Risk Mitigation through Negotiation and Project Management: Challenges and Opportunities in Utility-Scale Solar Power

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The concept of risk is nebulous by nature, and may trigger fear or adrenaline in our minds. The nature and number of risks in any given situation is infinite, because risk by definition is the unknown.

In the broad economic sense, risk drives markets: the more uncertain the outcome, the more volatile the market. In the more narrow and specific sense, however, we must not view risk as inherently negative. Instead, we must recognize the opportunity for identification and allocation of risk that is the essence of profitability. How well a company identifies, allocates, and manages risk may determine the result of any given project as well as any number of measurements of successful (or unsuccessful) returns.

The expanding utility-scale solar market in the Middle East and North Africa offers multiple opportunities to maximize returns through skilled risk management. As further developed in this manuscript, risk management is a science as well as an art: a utility-scale solar power plant requires both expertise in the identification and allocation of risk and creativity in the mitigation and management of manifested risks. From project planning through development to long-term operation and maintenance, the study of risk management offers powerful lessons for continued success and expansion of utility-scale solar power.

I. Planning and Preparation: Identifying Risk

Risk identification in the pre-development stage of a utility-scale solar power plant is essential to its long-term success. Failure to identify a potential risk may result in extreme or catastrophic failures of project budget, schedule, or output should such risk manifest. A skilled project development team first identifies potential risks in all spectrums of a project: environmental, regulatory, financial, topographical, design, procurement, construction, operation, and maintenance, among others.

One absolute requirement for early identification of risk is reviewing all proposed contract documents, including any agreements, laws, codes or other items incorporated into the proposed contract by reference. For example, although an owner may agree to provide a contractor with site access, it generally does so subject to all title documentation for that particular parcel of land or easement. By failing to locate and review the title documentation, contractors may fail to understand limitations and exceptions that accompany what otherwise appears to be an unqualified guarantee of site access. If the title documentation limits the type, nature or size of vehicles and equipment that can access the site, this can result in significant additional costs and delay for a contractor. Another example would be incorporation of a power purchase agreement or interconnection agreement in whole. Often, such documents are incorporated in whole without being attached to the engineering, procurement and construction (EPC) agreement, so the first step is to insist upon being provided a full copy of any document that is incorporated by reference. The next step is to ascertain what (if any) requirements or standards in the ancillary document could expand the scope or nature of work anticipated in the EPC agreement. Where there is any such potential conflict between the two documents, both parties must consult the "order of precedent" language in the EPC agreement to determine which obligation will govern. There has been a significant amount of litigation in the construction world based upon unanticipated incorporation of additional scope through incorporation by reference of third-party documentation, so responsible owners and EPC contractors must thoroughly review all documents included and incorporated in the EPC agreement.

After identification, the team must evaluate each risk. Evaluation of a risk should include analysis of the probability the risk will manifest, as well as the impact to the project if the risk manifests. If the probability of a risk is low and its impact likely small, the project development team should account for this and shift focus to other risks which may have a higher probability and more significant impact. Many organizations use a risk assessment matrix similar to the below matrix to classify identified potential risks:

		Impact				
		Insignificant	**Minor**	**Moderate**	**Significant**	**Catastrophic**
Probability	**Rare**	very low	very low	low	low	moderate
	Unlikely	very low	low	moderate	moderate	moderate
	Even	low	moderate	moderate	moderate	high
	Likely	low	moderate	moderate	high	critical
	Almost Certain	moderate	moderate	high	critical	critical

The matrix illustrates a prevailing risk assessment equation, where risk equals the likelihood of occurrence of an event multiplied by the consequences of the event. In addition to this numerical analysis, the psychology of risk also plays a factor in this stage of identification and evaluation. People are inherently likely to overestimate the probability of a risk that has occurred in immediate past experience, and similarly likely to underestimate the probability of a risk that has not occurred, and therefore is more difficult to imagine. People also tend to focus on the single catastrophic event (the rarest occurrence) rather than a series of minor risks – or indications of a coming catastrophic event – that culminate in a similarly extreme loss (a much more common occurrence). Key to effective risk management is recognizing these common, minor risks, and taking active steps to prevent cumulative impact.

