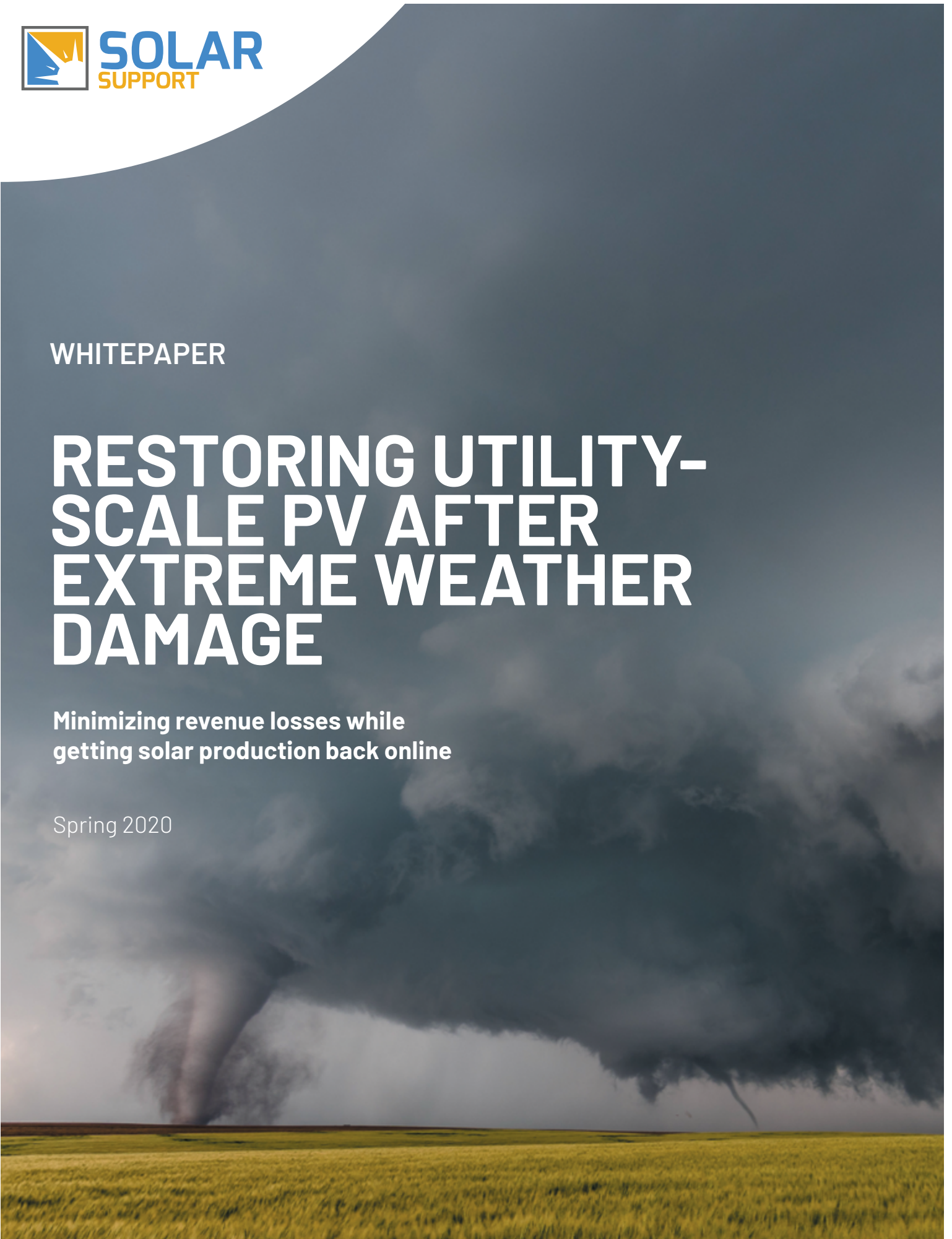


WHITEPAPER

RESTORING UTILITY- SCALE PV AFTER EXTREME WEATHER DAMAGE

Minimizing revenue losses while
getting solar production back online

Spring 2020



THE SILVER LINING

PV PLANT RESTORATION & RECOVERY

in partnership with



TABLE OF

CONTENTS

01
INTRODUCTION

.....

03
**OUR APPROACH TO
PLANT RESTORATION**

.....

02
**MINIMIZING PRODUCTION
AND REVENUE LOSSES**

.....

04
**CASE STUDY 1:
Saving with Salvage**

.....

