PV High Wind User Test Facility

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WE WANT YOUR INPUT!

The Challenge

Wind loading, such as that experienced during hurricanes Irma and Maria, has caused catastrophic damage to solar fields. This significantly reduces the potential value of solar as a resilient power solution. In many locations, there is a need and demand for stronger PV systems.

Photo from Above Photography

Photo from Andy Walker, NREL

Impact

There can be a tendency to race to the bottom cutting capital costs, devaluing robust design features and technologies. This project seeks to enable testing of various designs for PV systems in high wind or storm prone regions, with the goal of helping industry identify effective ways of hardening PV arrays in the face of high wind loads and protecting solar modules exposed to extreme or repetitive stresses. There is some indication that cost-effective, storm hardened design elements exist that could benefit from further evaluation and validation.

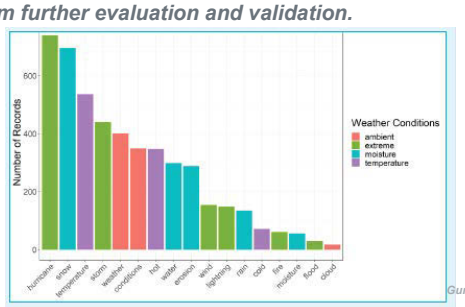

Figure from Gunda, T., 2019

The PVROM database documents common words featured in PV O&M tickets. The figure above shows that 'hurricane',' 'storm,' and 'wind' are the most common extreme weather events causing damage to the PV systems included in this analysis. The figure below shows that hurricanes were the top source of PV insurance claims, as well.

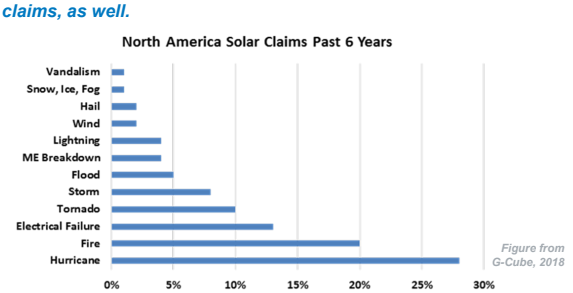

Figure from G-Cube, 2018

Photo from UTMSI

Proposed Project

The creation of a PV high wind test facility at the NREL Flatirons Campus that will enable private and public research efforts aimed at storm hardening PV systems. The facility will be instrumented to monitor effects of high wind conditions on modules and other array components. These in-field tests will coordinate with flow models, wind tunnel testing, validation of PV aeroelastic design codes, and post-testing module and system component analysis.

Initial Concept

Creation of an L-shaped testbed with a "strong floor" – a poured concrete slab with embedded threated inserts on a grid to which we could attach various system configurations for in-field testing. In-field testing will validate flow models and wind tunnel testing

Two images showing various impacts from the same storm in Puerto Rico. Humacao installation (left) suffered near total damage while Oriana array (right) needed replacement of only ~10% of modules, largely because of superior structural design

Potential Projects:

<u>Fasteners and Bolted Joints</u>: Testing of various bolted joint or clamping configurations such as through bolting, locking fasteners, clamp position, number, length

<u>Array shapes and layouts</u>: Testing of various tilt angles, heights, row spacing

<u>Tracker systems</u>: testing locking trackers, stow angles, racking designs

<u>Racking systems</u>: Various materials, shapes, and designs that can maintain structural integrity in the face of high winds and other severe weather

<u>Wind-calming fence:</u> Installing a fence around an array to reduce loads on perimeter rows.

(left) A solar PV tracker wind loading experimental setup showing instrumentation

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