Compared to traditional energy projects, the area of land required for utility-scale ground-mount photovoltaic projects multiplies the potential for various site conditions. A site containing subsurface rock imposes substantially different challenges in engineering and construction than a site without rock. These challenges affect both the plant's proposed schedule and costs. If a development team anticipates assuming the risk of subsurface site conditions, the knowledge that rock is or is not present significantly affects the project budget. If subsurface site conditions are unknown, on a utility-scale solar plant they fall into the risk assessment matrix category of unlikely but potentially catastrophic. The land area required for installation of utility-scale solar plants exposes the parties to a wide area of potential topographical or geotechnical site risk, but at the same time it offers significant risk management opportunities not available in traditional construction (including traditional power construction). Said differently, although subsurface conditions can vary across a large project site resulting in risk that preliminary geotechnical studies may not catch all areas of subsurface rock, the large footprint and nature of ground-mount solar installation allows an EPC contractor to supplement work forces (or add additional crews) to accelerate and catch up from subsurface impacts. In traditional construction, the singular critical path and limited area for work to be performed significantly constrains an EPC contractor's ability to bring in additional forces (or even parallel subcontractors) to speed up progress. The modular nature of constructing ground-mount solar projects, combined with the large space of the project footprint, results in solar EPC contractors having flexible tools to overcome potential delays by working in multiple areas at one time.

A project development team may conduct pre-development analysis for subsurface site conditions. A simplified analysis is illustrated below:

Project Budget	**$10,000,000.00**
Aggregate Probability of Subsurface Rock	0.2
Direct Cost of Subsurface Rock (if present) *includes engineering and construction modifications	$3,000,000.00
Schedule Impact of Subsurface Rock (if present) *includes acceleration and delay damages	$2,000,000.00
Mitigation Option: Cost of Geotechnical Survey	$50,000.00

In this scenario, because the probability multiplied by the total costs of subsurface rock equals $1,000,000 risk (indicating the risk is in the category of unlikely but significant/catastrophic pursuant to the risk assessment matrix), the project development team may opt to spend the $50,000 on a geotechnical survey of the proposed plant site in order to properly price the team's willingness to assume the risk. Such mitigation option may either conclusively determine the presence or absence of subsurface rock, moving the risk category from "low" (absence) to "critical" (presence) – or may merely narrow the probability of the risk to a more acceptable level.

Even in this simplified example, effective risk management cannot be viewed as isolated issues analyzed in a vacuum: whether the team chooses to conduct a survey may also depend on other project-specific factors. One such factor may be the team's negotiation position: if subsurface rock is found, does the team have the option to shift the risk or otherwise account for the cost and schedule impact of the rock? Even if the team does not, are the advantages of identifying a known risk in the predevelopment stage significant enough to proceed with the survey? Another factor may be whether the cost of the geotechnical survey will be at-risk for the team. In other words, assuming the team is competing for the award of project or negotiating a financing close, how likely is the project to be constructed – is it worth the risk of spending funds on a survey for a plant that may or may not be constructed?

The practice of risk management requires participants to identify and assess the risks of a proposed contract comprehensively, rigorously and honestly. True risk management combines the practical benefit of the participants' experience with the more "scientific" aspects of thorough calculation and assessment. A team must identify unknown risks (the practical benefit), it must evaluate the potential to discover such risks early in the course of the project, and it must be able to assign values to each risk appropriate for negotiation among the parties to reach a commercially viable agreement (the academic benefit).

II. From Negotiation to Execution: Allocating Risk

Once the project development team has thoroughly identified and analyzed project-specific risks, it must negotiate accordingly with other parties for the engineering, procurement and construction of the plant. One popular risk management philosophy advocates assigning risk to the party best able to control the risk. The negotiation of risk in utility-scale solar power plant project agreements will determine allocation of risk along a sliding scale of absolute assumption of risk to absolute avoidance of risk. One key to profitability is effective negotiation along this scale, which is dependent on the rigorous, comprehensive, and honest identification of known and unknown risks.

