



Field Install Guide





HALO SOLAR FIELD INSTALL GUIDE

Purpose

Halo solar has created this Field Install Guide to make it easy for our installation partners to work seamlessly with Halo Solar. We share what you can expect from us, what we expect from you, and a map of our interactions and each party's responsibilities. In addition, we have documented the installation steps along with detailed guidance and references to more in-depth enablement assets for the first-time installer.

Halo Solar's Commitment to Subcontractors

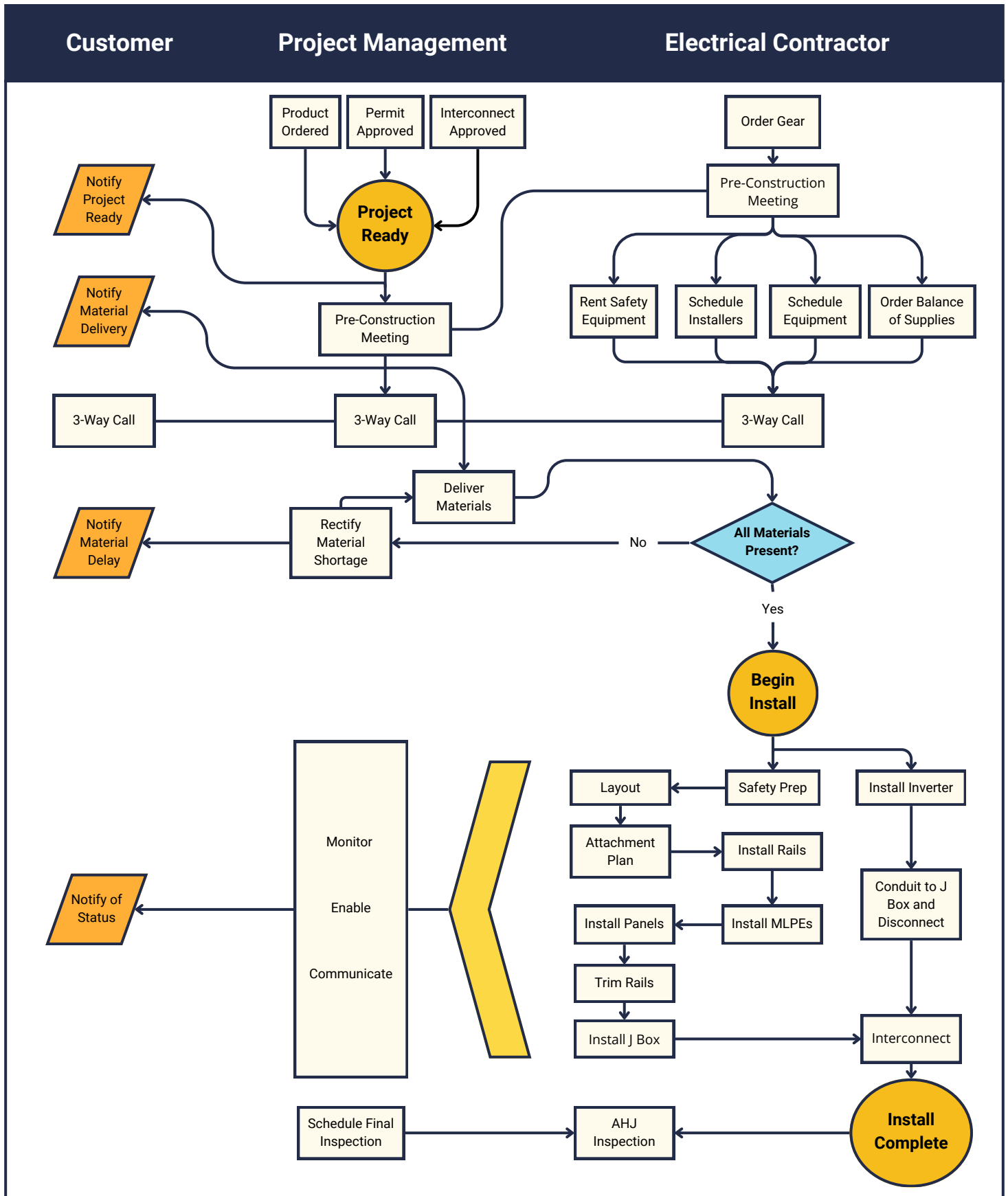
- We will communicate a clear scope of work.
- We will provide guidance on estimates when we identify potential problems.
- We will predict the construction start date to the best of our ability so that you can plan your resources. When third parties cause an unexpected a delay, we'll update you as soon as possible.
- We will handle the communication with the customer <need to verify>.
- We will provide an accurate plan set so that your install goes smoothly.
- We will support your team when they have questions or encounter difficulties.

