Solar PV System Operation and Maintenance

Host Customer Owned Systems

Background

A dedicated operations and maintenance (O&M) plan is essential for the long-term functionality and safety of your solar PV system. An O&M plan ensures the system meets production expectations and therefore provides maximum benefits to the residents and your utility bills. O&M for a system can be provided by the solar installer, a third-party company or managed in-house. O&M activities typically fall into preventive, corrective or real-time categories.

Solar PV systems, while relatively low maintenance, require occasional services like panel or inverter replacement, panel cleaning, vegetation control, monitoring, warranty claims, troubleshooting and emergency response.

This resource includes information on the following sections:

1. Panel Cleaning
2. Vegetation Management
3. Pest Management
4. Warranty Management
5. Power Cycling
6. Resources

1. Panel Cleaning

Production from solar panels depends on sunlight and dirty panels generate less power. *Soiling*, a common term in the solar industry, is caused by dust buildup and can result in 2-25% system production losses (NREL).

To avoid significant production losses, it is recommended to clean panels twice a year as a preventive measure. However, the cleaning frequency depends on location; urban, rainy areas need less, while dusty or agricultural regions may need frequent cleaning. Additionally, bird droppings can be stubborn and may require special attention.

Contracting panel cleaning

As the system owner, you may elect to contract panel cleaning as a part of a larger O&M plan with your solar installer, or schedule one-off panel cleanings.

Contracting out panel cleaning is a good option for:

- High roofs
- Hard-to-access panels
- Large quantities of panels
- Hard-to-access water source

- Peace of mind!

If you choose to schedule one-off panel cleanings, discuss the rate and the frequency with the company. The cost for a panel cleaning can vary widely depending on the size and features of your solar PV system. You can also contact SOMAH's Technical Assistance team for additional guidance on panel cleaning and to request an objective, third-party contract review. Refer to Section 6. Resources for SOMAH Technical Assistance contact information.

Do-it-yourself (DIY) panel cleaning

In some cases, it is possible for in-house staff to clean the panels. For ground-mounted systems or low-story buildings, a telescopic pole with a microfiber cloth in tandem with a spray hose can be used to clean panels.

For buildings over one story with low-pitched or flat roofs, DIY cleaning is possible with the right personnel and proper safety measures.

A DIY solution is a good option for:

- A small number of panels
- Easily accessible panels
- A dedicated in-house staff with proper equipment
- Low budget

Guidance on DIY cleaning:

Note: Only proceed with DIY cleaning if you are comfortable with the steps below. Never ascend a roof without proper safety equipment.

DO:

1. Check with the panel manufacturer to see if they provide specific maintenance and cleaning instructions. Using the wrong tools or cleaning products may cause damage and void your warranty.
2. Clean during a cool day or start early in the morning. This prevents the hot panels from being stressed by cold water.
3. Shut down your system per the instruction manual. For more information, skip to the Power Cycling section on page 9.
4. Most panel manufacturers suggest only using water to clean off your panels. Depending on your location, you might also consider using distilled water. Hard tap water contains minerals that may get left behind.
5. If there are stains left after using water, use a tiny amount of dish soap with a non-abrasive sponge to clean them.

DON'T:

1. Don't use abrasive tools: Hard bristles can scratch panel surfaces.
2. Avoid harsh chemicals: Avoid bleach and ammonia-based cleaners.

3. Don't use pressure washers: High-pressure hoses can damage the solar cells in the panels.
4. Avoid cleaning during hot days: Sudden temperature changes can stress the panels.
5. Don't walk on the panels: This could break the glass or damage the solar cells. In fact, it is recommended to not get on the roof at all.

Note: If you have experienced a sudden drop in production, your panels may be dirty. Contact your solar installer, or O&M provider, to schedule the next panel cleaning.

Panel cleaning FAQs

Q: *How much does panel cleaning impact the system?*

A: Cleaning an array of panels with significant soiling can increase the system's efficiency by 5%-10%. The impact of cleaning panels depends on how much it was soiled beforehand. For some residential customers, the price of hiring professionals to clean the panels may outweigh the benefit from increased energy output. Panel cleaning may be more beneficial for larger systems or systems in fields or agricultural areas.

