Wind Energy Generation and Regulation in Turkey

Wind energy is one of the fastest growing industries in Turkey due to government policies in response to climate change (e.g., Kyoto Protocol) that will result in carbon emission reduction targets and the necessity of energy supply diversification. In 2005, the total installed wind capacity in Turkey was only 20.1 MW generated by 34 turbines. With the introduction in 2005 of the first Law on Renewable Energy Resources by the Turkish Parliament, wind power capacity reached 50 MW in 2006 and 147 MW by the end of 2007. Among other renewable resources, wind has been the most popular and most accessible power source.

In 2007, the Turkish Electricity Survey and Development Administration (EIE) developed the Turkish Wind Atlas, which served as a big eye-opener to all types of investors. According to the government’s May 2009 Electricity Market and Security of Supply Strategy Paper, the Turkish government has set targets to meet 30% of the total national energy production from renewable sources, and has established a wind power goal of 20,000 MW by 2023.

As has been recognized in many other countries having (or seeking) high levels of renewable generation penetration (Denmark, Germany, US, etc.), for efficient integration in the system it is fundamental to have regulations in place that this type of generation has to meet. Thus, in parallel with the goals above, the first wind turbine generation (WTG) regulation for the Turkish power system was published by the Energy Market Regulatory Authority (EMRA) in 2008, and was revised in January 2013. This regulation addresses grid compliance for WTG plants with an installed capacity equal to or above 10 MW that are connected to the transmission system or distribution system. Regulation for wind energy generation plants addresses contributions at the point of common coupling (PCC), rather than issues associated with a single wind turbine generator. Some of the main regulation codes specified, including low voltage ride through (LVRT), frequency response, and reactive power capacity, are shown below.

1. LVRT requirements, which define the contribution of generation facilities of the plant during a fault and post recovery, are shown in Figure 1. In case phase to phase voltage of the grid remains in Area 1 and Area 2 due to voltage drop in any phase or all phases, the wind turbines have to remain connected to the network which means the WTG plant must not trip. If the voltage is in Area 1 due to a grid fault, active power of the wind turbine must reach its maximum value increasing at least 20% of the rated power per second immediately after the fault is cleared.
2. Frequency Response, which refers to the active power output of all turbines at the PCC as a function of frequency, is given in Figure 2. If the grid frequency is between 47.5 Hz and 50.3 Hz, the turbine must be able to produce all of the available power. In the case of the grid frequency exceeding 50.3 Hz the WTG plant must reduce its output in proportion to the frequency as defined in the figure, and must completely shut down when it is 51.5 Hz.

3. Reactive Power Capacity, which refers to the reactive power output of all turbines at the PCC for different active power values during over-excited and under-excited operation, is given in Figure 3. WTG plant should be operated at all points inside the polygon of bold lines shown in the figure. Down to 50% rated active power the plant must control the voltage at the PCC using up to the full reactive capability of the plant (i.e., the nominal reactive power). Below 50% the reactive power contribution can be reduced as a function of the power produced.
All of these changes are part of development of the wind energy sector in Turkey. The government has taken steps including introducing regulations, making revisions by following related standards, making the licensing process more rigorous, encouraging foreign investment and strategic partnerships, and supporting renewable developers in order to provide cleaner, more secure and sustainable energy in the future.