WIND EFFECTS ON SOLAR ENERGY SYSTEMS

Helping manufacturers optimize the wind stability of photovoltaic racking

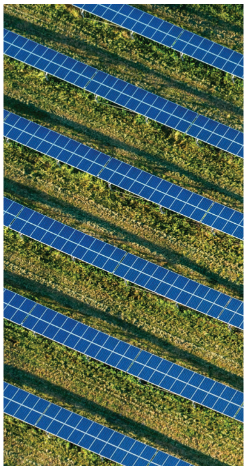
Demand for roof and ground-mounted photovoltaic systems is exploding—and the field is crowded with would-be suppliers. You need an edge to stand out, and there isn't much margin for error in either performance or cost.

A particular risk for such systems is damage from wind gusts. But if you're trying to design a wind-resilient solar array, you'll hit a wall: Good engineering guidance from traditional sources just doesn't exist.

The design wind loading values specified in building codes are based on general shape guidelines. But solar arrays are complex, and wind flows around them are equally complex. Thus the aerodynamic assumptions in standard codes are not truly accurate for these complex geometries. In this situation, how do you balance structural innovation with wind safety, budget with feasibility?

Our Service

We help manufacturers of photovoltaic systems understand and improve how solar arrays will behave in wind gusts. We offer consulting services that are responsive to your timetable, budget and technical needs.



Drawing on more than 30 years' worth of data and expertise, we'll give you customized, targeted recommendations for applying your product in a wide range of locations and situations—or in a specific project.

For example, with the more accurate wind loads that we can provide, you can design more effective anchoring systems and module clamps and fasteners. You can also calculate more accurately the necessary structural member strength, module strength and tracking drive power.

We always deliver our advice in a simple format, similar to building codes, so you can apply it immediately.

If you bring us a problem we haven't seen before, we do the necessary wind tunnel research to enhance our knowledge. For site-specific questions, we collaborate with colleagues who have experience in other areas, such as meteorology or drifting and blowing snow, to make sure we have considered all contributing factors.

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RWDI is a valuable partner to clients seeking to...

Explore Innovations

- Offer advanced designs with confidence

Create Opportunities

- Succeed in low-margin installations through multi-factor, site-specific evaluation
- Reduce costs by targeted fine-tuning of design

Meet Challenges

- Adapt solutions to challenging project-specific conditions

Fulfill Expectations

- Document performance for structural engineering review

How we work

Because we've been testing solar arrays in our wind tunnels for 30 years, we have detailed parametric data and aerodynamic coefficients for many common geometries.

In our wind tunnels we can measure peak instantaneous wind loads. From these loads we've derived such results as loads for individual modules, overturning moments on supports, or torque requirements for large-area drive motors. We tap this experience to predict wind loads and load distributions for the specific geometry of your system. We can provide general design tables or evaluate a unique installation.

Typical findings

For flexible systems, such as long, single-axis trackers, the dynamics of the array play a critical role. The inertial loads due to resonant vibration can contribute significantly to the fluctuating wind loads. So far, we have seen three mechanisms by which wind causes vibration or instability of portions of a solar installation:

1. Wake effect resonance. Turbulence generated from the first row of an array causes resonant vibration of subsequent rows. This effect is governed by size and wind speed.
2. Twisting vibration mode. For systems relying on a central torque tube driven from a single location, a twisting mode of vibration is possible. This vibration is created by a form of flutter, which generally begins at the ends of the row.
3. Torsional divergence. For systems relying on a highly flexible central torque tube, the change in torque applied to the row as it rotates can overpower the ability of the torque tube to resist. The resulting effect is known as torsional divergence.

Solutions

When these mechanisms could pose design problems for your system, we can apply the right tools to suggest solutions. If necessary, we can examine the aerodynamic stability of a solar array by using 3D sectional analysis, combined with our proprietary tools for nonlinear 3D flutter analysis. When needed, we continue with full aeroelastic model testing and sometimes also computational fluid dynamics (CFD) modeling.