DustIQ now has on-site calibration

If you search the internet for 'soiling of PV modules' you find more than half a million webpages and over 6,000 scientific papers on the subject! Countless hours have been spent researching this challenge for solar energy technologies. The locations on our planet that seem perfect for generating energy from the Sun, are often also locations where soiling is the biggest threat to reaching the contracted performance ratio.

The growing awareness of light transmission (and generated power) loss of PV modules due to soiling is stimulating scientific research and innovative developments to deal with the impact, such as anti-soiling glass coatings and more effective cleaning solutions. Kipp & Zonen's recent product developments, RaZON+, AirShield DNI for pyrheliometers and the RT1 rooftop monitoring system, are all designed to be soiling resistant or preventive. But the newest development is of course our DustIQ soiling monitoring system.

The measurement principle

DustIQ uses Kipp & Zonen's Optical Soiling Measurement (OSM) technology. A pulsed blue LED flashes light onto the glass cover from below and some of the light is reflected back inside by the soiling on top of the glass, which is measured by a photodiode. There is a linear relationship between the amount of soiling, LED light reflected and the loss of sunlight transmitted through the glass. From this the soiling ratio (SR) can be calculated.

DustIQ has unique features. No outside light source is needed, so it works day and night. The two sensors are not for a clean-dirty comparison, but to have two independent spot measurements to compare and use. DustIQ does not need to have a clean surface, it gets dirty at the same rate as the PV panels around it and you just clean it when they are cleaned. No additional maintenance is needed.

Where to position DustIQ

Installation is simple, using mounting clips to mount onto standard PV modules or to incorporate into arrays. Also, DustIQ is much lower cost than previous soiling monitoring systems, so it can be affordably installed at multiple locations and heights to provide a soiling map of a solar park.

According to the IEC61724-1:2017 standard for photovoltaic system performance monitoring, a PV plant should have as many soiling monitors as there are pyranometers for irradiance. However, soiling is a rather different phenomenon to radiation, and is also very site-specific. Where you normally expect the same average global horizontal irradiation (GHI) value for all the pyranometers across a solar plant over a day, this is not necessarily true for soiling. If the wind always blows from the East, one would expect more soiling (and thus a different cleaning interval policy) at the Eastern side of that plant. When the wind direction changes over seasons, this pattern could shift during the year.

We would recommend installing several units on a larger plant. For example, with 25 MW one DustIQ in the middle and one near each corner would be a logical choice to understand the soiling distribution. Of course, every additional DustIQ adds up to more detailed measurements to inform decisions on where and when to clean the plant.

Local dust calibration

A major recent enhancement is the addition of a small PV cell that is used for local dust calibration (LDC). The standard factory calibration is for Arizona Test Dust but, using a simple procedure, DustIQ can be site-calibrated for the local dust composition and the effect of it on the sunlight transmission loss.

A clean DustIQ is installed and left to get dirty until it reports at least 10% transmission loss. The 15 minute calibration procedure can then be carried out. It needs to be performed only once and no tools or software are needed, just pressing a button. The only requirement is a clear sky during a 4 hour window around solar noon.

The process is a step-by- step cleaning of the two sensors and the PV cell to create several step changes in measured signals that the DustIQ can interpret and correlate to transmission loss.

Ongoing field tests

A substantial part of the research and development testing was made indoors, in climate and dust chambers, but also outside at our facilities in Delft. However, our local environment in the Netherlands has a lot of rain and not a lot of dust in the air; leaving little to measure for the latest model DustIQ with the integrated PV cell for local calibration. Therefore, DustIQ's have been installed in several locations around the world to give serious exposure to different types of soiling.

One of the locations is the large research, development and test centre PSA (Plataforma Solar de Almeria) in the south of Spain, where CIEMAT and DLR evaluate concentrating solar power technologies. A great location for DustIQ because there are several other soiling measurement technologies installed on site such as the TraCS system that uses two CHP1 pyrheliometers and a dust collection mirror on a SOLYS2 sun tracker.

Morocco is well on its way to capitalising on the energy source of the sun and it is also a geographical area that has a lot of dust. We are happy to have added Green Energy Park as a test location for DustIQ. It is situated in Ben Guerir, about an hours' drive from Marrakech and has an arid environment where there is a lot of dust; especially in spring, summer and early autumn.

Keep an eye out for publications on the measurements, comparisons and conclusions from these and other DustIQ test sites ■


DustIQ