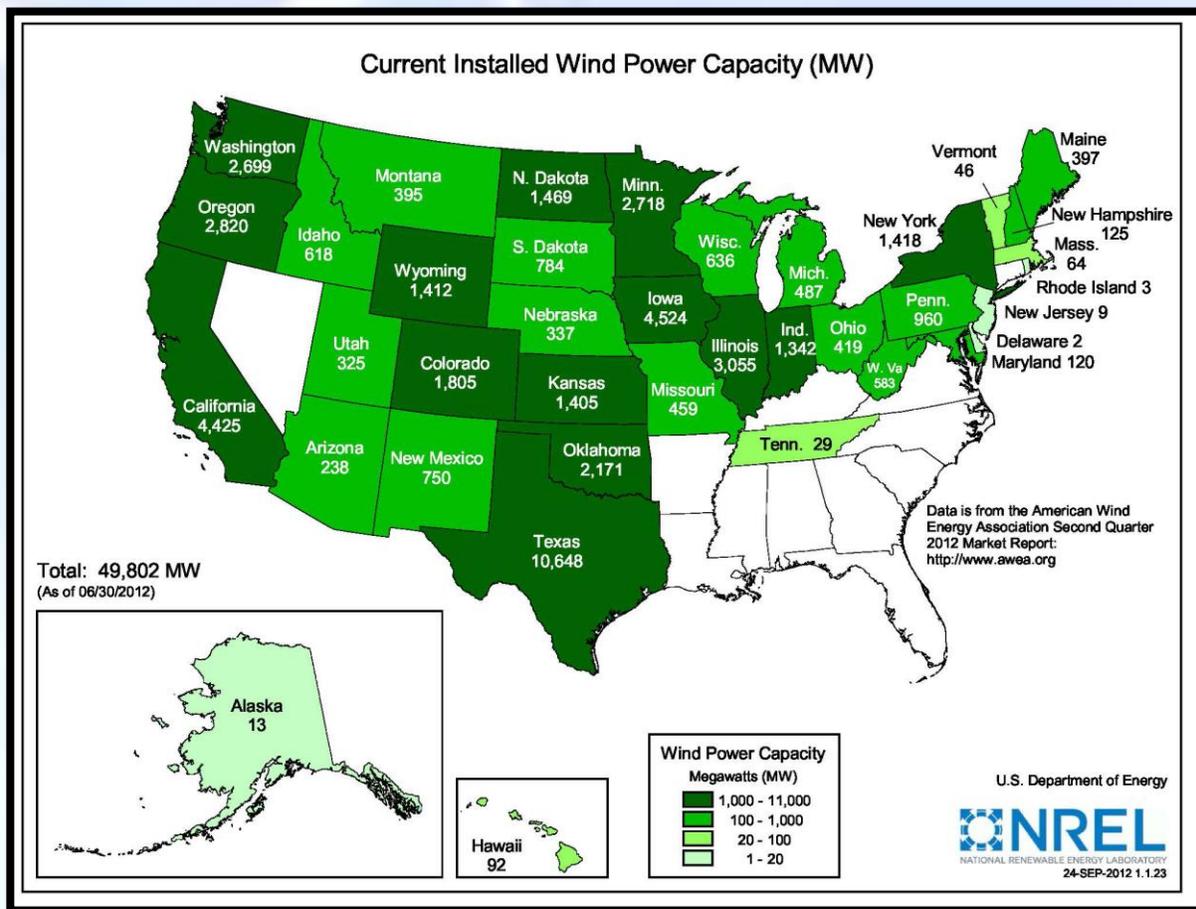


November, 2012

## Retrofitting Wind Farm Step-up Transformers

The wind energy market in the United States has grown by nearly 2000% since the year 2000. As detailed below, according to the US Department of Energy, the installed base is presently at nearly 50,000 MW having grown 20 fold since the year 2000.



This translates to well over 30,000 wind turbine step-up transformers of which one of each is installed at the base of each turbine.

Early wind farms may have been comprised of a mere handful of turbines whereas today's installations may easily number over 100.

### Pacific Crest Transformers

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As is typical in the design and procurement of the equipment necessary to construct a new wind farm, competitive bids are collected with awards going to those suppliers meeting specifications and delivery requirements.

Logically, each installed tower, turbine, and transformer assembly is identical to the others within the project. The turbine step-up transformers therefore are identical in size and configuration with common foundation pads, bushing configurations, and accessories.

