MAINTENANCE

Operations • Service & Repair • Inspection • Safety • Equipment • Condition Monitoring • Lubrication

Effective blade inspection plans involve advanced planning and method selection

By Jack Wallace
Frontier Pro Services

As the warmer weather is waning for most wind farms here in the U.S., the window for efficient blade repair service is quickly drawing to a close. This is because the blade repair guys don't like to get cold and will soon be heading out to the Bahamas for an all winter party.

The main reason that blade repairs are a mostly seasonal service is because the materials used for repair are temperature sensitive. Some materials that can cure in a few hours in 80 degrees can take days to cure in temperatures below 70 degrees. Although we can help the cure along by applying heat, this process consumes more time, and as they say — time is money. This process is just not as efficient as it is in warmer weather.

So, what about blade inspections? Did you get a chance this summer to look at them all? How did you do it? Are you still unsure if the process you use is adequate? Blade inspections can be completed in many different ways, and each of these ways has its pros and cons. Let's take some time here to discuss a variety of the most common ways blades are inspected. Remember, the main reason for blade inspections is to find problems, so you can decide what to do next — whether that is to run another season, to make repairs, or to take out of service.

Blade inspections should be happening on a continual basis with the personnel on site. To start, anyone that is near a wind turbine should be at least listening to the sounds it is making. Blades that have strange noises coming from them may be indicating that they have issues. Typically all three blades will make the same type of noise when the rotor is spinning so you have three blades to compare against each other. If one is making a different noise, then it is fair to assume that something is different and you may want to take time to further investigate.

Noises that should attract your attention are a blade whistle, or a ripping noise. A ripping noise is similar to the sound of a piece of paper being ripped. Both noises can indicate issues with the blade. Sometimes the source of the noise cannot be easily found. Other times the noise could be from a lightning strike, or simply from a torn piece of leading edge tape. While the lightning strike damage may be worth the time to repair, you may just let the torn tape go until it is worth dealing with.

Usually the first line of defense in blade inspection is your maintenance team. Again, when these personnel are near a turbine, they should be listening to the noise it makes. Additionally, if your turbine is stopped or pin wheeling, you should scan the blades with your binoculars (every truck has a set, right?).

The next cost-effective inspection is by blade-savvy teams that can come in and perform a ground-based inspection. These teams are experienced in knowing what to look for. They typically use spotting scopes or binoculars, and cameras with high-powered

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lenses. They first perform an inspection in the field, and then they take photos of the entire blade surface. They later review the high-resolution photos, using zoom capabilities to get a "close-up" view of the blade skin surface and inspect for damage.

Sometimes an even closer look is needed to determine suspicious points on a blade. This calls for an "on blade" inspection. There are two and a half ways to do this today. The first is by using a rope access team; secondly, using a cable-suspended basket. The "half" way is by utilizing the new drone-mounted aerial remote viewing cameras. I call this inspection method a "half" way because even though you can get right up to the damage with the drone, your physical access is still limited. You lose the ability to tap or poke at the blade surface that you have with the other methods. The drone, or quad copter, remote camera is a great example of how technology keeps helping us perform our work better. It is a great way of morphing between ground-based inspections and on-turbine inspections. These remote camera inspections are being performed by service companies, forward-thinking site technicians who own their own drone, as well as by entrepreneurs trying to make a focused business by utilizing this great new device. The only problem is, this new tool has raised the concern of the government as to whether or not they should be controlled. I think new technology always does that.

Having a team of techs on the blade is pretty expensive and is usually the last resort. But once a tech is there, he may be able to make the repair on the spot. I personally think that if I am going to put a tech on a blade, he better be able to make the repair. I feel I can get a good sense of the damage from ground-based and remote camera photos. Once the damage is found, I can determine, for the most part, if a repair is needed. Very rarely have I had to go on-blade to confirm an issue, but it has happened.

