

AVEC's Wind Program

by Amy Murphy

The skyrocketing cost of diesel last year resulted in the average AVEC consumer paying a fuel charge of almost 37 cents per kilowatt-hour, while residents of Toksook Bay, Kasigluk, and three nearby villages are paying 12 cents less, thanks to wind turbines installed by Alaska Village Electric Cooperative (AVEC).

In Kasigluk, the wind turbine project has displaced nearly 21 percent of the diesel fuel consumed to run generators and in Toksook Bay wind is good for about 22 percent.

AVEC's fledgling wind program has gained national and international recognition, most notably when AVEC received the 2007 Wind Cooperative of the Year Award from the U.S. Department of Energy's Wind Powering America Program. This award, presented in 2008,

recognized AVEC for leadership, demonstrated success and innovation in its wind power program, which was developed in response to rising fuel costs for its 48 prime diesel power plants.

"Rural Alaska's extremely challenging geographic and climatic conditions limit the options for generating electricity. Diesel fuel can be shipped and stored and the technology is very well known. There simply are no viable alternatives," said Meera Kohler, AVEC's President and CEO. "Wind generation, on the other hand, is also an old technology but, until recently, was not up to the challenge of remote Arctic conditions."

AVEC staff pioneered the integration of wind into its isolated village diesel systems and it has been a major learning experience, especially designing innovative tower

foundations to withstand challenging geographical conditions.

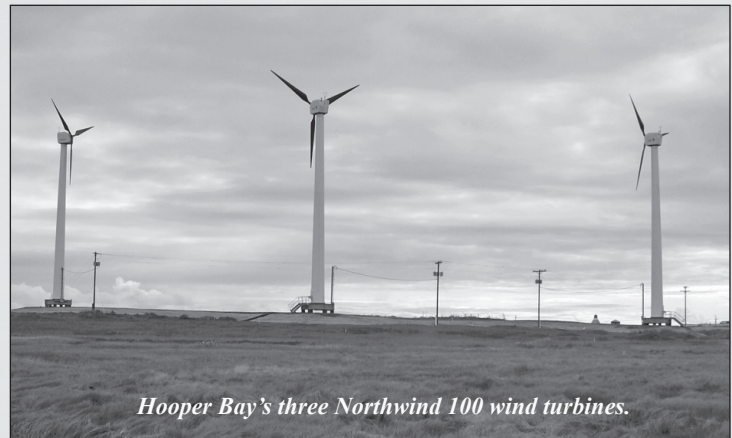
Most of the diesel-powered generation plants are nearly 40 years old with outdated technology. This requires installation of sophisticated control centers and power plant automation to allow the generators to operate in parallel with other generators in the system, including wind turbines. Transmission lines that connect other communities to a common grid also require specialized maintenance and repair, along with the wind turbines.

"Despite only a few years of actual field experience, we are enthusiastic about the successes we have seen and hope that wind can play a meaningful role in many of our villages," Kohler said. "In a best-case scenario though, wind can only be expected to produce about 30% of a community's annual electricity so diesel will continue to be the workhorse for the foreseeable future."

Wind Facilities

AVEC owns wind turbines operating in five communities with interties to three other communities. In 2008, AVEC's fleet of wind turbines, rated at 1,360 kW, had the highest total utility wind generating capacity and production in the whole state.

Selawik, the first integrated wind-diesel facility AVEC built, has four AOC 65-kW turbines with a generating capacity of 260 kW. Total wind-



Hooper Bay's three Northwind 100 wind turbines.



AVEC's first integrated wind-diesel facility in Selawik.

diesel generating capacity is 1,647 kW. Selawik has served to help work out design and performance challenges involved with this new sophisticated wind-diesel system.

Kasigluk has three Northwind 100 kW turbines with a total generating capacity of 300 kW. Total wind-diesel generating capacity is 1,624 kW. Power is also provided to the community of Nunapitchuk through a distribution intertie.

Toksook Bay has three Northwind 100 kW turbines with a total generating capacity of 300 kW. Total wind-diesel generating capacity is 1,618 kW. Power is also provided to the communities of Tununak and Nightmute through interties. After the tielines were built, two generating plants in Tununak and Nightmute were shut down, saving tens of thousands of dollars in additional operating and maintenance costs each year.

Savoonga's two Northwind 100 kW turbines with a generating capacity of 200 kW came online in the fall of 2008. Total wind-diesel generating capacity is 1,870 kWh.

Hooper Bay has three Northwind 100 turbines that are operational and will be fully commissioned in 2009.

Wales has two Atlantic Orient Corporation 65-kW turbines that are owned by Kotzebue Electric Association. They aren't fully operational but also provided valuable information related to wind-diesel integration.

AVEC plans to install seven more Northwind 100 turbines in 2009; four in Chevak and three in Gambell.

Tower Foundations

Two main components for generating wind power are a turbine and the tower, shipped in by barge and assembled on site on specially prepared foundations built to hold the weight of the whole assembly in variable ground and soil conditions.

For example, the total unit weight of the Northwind 100 turbines placed on top of 108'-tall Danwin towers is 42,000 pounds; subject to additional forces from wind and motion.

