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Project Title: Aleutian Pribilof Islands Wind Energy Feasibility Study

Project Director: Bruce Wright, brucew@apiai.org

Team Members: Tanadgusix Corporation (TDX), Connie Fredenberg

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Appendices (large files, attached)
Appendix 1. AEB_Energy_Assessment_5-18-10_FINAL.pdf
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Appendix 6. TimSandstromPowerHouse314120001.pdf
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Appendix 9. final report, DOE weatherization project.8-17-11.pdf
Appendix 10. Adak Renewable Reconnaissance Report-20110829_FINAL.pdf
Appendix 11. Sand Point EA.pdf
Appendix 12. False_Pass_Wind_Renewable_Energy_GrantApplication.3.pdf

EXECUTIVE SUMMARY

Under this project, the Aleutian Pribilof Islands Association (APIA) conducted wind feasibility studies for Adak, False Pass, Nikolski, Sand Point and St. George. The DOE funds were also be used to continue APIA's role as project coordinator, to expand the communication network quality between all participants and with other wind interest groups in the state and to provide continued education and training opportunities for regional participants. This DOE project began 09/01/2005.

The Aleutian Pribilof Islands Association, with the assistance of many partners, working on feasibility studies necessary for supporting wind-diesel hybrids systems in Adak, False Pass, Nikolski, Sand Point and St. George. In Adak, the data card failed to log data and the wind tower was eventually knocked down by storms. The Alaska Energy Authority provided funding to fix and re-erect the met tower in 2011and complete the Adak wind feasibility study.

TDX Power completed the economic and technical feasibility studies for Adak. These were funded by the Alaska Energy Authority. Both wind and hydro appear to be viable renewable energy options for Adak (see Appendix 10 attached)

In False Pass the wind resource is generally good but the site has high turbulence. This would require special care with turbine selection and operations. False Pass may be more suitable for a tidal project. APIA is funded to complete a False Pass tidal feasibility study in 2012.

Nikolski has superb potential for wind power development with Class 7 wind power density, moderate wind shear, bi-directional winds and low turbulence. APIA secured nearly $1M from the United States Department of Agriculture Rural Utilities Service Assistance to Rural Communities with Extremely High Energy Costs to install a 65kW wind turbine.

The measured average power density and wind speed at Sand Point measured at 20m (66ft), are 424 W/m2 and 6.7 m/s (14.9 mph) respectively. Two 500kW Vestas turbines were installed and when fully integrated in 2012 are expected to provide a cost effective and clean source of electricity, reduce overall diesel fuel consumption estimated at 130,000 gallons/year and decrease air emissions associated with the consumption of diesel fuel.

St. George Island has a Class 7 wind resource, which is superior for wind power development. The current strategy, led by Alaska Energy Authority, is to upgrade the St. George electrical distribution system and power plant.

Avian studies in Nikolski and Sand Point have allowed for proper wind turbine siting without killing birds, especially endangered species and bald eagles.

APIA continues coordinating and looking for funding opportunities for regional renewable energy projects. An important goal for APIA has been, and will continue to be,

to involve community members with renewable energy projects and energy conservation efforts.

BACKGROUND

The Aleutian Islands extend westward over 1,300 miles from the southwestern corner of the Alaska Mainland, and include the Pribilof Islands, which lie to the north. This area is distributed over approximately 100,000 square miles, a region about the size of Colorado.

The APIA was chartered as a non-profit in 1976 and is a federally recognized tribal organization of the Aleut people in Alaska. The 13 communities represented by APIA are Akutan, Atka, Belkofski, False Pass, King Cove, Nelson Lagoon, Nikolski, Pauloff Harbor, Sand Point, St. George, St. Paul, Unalaska, and Unga.

Aleutian communities are all wind rich, earning “Excellent” to “Superb” ratings on The Alaska Wind Resource Map produced by the USDOE/National Renewable Energy Lab (1987). The Alaska Energy Authority (AEA) completed a higher-resolution map of Alaska, which further documents what local people know well; the Aleutians are truly “the birthplace of the wind.” The Aleutian and Pribilof Islands and Alaska Peninsula are officially amongst the windiest places in the world.

PROJECT OBJECTIVES

The objective is to complete all the required feasibility studies necessary prior to wind diesel plant developments in Adak, False Pass, Nikolski, Sand Point and St. George. APIA will complete feasibility studies, improve communication amongst regional and statewide rural communities developing wind energy projects and continue coordinating and funding opportunities for regional participants to attend alternative energy conferences and workshops. An important goal for APIA has been, and will continue to be, to educate and involve community members in their own projects.

PROJECT ACTIVITIES

TASK 1: SITE SELECTION AND RESOURCE MONITORING

The five communities to be addressed under this project, (Adak, False Pass, Nikolski, Sand Point and St. George) each obtained anemometers (some of which were funded separately with Alaska Energy Authority funds) and used carefully chosen installation sites.

The Aleutian Islands, Pribilof Islands and Alaska Peninsula are officially amongst the windiest places in the world. TDX Power, a subsidiary of Tanadgusix Corporation, was widely respected as a world leader in the wind-diesel field. APIA was fortunate to have this local village ANCSA Corporation from St. Paul as its partner. With USDOE funds, APIA and TDX Power worked on the wind energy assessments. TDX Power, under contract to APIA, conducted a feasibility study for False Pass similar to the one they produced for Port Heiden, another Alaska Peninsula community. With funds from DOE, TDX Power was contracted by APIA to conduct wind studies for Sand Point, Nikolski, St. George and Adak.

John Wade, a meteorologist from Oregon, specializes in siting wind turbines. John looked at topographical maps of the region and spoke with local people prior to giving his recommendation regarding turbulence issues in each community. Avian issues required coordinating consultation and achieving consensus between local subsistence bird hunters, USFWS agents, utility owners, TDX Power and the Alaska Energy Authority in consideration with John Wade's recommendations (see also **TASK 2: AVIAN COLLISIONS MONITORING** below).

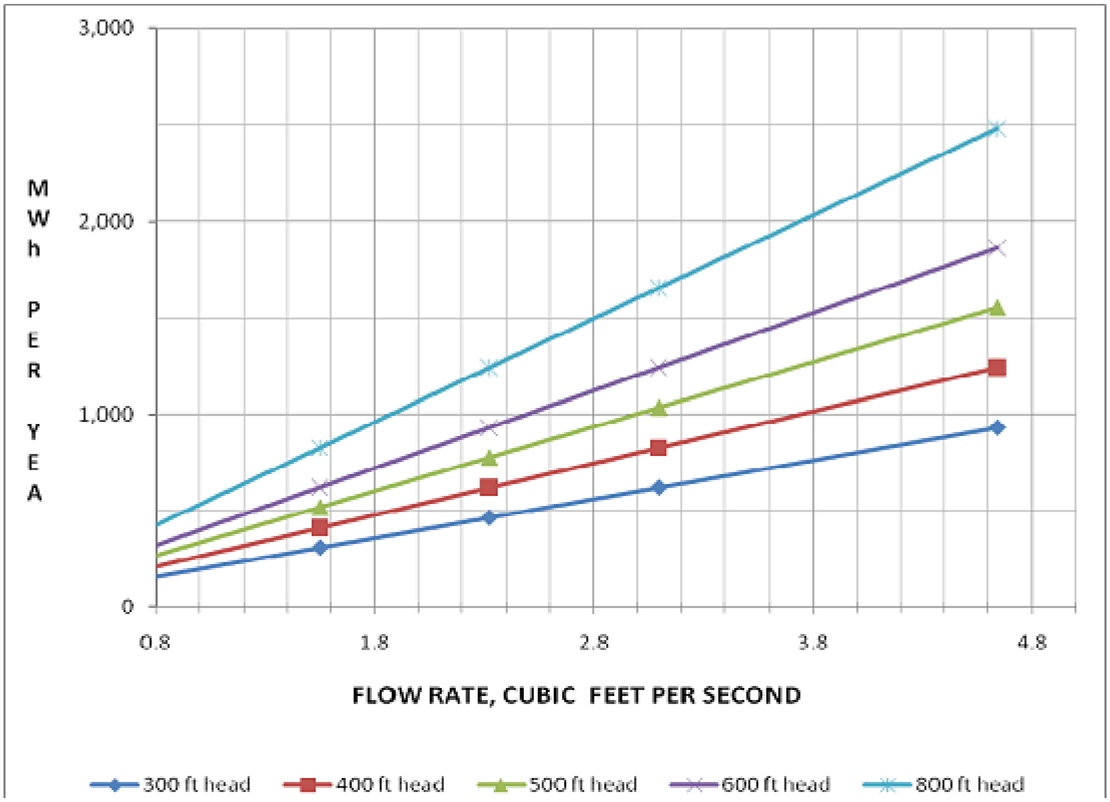
The six communities obtained anemometers and used carefully chosen installation sites. Sand Point's utility, owned and operated by TDX Power, erected an anemometer on loan from the USDOE/NREL in February of 2004. St. George, False Pass, King Cove, Nikolski and Adak all received 30-meter anemometer towers on loan from the Alaska Energy Authority (AEA). In September 2004, Tanaq Corporation (the St. George Island village ANCSA corporation) employees Andronik Kashevarof, Rodney Lekanof and John Lyons from TDX Power, Rueben Loewen from AEA, and Connie Fredenberg from APIA installed the anemometer during the St. George community visioning meeting. In December of 2004 the City of Adak's utility crew attempted to erect their anemometer, but had some technical difficulties (see below). False Pass and Nikolski installed their anemometers in 2005. APIA, through BIA training funds, provided travel costs for TDX Power to assist these local utilities with installation of their anemometer towers. Reuben Loewen, from AEA, assisted with the installation in False Pass.

In St. George, monitoring the wind resource is not considered as crucial as in other sites and was completed by May of 2005. St. George is located a mere 40 miles from St. Paul Island. The wind regime is likely to be quite similar, if not identical, to that at the site of TDX Power's 225 kW Vestas wind turbine.

The Aleutian East Borough was funded by Alaska Energy Authority to complete the Renewable Energy Resource Assessment for the Communities of Cold Bay, False Pass, and Nelson Lagoon (see Appendix 1 attached). This document is of great value for making progress with renewable energy development in these communities.

Adak

A met tower was purchased with Alaska Energy Authority funds and shipped to Adak. Due to technical difficulty with the installation including the logistical problems, the met tower was installed in 2007. The data card failed to log data and the wind tower was eventually knocked down by storm winds. In 2009 Bruce Wright, then of TDX Power, wrote a proposal which was funded by the Alaska Energy Authority to fix and re-erect the met tower (which was accomplished in 2011) and complete the Adak wind feasibility study. Data is still being collected, but a hydro feasibility study indicates hydro may be a good renewable energy option for Adak (see below graph provided by Roger Taylor, Bureau of Indians Affairs).



With a head of 700 feet, friction loss 0.2 in 12" pipe @1000 gpm we can produce about 3 MWh?

TDX Power completed the economic and technical feasibility studies for Adak. These were funded by the Alaska Energy Authority and the grant proposal was written by Bruce Wright when he worked for TDX Power. See Appendix 10 attached)

False Pass

The wind resource as the False Pass met tower site is generally good with measured wind power class 4 by measurement of wind power density (Class 3 if considering only mean annual wind speed). Given the moderately cool temperatures of the False Pass test site, air density is moderately higher than standard conditions. By other measures important for wind power analysis, the site has a low 50-year return period extreme wind probability but high turbulence; the latter apparently due to the high mountains that border Isanotski Strait and that are very near the met tower to the north, west and south. Turbulence intensity calculated from the met tower data indicates much higher than desirable turbulence conditions. This would require special care with turbine selection and operations.

It is not immediately clear if an alternate wind site that has good wind exposure and less turbulence exists in the near proximity of the village of False Pass. Siting restrictions include the obvious constraints of geography – mountains and Isanotski Strait – and the location and orientation of the False Pass airstrip. Computation fluid dynamics (CFD) modeling may lend insight into wind flow patterns at False Pass and would be a useful tool to investigate other wind turbine siting options (see Appendix 2 attached).

Data dates	May 7, 2005 to August 19, 2005 and November 30, 2005 to September 4, 2007 (24 months); status: operational
Wind power class	Class 3 to 4 (fair to good)
Wind power density mean, 30 m	338 W/m2
Wind speed mean, 30 m	6.11 m/s
Max. 10-min wind speed average	26.5 m/s
Maximum 2-sec. wind gust	39.0 m/s (January, 2007)
Weibull distribution parameters	k = 1.62, c = 6.76 m/s
Wind shear power law exponent	0.291 (high)
Roughness class	3.80 (suburban)
IEC 61400-1, 3rd ed. classification	Class III-S
Turbulence intensity, mean	0.173 (at 15 m/s)
Calm wind frequency (at 30 m)	35% (winds < 4 m/s)

Nikolski

Nikolski has superb potential for wind power development with Class 7 wind power density, moderate wind shear, bi-directional winds and low turbulence. (See Appendix 3 attached)

Meteorological Tower Data Synopsis Wind power class (measured to date)	Class 7 – Superb
Average wind speed (30 meters)	9.01 m/s (at 30 meters)
Maximum wind gust (2 sec average)	40.9 m/s, 1/24/07, 12 p.m.
Mean wind power density (50 meters)	1,118 W/m2 (predicted by calculation)
Mean wind power density (30 meters)	881 W/m2 (measured)
Roughness Class	1.77 (few trees)
Power law exponent	0.174 (moderate wind shear)
Turbulence Intensity (30 meters)	0.108
Data start date	December 11, 2005

Sand Point

As part of the NREL Native American Anemometer Loan Program an anemometer was installed near Sand Point, Alaska to assess the area's wind energy potential. The monitoring period ran from 14 February 2004 to 6 July 2005. The measured average power density and wind speed, measured at 20m (66ft), are 424 W/m2 and 6.7 m/s (14.9 mph) respectively. This is consistent with the resource indicated by publically available wind maps. For example, the 3Tier wind map (Figure 4 in Appendix 4) estimates the average wind speed at the site (@ 20m AGL) at between 5.9 and 10.6 m/s. (13.1 mph – 23.6 mph) (see Appendix 4 attached).

St. George
Wind resource data was collected from mid September 2004 through October 2005 on St. George Island, Alaska. The data was compared to long-term trends in the area. Based on correlations with the St. George ASOS weather data, estimates were made to create a long-term dataset for the St. George met tower site. This information was used to make predictions as to the potential energy production from various wind turbines at the site. It is estimated that the long-term annual average wind speed at the site is 9.3 m/s at a height of 30 meters above ground level. Taking the local air density into account, the average wind power density for the site is 921 W/m2. This information means that St. George Island has a Class 7 wind resource, which is superior for wind power development. (see Appendix 5 attached). The current strategy is to upgrade the St. George electrical distribution system and power plant (see Appendix 6).

TASK 2: AVIAN COLLISIONS MONITORING

The APIA Region is a major stop in the flight path of millions of migratory birds, home to the largest seabird breeding colonies in the world, is home to many bald eagles (Wright, B.A. and P. Schempf. 2005. The book on bald eagles. pages 8-14. in: Wright, B.A. and P. Schempf (Eds.). 2005. *Bald Eagles in Alaska.* Bald Eagle Research Institute. http://www.hancockhouse.com/products/akbal.htm) and is the wintering grounds of endangered Eiders. The US Fish and Wildlife Service (USFWS) is decidedly concerned about avian interactions with wind energy development in Alaska. As subsistence hunters, avoiding avian interactions with wind energy development is important to local people as well. APIA was awarded a grant from the USFWS to fulfill the required monitoring for avian interaction (outside this grant). After extensive consultation with USFWS Endangered Species Department, a plan acceptable to the USFWS was created and was followed. Avian monitoring by high school students occurred in Nikolski while professional staff was employed to do the avian study at Sand Point.

Adak
Adak has been a military establishment since WWII. There are many towers and other obstacles that are prime targets for avian collisions. The USFWS is not very concerned at this time about avian strikes with wind energy equipment in Adak. However, care was taken to site the anemometer properly with regard to flyways.

False Pass and Nikolski
In False Pass and Nikolski, wintering endangered Eiders are of major concern. The plan was to collect data on bird strikes at the met tower and to construct a fence around the met tower to keep any killed birds from being removed by foxes, dogs, wolves and bears. The 100 square foot, 6-foot high chain link fence surrounded the anemometer towers, and the posts were buried 2 feet underground to prevent predators from digging underneath. APIA contracted with a local entity for constructing the fences within one month of installing the anemometer. No dead birds were found within the Nikolski met tower

fence. The False Pass fence didn't survive the brown bears tearing it down and damaging met tower equipment and wiring. No dead birds were seen at the False Pass site.

High school avian study included training following an observation protocol and a protocol developed in case an injured or dead endangered eider was found (see below).

Protocol for Handling Sick, Injured, and Dead Spectacled and Steller's Eiders

revised 5/25/05

Reporting

All distressed, disabled, and dead spectacled and Steller's eiders found should be reported as soon as possible. Attempt to contact the following people in the order listed until you succeed in reaching someone (numbers are listed below in the *Contacts* section): Greg Balogh, Charla Sterne, Kim Trust, Ted Swem, Dan Mulcahy, Dave Dorsey, Cindy Palmatier, Robert Suydam, Dr. Derrick Leedy, Fred Broerman.

Illegally Killed Birds

If you find eiders that appear to have been killed illegally, contact a Service Law Enforcement office immediately (see *Contacts* section). When possible, notification should occur before the dead birds are removed from the site.

Notification should include:
1. Species, number of birds, date, time and location found;
2. Suspected cause of death;
3. Circumstances under which found;
4. If known, the names of witnesses or suspects, and a description of any vehicles or boats involved (non-law enforcement individuals are not expected to conduct investigations to obtain information that is not readily available).

If a camera is available, photograph birds and other evidence such as shotgun shells or casings, and persons and vehicles involved. Note photo date, time, and location.

Note: If you observe an eider being killed illegally and recover the dead bird, please refer to "Note" section under shipping instructions.

Handling Injured or Sick Birds

For apparently minor injuries (e.g. small lacerations, web tears, minor stunning), you should release the bird on site if: (1) you are so advised; or (2) you are out of radio/phone contact and the bird meets ALL OF THE FOLLOWING CRITERIA.

<u>Criteria for determining whether bird should be released:</u>
1. Bird can stand and walk using both feet.
2. Bird can flap both wings and there is no apparent wing droop.
3. Bird is alert, active, holds its head up and reacts to stimuli.

4. Bird is not bleeding freely.
5. Wing and tail feathers have not been lost and are in good condition.
6. Bird is waterproof (water beads up on feathers).

Retain birds that do not meet ALL of the above criteria, provide preliminary and secondary field care and report the bird (see *Reporting* section)

Preliminary Field Care:

1. Transport the bird to camp in a manner that is least likely to further injure or stress it.
2. Minimize bird handling (wear rubber gloves to prevent loss of feather waterproofing).
3. Keep birds in a quiet place.

Secondary Field Care:

1. Attempt to contact one of the following people in the order listed: Greg Balogh, Charla Sterne, Kim Trust, Ted Swem, Angela Matz, Dan Mulcahey, Dave Dorsey, Cindy Palmatier, Robert Suydam Dr. Derrick Leedy, Fred Broerman. They will help determine whether the bird should be shipped to Anchorage, will arrange for shipping and subsequent care of the bird, and will arrange for pick-up in Anchorage.
2. Note recovery location, time, persons involved, and reason bird was recovered.
3. Keep bird in a cage or box with adequate ventilation and access to cool or cold fresh water. Overheating is a common problem with captive eiders. If bird is dry, be careful not to place bird in overly warm environment. Wet birds should be placed in a warm (not hot) place to dry off. If possible, place absorbent materials or a frame covered with fine mesh Dacron netting in the bottom of the container to minimize contact between bird and feces.
4. Food may be offered if bird is alert. Try moistened cat or dog food, boiled egg, or seafood.
5. Record when bird eats and drinks.
6. Minimize handling of the bird. Wear rubber gloves to prevent loss of feather waterproofing.

Sacrificing Birds

If the bird is seriously injured, sick or suffering (and appears to be dying) and you cannot reach the listed contacts, you may euthanize it. An endangered species permit and this protocol authorize this activity. If appropriate, and if you know how, you may take samples before and after sacrificing the bird (contact AFWFO regarding which samples are needed). Otherwise, continue treating the bird as directed above or as advised by a D.V.M. until shipment to Anchorage can be arranged (see *Shipping Birds* section). Birds suffering from toxicity (e.g., lead poisoning), gunshot wounds, head injuries, or broken bones should be shipped live to Anchorage as soon as possible (unless circumstances warrant euthanasia). Field biologists who anticipate that they may need to sacrifice birds should receive training prior to their field season. Contact AFWFO or Dr. Dan Mulcahy to arrange for training. In locations near veterinary facilities, birds that warrant euthanasia may be transported to a veterinary office where the procedure can be administered professionally. [1]

Field Procedures for Sacrificing Birds

If you are trained and equipped, obtain blood samples before euthanizing the bird. Administer euthanasia away from the general public. The preferred field methods for euthanizing birds are cervical dislocation (breaking the neck) and decapitation.

Cervical Dislocation

Place the head, bottom of the bill down, on a flat, solid surface. Place a solid rod (stick, dowel, etc.) on the neck directly behind the head. Holding the rod firmly on the neck, seize the body in the other hand, and give a quick, definite, and strong yank backwards, without letting the head move. You should feel the neck stretch and break. A slow or tentative pull will not work. It may help to pull the bird's body up as well as backward. The bird may shudder or tremble for a minute. Repeat the procedure if necessary.

Decapitation

Use a large, heavy blade or ax. Cut through the neck in one stroke. This procedure is quick and minimizes suffering. However, it is messy and carries risk of injury to yourself.

Shipping Live Birds

Reporting

Attempt to contact one of the following people in the order listed: Greg Balogh, Charla Sterne, Kim Trust, Ted Swem, Angela Matz, Dan Mulcahey, Dave Dorsey, Cindy Palmatier. They will help determine whether the bird should be shipped to Anchorage, will arrange for shipping and subsequent care of the bird, and will arrange for pick-up in Anchorage.

Preparation

Stabilize and rehydrate birds (offer cool or cold water in a stable bowl) before shipping.

Shipping

Ship birds in a cat or small dog carrier. Place absorbent cardboard or shredded paper in the bottom (if you can fit a wooden frame to the bottom of the carrier and affix fine-mesh Dacron netting to it; that is even better). Do not ship with food or water. Block the front grate of the carrier with tape or cardboard to minimize stress to the bird (but ensure adequate ventilation). Tape the bird's records to the container. If you want the container back, include name and address for return. Clearly label the container with: LIVE BIRDS, U.S. Fish and Wildlife Service, Anchorage, AK. (907) 271-2778.

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[1] Note that, in all likelihood, a village veterinarian will not be covered under an endangered species permit. His or her assistance would, technically, be in violation of the ESA. Presumably, in situations where the vet was acting as a good Samaritan for a permittee, we would exercise discretionary enforcement.

Expenses
Some airlines will carry the birds for free, often in the crew's compartment. They do this as a favor and should be approached with courtesy. If the bird is being sent to the Bird TLC, it may be helpful to use their name in the conversation. Also mention the threatened species status where appropriate. If payment is necessary, AFWFO or FFWFO will cover shipping expenses.

Shipping Dead Birds
Note: Law Enforcement Concern - If the bird died as a result of an illegal act, such as shooting, and the illegal act was directly observed by the individual collecting the dead bird, a law enforcement office should be contacted for shipping instructions. Desired samples can be taken prior to shipping the bird to a law enforcement office. However, in order to properly pursue any related investigation, it will be necessary for law enforcement to take custody of the dead bird/s as soon as possible.

Storage
Obtain desired samples as soon as possible (e.g., blood or tissues for approved recovery task). Keep the carcass refrigerated if the bird will be sent within 48 hours for necropsy or additional samples. Only freeze birds after samples are taken or if shipping delays are inevitable. When in doubt, refrigerate until you talk to appropriate person(s). In remote field camps, place carcass in a pit dug down to permafrost.

Packaging
Wrap chilled carcass in absorbent material, if possible, and place in large ziplock or other waterproof plastic bag. Include a tag with complete information about the bird, its death and collection, and your name, address and phone number. Ship in an insulated container. Pack with frozen gel packs if available. Do not ship with wet ice. If it is obvious to you that the carcass will spoil during shipping, contact AFWFO or FFWFO prior to shipping for further instructions.

Shipping
Notify receiving person(s) of flight arrival time so the package will not sit at the airport. Avoid shipping to government offices on Thursdays or Fridays (There is no mail delivery there on Saturdays and Sundays).

Expenses
If needed, AFWFO/FFWFO will arrange for shipping and expenses.

Taking Samples
Sample needs change with time. Contact AFWFO/FFWFO for current sample needs and procedures.

Contacts

Greg Balogh AFWFO, Anchorage	(800) 272-4174 toll free (907) 271-2778 work

Contacts

	(907) 345-9899 home
Charla Sterne, AFWFO, Anchorage	(907) 271-2781 work
Ted Swem FFWFO, Fairbanks	(907) 456-0441 work
Kim Trust, AFWFO, Anchorage	(907) 271-2783 work (907) 276-0005 home
Angela Matz, FFWFO, Fairbanks	(907) 456-0442 work
Dan Mulcahy, D.V.M., National Biological Service	(907) 786-3451 work (907) 694-2514 home
Dave Dorsey, Bird TLC volunteer	(907) 351-4968 cell
Cindy Palmatier, Bird TLC director	(907) 522-4573 home
Bird TLC/Arctic Animal Hospital	(907) 562-4852 clinic
Pet Emergency Treatment, Inc.	(907) 274-5636
Robert Suydam, N.S. Borough, Barrow	(907) 852-0350
Dr. Derrick Leedy, DVM, Nome	(907) 443-2800
Fred Broerman, Yukon Delta NWR, Bethel	(907) 543-3151
Law Enforcement, FWS, Fairbanks	(907) 456-0255 (877)-535-1795 toll-free (907)-456-0459
Law Enforcement, FWS, Nome	(907) 443-2479 (907) 443-2938 fax
Law Enforcement, FWS, Regional Office	(907) 786-3311 (907) 786-3313 fax
Law Enforcement, FWS, Anchorage	(907) 271-2828 (800) 858-7621 toll-free (907) 271-2827 fax

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Sand Point
The USFWS required a two year avian study for Sand Point, but they were mostly concerned with Bald Eagle strikes. The following study design sufficed for collecting the data (see Appendix 11).

Sand Point Wind Farm Bald Eagle/Bird and Scavenger Monitoring Protocol

Birds have been observed to collide with the blades of wind generators and associated infrastructure (e.g., meteorological stations). This project is designed to assess potential and real bird strikes at the guyed meteorological tower and subsequent 500-KW wind-generator towers at Sand Point, Alaska. The field technicians, Anne Morris (907-383-6075, 907-383-2487, phttec@arctic.net) and Peter Devine (phone # and email), will follow established procedures for collecting data to help evaluate the hazard of the towers to birds. The two technicians were selected because of their experience in the local area with observing and identifying birds and other species of interest (e.g. dogs).

To insure observation consistency the field technicians will be trained. The instructor will go Sand Point to train both field technicians and gather data on a couple of occasions to reduce variability and increase confidence in search techniques.

Ms. Morris will:
(1) Make observations at least three times every week throughout the year to include spring and fall migration periods, and morning, afternoon, evening and night observations.
(2) Make observations from a location about 100 m from the guyed met tower and from the wind farm once it is built.
(3) Approach the site in a vehicle to about 100 m from the guyed met tower; spend 30 minutes in auto and record any predators or scavengers, especially dogs, ravens, or bald eagles. We are interested in collecting data on animals that may be scavenging tower-killed birds.
(4) Record all birds sighted during the observation period(s), their numbers, and approximate flight altitudes.
(5) After the ½-hour observation period is finished, exit the auto and walk the area under the tower(s) up to 50 m (150 ft) out from tower(s) or as permitted by thick vegetation; record any dead birds that you find, including partially scavenged ones. Photograph all dead birds. Note any tracks in the snow or dirt, including rabbit (introduced snowshoe hare) and dog tracks and any other signs of predators (e.g., scat).
(6) Record all observations of dead or downed birds. Include date, time of observations, observer's name, weather conditions, visibility, and observations (to include species of birds moving in the area and their proximity and altitude in relation to the met tower and proposed wind turbine; flight behaviors near the tower [e.g., fly through wires, avoid wires, etc.]); if dead birds are found, note their location on an area map, photograph the dead bird to help determine how it died, and revisit location on daily searches to determine when/if it is scavenged.

Mr. Devine will:
(1) Make observations three times/day when fueling his fuel-delivery truck. Some overlap in sampling time is expected and will be used to compare results of the two observers.
(2) Make observations every week day (Monday–Friday).
(3) Make observations from a location about 100 m from the guyed met tower.
(4) Record all birds sighted during the observation period(s), their numbers, and approximate flight altitudes; also record all scavengers that may be present, as described above.
(5) Record all observations of dead or downed birds. Include date, time of day, observer's name, weather conditions, visibility and observations.

Date:
Time of day:
Observer's name:
Weather conditions (windy, cloudy, rainy, sunny, snowy, etc):
Visibility (excellent, good, poor or bad):
Observations (Any predators or scavengers sighted? Any bald eagles sighted? List any birds sighted including magpies and crows. Note scavengers such as dogs.):

St. George
As home to the world's largest breeding colonies of Red-legged Kittiwakes and Whiskered Auklets, siting the anemometer in St. George was serious business.
Several sessions of site visits were required before consensus was achieved between USFWS, local bird hunters, landowners, and project developers. USFWS determined that Adak and St. George did not need fencing around their met towers. They were instead required to have cameras and motion detecting sensors installed on the gin poles. Strict monitoring was required to make sure every bird strike was counted. Local bird hunters, APIA, and USFWS worked with schools to have students perform an Avian Collisions Monitoring Study. The study required students to: create a grid map of the anemometer area; monitor the site daily; document the weather conditions; and, with assistance from hunters and field guidebooks, identify and record any dead birds found. The USFWS in Alaska is mainly concerned with the guyed anemometer towers. With funds from USFWS APIA purchased reflective bird deterrent devices. Sixteen of these devices were strategically placed on the 12 guy wires to increase visibility. The towers themselves were also decorated with multiple colors of reflective tape. The question of the effectiveness of reflective bird deterrents needs to be studied; we don't even know if these things act as attractants or deterrents so APIA and Alaska Energy Authority are proposing to DOE to study the effectiveness of bird deterrents.

TASK 3: TRAINING AND PROFESSIONAL DEVELOPMENT
APIA began coordinating training and professional development for wind energy projects in August of 2004. DOE/NREL provided travel money to APIA for 3 participants from the region to attend the Wind Energy Application and Training Symposium (WEATS) in Boulder, Colorado. APIA requested the St. George Tribal Council and The Aleut

Corporation to choose a representative to accompany Connie Fredenberg to WEATS. Phillip Lekanof, St. George Traditional Council, and Tara Bourdukofsky, The Aleut Corporation, traveled to Boulder. APIA covered the per diem for Phillip and Connie and TAC covered per diem for Tara.

In September of 2004, funding was rapidly and roughly cobbled together by APIA personnel to provide for 4 regional participants to attend the Wind-Diesel Conference in Anchorage and Girdwood, Alaska. In addition to Connie Fredenberg, APIA contributed money to bring in: Paul Melovidov, the TDX Power wind-diesel plant operator from St. Paul; Phillip Lekanof, St. George Tribal Council representative; George Jackson, the Municipal Utility Operator from False Pass, and Rex Willhite, the Tribal Utility Manager from Nikolski. Additional funding came from the Aleutian Pribilof Island Community Development Association (APICDA) and TDX Power.

BIA training funds for wind energy development became available in December of 2004. APIA was able to provide training and professional development opportunities for two participants from each of the 6 communities during 2005. AEA, the Renewable Energy Alaska Project (REAP), Earth Energy, SECAP and APIA have had worked together on the Alaskan Alternative Energy Event in late 2005.

With additional DOE funds, training and professional development opportunities for regional participants continued through 2006. By that time, plant and hardware specific training was required, APIA worked with turbine vendors, TDX Power, AEA, SECAP and Alaska Village Electric Cooperative (AVEC) to provide a class in Alaska for wind-diesel plant operators from around the state. APIA has a very successful training program and circuit rider O&M assistance program in place for water/waste water operators and will offer that as a model. Training and professional development continues including attending professional conferences (see Task 4 below).

TASK 4: COMMUNICATION NETWORK

St. George Island Community Visioning Meeting

In St. George, the anemometer tower was installed during the first and second days of a Community Visioning Meeting. The 3-day event was organized by the St. George Traditional Council as a response to a community in crisis. APIA contributed to funding the event and representatives from 5 different departments attended.

St. George high school students participated in the Visioning Meeting and were included in the breakout sessions. Wind energy dominated the thoughts of the Energy Group as we kept coming back to the successful project on St. Paul Island – just 40 miles away. As the groups reunited for discussion, the Economic Development Group presented first. All their suggestions for possible development hinged on economical energy. The Environmental Group's concerns included costs of and contamination from use of fossil fuels. Pribilovians take their role as stewards of the seabird colonies, fur seal and sea lion rookeries very serious. Subsistence hunting remains an integral part of life in the Pribilof

Islands. The negative effects of fossil fuel spills, emissions, and (possibly related) global climate change on their community are increasingly.

There was no question in anyone's mind that finding a clean, reliable and sustainable way to produce energy is the bottom line to a future on the Island. The City of St. George, the utility owner, had to borrow money in 2005 to repay the 2004 bulk fuel loan from AEA so they could purchase fuel again for 2005. A vicious circle is becoming a downward spiral. The weight of the crisis rests with energy. The entire community of St. George supported and continues to support wind energy development.

Sand Point Community Wind Energy Development Meeting
A meeting took place January 17, 2005 at the Sand Point City Chambers. Connie Fredenberg, APIA, contacted the Qagan Tayagungin Tribe (QTT), Unga Tribe and Pauloff Harbor Tribes. QTT, as the primary tribe, was asked for assistance to coordinate a contact with the school. Peter Devine chose John Cochran, advisor to the Junior Class at Sand Point School, as lead contact. Principal Dennis Simmons approved school participation in the project and the choice of contact. Gary Jacobsen, Superintendent for Aleutian's East School District, approved the proposed school involvement with project in Sand Point and also, in advance, for False Pass.

Beginning with the 3 tribes, information and agendas spread to: all 3 village ANCSA corporations (Shumagin, Sanak, and Unga); Stanley Mack, Mayor of the Aleutians East Borough; the City of Sand Point; representatives of the Alaska Migratory Bird Co-Management Council; and the local radio station. The junior class hung Community Wind Project Development Meeting flyers around town. John Lyons, Nick Goodman, TDX Power CEO, and Connie Fredenberg attended the meeting. Everyone supported renewable energy development in Sand Point.

Other meetings were held in all 5 communities. In addition, APIA staff attended:
Nikolski Wind-Diesel Project Presentation at Wind Energy Application Training in Anchorage.
Arctic Energy Summit presentation and panel discussion on Aleutian region renewable development.
Renewable Energy Alaska Project meeting attendance
Wind Energy Application Training and Symposium presentation
DOE Tribal Energy conference in Denver, November 2008, 2009, 2010, 2011
AFN's Energy Committee, the Southwest Alaska Municipal Conference (SWAMC)
Energy Task Force and the Renewable Energy Alaska Program (REAP)
Renewable Energy Conference (Girdwood, September 2008)
Present on the Aleutian region renewable energy development at the Alaska Forum on the Environment
Assisted the Alaska Energy Authority in their development of the Alaska State Energy Plan, and many, many more.

An effort to take charge of the energy problems that plague Aleutian communities gained steam at the 2010 Aleutian Pribilof Islands Energy Summit in Anchorage in late April

2010. More than 84 representatives of towns, boroughs, tribal groups and other Aleutian entities met in Anchorage to develop a plan to reduce local dependency on fossil fuels through alternatives that are sustainable, accessible, reliable and affordable. The goal is to ultimately reduce fossil fuel use in Aleutian communities by 85 percent and to develop a regional plan. The follow-on meeting of the A-Team energy group was held October 13, 2010 and significant progress on energy conservation and renewable energy was obvious. The Alaska Energy Authority requested APIA to submit an energy planning proposal to them.

Outreach is also provided by giving energy presentations at a rate of approximately 2 per month, mostly in Alaska, writing energy articles for the popular press and maintaining energy related material at the two web sites: http://www.aleutianenergy.org and APIA is developing an energy web page.

DOI Renewable Energy Program
In 2011, APIA participated with Alaska Federation of Natives meeting with Secretary Salazar at which the Secretary requested his staff to work on an Alaska Tribal energy initiative. APIA has continued to work with DOI staff on the government's Alaska renewable energy program.

Anemometer Study
Bruce Wright of APIA and Rich Stromberg of Alaska Energy Authority completed an evaluation of the Power Predictor 1.0™, a low-cost anemometer, vane and pyranometer used to determine energy potential at a given site. You can see the study results at http://www.akenergyauthority.org/PDF%20files/PowerPredictorEvaluation.pdf.

Peer Reviewed Publication
Much of the energy used in Alaska is for heating homes and facilities. In the typical Alaska village micro-grid connect wind energy system, the electric utility must continue to supply energy regardless of wind speed and wind energy contribution. Here, the wind generator(s) run in constant parallel with the utility, which serves to reduce the electric load at the facility. This configuration produces no cogenerated by-product such as hot water, as there is no excess energy. By integrating wind turbine generating capacity to achieve energy conservation as an aggregate of all energy, as well as the simultaneous production of a beneficial thermal, our conceptual design produces far greater total energy avoidance in terms of fuel savings and superior long term total system operating efficiencies. Accordingly, this design is focused on the low to mid penetration model with thermal electric integrating thermal storage nodes as its first priority use for wind generated energy. Secondarily, excess wind generated energy will be used to off-set electric energy consumption. (see: Wright, B. A., B. Hirsch and J. Lyons. 2012. A Better Use of Wind Energy in Alaska and Applicability for Russian Villages**.** In; Biological Diversity and Ecological Problems in Priamurie and Adjacent Territories. Regional Scientific Work with International Participants, Far Eastern Federal University for the Humanities. Issue 3). (Appendix 8 attached)

TASK 5: ENERGY CONSERVATION / ENERGY EFFICIENCY

When considering the exponentially rising economic, environmental and social costs of the fossil fuel economy, Alaska's many remote communities resemble the proverbial canary in the coalmine. At a representative price of $3.45/gallon (St. George per Bob Pawlowski in December 2004) for diesel, a fossil fuel future is not sustainable in remote communities. Without an alternative energy source, there is no economic future for rural Alaskans in their homelands. With good reason, whole communities are involved and committed to pursuing wind energy.

In December 2004 the City of Adak contracted with Clarissa Quinlan through Precision Power in Anchorage to come to the community and install PowerStat meters on all occupied housing units. PowerStat meters are a pre-pay system that allows customers to monitor how their household utilizes electricity. It enables customers to manipulate their use of appliances to optimize their energy savings. And, perhaps even more importantly, it provides the utility with a 100% collection rate

Energy conservation issues in the region are being addressed in multiple ways. Alaska Energy Authority (AEA) has energy conservation training available that communities can schedule. APIA, in conjunction with the Aleutian Housing Authority and Alaska Building Science Network, accomplished energy conservation training in May 2005 and again (with additional DOE funding) in 2010-2011 (Appendix 9 attached or at http://www.osti.gov/bridge/product.biblio.jsp?query_id=1&page=0&osti_id=1022118&Row=0&formname=advancedsearch.jsp). Several communities have installed PowerStat meters. PowerStats pre-pay systems show account funds running backwards. The meters ensure collections by the utility and provide consumers a clear and easily manipulated picture of their energy use. The meters are proven effective at energy conservation.

Energy Savers Tips for Alaska

APIA's Bruce Wright joined a team (APIA, Alaska Energy Authority, Southwest Alaska Municipal Conference and others) to adapt a booklet on energy efficiency and energy conservation entitled Energy Savers Tips For Rural Alaska (see at http://www.akenergyauthority.org/Efficiency/Energy_Savers_Tips_2011.pdf). Alaska Energy Authority printed copies for each rural Alaska household; APIA distributed the booklets to every household in the Aleutian Pribilof Islands Region.

Greenhouses

APIA considers greenhouses to be an important use of renewable energy, and APIA coordinated the writing and submission of a greenhouse proposal to the Alaska Legislature. The project would include one 51' diameter geodesic greenhouse fitted with lights, vertical axis wind turbines and staff time to make the operation work sustainably. Each community would be responsible for their greenhouse project which would cost about $324K or nearly $3.5M if all our communities are funded. The project team included our communities, University of Alaska, Tribes, AEB, APICDA and APIA (see greenhouse proposal 3-pager below).

Food Security in Rural Alaska, Controlled Environment Agriculture: Greenhouses
As energy prices increase, communities at the far end of the supply chain like the Aleutian and Pribilof Islands region experience significantly higher food prices and shipments delays; and sometimes no shipments at all. However, as a direct result of this experience, these communities seek to construct small, commercial-scale, greenhouse agriculture using locally available renewable energy resources.

These communities are small and remote. Frequently, planes carrying passengers and supplies are weathered out. Barge service is infrequent, often months between landings. We will use the village of Saint George as an economic “example” for discussing the communities of the region. St. George receives weekly scheduled air service directly from Anchorage; and is a good representation of the “averaged” economic values for the region. At the time of this writing, the price of #2 diesel fuel for power generation cost $5.46/gal. The price of grocery items vary, fresh produce regularly costs 10 to 80 percent higher than similar items in Anchorage. This cost estimate does not include the cost of items that spoil, freeze or otherwise become unfit for human consumption between the time of purchase and time of arrival, often one or two weeks later. All small communities in the region suffer these same problems.

In order to address the nutritional needs and high cost of food, these communities propose the construction of renewable energy powered greenhouses. Though each community is looking at which renewable energy option is best for their village, nearly all communities of this region have “Class 7” winds and are capable of generating commercial grade electricity year-round. This provides a unique opportunity to construct the greenhouse operations with a stand-alone power source, capable of local power integration for emergency back-up.

Though the primary purpose of these greenhouses is to provide affordable and fresh nutritional food items to the communities, other direct advantages from the greenhouses include: greater food security; increased community self-reliance; economic stimulus; sustainable economic activity; increasing the body of knowledge of greenhouse agriculture; and diversification of the local skill sets. The longer-term goal of these projects is to provide year-round produce to the village stores for local sales to village residents and the fishermen who may chose to refuel and resupply in their villages.

