

WIND ENERGY INTERCONNECTION

Issue Brief

ISSUE DESCRIPTION/PROBLEM STATEMENT

As bulk power competition has been introduced in the electric power industry, interconnecting generators to the grid has become more contentious. Today's processes guiding interconnection and planning must accommodate a more complex business environment, promoting competitive forces in separate generation, transmission, and retail markets on one hand while ensuring system reliability and promoting infrastructure efficiency, stakeholder participation, and other concerns on the other. At present, not everyone is satisfied with how generator interconnection is done. Generators believe interconnection is opaque and inefficient and acts as an entry barrier to new generators. Transmission providers assert they need minimum commitments from generators interested in interconnecting to sort out generators that are likely to interconnect from those that may not. They also seek assurances that their control area will benefit from adding new generation, especially if the new generator is located on one utility system while serving load in another utility system. In turn, some state regulators believe generators are unfairly burdening retail ratepayers with interconnection costs while serving loads in external markets.

In response to these problems, FERC has issued a final rule on interconnection for generating projects 20 MW and over, and has proposed a draft rule on small generator projects up to 20 MW.¹ When finalized,

FERC's interconnection rules could standardize interconnection policies and procedures; make access to transmission owner studies and data more transparent; and overall, make the task of interconnecting to the transmission system potentially more consistent and predictable.

The proposed small generator interconnection rule is discussed later in the brief. The large generator interconnection rule requires the approximately 176 FERC-jurisdictional utilities to amend their open access transmission tariffs to include standard interconnection procedures and a standard interconnection agreement. The rule encompasses two types of interconnection service: energy resource interconnection service that is a basic interconnection service, and network resource interconnection service that is a more flexible service and allows the generator to qualify as a network resource. Both types of interconnection services ensure a generator can be interconnected safely and reliably,

July 24, 2003. The final rule is at <http://www.ferc.gov/whats-new/comm-meet/072303/E-1.pdf>; a short summary is available at <http://www.ferc.gov/industries/electric/indus-act/gi/stnd-gen/LG-Fact-Sheets.pdf>. For FERC's proposed rule for small generators, see *Standardization of Small Generator Interconnection Agreements and Procedures*, Docket No. RM02-12-000, also issued July 24, 2003. Available at <http://www.ferc.gov/whats-new/comm-meet/072303/E-2.pdf>. A short summary is available at <http://www.ferc.gov/industries/electric/indus-act/gi/small-gen/sm-gen-fact-sheet.pdf>.

¹ For large generators, see *Standardizing Generator Interconnection Agreements and Procedures*, 104 FERC ¶ 61,103, Docket No. RM02-1-000, issued

but do not ensure energy delivery.² Pricing for interconnection and any upgrades to the transmission system, if necessary, will be discussed later.

Some commonly cited interconnection issues, as well as specific issues with interconnecting wind generators, are discussed below.

LACK OF TRANSPARENCY

The transmission provider generally determines the data, assumptions and methodology used in performing interconnection and system impact studies. These practices can vary among transmission providers. In addition, this information is not always available to generation developers or their consultants, leading to “black box” allegations. The lack of transparency can lead to delays and disputes; may impede early project development and financing; and make permitting more difficult, as interconnection studies are often a required element of a state permitting process.

CLOGGED QUEUES

A queue system is used for generator interconnection in many areas of the country. Under this system, interconnection requests are processed sequentially, with the interconnection study priority determined by the project’s position in the queue. In general, it is assumed that generators in the queue will come on-line in sequential order, meaning that generators must account for the possible reliability impacts of each

proposed generating project ahead in the queue.

Generators have identified several problems with the queue system. In many regions of the country, the queue is backlogged with proposed generating projects, both inactive and active. Because of this, generators enter the queue almost as a first step, when the project is at its conceptual stages, in order to reserve a place. Thus, the clogging of the queue is almost self-perpetuating. A secondary self-perpetuating effect can also occur: as more projects remain in the queue, more changes of circumstances can take place that require restudy of potential system impacts. In addition, system impact studies usually focus on one project at a time, but at the potential risk of ignoring the possible combined impacts of several generating projects that may be located within a geographic area.

Some generating companies view their queue positions as a “property right,” regardless of the viability of the generating project, and adjusting or eliminating their queue position may elicit claims for compensation to the generator.

