

How many monitoring stations for utility-scale PV power plants?

IEC 61724-1:2021 suggests a low number of stations. Interviews with worldwide Hukx users reveal a different story.

The IEC 61724-1:2021 standard offers guidance on the number of performance monitoring stations at utility-scale PV plants. To see how this compares with actual practices, Hukx interviewed users in the EU, USA, and India and compared their approaches to the IEC recommendations. The findings are clear: all interviewed PV operators install many more stations than the standard prescribes, which reflects the current need for more detailed performance monitoring. Typically, three Class A monitoring systems are installed for plants from 20 MW up to 50MW. For capacities exceeding 50MW, one additional system is required for every additional 30MW or part thereof.

Introduction

IEC 61724-1:2021 *Photovoltaic system performance monitoring—Guidelines for measurement, data exchange and analysis* provides recommendations for the number of monitoring stations at a PV power plant. See the IEC recommendations below in Table 1 and Hukx's observations of common practices in Table 2.

For all investigated regions, Hukx found many more stations at PV power plants than IEC recommends.

In some cases, Class A and Class B monitoring systems are mixed. For these installations, Class B systems contain only the most important sensors: GHI, POA, and PV module temperature.



Figure 1 Two SR300 Class A pyranometers measuring GHI (Global Horizontal Irradiance) and POA (Plane of Array) in a PV performance monitoring system. How many of these systems should there be on a power plant?

Table 1 How many monitoring systems per PV power plant? Copied from IEC 61724-1:2021 Table 3. The number suggested by IEC is not a requirement but “guidance” (IEC 61724-1 Clause 7). Although not specifically mentioned in IEC 61724-1, the suggested numbers are generally understood to be a minimum.

PV system size (AC)	number of stations suggested by IEC	comment Hukx
[MW]	[#]	
<40	2	
40 to 100	3	
≥ 100	4 + 1 / every additional 200 MW	The number of + 1 / 200 MW is considered significantly too low (by at least a factor of 4). See Table 2 for common practices.

Table 2 What number of monitoring stations to use? Common practices at utility-scale solar power plants, as observed by Hukx (continued on next page).

PV system size (AC)	number of stations	common practices and considerations, as observed by Hukx
[MW]	[#]	
all	+ 1 / offtaker	In case of a large power plant with multiple offtakers (i.e., buyers of electricity): at least 1 station per offtaker for confidentiality of data
	+ 1 / VPP source	In case of a large power plant consisting of smaller sources grouped together (forming a VPP or Virtual Power Plant): at least 1 station per smaller source
	+ 1 / terrain type	The terrain may require more systems to attain good representativeness, for example when including installation on slopes rather than a flat surface.
all	+ mixing Class A and Class B systems	Formally, once the IEC-prescribed minimum number of Class A systems is met, Class B or “secondary systems” may be added to Class A systems to reduce costs. IEC 61724-1 Class B systems carry a limited set of sensors only, measuring at least POA, GHI, and panel temperature. In such cases, Hukx observed that the Class B systems are equipped with sensors for GHI, POA, and panel temperature that are identical to those used in the Class A systems for standardization.

all	+ soiling systems	All monitoring systems contain a soiling sensor. However, in case non-uniform soiling is expected over the power plant, add separate systems that are only equipped with soiling measurements.
all	+ albedo / rear-side irradiance	In case of bifacial panels, rear-side irradiance should either be measured directly or estimated by albedo measurements combined with an optical model. Rear-side irradiance or albedo is typically measured at every station; however, at least 1 station / 50 MW.
all	+ diffuse irradiance	The optional diffuse measurement is often seen when single-axis trackers or bifacial panels are used, typically at least 1 station / 50 MW.
>10 MW	minimum number: 2	Users deploy Class A systems above 10 MW.
20 to 40/50 MW	minimum number: 3	Above 20 MW, Class A systems are commonly required as part of asset management. Many—but not all—users prefer a minimum of 3 systems because this guarantees: <ul style="list-style-type: none"> - spatial coverage - redundancy of data (possibility for cross checks) - redundancy in case of system malfunction - redundancy in case sensors are sent away for recalibration
> 40/50 MW	+ additional systems Simple rules of thumb that we see used in practice as the starting point for design:	Interview results: <ul style="list-style-type: none"> - minimum 3 Class A, above 40 MW + 1 / 20 MW or part thereof, all Class A - minimum 3 Class A, above 40 MW + 1 / 40 MW or part thereof, all Class A - minimum 3 Class A, above 50 MW + 1 / 50 MW or part thereof, all Class A - minimum 2 Class A, above 50 MW + 2 / 50 MW or part thereof, all Class A - minimum 3 Class A, above 50 MW + 2 / 50 MW or part thereof, (1 Class A + 1 Class B) - minimum 2 Class A, above 60 MW + 1 / 30 MW or part thereof, all Class A

Why is the IEC 61724-1 recommendation too low?

The recommendation strongly underestimates the number of necessary stations because it only assumes one additional monitoring system for every 200 MW of added capacity. This capacity roughly corresponds to an area of 2 km², which is far too large to be captured by a single station.

Where can I order the standard?

The standard can be purchased from the IEC Webshop.

Latest news: suggested text for 2025 revision of IEC 61724-1

Proposed text for a newly revised IEC 61724-1 is:

The minimum number of stations to comply with IEC 61624 Class A monitoring is:

- three Class A monitoring systems for capacities up to 50 MW.
- one additional system for each additional 30 MW capacity or part thereof.

Install more stations than the minimum number if:

- local conditions do not allow accurate performance measurement with the minimum recommended number. Such conditions may be different module orientations caused by the terrain or a fragmented layout over a larger-than-usual area.

About Hukx

Hukx is the leading innovator in solar radiation and heat flux sensor technology. We are proud to set the standard in high-accuracy measurement, and to be working at the heart of the energy transition.

Customers worldwide rely on our bestselling pyranometers and heat flux sensors. From sensor design and selection to supply and recalibration, we support you across the entire lifecycle.

Hukx is headquartered in the Netherlands, with locally owned representative sales offices in the USA, Brazil, India, China, Southeast Asia, and Japan.

Let us help you select the best sensor for your application. Get in touch with our experts today via: info@hukx.com

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