NREL simulates shade conditions in repeatable test for solar arrays

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The DOE's National Renewable Energy Laboratory (NREL) has released a new repeatable test protocol that simulates real shade conditions and can predict with much greater precision the effects of shade on a solar array.

The new test demonstrated that under heavy shading conditions the use of microinverters instead of typical string inverters can help mitigate the impacts of shade by improving system performance by more than 12 percent.

“Photovoltaic (PV) Shading Testbed for Module-level Power Electronics” was co-authored by NREL senior engineers Chris Deline and Jenya Meydbray, as well as Jason Forrest and Matt Donovan of PV Evolution Labs of Davis, Calif. The research was paid for by DOE.

Shade significantly impacts photovoltaic performance, and is considered in PV system design. The effects of shade can vary depending on the configuration of the PV modules, the extent of the shade, and the use of shade mitigating power electronics in the system. The industry currently lacks representative, repeatable test procedures for evaluating the annual effect of shade on different PV systems equipped with different shade mitigation devices.

The new report details a repeatable test procedure for simulating shaded operation of a PV system and an analysis model for converting these measurements into annual performance forecasts.

Shade measurements from more than 60 residential installations provide the basis for the shading conditions employed during the test, which are analyzed for three typical shade scenarios: “light”, “moderate”, and “heavy” shading. The relative performance of a system using shade mitigation devices is compared against an identical system equipped with a reference string inverter for these three shade scenarios, providing an annual performance improvement score.

Combined with additional derates like annual shade loss and inverter CEC efficiency, this annual shade improvement score can allow performance modeling software such as PV Watts rredc.nrel.gov/solar/calculato … S/version1/ and System Advisor Model sam.nrel.gov/ to better predict annual performance for PV systems that use shade mitigating power electronics. It also allows an accurate comparison between different devices.

An initial application of the test protocol was conducted by PV Evolution Labs, showing the shaded performance benefit of microinverters compared with a typical string inverter on identical 8-kW solar arrays. The microinverter was found to increase system production by 3.7 percent under light shading, 7.8 percent under moderate shading, and 12.3 percent under heavy shading, relative to the reference string inverter case. Additional detail is provided in the report to allow duplication of the test method for different power electronics devices and test installations.

Standard test methodologies using applicable test conditions should provide value to the PV community, since products can be compared by a common metric and accurate information can be collected about devices’ annual performance benefit.

This is a major step in establishing new and realistic testing standards for

PV power electronics," said David Briggs of Enphase Energy, a microinverter manufacturer.

More information: To download the study, go to www.nrel.gov/docs/fy12osti/54876.pdf . DOE funded NREL's participation in the study. Enphase Energy paid PV Evolution Labs to run the experiment.

Provided by National Renewable Energy Laboratory