FLUKE®

Blowin' in the wind

Today it's power...and jobs

Application Note

Testing Functions

Case Study

Tools: Fluke 87V Industrial Multimeter; Fluke 1587 Insulation Multimeter; Fluke 810 Handheld Vibration Tester; Fluke VT02 Visual IR Thermometer

Instructor: David Hastings, Northwest Renewable Energy Institute (NW-REI)

Applications: Check continuity and control signal strength; voltages to valve solenoids; electric pump function. Verify function of electrical motor and variable frequency drive. Check lubricant condition and temperature; check for vibration indicating trouble; check bearing and gear condition. Check voltage each leg and check phase balance; test insulation in each winding; check grounding system.

Your truck tops the crest of a hill and there they stand: towering over the horizon, giant wind turbines turning in the breeze.

More than 45,000 strong in 39 states, these machines are not just generating power—more than 60,000 megawatts (MW) by the end of 2012, according to the American Wind Energy Association (AWEA). They are also creating jobs.

Nearly a quarter of that power capacity, more than 13,000 MW, came online in 2012. Wind became the top source of new United States electricity generating capacity in 2012, providing some 42 percent of the year's new generating capacity. At year's end, some 43 MW of additional capacity was being built.

The engineers and manufacturers who design and build these mighty machines, the construction workers who install them, and technicians who handle setup and ongoing maintenance add up to some 75,000 jobs in all 50 states, according to AWEA. The top states for wind power are Texas, California, Iowa, Illinois, and Oregon.

The breeze is blowing

If the prevailing breeze is blowing us toward wind energy, it's the result of both public policy and our own self-interest. President Obama's American Recovery and Reinvestment Act of 2009 included more than $70 billion for clean energy and associated transportation programs.

The President called for renewed commitment to renewables in his 2012 State of the Union address.

Given the dangers of nuclear power dramatized by the 2011 Japanese earthquake, the vagaries of fossil fuel supply and price, and concern about carbon-caused global warming, it makes sense to grow renewable energy sources like wind power.

In Vancouver, Washington, the Northwest Renewable Energy Institute (NW-REI) is not waiting. NW-REI has stepped out with a training program to prepare students for careers in the wind industry. According to program manager Jason Bodily, NW-REI this year will train 390 students—one in five a veteran—as wind turbine technicians. The program gives graduates the basics to get started in the industry, where they will continue to learn the details of specific turbine brands and models.

Complex machines

Whether you handle installation, commissioning, and warranty service for a manufacturer, or do ongoing post-warranty service and maintenance for a power utility or service contractor, succeeding as a wind turbine technician requires a broad range of skills in electrical, mechanical, hydraulic, and control systems. These are complex machines (see table on next page).

Control systems detect changes in wind speed and direction, and send orders to pitch adjustment systems that vary the angle of the giant rotor blades to keep RPMs consistent as the wind varies, or change the turbine's alignment as wind direction shifts. The mechanical or hydraulic systems that actually move these huge, heavy components are likely to have variable frequency motor drives (VFDs) to prevent abrupt starts and stops. A gearbox connects the turbine shaft to the generator, stepping up the turbine's 5–8 RPM to 1500–1800 RPM at the generator. Huge bearings support each rotating component.

Starting at the top

At a cost of $4 to $6 million each (not including installation), turbines are major investments worth protecting. They will typically be tied into a network that operators use to control and monitor the performance of turbine components over time, from afar. But when those monitors see that hands-on work is required, they dispatch the wind turbine technician.

Those techs "won't be supervised out there," said instructor David Hastings, and conditions can be challenging. There's that 280-foot tower you have to climb, which makes strong legs and arms (and thorough safety training) a must. The nacelles (streamlined enclosures) that house the rotor hubs, gearboxes, and generators leave little room to work.

But you start your job at the top, and no CEO has a better view.