05
**CASE STUDY 2:
OPTIMIZING OVERALL
SYSTEM PERFORMANCE**

.....

06
SUMMARY

.....

01

INTRODUCTION

While climate change brings more and larger storms, it's not just the size of these extreme weather events that wreaks havoc. Rising ocean temperatures result in stronger wind speeds and more torrential rainfalls. Slow-moving hurricanes push massive storms ashore, causing surges and flooding.

All of this means PV plants across the country are being pummeled more each year by stronger, slower, and wetter storms than ever before. Extreme weather events mangle in minutes what had been designed to last decades. Sandstorms in New Mexico jam particles into delicate equipment. Tornadoes rip entire racking systems asunder. Wildfires whip across PV plants, melting wires and cables.

This is causing some insurance firms to stop underwriting renewable projects, while others are resetting premiums to higher levels.

When the floods recede and the winds die down, you're going to want expert help getting your crucial assets back online. While many O&M providers say they do recovery and restoration work, few have the hard-won experience after extreme weather events that Solar Support offers.

INSURANCE PROVIDER GCUBE FOUND THAT 50% OF ALL RENEWABLE ENERGY CLAIMS IN NORTH AMERICA RESULTED FROM WEATHER-RELATED INCIDENTS IN 2019.

According to the National Oceanic and Atmospheric Administration, wildfires, cyclones, flooding and storms have caused 14 separate billion-dollar extreme weather disasters.

From damage assessment and salvage expertise to insurance claims management and rapid restoration, our team keeps revenue loss under control. Solar Support works with EPC and O&M leaders DEPCOM Power and Power Factor to deliver a trifecta of experience, dedication, and results. Easy to manage through a single touchpoint, our end-to-end solution mitigates production losses and gets your PV back to peak performance.



02

MINIMIZING PRODUCTION AND REVENUE LOSSES

A PARTNERSHIP TRIFECTA OF EXPERIENCE, DEDICATION AND RESULTS

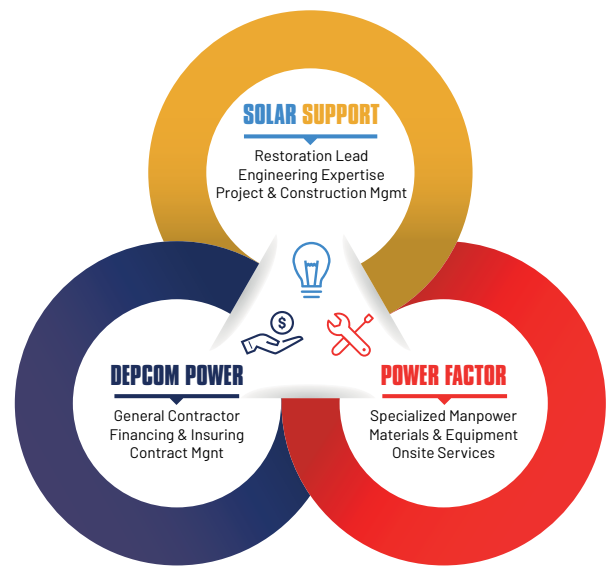
Recovery following an extreme weather event is complex, often even more so than initial plant construction. Unlike new builds, restorations involve balancing current production needs against deconstruction and replacement demands.

Solar Support has partnered with DEPCOM Power and Power Factor to deliver unparalleled plant recovery experience and know-how. Our team members offer unique expertise:

DEPCOM Power is one of the nation's leading EPC and O&M provider. Having built over 55 solar plants nationwide and operating 1 GW, DEPCOM provides turn-key experience from in-house engineering to plant operations with a 99% energy output guarantee rate. Power Factor offers specialized manpower with deep expertise in site repowering, recommissioning, and restoration.

Combined with Solar Support's unparalleled experience, our end-to-end solution approach to site restoration means you're working through a single point of contact, streamlining project management and maintaining a clear picture of what's happening throughout your project.

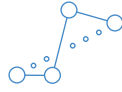
By bringing in our industry-first restoration experience early in the process, Solar Support and its partners can help you combat force majeure damage with initial inspections and documentation. Our know-how gets the process moving fast on subjective decisions about what needs to be replaced and what may be salvageable.



Alongside DEPCOM Power and Power Factor, we can weave legacy technology together with modern replacements seamlessly, without the conflicts and redesign headaches you may have come to expect.

