SepiSolar™
POWER BY DESIGN

C&I SOLAR RISK MANAGEMENT GUIDE

Remove The Element of Surprise With Project Planning

In this highly specialized world, interests have a way of shaping identities. Some people binge watch Game of Thrones. Some marvel at the turbocharged engine in the BMW X5. It can be hard to explain why these things matter when talking to people who don't share your tastes. That's ok. They have their interests. Football, perhaps. We have ours.

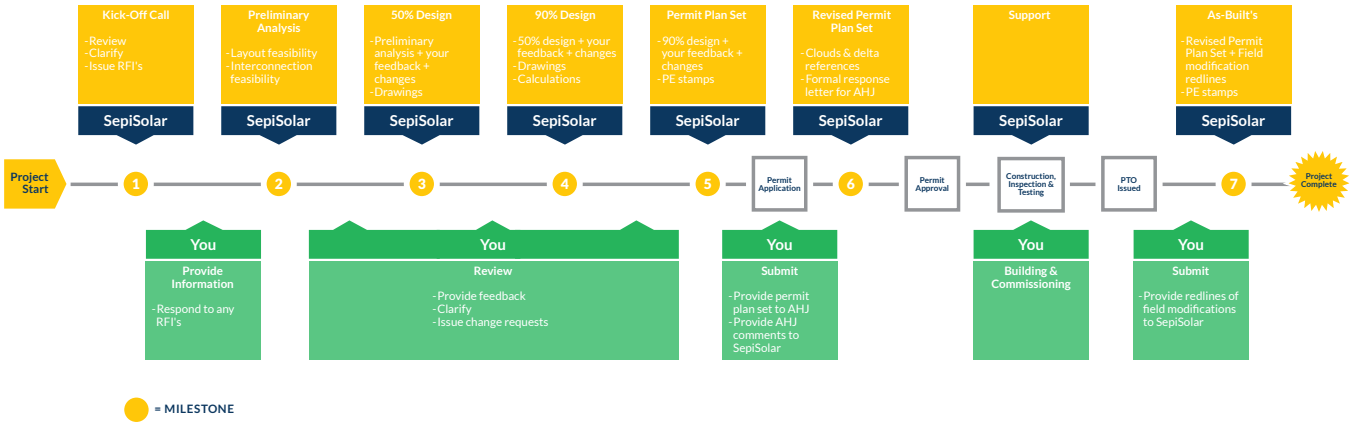
Solar project engineering and design is one of our passions. We recognize that this work is not for everyone, that the industry needs contractors and product developers, policymakers and finance providers to continue to scale. But we want to clarify a misconception out there that engineering and design work is simply a means to an end.

What is project engineering and design?

Technically, you'd be correct if you said project engineering and design is about analyzing technical data and creating project diagrams that have to be signed off by permitting and interconnection authorities before you, the contractor, can proceed with construction and commissioning. **However, if a plan set is the only output you're getting from your engineering and design team, you're probably taking on risks that impact project quality, cost and safety.**

Documentation is just a small part of the value provided by engineering and design. The greatest value comes from risk management.

Engineering and design can manage risk through a structured process that identifies and defines 7 key milestones affecting all C&I solar projects. The chart below has an overview of the entire process. **Download a full-page copy** and read on to see how each milestone affects project quality, cost and safety.



KICK-OFF

When you kick off engineering and design work, this is the time to review technical data, goals, and your overall project plan. Ensure that all data needed for design is available, and make a plan to collect any missing data. Check your preliminary design and site survey information at this time.

PRELIMINARY ANALYSIS

This is the time to check for site conflicts and feasibility. There are 3 main characteristics to check as early as possible:

1. Real Estate

   Confirm the array layout, including module dimensions, setbacks, and any fire department restrictions. You can also submit an interconnection application now.

2. Electrical

   Confirm that the PV system can interconnect at the existing (or new) electrical distribution equipment on site.

3. Structural

   Confirm that the PV system can structurally anchor to the existing soil conditions or roof framing system.