Training upwind and down

The 24-week NW-REI training program includes six four-week segments:

- Intro to Wind, a history of wind as an energy resource, OSHA Safety Certificate, wind turbine safety practices, rigging, inventory, drug and alcohol awareness, first aid/CPR/AED training, technical writing, and climbing and rescue certification.
- Mechanical includes two sections on mechanical drives (key components linking turbine rotors to their generators), laser alignment, and vibration analysis.
- Electrical, which includes introduction to multimeters (according to Hastings, the Fluke 87V Digital Multimeter [DMM] and Fluke 1587 Insulation Multimeter are the industry workhorses), AC/DC electrical systems, electrical relay control, and Qualified Safe Electrical Worker training.

Instructor David Hastings teaches continuity tests after Lockout/Tagout safety is in place. Students Robert Brents and Courtney Ringstrom use the Fluke 87V to make the measurements.

In a real-world scenario, students from the Northwest Renewable Energy Institute travel to south-central Washington state to experience scaling a 300-foot (91.4-meter) wind turbine and then using their Fluke tools.

At the Vancouver, Washington campus, students climb the training tower to learn safe climbing practices.

- Motor Controls, where students study electric machines (ac and dc electric motors) and continue to use the Fluke 87V DMM. They also study programmable logic controllers, including basic programming, motor control, and troubleshooting.
- Hydraulics includes systems used in the wind turbine industry, such as hydraulic power systems, basic hydraulic circuits, principles of hydraulic pressure and flow, hydraulic speed control, and pressure control circuits.
- Metallurgy delves into the origins, properties, and uses of iron, steel, and other commercial metals, and concludes with training on controls and rigging, bolting, torque, and tensioning.

Rules ... and opportunity

Hastings said instruction starts with the basics: the importance of teamwork and a good work attitude, showing up on time and being willing to learn. Safety is key, and students study the National Fire Protection Association (NFPA) 70E standard for electrical safety to learn the procedures and protective gear (including their CAT-hazard certified test instruments) required to be safe in the CAT III and CAT IV environments of a wind turbine.

More information on the wind tech job market is available from a variety of sources, including AWEA, the US Department of Labor, and the Bureau of Labor Statistics. Because wind farms are located in many areas of the country, it shouldn't be hard to find a nearby site where the opportunity for a wind turbine service tech job is blowing your way.

"Students come from all over, not just the Northwest," said Bodily. "We have a high retention rate across our program, and also have a high placement rate. We have placed graduates with about every manufacturer in the country. We have them in utilities, construction, commissioning, and project management."

Wind turbine maintenance—stem to stern

Component	Function	Tests	Test Tools
Anemometer/wind vane (mechanical or ultrasonic)	Reads wind speed and direction; input to control system for pitch control and nacelle orientation.	Check continuity and control signal strength.	Fluke 87V Digital Multimeter (DMM)
Pitch control system (electromechanical or hydraulic)	Matches rotor blade angle to wind, to adjust rotational speed. Variable frequency drive (VFD) assures gradual start/stop to prevent shock loads on blades.	Hydraulic: check voltages to valve solenoids, check electric pump function. Electromechanical: verify function of electric motor and variable frequency drive.	Fluke 87V DMM; Fluke 1587 Insulation Multimeter
Nacelle direction system	Supports nacelle and matches its orientation to wind direction.	Verify function of motor and drive.	Fluke 87V DMM
Rotor bearings	Support rotor in motion.	Check lubrication, check for vibration indicating trouble.	Fluke 810 Handheld Vibration Tester
Gearbox	Connects rotor shaft to generator; steps up RPM to appropriate level.	Check lubricant condition and temperature; check bearing and gear condition.	Fluke 810 Handheld Vibration Tester; Fluke VT02 Visual IR Thermometer or thermal imager
Generator	Produces electric power.	Check voltage each leg, check phase balance, test insulation in each winding, check grounding system, check bearings for vibration.	Fluke 87 DMM; Fluke 810 Handheld Vibration Tester; Fluke 1587 Insulation Multimeter

Jonathan Townsend looks on as a main bearing vibration is checked with the Fluke 805 Vibration Meter.

After a test run of a turbine, Damien Horand uses a Fluke VT02 Visual Thermometer to look at the heat signature on the bearing and drive shaft that runs from the gearbox to the generator.

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Web access: http://www.fluke.com

Printed in U.S.A. 7/2013 6000495A_EN