Systems Performance Analyses of Alaska Wind-Diesel Projects

St. Paul, Alaska

Saint Paul Island is one of the Pribilof Islands, a group of four volcanic islands located in the Bering Sea off the Alaskan coast. The island is home to the largest Native American Aleut community in the United States, and the city of St. Paul is the only residential area on the island.

The Tanadgusix Corporation (TDX), a native Alaskan corporation, needed a stand-alone power system for its facility on Saint Paul Island. The site is an airport and industrial complex with airline offices, equipment repair, and storage facilities. TDX wanted to reduce the overall energy costs for the camp's electrical and heating loads while maintaining reliable, utility-grade electrical service.

In 1999, Northern Power Systems installed a high-penetration, no-storage hybrid power system that maximized the island's abundant wind resource. The primary components of the plant included a 225-kW Vestas V27 wind turbine, two 150-kW Volvo diesel engine generators, a synchronous condenser, a 6,000 gallon insulated hot water tank, and a microprocessor-based control system capable of providing fully automatic plant operation.

The primary electrical load for the facility averages about 69.6 kW, but the system also supplies the primary space heating for the facility with excess power from the generators and thermal energy from the diesel plant. Although at one point the turbine generator failed and was completely replaced, the power system has operated well over the past 7 years. In 2004, for example, the wind turbine had a non-scheduled availability of 100% and a capacity factor of more than 40%.

Commissioning and blessing of the St. Paul power plant. TDX Power/ PIX13634.

Vestas 225-kW wind turbine on the St Paul. Ed Linton, Northern Power Systems/PIX10597.

The operating wind turbine has experienced a capacity factor of almost 32%. The average penetration for this system has been almost 55%, and the system often operates with both of its diesel generators off. Since January 2005, the wind energy has saved an estimated 150,000 gallons of diesel fuel, about 50% of the expected consumption without wind energy.

TDX is currently working with the City of St. Paul to interconnect two additional Vestas V27 turbines installed over winter 2007 to the City of St. Paul Municipal Electric Utility. This would interconnect the industrial complex power system with 725 kW of installed wind capacity to the cities' utility electric system, driven by a 2.1-MW diesel power station and having an average load of more than 600 kW. With a minimum load close to 400 kW, once interconnected the wind will supply a large amount of the power for the community, and depending on the final selection of control hardware, will represent a high-penetration power system for the entire St. Paul community.

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Turbines: One Vestas 225-kW

Capacity: Plant rating of 225 kW

Developer/owner: Tanadgusix Corp.

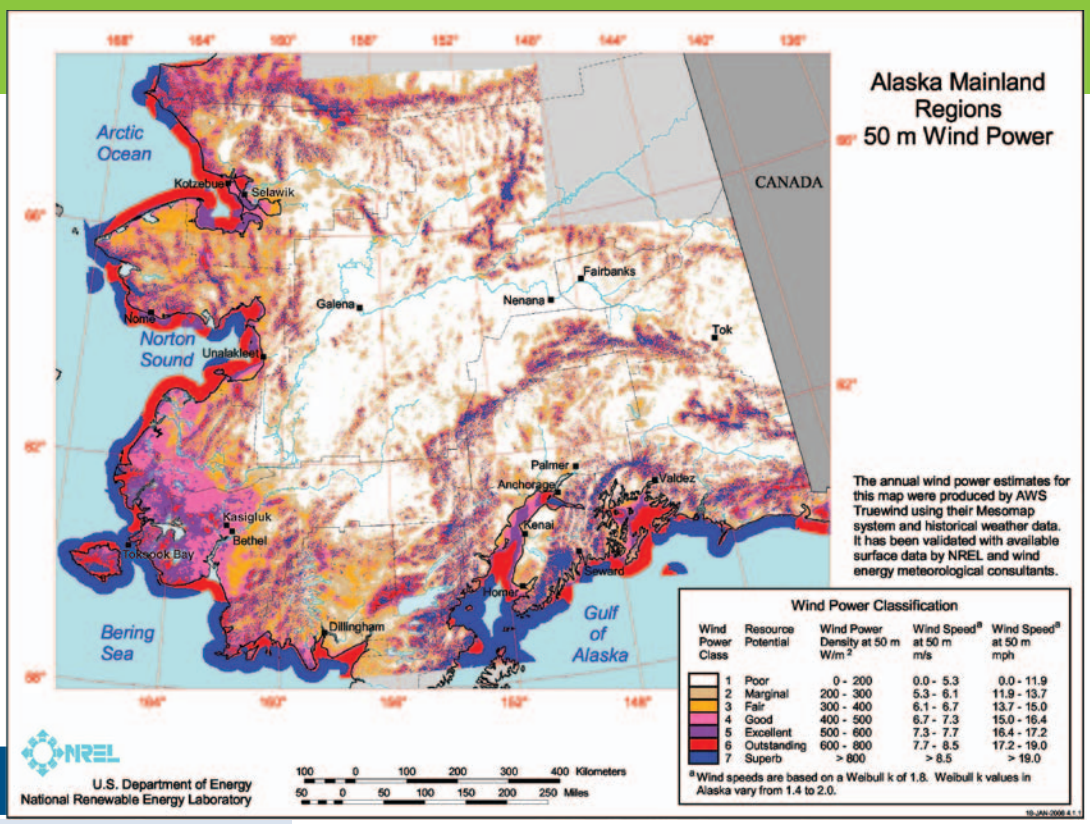
Date online: 6/99

Rated power: Plant rating of 225 kW

Data collection dates: 1/03 – 8/08

Systems analysis: 9/11/08

Note: The St. Paul project supplies power to an airport and industrial facility and is not connected to a community. The plant is comprised of one 225-kW wind turbine, two 150-kW diesel engines, a digital engine control, a synchronous condenser, active thermal loads, and a load regulator.



Energy Flow (Based on Monthly Summations)

Camp load data	Average electrical load 69.6 kW*; turbine also supplies thermal energy for heating
Average wind turbine output	71.8 kW*
Average diesel plant output	59.3 kW*
Dump (controlling) load (kW)	49.3 kW; includes excess diesel and wind energy

*1/03 – 9/08

Performance Characteristics Based on Energy Flow (Based on Monthly Summations)

Average net capacity factor	31.9%*
Average net wind penetration	54.8%**
Estimated fuel savings	136,764 gal***
Wind system availability	Not recorded. Total plant availability for 2007 (last full year of data) was 99.99%, with only 1 hour of system downtime

*1/03 – 9/08 **1/03 – 12/07 ***1/05 – 9/08

Other Data

Diesel fuel consumption	140,203 gal*
Diesel fuel price	$3.52/gal**
Diesel efficiency (kWh from diesel/gal)	13.83 kWh/gal***
Plant efficiency (kWh/gal diesel)	28.81 kWh/gal***

*1/05 – 9/08
**For St. Paul Alaska, *FY07 Statistical Report of the Power Cost Equalization Program* (Available at www.akenergyauthority.org/PDF%20files/AEA_PCEFY07.pdf)
***1/08 – 9/08

In the previous tables, **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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