



NAPA GREEN

SOLAR ARRAY MONITORING & MAINTENANCE

During our Napa Green Winery energy reviews we have encountered quite a few solar PV arrays. Frequently we have found inverter failures and high true up bills due to a long delay in identifying the inverter failure.

We are often asked how frequently PV panels should be cleaned and whether it should be done in-house to reduce costs. Doing some research, and based upon what we have heard and seen, we would like to offer some guidelines and recommendations for commercial PV arrays.

To start:

- What does your data indicate for current system performance versus design — what's the trend? A sudden drop (without a process change) points to an inverter. A slow decline points to panel cleanliness or performance. Remember PV panels lose production capacity at the rate of about 0.5-1.0% per year.
- How much is the loss in electrical output, and at \$0.20/kilowatt hour, how much is it costing you? You can also use this to judge how often to clean panels.
- Have all your array plans and manuals in one place. What do your manuals say about maintenance and cleaning?
- Is your array roof-top or ground-mount? If roof top, how are your access ladders, do you have safe passages on the roof, and adequate tie-off points for fall protection if needed?
- Is your PV array monitoring system working?
- Establish a service vendor relationship before you have a failure.
- This document covers all these aspects, and was used for the following recommendations and guidelines. If you are getting bids for this work, reference it as a guideline for what to expect:
<http://www.solarabcs.org/about/publications/reports/operations-maintenance/pdfs/SolarABCs-35-2013.pdf>



Panel Cleaning:

- Safety first—teams of two. Follow all OSHA requirements for ladder safety, tie off, etc., system electrical lockout. Do not walk on modules.
- Cleaning gains 5% to 7.5% improvement, so weigh cleaning costs against savings.
- Check your panel warranties to see if cleaning is required, and how often.
- As to when, this is depending on location, panel tilt, ag activities adjacent to the site. Remember peak solar production is June through October.
- As to how often, it depends but for the wine industry often see twice a year - late spring/early summer and just before harvest. Use production data to judge this. May want to start with annual, then use production data to judge if more is needed (and don't forget cleaning by rainfall). For agricultural areas, judge cleaning based on surrounding ag activities, and maximizing production when needed for harvest.
- Do this in-house or contract? Consider your labor costs, skill sets and equipment needs.
- Access – make sure you can reach all of the panels.
- Before you do clean:
 - Do a general walk around, inspect array mounts, roof penetrations
 - Look for issues like loose wiring, open electrical junction boxes
 - Loose mounting
 - Cracked panels



- Water source - while deionized is best, tap water is okay if you squeegee off to prevent mineral spotting.
- Avoid doing the cleaning when it is hot to avoid cracking panels due to thermal shock (early morning is best).
- Do not pressure wash the panels.
- Use soft bristled brushes only to get the accumulated grit.
- Check for any runoff needs/precautions for the wash waters.

Inverters:

Each inverter manufacturer will have specific requirements for inspection, testing, services, and documentation to meet its warranty obligations. Typical requirements for inverter inspections include:

- Record and validate all voltages and production values from the human-machine interface (HMI) display.
- Record last logged system error.
- Clean filters.
- Clean the inside of the cabinet.
- Test cabinet cooling fans for proper operation.
- Check fuses and breakers
- Check torque on wiring terminations.
- Check cabinet door gasket seal.
- Confirm warning labels are in place.
- Look for discoloration on the wiring from excessive heat buildup.
- Check continuity of system ground and equipment grounding.
- Check mechanical connection of the inverter to the wall or ground.
- Check the internal disconnect operation.
- Verify that current software is installed.
- Contact installer and/or manufacturer about any issues found.
- Document findings for all work performed.

List of Potential Service Vendors:

These vendors have indicated they will provide maintenance and monitoring support for systems they have not installed themselves, but you will need to verify this when contacting them.

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