50% DESIGN

Once you have completed all the data collection and analysis involved in the first two milestones, it's a good idea to proceed incrementally with project development. Start with a site plan, a PV array layout, an electrical layout, and a general three-line wire diagram that you can use to order long lead-time materials.

90% DESIGN

If you see the need to provide feedback or clarify issues in the 50% design package, it's easy and inexpensive to handle change requests at this stage. Upon completion of the review cycle, produce a detailed three-line wire diagram, engineering calculations, elevation views, and construction details.

PERMIT PLAN SET

Mark the final package with professional engineering (PE) stamps.

REVISED PERMIT PLAN SET

Issue itemized responses with clouded plans to any requests for information, clarification or comment from the authority having jurisdiction (AHJ).

AS-BUILT'S

An electrical PE reviews as-built conditions of the project and revises drawings after construction, final inspection, and permission to operate.

For many projects, permitting and interconnection are a matter of urgency. Can't the preliminary analysis of the project site, feasibility, and confirmation of the array layout be finished a little faster? The short answer: yes, but be careful what you wish for. You might just get it.

Read on to see why shortcuts in the early stages of the process can ultimately take a project longer to reach the finish line, and drive up costs along the way.

Quality

Here's how a poorly designed process can affect project quality.

The contractor asks for completed project plans very quickly because he or she is in a rush to reach a target payment milestone, like permit approval, which depends on two things: the speed of the designer to generate plans and the turnaround of the permitting authority's approval. Unfortunately, the contractor has no control over the permitting authority's timeline, so the contractor focuses and applies pressure on the designer's timeline.

Because there are often many ways to design the same system, the work product that comes back is filled with assumptions about the various project specifications, means and methods, component selection, and the associated bill of materials that the designer assumed would be acceptable by the contractor. After all, the system is still code-compliant, permittable, and feasible. By the time someone discovers that the plan set needs revisions to accommodate what the contractor may already have in stock in the warehouse, or that the contractor may prefer to install due to the specialized skill set of the installation crew doing the work, the contractor has already placed equipment orders and scheduled delivery to the job site. Change requests drive up costs and lengthen timelines as modifications push the project schedule further out.

The difference between a structured process and improvisational project development is similar to choosing between an asset with low CapEx and an asset with low Total Cost of Ownership. Higher quality sometimes means a higher upfront cost accompanied by better long-term value.

Bad process in engineering and design often comes about from trying to work too quickly, without verifying key pieces of information, or gaining enough consensus from project stakeholders (like contractors, subcontractors, developers, and owners). When a contractor requests changes weeks or even months after accepting an original plan set, the contractor loses time and may also lose money. This increases risk.

By adding structure with clearly defined activities, discrete handoffs, and interim approvals, we can reduce cost, time, and risk. The changes are effectively caught upfront, before significant work is done. It's a lot less expensive to correct something that hasn't yet gone wrong. As the saying goes, "Get it right the first time!" The best painters spend 90 percent of their time prepping (taping, protecting fixtures, covering furniture and floors) and 10 percent holding a brush. This is the value of planning.

Cost

A clear and complete scope of work is critical for catching all elements of the design and engineering work that needs to be budgeted for, scheduled, and controlled. When changes occur, it is usually due to lack of specificity in the original scope of work, or due to some factor that nobody saw coming. ("Surprise!") Changes often increase cost and timeline. This is why we don't like surprises in construction.

By thoroughly defining the scope of work upfront and identifying potential surprises that could come back to bite us, the engineering and design team and the contractor together can proceed in stages so we don't get too far ahead of ourselves.

What's the secret formula for keeping unpleasant surprises at bay? People + Process + Product.

PEOPLE

The measure of the people in engineering and design can be found in their experience, certifications, qualifications, the structure of their organization, and the quality of their work environment.

If you're evaluating a new service provider, ask who actually performs design and engineering.

Look for a team of dedicated NABCEP-certified designers, engineers, draftsmen and draftswomen. See how often they participate in trainings on the latest and greatest products, technologies, and policies available to solar contractors in all 50 states. Ask how long they have been designing solar systems, specifically, in the market(s) you care most about.

