



Do-it-yourself: Claus Engelbrechtsen of Breklingfeld, Germany, maintains his Nordtank himself. It continues to run perfectly. He installed the 65-kilowatt turbine in 1987; it was the first Nordtank in Germany. He bought it second-hand in Denmark in 1985 and connected it to the grid after months of type-testing in Schleswig-Holstein.

Oldies but goodies

Wind power plant owners are usually told that a new turbine will **last for 20 years**. But some rotors have what it takes to turn for a few more years.

Written by Nicole Weinhold, photographed by Jan Oelker

The American cars on Cuba's streets all have at least 50 years under their belt. The people there can hardly afford new cars. In fact, they're not even allowed to own one. Cubans are only allowed to own a car if it was already in the country before the revolution in 1959. Old cars are therefore very well taken care of. In Germany, the family car usually ends up as scrap after just twelve years. What does that tell us? First, if only we had taken better care of it, we could still be driving our good old Golf 1 today. Second, life expectancy is just a guideline – and in some cases, just another number in a long lifetime. The same is true of wind turbines.

They are usually designed to last 20 years. That means that calculations and simulations have shown that the most important components will fulfill their duties for at least that long. When the first turbines were installed, however, there were only imprecise calculations and no computer simulations. Turbines from the early days were only very rarely designed to chug along for two decades. In addition, the wind power industry is too young to have much experience with older units. According to the German Wind Energy Institute in Wilhelmshaven, about 400 turbines had reached 20 years of operation by 2009. About 550 old rotors have already been taken down.

On the grid for 26 years

Others have proven their mettle. "My turbine was the first to be connected to the German grid," Karl-Heinz Hansen recalls. "I never would have thought that it would last this long." Hansen's Vestas turbine, Kuddel, was connected to the grid in 1983 in Cecilienkoog in Schleswig-Holstein. That's more than 26 years ago. The pioneer says the 55-kilowatt (kW) V15 turbine has never given him trouble – "they're all still

the original parts." Similar situations can be found elsewhere. The V15 proved its durability en masse in the San Gorgonio Pass in California (*new energy* 4/2007).

In Germany, the wind farm operators especially interested in longer lifetimes are those whose older units can't be replaced in their location because they are not in areas designated for wind farms. The small turbines are often very close to farms and were grandfathered in after changes in laws. They can stay there as long as the owner wants them to. But how do things look when it comes to technical aspects? Can a turbine run longer than 20 years – and should it be allowed to? In fact, why aren't turbines simply designed for 30 years from the beginning?

Bernhard Richter was in charge of wind power for Germanischer Lloyd, a classification society based in Hamburg, Germany, from 1977 to 2005 and developed the certification center there. He says that the first systems back then could have been built for more than 20 years, but it would have been much more expensive for the manufacturers to guarantee operational stability for longer. "In terms of just technology, 30 years would have been possible. Probably not 40 years, since no rotor blade could last 40 years," he notes. Of course, the rotor blade can be replaced. "In terms of economics, however, more than 25 to 30 years just doesn't make sense," Richter suggests. Indeed, there are now offshore units designed for 25 years of operation. The larger the machine, the higher the amount of investments because of planning for installation in the water – for this reason, economics demands a lifetime of 25 or 30 years.

Richter says that a turbine's lifespan also depends on how much wear and tear it is subjected to. Inland turbines, which deal with less wind, can therefore last longer

than rotors in very windy areas. However, turbines intended for windy regions are also designed to be more robust. "It's possible to calculate the loads during operation and thereby estimate service life," Richter explains.

Location is not the only aspect that affects the length of a turbine's life. Reinhold Schaar of the Allianz Center for Technology (AZT) explains that it depends "significantly" on such things as repair and maintenance during operating. In other words, a turbine that is well taken care of lasts longer. Schaar points out, "Usually after 20 years of operation, a lot has to be invested to continue using a location. Because of how turbines are designed, some components – like the power train, rotor blades, and the foundation – will have reached the end of their serviceable life." If the turbine is in good condition, however, chances are good that it would make it beyond 20 years with a touch-up here or there. "Inspections of smaller turbines have shown that they were in surprisingly good condition even after longer operation," Schaar says. "It remains to be seen whether the same goes for large units." There is not yet any experience with longer lives for large turbines.

No oldies without spare parts

In fact, it looks as though megawatt (MW) turbines could also reach a ripe old age. Richter points out that calculations for wear are much better these days. "We didn't know about certain strains earlier. Original assumptions made for the large Growian turbine would increase by three times for today's calculations," says Richter. In other words, the old wind turbines could have a weak spot or two. Jürgen Holzmüller of 8.2, a group of experts in renewable energy, confirms this: "The instruments weren't as developed twenty years ago. Computer simu- ▶



Young and old: Father, son, and grandson of the Früchte family from Leeden, Germany, stand in front of their E-17, which will celebrate its 20th birthday next year. The manufacturer, Enercon, comes by regularly to service the machine. The turbine runs perfectly, but yield at this location is not optimal, so the Früchtes are not interested in repowering.

lations of loads and stress analyses using the finite element method were used only sporadically.” He believes the turbines designed today have longer lives thanks to the intensive use of these instruments.