One point of the blade inspection work we should think about is the timing. Since most blade inspections require the sharing of extremely large amounts of data consisting of photos and the results of analyzing these photos. This data review takes time. From the data review we will typically get a request for more in-depth inspection or repairs. To get this additional work completed takes time, budget, and resources. Although a person can be quickly trained to inspect for blade damage, it takes time to train a person to properly access a blade and to make a repair.

Since this all takes time, and in the U.S. we are all experiencing the summer during the same time, most of us are competing for these limited blade repair resources. My recommendation is to get your scheduled inspections lined up early in the summer so that you can get the blade repair techs to your site before the colder weather hits. Otherwise you can get in line for the repair teams, potentially miss the window of repair for the warm months, and get stuck paying for inefficient repairs in the colder months... if at all.

Hopefully you were able to manage your blades well this past wind season like a pro. If not, there is always next year to improve your process and to reduce your costs. Don't wait until summer to plan work on this.

As always work as safe as possible and work to prevent surprises.

Dual-stage magnetic filtration shown as effective in reducing fluid contamination

By One Eye Industries

Figure 1.

In the fast-growing industry of wind power, new technologies for gearboxes, blades, rotors, and other major components are emerging every day but something that is often overlooked is the root cause of most turbine failures.

Gearbox and hydraulic system failures make up the highest number of failures in the wind power industry, resulting in fire, shutdown, and loss of production. In order to minimize the downtime and costs associated with replacing a failed gearbox, don't let it fail. In order to reduce failure of gearboxes, find the root cause of the failure. In the majority of cases the root cause is contamination (mostly ferrous metals and silica dust) wearing the gearbox components prematurely. This contamination is the result of the machining process, airborne ferrous metal, break-in wear and is even found suspended in new hydraulic fluids, gear oils and glycol.

Research indicates that contamination under 10 microns to sub-micron in size is the most damaging to components in gearboxes, fuel, coolant and hydraulic systems. Advancements in machining tolerances for transmissions and gearbox bearings, shafts and seals, and hydraulic valves, seals, and actuators, are now three microns in size and lower, so filtration able to remove contamination below this level is essential.

The first step in reducing this wear is to create a proactive hydrocarbon

Figure 2.

Figure 3.

management program. In one regard ensuring that the oils, hydraulic fluids, and glycol used in the operation of the turbine are of good quality and are stored properly in a warm, dry location, closed off from the elements. The second step involves eliminating these wear particles, which is essential in maintaining the longevity of the fluids and the wind turbine.

New magnetic filtration technology developed by One Eye Industries offers the ability to remove ferrous and non-ferrous contaminants and protect the system from particles down to sub-micron levels. Traditionally, ceramic magnets have been used to filter hydraulic fluid and gear oil, but these offer minimal ability as the strength is low resulting in its inability to remove contamination below 10 microns. Another problem ceramic magnets pose is that they need to be in direct contact with the fluid to ensure the strength is not limited. This poses a contamination issue as the magnet is susceptible to vibration and temperature and can crack resulting in magnetic particles travelling through the system and attaching to metal components such as bearings. These in turn cause wear to the bearings and shafts.

GEARBOX

There is a link between failures of lubricants and failures of equipment. Oil analysis data will detect particles of contamination and degradation and the proper use of this information can detect the chance of a failure.

In November 2013 a wind turbine company in Taranto, Italy was finding it difficult to remove contamination below 20 microns using traditional filtration. This contamination was prematurely wearing the bearings, gears, and shafts of the turbine gearbox. Alex Priori of Renox suggested installing a dual-stage magnetic filtration system to increase the filtration efficiency to sub-micron levels, protecting the system components.

After seven months in operation, the magnetic filter removed a large amount of contamination from the gear oil. Analysis of the trapped particles indicated 48.3 percent was ferrous and 51.7 percent non-ferrous, down to 1 micron in size. “The company was amazed by how much contamination was retained by the magnetic rod,” Priori said. A bearing

Figure 4.

failure in a wind turbine gearbox can cost an excess of $500,000 plus the downtime of production. The magnetic filter has a holding capacity in excess of 12 ounces (0.34 kg) before cleaning is required.

