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Begin With the End in Mind When Navigating the Renewable Project Approval Queue

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The entire power industry is going through an unprecedented transformation. In response, regional transmission authorities across the country are initiating a variety of steps to improve long-term planning in preparation for a host of new demands that could threaten the high transmission reliability that power customers have come to count on.

As more renewable energy is connected to the grid, more grid-scale energy storage can provide operational flexibility, reliability and stability.

The Electric Reliability Council of Texas (ERCOT) market is among those markets finding an increase in emerging storage technologies interconnection requests. With more than 31 gigawatts (GW) of stand-alone energy storage projects and an additional 36 GW of combined solar and storage projects in the interconnection queue, ISOs and RTOs like ERCOT are continuing to find that dealing with the challenges of integration is a significant planning and operational burden.

The grid is changing rapidly. In ERCOT, for example, significant coal-fired capacity is being retired and ERCOT's energy-only market structure does not provide capacity-based incentives to build new conventional generation; instead, ERCOT relies on market volatility to signal the need for a potential new resource. The existing investment tax credit (ITC) incentive structure encourages renewable energy projects and these incentives will gain momentum under the 2022 Inflation Reduction Act (IRA).

The IRA establishes a new ITC structure for stand-alone battery energy storage systems (BESS). The result is that ERCOT has, and will likely continue to have, one of the country's highest percentages of renewable energy capacity connected to the grid. As of the end of 2021, 28.4 GW of wind capacity and 8.3 GW of solar capacity was connected to the ERCOT system. These numbers are expected to increase with passage of the IRA.

These factors are making it extremely challenging for independent system operators (ISOs) and regional transmission organizations (RTOs) to initiate and complete the transmission reliability studies that are necessary to support integration. The best opportunity to overcome these challenges is for ISOs and RTOs to have key partners on the other side of the table within BESS developer organizations that understand the purpose and drivers of these vital reliability studies. Navigating the design, construction and commissioning process for BESS with operations and planning in mind will require close collaboration among generators, transmission service providers (TSPs) and ISOs like ERCOT. This collaboration is the key to a win-win-win scenario for all players.

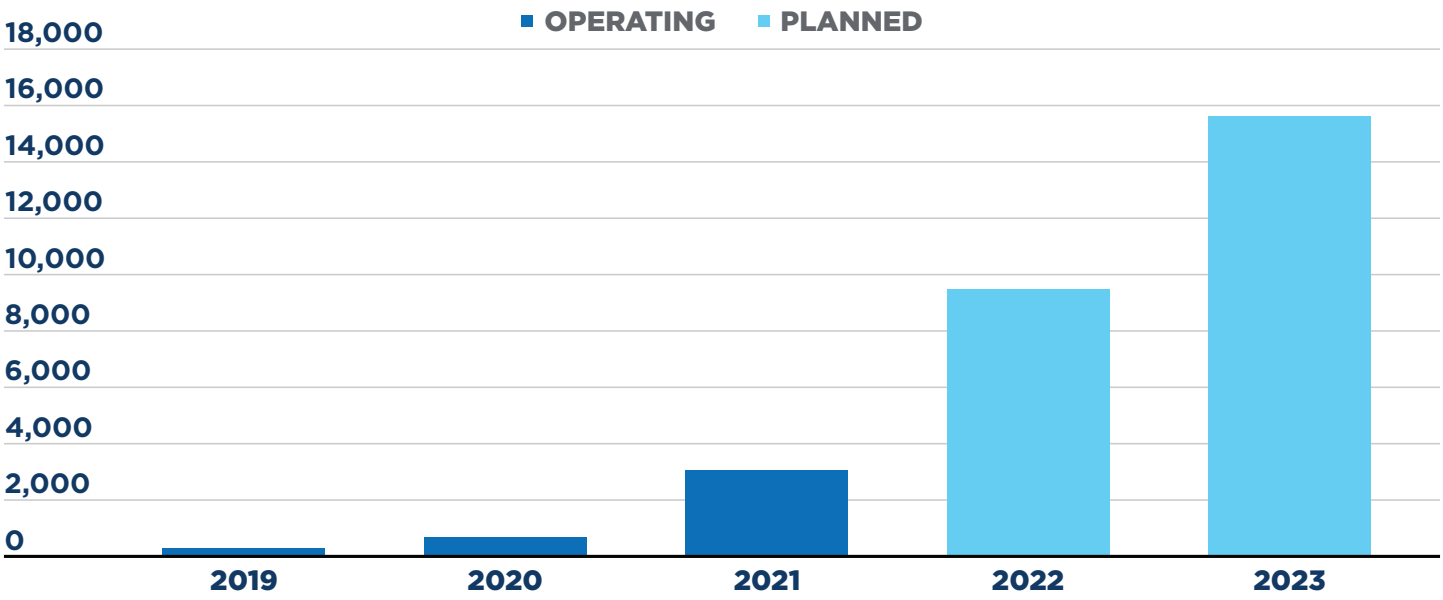

Figure 1: US Utility-Scale BESS Deployments (MW). Source: S&P Global Market Intelligence.

