



Technical Advisory  
Technical and Safety Considerations When Providing Building Enclosure  
Consulting Services on Low-Slope Roofs Equipped with Photovoltaic Arrays  
– 27-2025

**TITLE:** Technical and Safety Considerations When Providing Building Enclosure Consulting Services on Low-Slope Roofs Equipped with Photovoltaic Arrays

**DESIGNATION:** TA-27-2025

**OBJECTIVE:** To provide awareness pertaining to conducting building enclosure consulting work on a building equipped with a photovoltaic (PV) array.

### BACKGROUND AND DISCUSSION

More building owners are looking to alternative and renewable means of power generation for their buildings. A readily available and relatively cost-efficient means of power generation for buildings, whether it be fully or partially powering a building, can include photovoltaic (PV) arrays. PV modules are combined into panels, and one or more PV panels and the power source form a PV array. The information provided in this Technical Advisory (TA) applies regardless of the number of PV modules or panels that are installed in the array. The term *PV array* will be used throughout this TA.

Installing a new PV array on any new or existing building requires providing proper waterproofing details, ensuring continuity of air barrier and thermal insulation properties, and structural considerations. However, in addition to more obvious considerations, there are several other key technical and safety considerations not directly related to building enclosure performance that should be considered. These technical and safety considerations include, but are not limited to

- safe access and procedures for roof and exterior wall maintenance staff;
- safe access for emergency personnel; and
- safety considerations for construction personnel performing roof-related work.

This TA provides general guidelines for understanding technical and safety considerations for PV array installation on new and existing buildings.

**Disclaimer:** This Technical Advisory is not intended to provide any level of project-specific advice, suggestions, or recommendations with respect to photovoltaic (PV) arrays, panels, modules, and similar assemblies themselves, or any related electrical system components. This Technical Advisory is only intended to provide key considerations for occupational safety and fire safety from a building enclosure consulting perspective. PV arrays and their related components are considered to be extremely dangerous, high-risk, high-voltage electrical systems and should only be specified, handled, and directly accessed by a qualified professional.



## PV SYSTEMS – GENERAL DESCRIPTION

PV systems are complex electrical systems that contain multiple components that collectively convert solar radiation from the sun to usable electricity. The basic PV system generally consists of the following main assemblies:

- PV panels (or shingles) and supports
- Cables and connectors
- PV module-level power electronics (MLPE)
- Junction boxes
- Circuit breakers
- Direct current-to-alternating current (DC-to-AC) inverters
- Alternating current (AC) lines, panelboards, and storage

When working around any electrical equipment, the consultant should assume that once energized, PV arrays are “live,” even at night or when they are switched “off.” An energized PV array should be regarded as extremely hazardous to one’s safety.

## DESIGN CONSIDERATIONS

### Access

If the building owner(s) wishes to incorporate a PV array on the roof of a building, there are several resources that provide minimum guidelines with respect to maintaining safe access to and around roofs for either routine maintenance, repairs to building systems, and/or access for emergency personnel. They include

- *International Building Code (IBC)*;
- local codes;
- Metal Construction Association (MCA) “Best Practices” series;
- *National Building Code of Canada (NBCC)*;
- National Electric Code (NEC);
- National Fire Protection Association NFPA 1; and
- National Roofing Contractors Association (NRCA) *Guidelines for Rooftop-Mounted Photovoltaic Systems*, which details minimum distances from roof edges and parapets, minimum widths between PV arrays, and minimum clearances from drains and other roof penetrations.

The design professional should consult with the local authority having jurisdiction, fire department, and industry association (if available) for possible additional requirements unique to their geographic region.

### Mounting Methods and Building Enclosure Performance

There are several ways a PV array can be incorporated as part of a roof or exterior wall system of a building. A PV array can either be anchored to a roof or wall or ballasted on a roof.