HYDRAULICS

Hydraulic systems operate at under 1 micron tolerances, yet most traditional filtration is nominally rated to 3 microns. These ratings can be misleading, as nominal indicates that throughout a number of passes at one time a particle of 3 microns will be trapped by the filter. Patented rare earth magnetic filtration systems trap contamination to sub-micron levels at 97% efficiency.

In February 2014, a Diamond Mine North of Yellowknife in the North West Territories had a problem with dirty hydraulic fluid with an ISO of 25/24/16 on their 5500 Komatsu shovel operating with a 4500 PSI hydraulic system. Traditional filtration was not able to meet their minimum ISO standard of 18/16/13 with the limited 3-hour kidney loop filtration interval. Mark Robillard of Kingland Ford Mining Division suggested employing the OEI high flow magnetic filtration skid as it guaranteed this minimum ISO standard.

On its trial run, fluid samples were taken before and after the unit and sent to three independent labs. Common results showed that not only had the kidney loop met the anticipated standards, but exceeded them — retaining a cleanliness level of 17/14/10. The analyzed contamination on the magnetic filter rods identified ferrous (88 percent) and non-ferrous (12 percent; mainly consisting of carbon and calcium) contamination ranging from 100-plus microns to sub-micron in size.

The diamond mine maintenance manager is very pleased with the results and is incorporating other OEI filtration solutions.

In May 2008, Newcrest Mining's Cracow Gold Mine was finding large amounts of metal contamination were being missed by their traditional filters, degrading the fluid viscosity in the hydraulic cooling system of their Symons 4 1/4' Cone Crusher. After suggesting they replace one of the OEM filters with an OEI ADD-Vantage 9000 dual stage magnetic filter a 64-hour run was conducted. The amount of trapped contamination is shown in the adjacent photo. Newcrest anticipated that had this not been captured by the magnetic filter it would have found its way back to the valves, motor and hydraulic pump. As part of the continuous improvement program at this site other pieces of critical plant equipment have been identified as benefitting from magnetic filtration technology.

COOLANT

With the price of glycol constantly on the rise, wind operators are looking at ways to reduce the consumption of this substance. Most coolant