The Study Is Critical First Step

Interconnections have always been essential for a stable grid and this fact is only growing in importance as renewable generation and energy storage facilities are connected.

Navigating the interconnection process successfully all begins with the study and this process should involve discussions between the transmission authority and the utility or private generation provider to clarify the scope of the project, confirm assumptions and address other requirements. The team then runs the various analyses, focusing on defining any potential adverse impacts to the system first. Following this, mitigation options are surfaced and tested for further analysis.

Remember that the project is conceptual when it enters the queue but may look quite different when it comes out the other side. This is because technology is moving fast and regulations are evolving as well. Battery chemistries are advancing quickly, resulting in greater energy densities and changing safety features. Combine these advances with new specifications for inverter technology and the result is a situation where what you first specify on an application may not be the exact system that gets energized.

The inverters or battery technology filed with a plan may not be the latest version by the time the project is ready to execute a final interconnection application. If inverter technology changes, it typically means the interconnection application will need to be reevaluated. While not all the interconnection studies may need to be completed, if there is not some form of planning or analysis a project owner may be waiting on the ISO/RTO for an answer. This answer can be delayed, given the large number of projects the ISO/RTO must respond to. The right solution is to work with a third-party transmission partner who can compare inverter characteristics through the development and comparison of model quality test reports. This proactive step can arm project owners with potential solutions to bring to the ISO/RTO and other interested parties like TSPs to support their decision-making processes and timely consideration, saving time for all parties involved.

Current supply chain challenges need to be accounted for as well. If the equipment specified isn't available by the time procurements need to be made, quick pivots are required. Within ERCOT, if the approved equipment isn't available at the time of execution — and other components are substituted — it may or may not require a return trip through the process. That's where having the right partner in the room that understands the drivers behind important reliability studies proves extremely beneficial for all parties involved and for the success of the project.

Integration Is the Key

Executing these interconnection projects increasingly takes an integrated engineer-procure-construct (EPC) approach that is centered around reliability planning studies, interconnection queue support, and end-stage operational integration and commissioning. Emerging and quickly evolving technologies make this more crucial than ever.

It's a given that the interconnection queue can be lengthy. Utilities and developers alike need to be aware of many factors, including regional variations of the process, that could affect the ultimate success of an application.

How does one navigate that process appropriately and efficiently to attain project objectives? Time is money, and any unnecessary delays to interconnection can cost months of service, potentially representing the difference between a positive or negative net present value (NPV) for a project as a portfolio asset. That difference could determine whether the project ultimately goes forward.

Here are four tips for navigating the process.

1. Achieve Consistency Across Studies

With increasing numbers of renewable and storage projects being proposed and entering development, organizations — from municipalities and quasi-governmental entities to investor-owned utilities — are being saturated with study requests. A utility that performed 20 studies one year might be asked to perform 100 the next while needing to meet the same regulatory time frames.

Significant study areas of focus include:

- Power flow analysis
- Transient stability analysis
- Bus flow analysis for phase I and II of the annual cluster-based interconnection studies
- Subsynchronous resonance studies
- Reactive power assessments
- Model quality testing (PSSE & PSCAD)

Whether assisted, partnered or handled in-house, study consistency is essential to obtaining good results while minimizing demands on valuable time. Evaluators must take all technologies into account and approach each without biases, reflecting the reality that varying technologies come with different challenges and serve different objectives.

2. Adopt Best Practices

Renewables and inverter-based, resource-specific regulations tend to arise in a piecemeal fashion, starting in one region before being adopted in others, like a wave across the industry. EPC partners with a deep bench of qualified regulatory and transmission planning professionals who have knowledge of requirements spanning multiple regions can leverage first-mover experiences in one region to help smooth out the regulatory wrinkles in another. A technology-specific requirement in one region might be new to a given utility, but the integrated EPC partner might have already performed two, three or more studies in regions that already have addressed that regulation.

Drawing on that previous experience can bridge the knowledge gap for the project owner, ISO/RTO, and the utility, enabling the application of standards already established elsewhere to avoid reinventing the wheel and avoid hurdles or pitfalls already successfully navigated elsewhere. Trends tend to move like waves, whether they're regarding the hosting capacity requirements in one region or offshore wind integration in another. Leveling that industry knowledge base nationally is essential to promoting fast adoption of best practices.

From a developer/owner perspective, best practices can be attempting to standardize project-side details, such as major equipment and layout of inverter blocks. This standardization can help strengthen vendor relationships so owners can stay up to date and ahead of technology changes to minimize project impacts. This standardization can also help the ISO/RTO and TSPs know what to expect when certain entities apply for project studies.

3. Accelerate Through Modularization

Every project has its life cycle, moving from ideation and studies to design, energization and becoming commercially operational. Speed to market is an important driver.