Halo Solar's Expectations of Subcontractors

- All expectations are outlined in the subcontractor agreements below:
 - Halo Solar Subcontract Agreement
 - Halo Solar Agreement to Comply with Terms of the Illinois Shines Program

Install Process - Overview

The following swim-lane diagram maps the most important steps in the solar installation process.



Subcontractor Task Detail

Order Gear

The following is the gear that the electrical contractor is responsible for ordering:

- Switchboard
- PV Disconnect

Pre-Construction Meeting

The pre-construction meeting is designed to ensure that Halo and the install team are on the same page. The meeting will be run by Halo's project manager, and the agenda should include:

- Share permit numbers
- Share contact information for required inspections
- Review project-specific documentation
 - Review engineering plans
 - Review one-line diagram
 - Review installation estimate
 - Racking Report
 - Manufacturer's Module Install Guide
 - Flashing Install Guide
- Communicate customer concerns and preferences
- Halo will provide guidance on utility interconnect scheduling
- Agree on solar material delivery logistics
- Review schedule:
 - Estimated solar material delivery date
 - Estimated construction start date
 - Estimated construction completion date
- Confirm install team availability
- Confirm equipment needs
 - Safety Equipment
 - Other Equipment
- Establish enablement/training needs

Rent or Acquire Safety Equipment

The following safety equipment may be needed. Safety equipment is the responsibility of the EC.

- Barricades
- Cones/flags/tape to mark hazardous areas
- Fall Restraint System (Halo can provide details and part numbers)
 - Anchor points
 - Ropes
 - Harnesses
 - etc.

Schedule Installers

Scheduling installation crews is the responsibility of the EC, but should be done keeping in mind the expectations that have been provided to the customer. Any changes or issues with scheduling should be communicated clearly and early to Halo Solar Project Managers.

Schedule Equipment

The following non-safety equipment may be required for the install. Supply or rental of the equipment is the responsibility of the EC. This might include:

- Lifts
- Ladders
- Telehandler
- Dumpsters/Waste Disposal
- Dura-deck
- Portable bathrooms if necessary

Order Balance of Supplied

The following supplies are the responsibility of the EC:

- Disconnects
- Panels
- Breakers
- Boxes
- Conduit
- Fittings
- Straps
- High and low voltage wire
- Wire connectors
- Meter bases

Three-Way Call

The three-way call should include the customer representative, Halo's project manager, and install team leader. The agenda should include:

- Confirmation of schedule including:
 - Material delivery (if applicable)
- Planned construction start
- Estimated interconnection
- Estimated construction complete
- Discuss access points
- Discuss interconnection outage

- Predict outage duration
 - Identify backup power if needed
 - Identify preferred time of day
- Review of customer concerns and preferences
- Plan for communicating to the customer:
 - Frequency
 - Best method

Solar Material Review

Halo will provide a bill of materials in advance of the delivery of the solar equipment. Upon delivery, the EC should validate that all solar materials were delivered. If any materials are missing, EC should contact the Halo project manager immediately. The Halo project manager will ensure delivery of the missing material. The EC and the Halo project manager will decide together whether the installation can proceed prior to the delivery of the missing materials. Halo is responsible for procuring the following:

- Solar panels
- Racking
 - Racking
 - Racking hardware
 - Roof attachments
 - Trim caps
- Inverters
- Specialty roof branch wire
- Specialty jbox's
- Sealant
- Zip ties
- Warning labels
- Specialty data equipment such as:
 - Cell kits
 - Wifi extenders
 - eGauge metering equipment
- Specialty breakers

Subcontractor Task Checklist and Guidance

Safety Prep

	Tasks	Guidance
☐	Perform Job Hazard Assessment	Per EC's SOP
☐	Mark hazardous areas as necessary	Per EC's JHA
☐	Determine and mark designated access points	Customer may provide specific access points.
☐	Layout anchor points	Anchor point manufacturers provide guidance.
☐	Install anchor points	Anchor point manufacturers provide guidance.
☐	Install barricades as necessary	EC will determine the needs.