Ask if the service provider uses subcontractors. Outsourcing has its advantages, but only if it is controlled, scheduled, and managed effectively. For example, outsourcing can enable a single provider to oversee a nationwide network of professionals who can be available for projects wherever needed. Be sure subcontractors are professional engineers who are licensed in the state where the project is located and qualified in the requisite engineering discipline, be that structural, electrical or civil engineering. Also check that the service provider maintains proof of insurance and errors and omissions policies to backstop all work.

PROCESS

The difference between a structured process and improvisation boils down to the systems that a service provider puts in place to guide project management, capacity management, resource allocation and planning, scheduling, document control, budget tracking, automation and integration, and much more.

Ask about the process for intaking information from the field that the design and engineering team will use to produce deliverables. A haphazard series of phone calls and emails does not count as a process. There's too much risk involved. Busy people might not open their email. They might not transfer all the information where it needs to go. They might forget to ask an important question.

Forms and checklists are more effective at standardizing data acquisition and automating data analysis, ensuring that engineering and design has all the information needed, each and every time.

PRODUCT

Have you ever considered engaging in a side-by-side comparison of two or more companies performing engineering and design on the same project? Hiring two design firms instead of one would be a costly experiment, but it would reveal substantial differences in quality deliverables, scope of work clarity, quality of service and customer experience, response time to AHJ and utility company comments, value-added design and engineering, and solutions to technical problems.

The product itself is proof that design and engineering directly affects project success. It is not a commodity. You don't necessarily have to go through the entire process to get an impression of a firm's work product.

Ask what you should expect as a C&I solar contractor. If the answer is, "a set of plans, of course, so you can get a permit," it may be time to reconsider.

On the other hand, if this answer is, "upon contract execution, we will deliver a detailed scope of work, work order, and timeline that will explain assumptions, clarifications, inclusions, and exclusions for any and all work to be performed with major milestones identified. A technical sales rep will work with you to define this, and our operations and engineering team will schedule a kick-off call to confirm and deliver on what you expect to receive, every time," there's reason to believe that your project will be in good hands.

Try another question. Ask about the services that a company provides. See how much detail you get about the schedule of services, statement of capabilities, and rate sheets for a comprehensive list of services with accompanying descriptions and deliverables. Failure to prepare is preparing to fail.

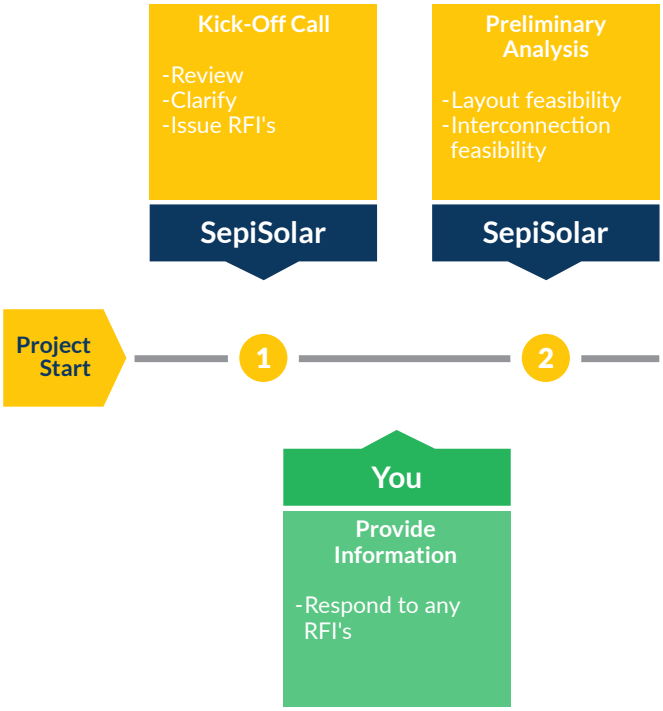
Change Orders

The full benefit of breaking projects down into milestones can be realized only if both the contractor and designer stay engaged with each step along the way. In a complete design package, for example, expect to start by scoping and identifying risks and critical path items for each milestone. With the initial analysis, make sure you receive a plan to tackle the big items. This gives you time to plan ahead, placing orders where needed and putting off orders where they are not needed or may be subject to change in a future milestone.

