Wind Turbine Foundations and Tower Installation

by Amy Murphy

AVEC was recently named the 2007 Wind Co-op of the Year by the Department of Energy. (See page 8.) Part of this award is due to AVEC’s staff for pioneering the integration of wind into our isolated village diesel systems. The award also recognizes our innovations building wind tower foundations in extremely remote locations. This article briefly recaps some of the work that goes into installing wind turbines.

Two main components for generating wind power are a turbine and the tower. These photos are from Toksook Bay and Kasigluk, where NorthWind 100, 100kW-turbines were placed on top of 108’-tall Danwin Towers. These wind towers and turbines are heavy, weighing 42,000 pounds and are subject to additional forces from wind and motion.

Unfortunately warming trends are affecting the expanse and depth of permafrost. Therefore designing a foundation in the changing permafrost conditions to support all this weight, plus the system frequencies and variable forces exerted by the rotating turbine, is extremely challenging. Tower foundations must not settle, tilt or be uplifted. Pile foundations may extend 1/3 to 2/3 the height of the tower into the ground.

This requires thorough geotechnical research and testing to assess the ground conditions at the site to determine foundation design recommendations. After the geotechnical assessment is performed, a different engineering group designs the foundations and pilings required to support the wind towers. A construction management team uses the finished designs to install the piles that support the foundation, build the foundation and install the wind towers and turbines. Another firm helps with the final commissioning of the turbines to integrate them with the diesel power generation system.

AVEC has relied on the following consultants with expertise in different fields to help design, engineer and build our wind turbine farms: Hattenburg Dilley & Linnell; Golder & Associates; Coffman Engineers; STG Inc.; and Northern Power and Distributed Energy.

The Toksook Bay and Kasigluk wind turbine foundations are based on a steel frame embedded within a 2-foot thick concrete foundation supported by piles. Holes for the piles are pre-drilled and the piles are driven to refusal and later cut to uniform height.

At Toksook Bay six piles per tower were driven approximately 18 feet deep to rock. Pile centers were

Photos provided courtesy of STG, Inc.

Left: piles are cut to uniform height, awaiting the next step of foundation preparation.

Right: Technicians stand on top of the tower sections while guiding the next section into place.