

Wind Turbine Repairs

January 6—June 9, 2017

Oregon experienced unusually frigid conditions in January of 2017. On January 6th, the temperature dropped to 14 degrees; on January 15 it dropped to 18 degrees. There was much snow during this two week timeframe. On January 11th, Governor Kate Brown declared a state of emergency in Oregon due to severe winter storm conditions.

As the cold finally gave way to more normal winter conditions, we began to hear grinding from the wind turbine — and the grinding got louder and louder. We tried to shut down the system but the braking system did not work. By late January the blades were spinning out of control at the slightest wind.

Trying to find a repairman was nearly impossible. The company that installed our Jacobs 31-20 Small Wind System, Kardon Construction, is now out of business. The closet repairman who does repair work for Jacobs Wind Energy Systems (Mike at All Star Electric, 505-730-3500) lives in New Mexico and was unable to get to the farm until June. Kathy contacted Portland General Electric (our net-metering partner), Energy Trust of Oregon, and schools that train wind turbine technicians (Columbia Gorge Community College at the Dalles Campus and Northwest Renewable Energy Institute in Vancouver). All to no avail.

We decided we needed to take a different approach to repairing the turbine. Jeff at Stayton Builder's Mart suggested we contact Powder River Development Services, LLC, which was located just down the street. Kathy called and spoke with the Vice President of Construction Services, Rob Angle (503-269-5866). Rob was familiar with our farm and stopped by the next day to see if they could help. Powder River, located only 16 miles away from the farm, specializes in towers, including cell and large utility wind turbine systems, and serve nationwide. The cargo trailer they brought to the farm was loaded with every kind of climbing rope, safety gear and support hardware. Rob sized up the situation and offered to help with his incredible crew and skills to tackle this job.



Lambing began on December 31, 2016. Here in mid-January, ewes are inside the barn to prevent birth of lambs outdoors in snow and freezing temperatures.



March, 2017. Wind spinning endlessly. Brake to system has also broken.

The first goal was for us to find the opportune moment when the wind died down, allowing someone to crawl up the 120' ladder and secure the blades. It would then allow a repairman to crawl up the ladder, diagnose and then repair the turbine. Time wore on and on. Winter storms kept the blades spinning. Finally, on March 16th, the wind stopped and Powder River responded instantaneously by sending out a crew to secure the blades.



March 16 — Gilbert from Powder River dashes up the wind turbine and ties down the blade to prevent them from spinning.



On March 27th, Powder River brought out a crane. The ground was so soft the crane was sinking in the pasture if it approached the turbine. So the smaller crane went back to Stayton and a larger 90 ton crane with 160' boom showed up later in the day. Gilbert climbed the ladder on the turbine, detached the casting tower and, using the crane, brought it down for evaluation and repair. All this occurred during typical winds and rains common to Western Oregon this time of year. Ken used our backhoe to remove the casting tower from the crane. The blades were removed and laid on the ground; the balance was secured upright, tied down and tarped to prevent damage from ongoing wind and rains. When time allowed on Casey's schedule, the gear head was detached and brought into our shop for diagnosis and repair. Casey disassembled portions of the gear head. Upon examination, Casey and Ken felt that the pinion shaft had disintegrated over the past five years. It appeared the metal had not been "hardened," which would have been necessary to handle incessant friction and heat generated by the spinning of the shaft inside the pinion gear. By not being hardened, the pinion shaft malfunctioned from the time the equipment was first installed. The brake had also failed. We set about to order parts from Joe Straley, 320-267-9463, at Jacobs Wind Energy Systems which is located in Minnesota www.jacobswind.net It took several weeks for the parts to arrive. Parts ordered included: pinion shaft, pinion gear and hypoid gear.



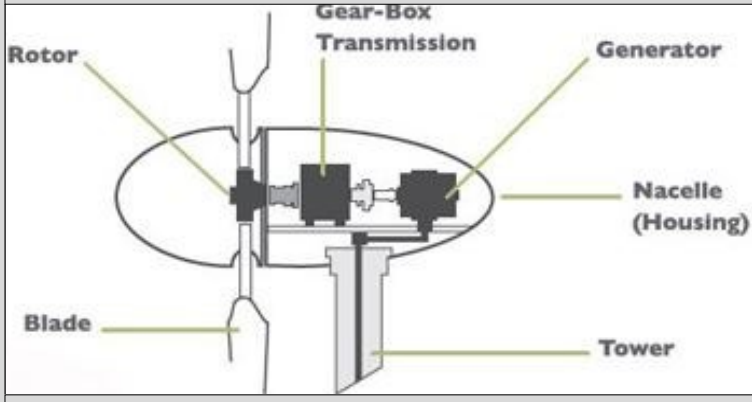
*Above: pinion gear
Below: cast iron brake*



