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Photovoltaic Installations on GAF Guaranteed Roofing Systems

-Commercial-

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COMMERCIAL

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PV Technology Evaluation

There are many PV technologies in the market. It is critical that the designer match the right PV technology with the right roof system.

Roof as a Substrate Evaluation

1. Before installing a PV system over an existing roof, consider whether the remaining roof system service life is equivalent to the expected life of the PV system (typically >20 years). If it is expected that the PV installation will function longer than the existing roof system, re-covering or roof replacement should be considered. Other factors to consider include additional roof system penetrations, increased rooftop traffic, increased surface temperatures, etc. Match roof membrane thickness and field performance to the required service life of the PV system.

2. General recommendations for all new roofs that will be receiving PV include:
    a. High compressive strength rigid board insulation.
    b. Cover board located directly under the roof membrane.
    c. Membrane of increased thickness for single-ply roofing.
    d. Reflective roof surfaces & coatings to protect against UV.

In addition to these general recommendations, GAF recommends the following best practices to extend the life of the roof:

a. Adhered systems for ballasted or self-adhering thin film PV installations. For self-adhering thin film PV, use of high temperature resistant membrane. Where a standard membrane is utilized, thin film PV should be installed to a sacrificial layer of membrane.
b. Use of slip sheets (sacrificial sheets) in between the contact areas of the ballasted PV and the roof. The slip sheet must be adhered (heat welded or cold applied with adhesive) to the roof membrane.
c. For ballasted PV systems, slope of the roof should not exceed 2:12.

Mechanically attached and Drill-Tec™ RhinoBond® attached roofing systems have the possibility of billowing due to high wind or building pressure differences. Billowing could cause ballasted PV systems to shift, and can also lead to localized abrasion of a roof membrane, as it rubs the edges and corners of a PV mounting system (at ballast trays, for example).

Structural Loading of PV on the Roof

1. The roofing system and building structural framing should be evaluated to verify there is enough load capacity to support the weight of the PV system (modules,

conduits, and electrical equipment), wind uplifts, and snow loadings. A licensed structural engineer should provide stamped drawings and calculations.

2. All vertical and horizontal loads should be transferred to the building structure without deforming or overloading the roofing system.
3. The roof deck should also be evaluated for loads due to traffic during installation and PV/Paver stacking.

Drainage

Installation of a PV system should not interfere with the drainage of the roof system. Consider the following:

1. Elevate framing and conduits above the roof surface to allow drainage.
2. Install crickets on any perpendicular to drainage flow and greater than 24" wide.
3. Projections through the roof system should not be located within 2 feet of valleys or designated drainage areas adjacent to drains, scuppers, or gutters.
4. Consider modifying solar racking heights to counter the varying thickness of tapered insulation.

Thermal Movement

The PV array and electrical conduits are subject to thermal movement. The effect of thermal movement may be reduced by:

1. Splitting larger arrays into smaller sub-arrays.
2. Using racking clips and attachments that accommodate thermal expansion without transferring movement to the underlying roofing systems. Some racking manufacturers have provisions for thermal expansion built into the PV systems.
3. Using flexible flashing details for mechanically attached racking systems.
4. Incorporating thermal expansion fittings in straight electrical conduit runs.
5. Racking systems should not cross over expansion joints.

Slip Sheets (or sacrificial sheets)

1. Use similar sacrificial sheet (min 60 mil for single-ply roofing systems) in-between

contact surfaces at the roof and the base of ballasted racking systems. The slip sheet should be adhered/welded to the roofing membrane, not the base mount. The slip sheet helps reduce wear & tear from incidental movement of the array, as well as helps reduce heat build-up on the primary waterproofing membrane.

2. The slip sheets should be a minimum 4" wider than the contact surface area of the rack base mount on all sides.

PV Service Access

1. Roof mounted PV systems generally should be mounted away from mechanical units, catwalks, permanent anchors, and other rooftop structures to provide access for service or maintenance of other rooftop equipment.
2. Space for service traffic paths should be designated and the roof system surface in these areas protected by walkways pads or pavers.
3. Consult the International Fire Code (IFC) for firefighting access recommendations for roof access hatches, access pathways, and equipment clearances.

Racking Systems

The solar racking system should be designed so that external forces acting on the rack do not compromise the waterproofing integrity of the roofing system. Loads to be considered include horizontal wind load, vertical wind uplift load, vertical dead load, and vertical snow load, as well as non-specific vibratory loads from external forces or building equipment.

