

# PV RESILIENCE: ADDRESSING WEATHER VULNERABILITIES

Step-by-step guidance to conducting a field audit to identify vulnerabilities and actions that can be taken to address them

## PV PERFORMANCE

How have PV Systems performed over time?

### PV IS RELIABLE

IN AN ANALYSIS OF 100,000 PV SYSTEMS, 80% TO 90% PERFORMED WITHIN 10% OF PREDICTED PRODUCTION OR BETTER<sup>1</sup>

## IMPACT OF 2017 HURRICANE SEASON

What was the major vulnerability found across PV arrays in Region 2?

**BERKELEY LAB AND NATIONAL RENEWABLE ENERGY LABORATORY** assessed the impact of the 2017 hurricane season on 5 PV arrays in the Caribbean



### INADEQUATE FASTENERS FOUND ACROSS ALL SITES

SMALL UP-FRONT INVESTMENT IN LOCKING HARDWARE, CLAMPS, AND THROUGH-BOLTING CAN HELP PROTECT PV ARRAYS<sup>2</sup>

## DEVELOPING GUIDANCE

Addressing weather vulnerabilities

**BERKELEY LAB** worked with the Federal Energy Management Program (FEMP) to identify additional weather vulnerability risks

**RISK ASSESSMENTS**  
FOR SAFETY, PERFORMANCE AND FINANCIAL<sup>3</sup>

**27 CORRECTIVE ACTIONS**  
MANY ARE LOW COST<sup>4</sup>

**CONSULT QUALIFIED ENGINEERS**  
TO INTEGRATE BEST PRACTICES<sup>5</sup>

## KEY VULNERABILTIES AND POTENTIAL SOLUTIONS

What are the key vulnerabilities that lab researchers identified?

Structural vulnerabilities	Electrical vulnerabilities	Site vulnerabilities
<b>Top down clamps loosening or bending</b> To correct: Use through-bolting or top-down clamps with improved features <sup>6</sup>	<b>Improper wire management</b> To correct: Protect wires from weather, support every 12 inches with clamps, clips or ties <sup>8</sup>	<b>Unobstructed wind forces</b> To correct: Use a wind calming fence to reduce wind forces on the PV system <sup>10</sup>
<b>Inadequate structural attachments to building in roof arrays</b> To correct: Add mechanical attachments to improve structural integrity <sup>7</sup>	<b>Inadequate electrical enclosures</b> To correct: Use proper NEMA-rated enclosures based on the site’s environmental conditions <sup>9</sup>	<b>Loose debris and equipment</b> To correct: Secure or remove loose equipment and debris from the area around the PV system <sup>11</sup>

Structural vulnerabilities exhibit the greatest safety, performance and financial risks. Wind is the most damaging weather factor and also the most complex to understand and plan for.

<sup>1</sup>Jordan, DC, Marion, B, Deline, C, Barnes, T, Bolinger, M. PV field reliability status—Analysis of 100 000 solar systems. Prog Photovolt Res Appl. 2020; 28: 739–754 <sup>2</sup>Solar Array Inspection, Failure Analysis, Specifications and Repair Scopes of Work, Caribbean Region. Gerald Robinson (LBNL), Andy Walker and Ran Fu (NREL) April 2018, p.9 <sup>3</sup>Federal Solar Photovoltaic Arrays, Gerald Robinson (LBNL) December 2020, p.6 <sup>4</sup>Ibid, p.14 <sup>5</sup>Ibid, p.8 <sup>6</sup>Ibid, p.19 <sup>7</sup>Ibid, p.32 <sup>8</sup>Ibid, p.39 <sup>9</sup>Ibid, p.50 <sup>10</sup>Ibid, p.55 <sup>11</sup>Ibid, p.58

