WINDLETTER

THE MONTHLY NEWSLETTER OF THE AMERICAN WIND ENERGY ASSOCIATION

Volume 21, Issue No. 12 – December 2002

SMALL TURBINE COLUMN:

WIND SYSTEM OPERATION AND MAINTENANCE COSTS

--Mick Sagrillo, Sagrillo Power & Light

When determining the life cycle cost of a given wind system, one important item that is often overlooked is the system operation and maintenance. By accounting for these expenses during the design and feasibility phase of your turbine, you will avoid unexpected future surprises.

Home-sized wind turbines, just like the cars we drive, the roofs we live under, and our heating systems, will eventually need some tune-ups and repairs, both minor and major. It is unrealistic to believe that something as complicated as a wind electric system will operate unattended and untouched for the 20-year-plus life expectancy of the system.

For example, your car makes an interesting analogy. If you drive your car for 100,000 miles before selling it, at an average speed of 40 miles per hour (combined city and highway driving), you will amass 2500 hours of driving time behind the steering wheel. Doesn't seem like much, does it?

There are 8,760 hours in a year. Your wind generator will be turning about 85% of that time, or nearly 7,500 hours per year. It won't be generating full output during that entire time, but "the ignition will be on," comparable to city driving, highway miles, and idle time.

So, the average home-sized wind turbine will put on as many "miles" in four months as the average car does in its 100,000-mile lifetime. No responsible automobile owner would expect their car to perform for such an extended period of time with no tune-ups or oil changes, let alone no maintenance.

Home-sized wind turbine technology has made great strides in the past 10 years in terms of reliability. Most of these improvements have not come from new designs. Indeed, the technology we have today was all developed between the 1890's and the 1940's. The increased in reliability we see in today's wind turbines is the result of simple designs and significant improvements in the materials that are used for the component parts.

Stainless steel used in fasteners, high-tech metal alloys for turbine bodies, and advanced bushing materials have gone a long way in extending turbine life. Carbon reinforced fiberglass, plastics, and epoxy composites have greatly improved blade life expectancy. Ultra-violet stabilized abrasion resistant tapes significantly reduce the erosion on the leading edges of blades. Improvements in insulating materials in the alternators and generators extend the life of the electrical generating components. Advanced paint coatings that stand up to the weather extremes that a wind turbine experiences reduce the maintenance expenses and down time associated with surface rust and subsequent component failure.

However, things do wear our, or just plain wear. Alternator bearings cannot be expected to spin for years without replacement. The same holds true for yaw bearings with their significant loading. Dust, debris, and even insects in the wind will eventually erode the most durable blade materials, leading edge tapes, and paint coatings. Tail bushings and governor components, subjected to dirt and moisture, inevitably wear as the turbine governs in storms or during windy periods. Paint coatings, subjected to sunlight, moisture, and temperature extremes will eventually deteriorate. If your system has a gearbox, the lubricant will degrade over time, just as the oil in your car engine does.

So, don't assume that your wind turbine will spin for 20 years carefree. While today's turbines are vastly improved over past offerings, you will need to allocate some money for repairs. How do you plan for that?

The rule of thumb I use is that you will need to allocate about 1% of the installed cost of the wind system for operation and maintenance expenses over the life of the system. For example, if you paid $40,000 to have your wind system installed, this would amount to $400 per year. This amount would be accrued over the life of the system. What this means is that you will not necessarily spend $400 every year, but you need to plan for that amount annually. "Accrued" means that this amount is banked on an annual basis. The above mentioned $40,000 system may not need any service or repairs for five years. But at the end of five years, you might reasonably expect to have five times $400, or $2000, in expenses for operation and maintenance.

If, after five years, the alternator bearings are beginning to rumble, it would be prudent to replace them rather than wait until the rotating alternator components began scraping against each other. This would result in significantly greater expense. In the bearing replacement scenario, the $2000 should cover the cost of your dealer or installer driving out to your site, removing the wind turbine from atop the tower, driving it back to the shop, disassembling the alternator, replacing the bearings, reassembling the alternator, driving it back to your site, reinstalling it on your tower, then driving back home. Labor, mileage, and materials add up in a hurry!

The items that will be a significant expense to repair or replace on a direct drive wind system are the alternator bearings, yaw bearings, and blades. Minor parts like tail bushings, slip rings or brushes, or paint are unfortunately usually left until a more substantial repair is warranted.

All of this assumes direct drive wind turbines, very simple and reliable devices. If your wind generator is a model that utilizes a gearbox, it falls into a different category. Gearboxes have at least an order of magnitude more moving parts than direct drive units, and several orders of magnitude more wear points. As a result, you can expect more costly and more frequent service and repairs for such models. For example, gearbox lubricant will need replacing on an annual basis. For such wind generators, I advise stashing away at least 2% of the installed cost for operation and maintenance rather than 1% as with direct drive wind systems.

None of this takes into consideration repairs that are needed as a result of what insurance companies would call an "act of God," such as a lightning strike. Nor does it take into account the added wear and tear that results from installing a wind turbine on a tower that is inadequate for the site. Short towers, which place the wind generator in turbulence caused by the obstacles on the ground (trees and buildings), may be a bargain at installation time, but they will result in considerably more wear and tear on the wind turbine as the rotor hunts for the wind. In this case, saving money by cutting corners on the tower invariably results in significantly higher operation and maintenance expenses down the road.

It's well know in the small wind turbine industry that the life expectancy of a wind system is directly proportional to the owner's involvement with the system. Ignore the system and some day you'll

be picking it up off the ground. Allocate enough money to take care of the system, then follow through when the situation warrants, and you'll easily exceed the arbitrary 20 year life expectance of the system.

[Editor's Note: The opinions expressed in this column belong solely to the author.]