From a profitability standpoint, the "amount" of risk is not necessarily determinative – more relevant is that all risks have been knowingly assumed, knowledgeably priced, and actively mitigated. Generally, one must take risks in order to obtain rewards. While higher risk can open the door to higher potential profits, higher risk also tends to hold higher potential for loss. In construction, as in business generally, the party who will consistently profit is the party best able to allocate appropriate levels of risk with a proportionate level of reward, and further mitigate and manage when "risks" become actual "impacts."

Parties may adjust this risk-return tradeoff by structuring allocation of the individual risk an almost infinite number of ways among the two extremes of (1) excluding the full risk to (2) accepting the full risk. If a party agrees to retain and assume the risk, he may negotiate a price that accounts for the uncertainty. Alternatively, he may push the risk to another party (a vendor, or a subcontractor, for example, who may be experts in managing the specific area of risk) by contract. Or he may obtain insurance to offset the impact of the risk. A party may exclude some or all of the risk – which could include negotiation of a limitation of liability or indemnification obligations from the other party to the agreement. Full exclusion of the risk may be specific in the agreement – excluded from scope and/or liability as appropriate.

A typical engineering, procurement and construction (EPC) agreement for a utility-scale solar plant may employ a variety of contractual tools to allocate risk. For example, one common risk is the condition of the proposed plant site, which leads parties to negotiate contractual provisions separately allocating risk of adverse site conditions. Such a provision may be contingency-based (risk entirely allocated to one party as reflected in price) or shared risk (one party assumes the risk to a certain price point or percentage, which when reached transfers the risk to the other party). In addition to site conditions, parties may also specifically craft risk allocation provisions for various other risks: hazardous materials (including procedures in the event of the discovery of hazardous materials and responsibilities for costs and manner of removal), payment of taxes (and interpretation of local rules and regulations involving taxes or similar assessments by governmental authorities), material and equipment supply disruptions, and interconnection issues (including functionality of the generation tie line and substation for the plant).

Another common contractual tool of an EPC agreement for a utility-scale solar plant is the force majeure provision. A force majeure provision often excepts "severe or extreme weather conditions" affecting the project site from inclusion in the overall agreement price and schedule. How the contract defines "severe" and "extreme" will dictate who bears the risk of weather. For instance, 100mph winds may be considered "extreme" in some areas, but "normal" in other areas, so the mere speed of wind resulting in damage is not necessarily determinative of who must pay for the damage. Often parties will contractually define weather conditions resulting in force majeure relief based on 10 year (or some other period) norms in a particular area, making the determination of force majeure site (or area) specific. Depending on the agreement's scope of work, the force majeure provision may include a variety of potential circumstances, including grid limitations imposed by local energy authorities, additional permitting requirements, labor strikes, war, political unrest, and other emergencies.

In addition to specific force majeure provisions, EPC providers and developers may negotiate a so-called "catchall provision," allocating costs among the parties should an unknown risk wholly outside the other party's control or responsibility occur. Instead of a specific and exhaustive list of conditions that will entitle a party to relief for force majeure, such provisions will generally allow relief for circumstances beyond the control of the injured party (and to the extent the injured party was unable to mitigate the loss), often accompanied by a non-exhaustive list of "examples" that could qualify as force majeure. Such provisions significantly expand the scope of force majeure relief and generally favor the EPC contractor's risk profile. However, even though the EPC contractor is more likely to benefit from the application of such provisions, combined with a limitation of liability, such catchall provisions allow the EPC contractor to price its work without substantial contingency amounts to protect against unknown risks, thus preserving the EPC agreement's price-competitiveness with structured mechanisms that allow both parties to predict business costs of unforeseen site conditions arising during the course of the project.

One trap that owners (and EPC contractors with their subcontractors) fall into is believing that it is always better to pass risks downstream to the lower-tier party, as shifting risk one way or the other can have significant unanticipated consequences. Owners (and EPC contractors with their subcontractors) must be careful not to overstep by pushing all risk downstream or resulting prices from bidders will be higher on the individual project (and across a portfolio of projects) to accommodate significant contingency amounts. Often, especially where the upstream party has many projects, it may make more sense to keep and manage certain risks with the upper tier, who may be in the best position to efficiently address the risk.