The communities seek funding to purchase a greenhouse, grow lights and power system for these operations. Due to the unique environmental conditions of the Aleutian and Pribilof region, the communities seek to purchase a geodesic dome greenhouses and small wind turbines, with associated storage and distribution systems, in order to produce and deliver 40 kWh of power. The greenhouse system that these communities seek to construct are, on average, intended to provide approximately 2000 square feet of year-round commercial vegetable production, with a seasonal shift to plant starts, for outside production. Cost analyses indicate that using renewable energy resources can make this endeavor economically viable on either a community or commercial scale.

An economic analysis for the St. George Greenhouse Project (a community of 111 residents) indicates an initial investment of approximately $270,000 for a controlled environment greenhouse facility should conservatively produce a mixed crop harvest, with a minimum annual wholesale value, of approximately $46,500. This translates into a retail value of approximately $66,500 once the standard 30% markup is factored in for the local stores. These figures do not include any outside agriculture, initiated from greenhouse starts. Using the upper level of the greenhouse structures to initiate plant starts for the beginning of the outdoor season could yield an additional $30,000 wholesale/$43,000 retail. Together, these combined agricultural assets have a potential for bringing in over $76,000 (wholesale dollars) into the community. This revenue is enough to sustain a profitable, well-maintained operation with a well-paid full-time employee, or a combination of repayment note and a part-time employee.

The economic model of the greenhouse operation is designed to be profitable and self-sufficient.

Capital Costs (as of January 2011)

Item	Individual Expense	Quantity	Item Expense
Greenhouse Dome	$ 41,900	1	$ 41,900
Wind Turbine	$ 20,000	4	$ 80,000
Storage and Inverter	$ 60,000	1	$ 60,000
Lights	$ 400	10	$ 4,000
Heating	$ 2,000	1	$ 2,000
Fertilizer	$ 3,100	1	$ 3,100
Shipping	$ 15,000	1	$ 15,000
Labor (3 person crew)	$ 16,000	1	$ 16,000
Plumbing	$ 3,800	1	$ 3,800
Admin, Setup & Supervision	$ 44,200	1	$ 44,200
Total		$ 270,000	

The idea of using greenhouses in Alaska villages is becoming more popular. See: http://www.newsminer.com/view/full_story/14799034/article-Remote-Aleutian-villages-seek-greenhouses--renewable-energy-projects?instance=home_news_window_left_bullets

TASK 6: LOAD ASSESSMENT, ECONOMIC AND TECHNICAL ANALYSES

Adak

TDX Power completed the economic and technical feasibility studies for Adak. These were funded by the Alaska Energy Authority and the grant proposal was written by Bruce Wright when he worked for TDX Power. See Appendix 10 attached)

False Pass
False Pass was chosen as the first regional recipient of the study because a new power plant just put in by AEA; it made sense to start with False Pass. The wind resource has proven to be good but the community's location near the mountains also creates turbulent winds. More will be known after completion of the current Alaska Energy Authority study, but False Pass may be more suitable for a tidal project. APIA is funded to complete a False Pass tidal feasibility study in 2012. See Appendix 12.

Nikolski
APIA secured nearly $1M from United States Department of Agriculture Rural Utilities Service Assistance to Rural Communities with Extremely High Energy Costs to install a wind turbine. It was clear to APIA and their partners in the project that this wind diesel configuration would produce the greatest potential future savings for the community, the greatest leverage against increasing fuel prices and other liabilities associated with diesel only generation, and flexibility for future electric and thermal load growth within the communities.

TDX Power completed the design and procured materials, equipment, labor, permits and supervision to construct a fully operational 65 kilowatt Wind Turbine Generator System (WTGS) and associated equipment and interconnect to the newly commissioned diesel fuel based power plant in Nikolski in accordance with the International Electrotechnical Commission (IEC) Wind Turbine Standards. This was accomplished by July 28, 2007.

The fully functional turbine could not be connected to the power plant through the installed transmission line due to potentially significant incompatibility with the control panels. Umnak Power, TDX Power, APICDA and Alaska Energy Authority (AEA) worked with the control panel manufacturer on the design and engineering aspects, including financing and development of the new control panels. By August 2010, and after many extra trips to Nikolski, project extensions and additional costs, all construction phases of the project meet substantial completion. In September 2010 AEA accepted that the wind system as "Commissioned", AEA (Kris Noonan) took control of the software and CPI, and TDX Power has an O&M contract with Umnak Power to provide support services as required (see attached Appendix 7).

Sand Point

(From the *Sand Point Wind Installation Project Draft Environmental Assessment*, see Appendix 11) The DOE's Wind & Hydropower Technologies Program is managed in accordance with the National Energy Policy. The U.S Congress and DOE's Wind and Hydropower Technologies Program supports wind power in an effort to stimulate rural economic development, displace harmful emissions created by traditional fuels, diversify the Nation's options for low-cost electricity generation, and increase energy and national security. The Proposed Action and the decision to provide federal funding for AWE's wind turbine installation project are intended to support the National Energy Policy and to continue deployment of wind generated power in rural Alaska.

The Proposed Action would provide a cost effective and clean source of electricity, reduce overall diesel fuel consumption, and decrease air emissions associated with the consumption of diesel fuel. TDX projects that the Proposed Action would produce 1 megawatt (MW) of renewable power, which would decrease diesel fuel consumption by an estimated 130,000 gallons/year under normal operating conditions. As recent prices of diesel in Sand Point have fluctuated between $4 and $5 per gallon, such a decrease in consumption would result in reduced fuel costs of $520,000 - $650,000 per year. The Environmental Protection Agency (EPA) estimates that one gallon of diesel can produce 22.2 pounds (lbs) of carbon dioxide (CO_2); hence about 1,443 tons of CO_2 emissions per year would be avoided if the Proposed Action is implemented.

St. George
A preliminary wind assessment was completed for St. George showing that a high penetration wind-diesel plant in St. George would be a viable project. As the price of diesel continues to increase, the projects economic benefits can only rise. Alaska Energy Authority is conducting a more in depth load analysis, economic and technical feasibility study. The first priority for St. George will be to upgrade the diesel power plant and the ready it for a wind project (see Appendix 6 attached).

TASK 7: POWER MARKET ASSESSMENT
In isolated Aleutian villages, there is no opportunity for selling power outside the community, other than to seafood processors. At this time seafood-processing plants located in almost every Aleutian community produce their own power with their own diesel generators. However, under this grant, APIA explored the possibility of selling power generated in these communities.

TASK 8: ENVIRONMENTAL EVALUATION
APIA assisted communities with environmental evaluations and preparation of the NEPA documents required to continue development of these wind energy projects. This effort went to completion at Sand Point where APIA's Bruce Wright managed the avian data collection and avian evaluation. The results from the study can be found in the attached Sand Point environmental assessment (see Appendix 11).

TASK 9: LONG-TERM OPERATING AND MAINTENANCE PLANNING
APIA continues to assist community utilities with O&M as a follow-up component to the economic and technical feasibility study and renewable energy installations. Special attention was given to linking communities with like equipment for parts exchange and technical assistance. APIA has worked with the Alaska Energy Authority, TDX Power, Marsh Creek, LLC and others to address O&M issues such as training, circuit rider visits and contracting for services in much the same way as we currently do with water/waste water plants.

TASK 10: BUSINESS AND ORGANIZATIONAL PLANNING
APIA and its contractor regularly provide advice and direction to communities regarding financial strategies for developing the projects in conjunction with their economic and technical feasibility studies.

Many individuals and organizations have joined our effort to reduce the use of fossil fuel in the Aleutian and Pribilof Islands Region. Our partners, their tasks and funding sources for this project (2005-2007) are described below:

Equipment and other expenditures	Funding source(s)
Anemometer towers, including freight	Alaska Energy Authority (AEA)
Bird diverters and fencing	US Fish and Wildlife Service (USFWS)
Bird monitoring cameras and sensors	USFWS
Conference/Training fees	TDX Power / The Aleut Corporation (TAC) / Aleutian Pribilof Island Community Development Association (APICDA) / APIA / Bureau of Indian Affairs (BIA)
Consultation with John Wade Meteorologist and turbine siting expert	AEA
Consultation with Mia Devine Economic analysis expert	National Renewable Energy Lab (NREL)
Salary for APIA Coordinator	APIA / BIA / USFWS
School Stipend	BIA
Subcontracts:	
Community Participants	BIA / USFWS
Doug Vaught	USFWS
TDX Power	BIA
Travel:	
TDX Power	TDX / BIA
APIA	APIA / NREL / BIA
Regional Representatives	APIA / NREL / APICDA / BIA

* USFWS and BIA funds are secured and administered by APIA

Participants and Roles:

TDX Power:
John Lyons, Operations Manager
Nick Goodman, Business Director
Bruce Levy, Developer
Ron Philemonof, President/CEO of Tanadgusix Corporation (Parent company of TDX Power)

- Participate in siting decision
- Lead installation of anemometer towers
- Work with AEA on wind resource profile and evaluation
- Participate in community meetings to provide technical information regarding wind energy and project development
- Conduct economic and technical feasibility study in False Pass
- Begin economic and technical feasibility study in Nikolski

Alaska Energy Authority:
Peter Crimp, Alternative Energy Development Project Manager
Reuben Loewen, Wind Resource Development, Anemometer Loan Program
Rebecca Garrett, Energy Conservation

- Distribute anemometer towers to communities that submit a successful application
- Coordinate monitoring of wind resource data
- Create wind resource profile and evaluation for each community
- Provide communities with energy conservation education
- Recommend projects to the Denali Commission for funding

APIA:
Connie Fredenberg, Wind Project Coordinator and Bruce Wright, Program Manager

- Work with USFWS and local bird experts to ensure equipment is sited, installed and monitored properly regarding avian concerns
- Ensure that all concerns regarding siting are heard by all parties involved and that a consensus is achieved
- Assist Reuben at AEA with the packing and delivery logistics for anemometer towers
- Purchase and arrange delivery of cameras, sensors, and fencing materials
- Assist in raising anemometer towers, placing bird diverting devices on the guy wires and reflective tape on tower
- Assist with installation of camera and sensors or predator proof fence per direction of USFWS
- Co-coordinate with tribes the community meetings
- Co- coordinate with tribes the school participation in monitoring the sites
- Keep participants informed via e-mail, teleconferences and newsletters about:
- Wind energy development in the region, in Alaska, and around the world
- Funding opportunities
- Upcoming conferences and trainings
- State and federal energy policy matters relating to alternative energy
- The evolution of green tag sales.
- Coordinate regional participation in alternative energy conferences, workshops and training sessions
- Contribute to the planning and implementation of a rural wind interest conference
- Write subcontract agreements.
- Write proposals, document projects and complete required grant reporting

Tribal
Nikolski IRA Council, Native Village of St. George, False Pass IRA Government, Agdaagux Tribe of King Cove, Qagan Tayagungin Tribe of Sand Point, Unga Tribe of Sand Point, Pauloff Harbor Tribe of Sand Point:

- Assist Project Coordinator and Utility Manager to select the appropriate representative and operator to attend trainings, conferences and workshops
- Coordinate involvement of appropriate community member(s) or entity for assistance in raising anemometer tower, monitoring the tower, and providing necessary heavy equipment and labor for construction of fencing where necessary
- Co-coordinate and co-host community meetings

- Co-coordinate school involvement and student participation
- Assume the position of “Wind Energy Central” for their community, housing and making available to the community:
    - up to date reports on the local project
    - wind energy newsletters from around the country
    - upcoming conferences, workshops and training opportunities

Community Participants:

False Pass:

John Nickels	City Manager, Manager of City owned Electric Utility
George Jackson	City of False Pass, power plant operator
	President, Native Village of False Pass
	President, False Pass Village Corporation
	Science Teacher at False Pass High School

St. George:

Max Malavansky, Sr.	City Administrator, City of St. George
Martha Malavansky	Concerned resident and Former TAC CEO
Bob Pawlowski	Acting CEO, Tanaq Corp.
Andronik Kashevarof	President, Tanaq Corporation; Traditional Bird Hunter
Anthony Merculief	President, St. George IRA Council
Andy Malavansky	Member of the Regional Management Body for the Alaska Migratory Bird Co-management Council (RMB / AMBCC)
Carol	St. George High School Coordinator
Chris Merculief	APIA Board Member

King Cove:

Clark Corbridge	Administrator, City of King Cove
	President, Agdaagux Tribe
	Science Teacher at King Cove High School
	APIA Board Member

Nikolski:

Tanya Kyle	Administrator, Nikolski IRA Council
Rex Willhite	Utility Manager, Nikolski IRA Council
Scott Kerr	RMB / AMBCC
	Teacher at Nikolski School
Arnold Dushkin	APIA Board Member

Sand Point:

Peter Devine, Jr.	Regional Representative to the AMBCC
Dorothy McCallum	President, Qagan Tayagungin Tribe
David Osterback	President, APIA Board of Directors
John Foster	APIA Board Member, Unga Tribe
Arlene Gundersen	APIA Board Member, Pauloff Harbor Tribe

APIA current renewable energy pre-proposals to BIA:
APIA researches and provides information regarding all possible funding options, including grants and loans. For example, the city of Akutan is interested in studying the use of residual hot geothermal water for use to heat homes and facilities, and Nelson Lagoon is interested in measuring their tidal energy potential. APIA contacted BIA concerning funding for these projects and was requested to submit pre-proposal for consideration (see below).

Akutan Geothermal Steam Energy Project Feasibility Study; Heating Homes with Piped Steam

A proposal by the Aleutian Pribilof Islands Association

The City of Akutan intends to develop an existing geothermal resource in the Hot Springs Bay Valley of Akutan Island. A resource assessment and a feasibility study have been completed in order to identify the location and characteristics of the reservoir, and to determine the feasibility of developing the resource for electric power generation. A screening study was performed to identify and compare various development alternatives, to develop pro forma financial models for each alternative, and to recommend a preferred alternative for development.

After thorough analysis and due consideration of the alternatives, the City intends to construct, operate and maintain two 5 Megawatt (MW) non-condensing steam plants, along with four production/injection wells, access roads, transmission lines and support facilities necessary to convey power to the City of Akutan and the Trident Seafoods Shore Plant, located adjacent to Akutan village.

The purpose of this project proposal is to request funds to study the feasibility of using residual steam and hot water to provide facility and home heating in Akutan, also referred to as teleheating. Over 50% of the energy used in Alaska communities is for heating and electrical resistance heating and is the most expensive while use of residual hot water from the geothermal steam plants in anticipated to be cost-effective.

This project will be managed by the Aleutian Pribilof Islands Association (APIA). APIA is the federally recognized tribal organization of the Aleut people in Alaska. APIA's mission is to promote the overall economic, social, and cultural development of its beneficiaries and to provide for the Aleut tribes of communities (Atka, Akutan, False Pass, King Cove, Nelson Lagoon, Nikolski, Sand Point, Saint George, Saint Paul and Unalaska) in the region designated by the Alaska Native Claims Settlement Act as the Aleut Region, which is also known as the Aleutian/Pribilof Islands region. Many of the Aleut Region organizations, collective known as the A-Team, have been working together to reduce their dependence on fossil fuels; they have established a long-term regional goal of reducing fossil fuels use by 80%. This proposed study is timely and appropriate as energy prices continue to rise and the A-Team continues to seek innovative ways to meet their goal.

A number of financial scenarios have been stress tested and analyzed, with a conclusion that an estimated development cost of $61 million will provide ten megawatts of power at a cost between $0.157 kWh and $0.179 kWh over the planned 20-year life of the project. By comparison, diesel fuel cost during the same period would be in excess $240 million, with a cost of power in the range of $0.21per kWh and $0.32 per kWh (after Power Cost Equalization subsidy).

Final design and permitting for the proposed system (Phase III) is being funded by Alaska Energy Authority and the City of Akutan under a Round IV Renewable Energy grant. The results of Phase III will determine the inputs, variables and cost estimates needed to complete the final operational and business plan for the project. Results from this space heating with hot water feasibility study would be considered in subsequent funding requests to the State of Alaska's Renewable Energy Fund.

The benefits and impacts of this project are both socio-economic and environmental. If the conceptual project design is deemed feasible through this study, as partners believe will be the case, a large percent of the community's heating energy demand could be met by clean, sustainable, flat-priced home heating from geothermal. Akutan could be the first community in Alaska to install geothermal district heating. By reducing carbon dioxide emissions, Akutan as a community will do its part to address climate change and ocean acidification, both of which threaten the subsistence and commercial livelihood of this maritime community. At the same time the associated economic benefits of producing fuel free electricity and heat, and creating local high quality sustainable jobs would enliven the community, creating economic stability and the associated social benefits to the community. Efforts here would be transferrable to many similarly placed Alaskan communities and could serve as a blueprint for other geothermal energy projects which would bring a necessary new source of power to remote predominately Alaska Native communities which suffer from high fossil fuel prices.

Project Costs and Timeline:
APIA will contract for feasibility of economic and engineering design and cost services estimated at $45,000. Project management and report writing is estimated to be $15,000. We expect one trip to the site with the contractor at $4,000. The APIA negotiated indirect rate is 37.5% and the project total is $88,000. If funding is received by September 30, 2012, we can expect to have the contractor working by January 2013 and their draft report available by June 2013. The final report will be completed by September 30, 2013. The contract services with be by University of Alaska, Cold Climate Research Center.

Salary and benefits: $15,000

Contract	$45,000
Travel	$ 4,000
Subtotal	$64,000
Indirect (37.5%)	$24,000
TOTAL	$88,000

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brucew@apiai.org

Nelson Lagoon Tidal Energy Project Feasibility Study

Applicant
Aleutian Pribilof Islands Association, Inc. (APIA)
1311 East International Airport Road, Anchorage, AK 99518
(907)276-2700 voice; (907)279-4351

Project Title
Feasibility of Tidal Current Energy in Nelson Lagoon, Aleutian Islands, Alaska

Project Locations
Nelson Lagoon, Aleutian Islands, Alaska

Project Objectives
1) Collect existing bathymetric, tidal, and ocean current data at the site to develop a basic model of current circulation at Nelson Lagoon.
2) Measure current velocities at site for a full lunar cycle to establish the viability of the current resource.
3) Perform analysis based on current costs of energy and amount of energy anticipated from and costs associated with tidal energy project conceptual design.
4) Compile a report for project partners.

Project Description
Residents of Nelson Lagoon have long known the power of the water that rushes daily through the Lagoon. A 2009 study funded by the Alaska Energy Authority confirmed the need to study more fully the area's potential for tidal power. To this end, and to address their fossil fuel reduction goal, the Aleutian Pribilof Islands Association and community of Nelson Lagoon are working together to determine if a tidal energy project could provide much needed sustainable energy to the community of Nelson Lagoon.

APIA brings expertise to this project. APIA, a past recipient of BIA, USDA-RUS and Department of Energy grants, is a capable business and technical lead and APIA has experience running multi-faceted projects, as well as the ability to reach out to and involve local community members. The contractor, Ocean Renewable Power Corp. (ORPC), with unmatched experience in the nascent tidal power industry, will supply technical expertise, manage site characterization and resource assessment data collection, provide key inputs to economic analysis through development of project installation and operation costs and benefits, and provide a conceptual design for the tidal energy project.

The **benefits and impacts** of this project are both socio-economic and environmental. If the tidal resource and conceptual project design are deemed feasible through this study, a large percent of the community's electricity demand could be met by clean, sustainable, flat-priced power from the ocean. Nelson Lagoon would be the first community in Alaska to install an ORPC power system for use in an ocean pass. By reducing carbon dioxide emissions, Nelson Lagoon as a community will do its part to address climate change and ocean acidification, both of which threaten the subsistence and commercial livelihood of this maritime community. At the same time the associated economic benefits of producing fuel free electricity and creating local high quality sustainable jobs would enliven the community, creating economic stability and the associated social benefits to the community. Efforts here would be transferrable to many similarly placed Alaskan communities and could serve as a blueprint for other tidal energy projects which would bring a necessary new source of power to remote predominately Alaska Native communities suffer from high fossil fuel prices.

Project Costs and Timeline:
APIA will contract for feasibility of economic and engineering design and cost services estimated at $60,000. Project management and report writing is estimated to be $15,000. We expect one trip to the site with the contractor at $4,000. The APIA negotiated indirect rate is 37.5% and the project total is $88,000. If funding is received by September 30, 2012, we can expect to have the contractor working by January 2013 and their draft report available by June 2013. The final report will be completed by September 30, 2013.

Salary and benefits:	$15,000
Contract	$60,000
Travel	$ 4,000
Subtotal	$79,000

Indirect (37.5%)	$29,625
TOTAL	$108,625

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CONCLUSIONS:

Under this project, the Aleutian Pribilof Islands Association (APIA) conducted wind feasibility studies for Adak, False Pass, Nikolski, Sand Point and St. George, and using resources, including funding, met and exceeded the requirements and deliverables of this (DOE funded) project. The DOE funds were also be used to continue APIA's role as project coordinator, to expand the communication network quality between all participants and with other wind interest groups in the state and to provide continued education and training opportunities for regional participants. APIA would like to thank DOE for their support of our efforts to reduce the use of fossil fuels in the Aleut Region by 85%.

Renewable Energy Resource Assessment

for the Communities of

Cold Bay,

False Pass,

and

Nelson Lagoon

This report for Aleutians East Borough was funded by a grant from the Alaska Energy Authority, Project No. 407051

FINAL REPORT COMPLETED MAY 18, 2010

BY: ANDY BAKER, P.E. & LEE BOLLING, E.I.T.

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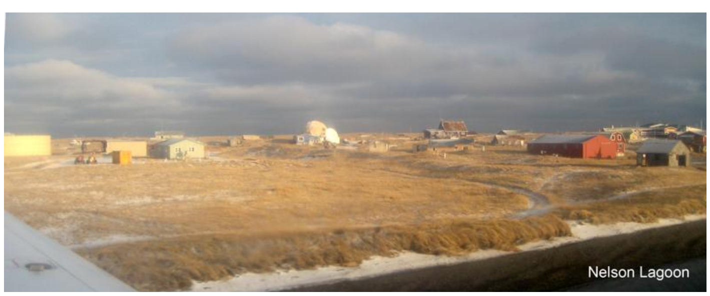
OVERVIEW

As a result of rising energy prices, the Aleutians East Borough (AEB) is motivated to lower energy costs for its community residents and facilities. Your Clean Energy, LLC (YCE) of Anchorage was retained to perform an assessment of renewable energy resources (hydro, wind, tidal, solar, waste heat recovery) for the small, isolated communities of Cold Bay, False Pass, and Nelson Lagoon, Alaska. This assessment was funded by a grant from the Alaska Energy Authority. This report includes an assessment of existing energy generation and usage in these three AEB communities, and an evaluation of available renewable energy resources for each community. The AEB will use this report to appropriate its own funds and/or to seek grant funds for the design and construction of appropriate renewable energy facilities.

This report was completed in three phases. Phase I was the research component. Background research was completed on each community and the findings include existing reports and studies, existing fuel facilities and prices, existing power generation facilities, community fuel and electricity usage, and current energy projects.

Phase II of the project involved in-person site visits to the communities. The site visits for each community were completed in January, 2010, to assess viability and potential locations for renewable energy systems.

Phase III incorporates economic evaluations of appropriate renewable energy projects for each community and a ranking of the cost effectiveness of the proposed projects.



EXECUTIVE SUMMARY OF RECOMMENDATIONS

The following list is an executive summary of all recommendations found in this report. The recommendations are prioritized with the preferred course of action listed first. These recommendations can serve as a guide in bringing more renewable energy projects to the communities of Cold Bay, False Pass and Nelson Lagoon.

COLD BAY

1. Obtain funding for the design and construction of one Northwind 100 Arctic B-Model wind turbine with tubular tower. It is recommended that the power utility G&K own and operate the wind turbine so that the 30% Federal Tax Credit can be utilized. Actual wind turbine locations will be determined with input from FAA, USFWS, G&K, land owners and the community. It is recommended that one wind turbine be installed initially to produce a low penetration wind system that the power utility can easily manage. This system can be integrated without complicated controls or major upgrades and allow a determination of the wind turbine's potential effects on bird populations in the area. In the future, once the wind turbine's environmental impacts are better known, and the power utility is ready for additional wind penetration, additional wind turbines can be installed.
2. Obtain funding for the design and construction of a district waste heat recovery system. Scenario 1 is recommended, which would supply waste heat to the FAA shop, DOT/PF shop, DOT/PF warm storage, and DOT/PF warm sand storage. This is the lowest cost option with the fastest payback. The system should be constructed with appropriate piping sizes to allow for additional district loops to be constructed in the future. This would allow Scenarios 2 and 3 to be constructed cost effectively when additional grant funding is available.
3. Obtain funding for a stream flow study of the four hydropower sites near Cold Bay in the 1980 US Army Corps of Engineers (USACE) Report, for a minimum of one year. The study will determine the stream flow of each site throughout the course of the year and identify potential stream sediment and environmental issues. The study will also identify potential stream intake and power house locations. All potential hydropower sites near Cold Bay are located on National Wildlife Refuge lands. It is recommended that the US Fish and Wildlife Service be engaged in all hydropower planning, including the stream flow study. This study should include stream flow of potential hydropower sites in False Pass to minimize the cost of the overall study.

FALSE PASS

1. It is recommended that a study be completed to ensure that a potential waste heat recovery system from the False Pass Power Plant to the False Pass School will provide sufficient heat to the school throughout the year. This study would monitor the school's daily heating oil use and the power plant's daily diesel consumption through the heating season.
2. Obtain funding for the design and construction of a waste heat recovery system that would use waste heat from the False Pass Power Plant to heat the False Pass School.
3. Obtain funding for the design and construction of two Bergey 10 kW wind turbines on 30m tilt up towers. This will provide a low wind penetration system which the power utility can easily manage. In the future, additional wind turbines could be installed. It is recommended that this project happen in conjunction with the Nelson Lagoon wind project to minimize mobilization costs, and future costs of maintenance, repairs, and spare parts.
4. Obtain funding for a stream flow study of Unga Man's Creek and Water Fall Creek. This study would have the same scope as the Cold Bay stream flow study and should be included with the Cold Bay stream flow study to minimize costs.

NELSON LAGOON

1. Obtain funding for the design and construction of two Bergey 10 kW wind turbines on 30m tilt up towers. This will provide a low wind penetration system which the power utility can integrate and manage. In the future, additional wind turbines could be installed. It is recommended that this project happen in conjunction with the False Pass wind project to minimize mobilization costs, as well as future costs of maintenance, repairs, and spare parts.
2. Obtain funding for the design and construction of a waste heat recovery system between the Nelson Lagoon Power Plant and the Nelson Lagoon Storage Building. Waste heat would be used to heat the Nelson Lagoon Storage Building, including the currently unheated warehouse space. During cold winter days, heating of the warehouse space would have a lower priority compared to the heating the occupied portion of the building. Because the existing Nelson Lagoon power plant does not utilize any waste heat recovery and the Nelson Lagoon Storage Building is very close to the power plant, it is not anticipated that daily fuel consumption monitoring of the building and the power plant is needed prior to obtaining funds for this project. This is due to the fact that there is significant waste heat available for the building to use. However, this data would be helpful in the design of the waste heat system.

COLD BAY

EXISTING RESEARCH AND STUDIES

There are four existing reports addressing renewable energy production Cold Bay, most of which were funded by the Alaska Energy Authority.

- 1980 - The earliest report found was a reconnaissance study for small hydropower projects in Alaska prepared by the U.S. Army Corps of Engineers.
    - **Regional inventory and reconnaissance study for small hydropower projects. Aleutian Islands, Alaska Peninsula, Kodiak Island, Alaska. Volume II: Community Hydropower Reports.** Department of the Army, Alaska District, Corps of Engineers. October 1980.
- 1982 - The second is a reconnaissance study of energy requirements and alternatives for 20 rural Alaskan communities, including Cold Bay.
    - **Reconnaissance Study of Energy Requirements and Alternatives for the Villages of Aniak, Atka, Chefornak, Chignik Lake, Cold Bay, False Pass, Hooper Bay, Ivanof Bay, Kotlik, Lower and Upper Kalskag, Mekoryuk, Newtok, Nightmute, Nikolski, St. George, St. Mary's, St. Paul, Toksook Bay and Tununak.** Northern Technical Services & Van Gulik and Associates. Alaska Power Authority Publication (now Alaska Energy Authority). July, 1982. Accessed from Alaska Housing Finance Corporation RIC Library.
- 1991 - The next report was initiated by the Cold Bay utility, G&K, through Alaska Energy Authority and is an in-depth economic and engineering study of using waste heat from the utility's generators to heat buildings in the community.
    - **Report and Concept Design, Cold Bay Waste Heat Recovery**. February 12, 1991. Frank Moolin & Associates, Inc. Sponsored by Alaska Energy Authority.
- 2005 - The final report is a wind resource summary that can be used to assess wind power production in Cold Bay.
    - **Weather Station Wind Resource Summary for Cold Bay Airport, AK**. August, 2005. Alaska Energy Authority.

GENERAL COMMUNITY INFORMATION

Cold Bay is located near the Izembek National Wildlife Refuge at the western end of the Alaska Peninsula. It lies 634 miles southwest of Anchorage, and 180 miles northeast of Unalaska. The population of Cold Bay is approximately 90 people. The local economy is mostly based on government services relating to the airport.

EXISTING FUEL FACILITIES

Like most rural Alaskan communities, Cold Bay uses diesel #2 and heating oil to produce both power and heat for the buildings in their community, respectively. Frosty Fuels, a subsidiary of Aleut Enterprises LLC, is the fuel distributer to Cold Bay.

Frosty Fuels buys diesel #2 and Jet A fuels from either Crowley or Delta Western depending on the best price and delivery times. Crowley and Delta Western are the only two fuel barge companies that serve Cold Bay and have the ability to regularly access Cold Bay throughout the year. There are 3 to 4 fuel delivery barges to Cold Bay annually.


Frosty Fuels Tank Farm - Cold Bay

Diesel #2 is used exclusively for power generation by the electric utility, G&K. Diesel #2 is either Ultra Low Sulfur or High Sulfur and depends on the fuel being delivered by the fuel barge companies. G&K usually receives Ultra Low Sulfur Diesel #2. Frosty Fuels has a 110,000 gallon Diesel #2 tank that is connected via buried pipeline to G&K's 12,500-gallon double wall tank at their site for storage. The utility also has an automated transfer system that brings fuel from the outdoor storage tank to a 950-gallon powerhouse day tank. This results in a combined total storage capacity of 123,450 gallons for the Cold Bay community.

Jet A fuel is stored in two 150,000 gallon tanks owned by Frosty Fuels, with a combined capacity of 300,000 gallons. The majority of the Jet A fuel is used at the airport for refueling airplanes. Some of the Jet A is sold as heating oil which is used for heating buildings in Cold Bay. In Cold Bay, heating oil and Jet A are equivalent fuels. As a side note, Jet A fuel can be sold as Heating Oil #1, however, Heating Oil #1 cannot be sold as Jet A fuel.

Fuel	Storage Capacity	Type	Uses
Diesel #2	123,450 gal	Typically Ultra Low Sulfur #2	G&K Power Plant
Jet A (or Heating Oil)	300,000 gal	Jet A (High Sulfur #1)	Heating Oil and Jet Fuel

Cold Bay Fuel Storage Capacity

Fuel prices

Cold Bay experiences swings in the price of fuel every 3 to 4 months, when a new barge shipment of fuel is received. The following table shows the current 2009 fuel prices for Diesel #2, Heating Oil #1, and Jet A. In Cold Bay, although Heating Oil #1 and Jet A Fuel are essentially the same fuel, they are sold at different rates. In the winter of 2008, heating oil #1 reached a high price of $5.15/gal.

Fuel	2009 Price	Uses
Diesel #2	$3.39/gal (G&K Yearly Average)	G&K Power Plant
Heating Oil #1	$3.59/gal	Heating Oil
Jet A	$3.99/gal	Airplanes

2009 Cold Bay Fuel Prices

In June 2010, the State will require all diesel internal combustion engines to use only Ultra Low Sulfur Diesel. In 2007, Tesoro became the only manufacturer of Ultra Low Sulfur Diesel in Alaska. Tesoro had to make a large investment to be able to produce this fuel which raises the price of the product compared to other fuels. Petrostar is in the process of making this investment and will be producing ultra low sulfur products soon. Flint Hills did not make this investment. Because of this market, switching to Ultra Low Sulfur Diesel will for some consumers mean that the price they pay for fuel will increase.

Community Heating Oil Usage

Over the last four years, an average of 192,400 gallons of heating oil #1 per year is used for heating buildings in Cold Bay. The annual gallons of heating oil #1 sold in Cold Bay by Frosty Fuels are shown below for 2006 to 2009.

Year	Gallons of Heating Oil Sold
2006	189,000
2007	178,300
2008	169,300
2009	232,900
4 year Average	**192,400**

2009 Cold Bay Fuel Prices

EXISTING POWER GENERATION

G&K is the electric utility in Cold Bay and was started by owner Gary Ferguson, who was hired by the Department of Military Affairs in 1984 to build a power plant to supply emergency power to the U.S. Air Force Base in Cold Bay. During this process Mr. Ferguson was asked by the State to rebuild the electric utility for the community of Cold Bay. Over the next three years the electric utility was completely rebuilt and G&K began operation in 1987. To meet the U.S. Air Force's power requirements, G&K had to produce guaranteed uninterrupted power by maintaining a spinning reserve of 100 kW, maintaining voltage within 5% and frequency within 1%, and be able to start up dead generators to running capacity in five seconds or less. Because of these requirements, G&K's power utility has never experienced an unexpected power outage. A drop in power only occurs during scheduled maintenance. G&K continues to supply firm power to the critical loads of the Air Force's Long Range Radar Site and the FAA's navigational equipment. G&K operates the Cold Bay generation facility under RCC certificate #88 through the Regulatory Commission of Alaska (RCA).

Electricity Price

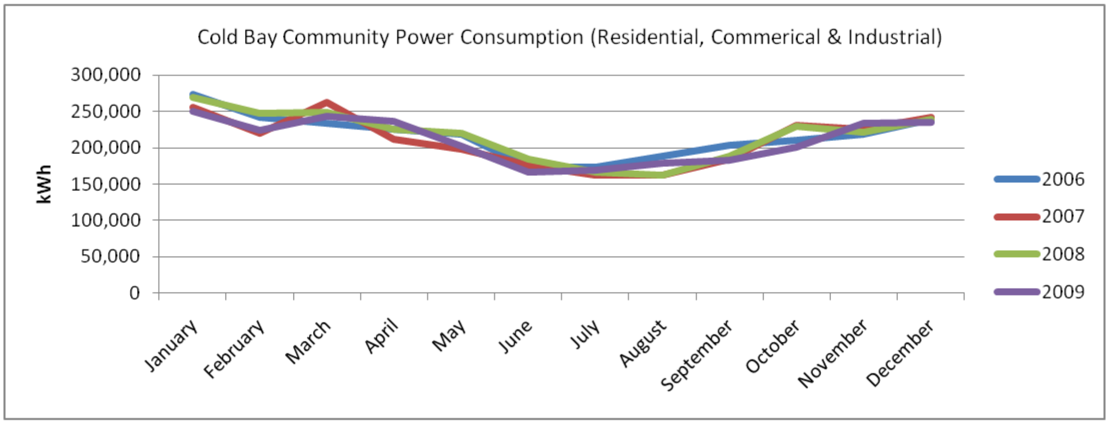
The G&K electricity costs for 2009 are shown below. Prices depend on if the client is residential or commercial and on whether the client is eligible for the Power Cost Equalization (PCE) program administered by AEA. Most residents and some community facilities receive PCE credits to lower the cost of electricity. The PCE program gives each eligible resident a credit to defer high electricity costs for the first 500 kWh of electricity used per month. The resident will not obtain PCE credits for any electricity used over the 500 kWh per month limit. The program also allocates a specific number of kWh in PCE credits to all eligible community facilities to share. This allocation is calculated as the population multiplied by a factor of 70 kwh per person for all eligible community facilities.

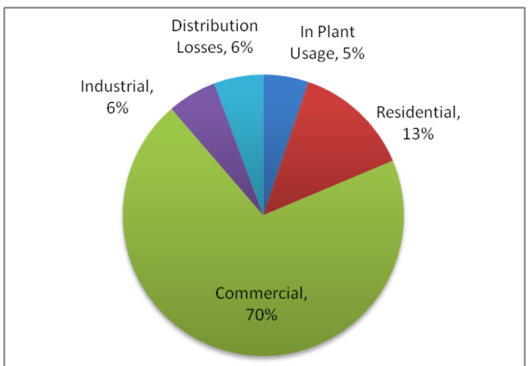
Residential price with PCE	59.12 cents/kWh
Residential price without PCE	67.61 cents/kWh
Commercial price with PCE	67.19 cents/kWh
Commercial price without PCE	68.57 cents/kWh

2009 Cold Bay Electricity Prices

Community Power Load

G&K provides power to approximately 61 residential, 53 commercial and 1 industrial customer (FAA) in Cold Bay. Governmental customers are categorized as commercial customers. The annual community power consumption (4-year Average) is approximately 2,600,000 kWh per year, which includes only power sold to customers and does not include power that is used to operate the power plant or power lost in distribution. In the past, when the military had a large presence at the airport, the power consumption of Cold Bay was much higher than it is today, with peak loads of 800 kW. In recent years the community power load has decreased because of decreased military operations and a decrease in population. The four year average peak load is now 328 kW.





Cold Bay Power Sectors

	2006	2007	2008	2009	Average	
Gross Generation	2,907,168	2,812,096	2,922,604	2,876,502	**2,879,593**	*kWh*
In Plant Usage	149,728	152,896	147,788	150,102	**150,129**	*kWh*
Residential	394,967	389,808	388,478	376,484	**387,434**	*kWh*
Commercial	2,049,941	1,990,110	2,043,726	1,978,707	**2,015,621**	*kWh*
Industrial	154,800	154,080	172,560	168,360	**162,450**	*kWh*
Distribution Losses	157,732	125,202	170,052	202,849	**163,959**	*kWh*
Peak Load	600	600	600	600	**600**	*kW*
Average Load	332	321	333	328	**328**	*kW*
Diesel Usage	215,198	211,235	216,431	212,374	**213,810**	*gallons/year*
kWh/gal Generated	13.51	13.31	13.50	13.54	**13.47**	*kWh/gal*
kWh/gal Sold	12.08	12.00	12.04	11.88	**12.00**	*kWh/gal*

Cold Bay Power Consumption Statistics

Diesel Usage for Power Generation

The Utility purchases about 220,000-gallons of Diesel #2 per year from Frosty Fuel. The diesel used for power generation is shown for 2006 through 2009 in the table above. The usage is shown in more detail in the table below. According to G&K, there was one time in 25 years that the fuel barge did not arrive on its scheduled date and the utility's diesel fuel reserve reduced to only 1,000 gallons.

Diesel used for generation per year	220,000	*gal/year*
Diesel used for generation per week	4,000 to 5,000	*gal/week*
Diesel used for generation on average	25	*gal/hr*
Diesel used for generation at Peak	30	*gal/hr*

Cold Bay Diesel Usage for Power Generation

Projected Power Loads

According to G&K, electric loads are anticipated to increase due to a new facility that the Coast Guard is planning to build. This new facility would draw power in the 50 to 100 kW range.

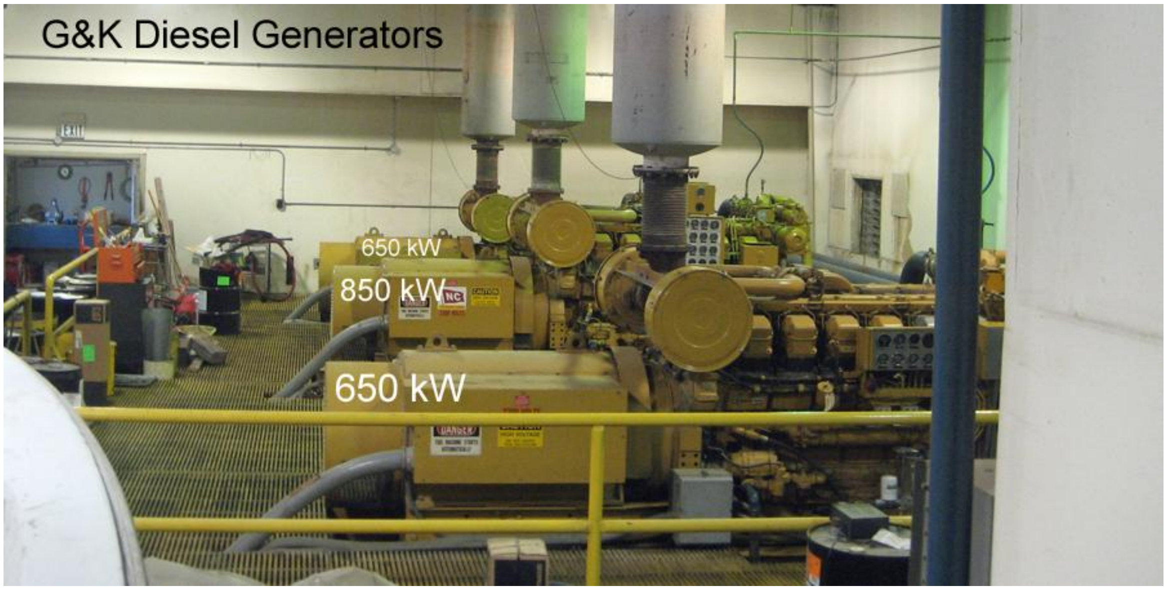
Power Transmission system

The Utility's distribution system is all underground, using 15 kV Pirelli cable and operates at 12,470 volts grounded Y. The underground cable is all in conduit, buried with engineered backfill. Most cable is three-phase with the exception of some single-phase runs and covers a distance of approximately 12 miles. All customers are individually metered, with all commercial customers also being demand metered.

Generator Status

The G&K generation system includes two Caterpillar 3512 diesel engines, 1200 RPM units, directly coupled to Kato 2400 V , 0.8 PF 3-phase generators rated at 650 kW each; and one Caterpillar 3512 diesel engine, 1200 RPM directly coupled to a Kato 2400 V, 0.8 PF generator rated at 850 kW. All generators feed into a Brown Bovari Switch gear rated at 1,200-amps. The Switch gear is computer controlled and is fully automatic on demand.

Typically the utility runs one generator at a time and cycles through each generator every 720 hours. The average operating efficiency of the generators over the last 12 months, from Dec 2008 to Nov 2009, is 13.53 kWh/gallon. The utility has reached an efficiency of up to 14 kWh/gallon, at times throughout the year.



