A Mighty Wind

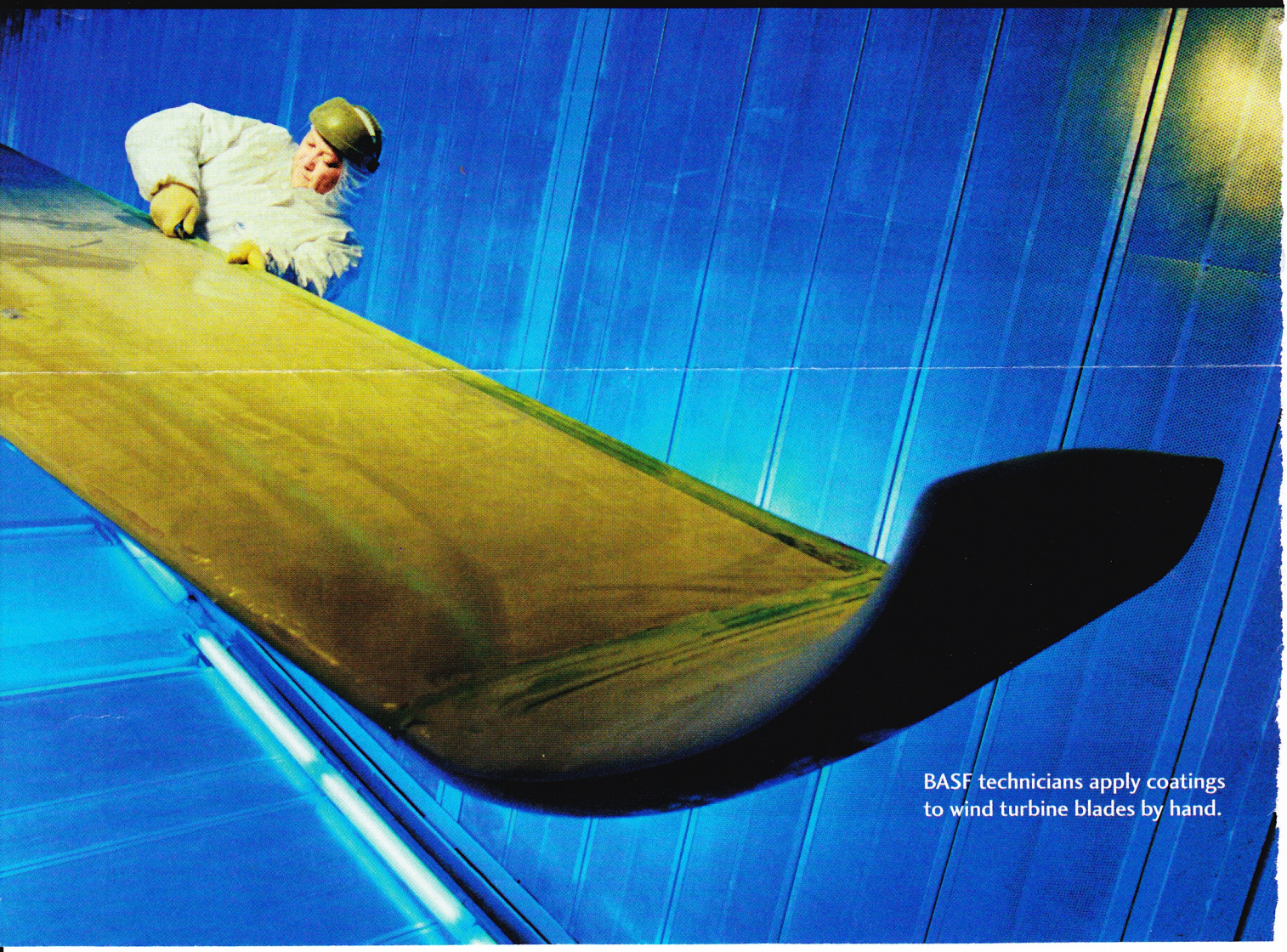
THE TURBINE ENERGY INDUSTRY IS GROWING, OFFERING COATERS GREATER OPPORTUNITIES

By Tim Pennington
Editor

When it comes to the power of wind energy, the numbers don't lie:

- More than 8,000 components are needed to make up a typical wind turbine, and each one needs a unique, often corrosion-resistant coating.
- About 75,000 people are employed in the wind power industry in the U.S.
- More than 400 wind-related manufacturing plants are located in 43 states.
- The Midwest has taken over California as the industry leader.