III. Project Development: Managing Risk

Once construction begins, risk management shifts from theory to practice. Active risk management requires constant communication among the development team to resolve construction issues as soon as they arise and to mitigate any impact to project cost and schedule. It is critical that project-level personnel have open lines of communication with commercial and legal leadership to facilitate quick and efficient risk management. If a project manager does not know to whom to reach out, or is reluctant to reach out to leadership or its legal team, the decision makers may not even find out about an impact until it is too late to seek recovery. Many construction contracts provide notification periods as short as 24 or 48 hours after the party claiming relief first encounters the circumstance giving rise to such relief. If, as a result of a lack of prior communication (or bad experiences with prior communication), a project team hesitates to inform commercial or legal leadership of a problem until the project team feels comfortable they can explain the full cause and resolution for such problem, the company's contractual right to recover for the underlying impact may have already been waived under the EPC agreement for failure to provide timely notice. The "home office" must be proactive to establish relationships of trust and confidence with its project teams to avoid any costly hesitation on the project team when it comes time to report a problem in the field. Establishing structure within the team with an internal designation of roles and responsibilities allows each person to lead efficient resolution of issues arising within his designated role.

For example, one team member may manage on-site procurement and scheduling. This role would include tracking site deliveries and adjusting construction schedules according to any manufacturing or delivery delays. As with all risk, the earlier a party can identify and accommodate procurement delays, the less disruptive (and accordingly less expensive) the necessary modifications will be to the project. As solar panel technology continues to advance rapidly, during the construction of a utility-scale solar project (which may last months or years depending on its size) panel advancements may lead to the need to revise engineering plans and/or amend procurement schedules to allow installation of more advanced, more efficient panels. A team member focused on this risk, including visibility into the benefits of new panels compared with the costs/delay associated with design change necessary to install such new panesl, is best able to assess the implication of advanced technology on the project at the earliest possible stage, thereby minimizing the impact of the risk.

In other words, and referring back to the risk assessment matrix, a skilled project development team may move a risk along the spectrum from “high” to “moderate” or even “low,” depending on the available means of adjustment to project schedules and construction at the time the risk manifests. This is the art of risk management that prevents a purely quantitative measurement of success: success is not necessarily avoiding all risk, as risk by nature is not avoidable. Instead, successful risk management is identifying a manifest risk at the earliest point in time and taking immediate appropriate action to mitigate the risk. Appropriate action may be price-based, schedule-based, design-based – or any combination of strategies that most effectively address the risk.

Proper training, safety equipment, and heat protection gear assists in the prevention of accidents and injuries during construction.

Another team member may supervise site safety and security, ensuring compliance with regulations and supervising site activities around energized portions of the plant. Security measures double as loss prevention protection for the project development team, as valuable materials and equipment are often stored on site. Although the entire team must prioritize safety and security, this designated team member offers extra support to ensure all subcontractors and personnel on site follow the site safety and health plan. In addition, this team member assumes the lead in responding to unanticipated issues relating to safety and health.

Especially in the desert climate of the Middle East and North Africa, a strictly-enforced heat safety plan allows efficient construction while also protecting construction workers. One important consideration is which party bears the risk (i.e., cost and delay) when work cannot continue because of severe climate. It is critical to establish clear criteria in the EPC agreement, based on sound health and safety principles, that define when a performing EPC contractor or its subcontractors must cease work, and further to establish how resulting delay will be addressed. In many instances, the EPC contractor will take the risk of delay/costs up to a certain number of missed days or manhours, at which point the risk of delay/costs will pass to the owner under the concept of force majeure.

Not only does such contractual clarity avoid disputes between the parties over liability, but further can avoid circumstances where teams in the field try to "push through" dangerous heat conditions to avoid incurring delay. The team's development and enforcement of such a plan conforming to the requirements of local jurisdictional regulations and labor union agreements also minimizes disruption to the project while preserving goodwill with authorities. The risk avoided with a heat safety plan is the risk of lost efficiency due to injury or illness of a worker as well as the risk of closure of the project by authorities as a penalty for failure to adequately account for heat conditions and failure to abide by appropriate regulations for the safety and health of construction workers.