The generators were installed in 1987 and now have between 67,000 and 79,000 hours of operation on them. The generators are well maintained and each one has been rebuilt at least twice. G&K expects them to have a usable life of 150,000 hours. Replacement cost for a single generator is over $300,000. Below is a summary of the generators and their status.

Generator	Rated Capacity	Type
Generator 1	650 kW	3512 Caterpillar Diesel Electric Generator
Generator 2	850 kW	3513 Caterpillar Diesel Electric Generator
Generator 3	650 kW	3514 Caterpillar Diesel Electric Generator
Total Generating Capacity	2,150 kW	

Generator Power Factor	0.8
Current Operating Hours of Generators	67,000 to 79,000 hours
Expected Life Time of Generators	150,000 hours
Replacement Costs	$300,000/generator
Condition and Age	Generators were installed in 1987 and have been well maintained

Cold Bay Generator Summary

Existing Waste Heat Recovery

G&K installed a heat recovery system designed to sell waste heat to the community when the power plant was built in 1987. It consists of a manifold cooling system with a tube and shell heat exchanger. A small fraction of the waste heat is used to heat all of G&K's buildings; these buildings have a combined size of approximately 10,000 square feet. Currently, no waste heat is used by the rest of the community.

In the 1990's, G&K applied for an AEA grant to evaluate the potential for a community scale waste heat recovery system. They received the grant and AEA contracted Frank Moolin & Associates, Inc., to complete the "Report and Concept Design, Cold Bay Waste Heat Recovery", an in-depth economic study on using waste heat from G&K to heat community buildings. The report was completed on February 12, 1991.

The report concluded that "a waste heat recovery system could provide enough heat to heat virtually all of the publicly owned buildings in the general vicinity of the power house and several publicly owned and private commercial buildings further from the power house as well. However, these buildings are spread out and cannot be served on an equal cost basis. Also, varying ownership and planned future use of the buildings makes some buildings more attractive for providing waste heat to. Therefore, policy makers will have to choose between alternatives."

The study identified six different scenarios for waste heat recovery, four of which were evaluated based on estimated project costs, total fuel oil savings, and operations & maintenance. The scenarios are presented below as they were presented in the study, in 1990 dollars (USD). To bring the costs up to date, the total annual fuel cost savings are also given based on Cold Bay's 2009 heating oil cost of $3.59/gallon.

- Scenario #1 provides waste heat to four public buildings nearest the power house. This includes the FAA shop, the State Department of Transportation / Public Facilities (DOT/PF) shop, State DOT/PF warm storage, and the state DOT/PF warm sand storage.

Estimated Project Cost	$429,839	(1990 USD)*
Total Annual Fuel Oil Savings	25,900 Gallons	

Total Annual Fuel Cost Savings	$28,500	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$92,981	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$7,600)	(1990 USD)

* The Estimated Project Cost is a correction from the Moolin report

- Scenario #2 includes the buildings in scenario #1 and extends a heating loop to the north to serve the City Office building and the U.S. Fish & Wildlife (USFWS) Complex. This complex includes the main office building, the bunkhouse, and four separate housing buildings. This scenario is an expansion of scenario #1 and includes the scenario #1 values.

Estimated Project Cost	$1,271,053	(1990 USD)
Total Annual Fuel Oil Savings	35,900 Gallons	
Total Annual Fuel Cost Savings	$39,500	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$128,881	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$13,700)	(1990 USD)

- Scenario #3 includes the buildings in scenario #1 and extends a heating loop to the south to serve the Cold Bay school. This scenario is an expansion of scenario #1 and includes the scenario #1 values.

Estimated Project Cost	$777,021	(1990 USD)
Total Annual Fuel Oil Savings	31,700 Gallons	
Total Annual Fuel Cost Savings	$34,900	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$113,803	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$11,700)	(1990 USD)

- Scenario #4 includes all of the buildings listed above (essentially it is scenario #1 expanded to the north to include the additional scenario #2 buildings and to the south to include the additional scenario #3 building).

Estimated Project Cost	$1,614,728	(1990 USD)
Total Annual Fuel Oil Savings	41,400 Gallons	
Total Annual Fuel Cost Savings	$45,500	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$148,626	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$16,800)	(1990 USD)

- Scenario #4a is identical to scenario #4 with distribution pipe sizes increased to allow for future expansion to the south. Annual fuel and dollar savings are identical.

Estimated Project Cost	$1,788,642	(1990 USD)

- Scenario #5 and scenario #6 expand the system further by extending a heating loop south past the school to serve the clinic, the airport buildings and buildings in between. There is not enough waste heat to serve these two scenarios. Both scenario #5 and #6 are considered a low probability for waste heat recovery due to high construction costs, piping heat losses, and uncertain future of some of the users.

Although the waste heat recovery study was completed in 1991, no waste heat recovery system has been implemented since that time. According to Gary Ferguson of G&K, community interest has been low, most likely due to the capital costs of the project. Ferguson says that the main hurdle is financing the project and recommends that grant funds should be used to construct a waste heat recovery system. Since 1990, the average community electrical load has decreased from 416 kW to 328 kW, resulting in a 20% decrease in waste heat production since the AEA report was written. Even with this reduction, a waste heat recovery system still has the potential for significantly reducing heating oil consumption in the community.

OTHER EXISTING ENERGY SYSTEMS

In February 2009, the U.S. Fish and Wildlife Service received money from the American Recovery and Reinvestment Act (ARRA) to construct wind projects at their stations in Cold Bay and King Salmon. The ARRA money must be obligated by October 2010, requiring that the wind projects in both locations be constructed before this date. The project is on a fast track so that it can be built and paid for by the ARRA funds. The Environmental Assessment (EA) for the project is currently underway and a draft EA was completed at the end of January, 2010. The USFWS hired Marsh Creek to engineer the wind projects. A contractor to build the projects has not been secured.

At the moment, the details of the USFWS wind project in Cold Bay have not been completely decided upon. The USFWS has decided to use GALE Vertical Axis Wind Turbines, manufactured by Tangarie. There will be 3 to 4 turbines installed at the station and each turbine will be 5 kW or 10 kW in size. The turbines will be mounted on top of 25 ft, tilt up, monopole towers. There are two potential locations for the wind turbines; one next to the bunkhouse and the other in the center field.

The use of the power produced by the wind turbines has not yet been decided by USFWS. The two options are to (1) connect the turbines to the G&K electrical grid, or (2) use electrical resistance heaters to heat water for space heating and domestic hot water for the buildings in the USFWS complex. G&K is cautious about USFWS connecting the wind turbines to the grid because they are concerned that they may not be able to control the voltages and frequencies to the standards required by the US Air Force. Additionally, recent high fuel costs have placed financial strain on the utility and they are concerned about a drop in sales that may occur if individual customers install and operate their own wind turbines.

APPROPRIATE RENEWABLE ENERGY TECHNOLOGIES IN COLD BAY

From background research and the January, 2010 site visit, it was determined that Cold Bay has three feasible sources for energy recovery or renewable energy production. Upon completing an economic evaluation for each, the following ranking is as follows:

1. Wind Power
2. Waste Heat Recovery
3. Hydroelectric Power

It was determined that the following other renewable energy sources were not feasible at this time: solar, geothermal, biomass, and tidal. Adequate sun exposure is not available for solar power. No geothermal hot springs were located in proximity to Cold Bay to be feasible for assessment. There is no wood source for biomass heating. Tidal currents occur in Cold Bay, however they are not strong enough at the city dock for any practical power production at this time and there is floating ice in the winter.

Economic Evaluations

For all economic evaluations completed for Cold Bay the following energy prices and associated escalation rates were used. The current price of energy as of January 2010 was used. Escalation rates were based on historic and recent trends in energy prices. A discount rate of 3% was used for the time-value of money in the net present worth evaluations.

Cold Bay		
Diesel #2 Price	$3.39	/gal
Escalation Used	8%	
Heating Oil Price	$3.59	/gal
Escalation	8%	
Residential Electricity Rate with PCE	$0.60	/kWh
Escalation	6%	
Discount Rate	3%	

Wind Power

Producing electrical power from the wind in Cold Bay is feasible and cost effective compared to power from diesel generation. The wind resource in Cold Bay is outstanding with average annual wind speeds of approximately 16.75 mph (7.5 m/s), as measured at a height of 10m from the Cold Bay Airport. This high wind speed, at this height above ground, give Cold Bay a wind power class of 7, which is the highest wind power class rating obtainable. In general, sites with a wind power class rating of 4 or higher are suitable for large scale wind plants. Wind resource data was analyzed by AEA and is shown on the following page along with details of the data collection site at the Cold Bay Airport.

The economics for wind power in Cold Bay was based on installing one Northwind 100 Arctic B-model wind turbine. This turbine has one of the best track records in Alaska with about 37 turbines installed statewide. The tower is a 37m monopole tubular tower that allows maintenance personnel to access the wind turbine from inside the tower, reducing maintenance costs. Current Cold Bay energy prices, escalations and 3% discount rate were used for the net present worth evaluation. Additionally, a 30% tax credit is available on the total installed cost of the wind project, if the project is financed by a private entity that pays taxes. The borough may not be eligible to directly receive the tax credit because they are a tax exempt entity. However, the 30% tax credit can be internalized by a private local utility company. This tax credit was included in the evaluation. O&M costs were estimated at $0.021/kWh produced and the turbine's reliability factor (RF) was estimated at 98% (i.e. the annual percentage of wind turbine operation). Both of these values come from Alaska Village Electric Cooperative's (AVEC) experience with the Northwind 100.

Cold Bay Wind Power	
Wind Turbine	Northwind 100kW Arctic B-model
Rotor Diameter	69ft (21m)
Design Life	20 yrs
Number of Turbines	1
Tower	120ft (37m) Tubular Tower
Estimated Project Cost	$1,100,000
Annual Electricity Savings (kWh) @ 98% RF	327,320
Annual Electricity Savings @ $0.60/kWh	$196,392
Average Energy Penetration	13%
Annual O&M Costs	$6,874
20 yr Net Present Worth	$4,170,654
Payback (yrs)	5

The use of wind power was discussed with Gary Ferguson of the Cold Bay power utility (G&K) to better understand their system needs. Currently, G&K is not certain how much wind penetration they can effectively manage. However, they would like an engineering study to determine the level of wind penetration that is appropriate for their system. The utility is also interested in the 50 kW vertical axis turbine because the generator for these units is on the ground, making it easier to maintain. G&K would be in favor of a wind project if there was grant money available to purchase and construct the system. However, G&K is not prepared to pay for the wind project on their own due to large capital costs of the system. If G&K were to pay for the project, they might not be able to lower power costs to consumers.

A low penetration system is a viable option for Cold Bay. Installing a single Northwind 100 Arctic wind turbine would provide a cost effective low penetration (13%) system for Cold Bay. Low penetration systems require fewer controls and are generally less expensive. As wind penetration increases to medium and high levels, the controls become more complex and the project increases in cost.

PENETRATION CLASS	OPERATING CHARACTERISTICS	PENETRATION	
		PEAK INSTANTANEOUS	ANNUAL AVERAGE
LOW	• Diesel runs full time • Wind power reduces net load on diesel • All wind energy goes to primary load • No supervisory control system	< 50%	< 20%
MEDIUM	• Diesel runs full time • At high wind power levels, secondary loads dispatched to ensure sufficient diesel loading • Alternatively, wind turbines are curtailed during high winds and low loads • Requires relatively simple control system	50 – 100%	20 – 50%
HIGH	• Diesels may be shut down during high wind availability • Auxiliary components required to regulate voltage and frequency • Requires sophisticated control system	100 - 400%	50 – 150%

Figure from the 'Wind-Diesel Hybrid System Options for Alaska' presentation by Steve Drouilhet, NREL

Regardless of the system penetration, the wind-diesel system must be designed as a whole system to ensure that the diesel generators run at optimum efficiencies and that excess wind power can be dumped to heat. This is important because G&K must maintain an efficiency of 11 kWh sold per gallon to qualify for PCE from AEA. If the utility drops below 11 kWh sold per gallon they may lose their PCE eligibility. G&K has space ready for another generator in their Generator Building and installing a smaller 400 kW diesel generator in this location in conjunction with wind generators may provide higher efficiencies.

The availability of a local crane for wind projects was researched. The electric utility, G&K, has a truck-mounted 60' boom crane made by National Crane. The truck is at its end of life and G&K is undecided whether or not to replace the crane due to large replacement costs.

MET Tower

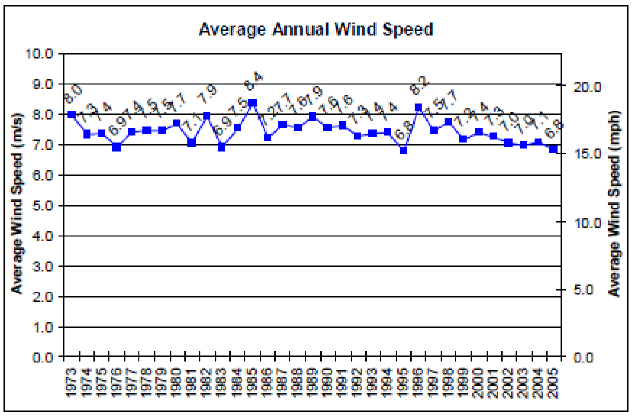
A 30-meter meteorological tower (or MET tower) used to collect wind speed and direction measurements at heights of 30 m and 20 m is the AEA standard for assessing wind power projects in Alaska. Although the wind resource measured at the Cold Bay Airport is known, installing a MET tower at the location of the actual wind turbine site and collecting data for an entire year will produce more accurate data for assessing wind power at that specific site. In Cold Bay where the wind resource has already determined to be outstanding, waiting over a year for MET tower installation and data collection to assess a specific wind site may not be the best use of time and resources.

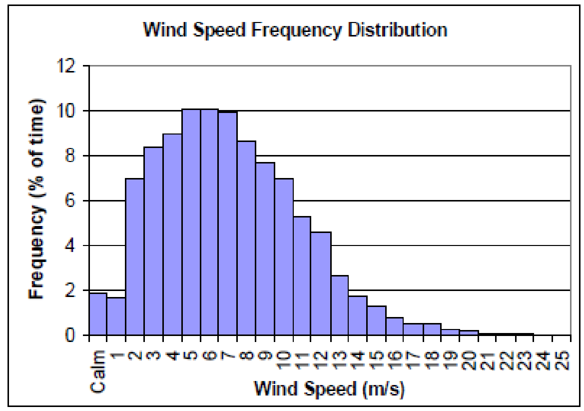
However, the Anemometer Loan Program through AEA will supply MET towers to qualified communities, at a low cost. The program is currently not funded and not operational, but is expected to be running again in July, 2010, according to the program manager James Jenson of AEA. In June of 2008, Gary Ferguson of G&K submitted an application to this program to bring an unused AEA MET tower from King Cove to Cold Bay. Because the loan program was not funded, there was no response to G&K and the tower is still awaiting use in King Cove. It is recommended that AEA be contacted to secure the King Cove MET tower once the loan program is once again funded and running.

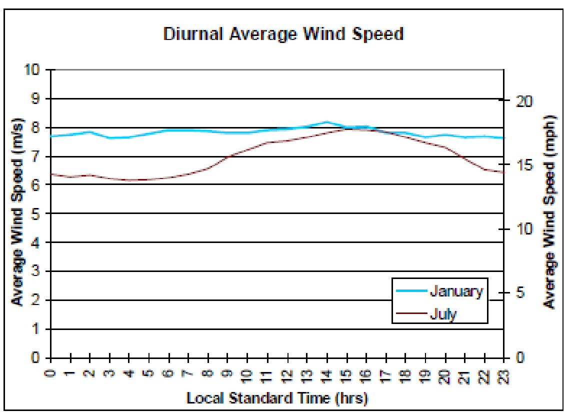
Cold Bay Wind Resource

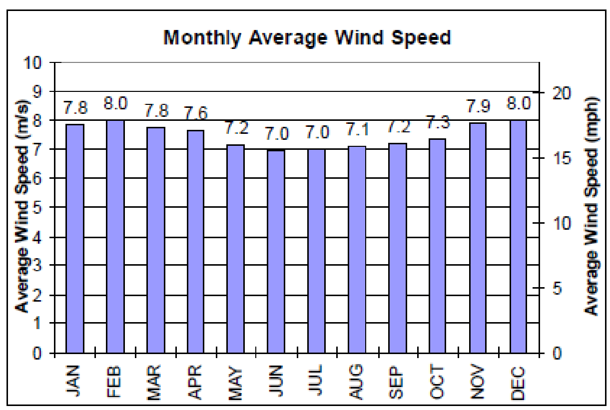
In August, 1995, AEA produced the "Weather Station Wind Resource Summary for Cold Bay Airport, AK". This report uses data collected by the Automated Surface Observing System (ASOS) at the Cold Bay airport from January 1973 to May 1995. The station is at an elevation of 29.9 meters and records wind speed and direction at 10 meters above the ground surface. The wind resource was determined to be outstanding at this location (16.75 mph, 7.5 m/s) at 10 m elevation, with a wind power class rating of 7.

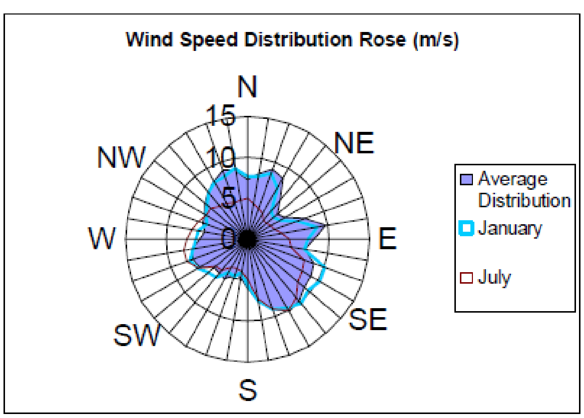
Average Power Density	502
Wind Power Class	7
Power Rating	Outstanding

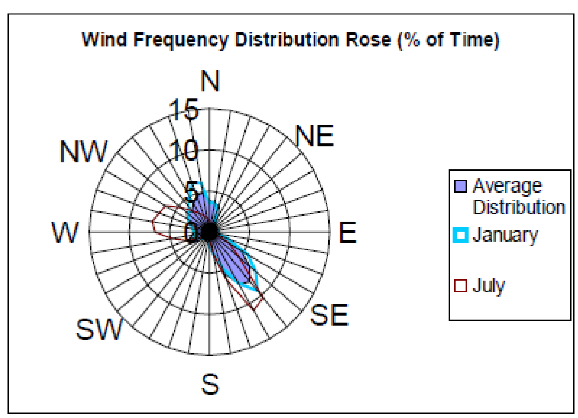








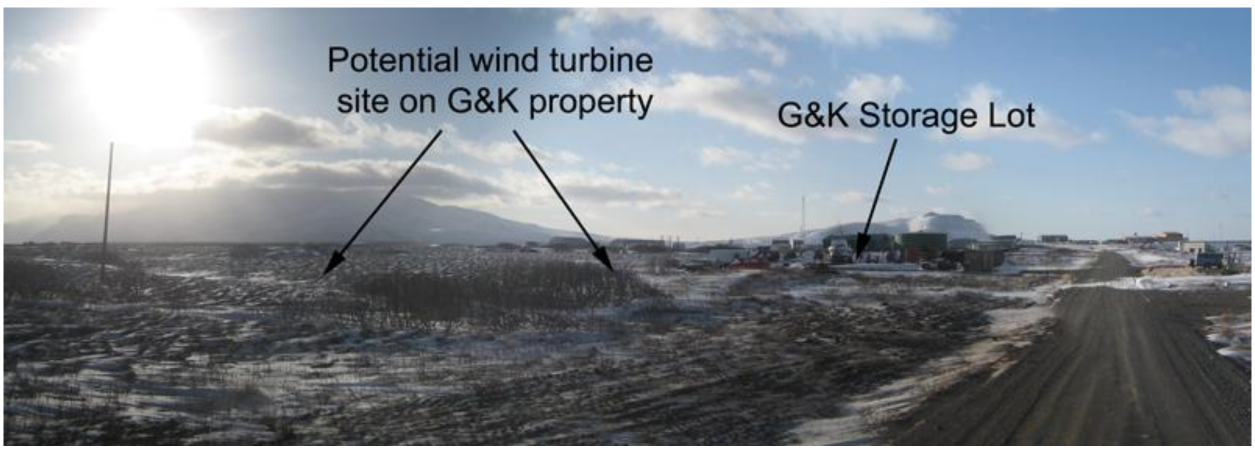




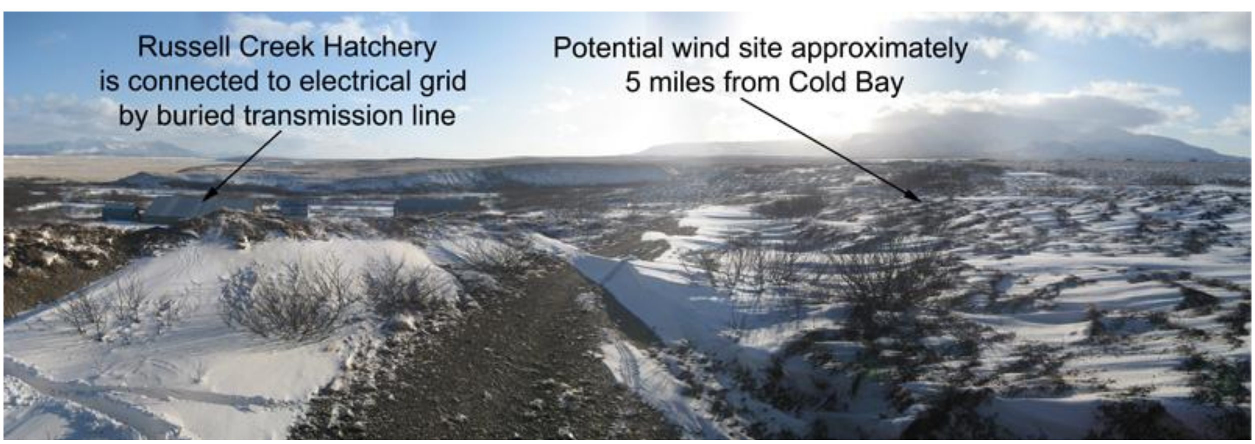
Potential Wind Turbine Sites in Cold Bay

During the site visit, three separate locations for wind turbine sites in Cold Bay were determined, as shown below. The ownership of the land is noted in each case below. All sites have a flat ground profile with limited turbulence from surrounding structures.

G&K Power Plant Wind Site - Located to the side of the Quonset hut near the G&K Power Plant.



G&K Storage Lot Wind Site - Located next to the G&K Storage Lot, across the street from Cold Bay Lodge.



Russell Creek Hatchery Wind Site - Located on the hills above the Russell Creek Hatchery and owned by the King Cove Corporation

Waste Heat Recovery

Although not a renewable energy source, waste heat recovery holds a substantial opportunity for the community to reduce their heating oil consumption. As explained in the Existing Waste Heat Recovery section above, G&K already has a waste heat manifold system installed that was designed to send waste heat to the surrounding buildings in the community.

The economic case for waste heat recovery in Cold Bay was based largely on the 1991 Frank Moolin & Associates report. The estimated project costs and O&M costs for the 4 different scenarios in the Moolin report were updated to 2010 dollars. The heating loads of the buildings in the scenarios were assumed to be the same as the recorded values in the Moolin report. Current energy prices with associated escalation rates and a 3% discount rate were used to complete the 30 year net present worth evaluation.

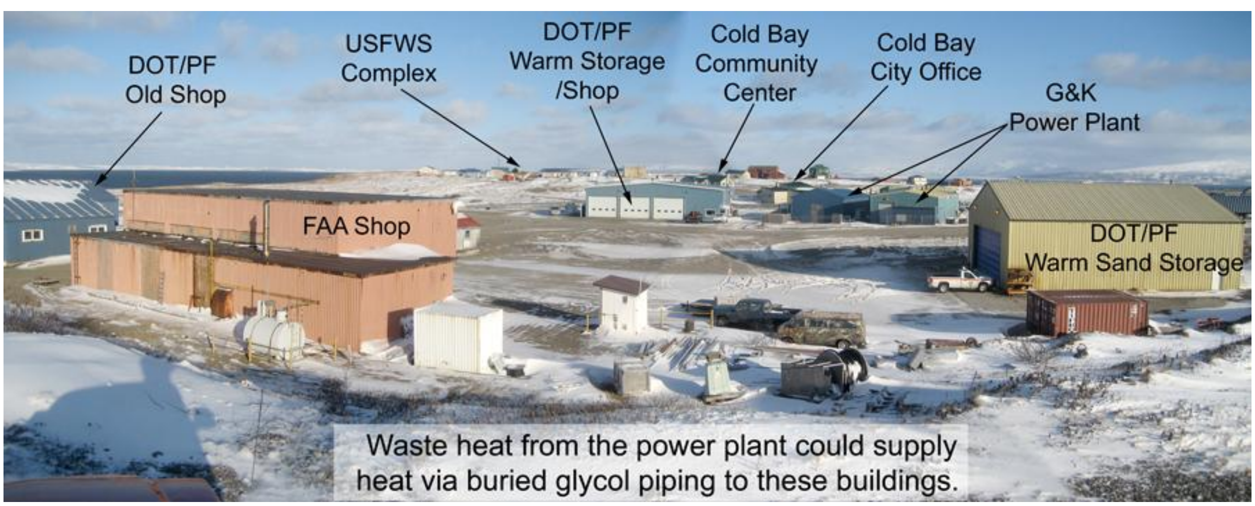
Cold Bay Waste Heat Recovery	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Estimated Project Cost	$684,022	$2,022,682	$1,236,507	$2,569,587
Annual Fuel Oil Savings (gal)	25,900	35,900	31,700	41,400
Annual Fuel Oil Savings @ $3.59/gal	$92,981	$128,881	$113,803	$148,626
Annual O&M Costs	$12,094	$21,801	$18,619	$26,735
30 yr Net Present Worth	$4,802,924	$5,431,647	$5,364,691	$5,978,977
Payback (yrs)	8	14	11	15

Scenario 1 - FAA shop, DOT/PF shop, DOT/PF warm storage, and DOT/PF warm sand storage.

Scenario 2 - City Office, USFWS Complex (the USFWS complex includes main office building, bunkhouse, and four separate housing buildings) and Scenario 1 buildings.

Scenario 3 - Cold Bay school and Scenario 1 buildings.

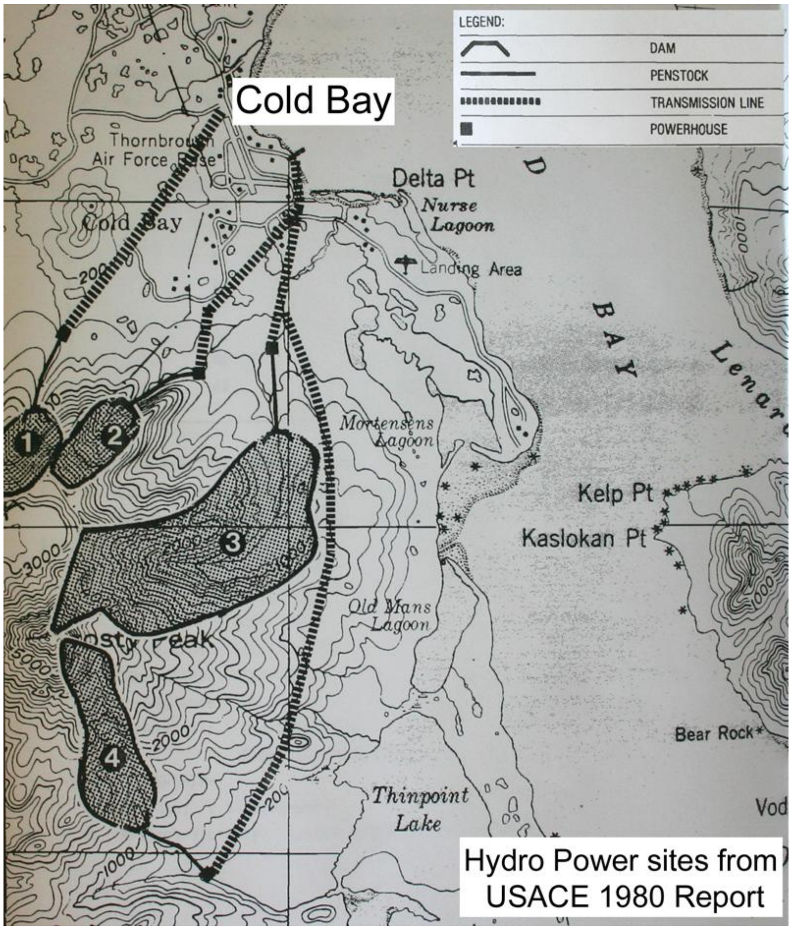
Scenario 4 - Includes all buildings in Scenarios 1, 2 and 3.



The buildings in each scenario will receive heat from an insulated, buried district heating loop that delivers waste heat from G&K's diesel generators. Piping lengths vary depending on the scenario. Please refer to the Moolin report for piping lengths, building heating loads, waste heat production and system layout.

Hydropower

The "Regional inventory and reconnaissance study for small hydropower projects" conducted by the U.S. Army Corps of Engineers (USACE), in October 1980, established four potential "run of the river" hydropower sites on the flanks of Frosty Peak, as shown in the map below. For each site a 50 year economic analysis was completed.



The USACE report was revisited by the "Reconnaissance Study of Energy Requirements and Alternatives" completed by Northern Technical Services & Van Gulik and Associates in July 1982. In the study, Northern Technical Services determined that the "hydropower potential for Cold Bay referenced from the USACE's 1980 reconnaissance study was found to be overly optimistic and therefore, the data was not used in the evaluation".

Due to the fact that the yearly flow regime of each site is unknown, power production could not be determined and an economic evaluation could not be completed. However, these sites still hold an opportunity for producing cost effective renewable energy. **It is recommended that the stream flows for the four sites be monitored for a minimum of one year to establish the annual power production of each site.**

Potential hurdles to these four hydro projects are anticipated to be land ownership and environmental issues. Site 1 (Frosty Creek) is located in the Izembek National Wildlife Refuge. Site 2 (North Fork of Russell Creek), Site 2 (South Fork of Russell Creek), and Site 4 (Thin Point Creek) are located in the Alaska Peninsula National Wildlife Refuge. There is annual salmon migration in all streams according to the USACE report.

FALSE PASS

EXISTING RESEARCH AND STUDIES

There are three existing reports concerning renewable energy in False Pass, all of which sponsored by the Alaska Energy Authority. The earliest report was a reconnaissance study for small hydropower projects in Alaska by the U.S. Army Corps of Engineers in 1980. The second was a reconnaissance study of energy requirements and alternatives for 20 rural Alaskan communities, including False Pass, completed in 1982. The final report, completed in 2010, was a draft wind resource summary which can be used to assess wind power production in False Pass.

- **Regional inventory and reconnaissance study for small hydropower projects. Aleutian Islands, Alaska Peninsula, Kodiak Island, Alaska. Volume II: Community Hydropower Reports**. Department of the Army, Alaska District, Corps of Engineers. October 1980.
- **Reconnaissance Study of Energy Requirements and Alternatives for the Villages of Aniak, Atka, Chefornak, Chignik Lake, Cold Bay, False Pass, Hooper Bay, Ivanof Bay, Kotlik, Lower and Upper Kalskag, Mekoryuk, Newtok, Nightmute, Nikolski, St. George, St. Mary's, St. Paul, Toksook Bay and Tununak.** Northern Technical Services & Van Gulik and Associates. Alaska Power Authority Publication (now Alaska Energy Authority). July, 1982. Accessed from Alaska Housing Finance Corporation RIC Library.
- **Draft Wind Resource Report of False Pass, AK**. Correspondence with James Jenson, AEA. January 21, 2010

GENERAL COMMUNITY INFORMATION

False Pass is located on the eastern shore of Unimak Island on a strait connecting the Pacific Gulf of Alaska to the Bering Sea. It is 646 air miles southwest of Anchorage. The local economy is based on commercial salmon fishing and fishing services. Bering Pacific has the only operational processing plant in False Pass. Peter Pan Seafoods owns a processing plant in False Pass that is currently not operating. The population of False Pass, according to the Alaska Department of Community and Economic Development, is 46 residents.

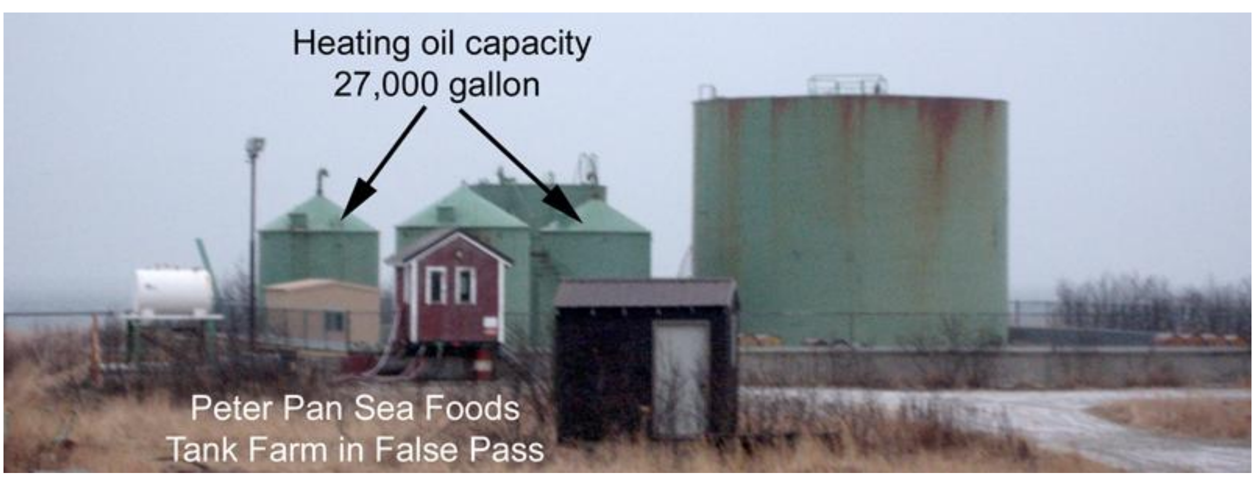
EXISTING FUEL FACILITIES

The City of False Pass owns and operates a 60,000 gallon diesel #2 tank farm, used exclusively for power production by the City-owned power utility. At the power plant the City owns a 5,000 gallon tank; fuel is delivered to this tank from the tank farm with an 850 gallon fuel truck about once every week. A year's worth of diesel #2 is purchased once a year in the spring and barged to False Pass.

Peter Pan Sea Foods owns and operates another tank farm in False Pass which sells heating oil, gasoline, and diesel #2 and collects waste oil from fishing boats. All heating oil used in False Pass is purchased from Peter Pan Seafoods.

Fuel	Storage Capacity	Uses
Diesel #2	65,000 gal	Power Generation
Heating Oil #1	27,000 gal	Heating Oil

False Pass Fuel Storage Capacity



Fuel Prices

Fuel prices vary from year to year depending on bulk fuel prices. In April 2008 the city purchased 40,000 gallons of Diesel #2 at $4.10/gal. In May 2009, the city purchased the same amount of Diesel #2 for $2.29/gal. Although Diesel #2 is purchased once a year through Crowley, this fuel can also be bought through Peter Pan Seafoods in False Pass. The current Peter Pan Seafoods price for Diesel #2 is $2.70/gal. The current price for heating oil #1 is $3.45/gal.

Fuel	2009 Price	Uses
Diesel #2	$2.29/gal	Power Generation
Heating Oil #1	$3.45/gal	Heating Oil

Current False Pass Fuel Prices (May 2009)

Community Heating Oil Usage

The table below shows the gallons of heating oil sold annually by Peter Pan Sea Foods to the community of False Pass. The past prices of heating oil could not be obtained from Peter Pan Sea Foods; however, prices were estimated from False Pass School's heating oil records. The prices shown are the average annual prices of heating oil.

Heating Fuel	2006	2007	2008	2009	Average	
Gross Heating Fuel Sales	18,000	21,000	20,000	17,000	19,000	gal/year
Average annual Heating Fuel Price	$2.83	$2.87	$3.78	$3.81	$3.32	/gal

EXISTING POWER GENERATION

The City of False Pass operates the community's power utility and serves 21 residential, 11 commercial, 1 Federal/State facility, and 9 community facilities customers. Residents pay for electricity with prepaid cards.

Electricity Price

The price of electricity in False Pass depends on a monthly base rate and surcharge and whether or not the customer gets PCE. The surcharge varies monthly, usually around 11 cents per kWh, and is the combination of a fuel surcharge and a repair & refurbish surcharge. Most residents and some community facilities receive PCE credits to lower the cost of electricity. The PCE program gives each eligible resident a credit to defer high electricity costs for the first 500 kWh of electricity used per month. The resident will not obtain PCE credits for any electricity used over the 500 kWh per month limit. The program also allocates a specific number of kWh in PCE credits to all eligible community facilities to share. This allocation is calculated as the population multiplied by a factor of 70 kwh per person for all eligible community facilities. In False Pass, commercial customers do not qualify for PCE.

Residential price with PCE	28 cents per kWh
Residential price without PCE	53 cents per kWh
Commercial price	47 cents per kWh

2009 False Pass Electricity Prices

Community Power Load

All available utility data concerning the community power load in False Pass has been collected, however the data set is incomplete with missing data for some months. 2008 was the only year that all of the PCE reports were valid, and was used to estimate the community power load. Upon review it appears that the utility data may be unreliable. This is due to the fact that distribution losses are 25% of gross power generation, much higher than should be expected. Due to this fact, the actual gross generation of False Pass is most likely lower than shown. In order for a more accurate evaluation of utility data to be performed, it will be necessary for the community to record data more consistently.

During the site visit in January, 2010, the average community demand load was recorded at 65 kW.

False Pass	kWh	% of Gross
Gross Generation	560,550	100%
Total Sales	384,699	69%
In-Plant Usage	36,358	6%
Distribution Losses	139,493	25%
Residential	88,462	16%
Commercial	206,447	37%
Community Facilities	79,598	14%
Fed/State Facilities	10,192	2%

2008 False Pass Community Power Load

Diesel Usage for Power Generation

In 2007 and 2008, False Pass used 50,662 gallons and 43,412 gallons of Diesel #2 for power production, respectively. This results in an average of 47,000 gallons of fuel used per year to produce power in the False Pass.

Projected Power Loads

The community population of False Pass has been decreasing in recent years. In 2005, the population was 62, and in 2008 the population dropped to 46 residents. However, according to the city maintenance personnel, the demand for power for some customers is increasing due to more shops being built. Two years ago Bering Pacific Seafoods (BPS) built a new fish processing plant near the False Pass harbor and installed their own diesel generators to power the facility during processing. As a result, BPS has not substantially increased the City's load. At times of high volume processing, BPS can draw power from the grid as needed to supplement their onsite generator power production.

It is possible that BPS would buy more electricity from the City during peak processing times if a renewable energy system was installed that produced power at a lower cost per kWh than BPS's diesel generators. From this information it can be conservatively estimated that in the near future the community power load for False Pass will most likely stay constant.

Generator Status

False Pass has three generators, which are listed below with their capacities. The size of Generator 3 was not confirmed by the utility during the time of the site visit, but was estimated to be 150 kW. The utility has a spare 125 kW generator, stored in the City Shop, to replace Generator 2.

Generator	Rated Capacity	Type
Generator 1	90 kW	John Deere Generator
Generator 2	125 kW	John Deere Generator
Generator 3	150 kW	John Deere Generator
Total Generating Capacity	365 kW	

Current Operating Hours of Generators	8,373 hrs for Gen 2, 10,860 hrs for Gen 3
Expected Life Time of Generators	20,000 hrs
Condition and Age	Well maintained

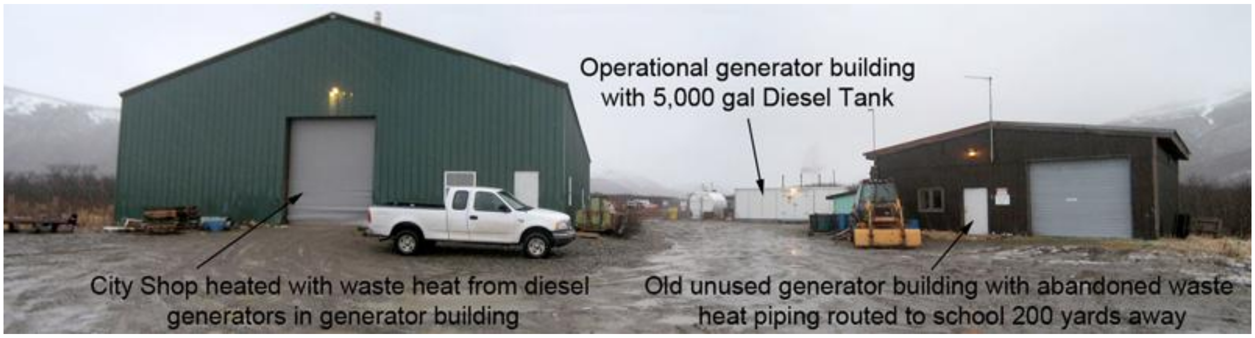
False Pass Generator Summary

Power Transmission

The utility's power distribution system is all underground 3-phase wire operating at 12,470 volts grounded Y. The northern extent of the community distribution system is located at Bering Pacific Sea Foods.

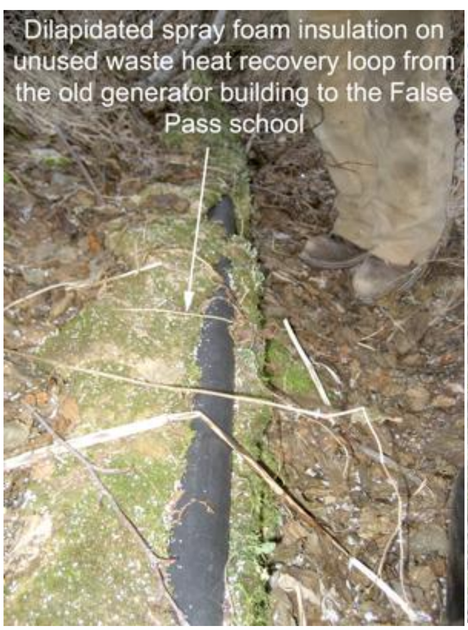
Existing Waste Heat Recovery

The False Pass utility has been using a waste heat recovery system to heat part of the city shop from the diesel generators. A tube and shell heat exchanger in the generator building transfers heat from the generators through a buried glycol piping loop to two Modine unit heaters in the City Shop. Two air cooling fans in the generator building dump excess heat that cannot be utilized by the City Shop.