Project Milestones

DISCOVERY

Site surveys are like a discovery mission. When building a solar project on a building or a piece of land, the first thing to know is what we're building on top of. Building a complete plan set on top of a flimsy site survey is like building a house on top of a broken foundation. The house might be perfectly built, but it will fail if the underlying foundation isn't solid. Site surveys should be as solid as the project's foundation. It's perhaps the most important part of the project planning.



Next, the designer/engineer checks that the site survey captured all information needed to complete design and engineering. If not, there will be some back and forth between the site surveyor and engineer downstream.

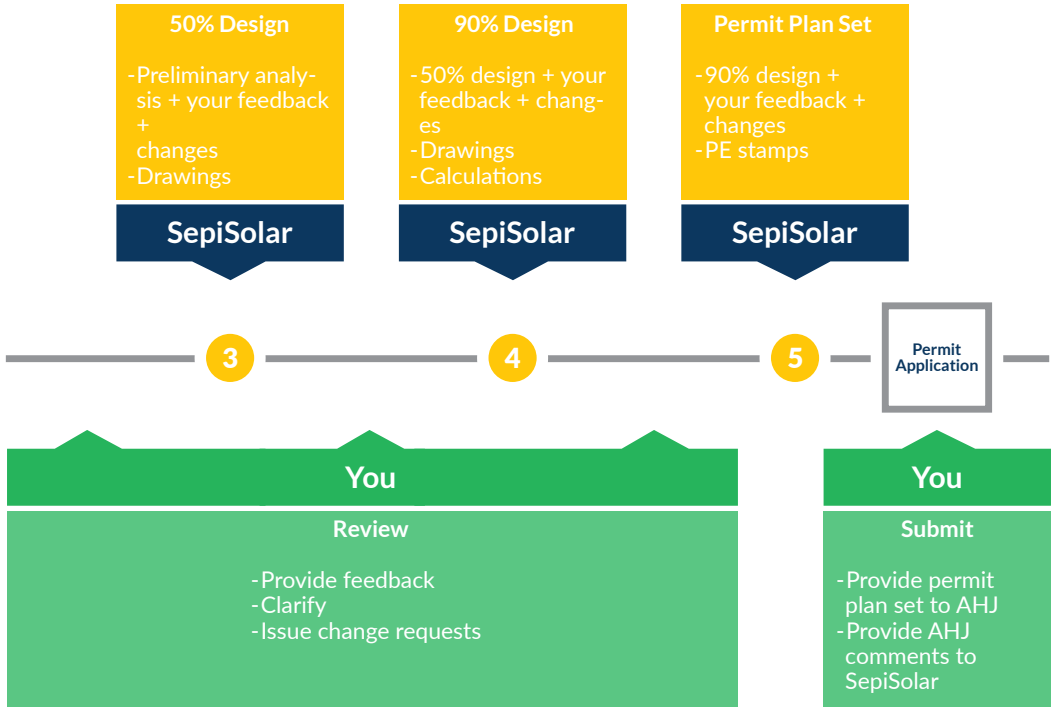
There's an inherent conflict here. Engineers are usually more expensive than field technicians. So it is cheaper to send a field tech out on site than an engineer. However, if pertinent details are missed by the field tech, then the engineer will produce a faulty design package, or the field technician will need to go back to the site at the contractor's expense. In more complex projects, it's not a bad idea to have an engineer on site during discovery. But for most mainstream projects, this isn't cost effective.

There's another alternative. Have the engineer give the field technician a comprehensive, concise, and clear checklist of items to capture on site that the engineer knows he or she will need. The field tech helps keep costs down. The checklist mitigates risk, delivering exactly what the engineer needs to complete the work. No surprises.

DEVELOPMENT

A deliberate pace of development gives design and engineering time needed to start creating project plan sets based on preliminary analysis. It also gives you a chance to provide feedback so design and engineering can make changes before those changes become expensive. In other words, you gain flexibility without all the cost.