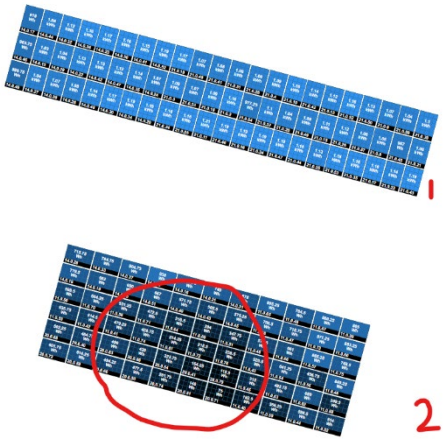
Q: *How do I know when the panels need to be cleaned?*

A: There are two ways to tell when the panels should be cleaned:

1. Visual inspection: If you notice your solar panels are accumulating dust, grime or bird droppings, it may be time to clean the panels. If you can't view the panels from the ground, consider using a drone to get a better view.
    a. The picture below shows the difference between a dirty panel and a clean panel.

2. Production monitoring: If you can't view the panels from the ground, the system's monitoring platform may inform you if the panels are experiencing production losses from soiling. If you notice a sudden drop in production or other anomalies, it may indicate efficiency losses from soiling. *Not all systems will have module-level power data. SolarEdge and Enphase are among the mainstream manufacturers that use module-level tracking.*
    a. The image shows a screenshot of an array of panels from the monitoring platform. The blue color intensity is proportional to the panel's daily energy. A significant difference in production between neighboring panels may indicate soiling or shading. In the screenshot, Array #1 has a consistent light-blue hue throughout, denoting expected

performance values. Conversely, Array #2 has a scattered dark-blue hue which may indicate shading or soiling.



Q: *How often should I clean the panels?*

A: As a system owner, you can outline the frequency of panel cleaning in an O&M plan with your O&M provider. In general, a good rule of thumb is to clean panels 1-2 times a year.

Q: *How much does it cost to clean the panels?*

A: It depends on the size of the system and the system layout. For example, hard-to-reach solar panels on pitched roofs may necessitate more time for labor, which increases the cost.

2. Vegetation Management

Maximizing sunlight on the panels is crucial. Maintaining nearby trees will ensure that panels receive sunlight throughout the day and produce as expected.

Below are several key considerations specific to vegetation management:

- Check for overgrown trees and plants that could cast shadows on the panels.
- Conduct visual inspections of surrounding vegetation every three months.
- Monitor shading at different times of the day, as shadows shift with the sun's movement.
- Trim trees. Keeping nearby trees trimmed will allow for the maximum amount of sunlight to hit the panels.

- Consider having a dedicated landscaping team informed about any shading concerns with the solar PV system.

3. Pest Management

*Note: This section is relevant for solar PV systems on **pitched, shingled** roofs.*

Background

Wild animals, particularly squirrels and birds, can pose significant challenges to solar PV systems. Squirrels nesting under panels and chewing on wires can cause damage and reduce production, leading to efficiency losses or complete production losses. Birds can obstruct proper ventilation with debris and droppings, resulting in increased panel temperatures and decreased efficiency.

When it comes to critters, it's best to take preventative measures to avoid costly damages. There is a straightforward preventative solution to deter pests called the Critter Guard. The Critter Guard inhibits birds and squirrels from nesting underneath your rooftop system by enclosing the space between the roof and the panels.

The following signs may indicate a need for a Critter Guard:

- Debris accumulated beneath the panels.
- Presence of bird droppings on the roof or panels.
- Birds gathering around the roof.
- Nearby trees that give critters easy access to the roof.
- Sudden production loss or entire strings of panels failing.

These pictures provide examples of critter invasions at solar PV systems:

Congregation of birds

Debris buildup underneath the panels

If you see any signs of critters, take the following steps:

1. Document the extent of damage or disruption, such as the number of affected panels or potential squirrel nests.
2. Check the monitoring platform for production losses.

3. Contact your solar installer or O&M provider promptly.

For more information on panel protection from critters, read an article from Solar Energy International:

- Solar Panel Protection from Critters.