Assuming the generator meets all necessary financial and procedural requirements of the standard interconnection agreement included, FERC’s large generator interconnection rule requires that a generator come on-line within 10 years after first filing an interconnection request. FERC stated that it expects transmission providers and generators to negotiate and include contingency provisions if expected network upgrades from a generator higher in the queue do not materialize.

² If there is a bid-based energy market, such as what exists in PJM, the NYISO, and ISO New England, then energy resource interconnection generators can bid into an energy market and be dispatched, if accepted. Otherwise, these generators must purchase non-firm or firm transmission service. Network resource interconnection generators must purchase network transmission service from transmission providers.

WHO PAYS FOR POTENTIAL NETWORK UPGRADES FROM GENERATOR INTERCONNECTIONS

There is considerable controversy over who should pay for transmission network upgrades that may be required as a result of interconnecting a generator. There is little dispute about requiring generators to pay for direct interconnection costs, such as attachment facilities (i.e., step-up transformers) that directly connect the generator to the transmission grid. Furthermore, there is little disagreement about requiring all ratepayers to pay for grid improvements necessary for reliability. The controversy exists over network upgrades required to interconnect a generator that would not be required otherwise for local service reliability, and in particular, for generators seeking to interconnect facilities in a control area but transmit the power to customers out of the control area. In that situation, native load ratepayers potentially could pay the costs of interconnecting the new generating plant while not receiving some or any of the electric power produced by that plant. On the other hand, generators maintain that these network upgrades are used by and benefit all transmission customers, including “native load” (i.e., retail ratepayers). Thus, generators believe it is unfair to require a new generator to pay for the total cost of these upgrades without adequate compensation for the “network benefits” they provide.

Two industry models currently exist for generator interconnections that require network upgrades. One is rolled-in transmission pricing where all ratepayers pay the costs of necessary transmission upgrades resulting from generator interconnections. In Texas, the Electric Reliability Council of Texas (ERCOT) practices rolled-in transmission pricing, i.e., all customers pay for network system upgrades or transmission capacity additions. Proponents assert that because the

transmission grid is used by and benefits all transmission customers, all transmission customers should pay for network upgrades.

Other regions of the country require generators to pay for any necessary transmission network upgrades. In these regions, the cost allocation of network upgrades is performed on a “but for” basis, i.e., generators pay the cost of any network upgrades that otherwise would not be necessary but for interconnecting the generation to the transmission system.³ Generators then receive a credit against their transmission costs, or in the case of some RTOs such as PJM and the NYISO, financial transmission rights, in order to avoid generators having to pay both the network upgrade costs and the cost to use those upgrades.⁴ Under an alternative arrangement known as participant funding, generators would receive neither a credit against their transmission costs nor financial transmission rights. Proponents argue that participant funding provides important locational price signals that are ignored under rolled-in pricing, providing the incentives for efficient siting of generation rather than socializing those costs.

Whether the costs of network upgrades should be paid for by all transmission customers or by generators is the subject of debate among policymakers, regulators, and industry participants. FERC historically has favored rolled-in transmission pricing, but signaled a change in direction with the large and small generator interconnection rules. There,

³ Generators can also receive a credit if the generating project defers or eliminates any transmission expansion or improvements needed for reliability. In addition, if multiple generators cause a local or network upgrade to be required, these costs are allocated among those generators.

⁴ FERC views the paying of network upgrade costs and power transmission costs as “and” pricing, which is prohibited under FERC policy.

FERC indicated it would allow pricing flexibility for network upgrades, including participant funding, as long as an independent entity administers generator interconnection and the determination of necessary network upgrades.⁵ If the transmission provider is not independent, then under both the small and large generator interconnection rules, generators would only pay for facilities on their side of the interconnection. Generators would also initially pay the cost of network upgrades to the transmission provider's transmission system, and the transmission provider would refund these amounts to the generators over five years (with interest) in the form of transmission service, but only once the generator begins commercial operation.⁶

More generally, FERC also addressed who pays for network upgrades in its proposed Standard Market Design rule in July 2002, as modified by the "White Paper" the Commission released in April 2003. FERC proposes to require RTOs to be responsible for transmission planning as soon as possible, and no later than when the RTO begins operations. RTOs must also coordinate transmission planning activities with state regulatory commissions and, if applicable, multi-state entities. The Commission proposes to leave what are considered transmission upgrades or enhancements necessary to maintain reliability, and what the Commission calls "economic enhancements," to regional state committees. The Commission defines economic enhancements as those not necessarily required to maintain reliability

⁵ FERC stated it would allow FERC-approved but not yet operating RTOs or ISOs to use participant funding for network upgrades as a transition mechanism for up to a year.

