SELECTING A WIND FARM SITE

Selecting a wind farm site is complex, time consuming, and involves multiple disciplines working on parallel paths. Financing, government permits, meteorological studies, land use restrictions, and design has to be completed or well along before a site is approved and before construction can begin. However, it is imperative in all of the above-referenced steps that construction expertise be involved and consulted to achieve maximum use of the approved site. There are three principle sources of construction expertise generally participating in wind farm projects. They are the design team responsible for conceptual and eventual site design, the developer or construction manager of the project, and the wind turbine generator contractor.

Wind farm developers should include on their initial concept and development team people with expertise in site design and wind farm construction, regardless of whether those people ultimately end up working on the wind farm construction. After conceptual approval and financing, expertise should be added to the team regarding the selection and operation of wind turbine generators. This expertise will allow the non-construction professionals on the project team to understand the limitations of various wind turbine designs, the site specific issues that may affect the layout and operation of the wind farm, and the scheduling, civil engineering, and electrical issues that will affect actual wind farm construction.
Wind is big and wind is heavy. These two factors introduce unique considerations to the construction of a wind farm that differ from the construction of other power generation facilities. Big and heavy will contribute to the determination of an appropriate site, will determine the schedule for constructing the wind farm, and will contribute additional costs to transportation, site preparation, construction, and commissioning.

When selecting the appropriate site for construction a wind farm, scheduling consideration should be given to accessing the site and to constructing the site. Integral to both of these site selection concerns is the preoperational project schedule. Development of a wind farm generally takes from 2 to 5 years with construction taking more or less than a year depending upon decisions made in the development phase. One of the key decisions that can affect the construction schedule would be the lead time in ordering the wind turbine generators selected for the project. To the layperson, all wind turbines may look the same, but that is not reflective of reality. Turbine design, turbine dimensions, turbine weights, and turbine manufacturing locations all affect the construction of a wind farm.

Another unique factor affecting project schedule and costs is the transportation and road system that exists between the wind turbine generator manufacturing point and the wind farm site. The excessive weight of a wind turbine nacelle and the excessive lengths of the wind turbine blades and tower segments require special attention to transporting the wind turbine generator to the wind farm site. Special vehicles are required to transport wind turbine components. Roads have to be selected that can adequately bear the load of wind turbine parts. The transportation route has to be selected with adequate turning radii to accommodate the wind turbine part dimensions and with adequate vertical clearances to allow wind turbine parts to pass under bridges, signs, power lines, and other overhead obstacles.
These transportation concerns are generally addressed in the site selection and design process and any associated roadway improvement costs are the equivalent of preparation costs often borne by the project owner or developer. The wind turbine generator manufacturer can provide assistance in analyzing the suitability of the transportation to the project site as can an Engineering, Procurement, and Construction (EPC) contractor.

Site soil composition and the presence of rock are issues that will affect construction methods and costs. Site soil composition has to be reviewed to determine its tolerance for placement of tower foundations, roads, and crane pads. Rock located on the wind farm site needs to be evaluated to determine if it is suitable for use as aggregate for foundations of roadways and crane pads on the site. The availability of aggregate onsite and the ability to quarry the aggregate for onsite construction purposes eliminates costs associated with both acquiring quarry from another location or entity and transporting that aggregate to the site. However, the location of suitable aggregate may otherwise impede construction by restricting or limiting access to the jobsite. Thus, the soil condition and availability of aggregate on a wind farm site may trigger construction costs of compensating for inadequate soil, purchasing necessary aggregate, or overcoming potential delays or inefficiencies in the actual construction attributable to mining and moving aggregate onsite.

