Systems Performance Analyses of Alaska Wind-Diesel Projects

Toksook Bay, Alaska

The interconnected Alaskan communities of Toksook, Tununak, and Nightmute on Nelson Island in Alaska have a combined population of approximately 1,160 people. Almost the entire population belongs to the Alaska Native Nunakauyak Tribe. Alaska Village Electric Cooperative (AVEC) operates the power system for the communities, which have an average load just under 370 kW.

The system incorporates three Northwind 100/19 100-kW wind turbines that were commissioned in October 2006 as part of a $22 million project to completely replace the power plant, upgrade the community intertie and distribution system, and install a new community bulk tank farm. Funding was provided by the Denali Commission, Rural Utility Service, Alaska Energy Authority, Coastal Village Regional Fund, and AVEC.

The turbines are dispatched to maintain operating levels, and community heating dump loads were added to address fast overload conditions (although in recent operations, little energy has been applied to heating). Except for some initial issues (including a blade failure), the power system is operating well with a first-year turbine availability of 92.4%.

The array of wind turbines achieved an average net capacity factor of 21% from September 2007 to August 2008. The average penetration for this system has been more than 23%, with average monthly penetrations more than 30% during the stronger winter wind months. In the year ending September 2008, almost 700 MWh of electricity was generated by wind, saving almost 46,000 gallons of fuel.

The cost of energy in Toksook Bay in 2007 was $0.46/kWh[1] prior to the Power Cost Equalization Program subsidy, while the expected power cost (assuming a barrel of fuel at $110) would be closer to $0.77/kWh[2].

Three 100-kW Northern Power Systems Northwind 100 turbines were installed as part of a power system upgrade to serve the community of Toksook Bay, Alaska. Photo credit: Northern Power Systems/ PIX14406 (top), PIX14401 (bottom left), PIX14405 (bottom right).

[1] FY07 Statistical Report of the Power Cost Equalization Program (Available at www.akenergyauthority.org/PDF%20files/AEA_PCEFY07.pdf).
[2] Alaska Energy: A First Step toward Energy Independence (Available at http://www.akenergyauthority.org/PDF%20files/AK%20Energy%20Final.pdf).

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Turbines: Three 100-kW Northern Power Systems Northwind 100/19 A turbines

Capacity: 0.3 MW

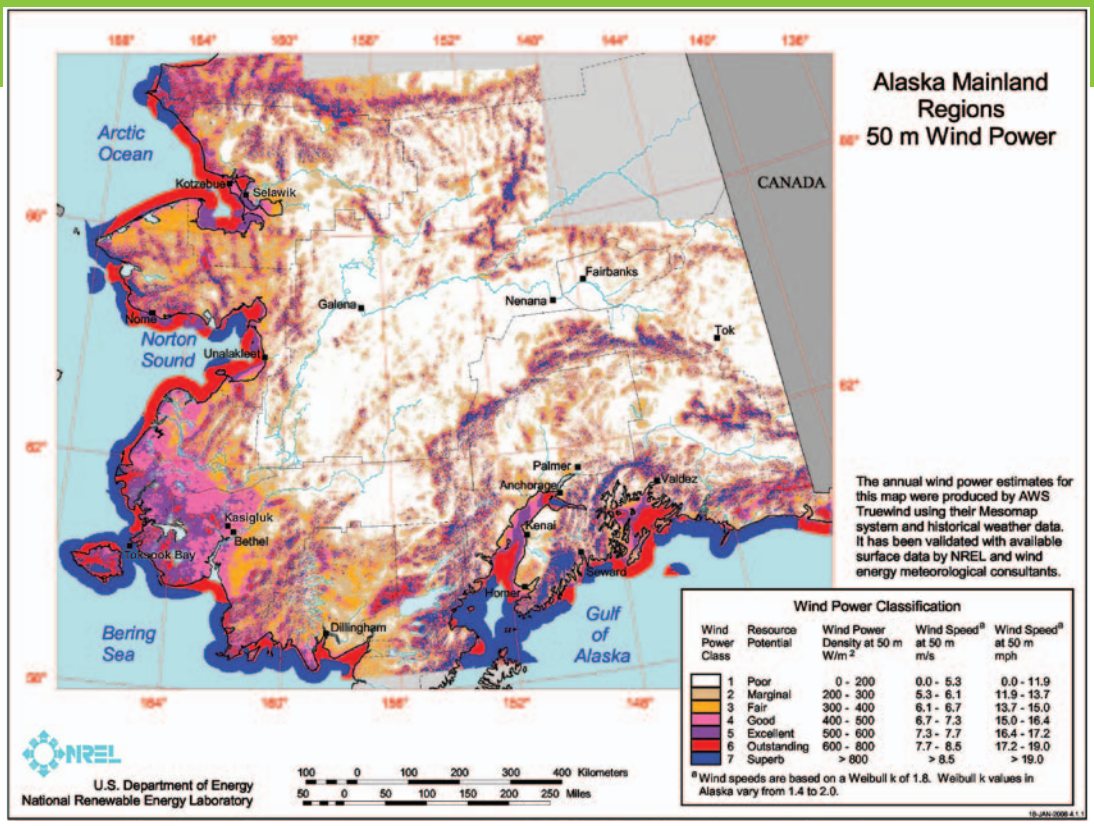
Developer/owner: Alaska Village Electric Cooperative

Date online: 10/06

Rated power: 100 kW per turbine, plant rating 300 kW

Data collection dates: Through 4/07

Toksook Bay systems analysis: 10/8/07



Energy Flow (Based on Monthly Summations)	
Community load data	259 kW*
Average wind plant output	62.6 kW**
Average diesel plant output	219 kW*
Thermal load data	6.1 kW**

*1/06 – 8/07
**9/06 – 8/07

Performance Characteristics Based on Energy Flow (Based on Monthly Summations)	
Average net capacity factor	20.9%*
Optimal net capacity factor based on Alaska Energy Authority wind data	HOMER: 30.1% Hybrid2: 28.5%
Average net wind penetration	22.7%*
Estimated fuel savings	31,693 gal**
Wind system availability	93.3% for the whole system; individual turbines range from 95% to 91%***

*9/06 – 8/07
**7/06 – 4/07
***11/06 - 10/07. Note that this represents the first year of turbine operation and should be considered low from a long-term perspective.

Other Data	
Residential electrical rate	$0.4818/kWh*

* FY06 Statistical Report of the Power Cost Equalization Program, available at www.akenergyauthority.org/PDF%20files/2007PCEStatisticsFY06.pdf

In the tables at left, **average net wind penetration** refers to the product of total wind turbine energy output (kWh) divided by the total primary electrical load (kWh) over a given time period and provides an idea of the amount of system energy produced by wind. **Capacity factor** is the ratio of actual average power produced to the rated power of the wind plant over a defined time period and provides an indication of the wind resource and system efficiencies (capacity factors above 15% for distributed wind systems would be considered good, although the acceptable capacity factor for a specific community will depend on project and alternative fuel costs). **Wind system availability** refers to the percentage of time that the wind turbine is available to produce power. Availability above 90% for new projects in remote communities would be considered acceptable; availability above 95% is desirable.

For more information on Alaska wind-diesel projects, please contact:

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Prepared by the National Renewable Energy Laboratory (NREL)
NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

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DOE/GO-102009-2713
April 2009

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