Integrated Wind-Water Treatment System

Researchers from the National Wind Institute (NWI) and Water Resources Center (WRC) recently completed a field demonstration project to explore the potential for connecting locally owned renewable wind energy systems with the electrical needs for pumping and treating locally available brackish groundwater. The project took place at Seminole, Texas, a town of 6,430 residents with a declining well field in the Ogallala Aquifer that is also impacted by arsenic and fluoride. The city officials were interested in drilling deeper wells into the Dockum formation to tap local brackish water for future water supply. The project objectives included installation of an 1800-ft deep well in the Dockum Aquifer, an appropriate reverse osmosis (RO) system, a 50-kW wind turbine, and other related infrastructure to collect and report useful data from the demonstration project. Operation began in April 2013 and ended in August 2014. The results provided operational experience and data for planning of larger-scale systems.

The total time of operation of the well and RO system was 250 day-equivalents, with total well production of 20,115,900 gallons at an average flow rate of 56 gpm. The average permeate flow was 41 gpm with average concentrate flow of 15 gpm, for an average volumetric recovery of 73 percent. The average TDS values were 7980, 520, and 20,600 mg/L for the feed, permeate, and concentrate flows, respectively. The permeate values for arsenic, fluoride, and TDS were <0.01, <0.5, and 436 mg/L, respectively. The wind turbine generated 37,054 kWh in 4276 hr of operation. The well and RO system electrical demand during their operation was approximately 78,000 kWh. The cost of energy per volume of permeate produced at the average of 41 gpm was about $0.33/1000 gal at the average $0.062/kWh charged locally by Xcel Energy. The amount of energy generated by the wind turbine was 47 percent of the demand of the well and RO system.

The project team brought together TTU researchers with local engineering and geological consultants to cover the required technical and regulatory aspects. The TTU team also worked with the City of Seminole and their grant consultant to build the necessary funding. A total of approximately $1.63 million was assembled from several local, state, and federal sources to design, construct, and operate this demonstration project. The equipment was left in place for future use by the City or third-party water treatment providers.

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