⁶ As noted before, FERC also said that providing well-defined capacity rights and financial transmission rights in lieu of refunds, such as is done in the PJM RTO and NYISO, would also be acceptable.

that would alleviate major and long-standing regional congestion; those unlikely to be participant-funded because of the size and scope of the transmission upgrades; and/or those with positive regional benefits from a cost benefit analysis that compares the costs and benefits to load in a region. FERC will allow regional flexibility in determining the boundary between reliability upgrades and economic enhancements, but such criteria in making that distinction must be non-discriminatory and be included in the RTO tariff.

Interaction with Transmission Planning

In some regions, the interconnection queue may be a primary input into transmission planning. The project-by-project nature of the queue may result in burdensome cost allocations, such as requiring one wind project in the queue to do network upgrades for other wind generating projects. This situation is another factor that encourages generators to file for interconnection as early as possible, so they are responsible for paying potential network upgrade costs for as few projects as possible.

There is important overlap between generator interconnection and transmission planning that suggests both should be integrated, but other factors may also drive transmission planning. These factors include load growth, equipment replacement, removing transmission bottlenecks to foster electric competition, new or additional transmission service requests, development of merchant transmission, and transmission system improvements to improve system reliability. A clear and structured transmission planning process can provide information to generators on preferred system locations to interconnect and determine the baseline network upgrades necessary for reliability reasons that would be paid for by electric customers.

For wind specifically, there is a significant mismatch between the modular, relatively small project size of wind projects and transmission planning processes. For instance, hundreds of megawatts of wind projects can be deployed in a year, whereas transmission planning and transmission enhancements can take some time, perhaps years, to accomplish. Under a project-by-project interconnection approach, participant funding may be problematic for wind generators, as the first wind generator may be responsible for paying the transmission upgrade costs necessary to bring on-line that particular wind generator and any other planned wind projects.

SMALL GENERATORS IN THE QUEUE

Small generators of 20 MW and under that are normally interconnected at lower system voltages and may have little or no bulk system impacts, may be lumped in the same interconnection queue as large projects. Even smaller projects, at 2 MW or under, have the potential for even fewer impacts, as they are often “packaged” facilities that operate on a “plug and play” basis, with power quality issues addressed through certification processes. These projects may not have system impacts that require further studies or upgrades, yet they may have to wait until issues with larger projects ahead in the queue are resolved. These smaller projects may also be interconnected on the distribution side of the grid, or installed “behind-the-meter.” In that situation, these facilities may not make wholesale sales over the transmission grid, or electrically interact with larger generating projects that would be interconnected at transmission-level voltage. For all small generators, profit margins are typically quite small, and unexpectedly large interconnection costs and/or lengthy processes that require significant upfront engineering analysis by the developer can quickly eliminate any project profit margin.

As noted before, FERC issued a proposed rule on interconnecting small generators, defined as up to 20 MW. Some of the same elements in the large interconnection rule apply to the proposed rule as well, i.e., the rule covers interconnection to a FERC-jurisdictional utility or to a utility’s distribution system if the distribution facilities are being used to make FERC-jurisdictional wholesale sales, and pricing for any necessary transmission network upgrades is the same as in the large generation interconnection rule.

The jurisdictional question is a big issue for small generators, as these generators may be interconnected with transmission lines that are used for distribution and wholesale purposes. FERC previously proposed to extend its jurisdiction to all generator interconnections where the generator proposed to provide FERC-jurisdictional service (e.g., a sale of energy or energy curtailment for resale), regardless of whether the generator proposed to interconnect to state-jurisdictional distribution lines or FERC-jurisdictional wholesale lines. After extensive protest by a number of parties, FERC revised its proposed rule to cover FERC-jurisdictional wholesale transactions only if the generator interconnects to a line already included under an open access transmission tariff (OATT). The proposed rule creates three subcategories for small generator interconnections: 1) generating facilities up to 2 MW that interconnect to a low-voltage transmission system (defined as less than 69 kV); 2) generating projects more than 2 MW but not exceeding 10 MW interconnecting to a low-voltage transmission system; and 3) generating projects larger than 10 MW interconnecting with a low-voltage transmission system, combined with all small generating facilities interconnecting to a high-voltage transmission system (69 kV and above).