"Wind power generates jobs and economic development," says Ellen Carey, a spokesperson for the American Wind Energy Association, which has more than 2,500 members and advocates.



BASF technicians apply coatings to wind turbine blades by hand.

Turbine coatings must withstand harsh environments

About one-fourth of the wind energy produced worldwide in 2011 comes from the U.S., Canada and Brazil. Here in the U.S., the wind energy market grew by about 60 percent from 2009 to 2010, and with more than 40,000 installed megawatts, we rank second to China.

Those numbers have caught the attention of finishers, who see a new market to plate parts, e-coat or powder coat turbines, or paint and anodize the hundreds of necessary components.

More than 8,000 separate components are in a typical wind turbine, and each needs a unique, often corrosion-resistant coating.

Shops like Landmark MetalCoat in Temecula, Calif., have made a concerted effort to go after projects in the wind energy market. Company President Jeff Smullen said that, as the wind energy industry continues to grow, wind turbine operators and blade manufacturers have discovered that blade pitting creates unstable harmonics and decreases efficiency, while increasing maintenance and repair costs.

"As the number of wind power installations in the United States increases dramatically, we look forward to providing this industry with viable and cost-effective solutions to some very real problems," Smullen says. "Our research and testing shows us that certain metals, such as stainless steel, provide unique protection and performance benefits that are far superior to all other solutions available today."

Automatic Coatings in Toronto, Canada, has been keeping its eye on the wind energy industry for several years and has been able to nab a few contracts for coating the large metal bases upon which the turbines sit. With a 35-foot paint booth, the company has used some ingenuity to coat projects up to 70-feet long, including many wind energy parts. The company specializes in coating pipes for the gas and oil industry, so it knows about working with large sizes.

"If we can get it in our doors, we'll coat it," says Jocelyn Williams, the company's vice president for business development. "We know that wind energy is going to be an emerging market for us to go after, so we've tried to make it known we can do such large parts. It's a valued-added service we provide to manufacturers who don't need to build up their own paint shop; we're here for them."

Specialty coatings giant BASF says it is represented in the wind-turbine coating industry in all of the major markets worldwide—in the leading European markets as well as in Asia and in the American continents, where demand has grown at an above-average rate in recent years.

"We are now reaping the benefits of having discovered the wind energy market at an early stage, for having invested in innovative products early on and for having built up a wealth of valuable experience," says Dr. Achim Gast, BASF's industrial coatings manager.

The company's latest product development is a new high-solid rain erosion coating based on polyurethane bonding. Gast says its higher solids content compared with conventional coatings reduces solvent emissions, cuts down on weight due to thinner coating layers and is highly erosion resistant. He says it provides two and a half to five times better protection against the extreme environmental conditions to which a typical turbine blade, measuring an average of 45 meters length and installed at a height of about 90 meters, is exposed.

The uniqueness of the turbine blades has caused some manufacturers to come up with improved weather resistant coatings.

"In severe wind conditions at this height, raindrops can turn into veritable missiles, not to mention grains of sand that can be stirred up in locations where wind turbines are installed in arid zones," Gast says. "The blade coatings are under constant attack from the cold, heat and UV radiation, and yet they are still expected to last for between 10 and 20 years."

According to Automatic Coatings' Williams, "You want it coated right the first time, because it's not a great idea

Automatic Coatings in Toronto, Canada, has been coating wind energy products for several years, including large base poles.

to send someone up 300 feet in the air to recoat these things."

The AWEA says that in 2010, the industry reached 50 percent domestic content for U.S.-deployed turbines, and that percentage will continue to rise with stable policy signals.

Carey says that in 2010, 14 more manufacturing facilities came online to serve the industry. She also says that wind farms provide lease payments to landowners—$3,000 a year per turbine is typical — giving America's farmers and ranchers a stable, new cash crop, as well as adding tax revenue to local communities, allowing them to build hospitals, schools, town halls and libraries.

After California Gov. Jerry Brown called for cleaner, affordable and homegrown energy with the strongest renewable target in the U.S. at 33 percent renewables by 2020, the state began realizing the economic benefits. Carey says the state now supports 15 wind-related manufacturing facilities with 4,000 – 5,000 permanent workers.