Melding the old with the new is a big part of what makes recovering from extreme weather events radically different from building a new solar plant. Solar contractors who excel at building a new site may never have had to retool damaged components or work around partially functioning systems. With our deep experience in damage recovery, Solar Support hits the ground running, ensuring your restoration is pointed in the right direction from the get-go.

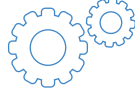
FOCUSING ON EXECUTION MEANS MAXIMIZING RECOVERY



Staggered approach

Minimizing the business interruption insurance claim can help to maximize recovery. Solar Support's unique approach starts with an emphasis on staggering the work to minimize interruption and prioritize production recovery.

For example, if one inverter is down simply because of a ground fault, but the rest of the array is in good shape, we prioritize restoration at that location to get an entire section of the plant back online, something typical O&M providers can't or won't do.



Contingency plans

Develop multiple contingency plans so that if one repair must be delayed, other activities can be slotted in immediately to keep the project moving forward. If components delivery is delayed in one area, shift work immediately to a process that doesn't require new parts. This helps to keep the best personnel active at all times.

Even as restoration work begins, Solar Support continues to reassess what needs to be done and when. While the restoration plan may call for replacing all cables, that may change as work moves forward. Or there may be the unpleasant surprise — as happened during one of our recovery projects — that an entire site was done with the wrong connectors in the first place, which means re-doing all of them site-wide. This is when our expertise in plant restoration really shines. We don't just restore the site; ultimately, we make it better than it was.

And with so many solar component manufacturers going out of business, Solar Support can help you understand what parts of your equipment may be obsolete — and what to do about it. Our experts can help locate hard-to-find components or even make arrangements to manufacture replacement parts.



Transparent Team Communications

Solar Support knows the value of maintaining a clear schedule with daily and weekly visibility. We define key milestones and make sure everyone tracks progress toward meeting them. Because we track the entire project, we include all subcontractors and contractors in every assessment; transparency can smooth out problems before they get a chance to become serious.

That transparency includes ensuring that everyone is putting the right people in the right place. It doesn't matter if a subcontractor has an excellent reputation if they're assigning their back-up bench to your project while their sharpest workers are out building new sites.

Solar Support has learned through hard-won experience that restoration requires detail-oriented, organized, punctual individuals who know their way around salvage, repair, and replacement and understand how to respond to a site's evolving needs.



03

OUR APPROACH TO PLANT RESTORATION

DRAWING PARAMETERS THROUGH ASSESSMENT

Fifteen years of experience refurbishing weather-beaten PV assets means we know what to look for after the storm clears. First up is a careful assessment of what's gone wrong. There are four levels of damage to consider:

- **Complete destruction:** Nothing is operational. There is no way to generate power from any part of the plant without significant remediation.
- **Partial destruction:** Anywhere from 15% to half of the site is offline. The rest may be operational, but balancing repairs elsewhere may require shutting down undamaged sections over time.
- **Minor damage:** Roughly 10% of the site has been affected. There might be one or two central inverters offline and some tracker rows may be damaged, but overall the site can produce power and perform.
- **Site intact with some production issues:** One or more inverters are offline, but the overall site is generating power.



ACHIEVING CLARITY THROUGH DOCUMENTATION

Initial impressions can be misleading. Solar Support's experts know that even if damage appears to be minimal, there is value in documenting every aspect of the site that appears to have been affected, even superficially. We take pictures, at least four or five for everything that will require attention. We note components that may no longer be in production and determine which OEMs will play significant roles moving forward.

For sites with more extensive damage, we coordinate a grid-by-grid drone flyover to map the level of destruction. Insurance companies often cover drone inspections because they want to know what they're dealing with just as much as you do. We get both standard and infrared views of the entire site; thermal problems invisible to the naked eye show up in IR.

While time-consuming, scrupulous documentation from the start prevents surprises during plant restoration and

can help stave off change orders down the line. Solar Support makes sure you know what to expect before you invite contractors in to prepare estimates:

Our engineers keep track of everything in a custom project dashboard visible to the customer, continuing to add information as the remediation project progresses. And we make sure all contractors on the site do the same.

Transparency minimizes revenue loss throughout the process by ensuring that every stakeholder — the asset owner, operator, insurance provider, and all contractors — knows exactly where things stand at any moment. Want to take an inverter offline? It's critical to know beforehand which ones remain operational. Trying to salvage panels from a damaged table? You should know which tables already have been repaired, and how.