For small generators interconnecting with a high-voltage transmission line or a small generator larger than 10 MW interconnecting with a low-voltage transmission line, the interconnection process is similar to interconnecting large generators but with faster timelines, according to FERC. Other procedures apply for generators less than 10 MW:

- ☞ Small generators more than 2 MW but not over 10 MW can be interconnected as long as the total new generation capacity does not exceed 15 percent of the circuit peak load as measured at the substation. If the transmission provider does not believe the small generator can be safely interconnected, regardless of the results of the screening criteria, then the process reverts to what is used for the large-scale generator interconnection: initial meeting and interconnection studies. FERC proposes that transmission providers pay the costs of interconnection studies if the studies show the small generator can be interconnected safely.
- ☞ Small generators 2 MW and less can be interconnected if they have been certified by a national testing laboratory as meeting all applicable consensus industry and safety standards and the new generating capacity does not exceed five percent of total circuit annual peak load, as measured at the substation. FERC has recognized that the recently adopted IEEE Standard 1547 for interconnecting distributed generators could serve as the basis for a national standard of pre-certification. If the generator fails to meet the criteria, the transmission provider may allow the interconnection to go forward after considering the location of the generator on its transmission system. Alternatively, the interconnection customer could ask for an additional engineering review, limited to six hours, that would identify minor modifications

to the transmission provider's system (e.g., changing meters, fuses or relay settings) that would allow the interconnection to proceed.

FERC proposes that small generators and large generators be in the same queue, but small generators that are shown to not impact the transmission system, as well as small generators that go through the interconnection process, can be processed without delay from the units ahead of the small generators in the queue.

ISSUE IMPORTANCE

These issues pose significant challenges for independent generators, including wind generators, looking to enter competitive or regulated power markets by building power plants. Securing approval to interconnect the new facility to the grid can be a very tangible obstacle in the business decision-making process for power generators, involving the navigation of a lengthy and complex series of milestones.

Wind generators face specific interconnection issues, as these generators need a clear and transparent interconnection process for a successful interconnection. There are at least three different wind turbine types, with each one having different electrical characteristics. There are also several engineering options for interconnecting multiple wind turbines at a single interconnection point, and there are multiple means of providing reactive compensation—either from the individual wind turbine, within the wind farm collection system, or on the grid itself. With all these variables, wind generators face the risk of proceeding with an inadequate or unnecessarily costly project design that will not be in the best interests of either the wind generator or the system operator. That suggests the interconnection study process should influence the electrical design of a wind project.

Wind generators also face special issues created by the modularity of the technology, and how quickly wind projects can be developed. Wind projects can be developed within a year, and can be added in small increments of capacity rather than in one large installation. In an interconnection queue, wind projects may be behind larger generating projects and as a result, the wind project may be responsible for any necessary transmission upgrades of all projects ahead of it in the queue, regardless of whether the generating projects that are ahead of the wind projects in the queue are viable or not.

FERC's large generator interconnection rule is aimed at making interconnection easier for generators and to clarify who pays for network transmission upgrades that may be required from interconnecting generators. The rule poses some concern for wind generators. Large generators would have to procure balancing service from transmission providers before becoming interconnected.⁷ FERC also may have inadvertently allowed for pancaked interconnection fees by breaking generator interconnection into high voltage (69 kV and over) and low voltage. In addition, FERC's specific interconnection requirements apply to synchronous machines, not recognizing that wind turbines are induction machines. For example, FERC's interconnection requirements instruct interconnecting generators to provide equipment specifications for the excitation system and automatic voltage regulator, technology that is not typically present in a wind project. Finally, FERC is requiring final designs and lay-outs 18 months to two years before operation, not recognizing that wind projects can be developed in shorter time periods than that.

Power flow models also have not been updated to incorporate the projected system impacts of modern wind turbines. Current stability models do not adequately represent modern wind turbines, and tend to overstate stability problems with interconnecting wind turbines. As a result, wind projects can face lower availability transmission capacity allocations or increased interconnections costs, simply because the transmission system stability model is not up to date. The ERCOT ISO released a RFP in early 2002 to update its stability model. ERCOT intends to make these model updates publicly available to all users of standard system analysis software. In addition, they intend to facilitate an ongoing model validation and update process to continually adapt to changing industry practice and wind turbine product development.

