To The Point
Photovoltaic Solar Renewable Energy Systems

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Photovoltaic (PV) system installations continue to grow exponentially. The growth of PV systems is credited to the readily available energy source, the reduction of dependence on fossil fuels, and the drive to use more sustainable energy sources. In addition, the cost to produce PV systems continues to decrease. In 2030, Solar Energy Industries Association predicted that PV is expected to account for 13% of all energy production worldwide and up to 20% in the US alone. Long term projections to 2050 estimate 19000 GW of solar power. Large PV utility sized installations are being constructed with the largest 2050Mw installation in India. Even smaller residential installations are expected to grow by 3x in the next five years in the United States. Solar power will be an important power producer in the future.

PV systems can generate electricity in geographies that are not consistently sunny. Germany for example, is a global solar PV leader, yet the country's annual sunlight profile is similar to Alaska. PV solar installations are a hallmark for creating distributed, micro-grid energy generation. Distributed generation will become a crucial facet for modernizing the world's electric grid, by creating bi-directional "smart grids" that do not solely rely on traditional power generating plants such as coal, natural gas and nuclear energy. One vision of the smart grid is for the PV owner/user to consume the system's own electricity and sell surplus energy back to the grid.

Many things need to be considered before installing a PV system: the size of the installation, engineering studies, permits, inspections, fire department involvement, standards and specifications. Before moving forward, a risk assessment should be performed. Elements of this risk assessment should include the following:

System Owner Goals
For example, some goals may be to generate onsite electricity or obtain a 'green building' certification. There may also be government incentives and revenue-generating reasons for installing a PV system. Many states in the U.S. have 'Renewable Portfolio Standards' (RPS) that pledge a goal for having a percentage of energy come from renewable sources by a specified future date. Other parts of the world use alternate funding mechanisms such as 'Feed-in-Tariffs' to achieve these goals. It is important to know what financial incentives are available locally.

Mounting Type

- PV systems have minimal moving parts and can be installed on the ground or roof tops.
  - **Ground mounted systems** tend to have a larger geographic footprint. However, some very large warehouse type occupancies and "big box" retail stores provide ample area to install a large commercial-scale PV system. Ground-mounted systems tend to be easier to maintain, but pose concerns including site security/theft prevention and damage from rodents. Natural catastrophes such as earthquakes, hail, high winds, flood and heavy snow falls present significant exposures to ground mounted systems. These exposures should be thoroughly evaluated as part of the risk assessment process.
  - **Roof mounted systems** have their own nuances to be addressed. Can the roof sustain the weight of the PV system's retrofit, as well as added dead loads such as snow, ice, and water? Can the roof sustain the effects of wind when the wind comes in contact with the panels? What is the age and condition of the current roof? With the expectation that panels will be mounted in excess of 20 years, what happens when the roof requires replacement mid-way through the panel's effective lifetime? Formal engineering studies must be performed before construction ever begins.

Building Attributes that Increase Risk Profile

- Underlying occupancy and combustible roof insulation are a few examples of building attributes that can increase the risk profile of the project.

Selecting a Responsible Contractor

- To ensure success, a reputable contractor with a proven track record is required. Installation variability can introduce reliability issues over the PV system's lifetime and require a greater degree of vigilance from an operations and maintenance perspective.

Selecting a Commissioning Firm

- It is best to use an independent commissioning firm that will work for the project owner, rather than the installation contractor. The commissioning agent is crucial in making sure that the PV system will perform as intended and is installed per the "Owner's Project Requirements" (OPR) and "Basis of Design" (BOD). The commissioning process should cover the entire process: planning, design, construction, and operation.

Maintenance and Repairs

- If a third party PV solar owner—the Independent Power Provider (IPP)—is responsible, the contract should clearly stipulate responsibilities for system inspection, maintenance, and repair as well as outline insurance limits and indemnification provisions. If the PV system will be owned directly by the building/asset owner, formal operations and maintenance contracts should include Service Level Agreements (SLA). Additionally, certificates of insurance should be obtained for both general liability and workers compensation prior to allowing the contractor on site. The appropriate limits of insurance should be discussed with your agent/broker and legal counsel.

Remote Monitoring

- Operations and maintenance activities must include the ability to remotely monitor the PV system at the component level (inverters, combiner boxes, strings and panels) to monitor operational parameters and send an alert for system components and functional measurements that are out of specification. Systems should be inspected on a periodic basis to ensure proper operation of both AC and DC components. This would include visual inspection, infrared scans of electrical components including the modules, and critical electrical tests. Having a robust Measurement and Verification system is crucial for identifying issues before they create significant problems.

Mitigate PV-System Induced Fire

- Arc faults, ground faults, and "islanding" protection issues need to be addressed for PV solar installations. Fires can occur when the system is not properly tied into the electrical grid or electrical faults occurs within the PV array. Certain faults can cause a high intensity arc that can ignite combustible roofing materials. Therefore, it is important to follow industry standards such as UL 1741, IEE 1547, UL 1699B, NEC 690 and Sandia National Laboratory.

Firefighter Pre-Planning

- Firefighter pre-department planning and facility business contingency are crucial when considering a PV installation. PV solar panels create electricity when exposed to light. Because they present a viable shock hazard and are always on, fire departments may be unwilling to aggressively fight a fire by accessing the roof and ventilating it. Therefore it is important to work with the fire department's commanders to discuss fire fighting options and create a plan that will allow for the best fire fighting outcomes.
- Some Authorities Having Jurisdiction (AHJ) require certain areas of a roof off-limits to installing solar panels, so that access and ventilation may be performed. If the fire department already established a conservative approach to fight a fire from a distance, this must be taken into account before advancing the project.

The overall trend is clear. The road toward renewable energy via PV arrays must be navigated with caution and a keen focus on arriving safely.

References

NFPA 1 Fire Code

NFPA 70 National Electric Code, Articles 690 and 691 Solar PV Systems

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