The AWEA says that the U.S. is ahead of schedule to make 20 percent of its electricity from wind by 2030, the goal identified during the Bush administration.

What could make an even bigger impact for the metal finishing industry is the introduction of "quieter" wind turbines into the U.S. market that could find their way into suburbs and more dense neighborhoods because of their lack of noise.

Jotun, a Norwegian painting and powder coating supplier, says it has seen increased business in Europe and Australia with its partnership with Quiet Revolution-brand wind

U.S. Wind Industry Fast Facts

Total U.S. Utility-Scale Wind Power Capacity through 1st Quarter of 2011: **41,400 MW**

U.S. Wind Power Capacity Installed in 2010: **5,116 MW**

U.S. Wind Power Capacity Installed in 1st Quarter of 2011: **1,118 MW**

U.S. Wind Power Capacity Under Construction as of 1st Quarter of 2011: **5,600 MW**

U.S. Wind Power Capacity Installed in Previous Years (including small-wind):

2009: 10,010 MW
2008: 8,366 MW
2007: 5,258 MW

Number of States with Utility-Scale Wind Installations, 2010: **38**

Number of States with More Than 1,000 MW of Wind Installations, 2010: **14**

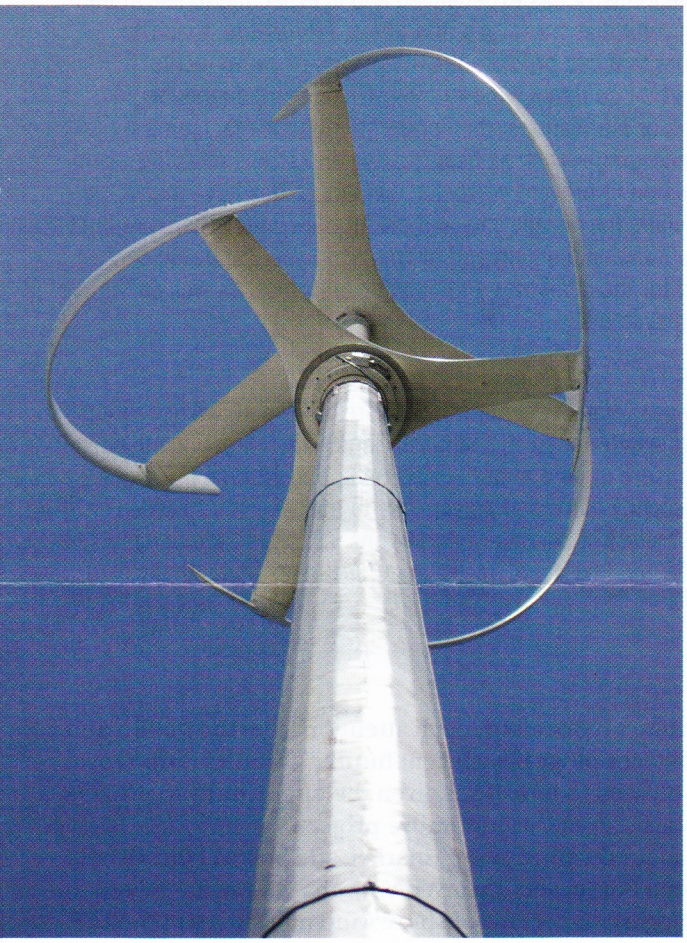
U.S. Wind Resource Potential, Onshore (Source: NREL): **10,400,000 MW**

U.S. Wind Resource Potential, Offshore (Source: NREL): **4,150,000 MW**

Top 5 States with Wind Power Capacity Installed, 2010:

1. **Texas: 10,135 MW**
2. **Iowa: 3,675 MW**
3. **California: 3,179 MW**
4. **Minnesota: 2,432 MW**
5. **Washington: 2,356 MW**

Source: American Wind Energy Association



turbines—vertical axis turbines that capture wind from all directions and can generate power at a higher level of productivity. The turbines are especially suitable for use in urban areas and can supply enough energy to power a home or small office building.

Windfall For Finishers?

WHAT WIND ENERGY MEANS TO FINISHERS

So how will finishers reap the benefits of an explosion in wind-energy equipment?

According to the American Wind Energy Association, metal components make up nearly 90 percent of the weight and more than one-third of the value of a modern wind turbine. The wind industry installed more than 5,000 commercial-scale wind turbines in each of the last few years, which translates into 15,000 tower sections, 2.4 million bolts and 27,000 miles of rebar in the turbine foundations annually.