SECURING MAXIMUM INSURANCE PAYOUTS

Unlike new plant construction, remediation projects require working closely with insurance companies from start to finish. To maximize the insurance pay-out, and ensure peace of mind both for insurers and asset owners, Solar Support’s dedicated team of experienced professionals manage the extensive, mandatory documentation. Done properly, this effort can cost as much as 15% to 25% of the entire project’s labor costs.

An insurer will have its own vendors tracking the project, such as subrogation and investigations teams. Although asset managers may work directly with an insurance adjuster, contractors are more likely to communicate through a third party hired to assist the adjuster.

Different documentation may be required at every level of the claims process, which will be reviewed by parties with varying degrees of technical understanding. Solar Support keeps your documentation clear for laypersons, but stands ready to provide complex details as required.

Insurers will want to vet contractors and Solar Support knows what they want and need to see. They want to see

rapid progress toward repairs – particularly if they’re paying lost production damages – but they also want to see extensive validation to justify those bids.

This is where a full-scope general contractor can be invaluable. A “one throat to choke” umbrella company can be responsible for the myriad subcontractors required to restore a damaged PV plant.

Solar Support works closely with DEPCOM Power and Power Factor to serve as a single point of contact – coordinating the work schedule, overseeing every aspect of the repair work, handling the project’s extensive documentation, and interacting with insurers throughout the process.

HAVING SOLAR SUPPORT ON BOARD CAN BE THE DIFFERENCE BETWEEN COLLECTING A FULL INSURANCE CLAIM AND INCURRING SUBSTANTIAL LOSSES DUE TO UNFORESEEN DELAYS

SAVING BIG THROUGH SALVAGE

Before beginning restoration work, Solar Support sets standards for testing damaged equipment and establishing criteria about what warrants repair and what mandates replacement. Here, too, is where substantial

restoration experience can prove invaluable. Flexibility is key; be assiduous about maintaining quality, but don’t miss an opportunity to continue using viable parts.

In one Solar Support case, a tornado had ripped off an older inverter’s top - and side panel. Although initially the asset owner and inverter manufacturer

INSTEAD OF SPENDING OVER \$200,000 TO REPLACE THE POWER CONVERSION STATION, WE WERE ABLE TO REPAIR THE DAMAGED ENCLOSURE AT MINIMAL COST.



agreed that the entire inverter would need to be replaced, upon further inspection the Solar Support team presented a plan to re-energize the equipment. It worked.

ENSURING SUCCESS THROUGH SAFETY

Every step of remediation must build safety into the equation. From the first moments inspecting a damaged site to the final walk-through after restoration is complete, safety protocols are key.

Restoration projects are uniquely complicated, and few of the workers on-site will have done this kind of repair work previously. We make sure they're ready for what's coming:

- There is no off switch for a solar panel. Live wires may be dangling in unexpected locations. Heavy equipment may not be secured in place. As work progresses, new hazards may arise unexpectedly. Beware!
- In addition to ensuring that every worker has a pristine safety record, Solar Support conducts ongoing worker training and builds site safety inspections into every step of the process.
- Each worker gets a site orientation as they begin every stage of the project, even if they've worked on earlier stages. Restoration work means ongoing dynamic changes throughout the site.

SECURING EFFICIENCY WITH TRAINING

An additional advantage that Solar Support can offer: Cross-training or cross-functional facilitation of O&M providers during the restoration process to help ensure that restored plants continue to operate at peak efficiency. Such a service can minimize the acclimation and training process required when a new O&M comes on-site.



04

CASE STUDY 1: SAVING WITH SALVAGE

FLOOD DAMAGE



SITUATION In the fall of 2018, two hurricanes swept through the southeastern U.S., bringing torrential rainfall and massive flooding. Ten of 40 power conversion stations at a 92 MW PV plant on the outskirts of both storms were inundated with between 12 and 18 inches of water and remained flooded for several days.

SOLUTION

That's when Solar Support was called in. Our experienced restoration experts quickly discovered the underlying issue: the condensation was the long-term result of poor design. None of the doors or seals on the damaged central inverters fit properly and cooling consisted of blowing humid outside air inside the unit with no effort to dehumidify it.

Ultimately the OEM relented and restored the warranty to the 30 inverters that had not flooded. It stood firm, however, on the ones that had been underwater. There would be no replacing them.