OPTIONS FOR RESOLVING THE ISSUES

FERC has argued that independent control of interconnection and planning is necessary to assure nondiscriminatory access to regional transmission facilities. In Order 2000, FERC required that the RTO have the sole authority for the evaluation and approval of all requests for new interconnections as well as for long-term transmission system planning. FERC's new large generator interconnection final rule, as well its proposed rule on small generator interconnection, take this argument a step further, with the intent of ensuring not just regional but also near-national uniformity in interconnection procedures, while respecting regional reliability practices. Finally, all of this activity intersects with FERC's current proposed rulemaking on Standard Market

⁷ FERC said the balancing service must be consistent "with the scheduling requirements of the Transmission Provider's Commission-approved tariff and any applicable Commission-approved market structure."

Design (SMD)⁸, as modified by the Commission's White Paper that was issued in April 2003.

The following options apply to interconnection policies and procedures. If adopted, these measures could increase the predictability and shorten the timeline associated with achieving interconnection to the transmission system. Many of these options can be implemented as a package or on a stand-alone basis. In addition, they are consistent with FERC's ongoing SMD activities but could also serve in a transitional capacity until some modified version of the SMD is implemented. Such interconnection policy and procedure modifications include:

(a.1.) Independently administer interconnection studies and processes.

Moving administration and control of interconnection processes to entities without a financial interest in their outcome could help reduce actual or perceived discriminatory treatment. Otherwise, a market participant that oversees its competitor's interconnection has a conflict of interest towards interconnecting that generator. In addition, independent administration of generator interconnection may help make data and methods more transparent to all market participants. FERC Order 2000 initiated the shift of such control to RTOs, while its SMD rulemaking (as modified by the White Paper) supports that stance and provides more detail on its implementation. The FERC large-scale and proposed small-scale generator interconnection rules would allow pricing flexibility on

network upgrades to independent grid administrators such as RTOs or ISOs.

(a.2.) Increase transparency of transmission system data.

Along with the shift toward independence comes the need for increased transparency of transmission interconnection studies, so that competitive generators themselves can challenge the results of the transmission-owner studies, or conduct their own analyses of the transmission system impacts associated with interconnection. Transparency is critical to making the queue more expeditious, as it will help developers acquire more accurate planning and siting information before entering the queue. The PJM RTO, for instance, posts the results of its interconnection studies and load flow cases on its web site, allowing developers to conduct their own analyses. The FERC large generator and small generator interconnection rules both require more transparency.

(a.3.) Do not make the queue the primary means of congestion mitigation or transmission planning.

Current interconnection practice often requires a generator to alleviate current transmission congestion, plus any potential impact of generators ahead in the queue, before being interconnected, at a high cost for potentially few hours of congestion a year. The FERC large generator and small generator interconnection rules allow generator interconnection to proceed if reliability or public safety is not threatened, but does not guarantee energy delivery or protection from congestion.

⁸ See *Standard Market Design*, Docket No. RM01-12-000, issued July 31, 2002. Available at <http://www.ferc.gov/Electric/RTO/Mrkt-Street-comments/smd.htm>. FERC is expected to issue a final SMD rule in mid to late 2003.

(a.4.) Cluster projects together for analysis. This would essentially involve two phases. The first phase would be a basic interconnection without considering the impact on other proposed projects, power deliverability, or incremental congestion on the grid. Generating projects that complete this phase can be interconnected and can receive transmission service on an “as available” basis. For Phase 2, generator projects are grouped with other proposed generating projects into a periodic open season. Periodically, all of the projects are studied collectively to determine the necessary upgrades needed for delivery of capacity, and alleviation or elimination of transmission congestion. In PJM, that collective study is done every 180 days, while it is done annually in the NYISO. Cost responsibility for upgrades would be determined in RTO or independent transmission provider tariffs reflecting regional policy set by the regional state committee, as called for in FERC’s White Paper. Projects that complete Phase 2 would receive transmission service to the entire transmission network once any necessary network upgrades are completed. The FERC large generator interconnection rule gave a ringing endorsement to clustering projects for interconnection, and urged (but not required) that transmission providers cluster projects to the extent feasible for interconnection. However, FERC allowed transmission providers to exclude generators from clustering based on the electrical remoteness of the generating facility, which may have some implications for wind generators.

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