Once a project reaches the 90 percent design stage, design and engineering can confidently proceed with wire sizing, string sizing, conduit sizing, and other electrical calculations. The project has undergone ample discussion. You have been able to review project documents, providing points of clarification and issuing change requests as needed. The decisions we have made thus far help you decide on the equipment and materials to order right away and those that you should not order until submission of the permit application.

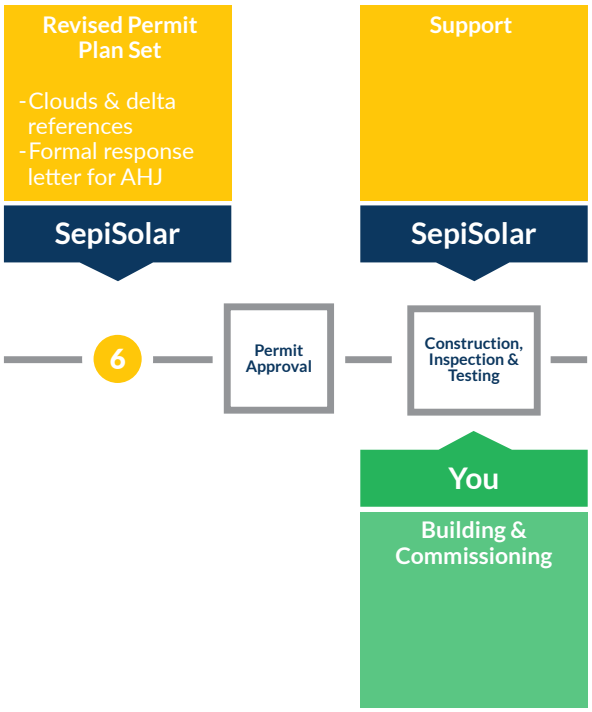


Now it's time to finalize the permit plan set and get PE stamps to show that the project has been designed according to professional codes and standards. Once again, you reap the benefit of each previous step in the process. The day to submit plan sets to the AHJ is a terrible time to discover that project drawings show conduit in the wrong place. At this point, a change order could mean delaying the project start date, changing the bill of materials, and a difficult conversation with the project owner. All the procedural steps that we put in place are designed to minimize change requests when they have the most potential to increase costs and interfere with the success of the project.

MAINTENANCE

The time to go from permit application to permit approval varies considerably from project to project and from jurisdiction to jurisdiction. Much of this process is out of your control. However, design and engineering can streamline and expedite the process if you promptly share AHJ comments so we can produce an itemized response sheet addressing any and all questions, comments, requests for clarification, or requests for information.

Any revisions during permit review should include cloud and delta references. Design and engineering can also assist with support for requests for information (RFI's) during construction, inspection and testing.



CLOSE-OUT

After construction is complete, final inspection has been approved, and permission to operate has been granted, an electrical PE performs a review of as-built conditions at the project site. Redlines of field modifications should go to the engineer as soon as possible to bring the project to a successful completion.

Safety

In C&I solar, as with many things in life, risk and planning go hand in hand. You set yourself up for success with a consistent, repeatable process that gets the job done right, again and again. When you improvise, that's when outcomes are less predictable. It's as true for project safety as it is for cost and quality.

To check the safety record of a professional engineering company, look for the entity that regulates licensed engineers in your state. In California, this responsibility is held by the Board of Professional Engineers, Land Surveyors, and Geologists. You can look up the current status of a California-licensed professional engineer **here.**

Sort of like the Hippocratic Oath that medical doctors pledge, PE's have a "duty of care" to ensure all designed systems are safe, compliant, and thoroughly evaluated. If a licensed professional engineer causes property damage or loss of life, or is negligent, the state board can revoke that person's license. The Board also keeps a record of all major incidents and posts them online.

Find the name of the professional engineers who will be working on your project. Search by name. The Board returns no results when you search by business name, because it does not license businesses. On the results page, check that the license status is clear, meaning that the engineer's license is current and valid. In addition, you can call the Board to check for complaints or disciplinary action as part of the license history.

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