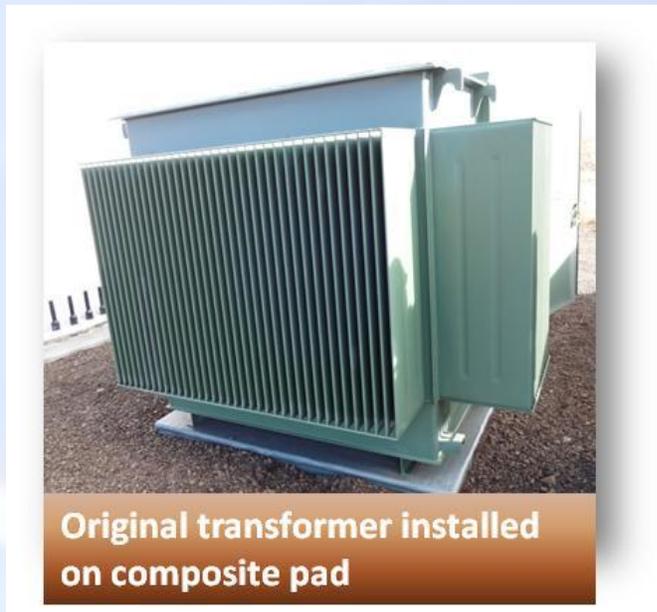


Step-up transformer installed at base of turbine tower



High voltage elbows, arresters, low voltage configurations and terminations, wired accessory packages, and low voltage breakers are but a few of the possible items which may be unique to the transformers supplied for the project.

Since the transformers are typically supplied by a single manufacturer, the base dimensions of the tanks dictate the required pad dimensions.



Properly designed and installed wind turbine step-up transformers provide many years of dependable service with little maintenance. With the installed base as large as it is however, there are certain to be occasions where transformer failures do occur. Additionally, there have been occurrences where traditional distribution transformers have been installed in lieu of step-up units due to the apparent first cost savings only to discover the real cost after

failures begin. What are the options available to facility operators when transformers must be replaced?

Pacific Crest Transformers has been designing and building distribution, small power, and specialty transformers since 1919. Products are designed for *specific loads and environments*. The company's specialty transformer experience includes the capability to retrofit new units to seamlessly integrate with existing equipment and dimensional constraints.

**PCT Customer Care personnel possess the skills to work closely with on-site**



**facility operators to obtain the necessary dimensional and interface requirements to insure that the replacement of a defective transformer is accomplished in a timely manner. Perfecting an initial field change-out provides the added benefit of knowing that PCT maintains the exact design parameters on file for additional replacements should the need occur on the wind farm in the future.**

The images in this paper were taken from an actual project. PCT worked closely with a major utility company to replace 3 failing step-up transformers installed on one of their major wind farms located near Goldendale, Washington. The transformers that were replaced were manufactured in Asia and installed on form fitting composite pads. Further, low voltage breakers and controls had been included in the secondary compartments.



**Completing installation of breaker in PCT retrofit transformer**

PCT traveled to the site to work directly with the customer in order to obtain a concrete understanding of the specific requirements necessary to insure the retrofit transformers met the customer's expectations. As a result the replacements were designed to precisely fit the existing composite foundations and were provided with provisions for mounting the circuit breakers which had been removed

from the original transformers. "We believe that long term relationships can best be built when working directly with our customers as partners" stated Rich Josephson, QA Customer Service Engineer for Pacific Crest Transformers.



**Installed PCT retrofit transformer**

Pacific Crest Transformers, a leader in the design and construction of liquid-filled distribution transformers, announces that it offers the PCT WTSU step-up transformer, specially designed for the wind farm turbine market.



The PCT WTSU is an engineered solution that addresses the specific needs of the wind farm turbine. It reduces lost revenues due to down time and provides a lower total cost of ownership compared to standard off-the-shelf distribution transformers. Standard transformers experience frequent failures when used in wind farms, due to heat build-up from rapid and irregular thermo-cycling, frequent fault conditions, and build-up of gasses from arcing that occurs when inexpensive tap changers are used.



To mitigate these issues, the Model WTSU features an innovative design that includes round coils, a cruciform, mitered core with heavy-duty clamping and a proprietary pressure plate design, as well as a premium no-load tap changer. The PCT design features circular windings which spread the radial forces evenly over their circumference and have cooling ducts throughout the coils, eliminating hot spots that lead to premature breakdown and ultimately to transformer failure. Coil end blocking with heavy duty

3 gauge steel bracing and proprietary pressure plates contains the axial forces

exerted during a fault condition. These forces can cause telescoping of the coils, shortening transformer life.

The WTSU has a unique cooling system, effectively shortening the path that heat generated within the core and coils must take to reach the cooling fluid. It also features a tap changer with silver-plated contacts, for long-life and reliable operation. Down time in a wind farm is expensive, because it leads to lost revenue, as well the high costs of repairing or replacing damaged transformers. The step-up transformer is a key component of wind farm electricity generation and the PCT WTSU is designed to meet the unique requirements of the individual farm, its turbine type and associated electrical components.

