Information Regarding EMFs from Solar Power Generation

The information below was obtained from the Department of Energy and Mineral Engineering, College of Earth and Mineral Sciences at Penn State University.

The following are some questions raised at recent school board meetings:

1. Do solar panels and inverters emit electromagnetic fields?
2. Is there a way to reduce EMF exposure from the solar array?
3. What is the difference between non-ionizing and ionizing radiation, and does solar power generation involve either type?

The EMF question somehow comes up often in public discussions of solar, although there is very little ground for concern as a matter of fact. Research studies have been conducted to provide data to the public, and here are a few things that can be noted:

• The electromagnetic fields associated with the solar panels, inverters, and transformers are similar to those we can expect from any household electronics.

• Frequencies emitted by the electronic equipment on solar farms were measured in the range 5—100kHz [Tell et all., 2015], which are in the range of radiofrequency. EMF in this frequency range is not considered harmful. (For reference, cell phone frequency is much higher (~700,000 kHz, high-end radiofrequency), and the frequency of 'ionizing' radiation (this type would be harmful) is 10,000,000,000,000 kHz and above by comparison).

• Field EMF measurements: 0.07—1.33 V/m in front of the PV panel, 0.70 V/m in front of the inverter [Bedeloglu et al.,2021], are way below the maximum permissible exposure levels - 614 V/m - according to standards of The Institute of Electrical and Electronics Engineers [IEEE, 2002; IEEE, 2006]

• The EMF strength will quickly fade with distance from the source according to the inverse square law.

Based on the above, solar equipment is considered fully IEEE-compliant as the EMF associated with it is rather weak and does not pose any tangible risk to public.

To more explicitly answer your questions:

1. EMF is indeed present around operational solar equipment (such as panels, inverters, and transformers), but it is no different than that of any other electronics that have around.

2. Considering the low levels of EMF issued, there is no need for any costly measures to especially reduce it. The simplest way is to put some distance between the person exposed and

the source of EMF. For example, if you move away from the transformer 5 times the distance, and the EMF will decrease 25 times (according to the inverse square law). Some fencing will probably take care of that and will also keep random visitors from getting into the transformer and being shocked :)

3. "Ionizing" radiation is an arbitrary term to define the range of the electromagnetic spectrum with high energy waves that are able to break cell membranes and thus cause damage. It is called "ionizing" because those high-energy photons can rip electrons from the atoms making them "ions". The ionizing radiation includes gamma rays, x-rays, and part of ultraviolet. Those are very high frequency types of waves (order of 10^{18}-10^{20} Hz). Solar system equipment is nowhere near that. In fact, you can catch more ionizing radiation from the regular sunlight, but fortunately our atmosphere blocks most of extraterrestrial ionizing flux. All other radiation around us (visible light, infrared, radio waves, etc.) is "non-ionizing."

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Cited sources:

Bedeloğlu, M., et al., Measurement and Analysis if Electric and Magnetic Field Strength in Grid-Tied Photovoltaic Power System Components, *Radiation Protection Dosimetry*, Volume 194, Issue 1, March 2021, Pages 57–64.

Tell., R.A. et al., Electromagnetic Fields Associated with Commercial Solar Photovoltaic Electric Power Generating Facilities, *Journal of Occupational and Environmental Hygiene*, Volume 12, 2015 - Issue 11, Pages 795-803.

IEEE, 2002 - IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz, IEEE Standards Coordinating Committee 28 IEEE International Committee on Electromagnetic Safety on Non-Ionizing Radiation, 23 October 2002.

IEEE, 2006 - IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE International Committee on Electromagnetic Safety, 19 April 2006.