



MOM/OSHD/2023-06

Date: 8 September 2023

To: All Photovoltaic (PV) System Contractors, Installers and Other Interested Persons

Circular on Safe Installation of Photovoltaic (PV) System

On 12 June 2023, a worker was electrocuted after coming into contact with the exposed cable of photovoltaic panel (PV) (refer to Annex A). He was subsequently conveyed to the hospital where he passed away on the same day.

2. As the installation of PV panels (or commonly known as solar panels) gains acceptance and wide adoption by building owners, it is crucial that industry stakeholders involved in installation of PV panels carry it out safely. In particular, MOM would like to highlight the following key risks and control measures for industry's compliance.

Working at Height

3. As most PV panels are installed on the roof of the building, workers are exposed to the risks of falling from heights. The risks extend to workers undertaking preparatory work such as cleaning and waterproofing prior to the installation of the PV panels. Thus safe work-at-height measures must include, but not limited to, the following:

- i) Establish and implement a Fall Prevention Plan (FPP) and a permit-to-work system before commencing any installation of PV system on the roof;
- ii) Ensure that the risk control measures as stated in the FPP and permit-to-work (e.g., the use of travel restraint or fall arrest systems) have been communicated to the workers involved and implemented onsite;
- iii) Ensure that the workers involved are adequately trained to be familiarised with the hazards associated with working at height, and that they adhere to the risk control measures as implemented (e.g., wearing of body harness, secured to proper anchorage at all times, etc) when working on the roof.

Installation of PV system

4. The PV panels installed in open spaces such as rooftops, generate electricity when exposed to sunlight, even before the connection of the PV modules is completed or commissioned. Workers involved in PV panel installations must be briefed on electrical safety requirements, which shall include but not limiting to the requirements stipulated within the Electricity Act, the Electricity (Electrical Installations) Regulations and the Singapore Standard 638 - Code of Practice for Electrical Installations. The installation of the PV system shall be undertaken, carried out and/or supervised by a Licensed Electrical Worker (LEW) of the appropriate class.

5. Safety measures for the installation of PV modules shall include, but not limited to, the following:

- i) Ensure that the installation of PV module is in accordance to the PV single line diagram that has been approved and endorsed by a LEW of the appropriate class and to conduct open circuit voltage (V_{oc}) measurement immediately on newly installed PV arrays to ensure that the total voltage does not exceed 1000 V DC;
- ii) Ensure that no live parts or conductors are exposed. Any breakdown or damage to the insulation of the cables and connectors shall be reported to the LEW immediately.
- iii) Treat all conductors as live, unless advised by the LEW otherwise; and
- iv) All persons carrying out the installation must be equipped with appropriate personal protective equipment (PPE), such as safety shoes, insulative rubber gloves (OSHA rating: at least class 0), etc.

Risk Management

6. In addition to the above risks, before commencing any work, a risk assessment (RA) must be conducted to evaluate the safety and health risks posed to any person who may be affected by the installation of the PV system. The RA must include, but not limited to, the following work activities and factors:

- i) Safe access to and egress from the work area and working at height;
- ii) Assessment of the roof's structural integrity;
- iii) Installation of PV system;
- iv) Assessment of weather conditions;
- v) Emergency responses, etc.

7. All reasonably practicable steps must be taken to ensure that the necessary risk control measures and safe work procedures are implemented to minimise and control the risks arising from the installation of PV system and working at height, among other considerations.

8. Please refer to Annex B on the list of relevant information and resources.



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WSH ALERT

FATAL ACCIDENT

Worker electrocuted during solar panel installation

On 12 June 2023, a group of workers was deployed to install solar panels on the rooftop of a building. During the installation, one of the workers noticed an exposed cable arcing and emitting smoke. He got electrocuted after coming into contact with the exposed cable.

He was sent to the hospital and died on the same day.

Preliminary investigations revealed that the cable was lying on the roof, which was wet due to rain before the incident.



Figure 1: Scene of the accident.

What companies should do

Electrocution is a major concern during the installation of solar panels. Solar panels generate live current when exposed to sunlight, even when they are not plugged in. The following measures should be taken to protect workers:

- **Connect solar panels as per design:** Ensure that the wiring of solar panels are connected in accordance to a design by a Licensed Electrical Worker.
- **Insulate exposed electrical parts:** Exposed cables or connectors that are not connected should have an insulated cap covering wire ends/terminals. Do not touch the terminals and use only insulated tools.
- **Isolate and report damaged equipment:** Identify and isolate any damaged wiring, connectors, or faulty equipment in the work area where possible, and report to the supervisor promptly.
- **Environmental conditions:** Stop electrical work during unfavourable weather, e.g. when there is heavy rain or when the work area is wet.
- **Trained workers:** Ensure that only trained and competent workers are allowed to carry out solar panel installation works. They should be familiar with safe work procedures and risk control measures to protect them and their co-workers from risks such as electrocution.
- **Personal protective equipment (PPE):** Equip workers with electrically resistant PPE such as arc-rated protective gloves and rubber-soled shoes.

Falls from height are also a risk when installing solar panels. While this case did not involve any falls, solar installers and contractors are reminded to establish and implement a site-specific fall prevention plan to eliminate or mitigate the risk of falling from height.

For more information, refer to the WSH Council's article on [Addressing WSH Risks for Safe Installation of Solar Photovoltaic \(PV\) Systems](#) and Energy Market Authority's [Guide to Solar PV](#).

Under the WSH Act, first-time corporate offenders may be sentenced to the maximum fine of \$500,000 whilst individuals can either be sentenced to the maximum fine of \$200,000 and/or an imprisonment not exceeding 2 years. Read more on the [WSH Act penalties](#).

Information on the accident is based on preliminary investigations by the Ministry of Manpower as at 19 June 2023. This may be subject to change as investigations are still on-going. Please also note that the recommendations provided here are not exhaustive and they are meant to enhance workplace safety and health so that a recurrence may be prevented. The information and recommendations provided are not to be construed as implying liability on any party nor should it be taken to encapsulate all the responsibilities and obligations under the law.

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List of relevant information and resources

1. Singapore Standards SS 638 (Code of Practice for electrical installations)
2. SS 601 Photovoltaic (PV) systems
3. IEC 62548 Photovoltaic (PV) arrays – Design requirements
4. IEC 60364 Requirements for special installations or locations – Solar Photovoltaic (PV) power supply systems
5. [Handbook for Solar Photovoltaic \(PV\) Systems by Energy Market Authority and Building Construction Authority](#)
6. [Best Practices for Installing Solar Panels on Building Rooftops by Building Construction Authority, Energy Market Authority and Urban Redevelopment Authority](#)
7. [PV guides](#) from SP Group resource page.