During the site visit an old waste heat recovery system was found at the Old Generator Building that includes a 3" HPDE piping loop to the school approximately 200 yards away. The pipe was insulated with spray foam only on the top side of the piping, with no other protection from the environment.

The insulation is now dilapidated with vegetation growing on it, and the piping is exposed in various places. The pipe runs to the crawlspace of the school in a 2' deep trench, which is covered by the school playground field. In the school crawlspace the piping is attached to copper fittings and is disconnected from the school's heating system. According to locals the system did not send adequate amounts of heat to the school because of a combination of poor piping insulation and the distance of the piping run.



OTHER EXISTING ENERGY SYSTEMS

In late 2008, the Aleutian Pribilof Island Community Development Association (APICDA) installed one small wind system each in the communities of False Pass, Nelson Lagoon, and Akutan. The projects were privately funded by APICDA, whose goal was to create pilot renewable energy projects to lower the cost of power in these communities. All three projects utilize a Sky Stream 1.8kW wind turbine with a 33 ft monopole tower and are equipped with data-loggers to measure wind speed, wind direction and power output, along with other data. Since installation, all wind turbines have had new inverters installed, giving them an upgraded capacity of 2.4 kW. All three of the systems are grid tied and the tower locations were chosen by the communities.

The False Pass wind system is located next to the City Office.

According to Everette Anderson, the project manager from APICDA, the systems in both False Pass and Nelson Lagoon have had data-logger issues and stopped operating correctly in December, 2009. In January, 2010, a technician from H&K Energy was sent to False Pass to troubleshoot the wind system. Since the visit the wind turbine has been operating properly.

APPROPRIATE RENEWABLE ENERGY TECHNOLOGIES IN FALSE PASS

From background research and the January, 2010 site visit, it was determined that False Pass has three feasible sources for energy and renewable energy production. Upon completing an economic evaluation for each, the ranking of these technologies is as follows:

1. Waste Heat Recovery
2. Wind Power
3. Hydroelectric Power

Hydroelectric power may prove to rank higher, however annual stream flow data must be collected from both Unga Man's creek and Waterfall creek to properly evaluate the power potential and cost savings.

Tidal Power in Isanotski Straight is potentially viable, but requires more research to determine its feasibility.

It was determined that the following other renewable energy sources were not feasible at this time: solar, geothermal, and biomass. Adequate sun exposure is not available for solar power. No geothermal hot springs were located in proximity to False Pass to be feasible for assessment. There is no considerable wood resource for biomass heating.

Economic Evaluations

For economic evaluations completed for False Pass in this report the following energy prices and associated escalation rates were used. The current price of energy as of January 2010 was used. Escalation rates were based on historic and recent trends in energy prices. A discount rate of 3% was used for the time-value of money in the net present worth evaluations.

False Pass		
Diesel #2 Price	$2.29	/gal
Escalation	8%	
Heating Oil Price	$3.45	/gal
Escalation	8%	
Residential Electricity Rate with PCE	$0.28	/kWh
Escalation	6%	
Discount Rate	3%	

Waste Heat Recovery

Although not a renewable energy source, waste heat recovery holds an opportunity for the community to reduce their heating oil consumption. The city already uses waste heat from the power plant to heat a section of the city shop. It was determined from the January, 2010, site visit by YCE that the next closest public building to the power plant is the False Pass School, approximately 600 ft away.

It appears that the amount of waste heat from the power plant is sufficient to heat a large percentage, if not all, of the school throughout the year. **To confirm this, it is recommended that daily heating oil use for the school and daily diesel consumption of the power plant be monitored through the heating season.** This data can ensure that the waste heat system will provide sufficient heat to the school for each day of the heating season. To complete the economic evaluation it was assumed that the waste heat system would displace all of the heating oil consumed by the school, approximately 5,162 gallons annually.

False Pass Waste Heat Recovery	
Building receiving heat	False Pass School
Distance from Power Plant	600 ft
Estimated Project Cost	$300,190
Annual Heating Oil Savings (gal)	5,162
Annual Heating Oil Savings @ $3.45/gal	$17,809
Annual O&M Costs	$1,500
30 yr Net Present Worth	$775,233
Payback (yrs)	14

Due to the 600 ft piping run from the power plant to the school, it is required that sufficient piping insulation is installed to limit heat loss. In the past, a similar waste heat project that brought waste heat from the old power plant to the school failed due to the inadequate insulation of the piping run. Proper insulation and jacketing of the heat distribution pipe is critical for the project to operate properly.

Wind Power

Producing power from the wind in False Pass is feasible and cost effective compared to power from diesel generation. The wind resource in False Pass is excellent with average annual wind speeds of 13.4 mph (6.0 m/s), occurring at a height of 30m. This wind speed, at this height above ground, gives False Pass a wind power class of 5. In general, sites with a wind power class rating of 4 or higher are suitable for large scale wind plants. Wind resource data was collected and analyzed by AEA using a MET tower and is shown on the following page along with details of the data collection.

False Pass has turbulent winds, confirmed by both local residents and the AEA wind data, caused by the city's proximity to mountains. Prevailing winds come from the north and south; however, large gusts of wind come from the west off of the mountains. Because of the high levels of turbulence in False Pass, it is important that any installed wind turbine be able to resist fatigue caused by the regular presence of turbulent winds.

The wind economic evaluation for False Pass was based on using two Bergey Excel 10kW wind turbines. The Bergey Excel is a heavy duty wind turbine suitable for rural Alaska. Currently, Port Heiden utilizes two grid tied Bergey Excels. The 30m tilt-up lattice tower can be tilted up and down without the need of a crane, reducing O&M costs.

False Pass Wind Power	
Wind Turbine	Bergey Excel 10kW
Rotor Diameter	22 ft (7 m)
Number of Turbines	2
Tower	30m Tilt-up Lattice Tower
Estimated Project Cost	$170,000
Annual Electricity Savings (kWh)	27,120
Annual Electricity Savings @ $0.28/kWh	$7,594
Annual Energy Penetration	7%
Annual O&M Costs	$570
20 yr Net Present Worth	$65,958
Payback (yrs)	15

This proposed wind system is low penetration, with an annual energy penetration of 7%. Connection of the two wind turbines to the grid will allow the existing diesel generators to operate without the need for advanced controls. In the future, additional wind turbines could be installed to increase penetration.

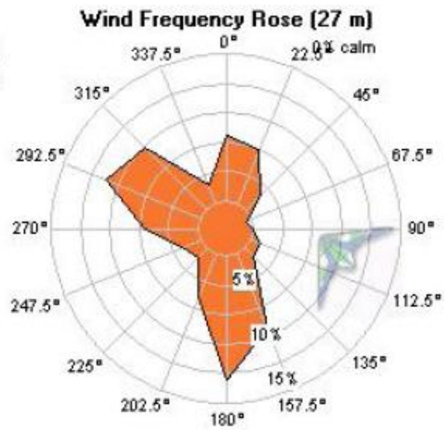
False Pass MET Tower

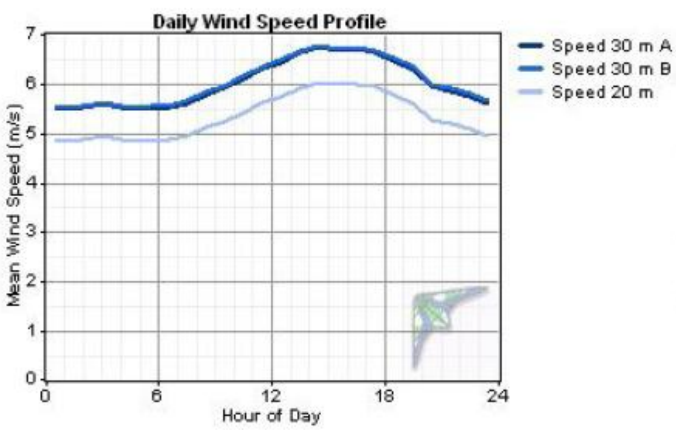
A 30-meter MET tower was installed in May, 2005, by AEA to measure wind speeds and directions in False Pass. The tower was installed at the north end of town near the new landfill. The data is not finalized and only a draft wind resource report has been created thus far.

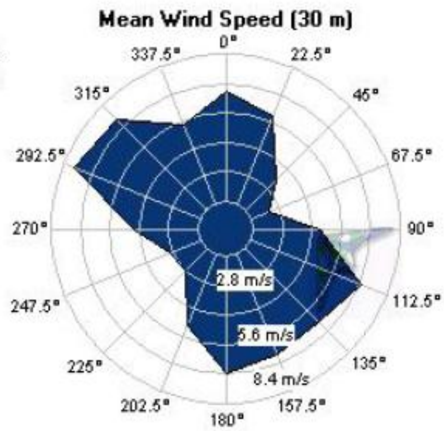
False Pass Wind Resource

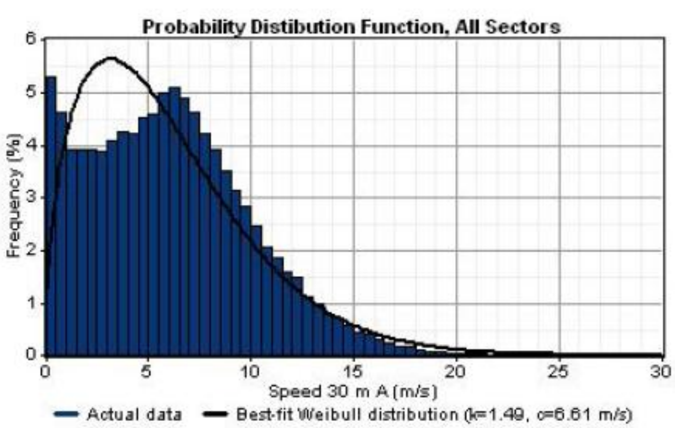
Below is the draft wind resource report from AEA. The MET tower has anemometers at 20 m and 30 m. The average annual wind speed at 30 m is 13.4 mph (6.0 m/s).

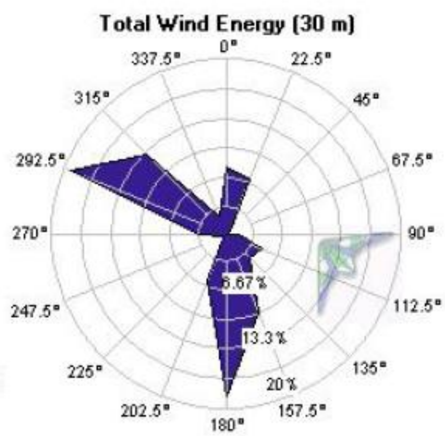
Power density at 50m	555 W/m²
Wind power class	5 (Excellent)







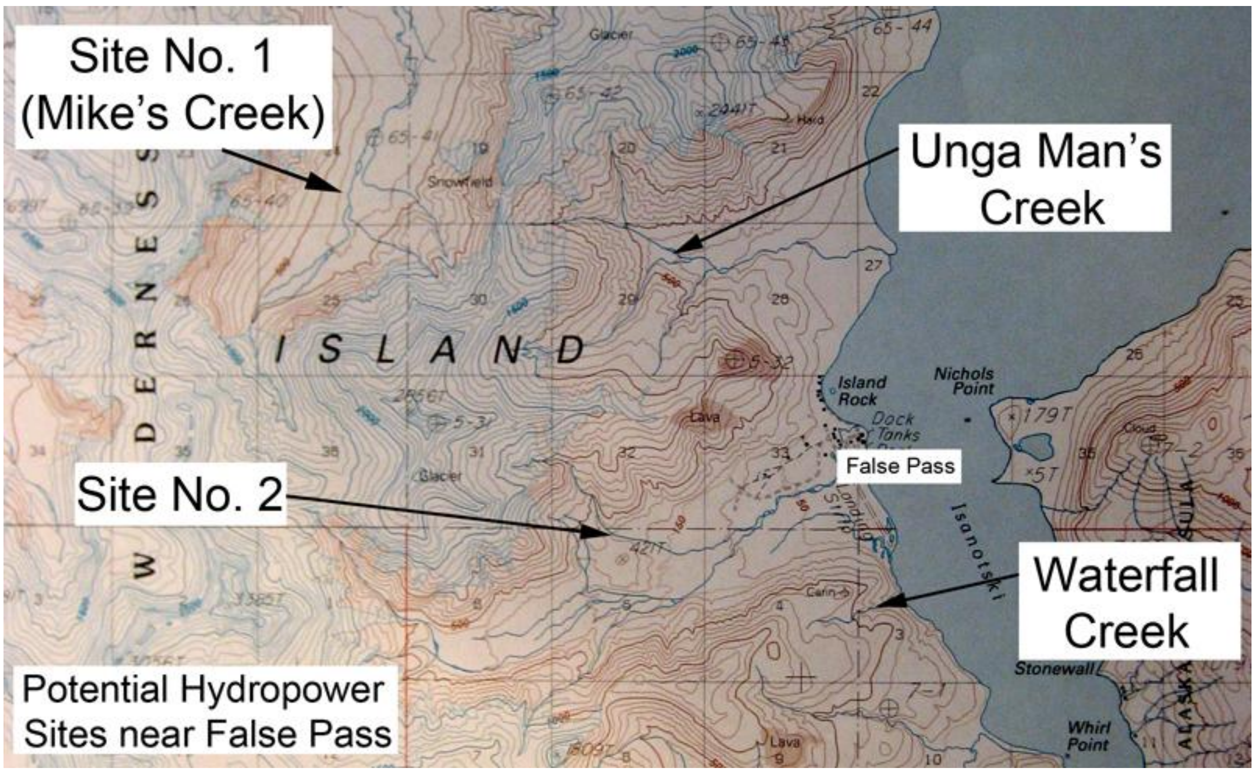




Hydropower

The "Regional inventory and reconnaissance study for small hydropower projects" conducted by the U.S. Army Corps of Engineers (USACE) in October 1980, established two potential run of the river hydropower sites near False Pass. For each site a 50 year economic analysis was completed. Site No. 1 is Mike's Creek, whose headwaters are located northwest over the mountains from False Pass and flows north to the Bering Sea. Site No. 2 is located three miles to the west of False Pass at the base of Round Top Mountain.

The USACE report was revisited by the "Reconnaissance Study of Energy Requirements and Alternatives" completed by Northern Technical Services & Van Gulik and Associates in July 1982. In the study, Northern Technical Services reviewed Site No. 2 and determined that "hydroelectric power generation was considered but was found to be economically unattractive" at this site. Although, the economics for Site No. 1 and Site No. 2 have most likely become more attractive due to the rise in energy costs, both sites are located in the Aleutians Peninsula National Wildlife Refuge, which may prohibit development of these hydro resources due to environmental impacts.



Following the January, 2010, site visit by YCE it was determined that Unga Man's Creek, located to the west of False Pass's new landfill, and Waterfall Creek, located to the southwest of the runway, may be viable sources of hydropower. Both creeks are located on land owned by the Isanotski Corporation, False Pass's Native Corporation, who is interested in developing hydropower on their land. According to locals both creeks are non-anadromous. In addition, Unga Man's Creek and Waterfall Creek are not listed in the Alaska Department of Fish and Game's Anadromous Waters Catalog.

Due to land ownership, absence of anadromous fish and proximity to False Pass, Unga Man's Creek and Waterfall Creek hold an opportunity for cost effective renewable energy production. However, the annual flow characteristics of both creeks are unknown, prohibiting an evaluation of the creeks' power potential throughout the year, and prohibiting a hydropower economic evaluation. **It is recommended that the stream flows of Unga Man's Creek and Waterfall Creek be monitored for a minimum of one year to obtain the power potential of each site.**

During the site visit by YCE, in January 2010, the flow of Unga Man's Creek was estimated at 10 cfs, using the drogue method. In February, Chuck Martinson of the Isanotski Corporation estimated the flow of Waterfall Creek at 300 gpm (0.67 cfs), using the bucket method. These measurements are insufficient to determine the power production of the sites due to the fact that stream flows can change drastically throughout the year.

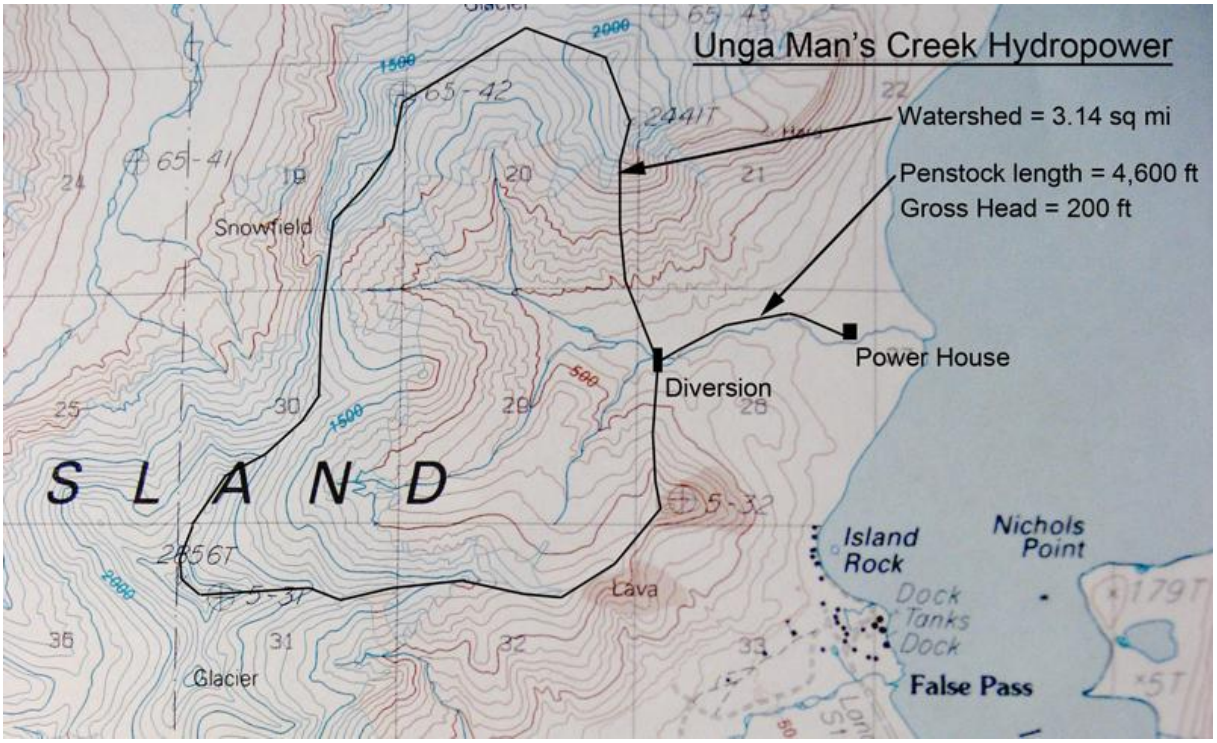
To illustrate the benefits that these two hydro projects could produce, the power potential and associated electricity savings were graphed as a function of stream flow, shown on the following pages. For these calculations it was assumed that 50% of the annual average stream flow was diverted to the penstock. A total system efficiency of 51% was used, which includes head losses in the penstock, manifold, turbine, drive, and generator.

False Pass Hydro Power	Unga Man's Creek	Waterfall Creek
Average Annual Flow	Unknown	Unknown
Estimated Flow in Jan-Feb	10 cfs	0.67 cfs
Gross Head	200 ft	400 ft
Penstock Length	4,600 ft	1,400 ft
Transmission Line Length	3,000 ft	2,200 ft
Access Road Length	4,600 ft	3,600 ft

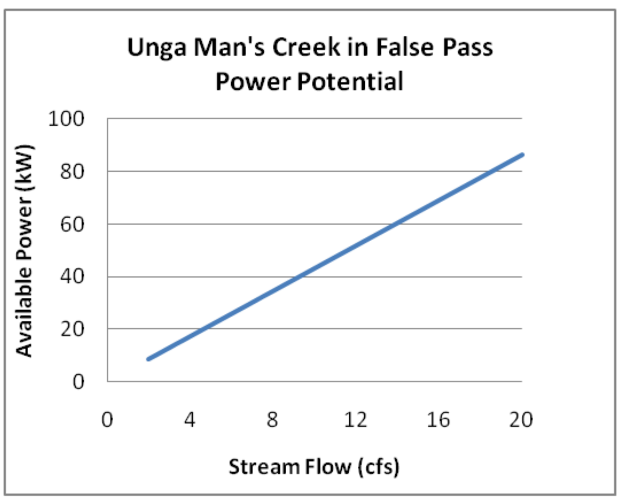
It appears that Unga Man's Creek hydro could provide significant energy savings to False Pass. If the average flow is determined to be 16 cfs, this would result in an average power production of 69 kW, which would cover the average load of False Pass of 65 kW. Waterfall Creek would provide smaller savings, most likely around 4 kW to 8 kW. However, all of these numbers depend on actual stream flows**. It is recommended that the flows of these creeks be monitored for a minimum of one year so that an accurate evaluation can be obtained.**

The power house for Unga Man's Creek Hydro would be best situated near the Unga Man's Creek Bridge on the road that travels from Bering Pacific Seafoods to the False Pass Landfill. Approximately 3,000 ft of underground transmission line would be required to deliver power from the power house to the False Pass electric grid located at Bering Pacific Seafoods. A 4,600 ft penstock with a gross head of 200 ft elevation will carry water from the diversion dam to the power house, located on the north side of Unga Man's Creek. An access road of the same length will be needed to access the diversion dam.

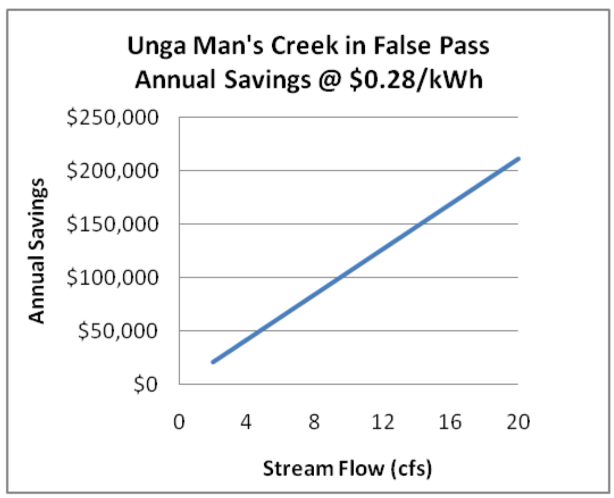
The power house for Waterfall Creek Hydro would be situated out of tidal zone of Isanotski Straight and easily assessable. Approximately 2,200 ft of buried transmission line would be required to deliver power to the electric grid located at the False Pass runway. A 1,400 ft penstock with a gross head of 400 ft would carry water from the diversion dam to the power house. An access road will be needed from the airport to the power house and from the power house to the diversion dam.



Unga Man's Creek Hydropower
Watershed = 3.14 sq mi
Penstock length = 4,600 ft
Gross Head = 200 ft
Power House
Diversion
Snowfield
S L A N D
Island Rock
Nichols Point
Dock
Tanks
Dock
False Pass
Lava
Glacier

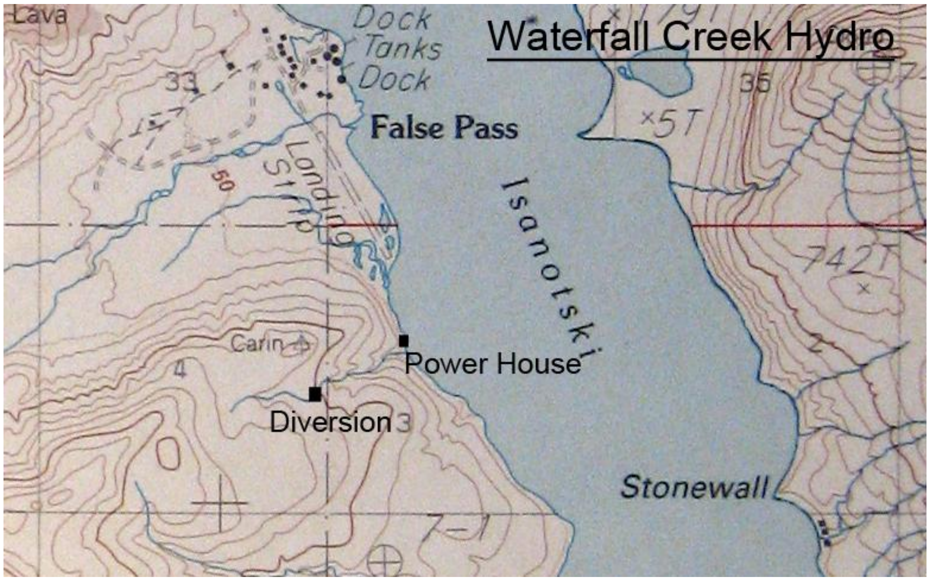


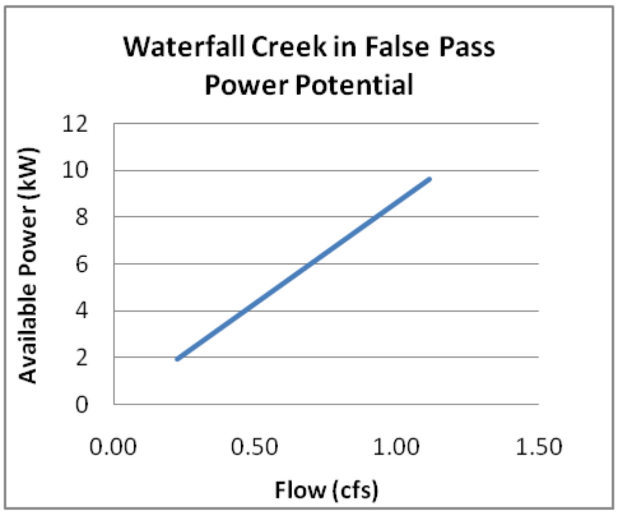
Unga Man's Creek in False Pass
Power Potential
Available Power (kW)
100
80
60
40
20
0
0
4
8
12
16
20
Stream Flow (cfs)

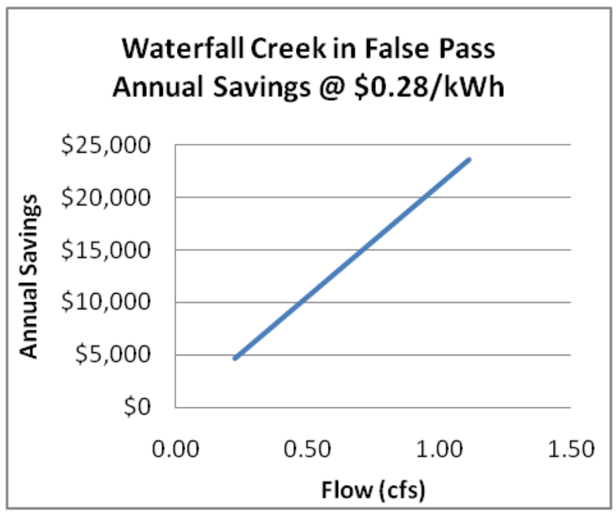


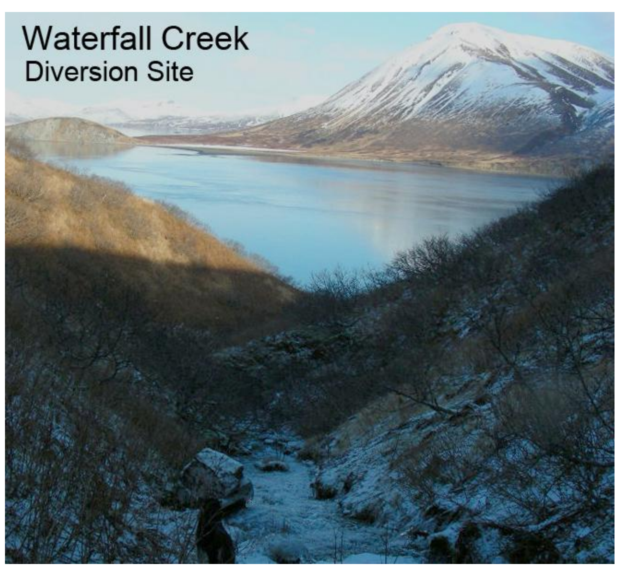
Unga Man's Creek in False Pass
Annual Savings @ $0.28/kWh
Annual Savings
$250,000
$200,000
$150,000
$100,000
$50,000
$0
0
4
8
12
16
20
Stream Flow (cfs)

Unga Man's Creek watershed
to the northwest of
False Pass


Waterfall Creek Hydro
Lava
Dock
Tanks
Dock
False Pass
Landing Strip
Isanotski
Carin
Power House
Diversion
Stonewall


Waterfall Creek in False Pass
Power Potential
Available Power (kW)
12
10
8
6
4
2
0
0.00
0.50
1.00
1.50
Flow (cfs)


Waterfall Creek in False Pass
Annual Savings @ $0.28/kWh
Annual Savings
$25,000
$20,000
$15,000
$10,000
$5,000
$0
0.00
0.50
1.00
1.50
Flow (cfs)


Waterfall Creek
Diversion Site

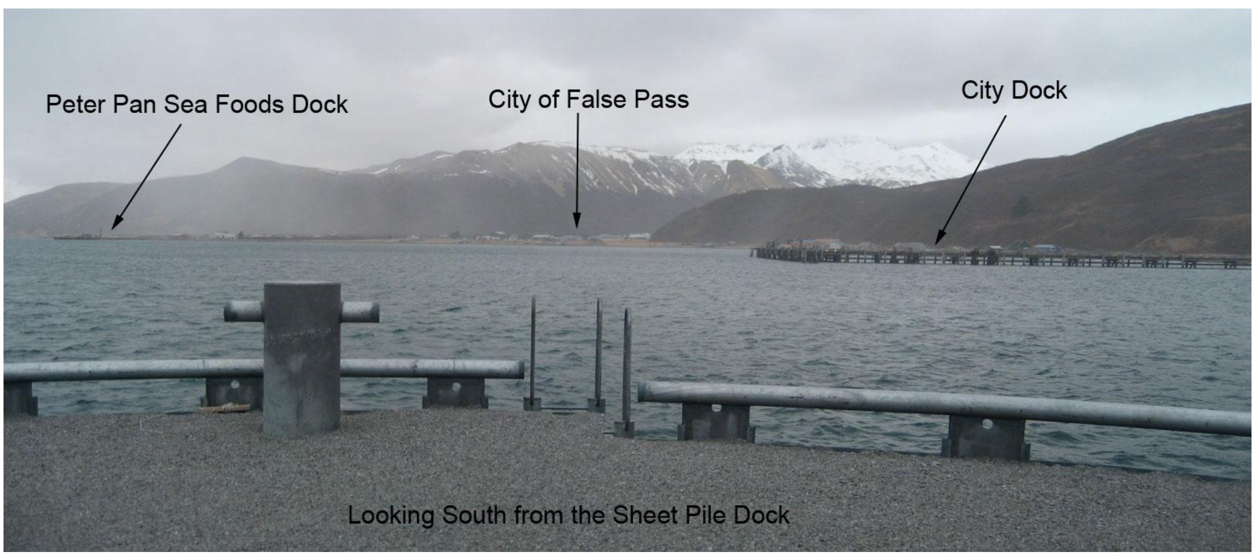
Tidal Power

Tidal power may be a potentially viable renewable energy resource in False Pass. Tidal currents for Isanotski Straight are calculated by NOAA Tides & Currents. Isanotski Straight is normally ice free from April through January.

Currently, tidal power technologies are in their infancy compared to the commercially viable technologies of wind power and hydropower. Maintenance costs for tidal power generators are unknown but are expected to require significantly more maintenance than a wind turbine due to the presence of moving parts in tidal sea water. Additionally, in False Pass, tidal power would be seasonal and would not operate when sea ice is present in Isanotski Straight.

Due to these challenges, it is recommended that wind power and hydropower be developed first before tidal power is explored further. Wind turbines and hydropower Pelton turbines can be maintained on land and will be simpler to maintain than a tidal generator. Furthermore, the wind resources in False Pass are excellent and wind turbines can produce energy year-round.

The current velocities and direction and water level have not been measured and documented at the False Pass docks, prohibiting a proper evaluation of the tidal power potential at the site. If at some time in the future tidal power becomes more commercially tested and viable, it is recommended that data loggers be mounted on both sides of the City dock and Sheet Pile dock to record this data for the ice free months of the year. With this data a proper evaluation of tidal power in False Pass can be completed.



NELSON LAGOON

Existing Research and Studies

One existing study was found for Nelson Lagoon concerning energy in the community. Completed in 1983, the study is a report on a diesel intertie wind generator system.

- **Nelson Lagoon Diesel Intertie Wind Generator Data Monitoring Project - Final Report.** S&S Electric Inc. Sponsored by the State of Alaska Dept. of Commerce & Economic Development. Completed February 1983.

General Community Information

Nelson Lagoon is located 580 miles southwest of Anchorage, on the northern coast of the Alaska Peninsula, on a narrow sand spit that separates the lagoon from the Bering Sea. The community economy is largely based on commercial fishing. Nelson Lagoon has a population of approximately 69 residents according to the Alaska Department of Community and Economic Development.

EXISTING FUEL FACILITIES

Nelson Lagoon Enterprises, Inc. owns and operates the Nelson Lagoon Electrical Cooperative and the Nelson Lagoon Fuel Company. Across the road from the community dock, Nelson Lagoon Enterprises owns a tank farm consisting of nine fuel tanks, each with a capacity of 27,000 gallons. The tanks contain a variety of fuels: AV gas, Unleaded, Heating Fuel #1, and Diesel #2. The table below shows the storage facilities and capacities. Diesel #2 is used exclusively for power generation. Heating Oil #1 is used for heating buildings in both Nelson Lagoon and surrounding cabins accessed by bush plane.

Fuel	Storage Capacity	Uses
Diesel #2	54,000 gal	Power Generation
Heating Oil #1	81,000 gal	Heating Oil
AV Gas	54,000 gal	Airplanes
Unleaded	54,000 gal	Ground Transportation

Nelson Lagoon Fuel Storage Capacity

Crowley is the only fuel supplier to Nelson Lagoon. A bulk delivery of fuel is barged in once a year, usually in June or July before the fishing season begins.

Fuel prices

Fuel prices in Nelson Lagoon fluctuate on a yearly basis depending on Crowley's fuel prices at the time fuels are purchased once a year. The current 2009 prices of fuels in Nelson Lagoon are shown below.

Fuel	2009 Price	Uses
Diesel #2	$4.10/gal	Power Generation
Heating Oil #1	$4.22/gal	Heating Oil
AV Gas	$5.95/gal	Airplanes
Unleaded	$4.58/gal	Ground Transportation

2009 Nelson Lagoon Fuel Prices

Community Heating Oil Usage

The table below is the estimate of Nelson Lagoon's heating oil consumption.

Heating Fuel	2006	2007	2008	2009	Average	
Nelson Lagoon Community Usage	34,334	30,388	32,221	32,725	32,417	*gal/year*
Average annual Heating Fuel Price	$3.71	$4.04	$5.12	$4.99	$4.46	*/gal*

EXISTING POWER GENERATION

Nelson Lagoon Electrical Cooperative operates the power utility and serves 47 residential, 11 commercial, 2 Federal/State Facilities, and 9 community facilities customers. Residents pay for electricity with prepaid cards.

The new Generator Building was built in 1998 by Alaska Power Systems and is located near the community dock, tank farm and Nelson Lagoon Storage Building.

Electricity Price

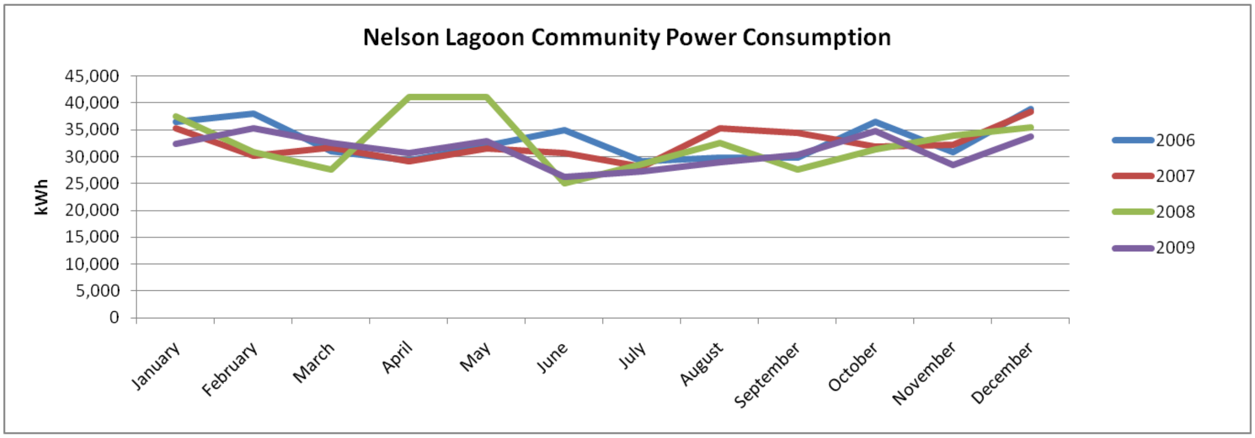
The Utility has two rates: an electric rate with the PCE credit and an electric rate without the PCE credit. Most residents and some community facilities receive PCE credits to lower the cost of electricity. The PCE program gives each eligible resident a credit to defer high electricity costs for the first 500 kWh of electricity used per month. The resident will not obtain PCE credits for any electricity used over the 500 kWh per month limit. The program also allocates a specific number of kWh in PCE credits to all eligible community facilities to share. This allocation is calculated as the population multiplied by a factor of 70 kwh per person for all eligible community facilities.

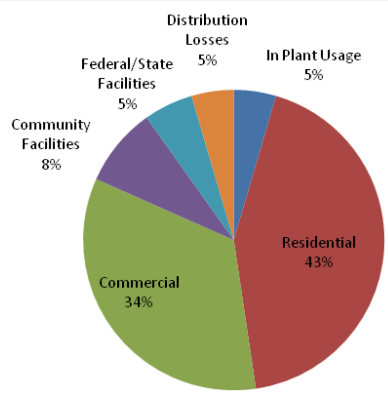
	2006	2007	2008	2009	Jan '10	Average	
Electric Rate - Non-PCE*	$0.46	$0.52	$0.52	$0.67	$0.74	$0.54	/kWh
PCE Credit*	$0.27	$0.31	$0.38	$0.39	$0.38	$0.34	/kWh
Electric Rate - with PCE*	$0.19	$0.21	$0.14	$0.28	$0.36	$0.20	/kWh
*All numbers are yearly averages except for January 2010							

Nelson Lagoon Electricity Prices

Community Power Load

The annual community power consumption (4-year average) of Nelson Lagoon is approximately 388,000 kWh per year, which includes power sold to customers and does not include power that is used to operate the power plant, or power lost in distribution. The following graphs and table are based on Nelson Lagoon's PCE reports. The kWh numbers provided by the Nelson Lagoon Electrical Coop for gross generation and in-plant usage were inconsistent and therefore not included in the table below. It is estimated that in-plant usage and distribution losses are each approximately 5% of the total power sales.





Nelson Lagoon Power Sectors

	2006	2007	2008	2009	Average	
Gross Generation	na	na	na	na	**426,803**	kWh (YCE estimate)
In Plant Usage	na	na	na	na	**19,400**	kWh (YCE estimate)
Residential	190,940	188,810	184,310	171,723	**183,946**	kWh (from Coop)
Commercial	132,853	143,849	153,754	149,888	**145,086**	kWh (from Coop)
Community Facilities	52,431	29,797	32,540	30,553	**36,330**	kWh (from Coop)
Federal/State Facilities	20,740	26,347	22,011	21,464	**22,641**	kWh (from Coop)
Distribution Losses	na	na	na	na	**19,400**	kWh (YCE estimate)
Peak Load	na	na	na	na	**75**	kW (YCE estimate)
Average Load	na	na	na	na	**49**	kW (YCE estimate)
Diesel Usage	30,826	36,622	32,523	33,036	**33,252**	*gallons/year (from Coop)*
kWh/gal Generated	na	na	na	na	**12.84**	*kWh/gal (YCE estimate)*
kWh/gal Sold	12.88	10.62	12.07	11.31	**11.72**	*kWh/gal (from Coop)*

Nelson Lagoon Power Consumption Statistics

Diesel Usage for Power Generation

Nelson Lagoon has used an average of 33,252 gallons per year of diesel #2 for electrical generation, for the last four years. The diesel used for power generation is shown for 2006 through 2009 in the table above.

Projected Power Loads

The population of Nelson Lagoon has stayed constant over the last four years. The power load has also stayed fairly constant. According to the community, Bering Pacific Sea Foods is planning on building a new fish processing facility near the dock, which would increase the power load of the community.

Generator Status

Nelson Lagoon has three diesel generators for power generation, all of which are manufactured by John Deere. The 90 kW generator is currently out of service.

Generator	Rated Capacity	Type	Status
Generator 1	125 kW	John Deere Generator	Operational
Generator 2	100 kW	John Deere Generator	Operational
Generator 3	90 kW	John Deere Generator	Currently Out of Service
Total Generating Capacity	315 kW		

Nelson Lagoon Generator Capacities and Type

Power Transmission system

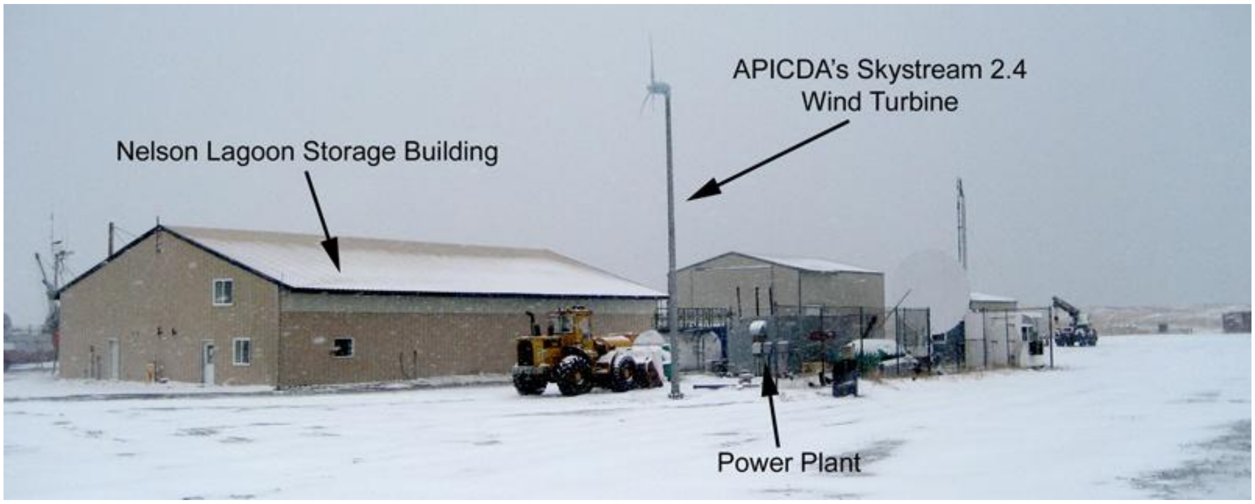
The utility's power distribution system is all underground 3-phase wire operating at 12,470 volts grounded Y.