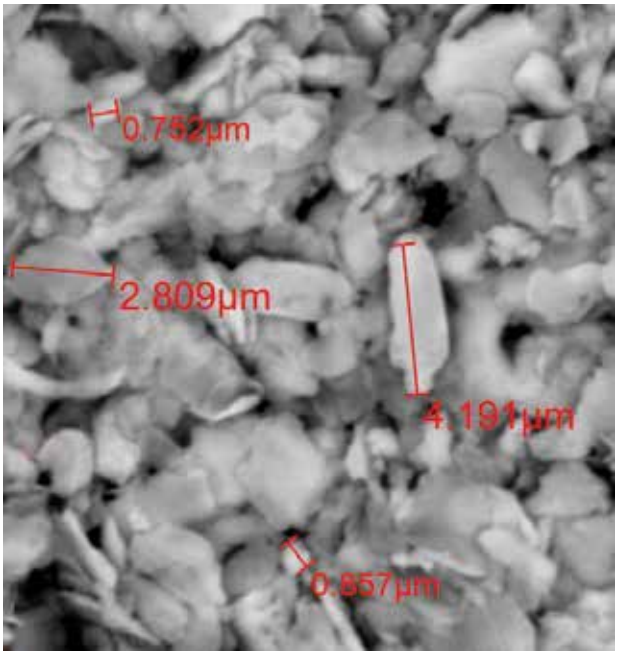


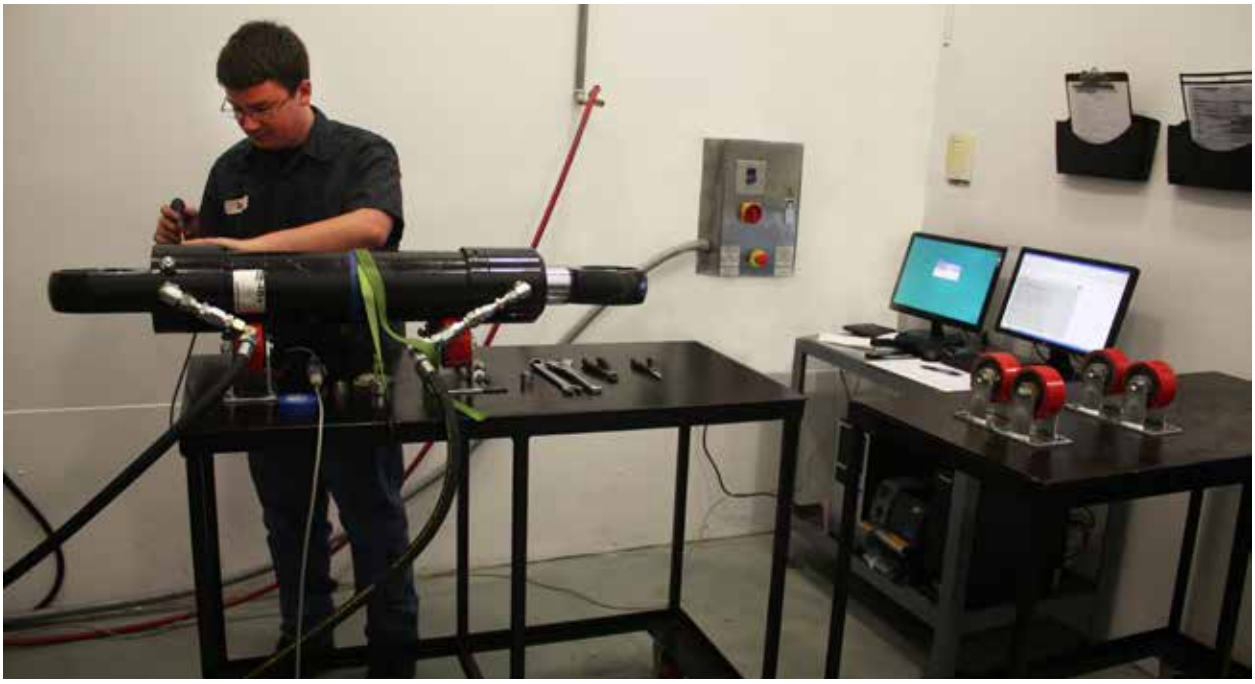
Figure 5.

lines have no filtration, but with the employment of rare earth magnetic filtration contamination is removed to sub-micron levels leaving the glycol — in most cases — cleaner than new. Fluid life can be extended by a factor of two to three times.

From 2007 to the present, Chris Hampson has been using magnetic filtration to remove harmful contamination found in the coolant system on his 2007 CAT C15 engine. Chris was experiencing seal wear and pump wear due to ferrous metal contamination in his coolant lines. One Eye Industries suggested the installation of a one-inch Y-Strainer in line of the engine coolant circulation system. After 12,000 km, a large amount of ferrous contamination was trapped. In June 2014 at the annual PM period, Chris is still finding a large amount of contamination trapped on the rod (see Figure 3). If left in the fluid, these metal particles will prematurely wear the water pump and radiator components and degrade the quality of the glycol.

SAFETY

Magnetic filtration offers a highly efficient, environmentally friendly solution to improve filtration capabilities. By employing this reusable, cleanable technology, the life of the components and fluids can be extended resulting in extended PM intervals, in turn reducing the risk of injury as the technician's contact and time to and from site is reduced. This should have a positive effect on insurance costs.



