Montana State University creates one of nation's largest databases for wind energy research

In a little lab on the campus of Montana State University, John Mandell, Dan Samborsky, and scores of students, have been breaking things to advance the field of wind energy.

"These machines keep grinding away around the clock," said Mandell as he flipped on the lab's lights.

Inside a windowless room, three machines seemed to tremble with effort. Each machine had two steel fists, roughly the size and shape of coffee cans. Held between these fists was a wafer of fiberglass and resin. Some of the machines pulled on a wafer, others pushed. Each pulse was a single cycle headed toward a final goal of destruction.

"This one has done more than seven million cycles," Mandell said. "But 10 million to 100 million is where the data are really valuable."

Fiberglass, carbon fiber, resin: combinations of these materials are the stuff of wind turbine blades. Modern blades reach lengths of up to 200 feet and weights of up to 50,000 pounds. They may spin half a billion times or more in their hoped-for 20-plus-year life spans.

But no one is willing to wait 20 years to see if a particular composite material for a blade holds up or not. That's where Mandell and his team come in.

In 1989, Sandia National Laboratories, the huge Department of Energy facility in Albuquerque, New Mexico, offered to fund Mandell in breaking things. He's been at it ever since.

A professor of materials science in MSU's department of chemical and biological engineering, Mandell's work is essentially about cheating time, or compressing it. He plugs his lab data into various models and tries to predict how a particular composite material will hold up over years or decades from the tug of gravity and the stress of wind.

"A lot of effort has gone into these tests so that the data mean something," Mandell said. "We've had to invent methods ourselves. It has been a great deal of work." Current materials last much longer in the tests and are stronger compared with the more primitive materials in early years of the study.

It is not fast work, it is simply faster work than observing a wind turbine blade in the field for 20 years. A fiberglass or carbon fiber sample can spend weeks or months – 24 hours a day – being fatigued in the grip of the laboratory's machines.

In 17 years, Mandell and Samborsky, a research specialist, have accumulated 10,000 results on about 150 different composite materials. The research has been gathered up on Sandia's Web site as the "MSU/DOE Fatigue Database for Composite Materials." It is one of the world's largest open-access libraries on wind turbine materials and the largest in the United States, according to Sandia. It is used by researchers around the globe.

"Within in the U.S., we are still doing the bulk of the testing that's open literature," Mandell said.

U. S. blade manufacturers and materials suppliers send Mandell materials for testing. He also creates his own composites with resin and cuttings from bolts of fiberglass and carbon fiber cloth. Over time, interest

has shifted from fiberglass to carbon fiber. Though carbon fiber is stronger and lighter, it's also more expensive.

Mandell works closely with fellow MSU engineering professor Doug Cairns. Cairns' program is in the manufacture of composite materials, where it's no small matter understanding how to resin-infuse and cure layers of fiberglass and carbon fiber on a 150-foot-long blade.

The lab's work is so time consuming, yet so important, that Samborsky has a Web camera mounted in the room. From home, he can zoom in on any machine to make sure it is functioning properly 24 hours a day.

"If the power goes out we have to start over," Mandell said.

The Department of Energy gave Mandell and Cairns, and their counterparts at Sandia, the first wind energy Outstanding Research and Partnership Development Award in 2003. But maybe the greatest reward Mandell's gotten is seeing wind finally used on a large scale to produce energy.

"In the 1980s and 1990s, wind was a boom or bust research technology, and putting up wind turbines depended strongly on subsidies," Mandell said. "In 1987, wind cost 10 cents per kilowatt hour to produce. Now, it's down to about 4 cents."

That price makes wind competitive with new natural gas and coal-fired power plants, Mandell said.

"The United States has the best wind resources of any county in the world and Montana has the fifth-best wind resources of any state," he said. "The technology is efficient enough that huge areas from the Rocky Mountain front in Montana and Wyoming, across the Dakotas, are developable."

In late 2005, Invenergy developed a 90-turbine wind farm on the transmission line near Judith Gap. The Judith Gap Wind Energy Center can produce enough electricity for about 36,000 homes, year after year. Though Mandell had no direct involvement in the project, he's an enthusiastic supporter.

"I think they look great compared to smoke stacks. These big turbines rotate slowly. They remind me of sail boats," Mandell said. "They are relatively quiet; they just turn in the wind and keep the lights on. I wouldn't mind if they were put on the hills behind my house."

Source: Montana State University