Modularization solutions are an increasingly popular way to speed up project execution, and they can be a sensible choice in many contexts. However, there are caveats. Modular packages and approaches that cost less upfront or work well in one region might not be worthwhile in another if they cannot gain acceptance from governing regulatory bodies. There are differences in modular packages and solutions, so it is prudent to investigate how the preferred option might impact project timing and regulatory filings. Standard designs can be a starting point, but even they can require tailoring to individualized circumstances.

4. Adapt for Differing Penetration

Not all power is equal. For example, some types of inverter technology can add nonstandard power quality into a system. Why is that potentially a problem? Think of the ideal electrical grid as a pool of clean water. When nonstandard power or harmonics are injected into the system, maybe it adds a little salt. If that is just a single, small occurrence — perhaps

equivalent to adding a gallon of salt in a 200-gallon pool — it's not too big of a deal. But what if industry trends lead to 100 new resources, somewhat like adding 100 gallons of salt into that 200-gallon pool? It would make a big difference, and that could lead to technical problems in the system that wouldn't crop up in the smaller example.

Size, scale and penetration matter tremendously, as does knowledge of the technical nuances of varying technologies. Differing penetration scenarios call for different studies. Utilities may not want or need an advanced set of studies in a small-penetration scenario, but they also would not want to be taken by surprise if the combined effects lead to unforeseen system issues, due to higher penetration trends in certain areas of the system.

It is essential to understand the broader context of a project and see the big picture. In the long run, it is far more economical to build the right system upgrade than to underestimate, make multiple adjustments and wind up with a large system rework. Spending a little more upfront or taking a slightly different approach from the beginning could reap huge future-proofing benefits.

Defeating Misconceptions

As use of solar, wind and other forms of renewable energy sources expands across the globe, so does the common misperception that such projects are simple to execute. Though construction of a solar, wind or battery storage facility may involve fewer components than those installed in a gas-fired power plant, for instance, it does not mean that expensive and potentially catastrophic issues cannot arise.

The assembly-line nature of installing thousands of photovoltaic (PV) panels or batteries on a site means that one mistake could be repeated over and over again, resulting in expensive and potentially schedule-busting fixes. An integrated EPC approach is becoming widely acknowledged as one of the most effective insurance policies available to reduce the risks of bad outcomes and unintended consequences in solar and storage installations.

There is no question that EPC is becoming the preferred delivery method for both renewable and renewable-plus storage projects. The key question owners should be asking is: How experienced and knowledgeable is my EPC team? Can it perform all or nearly all phases of my project, or will I be dealing with multiple subcontractors?

It is not uncommon for a single installation project to involve five or more separate subcontractors to execute PV engineering, BESS and balance-of-plant (BOP) engineering, BESS integration, high-voltage engineering, and overarching construction. An integrated EPC firm knits together those functions to provide the full range of services including planning and permitting, all engineering disciplines and self-perform construction.

Illustrating the value this can provide, environmental specialists on an integrated team can identify site constraints like wetland areas or underground utilities along with local rules and regulations before the design is finalized. High-voltage engineers can weigh in on interconnection and substation requirements. Thermal management specialists can provide valuable insight on energy storage system cooling requirements. All these specialties and more increase the probability that accurate information will be delivered to the owner, helping to plan around project challenges proactively instead of reacting from one challenge to the next as the project is passed off from subcontractor to subcontractor.

Engineers who work closely on-site with construction crafts and trades see firsthand how to improve the execution process. This leads to a learning environment of continuous improvement for construction-led design that enables better sequencing of implementation. Because solar and storage projects are such highly repetitive installations, this is an essential mindset. A construction-minded design can plan for site nuances, such as where to include civil features like temporary retention basins and temporary laydown areas, as well as the proper order of construction — enhancing project efficiencies and reducing the need to go back to the drawing board if issues arise. An accurate design is the key to correct installation and close collaboration is how it all gets done. Moreover, it helps the team pivot quickly and safely as unanticipated issues emerge, as they always do on every project site.

Combine these challenges with increasing complexity in gaining approval from regional transmission authorities to interconnect the project and it only increases the argument in favor of an integrated EPC approach with a properly qualified firm. EPC firms are incentivized based on overall project is successful, unlike specialized firms that may only be focused on one piece to maximize their returns. Integrated firms do not succeed unless and until the overall project succeeds.

Safely Navigating Risk

The demand for solar and storage projects right now is booming, and owners have a wide array of firms and implementation methods to choose from. Before making a choice of contractors heavily weighted by cost, it's vital to equally consider the team dynamic. An integrated EPC firm offers exceptional value and understanding of all project aspects, including regulatory, transmission planning, environmental, design, construction and commissioning, with seamless and ongoing communication to mitigate risks and deliver a final product with the preferred performance within budget and schedule.

As renewable projects get larger and more complex, battery storage projects will follow suit. The timing of the approval processes administered by the ISO/RTOs is simply the reality today. Studies and related analyses supported by partners integrated with an entire team capable of delivering a project end to end is a pathway to a win-win-win outcome.

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