Hydratech opens wind service and repair center in Alabama

Hydratech Industries Wind Power has opened a state-of-the-art service and repair facility in the United States with world-class hydraulic cylinder design and manufacturing experts to service and repair hydraulic cylinders for pitch hydraulics and hydraulic braking.

With three manufacturing facilities strategically located worldwide, two research and design facilities and now a repair and service facility in the U.S., HWP has shifted to a major focus in providing a service oriented business around the needs of renewable energy technology providers, as well as to continue manufacturing components that are built to endure harsh operating conditions for this market.

The new service and repair wind power facility is strategically located at the Robertsdale, Alabama, Hydratech Industries Fluid Power manufacturing facility. Existing space adjacent to the Fluid Power plant was expanded, built out, redesigned and reconfigured to incorporate the specialized needs and equipment for wind power service and repair.

"The installation of the new facility for wind power repair in the U.S. further solidifies our commitment to global customers in the renewable energy business. We are excited to expand our global reach in this industry," remarks Bill Vosen, General Manager of Hydratech Industries USA.

HWP service and repair facility was designed and built around the needs of existing renewable energy customers and the critical operating nature these components must perform to day in and day out. To keep the quality of work to the highest standards each component undergoes a rigorous inspection process. All aspects of the inspection and dismantling are recorded in a detailed report for ten test points including upgrading sealing systems to the newest standards, replacing or repairing damaged parts, fluid leakage checks and components. Inspection, assembly and testing are completed in positive air pressure clean rooms meeting NAS class 4 requirements for environmental cleanliness. Environmental cleanliness is essential to ensuring all fluids and seals stay clean from dirt and debris.

"Fluid cleanliness testing is crucial in all service and repair projects at our wind power facility," explains Vosen. "Our fluid cleanliness meets ISO 4406 test standards above AWEA standards." More than 75% of hydraulic problems can be traced back to contaminated oil. "Monitoring cleanliness is therefore the most important factor in preventing failures and getting these components back to working order," states Vosen.

After the service, repair, assembly and testing are complete all statistics and measurements are provided to the customer in a comprehensive report. With a universal mindset, customer oriented approach and 30 years of experience, global leading providers of renewable energy technology know that they can rely on Hydratech Industries Wind Power's team.

Availon subsidiary branches into energy management

Availon recently established Availon Energy Management GmbH (AEM), a subsidiary seeking to complement the company's existing technical service solutions by offering customer-specific energy management, wind performance forecasts, direct marketing support, contract management and further commercial services.

Among other areas, AEM focuses on the calibration and optimization of wind forecasts, which are in part based on the specific features of the respective wind farms. The standardization of communications between all areas makes it easier for service companies, senior management and energy traders to coordinate their activities. It also enables the usage of uniform procedures in the event that deficits are discovered. The financial reporting process looks at the areas of liquidity, interest rate development and insurance and profit-related contracts.

AEM already manages commercial and technical matters relating to wind turbine generators with a total capacity of almost 100 MW. The Availon subsidiary furthermore offers equally optimized and calibrated wind performance forecasts for a total of 190 MW.

The complementary AEM services are aimed at both large and small wind farm operators, managers, energy suppliers, public services, investors and direct marketers. "For operators, it is not just the number of kilowatt hours produced that matters but the yield per kilowatt hour," said Availon Managing Director Markus Spitzer, describing customer requirements.

"The extent of our support depends on the customer's needs. We offer our services in a modular format or as an all-in-one package."

Availon hired Claudio Papa to head AEM. As a qualified economist, 36-year-old Claudio Papa from Kassel has managed numerous wind projects both domestically and abroad over the last 12 years. His expertise includes planning and creating wind farms, project financing and technical and commercial support. "We are delighted to welcome Claudio Papa to AEM," Spitzer said. "Thanks to him and his team of experts, Availon can now offer all services from a single source."