A project development team member devoted to management of certain scopes of work on a project – or certain subcontractors, if the team prefers organizationally – maximizes opportunities to improve efficiency in coordinated scopes of work and minimizes potential for conflict and inefficiency between dependent scopes of work. For example, a utility-scale solar power project requires significant high voltage and electrical work. A team member overseeing high voltage and electrical scopes of work may facilitate installation of transformers and inverters, confirming timely delivery, installation, and energization from subcontractors and suppliers. He may also deal with related issues as they arise during the course of the project. For example, if an electrical subcontractor severs an unmarked underground cable during trenching, resulting in loss of power to the site (or an adjacent site), this team member will coordinate resolution of the issue and safe replacement of the cable. Once the immediate risk is resolved, a skilled team member investigates the cause and origin of the risk in order to prevent reoccurrence. He communicates the results of his investigation to his team and any appropriate subcontractor to ensure a similar event does not disrupt the project moving forward.

Team organization, designated roles, and constant communication are key to mitigating risk on a utility-scale solar project. Above, a construction team examines site drawings, and a utility-scale solar project site under construction shows open trenches for electrical wiring.

One common thread in project risk management is constant communication. Project development team members cannot effectively manage risk without timely informing each other of the occurrence of a risk, including measures taken to mitigate the present risk and avoid the future risk. Notice requirements in EPC agreements are generally based on two underlying themes. First, the upstream party requires timely notification of any potential impacts (including claims for time or cost) in order to understand and control cost or time overruns on its project. If the downstream party is able to assert claims at any time, even at the end of the project, then the upstream party never has certainty around the economics of its project until final completion. Second, and perhaps most important, the upstream party requires notification of potential impacts so that the upstream party maintains the right to direct how the project team will manage such impacts. For instance, on construction of a ground-mount solar plant, a site subcontractor may encounter mud following heavy rains on the portion of the project site where it intended to start work. While the subcontractor may prefer to keep the same sequence and work through the mud (including additional manpower and overtime in order to maintain schedule), the EPC contractor may prefer to resequence the work starting in another area that is dry until the muddy area dries out (which should have little or no additional cost or delay). As with most problems, there are multiple ways to react to such a site condition, but each has its benefits and costs. While the first option benefits the subcontractor with additional costs (onto which the subcontractor can apply additional profit), the second option benefits the EPC contractor by minimizing or avoiding altogether any additional cost. By including strict notice requirements in its subcontract, the EPC contractor informed the subcontractor and bought the right to control how problems in the field are addressed and, further, to make sure that such problems are addressed in the manner most beneficial to the EPC contractor.

With time, the gains of such communication may be transferred to a new project through instructional sessions designed to build on past experience, streamlining more efficient reactions to manifest risk and preventing the occurrence of unnecessary risks.

Active risk management during project construction must also include communication to third parties involved in the project. A project development team demonstrates added value to a project owner by informing the owner of actions taken to mitigate risk and pursue completion of a project within the originally-contemplated price and schedule. A project development team improves working relationships with subcontractors by providing timely responses to project issues and by collaborating among subcontractors for optimal solutions to project risks.

IV. Operation & Maintenance: Monitoring Risk

The financing and construction of a utility-scale solar power plant is a noteworthy achievement – but it is only the beginning of a long and profitable project life. Once a plant is energized, the skilled long-term operation and maintenance of a utility-scale solar power plant preserves panel and equipment warranties (or performance guarantees, according to project structure), as well as ensuring maximum output for the life of the plant. As the management of risk differs from project negotiation to project development, so again does the focus of risk shift in a plant's operation and maintenance (O&M) phase. The type and frequency of O&M risks differ from these first two phases – as does the appropriate response and mitigation measures to O&M risk.

An O&M team must be knowledgeable of the standards for operation of the plant, including relevant laws, permitting regulations, and warranty documents. The team must be prepared to react to unanticipated risks with the appropriate speed and diligence. Because the plant is energized and producing revenue, the financial impact of O&M risks may be greater than other project phases due to the effect of such risks on project output. Therefore, a risk assessment matrix for the O&M stage may have fewer risks in the "low" category and more risks in the "high" or "critical" categories. A well-drafted O&M agreement with a defined scope of services, insurance, and indemnity provisions sets the framework for the O&M team to react to unanticipated risks. Such agreement should also provide a mechanism to add services at negotiated rates when authorized by the responsible party.