Energy in the wind turns the blades around a rotor. The rotor is connected to the shaft, which spins a generator to create electricity. A simple wind turbine consists of three main parts, the blades, shaft and generator:

- 1) Blades: The blade acts as barriers to the wind. When the wind forces the blade to move, some of the wind energy is transferred to the rotor.*
- 2) Shaft: When the rotor spins, the shaft also spins, and transfers the mechanical energy into rotational energy.*
- 3) Generator: A generator uses the difference in electrical charge to produce a change in voltage. Voltage is actually electrical pressure, the force that moves an electrical current. The voltage drives the electrical current (alternating current power) through power lines for distribution.*

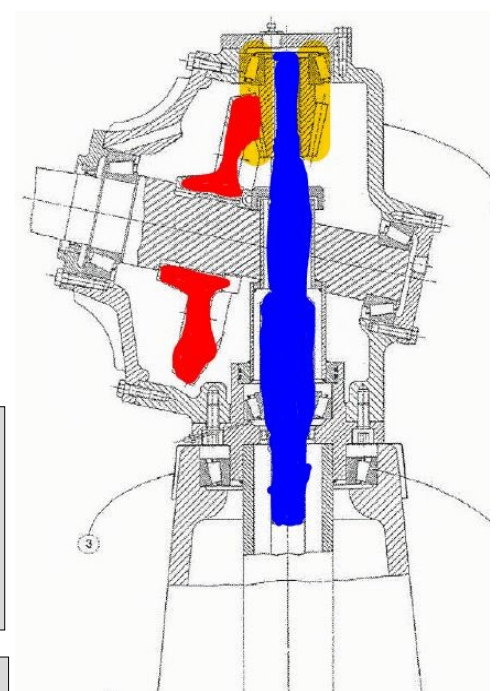
How does a wind turbine work?



Repairs at Santiam Valley Ranch were concentrated in the Gear-Box Transmission and the mechanical floating caliper brake which is located between the gear-box and generator.



Casey working in the farm shop to replace the pinion shaft, pinion gear, hypoid gear and brake.



Right: Notes for diagram
 Parts replaced in Gear Head Transmission —
 Red: hypoid gear
 Blue: pinion shaft
 Yellow: pinion gear



Left: Ken and Casey reassembled the gear box and used the tractor to transport it to the casting tower which is stored outside under a tarp.

Drawing above from Jacob 31-20 20KW Service Manual, Wind Turbine Industries, Corp.



Ken and Casey reattached gear box to casting tower and attached the blades.





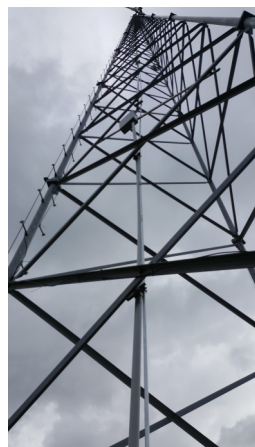
On June 7, Powder River brought a 90 ton crane with 160' boom and three professionals to the farm and remounted the casting tower to the top of the turbine. Gilbert is back on top, making it all happen!

When the turbine was installed in 2010, the electrician did a very mediocre job. Although it was approved by Marion County, we felt that the PVC housing the electrical line needed to be replaced. Casey and Gilbert mounted metal conduit runs and installed a new rain tight junction box to replace the PVC box that leaked. The existing wires were re-pulled, along with sensor wires for URL software program.

And then we pulled the "On" lever!



It took 5 months to repair the wind turbine at a cost of \$9,582.45, not including our time and equipment. When installing a utility system, one needs to deal with complex repairs, including parts, expertise and handling, and its associated costs. And don't forget the crane, backhoe, tractor, indoor shop and creative energies, networking and teamwork.



New metal conduit mounted, replacing PVC electrical lines.

Thank you:
 *Rob, Gilbert & Casey, Powder River Development Services, LLC
 *Joe, Jacobs Wind Electric
 * D&W Automotive for pulling out the hypoid gear
 * Don for providing 550# torque wrench
 And all the teamwork that pulled this together!

Budget for Repair

Wind Turbine Parts

Jacobs Wind Energy Systems (hypoid gear, pinion shaft, pinion gear, brake)	\$2,462
NAPA (fluids)	115
D&W Automotive (disassembly of gear head)	202

Crane (Powder River Development Service, LLC) 2,899

Labor (Powder River Development Service, LLC) 3,545

Electrical Conduit

Home Depot	262
Power River Development Service, LLC	53
North Coast Electric	44

Total \$9,582