Waste Heat Recovery

There is no waste heat recovery system installed on diesel generators at the Nelson Lagoon power plant. Waste heat is currently being dumped to outside air with two air coolers. The Nelson Lagoon Storage Building is the most proximal building to the power plant and could utilize waste heat from the generators for space heating. This potential project is discussed in the following pages.

OTHER EXISTING ENERGY SYSTEMS

In late 2008, the Aleutian Pribilof Island Community Development Association (APICDA) installed one small wind system each in the communities of False Pass, Nelson Lagoon, and Akutan. The projects were privately funded by APICDA, whose goal was to create pilot renewable energy projects to lower the cost of power in these communities. All three projects utilize a Sky Stream 1.8kW wind turbine with a 33 ft monopole tower and are equipped with data-loggers to measure wind speed, wind direction and power output, along with other data. Since installation, all wind turbines have had new inverters installed, giving them an upgraded capacity of 2.4 kW. All three of the systems are grid tied and the tower locations were chosen by the communities.



The Nelson Lagoon wind system is located next to the Nelson Lagoon Storage Building and the power plant, near the city dock.

According to Everette Anderson, the project manager from APICDA, the systems in both False Pass and Nelson Lagoon have had data-logger issues and stopped operating correctly in December, 2009. In January, 2010, a technician from H&K Energy was sent to Nelson Lagoon to troubleshoot the wind system. Since this visit the wind turbine in Nelson Lagoon has been operating properly.

APPROPRIATE RENEWABLE ENERGY TECHNOLOGIES IN NELSON LAGOON

From background research and the January, 2010 site visit by YCE it was determined that Nelson Lagoon has two feasible sources for energy and renewable energy production. Upon completing an economic evaluation for each, the ranking of energy technologies is as follows:

1. Wind Power
2. Waste Heat Recovery

Tidal Power in the lagoon off of the community dock is potentially viable, but requires more research to determine its feasibility.

It was determined that other renewable energy sources were not feasible at this time: solar, geothermal, and biomass. Adequate sun exposure is not available for solar power. No geothermal hot springs were located in proximity to Nelson Lagoon to be feasible for assessment. There is no considerable wood resource for large scale biomass heating.

Economic Evaluations

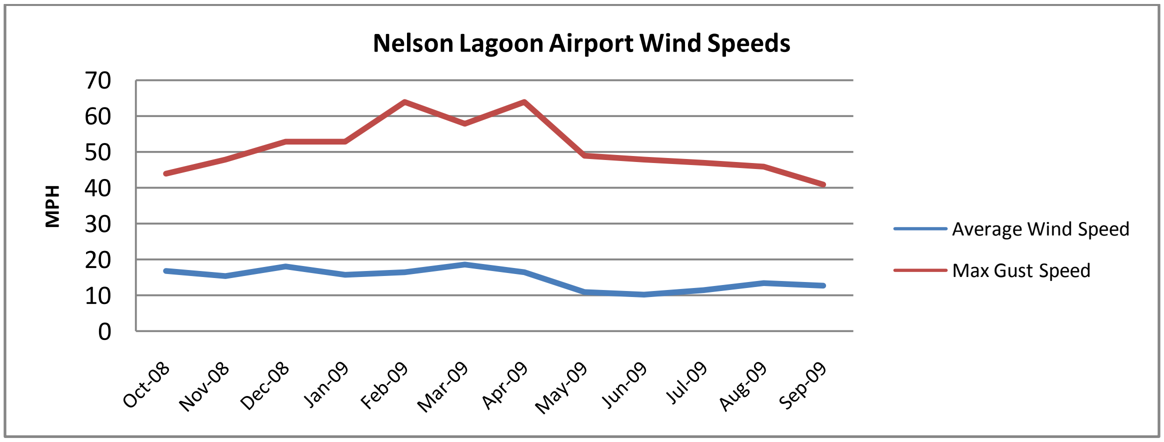
For all economic evaluations completed for Nelson Lagoon the following energy prices and associated escalation rates were used. The current price of energy as of January 2010 was used. Escalation rates were based on historic and recent trends in energy prices. A discount rate of 3% was used for the time-value of money in the net present worth evaluations.

Nelson Lagoon		
Diesel #2 Price	$4.10	/gal
Escalation	8%	
Heating Oil Price	$4.22	/gal
Escalation	8%	
Residential Electricity Rate with PCE	$0.36	/kWh
Escalation	6%	
Discount Rate	3%	

Wind Power

Producing power from the wind in Nelson Lagoon is feasible and cost effective compared to power from diesel generation. An interesting historical note is that in 1976, the Division of Energy and Power installed the first community-scale wind project in the State of Alaska in Nelson Lagoon. However, the 20 kW Grumman Windstream turbine had a design flaw and was dismantled. Today, wind technology has matured from its infancy in the 1970's. Modern heavy duty wind turbines, such as the Bergey Excel 10kw, hold promise for energy and cost savings for the community of Nelson Lagoon.

Nelson Lagoon's wind resource has not been properly characterized with an AEA Met Tower for wind power production. However, wind data from the Nelson Lagoon Airport (Station ID. PAOU) automated weather station was used to assess wind power in Nelson Lagoon. The average annual wind speed was determined to be 14.7 mph, with a max wind gust speed of 64 mph. During the operation of the 1976 wind turbine, an annual average wind speed of 14 mph was recorded. This high wind speed makes Nelson Lagoon an excellent location for wind power production. The figure below shows the average monthly wind speeds and maximum wind gust speeds collected at the airport from October 2008 to September 2009. Prevailing winds come from both the southeast and the northwest.

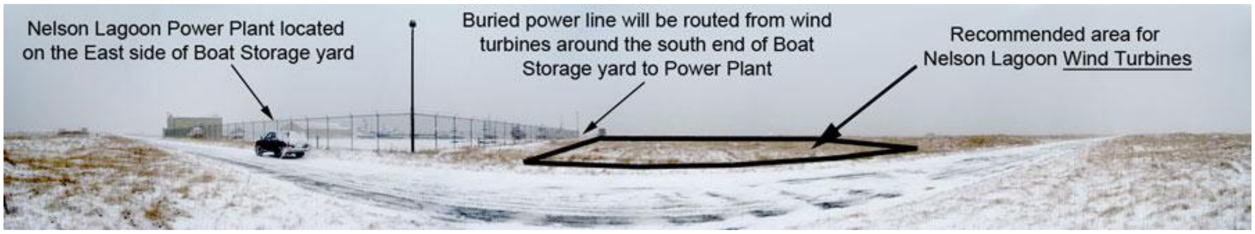


The wind economic evaluation for False Pass was based on using two Bergey Excel 10kW wind turbines. The Bergey Excel is a proven heavy duty wind turbine. Currently, Port Heiden utilizes two grid tied Bergey Excels. The 30m tilt-up lattice tower can be tilted up and down without the need of a crane, reducing O&M costs.

Nelson Lagoon Wind Power	
Wind Turbine	Bergey Excel 10kW
Rotor Diameter	22 ft (7 m)
Number of Turbines	2
Tower	30m Tilt-up Lattice Tower
Estimated Project Cost	$170,000
Annual Electricity Savings (kWh)	32,880
Annual Electricity Savings @ $0.36/kWh	$11,837
Annual Energy Penetration	8%
Annual O&M Costs	$690
20 yr Net Present Worth	$241,389
Payback (yrs)	9

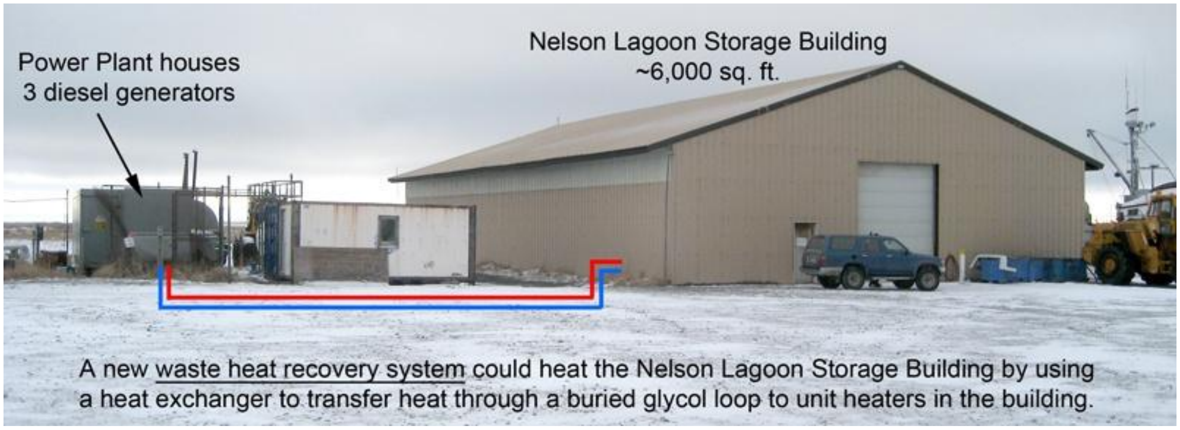
This wind system is low penetration, with an annual energy penetration of 8%. Connection of the two wind turbines to the grid will allow the existing diesel generators to operate without the need for advanced controls. In the future, additional wind turbines could be installed to increase penetration.

Land located next to the boat storage yard is the recommended area for installation of wind turbines. The location is near the power plant and there are no buildings to obstruct wind flow at the site. The land is owned by APICDA.



Waste Heat Recovery

Although not a renewable energy source, waste heat recovery holds an opportunity for the community to reduce their heating oil consumption. It was determined from the January, 2010 site visit by YCE that the closest building to the power plant is the Nelson Lagoon Storage Building, owned by APICDA. The storage building would be the most practical user of waste heat because the remainder of community buildings are located approximately one mile away from the power plant, making a waste heat loop to those community buildings expensive and potentially unusable because of heat loss. The Nelson Lagoon Storage Building is approximately 60ft from the Power Plant.



The Nelson Lagoon Storage Building is approximately 6,000 sq. ft. and is used for fishing net and gear storage and houses the harbor masters office, including bathrooms with showers and a common room. The fishing net and gear storage uses three quarters of the building and is currently unheated warehouse space, with no roof or wall insulation. The other quarter of the building is heated with a forced air furnace burning heating oil. There is a community need for the fishing net and gear storage to be heated so that nets can be worked on in the winter more effectively.

It appears that the power plant produces enough waste heat to cover the existing heating load of the storage building with extra heat available. **To confirm this, it is recommended that daily heating oil use for the building and daily diesel consumption of the power plant be monitored through the heating season to ensure that the waste heat system can provide sufficient heat to the building for each day of the heating season.**

The waste heat economic evaluation was based on two scenarios. Scenario 1 uses waste heat from the power plant to offset the existing heating oil consumption of the storage building, estimated at 1,200 gallons annually. Scenario 2 evaluates the potential savings if the entire storage building was heated, including fishing net and gear storage areas, with heating oil savings estimated at 3,000 gallons annually. An insulated and buried 60ft pipe is proposed to carry waste heat from the power plant to the storage building.

Nelson Lagoon Waste Heat Recovery	Scenario 1	Scenario 2
Building receiving heat	Nelson Lagoon Storage Building (existing heating load)	Nelson Lagoon Storage Building (if whole building is heated)
Distance from Power Plant	60 ft	60 ft
Estimated Project Cost	$66,019	$71,019
Estimated Annual Heating Oil Savings (gal)	1,200	3,000
Annual Heating Oil Savings @ $4.22/gal	$5,064	$12,660
Estimated Annual O&M Costs	$1,000	$1,000
30 yr Net Present Worth	$222,576	$695,468
Payback (yrs)	13	6

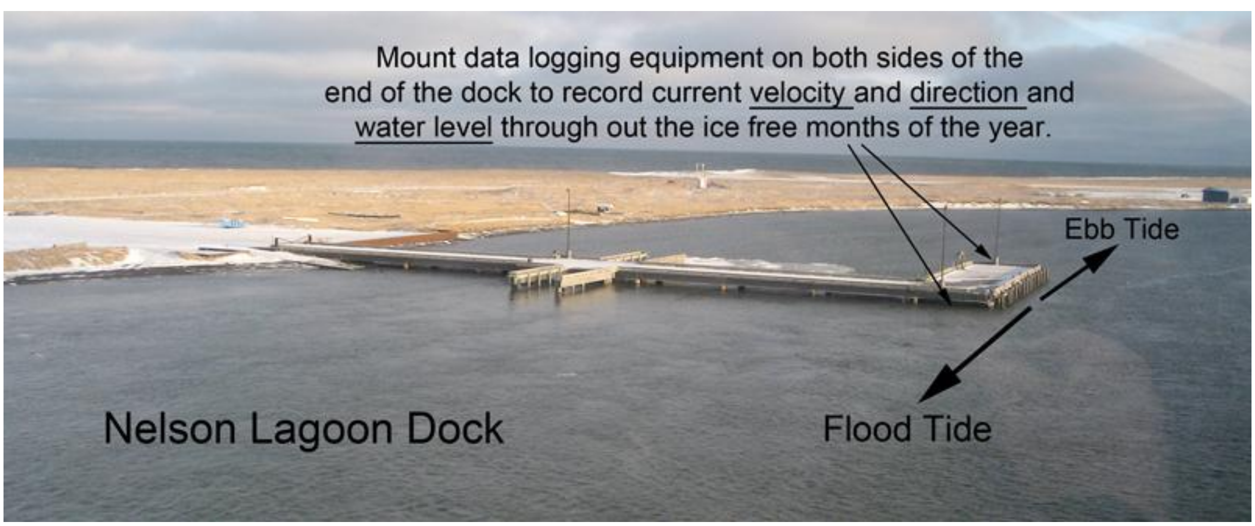
Tidal Power

There are strong tidal currents at the Nelson Lagoon dock that may be appropriate for power production. The tides flow into and out of Nelson Lagoon at an estimated speed of 7 to 8 knots in each direction. The speed of the tides out of Nelson Lagoon (ebb tides) are faster due to the added velocity of the out flowing Nelson River, due to the fact that the lagoon is situated at the outfall of the Nelson River. The dock could potentially be a good site because it is close to existing power lines and power plant. The lagoon is ice free from early June to late October. The dock is positioned close to the deeper part of the river channel and experiences higher flow velocities. Hydrokinetic units could potentially be installed to the east and west side of the dock to produce power. The system must be protected from alders and mud lumps floating down river and in from the lagoon.

However, at this time, tidal power technologies are in their infancy compared to the commercially viable technologies of wind power. Maintenance costs for tidal power generators are unknown but are expected to require significantly more maintenance than a wind turbine due to moving parts in sea water. Additionally, in Nelson Lagoon, tidal power would be seasonal and would not operate when sea ice is present. Although the Nelson Lagoon dock does have a potentially good site to use tidal power, using Nelson Lagoon as a place to field test emerging tidal technology will be very expensive due to high transportation and construction costs.

Due to these challenges, it is recommended that wind power be developed first before tidal power is explored further. Wind turbines can be maintained on land and will be simpler to maintain than a tidal generator. Furthermore, the wind resources in Nelson Lagoon are excellent and wind turbines can produce energy year-round.

The current velocities and direction and water level have not been measured in Nelson Lagoon, prohibiting a proper evaluation of the tidal power potential at the site. If at some time in the future small scale tidal power becomes more commercially tested and viable, it is recommended that data loggers be mounted on both sides of the dock to record this data for the ice free months of the year. With this data a proper evaluation of tidal power in Nelson Lagoon could be completed.



ENVIRONMENTAL PERMITTING FOR RENEWABLE ENERGY PROJECTS

All of the renewable energy options in the report may be subject to State and or permitting requirements. Each project will require specific permits based on its location and potential impacts and will be dictated by the agencies relevant to those impacts. For the purpose of this report, a comprehensive list of possible permits will be presented and in the planning phase of an actual project, specific permit applications should be identified. As a result of an actual permit application, a renewable energy project could be restricted or prohibited. However, such a conclusion will only be known upon review of the appropriate agency.

WIND POWER PERMITTING

The major permitting challenges for wind power in Cold Bay, False Pass and Nelson Lagoon include:

- Threatened Species - The Steller's Eider is currently federally listed as threatened and regularly occurs on Izembek NWR, near Cold Bay. Steller's eider also occurs in Nelson Lagoon, currently listed as critical habitat for the species.
- Telecommunications Interference - Wind turbines may interfere with communications signals by generating electromagnetic noise and/or creating physical obstructions that distort communications signals. The Cold Bay airport contains many government radar facilities.
- Aviation Considerations - All wind tower locations must be approved by the Federal Aviation Administration (FAA).

The potential impacts of wind turbines on threatened and migratory birds were discussed with Nancy Hoffman, the USFWS Izembek Refuge Manager, during the site visit. The USFWS is concerned about bird kills caused by birds flying into wind turbines, towers and guy wires. They have not adopted a formal position against installing wind turbines. In fact, the USFWS is in the process of installing vertical axis wind turbines at their complex in Cold Bay. The USFWS staff in Cold Bay has expressed the position that at potential wind turbine sites the flight patterns of birds should be assessed before turbine installation so that bird kills can be minimized.

The USFWS has not prohibited horizontal axis wind turbines in Cold Bay, however at this present time they prefer vertical axis wind turbines because they have reduced blade area and tip speed, both of which to mitigate bird collisions. Nancy Hoffman said that she would be more interested in horizontal axis wind turbines if the turbines were used in a research project to determine how horizontal axis and vertical axis wind turbines compare with respect to bird collisions. If Cold Bay USFWS staff is sufficient at the time of the project, USFWS resources could be used to conduct baseline preconstruction surveys along with creating and implementing a wind turbine monitoring plan.

During the site visit USFWS and YCE discussed the following mitigation measures:

- Coloring or striping wind turbine blades and towers to make them more visible to birds
- Keeping tower heights less than 40 ft, because birds at the site typically fly at elevations greater than 40 ft.
- If structurally and economically feasible, using monopole towers that do not use guy wires
- If guy wires are necessary, using streamers to make guy wires visible to birds
- Using vertical axis wind turbines that reduce the potential contact area and blade speed for bird collisions

Below is a comprehensive list of agencies and possible permits required for wind power projects.

Agency	**Permits/General Concerns**
Federal Aviation Administration (FAA)	Notice of Proposed Construction, Hazard Determination, Telecommunication impacts
National Telecommunications Information Administration, and National Weather Service	Telecommunications impacts
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Fish and Wildlife Service-Fisheries and Ecological Services	Migratory Birds
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration-Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding

WASTE HEAT RECOVERY PERMITTING

Waste heat recovery projects typically have limited potential environmental impacts due to urbanized nature of the project. Due to this fact, there are no major environmental challenges, as yet determined, that would restrict a waste heat recovery project. Below is a comprehensive list of agencies and possible permits required for a waste heat recovery project.

Agency	Permits/General Concerns
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration-Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding

HYDRO POWER PERMITTING

Cold Bay is the only community with anticipated environmental permitting challenges for the development of hydro power projects. Potential hurdles for the four hydro projects identified in this report are land ownership and environmental issues. Site 1 (Frosty Creek) is located in the Izembek National Wildlife Refuge. Site 2 (North Fork of Russell Creek), Site 2 (South Fork of Russell Creek), and Site 4 (Thin Point Creek) are located in the Alaska Peninsula National Wildlife Refuge. Furthermore, there is salmon migration in all streams according to the USACE report.

False Pass is anticipated to have less environmental permitting challenges due to the fact that both Man's Creek and Waterfall Creek are non-anadromous according locals and are located on land owned by the Isanotski Corporation. Both creeks are not listed in the Alaska Department of Fish and Game's Anadromous Waters Catalog.

Below is a comprehensive list of agencies and possible permits required for hydro power projects.

Agency	Permits/General Concerns
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Fish and Wildlife Service-Fisheries and Ecological Services	Migratory Birds, Fisheries
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Fish and Game-Habitat Division	Fish Habitat Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration-Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
National Oceanic and Atmospheric Administration-Habitat Conservation	Anadromous Fisheries
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding

TIDAL POWER PERMITTING

Currently, tidal power is in its infancy compared to the technologies of wind power, hydro power, and waste heat recovery. As a result, anticipated environmental permitting challenges are not well known. Below is a comprehensive list of agencies and possible permits required for tidal power projects.

Agency	Permits/General Concerns
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Fish and Wildlife Service-Fisheries and Ecological Services	Migratory Birds, Fisheries
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Fish and Game-Habitat Division	Fish Habitat Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration- Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
National Oceanic and Atmospheric Administration-Habitat Conservation	Anadromous Fisheries
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding

False Pass Wind Resource Report

False Pass meteorological tower, view to the east, D. Vaught photo

January 27, 2012

Douglas Vaught, P.E.
V3 Energy, LLC
Eagle River, Alaska

Summary

The wind resource as the False Pass met tower site is generally good with measured wind power class 4 by measurement of wind power density (Class 3 if considering only mean annual wind speed). Given the moderately cool temperatures of False Pass test site, air density is moderately higher than standard conditions. By other measures important for wind power analysis, the site has a low 50-year return period extreme wind probability but high turbulence; the latter apparently due to the high mountains that border Isantoski Strait and that are very near the met tower to the north, west and south. Turbulence intensity calculated from the met tower data indicates much higher than desirable turbulence conditions. This would require special care with turbine selection and operations.

It is not immediately clear if an alternate wind site that has good wind exposure and less turbulence exists in the near proximity of the village of False Pass. Siting restrictions include the obvious constraints of geography – mountains and Isantoski Strait – and the location and orientation of the False Pass airstrip. Computation fluid dynamics (CFD) modeling may lend insight into wind flow patterns at False Pass and would be a useful tool to investigate other wind turbine siting options.

Met tower data synopsis

Data dates	May 7, 2005 to August 19, 2005 and November 30, 2005 to September 4, 2007 (24 months); status: operational
Wind power class	Class 3 to 4 (fair to good)
Wind power density mean, 30 m	338 W/m^2
Wind speed mean, 30 m	6.11 m/s
Max. 10-min wind speed average	26.5 m/s
Maximum 2-sec. wind gust	39.0 m/s (January, 2007)
Weibull distribution parameters	k = 1.62, c = 6.76 m/s
Wind shear power law exponent	0.291 (high)
Roughness class	3.80 (suburban)
IEC 61400-1, 3rd ed. classification	Class III-S
Turbulence intensity, mean	0.173 (at 15 m/s)
Calm wind frequency (at 30 m)	35% (winds < 4 m/s)

Test Site Location

Wind measurement instrumentation (anemometers, wind vane, temperature sensor) was installed on a 30 meter tall, six-inch diameter NRG Systems Inc. tubular meteorological (met) test tower in an open area near the coast, approximately 2.4 km (1.5 miles) north of the village of False Pass. The tower (still standing and operational again in October 2011) is located on a grassy outwash plain immediately north of a moderately-sized stream that drains from the extensive mountain range immediately west of the site. This location had been the village's preferred site for wind turbines, but more recent thoughts are to locate wind turbines closer to the village.

Met tower installation was accomplished on May 6 and 7, 2005 by Doug Vaught of V3 Energy, LLC, Connie Fredenberg of Aleutian/Pribilof Islands Association, Mia Devine of Alaska Energy Authority, and George Jackson, power plant operator of the village of False Pass.

Site information

Site number	2399
Latitude/longitude	N 54° 52.443' W 163° 24.646', WGS 84
Site elevation	17 meters (54 ft)
Datalogger type	NRG Symphonie, 10 minute time step
Tower type	NRG 6-inch diameter tubular, 30 meter height

Tower installation photographs (May, 2005; D. Vaught photos)

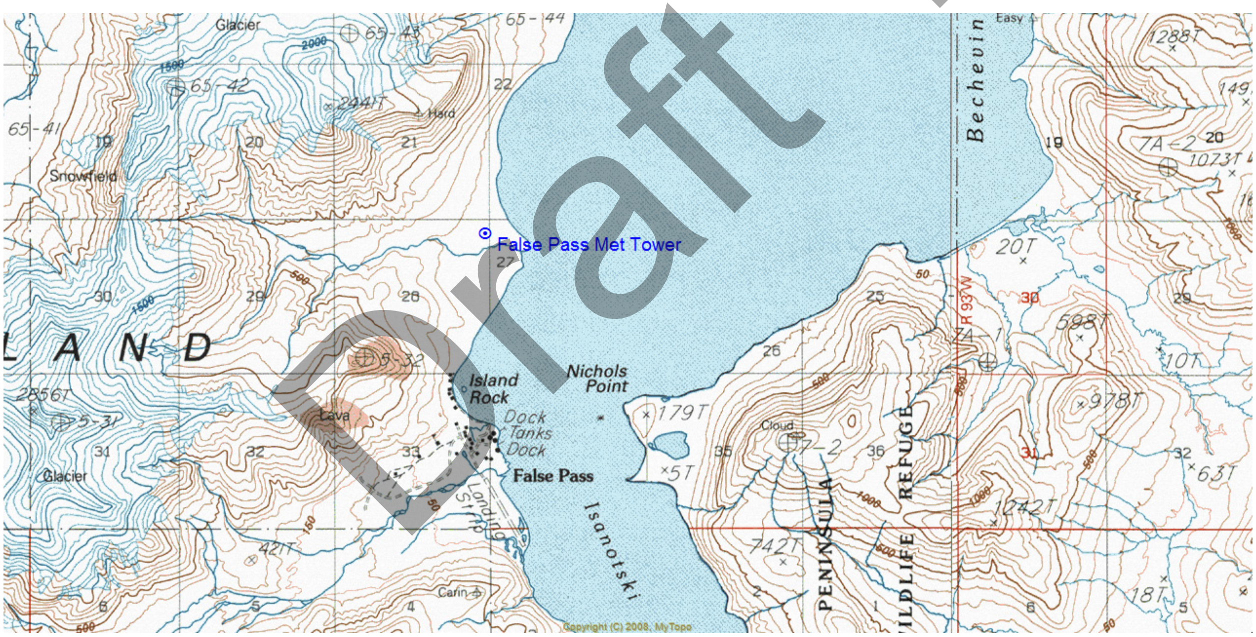
C. Fredenberg and M. Devine heading to the site

C. Fredenberg and G. Jackson assembling the tower

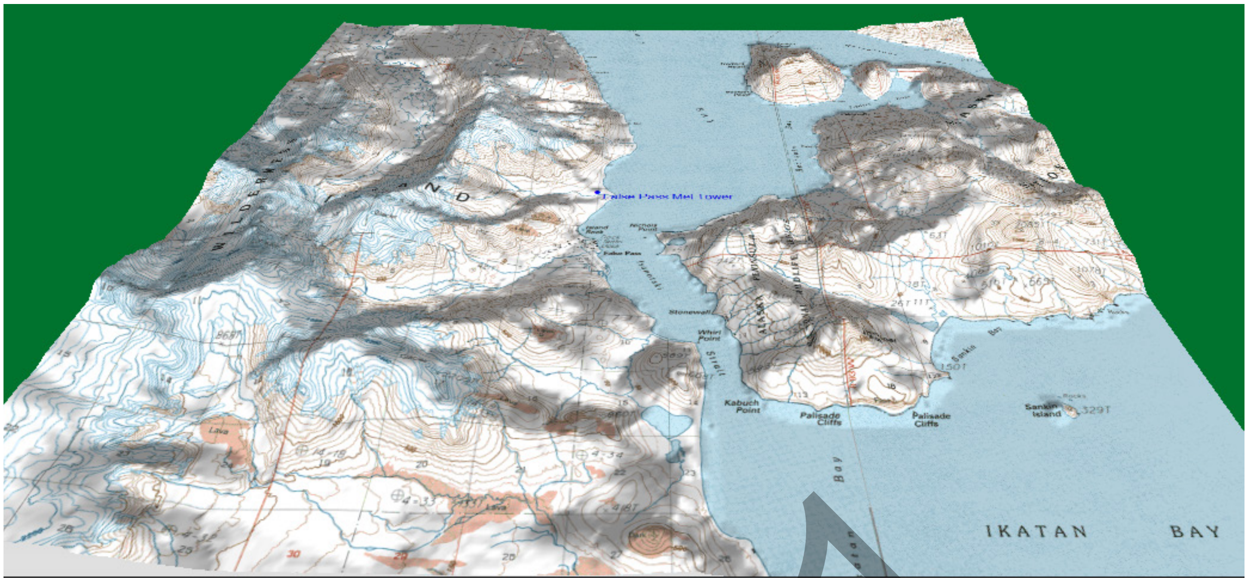
Lifting the met tower

M. Devine, G. Jackson, C. Fredenber wrapping up

Topographic maps, 2D views



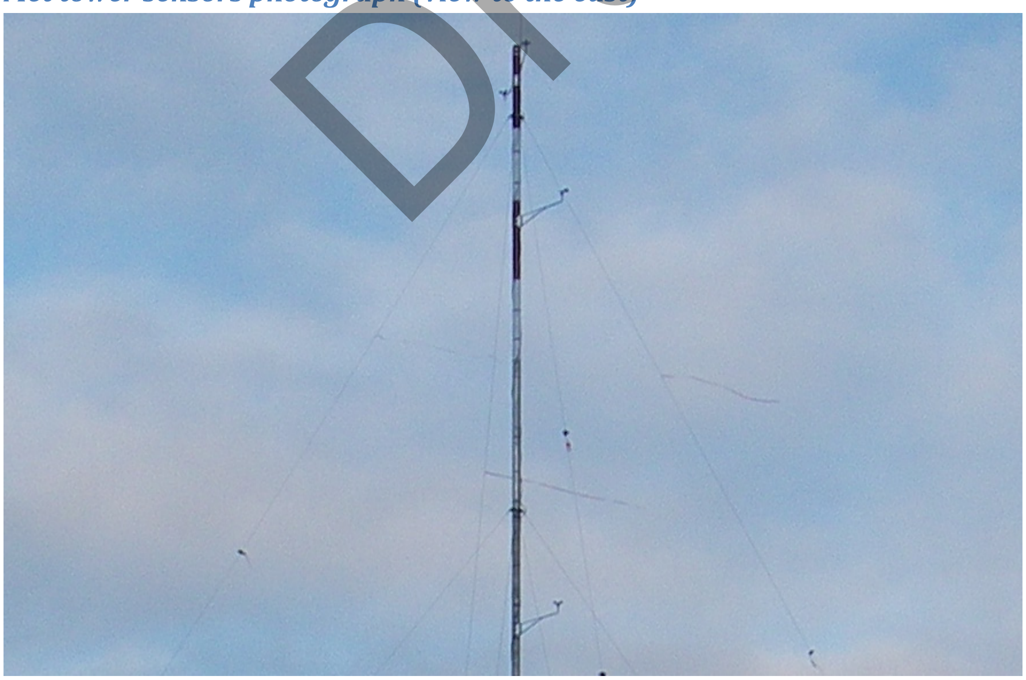
Topographic map, 3D view



Tower sensor information

Channel	Sensor type	Height	Multiplier	Offset	Orientation
1	NRG #40 anemometer	30 m (A)	0.765	0.35	~275° T
2	NRG #40 anemometer	30 m (B)	0.765	0.35	095° T
3	NRG #40 anemometer	20 m	0.765	0.35	240° T
7	NRG #200P wind vane	27 m	0.351	050	230° T
9	NRG #110S Temp C	3 m	0.138	-86.3	N

Met tower sensors photograph (view to the east)



Data Quality Control

Data quality is excellent with data recovery of all three anemometers at nearly 100 percent for the time periods of actual data recovery (8/19/05 to 11/30/05 excluded) and 87.5 percent with that time period included. On 8/19/05 a bear visiting the site ripped out the sensor wiring inputs to the datalogger; this damage was repaired on 11/30/05. Although False Pass is located in a cold climate where icing conditions might be expected, very few icing events were detected in the data. Note that the temperature sensor was not functional from initial tower installation on 5/7/05 until 11/30/05, the date that the bear damage to sensor wiring was repaired.

Data recovery summary table

Label	Units	Height	Possible Records	Valid Records	Recovery Rate (%)
Speed 30 m A	m/s	30 m	122,386	107,093	87.5
Speed 30 m B	m/s	30 m	122,386	107,087	87.5
Speed 20 m	m/s	20 m	122,386	107,090	87.5
Direction 27 m	°	27 m	122,386	107,066	87.5
Temperature	°C	3 m	122,386	92,506	75.6

Anemometer and wind vane data recovery

Year	Month	Possible Records	Valid Records	30 m A Recovery Rate (%)	30 m B Recovery Rate (%)	20 m Recovery Rate (%)	Vane Recovery Rate (%)	Temp Recovery Rate (%)
2005	May	3,514	3,482	99.1	99.1	99.1	99.1	0.0
2005	Jun	4,320	4,320	100.0	100.0	100.0	100.0	0.0
2005	Jul	4,464	4,464	100.0	100.0	100.0	100.0	0.0
2005	Aug	4,464	2,740	61.4	61.4	61.4	61.4	0.0
2005	Sep	4,320	0	0.0	0.0	0.0	0.0	0.0
2005	Oct	4,464	0	0.0	0.0	0.0	0.0	0.0
2005	Nov	4,320	46	1.1	1.1	1.1	1.1	1.1
2005	Dec	4,464	4,335	97.1	96.9	97.8	91.6	100.0
2006	Jan	4,464	4,460	99.9	100.0	100.0	100.0	100.0
2006	Feb	4,032	4,032	100.0	100.0	99.1	100.0	100.0
2006	Mar	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2006	Apr	4,320	4,320	100.0	100.0	100.0	100.0	100.0
2006	May	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2006	Jun	4,320	4,320	100.0	100.0	100.0	100.0	100.0
2006	Jul	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2006	Aug	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2006	Sep	4,320	4,260	98.6	98.6	98.6	98.6	98.6
2006	Oct	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2006	Nov	4,320	4,320	100.0	100.0	100.0	100.0	100.0
2006	Dec	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2007	Jan	4,464	4,464	100.0	100.0	100.0	100.0	100.0

2007	Feb	4,032	3,833	95.1	95.1	95.1	100.0	100.0
2007	Mar	4,464	4,377	98.1	98.1	98.1	98.4	100.0
2007	Apr	4,320	4,320	100.0	100.0	100.0	100.0	100.0
2007	May	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2007	Jun	4,320	4,320	100.0	100.0	100.0	100.0	100.0
2007	Jul	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2007	Aug	4,464	4,464	100.0	100.0	100.0	100.0	100.0
2007	Sep	504	504	100.0	100.0	100.0	100.0	100.0
All data		122,386	107,093	87.5	87.5	87.5	87.5	75.6

Wind Speed

Anemometer data obtained from the met tower, from the perspectives of both mean wind speed and mean wind power density, indicate a very good wind resource. Mean wind speeds are greater at higher elevations on the met tower, as one would expect. Note that relatively cold temperatures contributed to higher wind power density than otherwise might have been expected for the mean wind speeds

Anemometer data summary

Variable	Speed 30 m A	Speed 30 m B	Speed 20 m
Measurement height (m)	30	30	20
Mean wind speed (m/s)	6.01	6.06	5.34
MMM wind speed (m/s)	6.06	6.11	5.38
Max 10-min avg wind speed (m/s)	26.2	26.5	22.4
Max gust wind speed (m/s)	39.0	38.6	37.1
Weibull k	1.59	1.62	1.55
Weibull c (m/s)	6.54	6.76	5.93
Mean power density (W/m²)	329	333	237
MMM power density (W/m²)	333	338	239
Mean energy content (kWh/m²/yr)	2,882	2,920	2,073
MMM energy content (kWh/m²/yr)	2,917	2,961	2,094
Energy pattern factor	2.40	2.38	2.46
Frequency of calms (%)	34.5	34.2	39.3
1-hr autocorrelation coefficient	0.863	0.864	0.859
Diurnal pattern strength	0.105	0.104	0.112
Hour of peak wind speed	16	16	16

MMM = mean of monthly means

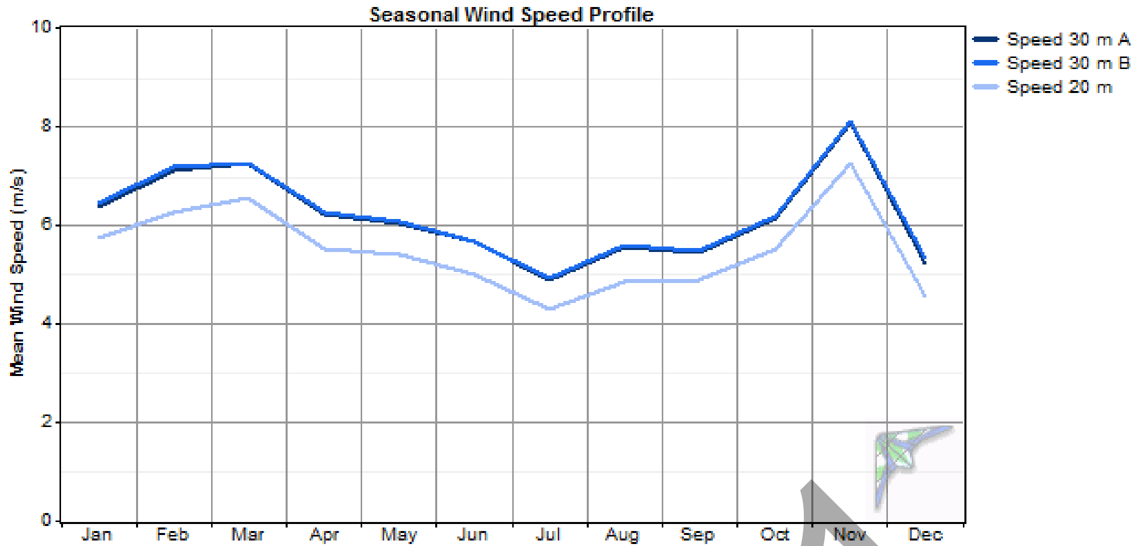
Time Series

Time series calculations indicate high mean wind speeds during the winter months with more moderate mean wind speeds during summer months. This correlates well with a typical village load profile of high electric and heat demand during the winter months and lower demand during summer months. The annual and monthly daily wind profiles indicate highest wind during the mid-afternoon hours.

