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EDITORIAL

Power from Wind Turbines

Investor-owned public utilities are beginning to evince meaningful interest in obtaining electric power from wind turbines. Costs per kilowatt-hour (kWh) have diminished from about 30 cents in 1980 to a recent 7 to 9 cents. With new, improved machines, costs soon will be 5 cents/kWh. Prospects are good that a further decrease to 4 cents/kWh will occur by 2000. The energy bill enacted last October included a tax benefit provision for investor-owned utilities of 1.5 cents/kWh, making wind power even more attractive to them. Potential supplies of wind power are substantial.

Efforts to exploit renewable resources in the late 1970s included state and federal funding for wind turbines, especially in California. The subsidies were not made directly available to utilities but rather went to private entrepreneurs. Utilities had little stake in improving the wind power equipment. Wind turbines at that time were not well designed or sufficiently tested. As a result, many kinds of failures occurred, and the machines were available for power production only 50 to 60% of the time. Their installed capital cost was about $2000/kW.

Components were susceptible to fatigue, vibration failure, and mechanical breakdowns. The expected lifetime of the machines was 20 to 30 years, but many lasted only 5 years. With bitter lessons learned, equipment and performance were gradually improved so that systems now operate 95 to 98% of the time. Almost all the wind turbines in use today are designed to produce 60-cycle ac power directly. Accordingly, the speed of their rotors must be precisely controlled. To achieve this in spite of variable wind speeds and gusts requires a heavy braking system.

New wind turbines coming on the market contain devices that permit the airfoils to rotate freely in winds ranging from 9 to 60 mph. The energy is converted into 60-cycle ac by an electronic converter. When the new electric conversion device is used, the weight of the components of the wind turbine is about halved. Installed capital costs are about $1000/kW.

Most machines have two- or three-bladed rotors mounted on a horizontal axis. The hub of the axis in many instances is about 30 m above ground. The rotor diameter in one model is 33 m. Wind power is proportional to the cube of wind speed. With winds averaging 16 mph (7.3 m/s), the output is about 400 kW. If the elevation of the hub is increased, for example, to 50 m, the wind speed is greater and output increases by about 20%. In one test, the hub will be 82 m above ground.

The original design of the airfoil was based on airplane experience. However, the wind turbine presents a different aerodynamic circumstance, and considerable benefits are being achieved by new airfoils. Because of air turbulence created by wind turbines in a wind farm, they would be placed 150 to 300 m apart in flat terrain. In the future a typical production farm will contain a minimum of 100 turbines.

Attitudes of utilities toward adopting new technology tend to be cautious. If there are disappointments and cost overruns, the utility and its stockholders usually end up holding the bag. The primary responsibility of the utility is to be a dependable source of power. A heightened level of interest now being shown by utilities is indicative of their judgments that wind turbines are destined to provide substantial amounts of electric power economically. Their agent, the Electric Power Research Institute (EPRI), is cooperating with the Department of Energy in encouraging and subsidizing tests of new, improved turbines. These will be supplied by as many as five manufacturers. The tests will be closely monitored and results supplied to the various utility companies. The situation is one designed to encourage widespread adoption of the best of the new turbines. Utilities tend to have much more confidence in information supplied by EPRI and fellow utilities than by manufacturers of equipment.

An increasing number of wind turbines are located in western Europe. In the United States, almost all of them now are in California, where they supply about 1% of the state's electrical demand. However, about 14 states have wind potential that equals or exceeds that of California. The prime region is the Great Plains. There the state of North Dakota has a potential estimated at the equivalent of 36% of the total electrical power output of the United States. A more realistic figure is that wind power might ultimately provide 20% of the nation's electricity needs. The wind farms would be located mainly in rural areas. About 5% of a surface would be devoted to the turbine supports and access roads. Otherwise, farming or ranching would not be disturbed.

Philip H. Abelson