Strange Skriver of the Danish Association of Wind Turbine Owners also points out that manufacturers know more about strains now. In addition, he says, throughout the wind industry’s history, certain classes have proven to be especially robust.

Skriver thinks the 600-kW turbines, for example, have what it takes to make it beyond 20 years, but he warns, “Rotor blades will break – and there won’t be any spare parts.” LM Glasfiber, the largest supplier of rotor blades, cannot even replace blades for some ten-year-old turbines. The situation is similar for other spare parts. The topic is so important to the Danish turbine owners that they organized a meeting with Vestas in January. Skriver stresses, “Manufac-

turers have to put pressure on their suppliers so they can offer spare parts for older units, too.”

Ralf Peters, spokesman for Nordex, says his company offers a comprehensive modernization package for old turbines. He points out, however, that while extending very old Nordex turbines’ lives is theoretically possible, they are stall turbines that could not stabilize the power grid. Extending operation for a lot of these turbine would not exactly help grid integration for a large share of renewables. “I think that, for operators right now, the more important question is at which point before the 20 years are up it makes sense to invest in extensive updates,” Peters says. The decision affects not only wallets, but also machines; if upgrades are made too early, they might have to be made again later. If they are made too late, wear could have already caused expensive damage.

Twenty years in Klein Köhren

“The manufacturer told me back then that the turbine had a life expectancy of 20 to 40 years,” recalls Cord Remke from Klein Köhren, Germany. In December 1989, his 150-kW turbine was the first Bonus machine to be installed in Germany. It has now survived two decades without a single problem. In late January, the turbine owner in Lower Saxony celebrated “20 Years of Producing Wind Power in Klein Köhren.” Remke says the construction permit for the small plot of farmland has no term limit. However, the authorities require the turbine to be periodically inspected.



Today, an individual or type test is necessary for a wind turbine to receive a permit. The test also verifies the life expectancy of at least 20 years. If owners of turbines that have undergone a type test want to operate it for longer, they must prove that the machine's quality is sufficient. In early 2009, Germanischer Lloyd announced a policy that allows turbine owners to extend their machines' service lives. Operators can choose between two methods used to inspect turbines, explains Torsten Faber, head of the rotor blades and structural engineering department at Germanischer Lloyd (GL) Industrial Services. "With the practical method, the wind turbine undergoes an intensive inspection," the policy's co-author explains. The inspection includes documentation, fault analysis, an inspection plan, and an assessment report noting when the next inspection must be – usually one or two years under qualified supervision. The entire appraisal ends up costing about EUR 5,500. Meanwhile, the analytical method makes more sense for a whole wind farm with turbines of the same type. This method uses calculations to determine how much longer the turbines should be allowed to run. "It's more work and money than the practical method, so it doesn't really make sense for small, individual turbines," Faber says.

So far, demand for these assessments has not been too high. The policy is currently being tested for the first time on a turbine in Schleswig-Holstein. The machine is to be relocated and therefore needs to be inspected. Such a case happens every once in

a while: in 2007, for example, a Furhländer turbine was moved from the Westerwald mountain range to East Frisia. P.E. Concepts had analyzed the machine and provided the required verification using a simplified calculation process. Originally put together in 1993, the FL100 may now run for another 20 years starting from when it was reassembled.

Engineering firm Prass und Partner in Hamburg also made an extra-long operating life possible for a foundation. After an eight-year-old NEG Micon turbine was completely destroyed in a fire, Prass reassessed the undamaged foundation for a Vensys 62. It can now be used for another 20 years.

EEG compensation until 2020

Meanwhile, Cord Remke is hoping that the 20-year-old Bonus turbine on his land will keep fulfilling its duties for a long time to come, since compensation from the German Renewable Energy Act (EEG) continues to be quite acceptable. It provides payment for 20 years. And since the act came into effect just ten years ago, Remke can still expect compensation until 2020. He can even claim the higher rate for the first five years, since the wind in Klein Köhnen doesn't blow as strongly as on the coast.

Replacing the turbine is out of the question for the regional director for Lower Saxony's rural adult education program. "Since I wouldn't be approved for a new machine at this location, I can't replace it," he explains. Others who have been operating turbines from the beginning are in similar

situations. These are owners whose turbines are not in areas (later) designated for wind energy and who have neither money nor interest in working with other operators on a repowering project in a better location.

In terms of energy policy, however, the fewer old machines that continue to be operated, the better. This is especially true when the old turbines are in locations that could be used for new technology, since the German wind power expansion goals can only be reached with the help of megawatt turbines. The average machine installed today has the capacity of 16 turbines from 1990. While turbines put up then produced an average of 160 kW, the figure was 2.5 MW for those put up in mid-2009. Increasing renewable energy to a 47 percent share of total electricity in Germany by 2020, which the German Renewable Energy Federation has set as a goal, is only possible with the help of many more new wind turbines.

Thankfully, figures from the German Wind Energy Institute show that repowering has been going on for some time now. The government is providing another incentive by handing out bonuses for replacing older machines. It can therefore be assumed that most of the aged turbines will be retired after 20 years at the latest. But, Hermann Albers says, a few operators still hang on to their old turbines. "These machines provide a glimpse of historical turbine technology," says the president of the German WindEnergy Association. He adds that the old turbines also demonstrate turbine technology's quality and durability. ◀