Initially, the O&M team should be aware of its allocated risk in the O&M agreement and should structure a response system for manifested risks according to the party responsible for the risk. This initial response system provides the O&M team direction that allows the responsible party to select appropriate mitigation measures. (In contrast, a team that does not have such an initial response system may not promptly inform a third party responsible for the impact of a risk on the project – thereby leading to conflict between the O&M team and the third party regarding the choice of mitigation measure and ultimate responsibility for the effectiveness of the mitigation measure.)

A successful O&M team manages risk by understanding the constraints of the plant and reacting appropriately to events that affect plant availability or output. Risks may be internal to the plant (such as wind damage to arrays of solar panels) or external to the plant (such as a

Above, an O&M provider monitors plant systems for prompt reactions to output issues.

Below, a well-maintained utility-scale solar plant produces energy (and revenue) for its design life.

utility's curtailment of plant output). With either type of risk, at the O&M stage the team's immediate and appropriate reaction is critical to mitigate damages of lost revenue. The O&M team should determine based on its initial response system whether any third parties should be notified of the risk event, and should analyze potential options for effective response to resolve or mitigate the impact of the event. If a utility or government agency is involved in the event, the O&M team must coordinate its communication with the utility or agency to estimate the time and impact of the event (and ultimately to potentially negotiate a resolution of the event). If resolution requires an outside vendor, the O&M team should be prepared to quickly engage such vendor and supervise the appropriate scope of work to complete the resolution.

The O&M team's experience is an advantage in these situations. For example, a risk event of weather-damaged panels may require knowledgeable supervision of technical troubleshooting or repair of energized portions of the plant. An experienced O&M team will be well-informed of the extent of the outage required for repairs (in the event of damage presenting a danger to safe operation of the plant), or whether repair work may be completed on a more routine schedule (when the plant is offline or at night, in the event of damage that does not present a danger to safe operation of the plant and does not significantly prevent or impede plant output).

As in the project development stage, communication among the O&M team and third parties (owners or regulatory authorities) is critical to successful risk management. Local jurisdictions, system operators, and utilities may impose periodic regulatory planning and reporting requirements. Due to the confidential and proprietary nature of the utility-scale solar industry, any disclosure of data to third parties will likely be subject to confidential information obligations under the O&M agreement or separate obligations pursuant to a non-disclosure agreement. The O&M team must balance its confidentiality obligations with the extent of disclosure required by any periodic reporting.

Equally critical to risk management in the O&M stage is a team's collection and skilled interpretation of plant performance data over the life of the plant. Rapidly expanding technology only further heightens the importance of real-time and accurate data analysis, as the growing complexity of systems leads to an increase in the number and type of potential problems affecting plant output. As one example, the growing preference for tracker systems in plants requires greater oversight and monitoring in the O&M phase (to ensure trackers function as intended, in part by preventing interference with tracker parts caused by weather or site conditions). Consistent with accepted risk management principles, the more quickly the O&M team is able to identify an issue, the easier and less costly its resolution is likely to be.

V. Conclusion: Proactive Risk Assessment and Management are Key to Long-Term Success in Utility-Scale Solar Power

As the utility-scale solar power industry expands in the Middle East and North Africa, active risk management strategy and its implementation will be key to continued success for financiers, developers, and contractors. Utility-scale solar power projects are inherently risky, but their risk presents significant opportunities for parties to provide an economical and environmentally-beneficial power source for the region. Skilled and customized risk management on each project maximizes profit potential and longevity of the plants, making the most of the opportunity presented by current technology and site availability.

The proactive identification and allocation of risk, active management and problem-solving in construction, and finally, monitoring and interpretation of an energized plant's output are essential to the success of any utility-scale solar power project. Each project is unique and requires diligent risk management in planning, negotiation, and execution to address continuing challenges and constantly-evolving issues specific to each project and the parties involved in its construction and operation.