storage systems (BESS)
- Solar electricity will still be produced at dangerous voltages in low light conditions
- Typically, DC voltages exceed 1000 Volts which presents a risk of arcing in fault conditions
- Electrical faults can result in electrical fires
- DC electrical faults may not be automatically isolated by protection systems and may continue to arc/burn until input power is switched off or burnt to open circuit
- Wiring is live/energised as soon as it is connected to the solar system
- DC arcing can be caused when disconnecting DC connectors whilst under load (to be undertaken by authorised person for the Solar Farm site).
- Insulation faults or contact with live circuits can cause a rapid release of energy resulting in electrical arcing
- Solar electricity production includes both DC and AC electrical currents.
- Multiple sources of electricity (eg high voltage electricity from the transmission or distribution network and the solar array that is absorbing light)

Electrical and other safety hazards associated with solar Photovoltaic (PV) systems include:

- PV array and PV modules being live (energised) as soon as they are exposed to light
- Power Conversion Equipment (PCE), e.g. inverters, having hazardous voltages once connected to the PV array
- wiring being live (energised) once connected
- the risk of electrical faults causing explosion, arcing and fires

- DC voltages and current sources of PV modules causing series arcing that may not be identified by automatic protection devices and so remain in place unless physical action to remove the fault occurs
- DC arcing caused by disconnection of DC connectors under load
- rapid energy release from energy storage (if used) if an insulation fault occurs or contact is made between live (energised) circuits, resulting in arc flash hazards
- toxic gases
- flammable gases
- hazardous chemicals.

(Photograph 1: Solar Farm example)

(Photograph 2: Fire damaged Inverter post fire event)

MANAGEMENT

Planning and Preparedness:

- Under the Construction and Operation of Solar Farms Code of Practice 2019, Industrial Solar Farms will have an **Emergency Management Plan** to outline the procedures for access by emergency responders, evacuation of people on the site and site control measures during an incident. The emergency plan should also identify the hazards (e.g. electric shock, contact with hazardous substances, toxic gases) that may occur and how to safely manage those hazards during the emergency. It should also include information on safe remediation procedures or clean-up work after the emergency. RFS and FRS should engage with Solar Farms in their local area and obtain a copy of the Emergency Plan for station/brigade reference. RFS and FRS officers to ensure that they are aware of the contact details for the Solar Farm if unstaffed. The Code of Practice states that emergency contact details should be displayed at the site entrance.
- It is important to be aware of the level of acceptable loss that your local Solar Farm is willing to accept as this will impact the level of response required from QFES.

Response:

- Self Contained Breathing Apparatus (SCBA) **must** be worn when working around burning solar panels and BESS due to the highly toxic gases. Under no circumstances should an officer go into the smoke or approach a fire without the correct respiratory protection.
- As RFS do not carry SCBA, RFS officers must not undertake a direct attack of solar panels that are burning, or operations that require crews to work in smoke from burning solar panels. RFS officers will be restricted to fighting exposure fires where the Solar Farm is not burning.
- Isolation of electricity production on solar farms must only be undertaken by an authorised person for the Solar Farm site.
- QFES Staff and volunteers are **not to enter** the solar farm property until an appropriately qualified electricity representative from the Solar Farm is onsite and deems the area safe to enter, and safe to investigate smoke or undertake fire response activities.
- Do not put water on Solar Panels. Emergency responders are to treat all wiring and solar module components as though they are electrically energised.
- Bush Fire Air Operations should operate upwind from the smoke plume of Solar Farm Fires due to the toxicity of the gases and visibility for the aircraft. The aircraft will also attempt to avoid hitting solar panel arrays with firebombing loads due to possible damage to structures and panels.
- When fighting wildfires in the vicinity of a Solar Farm, officers will need to, as per doctrine, wear negative pressure masks with MPC canisters.

Post-Response:

- Responding crews to ensure that all PPC are laundered correctly due to the contaminants.

References

Electrical Safety Act 2002
Electrical Safety Regulations 2013
Qld Work Health and Safety Act and Regulation 2011
How to manage work health and safety risks code of practice 2021
Construction and Operation of Solar Farms Code of Practice 2019
A Review on Safety Practices for Firefighters During Photovoltaic (PV) Fires Section 4.3.6
TacG-02-11-00-Hazardous-Materials-Large-Battery-Energy-Storage-Systems-Incidents.pdf (sharepoint.com)
TacG-02-07-00-Electricity-Supply-and-Distribution-Infrastructure.pdf (sharepoint.com)
Tactical Directive (TacD) 14.03.00 – Hazardous Material Incidents – Decontamination of QFES Staff and Volunteers and Members of the Community; (sharepoint.com)

David Hermann AFSM GAICD
Assistant Commissioner, QFES People

Relevancy Matrix									
	Fire and Rescue		Emergency Management	Rural Fire Service		State Emergency Service		QFES Support	
	Full-time	Part-time	Full-time	Full-time	Volunteers	Full-time	Volunteers	Full-time	Part-time
Applicable:	✓	✓		✓	✓				
Not applicable:			X			X	X	X	X
Contact: Manager, Safety and Wellbeing 0477 985 925			Issue Date:	Removal Date:					
			21/11/2023						