Racking systems should have:

1. Thermal and dynamic movement provisions within the racking system.
2. Minimal UV exposure of washers/gaskets.
3. Base mounts of ballasted PV systems with sufficient area to distribute vertical loads without cutting or compressing the underlying roofing system.
4. Ballast pavers that have been tested for long-term durability (for ballasted PV systems), including freeze-thaw durability.
5. Compatible corrosion-resistant rack components.
6. Sufficient racking clearances for inspection, maintenance, repair, or reroofing.

Racking systems should allow ease of removal by trained personnel without

significantly exposing the roof system to the possibility of damage. Racking systems should also be easy to flash.

Guarantees

Roofing guarantees are a valuable tool for the building owner, but they carry important limitations and conditions that must be addressed for successful rooftop PV installation and operation.

1. From the start, the roofing system must be designed and installed in accordance with GAF published specifications, and PV system details must be accepted by GAF prior to installation to avoid any lessening of coverage of the guarantee.
2. GAF does not guarantee the solar mount system utilized in the solar installation or any other non- GAF products on the roof. GAF therefore specifically disclaims any liability arising out of or in connection with the integrity, installation or performance of, or damages sustained by or caused by the roof mount or PV systems.

Flashings

1. PV systems using support stands should use round steel pipes or square tubes to facilitate effective flashing installation methods.
2. All penetrations should be flashed in accordance with appropriate NRCA or GAF construction details.
3. Installation of thicker flashing membranes, additional layers of flashing membranes, or UV protective coatings is recommended for highly reflective PV system arrays.

Electrical Connections

1. The number of roof penetrations should be kept to a minimum. Cables passing through the roof assembly should not travel horizontally within a roof system, such as directly under the roof membrane or in a notched-out section of the insulation.
2. Penetrations of electrical conduit into the building should be properly flashed to the roof system. Electrical conduit passing through a roof assembly should be run inside a sheet- metal enclosure with roof curbs [e.g., doghouse]. A gooseneck-type penetration detail can be used where a cable needs to pass

through a roof assembly and be flashed.

3. Penetration pockets (pitch pockets or pitch pans) are acceptable as a last alternative for flashing PV system electrical connections passing through a roof assembly. TOPCOAT® FlexSeal Caulk Grade Sealant should be used as the top fill material for pitch pockets.

Pre-Job Conference

A pre-job meeting should be held with the building owner, designer, PV system manufacturer, roof system manufacturer, general contractor, electrical contractor, roofing contractor, and any others whose work may have an effect on successful project completion. The PV system designer's specifications/plans and flashing details should be reviewed during the pre- job meeting. The following items should also be discussed at the pre-job conference:

1. Establish construction schedules and work methods that will prevent damage to the PV system flashing and the roof system.
2. Establish procedures for reporting and repairing any damage to flashings or any part of the roof system.
3. Designate access, staging, work, storage, and disposal areas.
4. Establish suitable weather conditions and working temperature criteria to which all parties agree.
5. Establish safety regulations/requirements and good roofing practices.

Codes, Standards & Guidelines

Below is a list of references to codes, standards, and guidelines relevant to installation of a solar PV system on a roof. The local Authority Having Jurisdiction (AHJ) should be consulted to determine the specific requirements for code compliance of the solar PV system.

Part	Agency	Code	Description
Fire Rating	UL	1703	Fire rating tests for PV
	ICC	IBC	Fire Classification of PV
	ICC	IEC	PV Module Safety
	ASTM	E44.44	PV System Fire Safety

	US/ASTM	709/E108	Standard test methods for fire tests of roof coverings
Installation	NECA	412 (201x)	Standard for installing & Maintaining PV systems
	ICC	IFC	PV systems code permit requirements
Module Mounting/Framing	ICC-ES	AC428	Acceptance Criteria for Modular Framing systems used to support PV Modules
	ICC-EC	AC286	Acceptance Criteria for roof flashing for pipe penetrations
	SMACNA	-	Sheet Metal Manual (For PV standoff/pipe penetration)
Design, Installation & Commissioning Best Practices	NRCA	-	Guidelines for Roof systems with Rooftop PV Components
	ICC	IFC	Solar PV power systems
	NRCA	-	Membrane Roof Systems
	NRCA	-	Metal Panel & SPF Roof systems
	NECA	412	Standard for installing PV Power systems
Roof	ASCE	7-02	Minimum Design loads for buildings (Snow & Wind)
	ICC	IBC	Wind Resistance - Rooftop PV
	ANSI/SPRI	RP-4	Wind Design Standard for Ballasted Ply (Applicable to Ballasted PV)
	UL	1897	Uplift Tests for Roof Covering Systems (Applicable to BIPV)