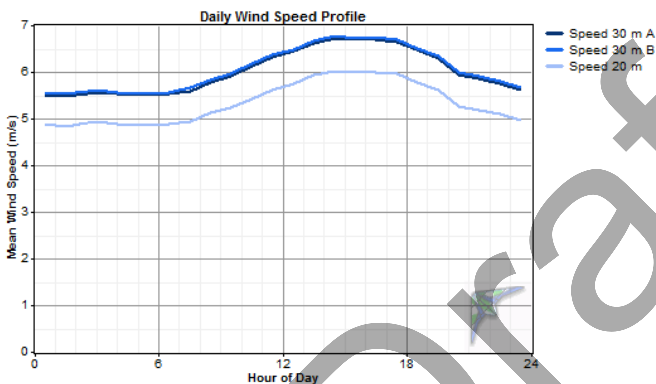
30 m B anemometer data summary

Year	Month	Mean (m/s)	Max (m/s)	Gust (m/s)	Std. Dev. (m/s)	Weibull k (-)	Weibull c (m/s)
2005	May	6.32	19.5	27.1	3.70	1.74	7.08
2005	Jun	5.89	16.9	23.3	3.47	1.66	6.55
2005	Jul	4.44	12.9	18.3	2.61	1.71	4.96
2005	Aug	7.02	17.6	23.3	4.08	1.62	7.76
2005	Sep						
2005	Oct						
2005	Nov						
2005	Dec	5.54	19.7	29.8	3.71	1.45	6.09
2006	Jan	5.73	16.5	27.9	3.13	1.81	6.40
2006	Feb	7.28	20.1	30.9	4.49	1.61	8.09
2006	Mar	6.37	22.2	32.4	4.09	1.51	7.03
2006	Apr	6.84	22.7	31.8	3.98	1.72	7.64
2006	May	6.49	23.1	29.8	4.61	1.35	7.05
2006	Jun	5.77	17.5	24.0	3.75	1.46	6.34
2006	Jul	5.80	17.9	23.7	3.26	1.75	6.47
2006	Aug	4.86	17.1	27.5	3.63	1.26	5.22
2006	Sep	5.34	24.2	35.9	3.88	1.33	5.80
2006	Oct	6.18	21.6	36.3	3.89	1.56	6.85
2006	Nov	8.16	20.6	36.3	3.89	2.17	9.18
2006	Dec	5.11	19.1	24.8	3.03	1.67	5.70
2007	Jan	7.17	26.5	38.6	4.60	1.55	7.96
2007	Feb	7.08	18.9	27.1	3.89	1.80	7.90
2007	Mar	8.17	19.3	30.2	3.92	2.17	9.18
2007	Apr	5.67	21.5	36.3	3.54	1.55	6.26
2007	May	5.50	17.5	24.0	3.89	1.33	5.95
2007	Jun	5.37	16.8	24.0	3.27	1.65	5.99
2007	Jul	4.58	13.8	21.8	3.12	1.40	5.00
2007	Aug	5.45	17.9	24.4	3.45	1.52	6.01
2007	Sep	6.63	16.5	27.5	3.82	1.69	7.37
All data		6.06	26.5	38.6	3.86	1.53	6.70
MMM		6.11			3.72	1.62	6.76

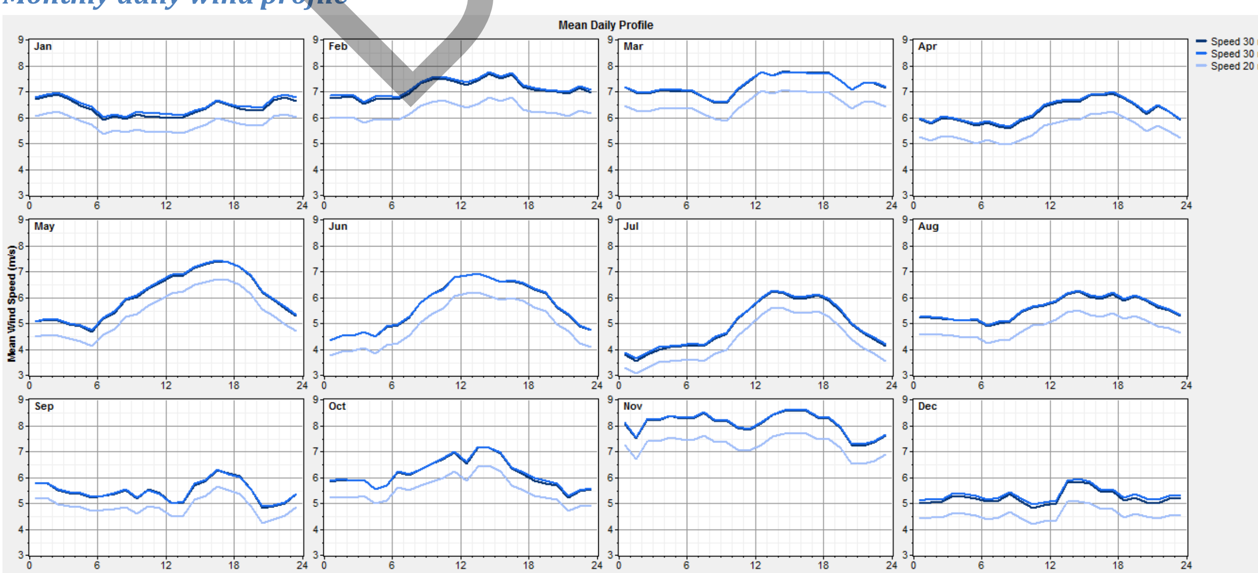
Seasonal time series graph



Annual daily wind profile



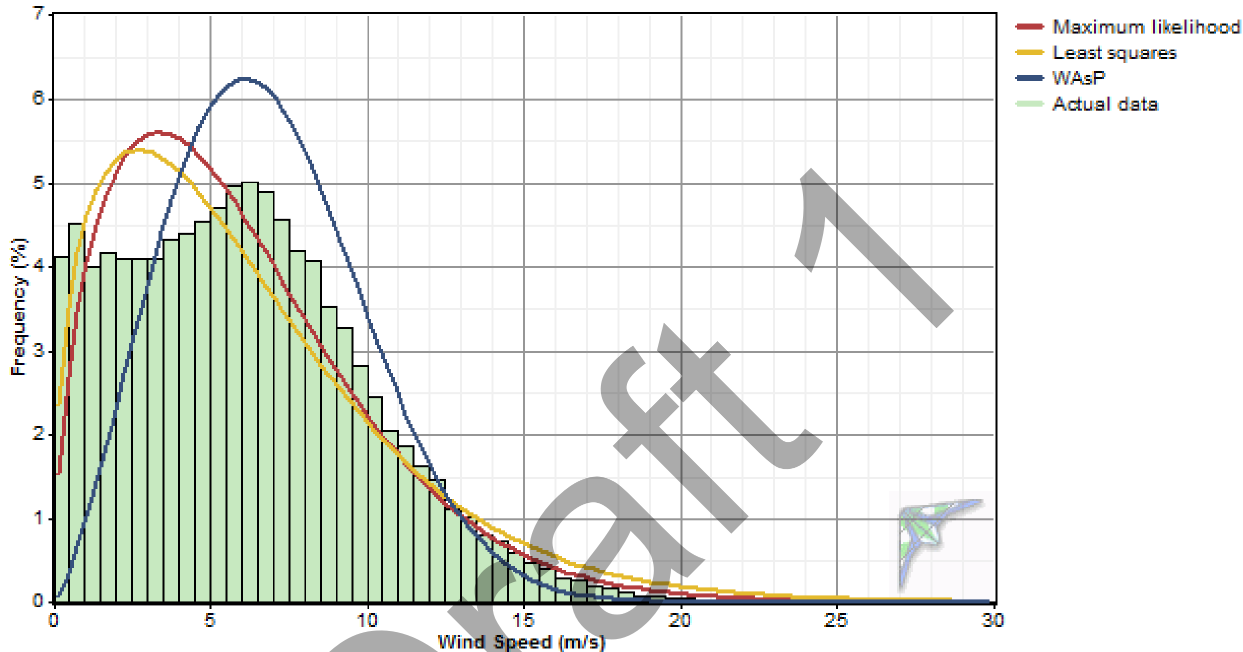
Monthly daily wind profile



Probability Distribution Function

The probability distribution function (PDF), or histogram, of the False Pass met tower site wind speed indicates a shape curve somewhat dominated by lower wind speeds, as opposed to a “normal” shape curve, known as the Rayleigh distribution (Weibull k = 2.0), which is defined as the standard wind distribution for wind power analysis. As seen in the PDF of the 30 m B anemometer, the most frequently occurring wind speeds are between 5 and 7 m/s with essentially no wind events exceeding 25 m/s (the cutout speed of most wind turbines; see following wind speed statistical table).

PDF of 30 m B anemometer



Frequency distribution table

Algorithm	Weibull k	Weibull c (m/s)	Mean (m/s)	Proportion Above Mean	Power Density (W/m2)	R Squared
Maximum likelihood	1.53	6.70	6.03	0.427	354	0.896
Least squares	1.38	6.81	6.22	0.414	455	0.903
WAsP	2.35	7.72	6.84	0.471	324	0.751
Actual data	(107,087 time steps)		6.06	0.471	324	

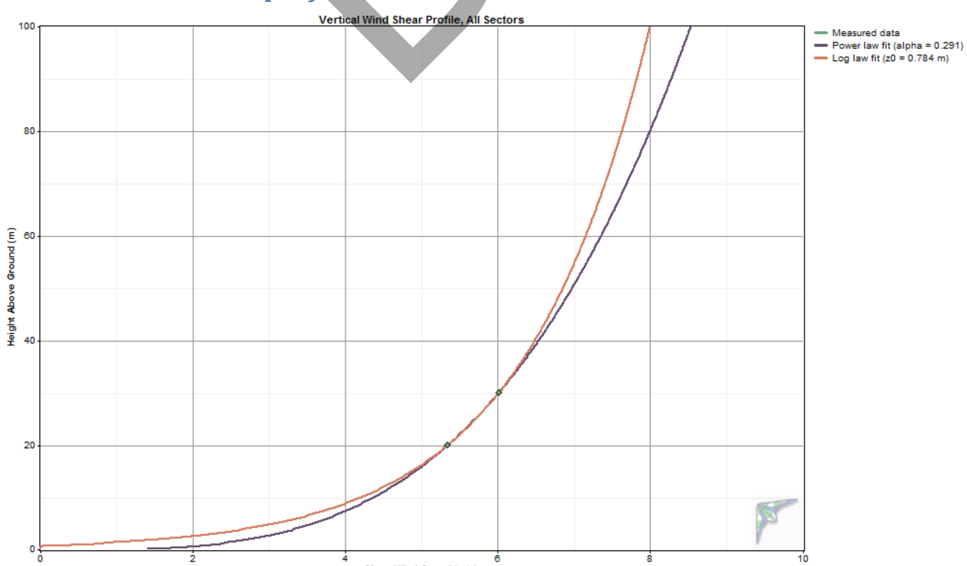
Occurrence by wind speed bin, 30 m B anemometer

Bin Endpoints (m/s)		Occurrences		Bin Endpoints (m/s)		Occurrences	
Lower	Upper	No.	Percent	Lower	Upper	No.	Percent
0	1	9,225	8.80%	15	16	923	0.88%
1	2	8,708	8.31%	16	17	588	0.56%
2	3	8,737	8.34%	17	18	365	0.35%
3	4	8,988	8.58%	18	19	195	0.19%
4	5	9,568	9.13%	19	20	104	0.10%
5	6	10,356	9.88%	20	21	77	0.07%
6	7	10,582	10.10%	21	22	44	0.04%
7	8	9,356	8.93%	22	23	8	0.01%
8	9	8,118	7.75%	23	24	6	0.01%
9	10	6,530	6.23%	24	25	4	0.00%
10	11	4,798	4.58%	25	26	0	0.00%
11	12	3,715	3.55%	26	27	1	0.00%
12	13	2,751	2.63%	27	28	0	0.00%
13	14	1,930	1.84%	28	29	0	0.00%
14	15	1,410	1.35%	29	30	0	0.00%

Wind Shear and Roughness

A wind shear power law exponent (α) of 0.291 indicates high wind shear at the site. Related to wind shear, a calculated surface roughness of 0.878 meters (indicating the height above ground level where wind velocity would be zero) indicates very rough terrain (roughness description: suburban). This is somewhat curious as the terrain surrounding the met tower is mostly comprised of low-lying grass and light brush and presumably snow cover during the winter months. The high wind shear measured at the site indicates that it would be advantageous to erect wind turbines at higher hub heights if possible.

Vertical wind shear profile



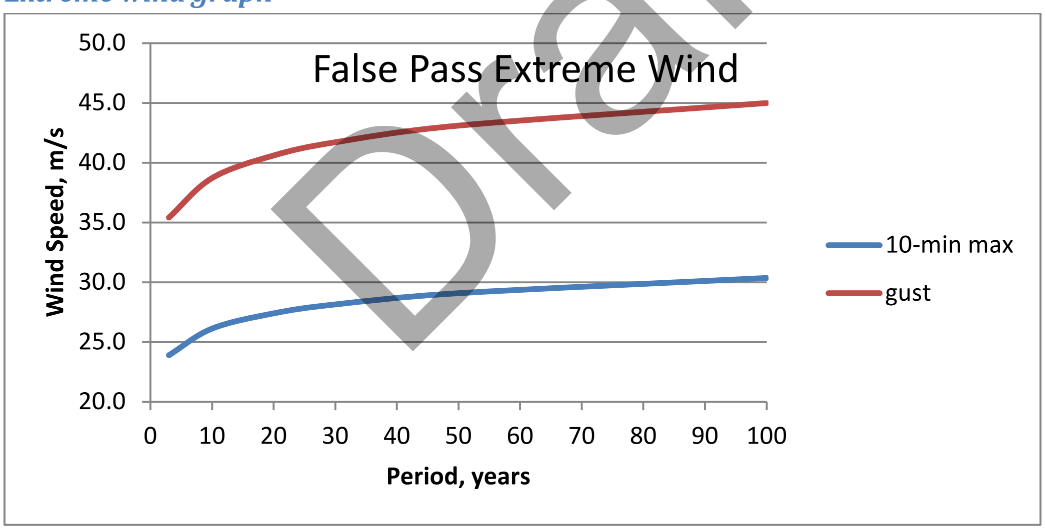
Extreme Winds

A modified Gumbel distribution analysis, based on monthly maximum winds vice annual maximum winds, was used to predict extreme winds at the False Pass met tower site. Note below that the extreme wind analysis shows relatively low extreme winds. Industry standard reference of extreme wind is the 50 year probable (50 year return period) ten-minute average wind speed, referred to as V_{ref}. For False Pass this calculates to 29.1 m/s (at 30 meters), which meets International Electrotechnical Commission (IEC) 61400-1, 3rd edition Class III criteria. All wind turbines are designed for IEC Class III extreme winds.

Extreme wind probability table, 30 m A data

Period (years)	V_{ref} (m/s)	Gust (m/s)	IEC 61400-1, 3rd ed. Class	V_{ref}, m/s
3	23.9	35.4	I	50.0
10	26.1	38.7	II	42.5
20	27.4	40.6	III	37.5
30	28.1	41.7	S	designer-specified
50	29.1	43.1		
100	30.4	45.0		
average gust factor:	1.48			

Extreme wind graph



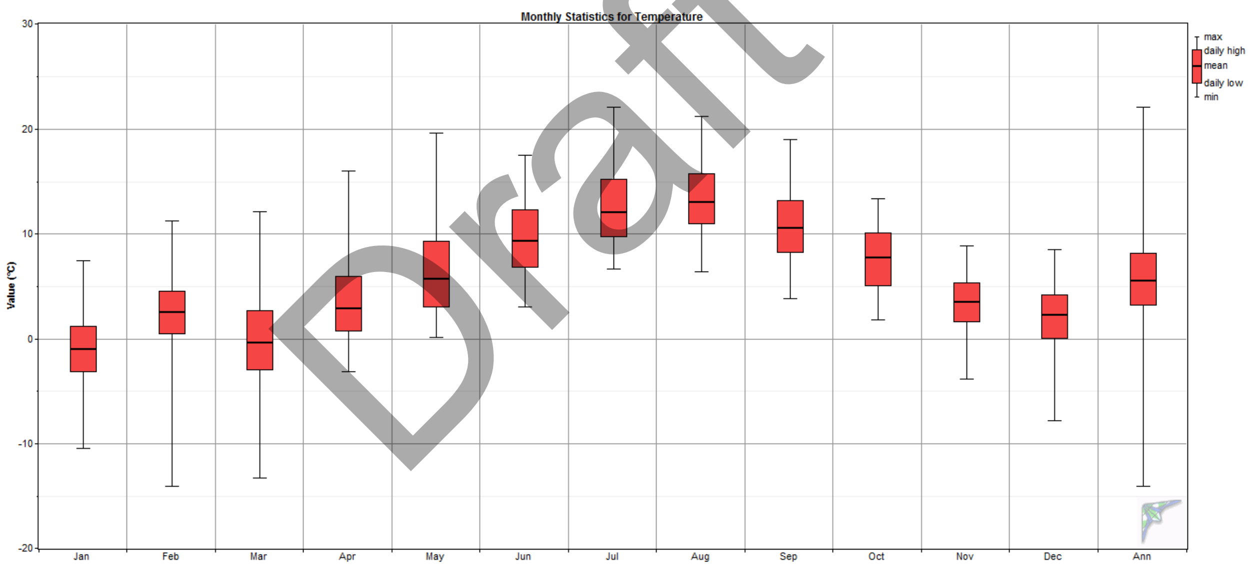
Temperature, Density, and Relative Humidity

False Pass experiences cool summers and moderately cold winters with resulting higher than standard air density. Calculated mean-of-monthly-mean air density during the met tower test period exceeds the 1.223 kg/m^3 standard air density for a 17 meter elevation by approximately three percent. This is advantageous in wind power operations as wind turbines produce more power at low temperatures (high air density) than at standard temperature and density.

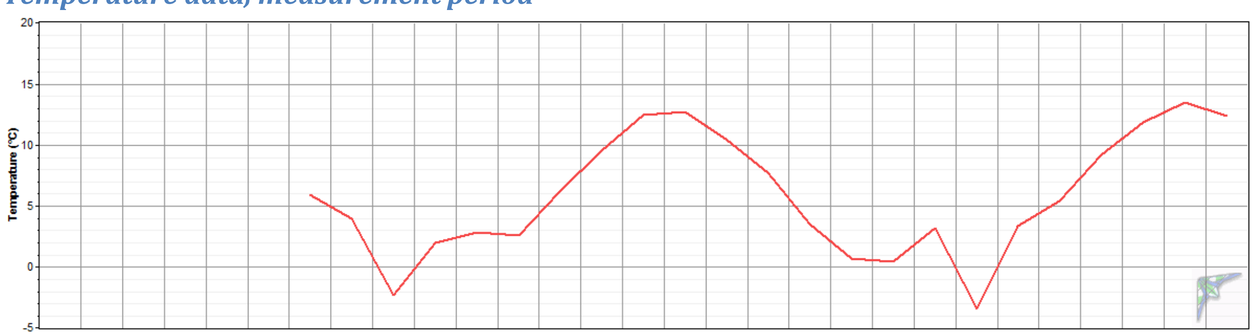
Temperature and density table

Month	Temperature				Air Density		
	Mean (°C)	Mean (°F)	Min (°C)	Max (°C)	Mean (kg/m³)	Min (kg/m³)	Max (kg/m³)
Jan	-0.9	30.3	-10.5	7.4	1.294	1.255	1.341
Feb	2.6	36.6	-14.1	11.2	1.278	1.239	1.359
Mar	-0.3	31.4	-13.3	12.1	1.291	1.235	1.355
Apr	2.9	37.3	-3.2	16.0	1.276	1.218	1.305
May	5.8	42.4	0.1	19.6	1.251	1.203	1.289
Jun	9.4	48.8	3.0	17.5	1.239	1.212	1.275
Jul	12.1	53.9	6.6	22.1	1.231	1.193	1.259
Aug	13.1	55.5	6.4	21.2	1.228	1.196	1.260
Sep	10.6	51.1	3.8	19.0	1.232	1.205	1.272
Oct	7.7	45.9	1.8	13.3	1.238	1.223	1.281
Nov	3.5	38.3	-3.9	8.8	1.248	1.223	1.308
Dec	2.3	36.1	-7.8	8.5	1.279	1.250	1.327
Annual	5.7	42.3	-14.1	22.1	1.257	1.193	1.359

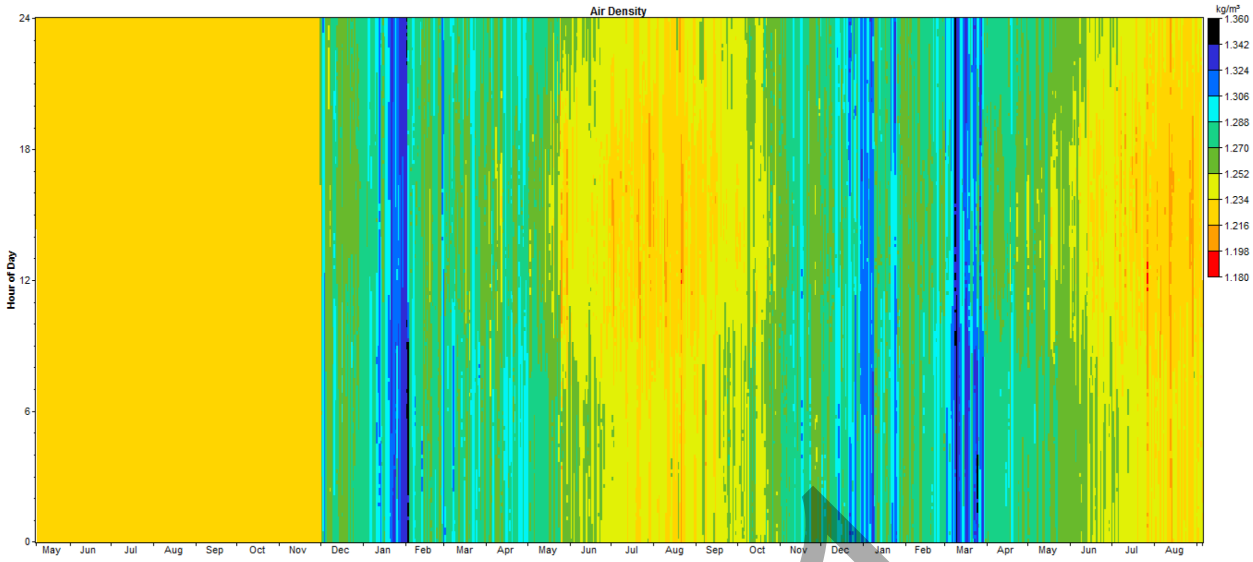
Annual temperature boxplot



Temperature data, measurement period



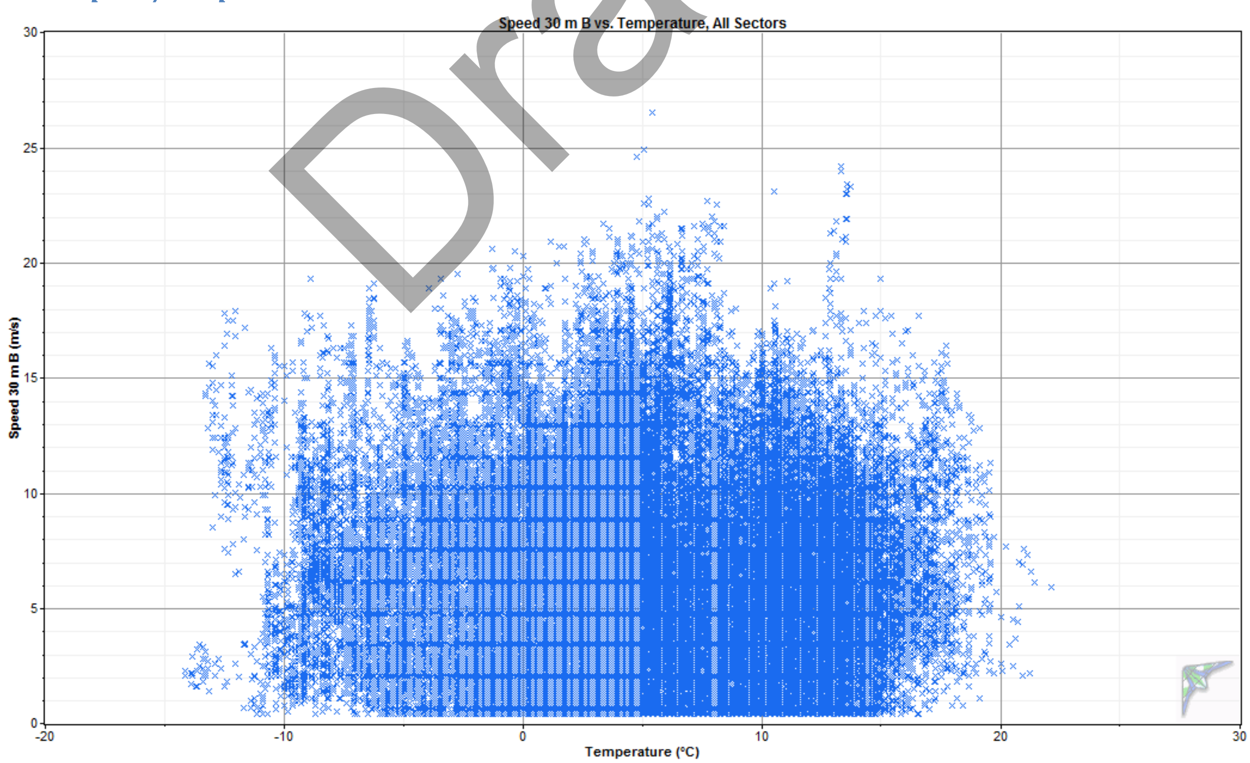
Air density DMap



Wind Speed Scatterplot

The wind speed versus temperature scatterplot for the False Pass wind site indicates a relatively even percentage of wind events across all temperatures. The minimum temperature is relatively warm by Alaska standards at -14°C (7° F). It is not likely that arctic-capable wind turbines with special low temperatures lubricants and heaters would be necessary for False Pass.

Wind speed/temperature

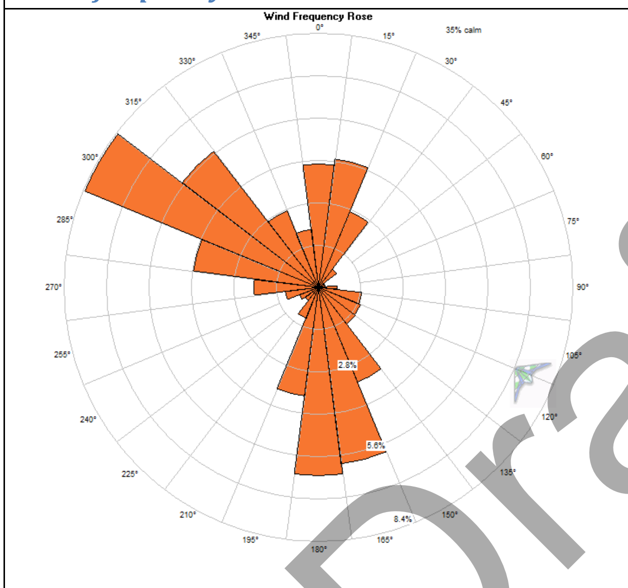


Wind Direction

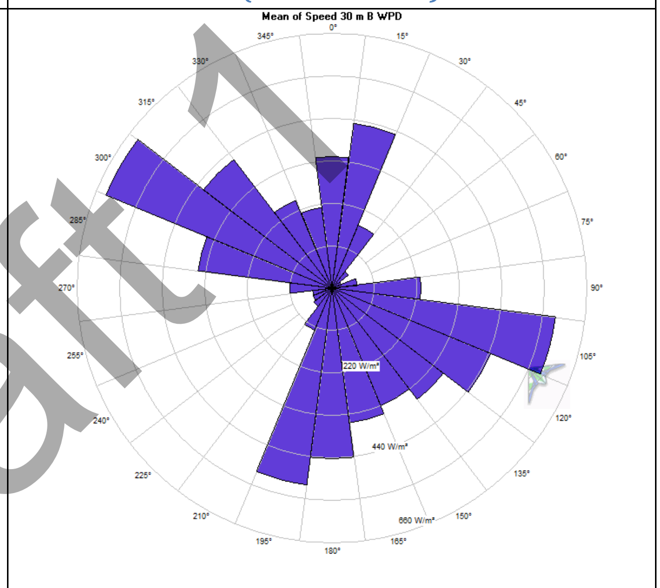
Wind frequency rose data indicates that winds at False Pass are primarily northwest and south with a lesser component of north winds. The mean value rose indicates that the primary and secondary frequency winds occur in strength proportional to their occurrence, but interestingly, when infrequent east-southeast winds occur, they are very strong. Combining these roses into a wind energy rose, one can see that the power-producing winds at the False Pass met tower site are predominately northwest and south, with a lesser degree of northerly winds. Calm frequency (percent of time that winds at the 30 meter level are less than 4 m/s) was a moderately high 35 percent during the test period.

Observing winds on a monthly basis indicates that northwesterly winds mostly occur during the spring and summer months while northerly and southerly winds mostly occur during the winter months.

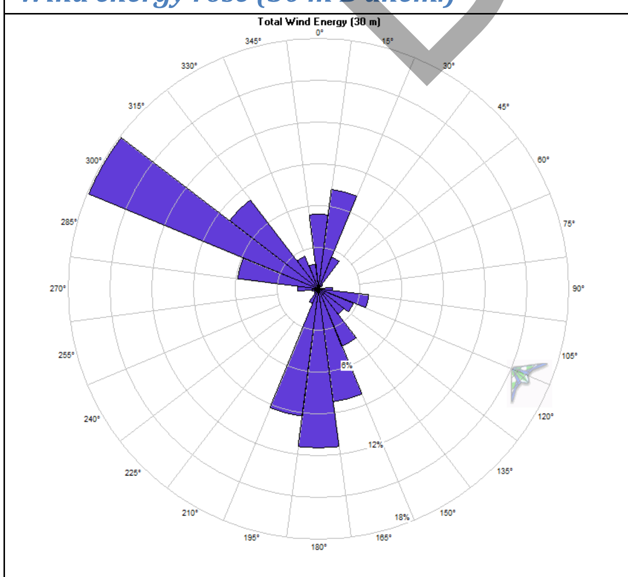
Wind frequency rose



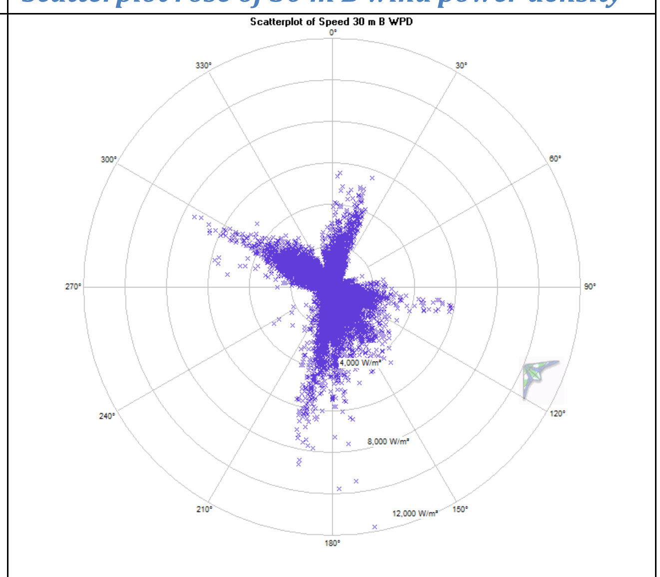
Mean value rose (30 m B anem.)



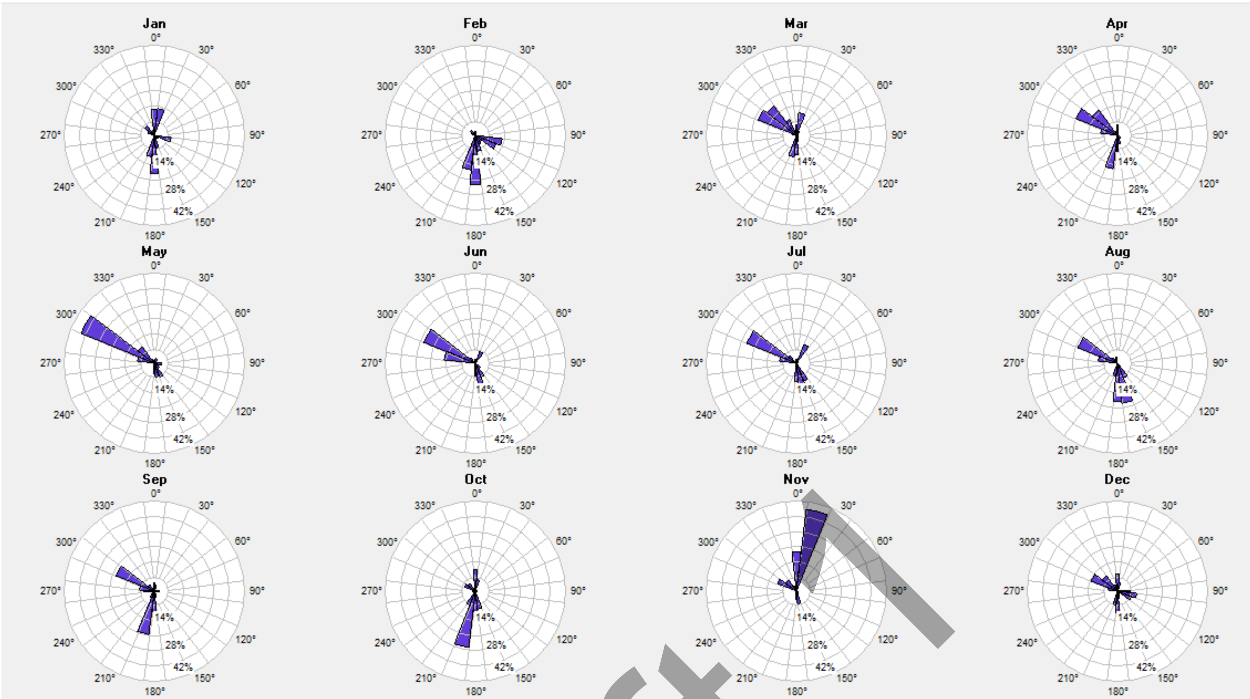
Wind energy rose (30 m B anem.)



Scatterplot rose of 30 m B wind power density



Wind density roses by month (common scale)



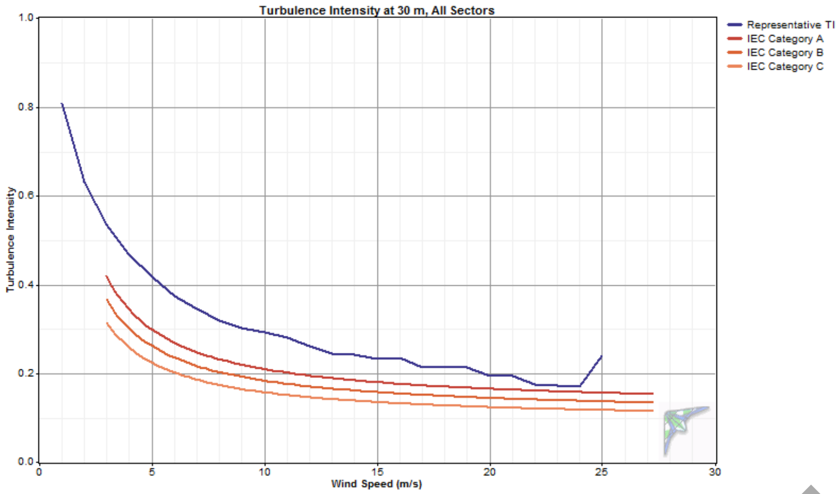
Turbulence

Turbulence intensity (TI) at the False Pass met tower site indicates unexpectedly turbulent conditions that are well above IEC 61400-1, 3rd edition (2005) turbulence category A criteria, which is the most turbulent defined category. This can be seen in the TI graph of anemometer 30 m B at all directions sectors, and also in TI graphs of isolating the north, south, and northwest direction sectors that represent the power-producing winds at the site.

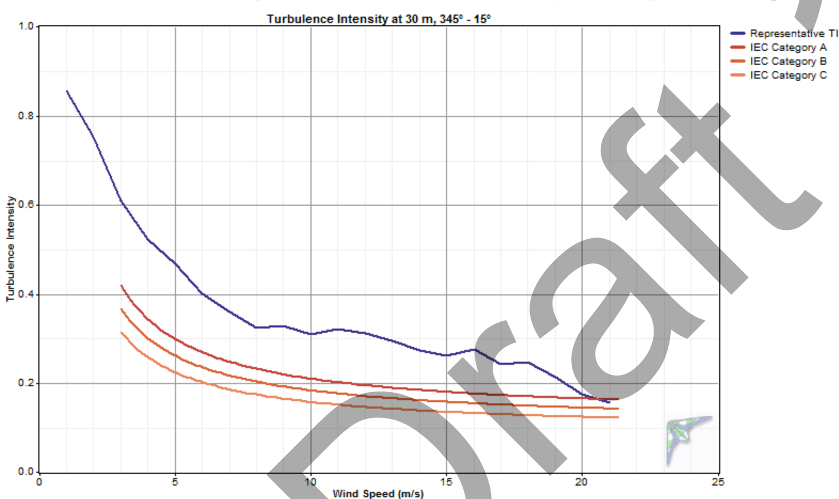
With the high turbulence, the False Pass site classifies by IEC 61400-1, 3rd Edition, criteria as Category S, or special conditions. The 30 meter B anemometer mean TI at 15 m/s is 0.173 and the representative TI at 15 m/s is 0.232, both of which are quite high and considered generally undesirable for wind turbine operations.

High turbulence at the met tower test site is almost certainly due to the high mountains that border Isantoski Strait and that are very near the met tower to the north, west and south. It's likely that air flowing more through the center of Isantoski Strait is less turbulent that at the margins near the mountains, which is the location of the met tower, but that is an academic consideration as it would be impractical from a wind power siting perspective. Insight into turbulent airflow in the False Pass area could be aided by use of computational fluid dynamics analysis to predict airflow patterns.

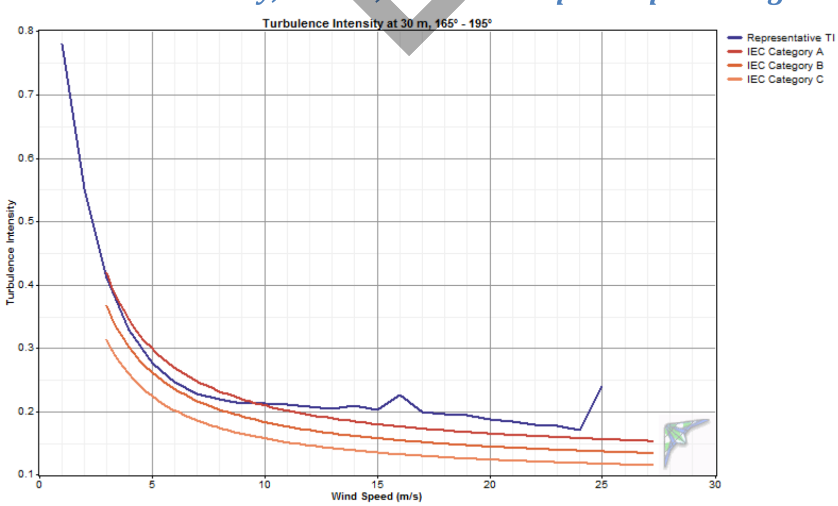
Turbulence intensity graph, 30 m B, all direction sectors



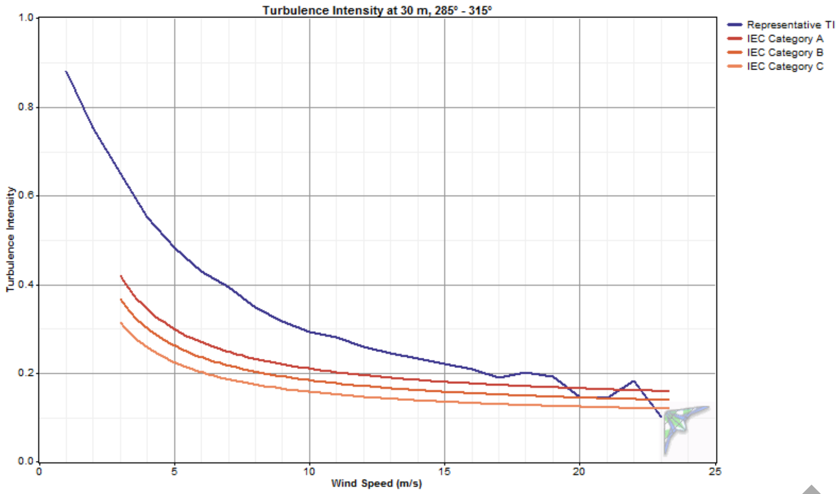
Turbulence intensity, 30 m B, north sector power-producing winds



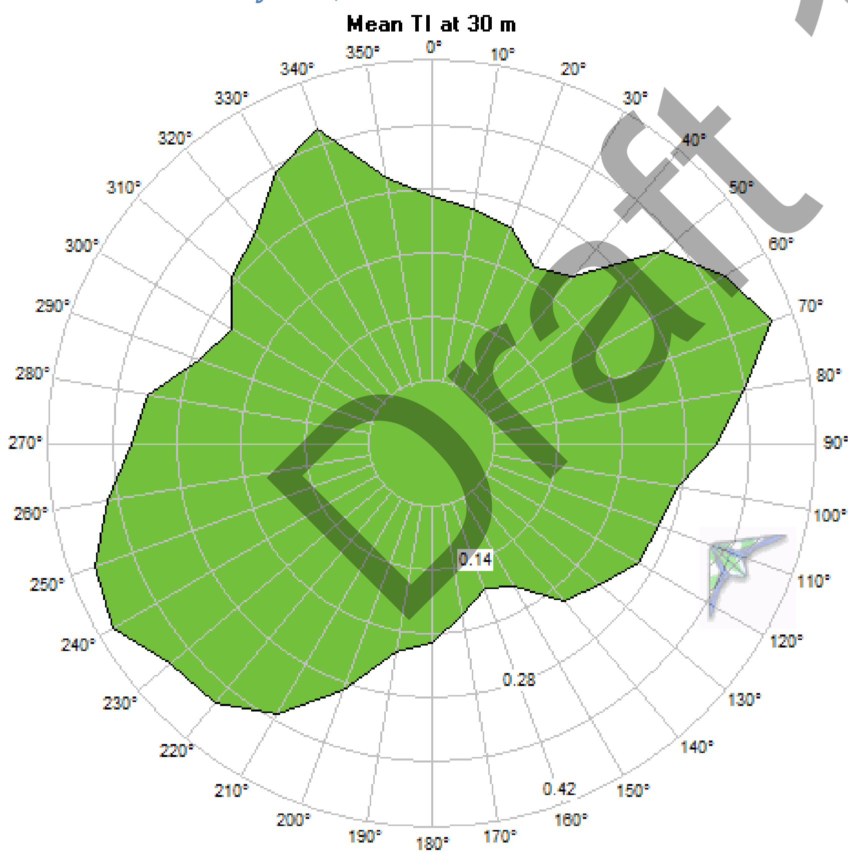
Turbulence intensity, 30 m B, south sector power-producing winds



Turbulence intensity, 30 m A, northwest sector power-producing winds



Turbulence intensity rose, 30 m B



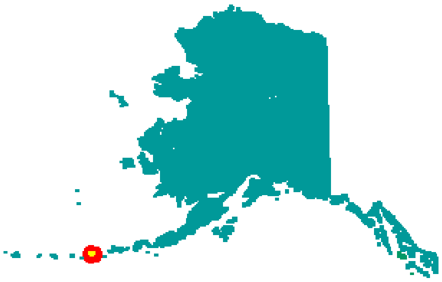
Turbulence table, 30 m B data, all wind sectors

Bin Midpoint (m/s)	Bin Endpoints Lower (m/s)	Upper (m/s)	Records in Bin	Mean TI	SD of TI	Representative TI	Peak TI
1.0	0.5	1.5	9,100	0.583	0.176	0.808	1.571
2.0	1.5	2.5	8,810	0.395	0.185	0.631	1.300
3.0	2.5	3.5	8,736	0.327	0.162	0.534	1.346
4.0	3.5	4.5	9,327	0.287	0.141	0.468	0.972
5.0	4.5	5.5	9,898	0.262	0.121	0.418	0.844
6.0	5.5	6.5	10,680	0.238	0.107	0.374	0.732
7.0	6.5	7.5	10,107	0.221	0.098	0.346	0.682
8.0	7.5	8.5	8,823	0.209	0.086	0.319	0.603
9.0	8.5	9.5	7,264	0.199	0.080	0.301	0.547
10.0	9.5	10.5	5,643	0.196	0.074	0.291	0.510
11.0	10.5	11.5	4,172	0.193	0.068	0.280	0.458
12.0	11.5	12.5	3,287	0.186	0.059	0.262	0.475
13.0	12.5	13.5	2,266	0.181	0.051	0.246	0.418
14.0	13.5	14.5	1,635	0.180	0.050	0.243	0.424
15.0	14.5	15.5	1,135	0.173	0.046	0.232	0.360
16.0	15.5	16.5	732	0.173	0.048	0.235	0.364
17.0	16.5	17.5	475	0.163	0.040	0.214	0.374
18.0	17.5	18.5	280	0.166	0.039	0.215	0.290
19.0	18.5	19.5	143	0.167	0.035	0.212	0.265
20.0	19.5	20.5	86	0.158	0.029	0.195	0.228
21.0	20.5	21.5	53	0.158	0.027	0.193	0.227
22.0	21.5	22.5	26	0.146	0.022	0.175	0.200
23.0	22.5	23.5	11	0.136	0.028	0.172	0.177
24.0	23.5	24.5	2	0.168	0.002	0.171	0.169
25.0	24.5	25.5	2	0.212	0.022	0.240	0.228
26.0	25.5	26.5	0				
27.0	26.5	27.5	1	0.185	0.000	0.185	0.185

Nikolski, Alaska Wind Resource Report

Report written by: Douglas Vaught, P.E., V3 Energy LLC, Eagle River, AK
Date of report: March 27, 2007

Photo by Mia Devine, Alaska Energy Authority



Summary Information

Nikolski has superb potential for wind power development with Class 7 wind power density, moderate wind shear, bi-directional winds and low turbulence.