Layout - Sloped Shingle

	Tasks	Guidance
☐	Examine layout	Using the layout provided by Halo, determine the module orientation and count.
☐	Verify Truss/Purlin Spacing	If possible, access attic space to get measurements. Check for consistent truss spacing. If spacing is not consistent, make a diagram of the truss spacing throughout the area that the array will cover.
☐	Measure Roof	Using the included Racking Report, measure out the area on the roof that the array will cover. It is a good idea to verify that the panel dimensions on the report match the dimensions of the panels being used for that job.
☐	Mark Edges	Using chalk, mark where the edges of the array will be on the roof.
☐	Plan Rail Location	Using the included module manufacturer install guide, check module recommended clamping locations. Remember, the two rails do not need to be symmetrical on the module if they are in the recommended area set by the manufacturer. Keeping this in mind will help with proper flashing install.
☐		Reference the included flashing install guide. It shows the optimal location for the flashing in relation to where the shingles overlap. This is important to prevent leaks over time.
☐		By referencing the module install guide, the flashing install guide, and the plans, the correct location of each rail can be determined. With chalk or crayon, mark the locations of each rail on the outside edges of the array.
☐	Snap Lines	With a chalk line, snap lines across the outside marks just made. Then snap lines where the trusses are located. This will form a square grid.

Layout - Sloped Metal

✓	Tasks	Guidance
	Examine layout	Using the layout provided by Halo, determine the module orientation and count.
	Verify Purlin Spacing	Generally, this can be determined by looking at where the fasteners are on the roof.
	Measure Roof	Using the included Racking Report, measure out the area on the roof that the array will cover. It is a good idea to verify that the panel dimensions on the report match the dimensions of the panels being used for that job.
	Mark Edges	Using marker, discretely mark where the edges of the array will be on the roof.
	Plan Rail Location	If purlins are offset across the roof (most common for pole buildings) the rail is to be installed vertically, across the purlins and the panels will be installed in landscape. Use either a 2x4 or piece of strut cut to the same length as the long side of the panel PLUS the width of a midclamp (~3/8"). Mark out the panel edges as well as where the acceptable clamping locations are on this piece. Use it as a guide. Begin by lining up one end of the guide with an edge mark for the array. Pick a purlin and move across the roof, marking where the rail will be located as well as where the edges of each column of panels are located. Use an "X" for rail locations and a crow's foot "^" for marking where the panel edges are. If purlins are mounted end to end with no offsets, the rail can be mounted horizontally, parallel to the purlins and (panels can be installed in portrait). The same guide stick can be used to determine which purlins will be carrying the L-feet. In this case the guide would start on either the top or bottom edge of array mark and moved up or down accordingly to mark the edges of the panels. Some adjusting up or down may be required to keep the rails within the recommended clamping area on the panel.

Layout - Ballasted (Flat Roofs)

	Tasks	Guidance
☐	Examine layout	Using the layout provided by Halo, determine the module orientation and count.
☐	Validate Obstructions	Establish setbacks and validate that panel layout will align appropriately with obstructions.
☐	Establish first corner	Mark the first corner, snap references lines at right angles for 100 feet in each direction. Mark crow's feet along the reference lines in case of weather.

Roof Attachment (NA for Ballasted Arrays)

	Tasks	Guidance
☐	Plan Attachments	Check the plans for the distance between roof anchors, determine the required number of attachments, and ensure that enough attachments have been delivered.
☐	Install Attachment (Shingle)	Install anchor/flashings at the appropriate chalk line intersections. An impact driver can be used.
☐	Install Attachment (Metal)	Once the L-foot locations are marked, follow the L-foot or roof attachment install guide to complete the anchor install. Make sure the roof is clean around the hole where the sealing bushing will be. Use shop towels and/or a scraper to clean as needed.

Install Rails (NA for Ballasted Arrays)

	Tasks	Guidance
	Set Rails	Read the included racking manufacturer's install guide. Then, set rail onto the roof anchors. Secure the very top and bottom rails approximately in the middle of the L-feet. Ensure that the end of the rails are offset from the edge of the roof or roof hip consistently. Leave the rail between them loose and bottomed out in the L-feet.
	Level Rails	Pull a string line tight across the top and bottom rail. Bring rails in the middle up to the string line then tighten. Continue across the array until all rail is leveled.
	Secure Rails	Make sure all hardware is tight before proceeding. Use battery drill with clutch set to appropriate torque setting to tighten hardware.
	Mark Rails	The plan set will specify the panel attachment points. Mark the clamping locations for the first panel.

Install Junction Box

	Tasks	Guidance
	Install Junction Box	Select location for a rooftop junction box. Try to install the box under a module near the outside of the array, for easy access in the future.