The industry saw an investment in wind turbine equipment in the U.S. of more than $8.5 billion in 2008, and the annual demand is projected to double during the next few decades as the industry ramps up to produce a larger share of the nation's electricity.

The rapid growth the industry has experienced and is expecting to see in the future opens up opportunities for forges, foundries, fabricators, machine shops and integrators that can produce the thousands of components and sub-assemblies that go into a wind turbine. These components begin as castings, forgings or fabrications, then undergo multiple machining operations post-processing—such as heat treating and stress relieving—and then are typically coated to prevent corrosion. Wind turbines have many subsystems that include the nacelle yaw and blade-pitch units. There are fluid systems used for lubrication, cooling and hydraulic power. Electronic control systems are utilized for the generator and power electronics, as well as the yaw and blade-pitch systems.

FORGED PARTS

The main shaft and gear blanks are hammer- or press-formed, while bearing rings and tower flanges are rolled as seamless rings. The rolled rings used in today's turbines measure up to 6 meters in diameter and 12 tons in weight. One U.S. supplier recently increased its capacity to make seamless rolled rings that exceed 7 meters in diameter and 17 tons in weight. Additionally, one forge bought a 4,500-ton hydraulic press to produce main shafts that weigh up to 18 tons.

"These small turbines have raised much attention from the public, and we believe that this technology has a bright future," Jotun's Frank Brown says. "We are very pleased to have been given the opportunity to provide our products and services in this innovative project."

So what lies ahead for the wind energy market, and how will this all help coaters and finishers? For starters, the AWEA says that 2011 is already guaranteed to be the biggest year yet for offshore wind milestones in the U.S.

Earlier this year, Secretary of the Interior Ken Salazar and Secretary of Energy Steven Chu unveiled a coordinated strategic plan called "A National Offshore Wind Strategy: Creating an Offshore Wind Industry in the United States," which pursues the goal of 10 gigawatts of offshore wind capacity by 2020 and 54 gigawatts by 2030.

They also promised $50.5 million in federal dollars for projects that

CAST PARTS

Cast iron is typically used for the rotor hub, mainframe, forward housing or frame, gearbox housing, and bearing housings. Depending on the size of the turbine, one wind turbine requires between 10 and 25 tons of ductile iron castings ranging in size from less than 100 lbs. to 50,000 lbs. Some wind turbines' rotor hubs weigh 36,000 lbs. and can be as large as 15 feet in diameter. Like the hubs, the bases are castings of ductile iron in a grade with superior low-temperature properties. The bases are configured like a gigantic bowl-shaped lower jaw weighing and can exceed 32,000 lbs.

The majority of wind turbine parts are made out of the more-challenging ductile iron grades, such as the EN specification 1563. This grade of ductile iron features the properties necessary to withstand the force of the wind and long-term exposure to the environment without failure. The castings must achieve high-impact strength at low temperatures, so the metal must be modified to achieve lower silicon and phosphorus levels. The alloy also must have high nodularity without a high nodule count, so great care is taken during solidification to achieve optimal nodularity.

Wind turbine manufacturers prefer these properties to be met as-cast in the critical castings. The components must pass stringent mechanical property tests and are subjected to extensive non-destructive evaluations that include ultrasonic-, magnetic- and penetrant-inspection methods.

MACHINED PARTS

Studs, bolts and nuts are either machined or forged, depending on the application or the client specification. High-quality fasteners, washers and dowel pins are utilized for internal and external bolting of the tower sections, blade and hub joints, and nacelle components, such as the generator and gearbox assemblies.

Many of the main components are large castings with features that require hundreds of hours of precision machining. The processing of these components includes boring, milling, drilling, tapping, turning and welding. Handling these large castings requires stout cranes and other material-handling devices and, most importantly, machine tools that can accommodate the enormous size and weight while machining them with great precision.

support offshore wind energy deployment.

In addition, Secretary Salazar announced the creation of high-priority Wind Energy Areas through the "Smart from the Start" initiative, and the Bureau of Ocean Energy Management, Regulation and Enforcement designated leasing areas for wind energy off the coasts of Delaware, Maryland, New Jersey and Virginia, and outlined plans to identify additional WEAs off the coasts of Massachusetts and Rhode Island. ■

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