- **Anchored (Penetrating) Systems:** The PV array is affixed to a frame or rail system that is anchored or connected directly to the building's structure. Provided the penetrations through the roof or wall assemblies are properly detailed and that the building's structure is capable of handling the additional load, the anchored system is often the preferred method but typically involves greater initial costs. This installation method can provide the most reliable method of securement, as long as sufficient clearance is provided between the roof surface and PV array and appropriate access to the finished system is provided.
- **Ballasted (Non-Penetrating) Systems:** The PV array is affixed to a frame system that is loose laid on the roof surface and held down with weighted objects (ballast). The roof structure should be reviewed to confirm that it can accommodate the additional loads imposed by the array, and the roof surface may require additional layers of insulation, protection pads, or blocking placed under the frame system. Ballasted systems have been known to move position over time related to exposure to wind-related forces or thermal cycling of the support frame elements. As with anchored systems, there should be sufficient clearance between the roof surface and the PV array.
- **Clamping Systems:** Commonly found on standing-seam metal roofs, this type of system is attached to a roof element that is attached to the building structure. Consideration should be given to the anchoring strength of the fasteners to ensure suitable wind uplift resistance. The attachment of the metal panel roof to the underlying structure should be reviewed to confirm that the system can accommodate additional loads imposed by the array.

The building enclosure consultant should provide input on how to accommodate the chosen mounting methods on building enclosure components in a way that allows the building enclosure to continue to perform its functions. These functions include roof and wall access, resilience against physical wear and tear, watertightness, water and ice shedding, drainage, thermal performance, and wind resistance.

Apart from the installation of the PV array, the building enclosure consultant should provide advice on overall design considerations for the roof and wall system that might interact with the PV array. Reflective and light-colored roof surfaces are generally found to provide a better thermal microclimate for the performance of PV arrays. Where PV arrays are to be installed on an existing roof or wall assembly, the building enclosure consultant should provide input on the estimated remaining life expectancy of the roof or wall to be covered so that repairs to those elements can be properly scheduled.

### Fire Safety Considerations

Aside from the penetrations, discontinuities, and stresses that PV arrays can impose on building enclosure assemblies and the building's primary structure, the installation of PV arrays introduces a combustible element to the roof or wall assembly. Concerns over fire hazards from PV arrays can be subdivided into three categories:

1. **PV Array Component Combustibility:** PV arrays are generally constructed with glass and aluminum frames, with combustible backing or associated system materials.
2. **Ignition Hazards:** As listed above, a PV array consists of various materials and components. Potential failure modes exist at the assemblies, as well as at the junctions among them.



There have been several documented cases of fires associated with electrical faults at the connection points between PV array components.

3. Fire Dynamics: The presence of a PV array on a roof or wall can alter the behavior of a fire on a roof/wall regardless of the source of ignition or the combustibility of the roof/wall or the PV components.

It is anticipated that minimizing the risk of fire with respect to the PV array itself will most likely be beyond the capabilities and expertise of most building enclosure design professionals. However, one option to minimize the risk of flame spread on a roof could include recommending or specifying a roof system that has a high flame spread resistance rating, as well as recommending that the PV system (PV module and mounting system) have a fire rating that meets or exceeds the site requirement.

According to the IBC, a PV system in an array, which is the installed combination of a PV panel and mounting system, shall have the same or greater fire classification rating as that required for the roof covering for the type of building construction. The PV system shall be listed and labeled in accordance with UL 2703, *Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels*, and shall be installed in accordance with the manufacturer's instructions. This listing requires the fire type classification of the PV panel in accordance with UL 1703, *Standard for Flat-Plate Photovoltaic Modules and Panels*. A PV system installation shall comply with the *International Fire Code* where adopted, NFPA 1 where adopted, and/or all other applicable codes, rules, and regulations of the authority having jurisdiction.

Most, if not all, of the building codes in North America provide requirements for roofs to be tested in accordance with ASTM E108, *Standard Test Methods for Fire Tests of Roof Coverings*, or UL 790, *Standard Test Methods for Fire Tests of Roof Coverings* (for Building Integrated Photovoltaics products only). ASTM E108 test standard describes a series of four tests and classifies roof assemblies as follows:

- Class A: Considered to be effective against severe fire test exposures
- Class B: Considered to be effective against moderate fire test exposures
- Class C: Considered to be effective against light fire test exposures

The design professional should consider recommending a roof assembly with an FM/UL Class A fire rating to provide maximum protection from flame spread in the event of a PV-related fire. Additional noncombustible materials, such as concrete pavers, could also be considered for installation under PV arrays if the structure can withstand the additional load.

### Contractual Considerations

Design professionals may be engaged in building enclosure restoration projects where the operation of an existing PV installation will be affected by the project work. It is important, especially for the project's prime consultant, to understand the implications of the project on other contracts that may be in place for the operation of the PV system. Different types of contracts may exist between the PV array installer, maintainer, or operator and the building owner or manager, possibly including



the local electrical power utility. The design professional should be aware of these other contractual implications and advise the client of the implications of the repair project on those contracts.

