Bond Tester Helps Protect Wind Turbines from Lightning

Introduction

Wind power is growing faster than ever. According to the American Wind Energy Association, nearly half the new electric power generating capacity added in the U.S. in 2012 was wind power. More than 13,000 MW of capacity was installed in 2012, bringing the total U.S. wind power capacity to more than 60,000 MW. There are now more than 45, 100 wind turbines installed across the U.S.

One of the problems that wind-turbine operators face is lightning. Because the turbines are up so high, they are often struck by lightning. Strikes can cause energy surges of 200 kA and raise temperatures to 30,000 °C, severely damaging the wind turbine blade surface. These strikes can also damage power and signal leads and equipment.

The costs of a lightning strike can be quite consequential. Perhaps even more costly than damaged equipment, energy production is lost when a lightning strike occurs.

Because this is such an important issue, wind turbine blades have built-in lightning protection. Typically, there's an electrode, or receptor, on the tip of the turbine blade that's designed to attract lightning and a conductor that runs the length of the blade to conduct the current to ground. This design provides a more predictable path for the current to flow, mitigating damage to the blade.

But damage does occur. After lightning has struck a turbine blade, the lightning receptor usually must be replaced, and some mechanical repairs must be made as well. To make these repairs, the blade is positioned so that the blade points straight down and then technicians are lowered down to the blade tip, as shown in the figure at right.

After these repairs are made, the resistance of the conductor from the receptor to the ground connection must be tested to ensure that the repairs were made properly and that lightning-protection components will work as well after the strike as before the strike.

The TEGAM R1L-BR Bond Tester for Wind Turbines is the perfect instrument for this test. It measures microohm resistances with currents 100 times lower than other bonding testers. Not only does this increase battery life, it allows you to use longer lead lengths, an important consideration when you're testing 60 m or 70 m turbine blades.

Test procedure

To test the receptor and conductor, technicians would first connect the Kelvin clip of the test lead set to the hub end of the conductor. The HKP-125 test lead set would be used to test blades up to 125 ft (37.5 m) long, while the HKP-250 would be used when testing blades up to 250 ft (75 m) long. The long test lead is made from 16/2 SJO cable for mechanical strength and abrasion resistance. The cable is managed on a convenient cord reel that is easy to stow and secure, and which pays out easily as the technicians are lowered to the tip of the blade.

Next, the technicians are lowered to the blade tip. The lightweight and rugged design of the RL1-BR allows it to easily be used in this application. Once lowered, the technicians switch on the R1L-BR, and set the instrument to the appropriate range. Depending on the length of the turbine blade, the resistance should be somewhere between 20 mΩ and 50 mΩ, so technicians would set the meter to the 200 mΩ range.

Finally, the technician uses the pistol grip probe to contact the receptor at the end of the blade. The TEGAM pistol grip probe has durable stainless steel contact pins on 1/2" (12.4 mm) centers. These stainless steel pins rotate as they are pressed to punch through oxides, paints and other surface contaminants to ensure a correct measurement. If required, the technician then records the measurement.

Wind power is expected to gain an even larger share of the U.S. market in the future. There are currently 42.91 MW under construction in two states. TEGAM is prepared to support this expansion by providing the equipment needed to ensure that turbine blades have the proper lightning protection.