As is standard practice, all of the plant's inverters had been taken offline before the hurricanes roared through. So when the inverter manufacturer came to inspect damage at the flooded sites, the OEM discovered that the shutdown had left condensate inside all 40 inverters. Rather than voiding the warranty only on the 10 flooded units, the OEM abruptly denied responsibility for any of them.

RESULTS

As the plant owner and insurance company prepared to spend about \$4 million to replace the flooded inverters, Solar Support offered an alternative plan to salvage and refurbish the existing units.

While the insurer approved the plan, it wanted to be certain that those ten inverters never flooded again. Solar Support put together a \$600,000 plan to raise their pads three feet – well above the highest flood point.

In a rare turn of events aimed at minimizing revenue loss, Solar Support was able to do the work while allowing continued power production in the areas of the plant where work was not taking place.

Six weeks later – rather than the 16-week to 22-week lead time that would have been required to bring in new inverters – Solar Support had raised the pads and got the flooded portion of the plant back online.

The rapid return to production means the plant generated revenues between \$400,000 and \$700,000 more than if the restoration had required waiting for all-new inverters. Combined with the \$1.8 million avoided cost from replacing the flooded units, Solar Support's expertise and execution resulted in total savings of over \$2.5 million for the asset owner.

Interruption savings

\$1.3M in business interruption damages

Restoration time

152 days faster than alternative

Competitive advantage

59% lower cost than alternative

Total savings

\$2.5M



05

CASE STUDY 2: OPTIMIZING OVERALL SYSTEM PERFORMANCE

WIND DAMAGE



Sometimes restoration requires fixing problems that pre-date extreme weather damage.

SITUATION

After a rogue storm tore through a PV power plant with 60 to 80 mile-per-hour winds, damaging 15% of its trackers, Solar Support discovered that the site's O&M contractor had not been doing proper maintenance prior to the weather event.

More than one-quarter of the site's trackers weren't operational before the winds hit, making it impossible to

maneuver them into a protective stow position. As a result, 233 of 1,600 full trackers were damaged and had to be restored.

Initially, the plant owner relied on O&M personnel to assess the damage and submit insurance claims. But four months after the damage was done – with no restoration work yet started – Solar Support was asked to take over.

SOLUTION

Within four weeks, we had set up a plan for deconstruction of the damaged areas, a testing process to determine viability for salvage, sourced components that needed to be replaced, and developed a flexible restoration plan to minimize revenue loss and maximize production output.

Ultimately, we successfully married the original older technology with the new, modern equipment required to repower the site – all without a significant (and costly) redesign. Such a complex accomplishment would not have been possible without our extensive restoration experience.

Interruption savings

\$381k in business interruption damages

Restoration time

126 days faster than alternative

Competitive advantage

40% lower cost than alternative

Total savings

\$3.3M

RESULTS

Perhaps even more importantly, while the asset owner anticipated replacing a large number of the damaged components for roughly \$1.75 million, Solar Support developed a salvage plan for the modules resulting in a saving of 1.3M, recovering 70% more modules than their original budget.

Other savings came from reduced business interruption claims and a more efficient timeline, staggered approach to the execution – which resulted in substantial savings.



Image taken from another site – photo credits from Rocky Mountain Institute

RESTORING A WEATHER-BEATEN PV PLANT MEANS FAR MORE THAN PICKING UP THE PIECES AND COBBLING THEM BACK TOGETHER AGAIN.

COMPLEX SITE RECOVERY DEMANDS THE UNIQUE SKILLS AND EXPERTISE THAT SOLAR SUPPORT HAS DEVELOPED OVER THE YEARS.

GOING BEYOND REBUILDING TO FULL SITE OPTIMIZATION, SOLAR SUPPORT MINIMIZES LOSSES WHILE BRINGING PLANTS BACK TO PEAK PRODUCTION PERFORMANCE.



AUTHORS



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John is a proven sales executive with 10 years in the solar industry and a proven track record of success with major utility and IPP customers. John's ability to build relationships, develop and implement innovative solutions and drive results have allowed him to succeed across industry segments. With management and quality experience at both Fortune 100 and Start-up organizations, John leads Solar Supports sales and business development efforts.

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Cliff, a Navy Veteran, drives restoration excellence, bringing his expertise in solar systems fault resolution and performance optimization to DEPCOM Power. With over 14 years combined experience in utility PV technology and power conversion systems, Cliff steers the company's restoration, repowering, and recertification strategies. Cliff graduated Magna Cum Laude from Arizona State University with a Bachelor of Science in Electrical Engineering.



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