## ROOF REVIEWS AND MAINTENANCE

PV arrays on roofs pose safety hazards that may not be encountered on roofs without PV arrays. A qualified person who is able to identify potential hazards should be consulted, and appropriate actions should be taken to remove those hazards prior to commencing roof review and maintenance work.

In many PV arrays, where the clearance between the PV panels and roof surface is likely minimal, it is imperative for personal safety that a PV-certified electrical contractor make the area of the roof safe to approach and conduct appropriate work around the PV arrays. In many cases where maintenance is required, removal of several PV panels within the array may be necessary, which requires the services of a specially trained and certified electrical contractor. Untrained individuals should not attempt to disconnect or move any part of a PV array.

## CONCLUSIONS

PV arrays, associated systems, and components require specific expertise separate from standard and routine building enclosure consulting expertise. PV arrays can involve critical safety and fire safety considerations not normally encountered on roofs.

The building enclosure consultant should recommend details and procedures relating to PV array installation that maintain and protect the intended primary functions of the building enclosure.

Where rooftop PV arrays are to be used, the building enclosure design professional should recommend a roof assembly with an FM/UL Class A rating. However, if a roof assembly with an FM/UL Class B or Class C rating is confirmed to be installed on an existing roof to receive a PV array, additional measures to mitigate potential flame spread, such as a layer of concrete pavers between the PV array and underlying roof system, should be considered.

If retained to conduct a review of a building equipped with PV arrays, it is recommended that the building enclosure consultant advise the owner to also retain the services of an electrical contractor certified to handle PV systems. This is because even if the system is switched off or the PV system is disconnected, the PV system is still “live” with electricity. If the roof or exterior wall assembly requiring review or access is directly below or immediately adjacent to a PV array, it may be necessary to properly deactivate and temporarily remove the system by a certified electrical contractor.

## REFERENCES

- ASTM International. 2011. *Standard Test Methods for Fire Tests of Roof Coverings*. ASTM E108. West Conshohocken, PA: ASTM International.
- Canadian Roofing Contractors Association (CRCA). 2010. “Photovoltaics in Roofing.” *Technical Bulletin*, Vol. 57. Ottawa, ON: CRCA.



- International Code Council (ICC). 2015. *International Building Code*. Country Club Hills, IL: ICC.
- Metal Construction Association (MCA). 2021. “Metal Roofing & PV Solar Systems Parts 1, 2 & 3.” MCA. <https://www.metalconstruction.org/index.php/online-education/metal-roofing--pv-systems-1-2-3>.
- National Fire Protection Association (NFPA). 2024. *Fire Code*. NFPA 1. Quincy, MA: NFPA.
- NFPA. 2026. *National Electric Code*. NFPA 70. Quincy, MA: NFPA.
- National Research Council Canada (NRCC). 2020. *National Building Code of Canada*. Ottawa, ON: NRCC.
- National Roofing Contractors Association (NRCA). 2019. *The NRCA Roofing Manual: Membrane Roof Systems*. Rosemont, IL: NRCA.
- NRCA. 2018. *Guidelines for Rooftop-Mounted Photovoltaic System*. Rosemont, IL: NRCA.
- Sipe, Joel. 2016. *Development of Fire Mitigation Solutions for Photovoltaic (PV) Systems Installed on Building Roofs – Ph. 1*. Quincy, MA: National Fire Protection Association (NFPA) Research Foundation.
- UL Solutions. 2015. *Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels*. UL 2703. Northbrook, IL: UL Solutions.
- UL Solutions. 2024. *Standard for Flat-Plate Photovoltaic Modules and Panels*.
- UL 1703. Northbrook, IL: UL Solutions.
- UL Solutions. 2022. *Standard Test Methods for Fire Tests of Roof Coverings*. UL 790. Northbrook, IL: UL Solutions.
- UL Solutions. 2014. “Photovoltaic Systems – Achieving Code Compliant Installations Using UL Certified Products.” *The Code Authority Newsletter*. Northbrook, IL: UL Solutions.
- UL Solutions. 2014. “Class A, B, and C Roof Ratings – Helpful Hints for Achieving Code Compliance.” *The Code Authority Newsletter*. Northbrook, IL: UL Solutions.
- Van de Velde, Marc. 2016. “Photovoltaic Systems – European Perspective.” Presented at the NFP Conference in Munich, Germany.