AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

1394

RECEIVED

MAY 23 1994

Wind Turbine Development

OSTI

The Near-Term Product Development Project

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

U.S. Wind Turbines for the 1990s and Beyond

Since 1990, the U.S. Department of Energy (DOE) and members of the U.S. wind industry have been working as partners to develop advanced, highly efficient wind turbines.

The overall goal of these partnerships is to develop turbines that can compete successfully in the world's utility markets for low-cost electricity. The cost goal is to produce electricity at or below \$0.05/kWh in moderate winds. Moderate winds (6.9 mps [15.4 mph] at hub heights) prevail in large expanses of the Great Plains, where much of the vast wind resources of this country are located.

Under the Near-Term Product Development Project, begun in 1992, several U.S. companies are building and testing turbine prototypes. Currently, there are four companies participating:

Atlantic Orient Corporation
Carter Wind Turbines, Inc.
Northern Power Systems
R. Lynette & Associates

The AOC 15/50 by Atlantic Orient Corporation

Atlantic Orient Corporation (AOC) is developing a new turbine that targets rural and utility markets. The turbine, rated at 50 kW, is designed to provide electricity for large farms, ranches, remote villages, outlying industries, and isolated military or recreational facilities. It could also be used in utility-scale power plants, particularly in developing countries, where larger turbines are not feasible or desirable.

The turbine has a three-bladed downwind configuration (passive yaw) with a rigid hub.

AOC designers have included some singular features that make this turbine stand out among others with a similar power rating. For example, they have incorporated advanced airfoils designed at the National Renewable Energy Laboratory (NREL) which have already proven their efficacy on larger turbines. They have redesigned the tip-brakes to make them more robust. This robustness is important because the tip-brakes operate in a difficult environment at the ends of the blades where the largest aerodynamic and centrifugal forces are generated. And the AOC engineers have added a novel control—a dynamic brake—that stops the machine through the electromagnetic force in the generator.

Near-Term Technological Advances

In 1994, the first wind turbines developed under the Near-Term Product Development Project became available commercially. The designs of the new turbines incorporate the lessons learned from operating turbines in wind power plants in the 1980s and the latest technological advances from industry and government-supported research and development. These advances include:

Improved aerodynamic performance of turbine blades.

Turbines with blades shaped from advanced airfoils designed specifically for wind turbines are significantly more efficient in the range of wind speeds where they normally operate.

Improved designs that reduce fatigue to turbine components.

Turbines built with teetering hubs pivot back and forth on a teeter pin in turbulent winds, thus reducing mechanical loads that could harm turbine components.

Improved aerodynamic controls that regulate power production in high winds.

Turbines with new blades regulate power output through stall or aileron control. With stall or aileron control, the shape of the airfoil itself reduces the aerodynamic lift force on the blade, thus reducing power output and minimizing stress on the machine's components.

Additionally, NPS has designed the drive train so that it, too, will be fabricated as a single unit in an "integrated" design. The integrated drive train reduces the number of parts required to produce and maintain it, thus lowering overall cost.

The AWT-26 by R. Lynette & Associates

R. Lynette & Associates is developing an advanced wind turbine that achieves low capital and maintenance costs through efficient, lightweight design.

The turbine, the AWT-26, features the latest available aerodynamic technology. The turbine blades are made from advanced airfoils designed at NREL, the same airfoils that have shown up to 30% increase in power output over other airfoils. The advanced airfoils also regulate power output in high winds through stall control.

For overspeed protection, the turbine has two independent braking mechanisms. The mechanisms include enhanced tip brakes located at the ends of the blades that slow the rotor aerodynamically when deployed and a disc brake located in the drive train.

The turbine features a two-blade rotor with a downwind, free-yaw orientation. The hub teeters in turbulent winds, reducing stress on turbine components. The rotor diameter is 26.2 m (86 ft), and the generator is rated at 275 kW.

Two production prototypes were installed in 1993 and are operating in a wind power plant in Tehachapi, California.

The AWT-26 has been selected for a 25-MW wind installation in Washington state's Columbia Hills. Construction of this project, consisting of 91 AWT-26 wind turbines, will begin in 1995.

The CWT Model 300 by Carter Wind Turbines, Inc.

Carter Wind Turbines' (CWT) Model 300 wind turbine is already available commercially. In fact, by early 1994 Carter had installed 20 turbines at several locations in Texas and in the United Kingdom.

The turbine, rated at 300 kW, has a very lightweight, flexible design. It behaves much like a palm tree in high winds, withstanding the forces in the winds by flexing and bending. Due

to its flexible design, the Model 300 can operate in higher winds than most other wind turbines in the world.

The turbine sits atop a 50-m, tubular tower anchored by guy wires. Since most winds increase with height in flat terrain, the higher tower allows the turbine to capture more energy. This turbine has one of the tallest towers of any turbine in the world.

For maintenance, the tower is lowered to the ground by tilting it down with a winch. Performing maintenance on the ground in this manner is convenient and also reduces maintenance cost and increases the safety of maintenance personnel.

Carter is participating in the Near-Term Product Development Project with three goals in mind. First, Carter engineers will investigate the benefits of designing new blades that use

NREL-developed airfoils. Second, they are developing a new data management and communications system to improve availability. Third, they will complete design analysis that will assist their efforts directed toward certification of the design.

The North Wind 250 by Northern Power Systems

Northern Power Systems (NPS) is developing a new turbine, the North Wind 250, that will be available commercially in 1995.

NPS engineers have incorporated several advanced aerodynamic and mechanical design features into the new turbine. For example, it will feature aileron controls that regulate power aerodynamically in high winds. NPS designers believe the new ailerons, similar to flaps on airplane wings, will be a significant improvement over other types of aerodynamic controls on wind turbines.

The NPS engineers have also incorporated a unique mechanical feature into their turbine by constructing the rotor as a single unit. Constructed in this manner, the two-bladed rotor has few mechanical joints. The NPS designers believe it will therefore resist fatigue better than other rotors and will be less costly to manufacture. The rotor will be mounted on an elastomeric teetering hub.

DATE

FILMED

10 / 3 / 94

END