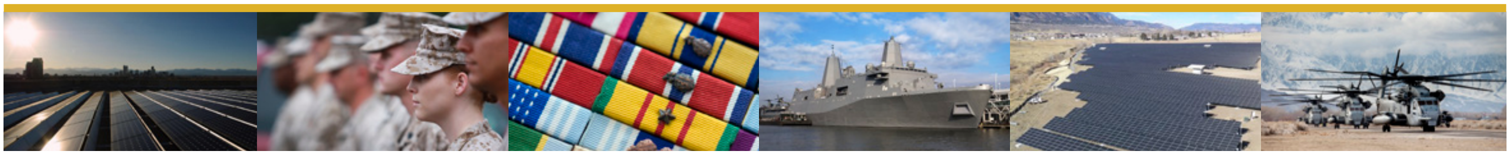

Electro-Magnetic Interference from Solar Photovoltaic Arrays

While the risk of electro-magnetic and/or radar interference from PV systems is very low, it does merit evaluation, if only to improve the confidence of site owners and other stakeholders.

Electro-Magnetic Interference

Electro-magnetic interference (EMI) is typically taken to mean radiofrequency (RF) emissions emanating from PV systems impacting nearby radio receivers, but can also include interference with communication devices, navigational aids, and explosives triggers.

The Federal Aviation Admiration (FAA) has indicated that EMI from PV installations is low risk. PV systems equipment such as step-up transformers and electrical cables are not sources of electromagnetic interference because of their low-frequency (60 Hz) of operation and PV panels themselves do not emit EMI. The only component of a PV array that may be capable of emitting EMI is the inverter. Inverters, however, produce extremely low frequency EMI similar to electrical appliances and at a distance of 150 feet from the inverters the EM field is at or below background levels. Also proper inverter enclosure grounding, filtering, and circuit layout further reduce EM radiation.

Photovoltaic inverters are inherently low-frequency devices that are not prone to radiating EMI. No interference is expected above 1 MHz because of the inverters' low-frequency operation. In addition, interaction at lower frequencies (100 kHz to1 MHz) is also very low risk because of the poor coupling of these extremely long wavelengths to free space, limiting propagation of the signal.

Additionally, the Code of Federal Regulations, Title 47, Part 15 regulates radio frequency (RF) emission from commercial products and many PV inverter manufacturers do qualify their residential or utility-scale equipment to this standard.

Radar Interference

Another concern is blocking or attenuation of nearby radar by the PV array, which are similar to other non-transmitting built structure like building or sheds in that they are constructed of metal and glass.

PV arrays have low profiles (i.e. height) relative to most built structures that may be found on or around airfields and in general airport radar systems (e.g., airport surveillance radar) are installed on elevated platforms or towers. The FAA has published a number of case studies that indicate that a setback of 250' to 500' between the leading edges of a PV array and existing radar equipment is sufficient to prevent blocking and/or signal reflection issues.

Siting Considerations

When considering sites for a PV array in close proximity to airfield navigational instruments or communications the tolerance of the equipment to EMI and susceptibility to radar signal blocking/attenuation should be considered. Fortunately, both of these concerns have been researched and vetted by the FAA and industry, and the following specifications should be applied:

1. PV system inverters should be sited at least 150' away from navigational and communications equipment that may be sensitive to EMI.
2. A minimum setback distance of 250' should be imposed between an airfields radar system and the leading edge of a PV array or any of its ancillary support equipment.

In the unlikely event that a PV array was to be built within the EMI setback distance, options are available to address interference if it were to occur. Inductor-capacitor (LC) filters can be installed to attenuate RF emissions at specific frequencies causing undesired interaction. Grounding of PV conductors either directly or via the inverter can also attenuate undesired RF emissions.

Additional Considerations

Where the FAA has identified interactions between PV systems and aircraft communication, this was often due to the prototype nature of the PV equipment in question. Some power electronics equipment operates at a higher frequency than we have discussed so far. This can be because the inverter uses advanced wide-bandgap semiconductors such as Silicon Carbide (SiC) or Gallium Nitride (GaN). Alternatively, the power electronics could be embedded within the PV module, which can enable or require a high switching frequency. In either case, these types of power conversion devices should be assessed for compliance with FCC emission limits, just as a conventional PV inverter would be.

As an illustration of the relative low allowable FCC limits, we can compare the maximum emission allowed for a FCC class-A compliant inverter with a typical cell phone. The maximum expected field strength for this inverter at a distance of 100′ is very low- comparable to the field strength of a cell phone a mile away, and unlikely to be distinguishable from background noise.

In conclusion, with diligent procurement and siting of PV system components, including specifications for FCC Part 15 compliant equipment and observation of minimum setbacks from potentially sensitive equipment, it is unlikely that a PV system will cause negative interactions with existing equipment or operations.

> "Due to their low profiles, solar PV systems typically represent little risk of interfering with radar transmissions. In addition, solar panels do not emit electromagnetic waves over distances that could interfere with radar signal transmissions, and any electrical facilities that do carry concentrated current are buried beneath the ground and away from any signal transmission." - FAA Solar Guide.
>
> "Prior research and field investigations of electromagnetic emission (EME) from Solar PV arrays concluded that they produce extremely low frequency EME similar to electrical appliances and wiring.…At a distance of 150 feet from the inverters, these fields dropped back to very low levels of 0.5 mG or less, and in many cases to much less than background levels (<0.2 mG)." - Air Force Tiger Team investigation.

Useful References

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