The primary use of Critter Guard is intended for pitched and shingled roofs as opposed to carports, ground mounts or systems on a flat roof. These different system styles are generally less affected by critters, however, they may require their own unique preventative maintenance tactics.

Contact your solar installer to determine if a critter guard is a good fit for your system.

4. Warranty Management

Over the lifetime of a system, some components, such as the panels, power optimizers or inverters, will inevitably fail or degrade. Luckily, most panels, inverters and other energy tracking mechanisms come with a manufacturer warranty. Warranties are important because if the panels in your system degrade too quickly over time, the system will generate less long-term value than if your panels degrade at a normal rate.

Panels come with two warranties. The *product warranty* covers the equipment and typically guarantees at least 10-12 years without fail. The *power or performance warranty* typically guarantees the panel will provide at least 90% of its original production output after 10 years and 80% at 25 years. Specific warranty details differ by manufacturer.

As a system owner, you may be the first to discover failed or faulty equipment. It is crucial to understand your solar system's equipment warranties, as well as the workmanship warranties outlined by your solar installer and the SOMAH program's warranty requirements outlined for installers. SOMAH has stringent warranty requirements for all participating projects.

Warranty requirements - SOMAH

The SOMAH Program warranty requirements for installers can be found in the SOMAH Program Handbook, Section 2.3.4, Warranty Requirements, and are as follows:

- All solar energy equipment for electricity generation (PV modules, inverters, tracking mechanisms) shall have a minimum 20-year performance warranty to protect against degradation of electrical generation output of more than 15% from their originally rated electrical output. This may require obtaining an extended warranty for some equipment.
- All contractors shall provide a minimum 10-year workmanship warranty to provide for no-cost repair and replacement of the system for any expenses not otherwise covered by the manufacturer.
- All contractors shall provide a minimum 20-year warranty to protect the purchaser against more than a 10% degradation of electrical generation output that may occur as a result of faulty installation.
- Meters must have a one-year warranty to ensure against defective workmanship, system or component breakdown or degradation in electrical output of more than 15% from their

originally rated electrical output during the warranty period. For meters that are integrated into the inverter, the inverter warranty requirement of 20 years will take precedence.

Specific warranty details outlined by your solar installer may differ from the SOMAH Program warranty requirements. However, warranties from your solar installer MUST at least meet the SOMAH Program requirements.

If the solar PV system requires a warranty replacement, the solar installer or O&M provider will be responsible for handling the process. However, as a system owner, if you discover a faulty component, you may initiate the warranty replacement process with your solar installer.

Note: Don't ignore solar equipment that has failed. If you believe your solar PV system requires a warranty replacement, contact your solar installer to initiate the warranty replacement.

Warranties – SolarEdge inverters

Note: SolarEdge is the most common inverter manufacturer in the SOMAH Program. Check with your solar installer if you are not sure what equipment is installed.

Warranties for SolarEdge inverters are an industry standard:

- SolarEdge provides a standard 12-year warranty on all inverters.
- SolarEdge's inverter warranty is extendable up to 20 or 25 years, depending on the inverter model.
- To check the inverter warranty expiration date, please visit the SolarEdge Warranty Status webpage and enter your inverter serial number.

For warranty related questions on SolarEdge inverters, please read this article:

- Solar Edge Warranties

5. Power Cycling

Note: We do not recommend anyone to power cycle inverters over 50kW in size for safety reasons without a qualified technician present.

Power cycling may be needed for panel cleaning, repairs or remote troubleshooting. In some cases, a system owner may power cycle the system themselves.

Power cycling is the step-by-step process of restarting a solar PV system. These steps can resolve many issues that are noted in the system's monitoring platform. It's important to note that if done properly, power cycling will never harm the solar PV system.

For a step-by-step guide on power cycling your PV system, please reference these guides:

- Power Cycling SolarEdge Inverters Smaller than 10kW
- Power Cycling SolarEdge Inverters Larger than 10kW

6. Resources

If additional support is needed to navigate the SolarEdge monitoring platform or troubleshoot your PV system, please use the following resources to request SOMAH's Technical Assistance and Support Services.

- calsomah.org/TA-request
- QR code:

SOMAH TA and Support Services Request Form