Electrical issues are also different in the construction of a wind farm. An electrical substation is required to receive power from each tower and then to step up the wind generated voltage to match the voltage in the power grid. Substation placement optimally should be central to the majority of towers on the site. Underground wiring should be used to connect each tower to the substation. The underground power systems should be designed to dissipate heat build-up so as not to damage the cables or affect their design life during transmission of the wind
generated power to the substation. Also, cables to monitor individual tower performance and any other tower control cables should be trenches where possible between each tower and the wind farm operational control building. Site configuration will determine where to place the operational control building, but it is normally placed near the main entrance to the wind farm.

It is important at this point to distinguish in the construction process between the wind turbine generator and the civil and electrical works. In the construction process, the supplier of the wind turbine generator is responsible for providing the tower, the blades, the hub, the nose cone, and the power unit. The supplier of the wind turbine generator is also usually responsible for the Supervisory Control and Data Acquisition (SCADA) system and can also be responsible for the provision of an initial spare part inventory and the possible design of any desired maintenance facilities.

The wind turbine supplier is also usually responsible to commission the operation of the wind turbines to demonstrate achievement of the stated performance criteria. It is important to point out that there is no standard definition of commissioning except for what is provided by contract or by technical data sheet provided by the wind turbine supplier. However, the electrical infrastructure can be tested by reliance on standard electrical tests recognized in the industry or required by applicable codes. Commissioning is necessary to commence the wind turbine warranty. Warranties generally run from two to five years and cover lost revenue, downtime to correct faults, and an evaluation of the power curve. A wind turbine power curve is a graph indicating the individual turbine’s electrical power output for operation at different wind speeds. The power curve is generally determined by local wind field measurements. Failure to achieve power curve standards is often addressed in a contract by the imposition of liquidated damages.
The wind farm civil works and electrical works are usually referred to as the Balance of Plant (BOP) and are provided by a contractor different from the wind turbine supplier. BOP civil engineering scopes of work include roads and drainage, crane pads, turbine foundation, meteorological mast foundations, and buildings for electrical switch gear, SCADA equipment, and a maintenance/spare part facility. BOP electrical work scopes include point of connection equipment to feed the wind farm’s power generation into the electrical grid, underground cable networks and overhead transmission lines, electrical switch gear to protect and/or disconnect turbines or other equipment from the system, transformers and switches for individual turbines unless located within the turbine and provided by the turbine supplier, and grounding and connections for control rooms, maintenance facilities, and any other buildings onsite.

This difference in responsibility between the wind turbine supplier and the BOP contractor is the topic of some debate regarding selection of the proper project delivery system for a wind farm. Project developers generally use EPC contractors as the entity to design a wind farm project and manage construction through the commissioning phase. The EPC contractor would be responsible for contracting with the wind turbine supplier and with any BOP contractors. However, this arrangement exposes the EPC contractor to damages should the wind turbine fail from a performance or delivery perspective. Additionally, the wind turbine generator represents a high percentage of project costs without provision of an appropriate markup available to the EPC contractor. That is because the wind turbine is commonly shipped, erected, and commissioned by the wind turbine supplier and not by EPC contractor personnel. Thus, EPC contractors have begun to perceive a disproportionate risk/reward ratio in contracting with the turbine supplier, encouraging some movement to a project delivery system where the
developer contracts with the wind turbine supplier directly, instead of through the EPC contractor.

Construction issues related to wind farm site selection are also affected by other issues unique to the selected parcel. Construction may be affected by land use restrictions or zoning issues, such as hunting rights, grazing rights, and cultural issues. Additionally, wildlife issues may restrict construction due to bird or bat migration, wildlife migration, spawning issues, wetlands and surface water issues. Last, noise or visual obstruction restrictions may affect placement of turbines or hours of construction operation.

Construction of wind turbine farms is greatly affected by site selection. Though these issues are relatively new in the United States, there are well developed practices within the wind turbine and wind farm industries developed in other countries and adopted within the United States to address constructability concerns. So, despite all of the publicity related to wind farm site selection regarding zoning, permitting, environmental concerns, and community reaction, the construction industry is capable of constructing a wind farm in the face of multiple site specific issues.