Accurately Measuring PV Soiling Losses Using Module Power Measurements

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Non-uniform PV soiling can’t be measured by short-circuit current alone.¹

Non-Uniform PV Soiling

- In some conditions, soiling may accumulate non-uniformly on PV modules
- Wind, rain, condensation, temperature, and gravity all affect soiling distribution
- Often, soiling is concentrated at module edges

Example of edge soiling on utility-scale tracking system:

Examples on ground and roof-mount systems:

Pmax vs. Isc as Soiling Metric

- “Soiling Ratio” (SR) metric can be based on losses in measured current (Isc) or power (Pmax)
- Isc measurement simpler, but only approximates true power loss in case of uniform soiling
- Experiment shows Isc measurements can severely over- or under-estimate true power loss for non-uniform soiling on c-Si PV modules

Experiment with Simulated Soiling

Soiling Ratio Metrics

\[
\text{SR}^{\text{Isc}} = \frac{\text{Measured Isc Soiled}}{\text{Predicted Isc Clean}}
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\[
\text{SR}^{\text{Pmax}} = \frac{\text{Measured Pmax Soiled}}{\text{Predicted Pmax Clean}}
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**Irradiance- and temperature-corrected

Results

Soiled Reference Module

Soiling Measurement System

- Soiling measurement: use “soiled” module and “clean” control
- “Clean” control: may use automatically cleaned reference cell
- For “soiled module” use actual PV module representative of site, to capture module-specific effects and non-uniformities
- Should measure both module current and power

This poster contains no confidential information.¹