Proper foundation design is critical as tower foundations must not settle, tilt or be uplifted. Unfortunately warming trends are affecting the expanse and depth of Alaska's 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 difficult.

Thorough geotechnical research and testing assesses ground conditions to determine design recommendations and optimal pile foundations. AVEC's talented team pioneered innovations in tower foundations based on a steel frame embedded within a two-foot thick concrete foundation supported by piles that may extend 1/3 to 2/3 the height of the tower into the ground. The pile foundations are modified by adding a 130,000-pound concrete and steel mass between the tower and piles to dampen vibrations.

Annualized Results

Wind resources vary by village throughout the year and affect overall output. AVEC support staff and local operators are fine tuning the integrated operations of the wind and diesel systems and in 2008 net wind production to the systems in Kasigluk and Toksook Bay increased 27% with no change in equipment.

The following figures are for villages with turbines operational for two full years. In 2007, wind in Selawik provided an average net wind generating capacity of about 5% of total kWh generated vs. 3% for 2008; Kasigluk's wind turbines generated an average of 16.23% vs. 21.9% for 2008; while Toksook Bay's 2007 av-



Preparing a tower foundation in Toksook Bay.

erage of 23.53% was slightly higher than 2008's 20.7% net wind versus total kWh generated. (Toksook Bay's net wind declined in 2008 with the addition of Nightmute to the service area after completion of the intertie.)

In 2007, turbines in these three communities generated 1,100,000 kWh (net) and displaced 81,481 gallons of diesel fuel. At an average cost of \$2.75/gallon (with Selawik having the highest fuel cost at \$3.30/gallon), AVEC saved more than \$200,000 dollars in diesel generating costs.

In 2008, turbines in these three communities generated 1,322,110 kWh (net) and displaced 99,191 gallons of diesel fuel. At an average cost of \$4.73/gallon, this equates to a savings of \$453,000 in diesel generating costs.

Including wind turbines that came online late in 2008, AVEC's total combined net wind energy production is 1,442,275 kWh. Total combined net energy production (wind and diesel) was 13,682,946

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kWh. Wind displaced 108,057 gallons of fuel, saving \$493,000 in fuel costs.

Wind/Diesel Tour – Kasigluk

In April 2008, 30 people from 12 countries toured AVEC's wind-diesel power generation facility in Kasigluk in conjunction with an International Wind-Diesel Workshop held in Girdwood, Alaska.

These engineers and officials, some of whom hold high-level positions, represent various national and international organizations and large utilities. They are all involved in testing, evaluating or building wind generation systems to operate in conjunction with isolated diesel generating systems.

Everybody was extraordinarily impressed with AVEC's system and amazed to see extremely high-tech facilities in such remote areas with challenging logistical and environmental conditions.

"The trip to Kasigluk was the highlight of the wind-diesel meeting," said Larry Flowers, of National Renewable Energy Lab, one of the workshop organizers. "Seeing the three turbines spinning and knowing they're saving 30- to 40,000 gallons of fuel each year and the associated cost was inspiring. AVEC is leading the way to a more sustainable village power future."

Kasigluk's wind-diesel facility.



Nunapitchuk and Kasigluk residents now have a reason to be happy when the strong winds blow and the wind turbines start spinning. While their electric rates are still amongst the highest in the nation, there is satisfaction in knowing they are 12 cents a kWh less than what they otherwise might have been.

Having wind turbines produce power to reduce diesel fuel consumption is growing increasingly important as the cost of fuel escalates. However, the investment to realize these cost savings isn't cheap. The Kasigluk project cost \$14.5 million for a new automated, fuel-efficient power plant, upgraded transmission line to Nunapitchuk, new bulk fuel storage tanks and three Northwind 100 wind turbines, designed for cold, remote locations.

"Kasigluk is one of the best, smoothest wind operations I have seen," said David Connelly, Principal of the Ile Royale Enterprises of Northwest Territories Canada. "The village residents are very proud of feeling like they are getting back some of their self-sustainability and reducing diesel fuel consumption. They are also proud their local [trained] plant operators are competent and capable of operating the advanced wind-diesel generating system."

Training

Only one of AVEC's 53 villages is accessible by road. Performing routine maintenance and making prompt repairs is critical but can be challenging, especially if technicians have to travel hundreds of miles to get there.



Erecting a wind tower.

Developing a week-long training program to teach trainees how to service and troubleshoot the turbines in their communities became an integral component of the wind program. The training program is conducted by Northern Power at its manufacturing facility in Barre, Vermont. Having trained technicians living in the villages provides a source of local income and saves a tremendous amount of time, money and down time by not having to rely on help flown in from distant places.

One trainee from Toksook Bay was immediately put to the test when he returned home from training and learned a wind turbine wasn't operating. "He discovered that a PLC card failed and by exchanging e-mail messages and phone calls we figured out which parts were needed," said Chris Haraldsen of Northern Power. "They were shipped out and the turbine got running again."

Future Plans

With the assistance of funding partners like the Denali Commission, Rural Utilities Service, Coastal Villages Region Fund and others, AVEC has developed a successful wind program that will provide benefits to our members and our environment for many years. As future funding becomes available, AVEC will continue to build on this solid foundation to expand our successful wind program into other communities with feasible wind resources.