Meteorological Tower Data Synopsis

Wind power class (measured to date)	Class 7 – Superb
Average wind speed (30 meters)	9.01 m/s (at 30 meters)
Maximum wind gust (2 sec average)	40.9 m/s, 1/24/07, 12 p.m.
Mean wind power density (50 meters)	1,118 W/m^2 (predicted by calculation)
Mean wind power density (30 meters)	881 W/m^2 (measured)
Roughness Class	1.77 (few trees)
Power law exponent	0.174 (moderate wind shear)
Turbulence Intensity (30 meters)	0.108
Data start date	December 11, 2005
Most recent data date	March 13, 2007

Community Profile

Current Population:	31 (2005 State Demographer est.)
Pronunciation/Other Names:	(nih-COAL-skee)
Incorporation Type:	Unincorporated
Borough Located In:	Unorganized
School District:	Aleutian Region Schools
Regional Native Corporation:	Aleut Corporation

Location:
Nikolski is located on Nikolski Bay, off the southwest end of Umnak Island, one of the Fox Islands. It lies 116 air miles west of Unalaska, and 900 air miles from Anchorage. It lies at approximately 52.938060° North Latitude and -168.867780° West Longitude. (Sec. 04, T084S, R136W, Seward Meridian.) Nikolski is located in the Aleutian Islands Recording District. The area encompasses 132.1 sq. miles of land and 0.7 sq. miles of water.

History:
Nikolski is reputed by some to be the oldest continuously-occupied community in the world. Archaeological evidence from Ananiuliak Island, on the north side of Nikolski Bay, dates as far back as 8,500 years ago. The Chaluka archaeological site, in the village of Nikolski, indicates 4,000 years of virtually continuous occupation. People were living in Nikloski before the pyramids were built, the Mayan calendar was invented, or the Chinese language was written. In 1834, it was the site of sea otter hunting, and was recorded by the Russians as "Recheshnoe," which means "river." In 1920, a boom in fox farming occurred here. The Unangan became affluent enough to purchase a relatively large boat, the "Umnak Native," which was wrecked in 1933. A sheep ranch was established in 1926 as part of the Aleutian Livestock Company. In June 1942, when the Japanese attacked Unalaska and seized Attu and Kiska, residents were evacuated to the Ketchikan area. Locals were allowed to return in 1944, but the exposure to the outside world brought about many changes in the traditional lifestyle and community attitudes. In the 1950s, the Air Force constructed a White Alice radar communication site here, which provided some jobs. It was abandoned in late 1977.

Culture:
Residents are known as Unangan, and Aleut is spoken in three-quarters of all homes. Subsistence activities, sheep and cattle raising, and fishing-related employment sustain the community.

Economy:
Most residents support themselves by working outside the village at crab canneries and on processing ships. The lack of a harbor and dock has limited fisheries-related activities. The village is interested in developing a small value-added fish processing plant and a sport fishing lodge to attract former residents who left Nikolski for economic reasons. A sport-fishing charter boat was recently purchased by APICDA. Sheep, cattle and horses graze over much of the island. Income is supplemented by subsistence activities, which provide a substantial part of the villagers' diets. Salmon, halibut, seals and ducks are utilized.

Facilities:
The twelve occupied homes in Nikolski are connected to a piped water system and individual septic tanks. All homes are fully plumbed. The Council provides septic pumping services. The village has requested funds to develop a treated water supply.

Transportation:
Nikolski has a 3,500' unlighted gravel runway which provides passenger, mail and cargo service. The airstrip is owned by the U.S. Air Force. It has no landing or port facilities for ships. Barges deliver cargo once or twice a year. Goods and passengers are lightered three miles to the beach.

Climate:
Nikolski lies in the maritime climate zone. Temperatures range from 11 to 65 degrees Fahrenheit. Snowfall averages 41 inches; total precipitation is 21 inches. Strong winds are frequent during the winter and fog during the summer, which limits accessibility.

(Above information from State of Alaska Department of Commerce, Community, and Economic Development website, www.dced.state.ak.us).

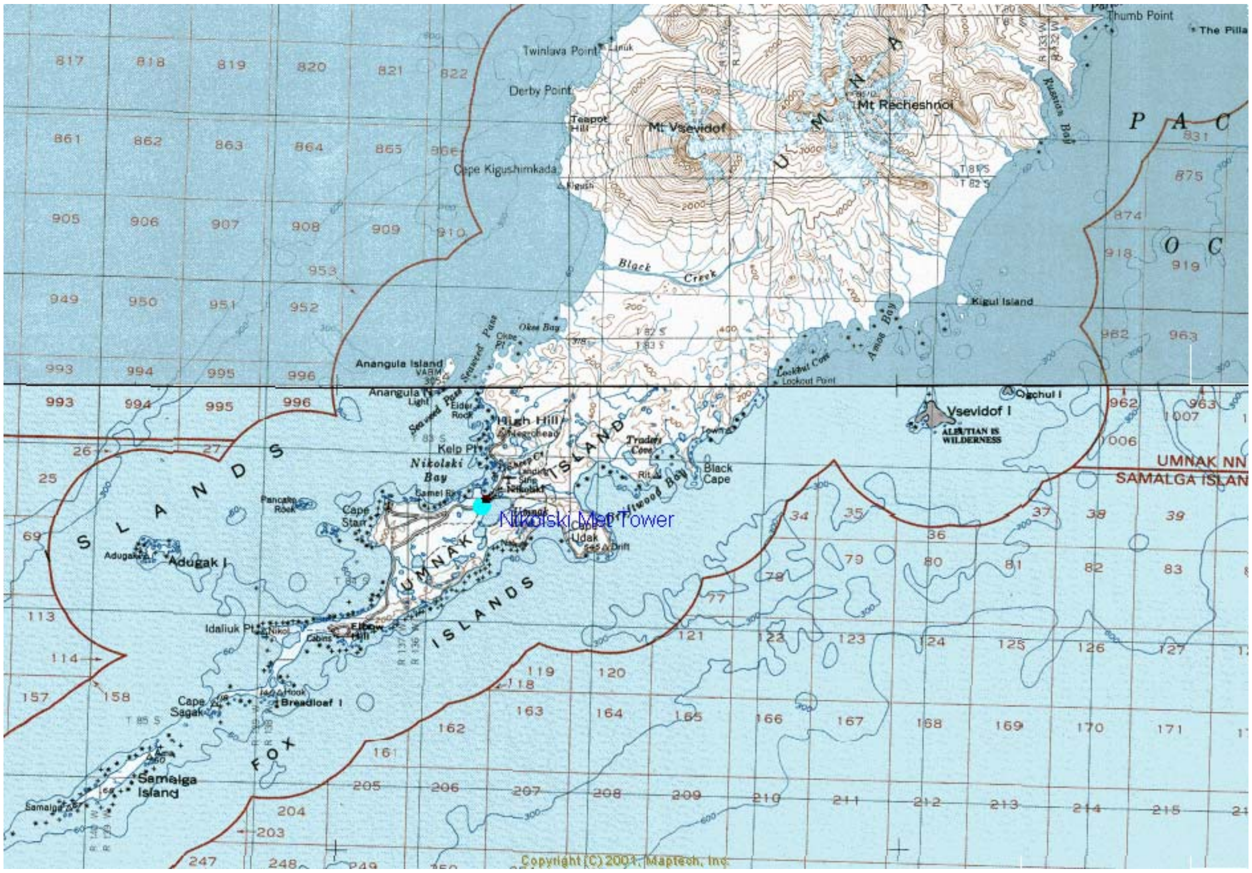
Met Tower Sensor Information

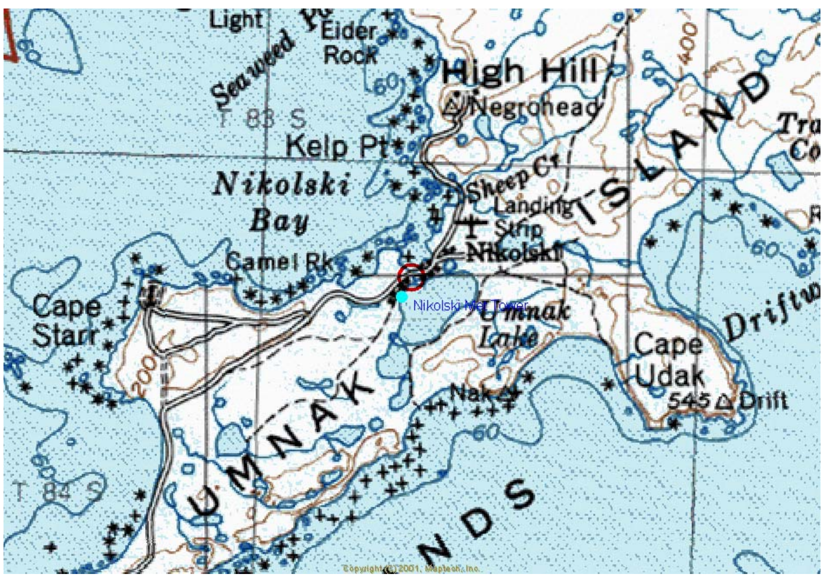
Channel	Sensor type	Height	Multiplier	Offset	Orientation
1	NRG #40 anemometer	30 m (A)	0.765	0.35	North (0°)
2	NRG #40 anemometer	30 m (B)	0.765	0.35	South (170°)
3	NRG #40 anemometer	20 m	0.765	0.35	South (170°)
7	NRG #200P wind vane	27 m	0.351	270	East (90°)
9	NRG #110S Temp C	2 m	0.138	-86.383	N/A

Site Information

Site number	4061
Site Description	On a hill overlooking Umnak Lake, immediately southwest of the village
Latitude/longitude	N 052° 56.025’; W 168° 52.239’
Site elevation	27 meters
Datalogger type	NRG Symphonie
Tower type	NRG 30-meter Tall Tower, 152 mm (6 in) diameter

Site Location Maps





Data Quality Control Summary

Data was filtered to remove presumed icing events that yield false zero wind speed data. A small amount of January 2006 anemometer data was removed because of apparent icing that did not affect the wind vane. A more substantial data problem is the temperature sensor which had a very strange data output in October and early November 2006, but then returned to seemingly normal operation until February 2007 when it apparently quit working. For this wind resource report, data was not synthesized to replace data lost due to icing or the faulty temperature sensor.

		Ch 1, 30 m (A)		Ch 2, 30 m (B)		Ch 3, 20 m	
Year	Month	Records	Recovery Rate (%)	Records	Recovery Rate (%)	Records	Recovery Rate (%)
2005	Dec	3,024	100	3,024	100	3,024	100
2006	Jan	4,429	99.2	4,429	99.2	4,429	99.2
2006	Feb	4,032	100	4,032	100	4,032	100
2006	Mar	4,464	100	4,464	100	4,464	100
2006	Apr	4,320	100	4,320	100	4,320	100
2006	May	4,464	100	4,464	100	4,464	100
2006	Jun	4,320	100	4,320	100	4,320	100
2006	Jul	4,464	100	4,464	100	4,464	100
2006	Aug	4,464	100	4,464	100	4,464	100
2006	Sep	4,320	100	4,320	100	4,320	100
2006	Oct	4,464	100	4,464	100	4,464	100
2006	Nov	4,320	100	4,320	100	4,320	100
2006	Dec	4,464	100	4,464	100	4,464	100
2007	Jan	4,464	100	4,464	100	4,464	100
2007	Feb	4,032	100	4,032	100	4,032	100
2007	Mar	1,812	100	1,812	100	1,812	100
All data		65,857	99.9	65,857	99.9	65,857	99.9

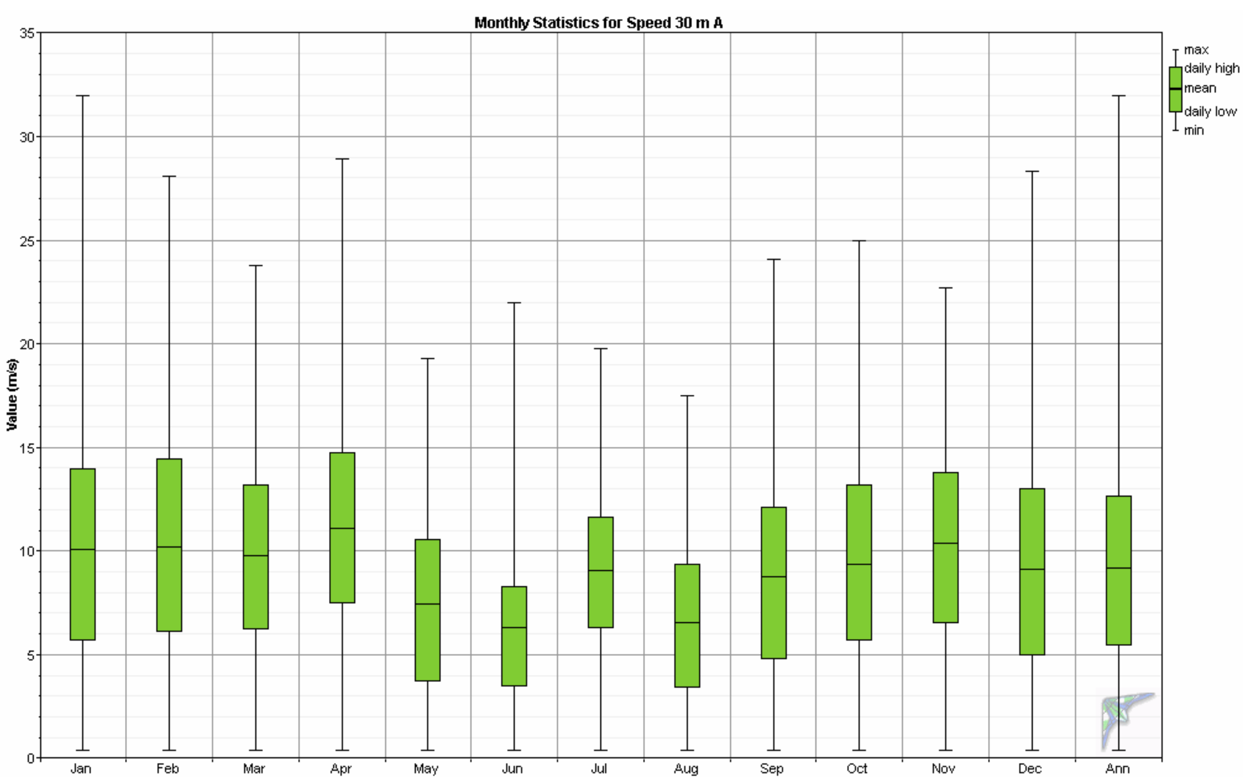
		Ch 7, vane		Ch 9, temperature	
Year	Month	Records	Recovery Rate (%)	Records	Recovery Rate (%)
2005	Dec	3,024	100	3,024	100
2006	Jan	4,464	100	4,464	100
2006	Feb	4,032	100	4,032	100
2006	Mar	4,464	100	4,464	100
2006	Apr	4,320	100	4,320	100
2006	May	4,464	100	4,464	100
2006	Jun	4,320	100	4,320	100
2006	Jul	4,464	100	4,464	100
2006	Aug	4,464	100	4,464	100
2006	Sep	4,320	100	4,320	100
2006	Oct	4,464	100	1,707	38.2
2006	Nov	4,320	100	4,127	95.5
2006	Dec	4,464	100	4,464	100
2007	Jan	4,464	100	4,455	99.8
2007	Feb	4,032	100	559	13.9
2007	Mar	1,812	100	0	0
All data		65,892	100	57,648	87.5

Measured Wind Speeds

The 30 meter (A) anemometer wind speed average for the reporting period is 9.01 m/s, the 30 meter (B) anemometer wind speed average is 8.98 m/s, and the 20 meter anemometer wind speed average is 8.37 m/s. Note that the maximum wind speed data represent ten-minute average wind speed measurements.

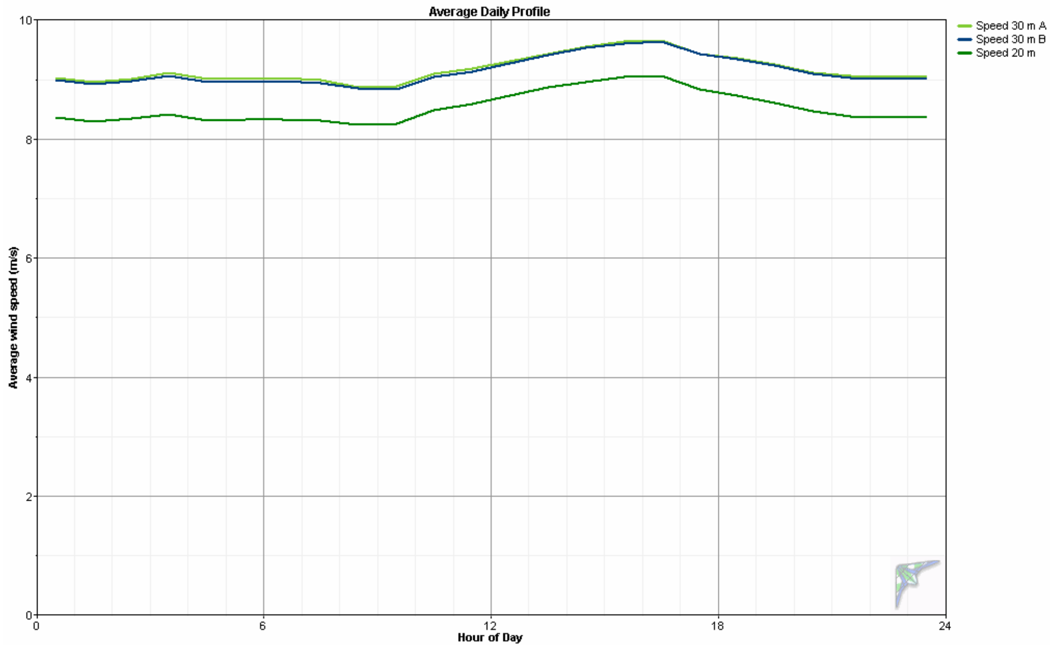
Wind Speed Summary

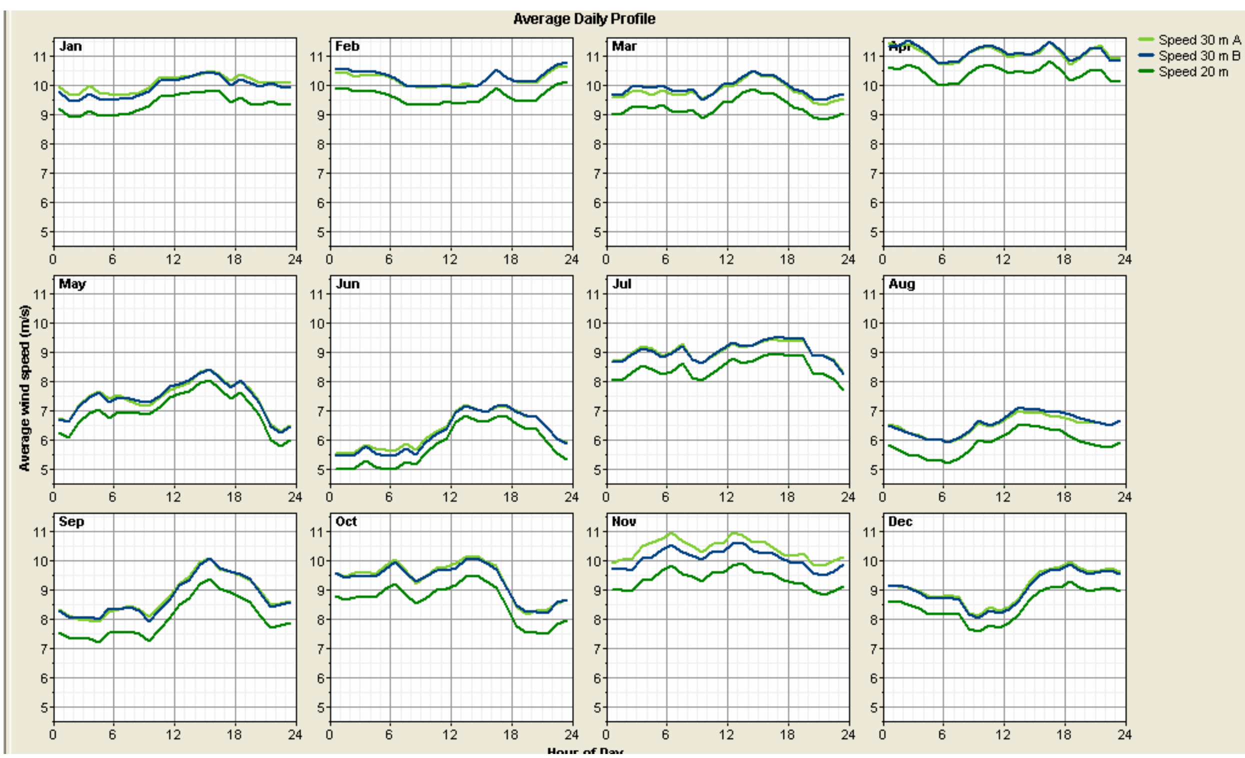
	30 m (A) speed		30 m (B) speed		20 m speed	
Month	Mean (m/s)	Max (m/s)	Mean (m/s)	Max (m/s)	Mean (m/s)	Max (m/s)
Jan	10.06	32.0	9.93	32.1	9.36	30.8
Feb	10.21	28.1	10.26	27.8	9.63	27.0
Mar	9.81	23.8	9.90	24.1	9.25	23.0
Apr	11.10	28.9	11.13	29.4	10.43	27.2
May	7.45	19.3	7.45	19.9	7.00	18.7
Jun	6.32	22.0	6.26	22.2	5.84	20.8
Jul	9.04	19.8	9.03	20.0	8.45	18.9
Aug	6.52	17.5	6.57	17.9	5.90	16.6
Sep	8.78	24.1	8.75	24.3	8.03	22.9
Oct	9.38	25.0	9.32	25.3	8.64	23.6
Nov	10.39	22.7	10.08	22.9	9.37	21.9
Dec	9.10	28.3	9.04	28.3	8.49	27.1
Annual	**9.01**	32.0	**8.98**	32.1	**8.37**	30.8



Daily wind profile

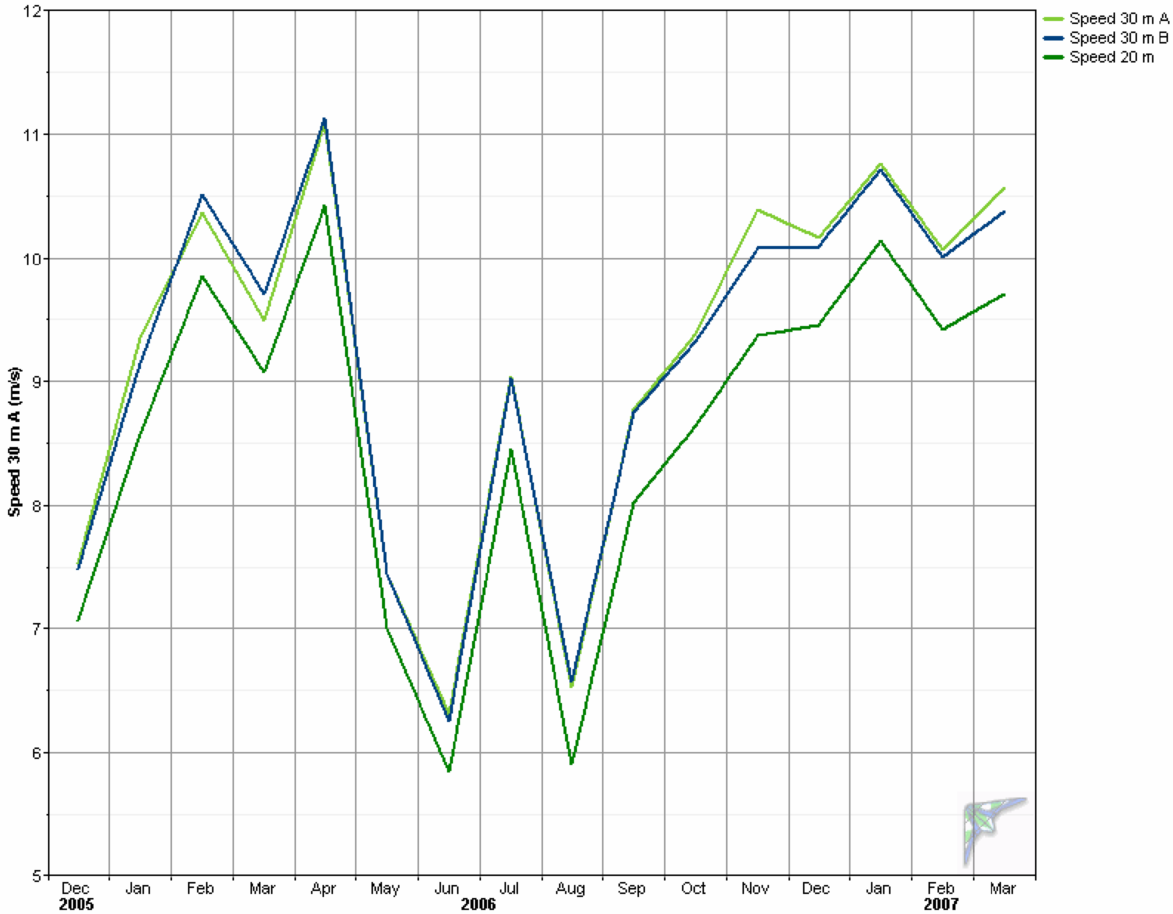
The daily wind profile indicates that the lowest wind speeds of the day occur in the night and morning hours of 9 p.m. to 9 a.m. and the highest wind speeds of the day occur during the late morning, afternoon and evening hours of 9 a.m. to 9 p.m. The daily variation of wind speed is quite minimal on an annual basis, but as shown below, more pronounced on a monthly basis.

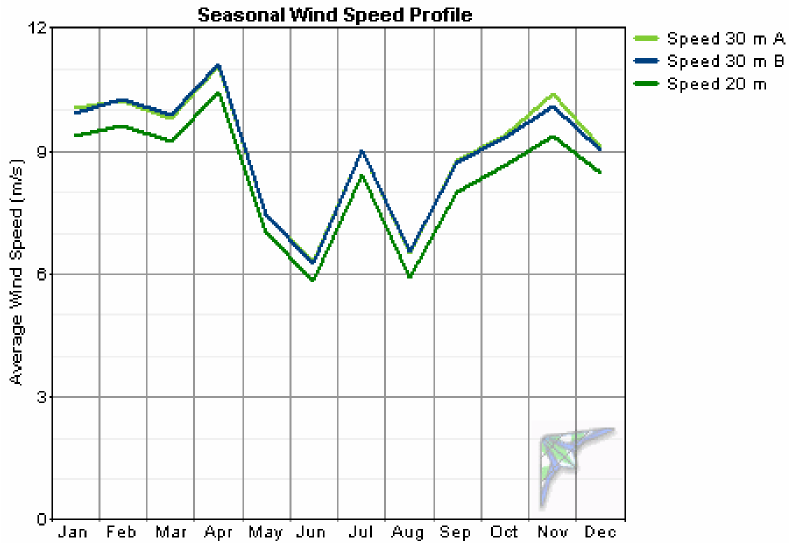




Time Series of Wind Speed Monthly Averages

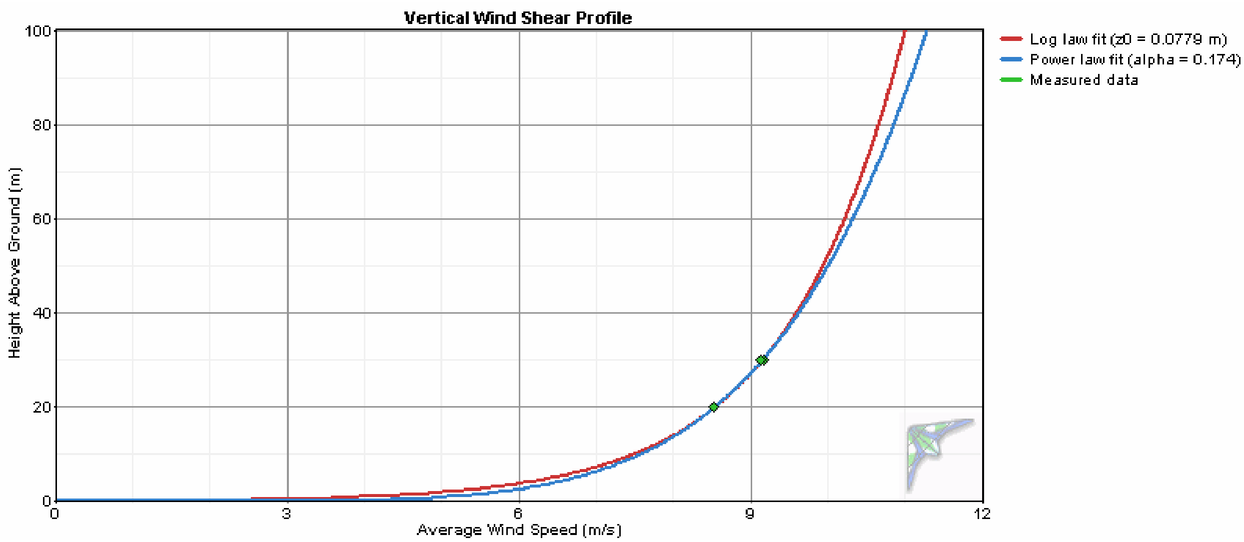
As expected, the highest winds occurred during the fall through spring months with lighter, but still very strong, winds during in May through September. Note that measured winds during winter 2006/2007 are about equivalent to the winter 2005/2006 winds.

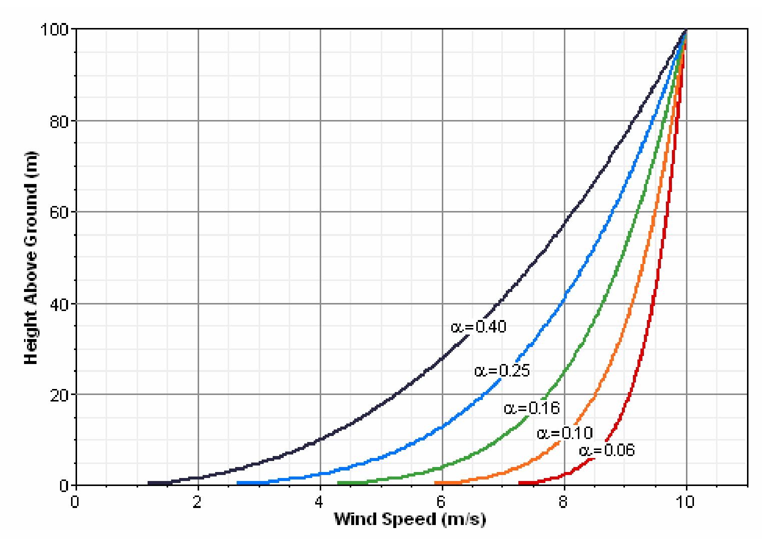


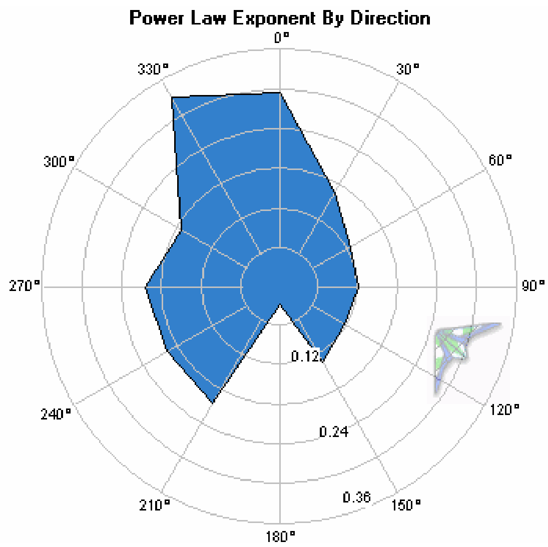


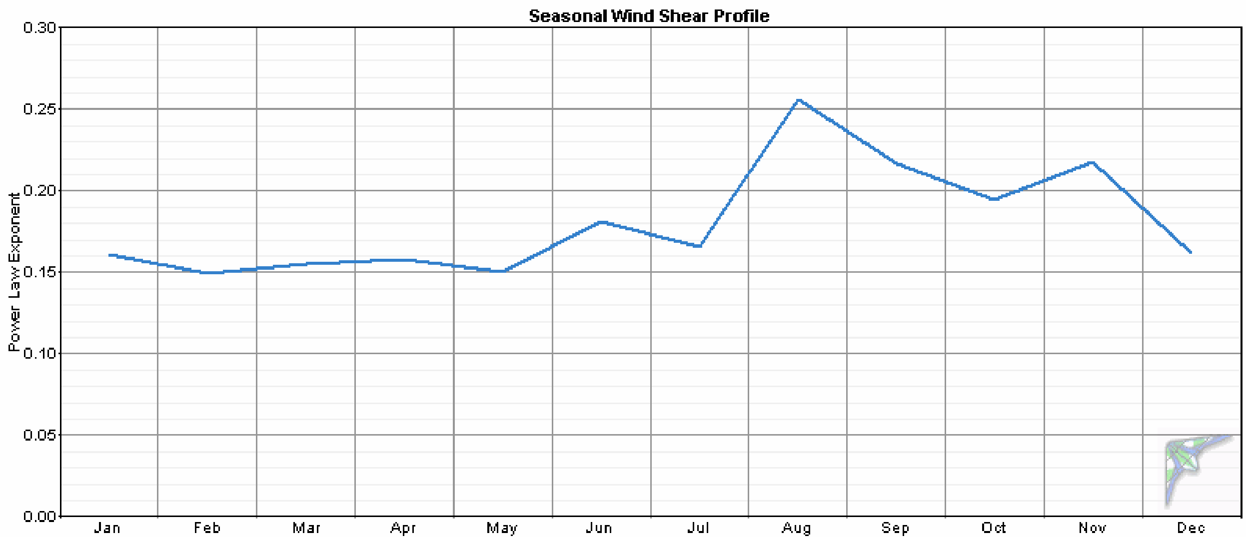
Wind Shear Profile

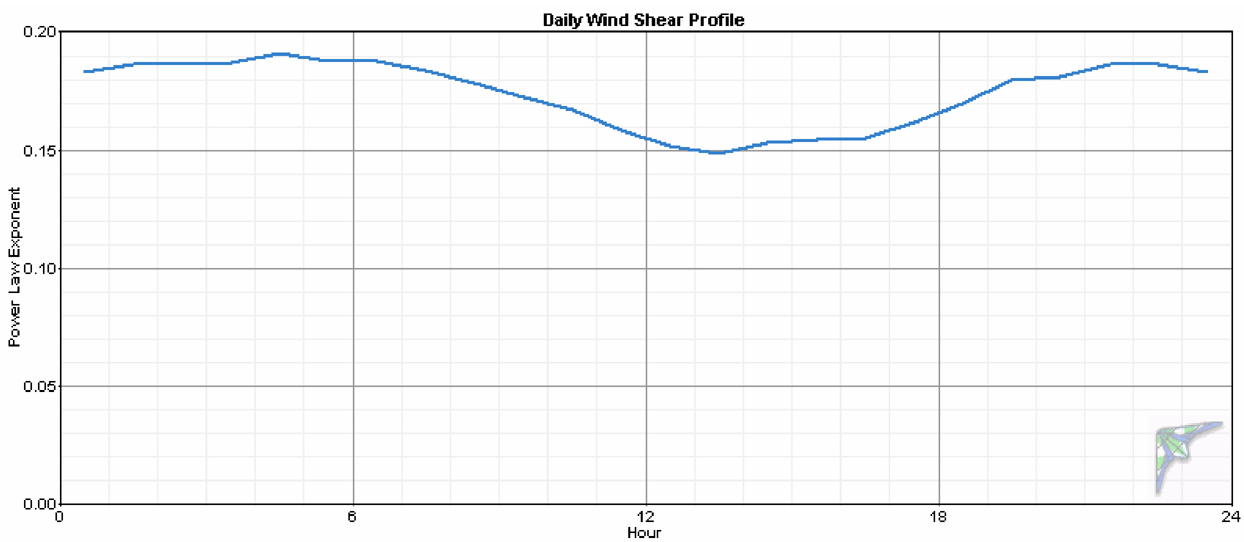
The average power law exponent was calculated at 0.174, indicating moderate wind shear at the Nikolski test site. The practical application of this information is that a higher turbine tower height would yield a desirable marginal gain in average wind speed with height, but the wind resource in Nikolski is so exceptionally strong that lower tower heights are advisable for reasons of cost and foundation engineering considerations. Other figures below show the variability of wind shear by direction and seasonal and daily variability.





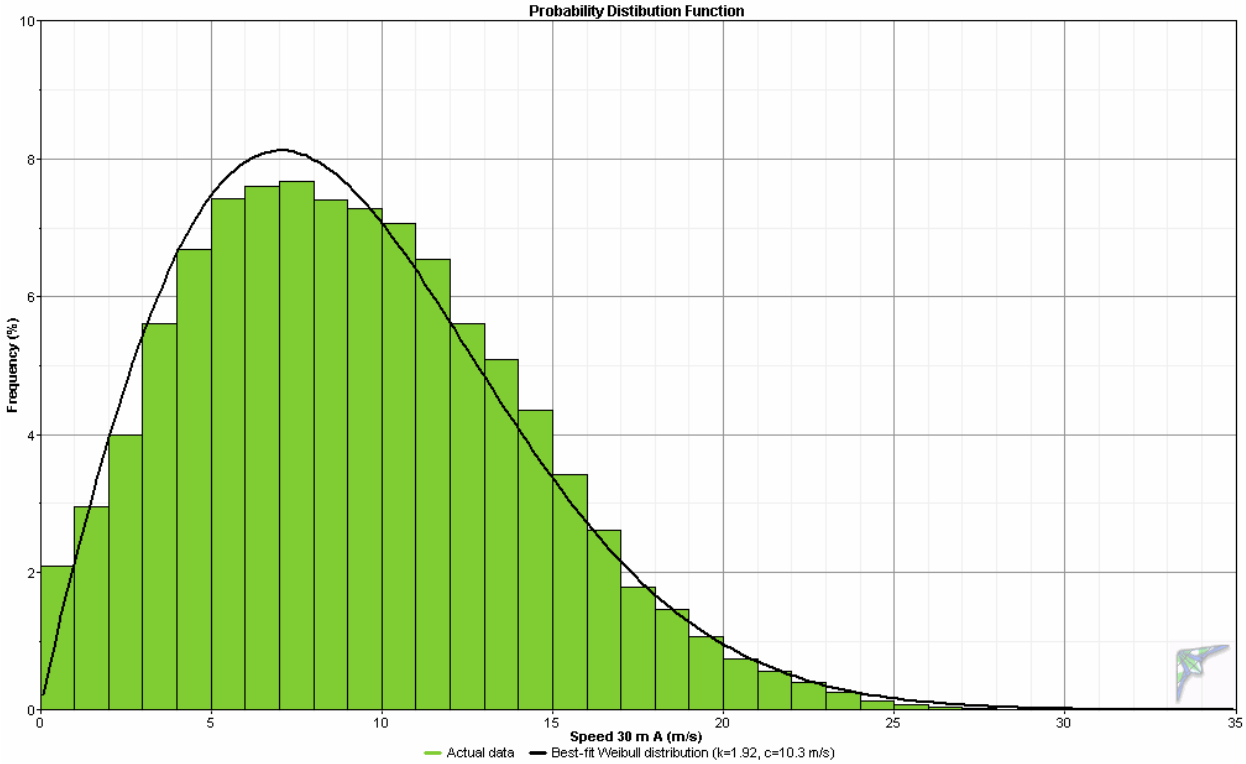

Power Law Exponent By Direction
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°
0.12
0.24
0.36

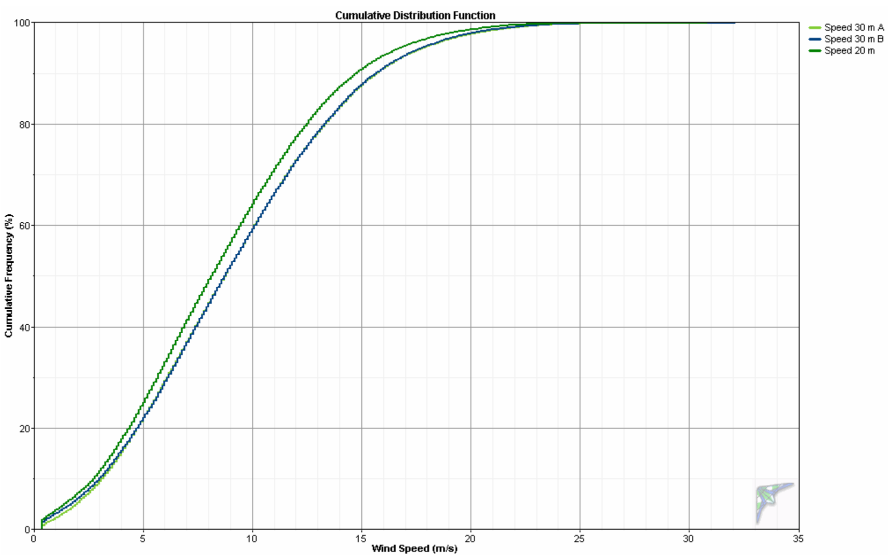

Seasonal Wind Shear Profile
Power Law Exponent
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Daily Wind Shear Profile
Power Law Exponent
0.00
0.05
0.10
0.15
0.20
0
6
12
18
24
Hour

Probability Distribution Function

The probability distribution function provides a visual indication of measured wind speeds in one meter per second "bins". Note that most wind turbines do not begin to generate power until the wind speed at hub height reaches 4 m/s, also known as the "cut-in" wind speed. The black line in the graph is a best fit Weibull distribution. At the 30 meter level, Weibull parameters are k = 1.92 (indicates a broad distribution of wind speeds) and c = 10.3 m/s (scale factor for the Weibull distribution) for the measurement period of 121/11/2005 to 3/13/2007. At 20 meters, k = 1.85 and c = 9.56 m/s for the same measurement period.

