Novel Wind Turbine Power for Oilfield Pumping Units

2009 Proposal to the Stripper Well Consortium
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PUBLIC EXECUTIVE SUMMARY

It is proposed to power the production units of one or more oilfield stripper wells using a wind turbine with a storage system. There are over 400,000 stripper wells, both oil and gas producers, in the US and they need to lower costs to operate as production decreases over time to maintain their economic life. Many stripper oil wells produce very low volumes (1-15 barrels per day) of liquid (crude oil plus water) and need only a low volume pump to produce these volumes to the surface. Many stripper gas wells need to remove low volumes of liquid out of the wellbore to maintain gas production. These processes must be done cleanly, efficiently, with low capital and operating cost and be environmentally friendly. Most of these well depths are less than 5,000 ft and utilize beam pumping units that can require one to five (1-5) horsepower to lift these low volumes. Low volume Progressing Cavity Pumps (PCP or moyno types) also use as low as 5 horsepower for operation. Most small beam units utilize electrical motors or natural gas engines for operation. Most PCPs are run by electrical motors. Other devices using low power, such as transfer pumps, are also common. Most of these pumping units and devices do not run constantly, but in timed sequences for maximizing production.

Many times the electricity source is too far to economically run electrical power lines or the utility power cost ($/kWh or $/kW demand) is too high to afford for such low volume wells. The cost associated with laying 50ft of line to connect to the grid can run as high as $7,000, with most locations costing $25,000. In addition, labor cost to connect lines can run $32,000 with the cost of burying the electrical line an average of $250,000 depending on geography. Natural gas engines (Arrow or Continental) to drive pumping units are expensive to install ($15,000) and utilize wellhead gas or propane. However, the natural gas from the well annulus may be depleted or more valuable for sale into a pipeline. Many times the cost to produce is too high and the wells are shut-in or plugged and abandoned.

To solve this problem, SWC has previously funded testing of a solar powered pumping unit. That application is working well. Another energy source for remote oilfield operation is the free wind. In many oilfield areas, the wind blows constantly and in sufficient force to operate a small 5 kW wind turbine for oilfield pumping units. However, the wind strength is variable and unpredictable and the peak turbine power does not normally occur when the well needs pumping. Thus, an energy storage device, similar to a standard electro-chemical battery, is needed to save the power generated by the turbine for use when needed. To keep efficiency high, this proposal uses hydraulic- pneumatic accumulators which will sufficiently run the pumping units or other devices intermittently throughout the day, however it is still wind dependent. Thus, the overall system efficiency is improved by utilizing a mechanical system only (wind >turbine rotation> hydraulic pump and storage> hydraulic motor on the pumping unit or other device.

Such benefits will allow many of the 400,000+ stripper wells in the United States a longer productive life and provide significant additional gas and oil reserves for the public good.