Install MLPEs

	Tasks	Guidance
	Install MLPEs	They should be attached to the rails under the position of each panel unless plans say otherwise. Panel lead lengths and the location of the panel junction box affect the location. Use battery drill with clutch set to appropriate torque. Do not use impact driver.
	Run PV Wiring	Install PV wiring on roof. Use the module string layout if provided as reference. Pull wire from inverter to jbox on roof. Then using appropriate wire connectors, connect home run wires to the PV wire going out on the roof. Don't forget to install rail ground (see racking install manual). Make sure there is NO wire touching the roof. All exposed wire must be securely strapped to the rails or panels.
	QR Codes	Pull QR code from each MLBE and place it in the appropriate spot on the Halo Monitoring Map. IF PANELS ARE INSTALLED BEFORE THIS STEP, THE PANELS MAY HAVE TO BE REMOVED TO RETRIEVE THE QR CODE!

Install Panels

	Tasks	Guidance
	Install First Row	Install panels at attachment point marked on the rails. Use a battery drill with a clutch set to the appropriate torque to tighten panels clamps. Do not use impact driver.
	Install Remaining Panels	Try to keep spacing between all sides of panels as consistent as possible.

Trim Rails

	Tasks	Guidance
☐	Trim Rails	Trim the rail ends to within approximately 2" from the edge of the panels.
☐	End Caps	Install rail trim end caps.

Note: the following two steps can occur in parallel with array install.

Run Conduit/Wire

	Tasks	Guidance
☐	Inverter to Jbox	Run conduit or romex (if applicable) from rooftop jbox to inverter. Any DC power conduits running inside a building must be metallic. Up to ¾ sealtite or flex can be used.
☐	Inverter/controller to disconnect	Run conduit and/or romex (if applicable) from inverter/controller.
☐	Disconnect to interconnect	Run conduit and/or romex (if applicable) from disconnect to interconnect.

Install Inverter/Controller

	Tasks	Guidance
☐	Determine location	If the plan set does not establish the location, the EC should place the device between the array and the interconnection with the least amount of diversion while taking into account customer preferences.
☐	Attach device to the structure	Follow manufacturer guidance.
☐	Terminate conductors	Follow manufacturer guidance.

Line-Side Interconnection

	<i>Tasks</i>	<i>Guidance</i>
☐	Determine type of interconnection	Plan set should determine the type of interconnection. If site conditions conflict with plan set, contact Halo for guidance.
☐	Coordinate timing with utility	Contact the utility to schedule interconnect in advance. Suggested advance notice was suggested in the pre-construction call. EC will specify the location of the point of disconnect while scheduling the outage.
☐	Coordinate Downtime with customer	Confirm schedule with customer. Adjust schedule with utility if necessary. Deploy backup power plans if specified.
☐	De-Energize	Meet the utility per schedule. Utility will disconnect power at the specified location.
☐	Perform Interconnection	Tap into the line per the specifications in the plan.
☐	Re-Energize	Contact utility to reconnect power.

Load-Side Interconnection

	Tasks	Guidance
☐	Determine type of interconnection	Plan set should determine the type of interconnection. If site conditions conflict with plan set, contact Halo for guidance.
☐	Coordinate Downtime with customer	Confirm schedule with customer. Adjust schedule with utility if necessary. Deploy backup power plans if specified.
☐	De-Energize	Open main disconnect per plans.
☐	Perform Interconnection	Connect the PV source wires to the point specified in the plans.
☐	Re-energize	Close main disconnect.

AHJ Inspection

	Tasks	Guidance
☐	Schedule Inspection	Reference permit or contact Halo project manager. When contacting jurisdiction, determine whether EC presence is required at inspection.
☐	Attend Inspection	If required by the jurisdiction.
☐	Remediate	As necessary.

Warranty Process

After the project is energized, Halo Solar will monitor the system for problems. When a fault is detected, Halo Solar will troubleshoot the problem remotely as much as possible. If Halo Solar cannot resolve the problem remotely, Halo Solar will contact the subcontractor to perform a site visit. The subcontractor will be provided with a case #, contact information for the manufacturer, and a reference number for the subcontractor to include in their invoice to Halo Solar.

After the subcontractor troubleshoots the problem on-site, they will report their findings, manufacturer guidance, and any case or RMA numbers from the manufacturer.

Halo will handle warranty-related communications with the manufacturer as well as all communications with the customer until the issue is resolved.