Wind Power in the Turkish Transmission System

Increasing demand for power and depletion of conventional fuel resources are forcing the world to produce electricity in a sustainable way – renewable energy. One of the most cost-effective renewable energy resources is wind power. A sharp increase in wind power generation can be easily identified all around the world and Turkey is no exception – wind power generation has begun to blow in Turkey. As a first step to meeting the need for renewable generation, Turkey has given permission for the construction of 12 GW of wind power generation by 2015.

Because of variations in wind speed and consistency, wind power generation is not spreading homogeneously in Turkey as in other areas of the world. The western area of the country has great wind potential while the eastern and southern areas do not. The wind map of Turkey showing the wind power integration capacities based on transformer station eligibility is shown in Figure 1. The blue boxes (labeled A) show the maximum capacity of each region’s transformer station. In the orange boxes (labeled B) we see the highest value of that region’s transformer station eligibility and the province where it is located. The 12 GW of new wind power generation will be constructed primarily in the western areas of Turkey, with some construction in the southern areas.

Wind farms require controls similar to those of conventional power plants. Power quality for wind farms, like conventional power plants, is reflected in the level and fluctuation of system voltage and frequency. At the time of grid perturbations a power plant should react very quickly and should support the grid as required. For conventional power plants, voltage and frequency control can be easily maintained by the governor and the excitation system responses. However, the integration of a large amount of renewable energy, if not well planned, will change the effectiveness of voltage and frequency control, which may lead to large scale blackouts. In order to ensure the required support to the grid, additional requirements should be added to grid codes.
In order to cope with the negative aspects of wind power integration, in 2008 the regulation authority in Turkey implemented annex-18 to the current grid code. This annex defines the behavior of wind farms for both steady state and dynamic cases. This includes reactive power response at the point of common coupling at steady state, low voltage ride through capabilities, the response speed and the slope of active and reactive power that shall be provided by the turbines. It basically focuses on the point of common coupling, but it also has some restrictions at the turbine level.

Siemens PTI Turkey has successfully completed two projects (with Siemens 2.3 MW and Vestas 1.8 MW turbines) and has one ongoing project (with Siemens 3.0 MW turbines) for renewable energy integration to the grid. We are using PSS®E and PSS®SINCAL software to fulfill the simulation requirements. PSS®E is used primarily for dynamic analysis purposes, however, it can also be used to identify reactive power capability in steady state. PSS®SINCAL is used for harmonic analysis and protection coordination purposes. Simulation can be carried out independently of the turbine manufacturer.

In addition to projects within Turkey, Siemens PTI Turkey is also responsible for the total Central and Eastern European market (excluding Austria). Covering the complete portfolio of network consulting, Siemens PTI Turkey will perform in accordance with the highest technical standards to achieve consulting services that ensure reliability, continuity and quality to all customers, with a focus on transmission companies, distribution companies, refineries and wind farms.