

## Rooftop Photovoltaics Position

Increasingly, roofs are being used as more than the waterproofing element of the building envelope. The push toward green and sustainable building practices has led design professionals to look at roofs as opportune space for renewable energy sources such as photovoltaics (PV). While PV systems can offer benefits to both the environment and the building owner, their potential negative impact on roof membrane performance must be considered.

So what is it about PV systems that presents a challenge to low-slope membranes so significant that membrane performance could be compromised? The real issue is the increased heat load imposed on roof membranes by some PV systems.

The ultimate failure mode of most roof membrane types is chemical breakdown caused by heat combined with oxygen, whether the failure occurs with the membrane itself or the bonding adhesives used to seam the membrane. It is understood that high membrane temperatures accelerate the aging process. Scientifically, this fact is supported using the Arrhenius Equation. Aging studies comparing thermoplastic roof membranes taken from the field to thermoplastic roof membrane samples aged in a laboratory have affirmed the relevance of that equation; that is, the aging (reaction) rate of the membrane doubles with each temperature increase of 18°F (10°C).

Generally speaking, increased heat load and life expectancy of roof membranes are inversely proportional, and at elevated temperatures all commercial roof membrane systems will feel the effect of accelerated aging. The decision to add anything to the roof system that elevates the temperature should be approached carefully – this includes PV systems.

There are several suppliers and designs of roof-mounted PV systems, but there are two basic varieties: building-integrated photovoltaics (BIPV) and rack-mounted PV. BIPV systems are flexible and are typically adhered directly to the roof membrane via a self-stick backing. Rack-mounted PV systems are rigid panel systems that are mounted on mechanical supports so that the panels do not make direct contact with the roof membrane surface. The virtues and efficiency of one PV system versus another with regard to electricity generation can be debated. But from a roof design perspective, BIPV systems present considerably larger challenges for roof membranes than rack-mounted systems.

Certainly, BIPV systems are relatively quick and easy to install as compared to most rack-mounted systems. But because of the intimate contact with the roof surface, the higher than normal heat gain developed by the BIPV panels is rapidly transferred into the roof membrane. The increased heat load can be significant – BIPV panels have dark surfaces designed to capture the sun’s energy. In the southern United States and in high altitude regions, panel temperatures can exceed 200°F on sunny days.

Properly formulated and fabricated roof membrane materials are designed to withstand normal rooftop heat. But because they transfer higher than normal heat load into the roof membrane, BIPV systems potentially reduce the roof membrane’s designed service life.

Rack-mounted PV systems feature rigid raised panels or PV tubes that are attached to supports that rest atop or penetrate the roof membrane. Of course, the additional penetrations or increased foot traffic required by some rack-mounted systems can easily be addressed. With rack-mounted systems, whether they incorporate raised panels or tubes, the roof membrane is not subjected to any additional heat load. In fact, the shading effect of the raised panels may provide some benefit by reducing the heat history of the membrane over its service life.

An additional consideration sure to be of interest to any building owner is the service life of the proposed PV system compared to that of the roof membrane. Shortening the service life of the roof membrane by compromising it with a BIPV system could result in premature removal and reinstallation of the BIPV system at the time of reroofing. It is stated in the National Roofing Contractors Association (NRCA) **Guidelines for Roof-Mounted Photovoltaic System Installations**, “NRCA encourages designers and installers of roof-mounted PV systems to give proper consideration of a roof system’s primary function (providing long-term weather protection) when executing a roof-mounted PV system installation.”

The technology exists for rooftop PV electricity generation and proven long-lasting roof systems to harmoniously coexist. Why risk installing unproven systems that may result in unintended consequences?