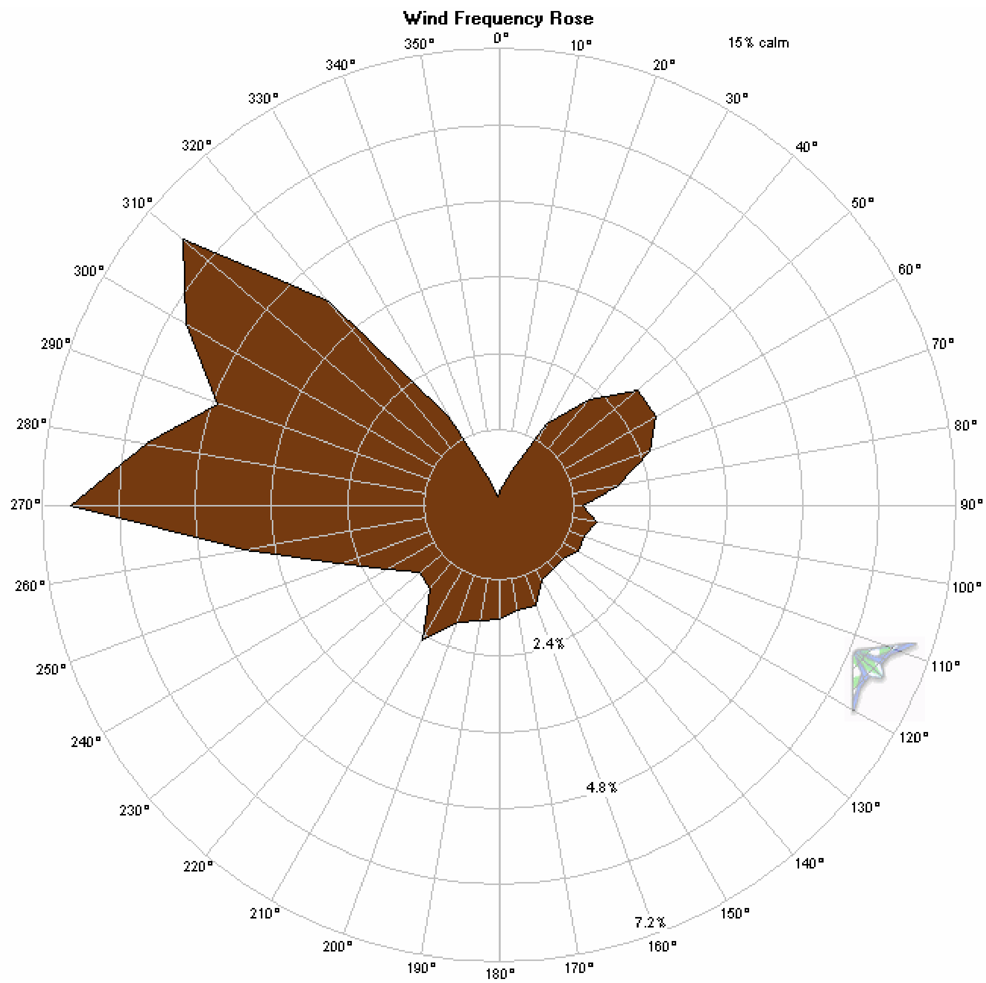




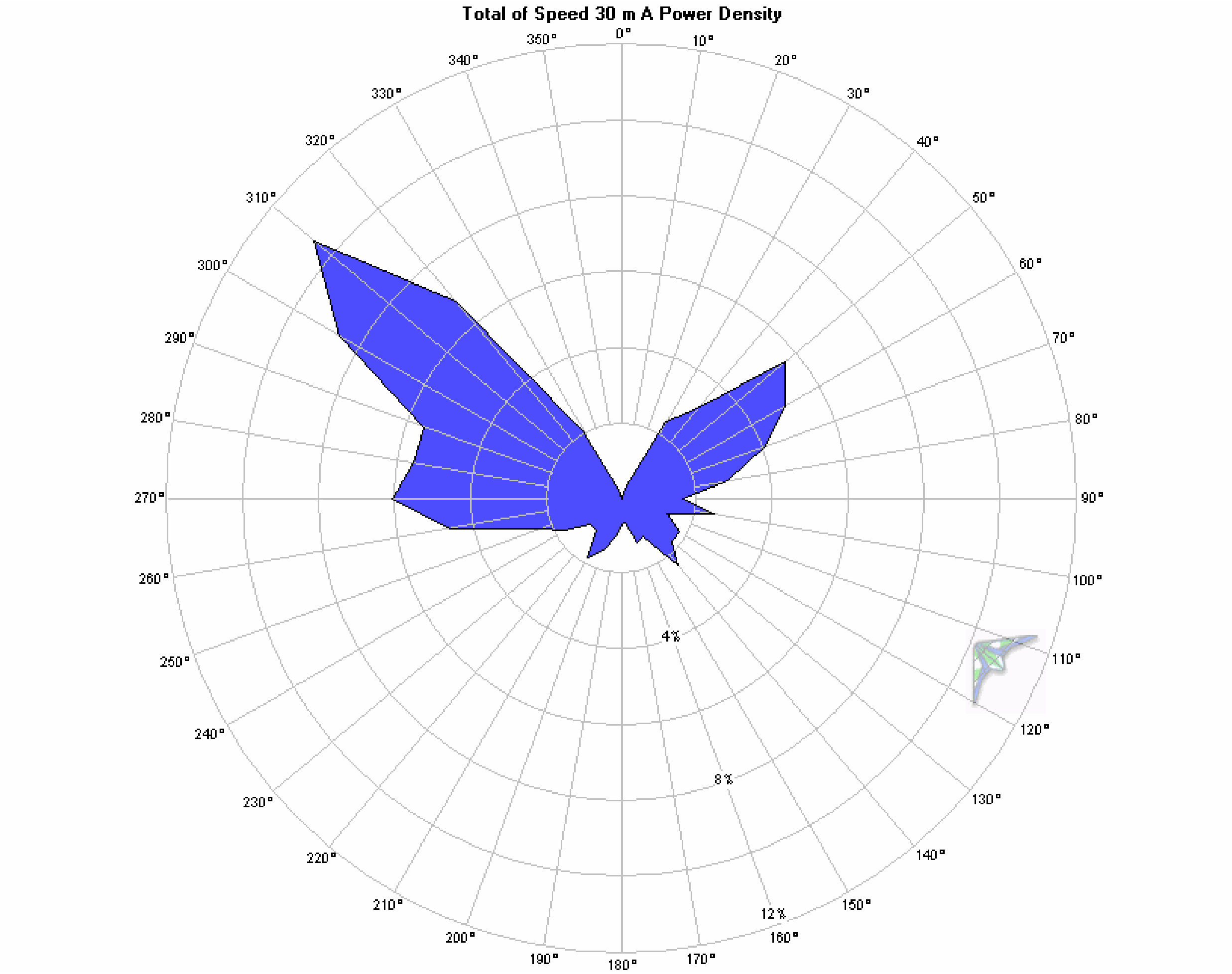
Wind Roses

Nikolski's winds are strongly bi-directional. The wind frequency rose indicates predominately north to northwest winds with a lesser component of northeast winds. This data observation is even stronger when one considers the power density rose (second wind rose). As one can see, the power producing winds are primarily northwest with lesser components of west and north-east. The practical application of this information is that multiple turbines should be spaced to avoid downwind effects from north to northwest and northeast sectors.

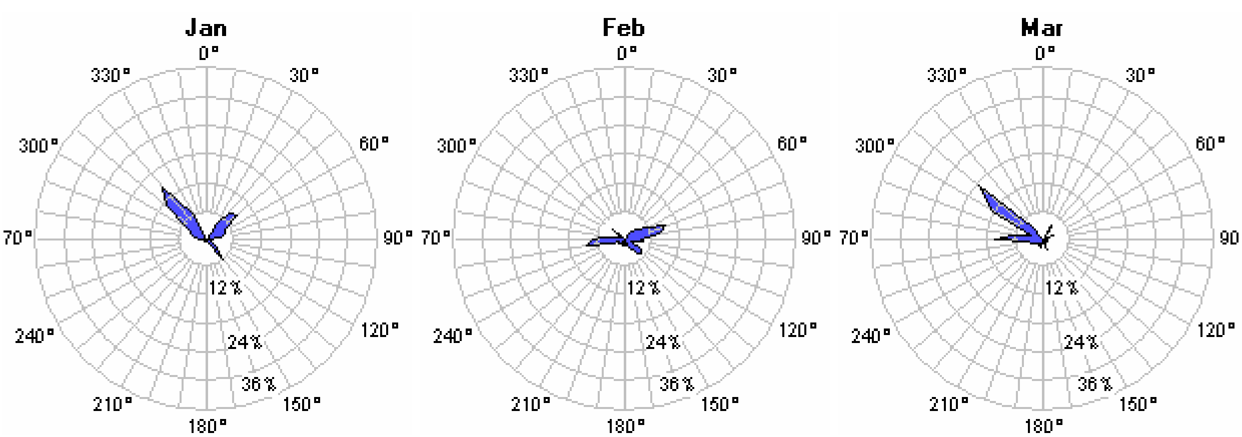
Wind frequency rose (30 meters)

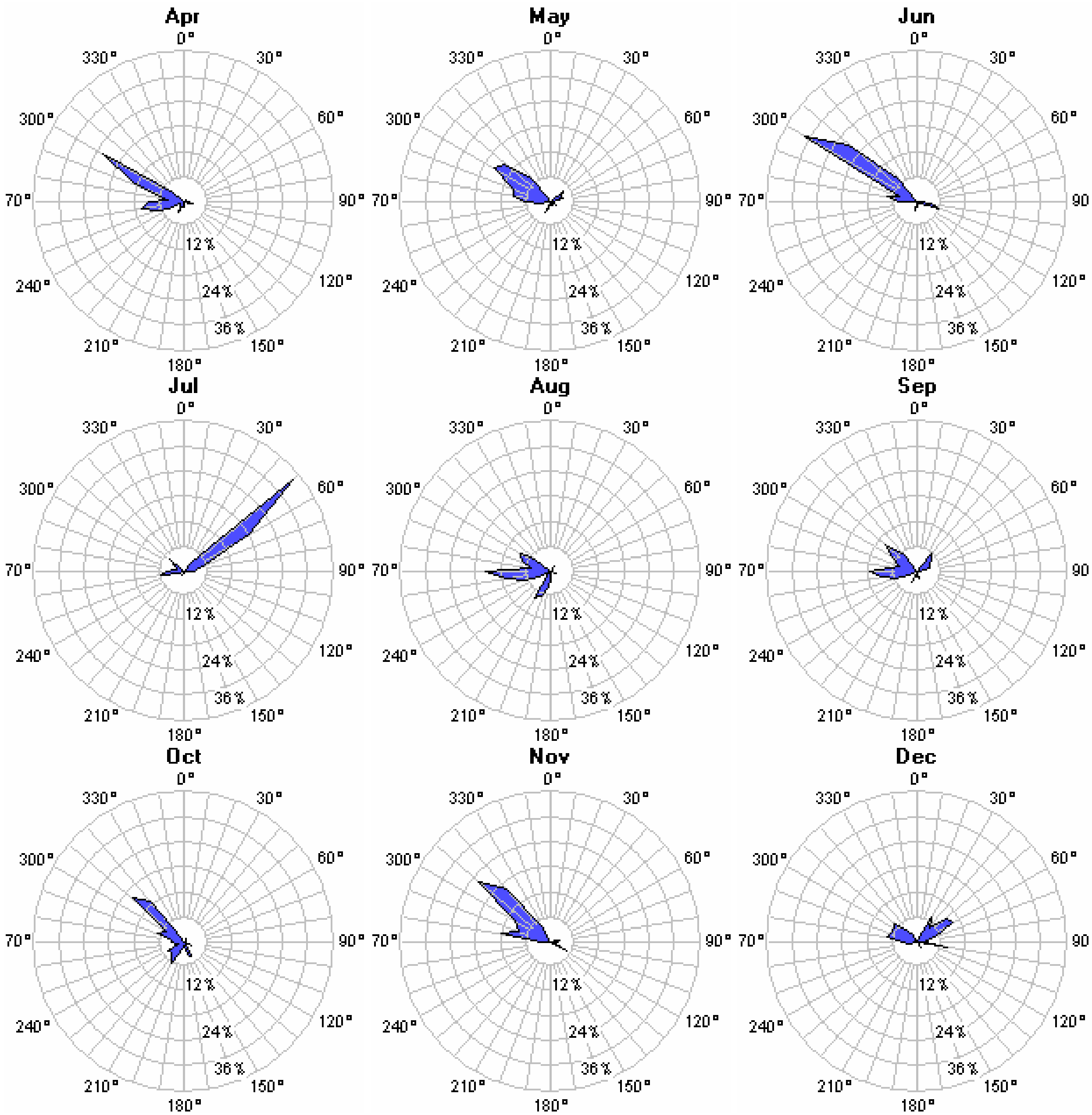


Power density rose (30 meters)



Wind Power Density Rose by Month (30 meters); note that scale is common

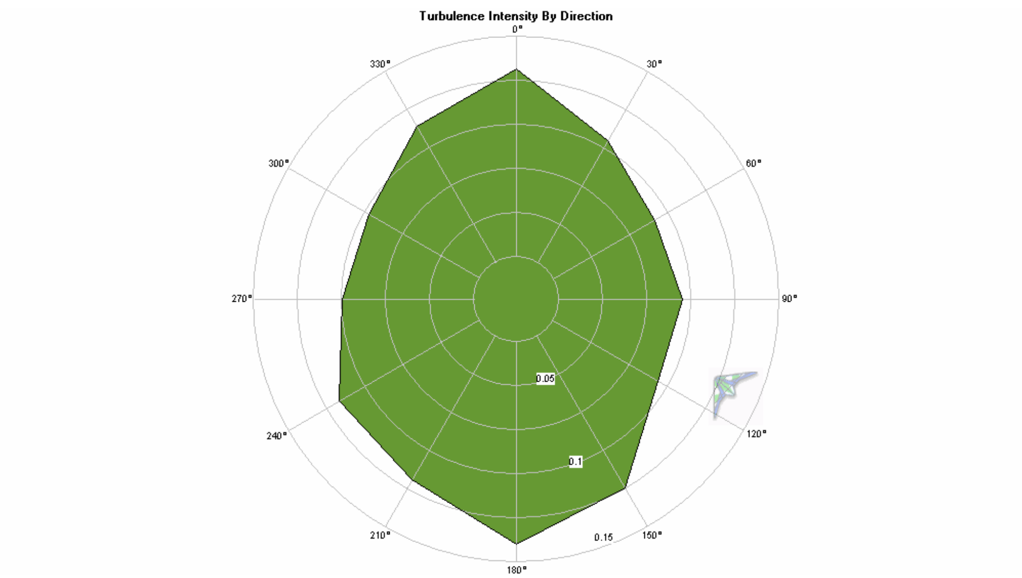



Apr
0°
30°
60°
90°
120°
150°
180°
210°
240°
70°
300°
330°
12%
24%
36%
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

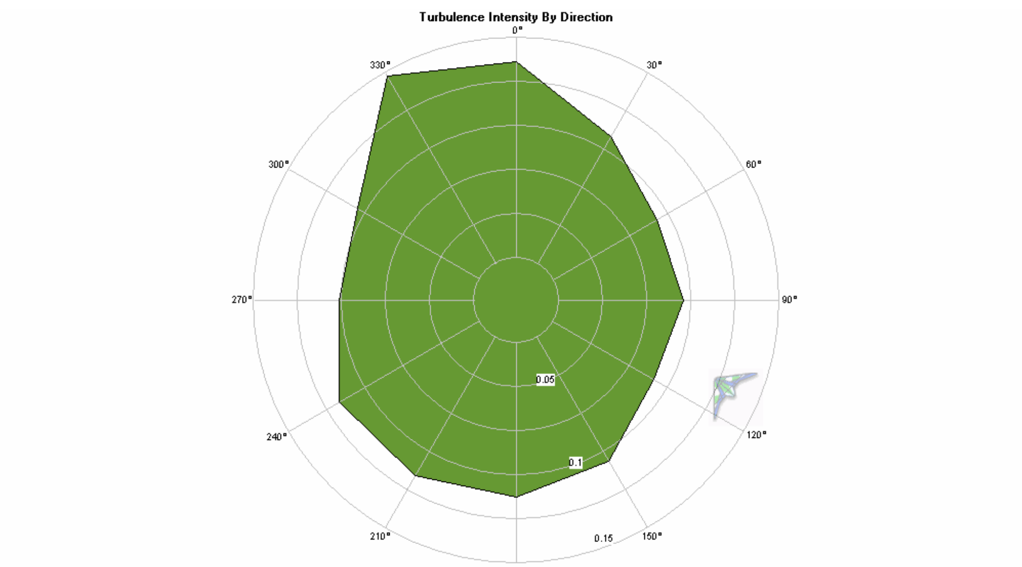
Turbulence Intensity

The Nikolski test site turbulence intensity is quite acceptable with a mean of 0.106 (A channel) and 0.108 (B channel) at 30 meters. The higher turbulence in the north and south quadrants in the A channel is inconsequential as the wind rarely blows from these directions. The higher turbulence intensity to the north-northwest in B channel can be attributed to the placement of the sensor facing south; northwesterly winds must flow around the tower before reaching the sensor and hence appear more turbulent than is the case. Note that turbulence intensity is calculated for each time step as the standard deviation of the wind speed divided by the mean of the wind speed.

30 meter vane – 30 meter (A) Turbulence Intensity (Mean = 0.106)



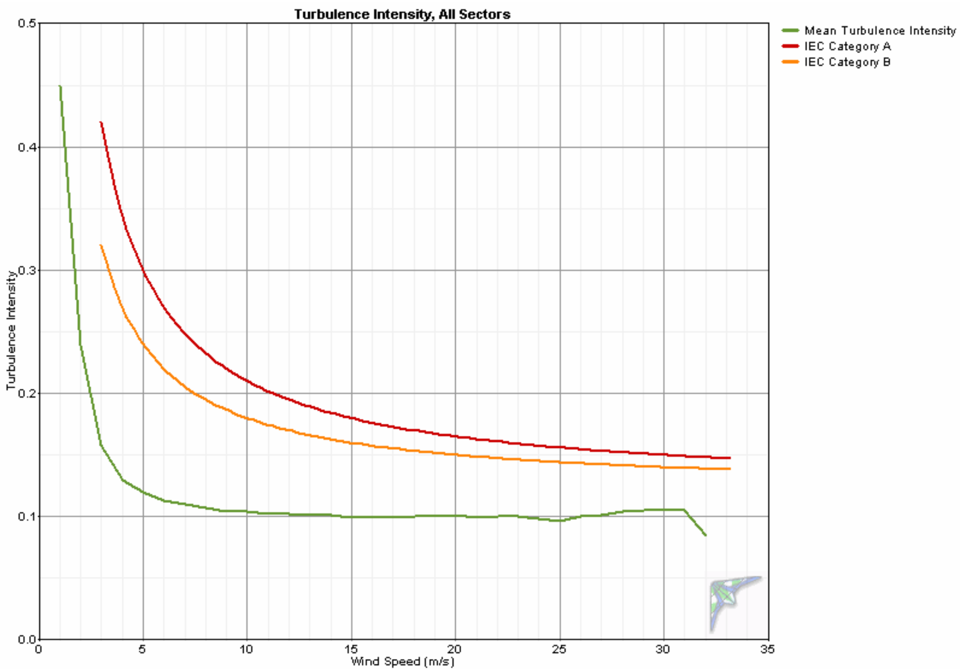
30 meter vane – 30 meter (B) Turbulence Intensity (Mean = 0.108)

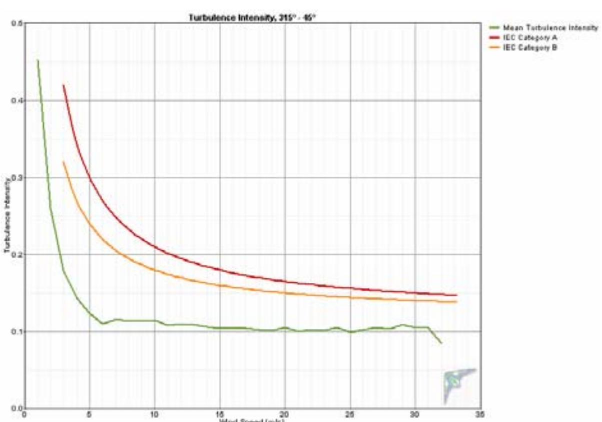


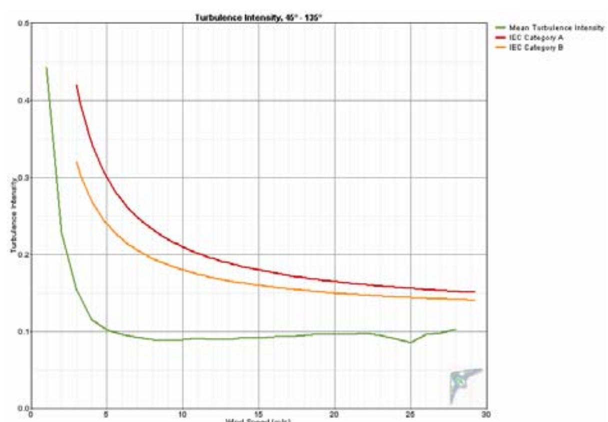
International Energy Agency turbulence standard comparisons

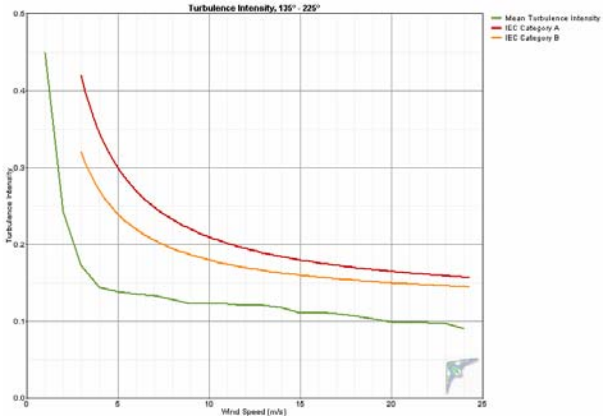
As indicated, turbulence is within International Energy Agency (IEA) Category A and B standards for all wind directions and at all measured wind speeds.

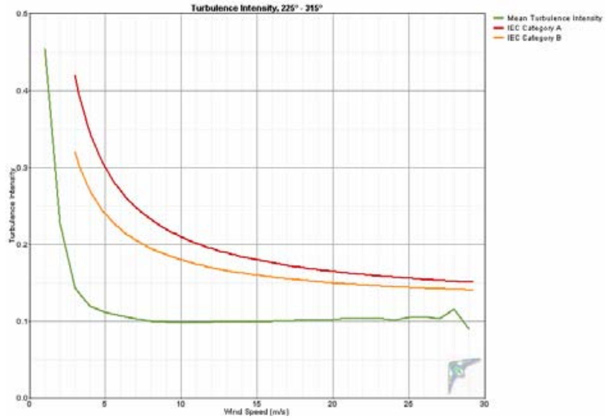
30 meter vane – 30 meter (A) speed











Turbulence Tables

30 m A speed - 27 m vane, 4 m/s threshold wind speed, 12/11/05 to 3/13/07

Bin Midpoint (m/s)	Bin Endpoints Lower (m/s)	Bin Endpoints Upper (m/s)	Records In Bin	Standard Deviation of Wind Speed (m/s)	Mean Turbulence Intensity	Standard Deviation of Turbulence Intensity	Characteristic Turbulence Intensity
1	0.5	1.5	394	0.425	0.454	0.163	0.618
2	1.5	2.5	825	0.442	0.228	0.109	0.337
3	2.5	3.5	1307	0.423	0.143	0.069	0.213
4	3.5	4.5	1664	0.472	0.120	0.046	0.165
5	4.5	5.5	1723	0.556	0.112	0.042	0.155
6	5.5	6.5	2203	0.637	0.107	0.037	0.144
7	6.5	7.5	2481	0.715	0.103	0.032	0.135
8	7.5	8.5	2413	0.799	0.101	0.032	0.133
9	8.5	9.5	2313	0.890	0.099	0.029	0.128
10	9.5	10.5	2501	0.983	0.099	0.027	0.125
11	10.5	11.5	2261	1.077	0.099	0.026	0.124
12	11.5	12.5	1967	1.183	0.099	0.023	0.123
13	12.5	13.5	1688	1.286	0.099	0.020	0.119
14	13.5	14.5	1576	1.392	0.100	0.020	0.120
15	14.5	15.5	1248	1.482	0.099	0.020	0.120
16	15.5	16.5	958	1.598	0.100	0.020	0.120
17	16.5	17.5	758	1.696	0.100	0.020	0.120
18	17.5	18.5	543	1.828	0.102	0.022	0.124
19	18.5	19.5	412	1.913	0.101	0.021	0.122
20	19.5	20.5	253	2.040	0.102	0.021	0.123
21	20.5	21.5	117	2.181	0.104	0.020	0.125
22	21.5	22.5	103	2.265	0.103	0.016	0.120
23	22.5	23.5	87	2.405	0.105	0.015	0.120
24	23.5	24.5	41	2.439	0.102	0.015	0.117
25	24.5	25.5	22	2.627	0.106	0.017	0.123
26	25.5	26.5	6	2.767	0.106	0.012	0.118
27	26.5	27.5	1	2.800	0.104	0.000	0.104
28	27.5	28.5	1	3.200	0.116	0.000	0.116
29	28.5	29.5	1	2.600	0.090	0.000	0.090

30 m B speed - 27 m vane, 4 m/s threshold wind speed, 12/11/05 to 3/13/07

Bin Midpoint (m/s)	Bin Endpoints Lower (m/s)	Upper (m/s)	Records In Bin	Standard Deviation of Wind Speed (m/s)	Mean Turbulence Intensity	Standard Deviation of Turbulence Intensity	Characteristic Turbulence Intensity
1	0.5	1.5	541	0.463	0.496	0.165	0.661
2	1.5	2.5	823	0.498	0.258	0.112	0.370
3	2.5	3.5	1197	0.472	0.159	0.073	0.232
4	3.5	4.5	1576	0.497	0.126	0.050	0.177
5	4.5	5.5	1696	0.578	0.116	0.045	0.162
6	5.5	6.5	2115	0.655	0.110	0.038	0.148
7	6.5	7.5	2444	0.735	0.106	0.032	0.137
8	7.5	8.5	2455	0.822	0.104	0.034	0.137
9	8.5	9.5	2253	0.917	0.102	0.029	0.132
10	9.5	10.5	2437	1.018	0.102	0.027	0.129
11	10.5	11.5	2261	1.124	0.103	0.027	0.130
12	11.5	12.5	1955	1.225	0.103	0.023	0.125
13	12.5	13.5	1727	1.357	0.105	0.022	0.127
14	13.5	14.5	1609	1.470	0.105	0.020	0.125
15	14.5	15.5	1309	1.576	0.106	0.021	0.126
16	15.5	16.5	902	1.677	0.105	0.020	0.125
17	16.5	17.5	790	1.761	0.104	0.019	0.123
18	17.5	18.5	555	1.917	0.107	0.022	0.128
19	18.5	19.5	439	1.991	0.105	0.021	0.126
20	19.5	20.5	273	2.115	0.106	0.021	0.127
21	20.5	21.5	146	2.265	0.108	0.019	0.128
22	21.5	22.5	98	2.349	0.107	0.016	0.123
23	22.5	23.5	79	2.491	0.108	0.017	0.125
24	23.5	24.5	42	2.550	0.107	0.013	0.119
25	24.5	25.5	21	2.748	0.111	0.015	0.126
26	25.5	26.5	9	2.856	0.110	0.019	0.129
27	26.5	27.5	2	2.750	0.102	0.001	0.104
28	27.5	28.5	1	3.300	0.119	0.000	0.119
29	28.5	29.5	1	2.600	0.088	0.000	0.088
30	29.5	30.5	0	2.600	0.088	0.000	0.088

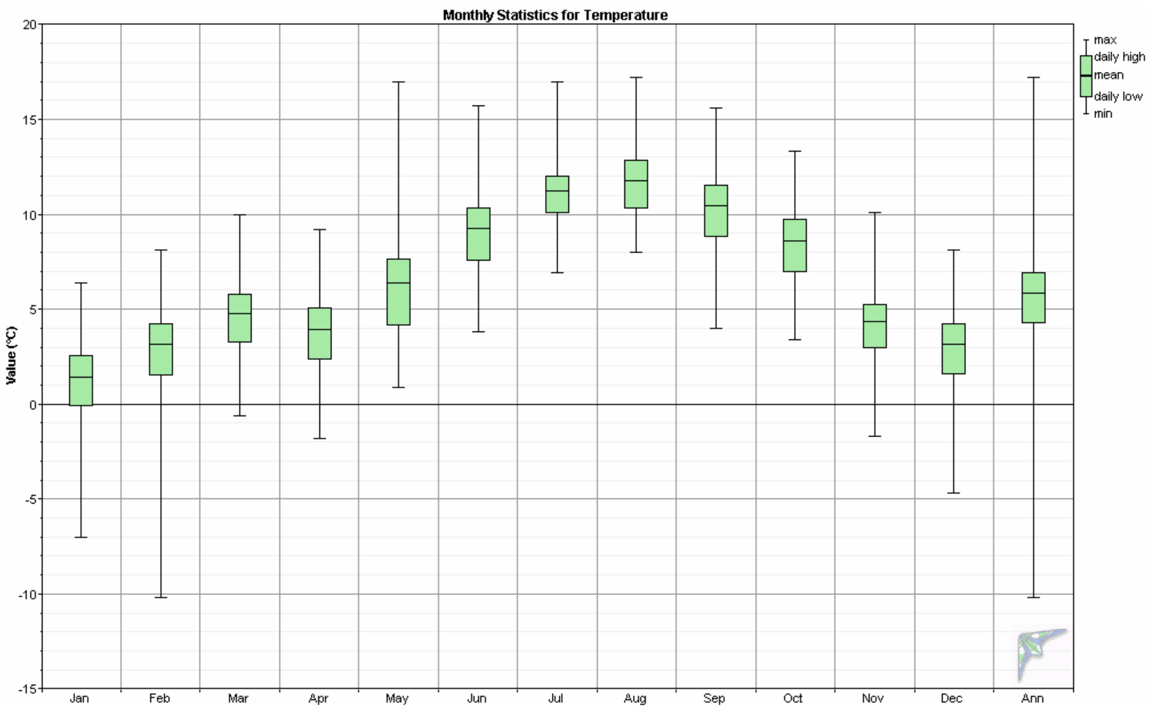
20 m speed - 27 m vane, 4 m/s threshold wind speed, 12/11/05 to 3/13/07

Bin Midpoint (m/s)	Bin Endpoints Lower (m/s)	Upper (m/s)	Records In Bin	Standard Deviation of Wind Speed (m/s)	Mean Turbulence Intensity	Standard Deviation of Turbulence Intensity	Characteristic Turbulence Intensity
1	0.5	1.5	605	0.463	0.498	0.170	0.668
2	1.5	2.5	889	0.504	0.260	0.116	0.376
3	2.5	3.5	1448	0.501	0.169	0.072	0.241
4	3.5	4.5	1736	0.559	0.142	0.054	0.196
5	4.5	5.5	2204	0.666	0.134	0.042	0.176
6	5.5	6.5	2583	0.779	0.130	0.033	0.164
7	6.5	7.5	2585	0.884	0.127	0.032	0.159
8	7.5	8.5	2437	0.994	0.125	0.030	0.155
9	8.5	9.5	2493	1.107	0.123	0.025	0.149
10	9.5	10.5	2433	1.218	0.123	0.025	0.148
11	10.5	11.5	2171	1.326	0.121	0.024	0.145
12	11.5	12.5	1803	1.460	0.122	0.022	0.145
13	12.5	13.5	1696	1.592	0.123	0.020	0.143
14	13.5	14.5	1285	1.712	0.123	0.021	0.144
15	14.5	15.5	959	1.811	0.121	0.020	0.141
16	15.5	16.5	771	1.888	0.119	0.021	0.139
17	16.5	17.5	599	2.014	0.119	0.022	0.141
18	17.5	18.5	409	2.104	0.117	0.022	0.139
19	18.5	19.5	234	2.204	0.117	0.020	0.137
20	19.5	20.5	131	2.377	0.120	0.019	0.138
21	20.5	21.5	101	2.464	0.118	0.018	0.136
22	21.5	22.5	71	2.600	0.119	0.013	0.132
23	22.5	23.5	39	2.762	0.121	0.017	0.137
24	23.5	24.5	13	2.723	0.114	0.012	0.127
25	24.5	25.5	4	2.950	0.119	0.010	0.129
26	25.5	26.5	1	3.300	0.127	0.000	0.127
27	26.5	27.5	1	3.300	0.121	0.000	0.121
28	27.5	28.5	0	3.300	0.121	0.000	0.121

Air Temperature and Density

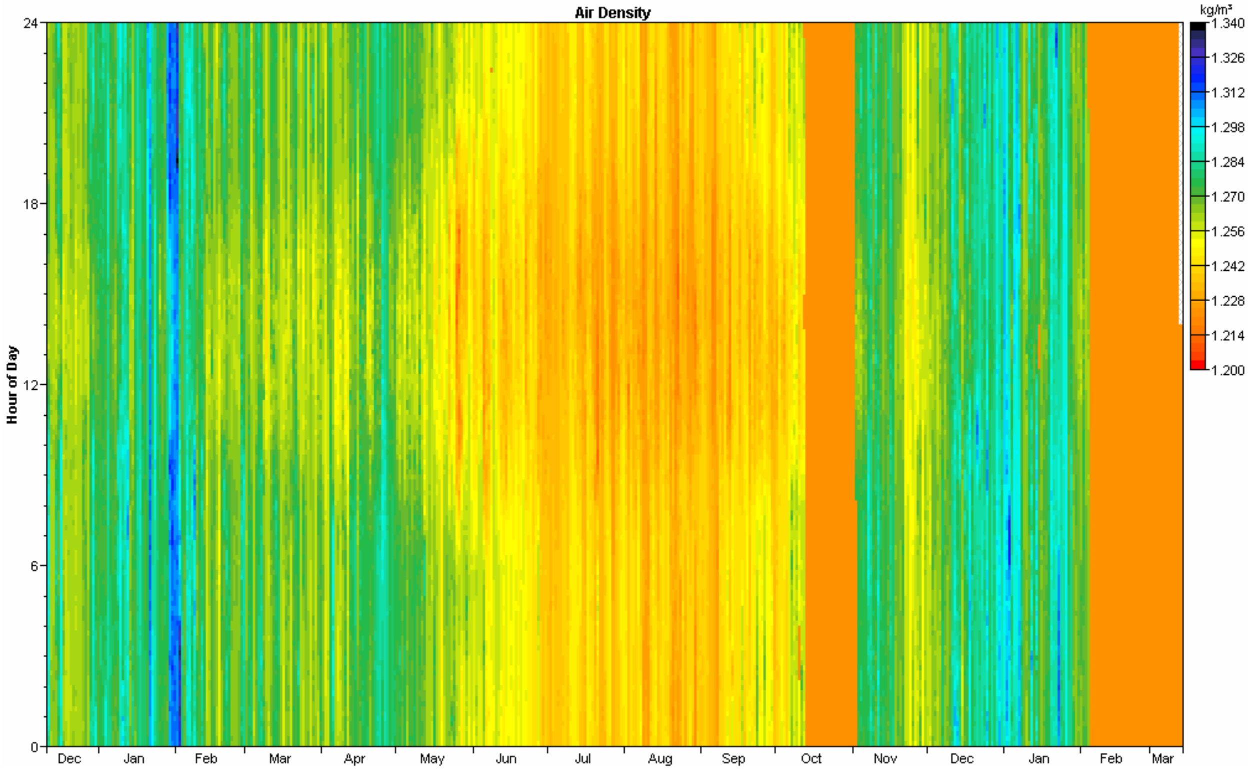
Over the reporting period, Nikolski had an average temperature of 6.5° C, although note that the temperature sensor began to fail in October 2006 and completely failed in February 2007. The minimum recorded temperature during the measurement period was -10.2° C and the maximum temperature was 17.2° C, indicating a cool temperate operating environment for wind turbine operations. Consequent to Nikolski's cool temperatures, the average air density of 1.253 kg/m^3 is 2.5 percent higher than the standard air density of 1.222 kg/m^3 (at 14.8° C and 100.9 kPa) at the test site elevation of 27 meters. Density variance from standard is accounted for in turbine performance predictions.

	Temperature				Density		
Month	Mean (°C)	Min (°C)	Max (°C)	Std. Dev. (°C)	Mean (kg/m³)	Min (kg/m³)	Max (kg/m³)
Jan	1.4	-7.0	6.4	2.59	1.281	1.221	1.322
Feb	3.2	-10.2	8.1	2.68	1.251	1.221	1.338
Mar	4.8	-0.6	10.0	1.58	1.253	1.221	1.291
Apr	4.0	-1.8	9.2	2.08	1.269	1.246	1.296
May	6.4	0.9	17.0	2.39	1.258	1.212	1.284
Jun	9.3	3.8	15.7	1.80	1.246	1.218	1.270
Jul	11.2	6.9	17.0	1.39	1.237	1.212	1.256
Aug	11.8	8.0	17.2	1.50	1.235	1.211	1.251
Sep	10.5	4.0	15.6	1.80	1.240	1.218	1.269
Oct	8.6	3.4	13.3	1.75	1.232	1.221	1.272
Nov	4.4	-1.7	10.1	2.24	1.266	1.221	1.296
Dec	3.2	-4.7	8.1	2.46	1.273	1.251	1.310
Annual	6.5	-10.2	17.2	4.17	1.253	1.211	1.338



Air Density DMap

The DMap is a visual indication of the daily and seasonal variations of air density (and hence temperature). Air densities higher than standard will yield higher turbine power than predicted by turbine power curves (which are calibrated for a sea level temperature of 15° C, air pressure of 101.3 kPa, and air density of 1.225 kg/m^3), while densities lower than standard will yield lower turbine power than predicted by the power curves. Orange bands in October 2006 and February and March 2007 indicated compromised temperature data. For these time periods, a standard temperature and air density are assumed.



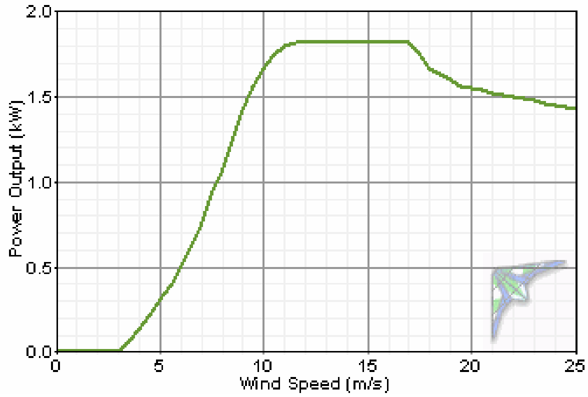
Turbine Performance Predictions

The turbine performance predictions noted below are based on 100 percent and 89 percent turbine availabilities. The 100 percent data is for use as a baseline of comparison, but it is realistic to expect ten percent or more of losses or downtime for wind turbines located in a small, remote community such as Nikolski.

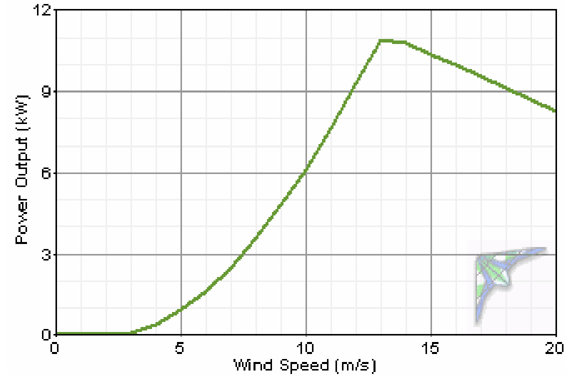
Note that these performance estimates were predicted with use of Windographer® wind analysis software; power curves provided by manufacturers are not independently verified and are assumed to be accurate. The power curves are presented for a standard air density of 1.225 kg/m^3 at sea level with standard temperature and pressure. However, the predictions of power production are density compensated by multiplying the standard density power output by the ratio of the measured air density to standard air density, accounting for the site elevation.

A number of smaller village-scale grid-connected turbines are profiled in this report for comparison purposes. These turbines were selected because they have market availability and they are deemed to be within a suitable range for consideration of wind power development in a village the size of Nikolski.

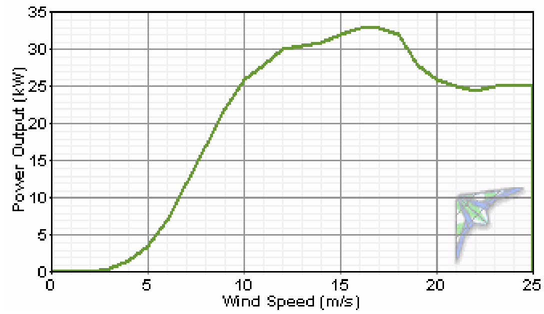
Southwest Skystream 3.7: 1.8 kW rated power output, 3.7 meter rotor diameter, stall-controlled. Available tower heights: 10.7 and 33.5 meters. Additional information is available at www.skystreamenergy.com.



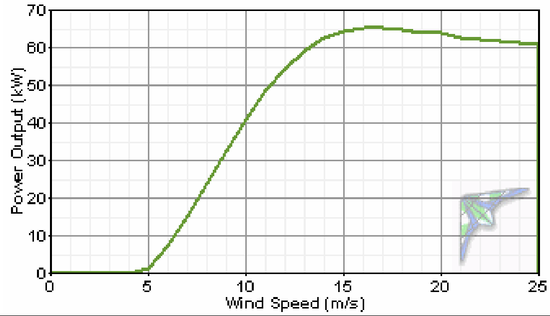
Bergey Excel-S: 10 kW rated power output, 6.7 meter rotor diameter, stall-controlled. Available tower heights: 18, 24, 30, 37 and 43 meters. Additional information is available at www.bergey.com.



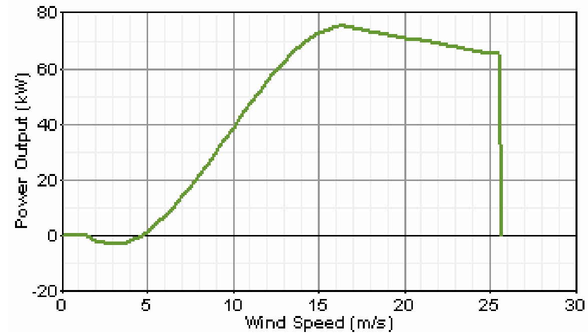
Fuhrländer FL30: 30 kW rated power output, 13 meter rotor, stall-controlled (power curve provided by Lorax Energy, LLC). Available tower heights: 26 and 30 meters. Additional information is available at http://www.fuhrlaender.de/ and http://www.lorax-energy.com/.



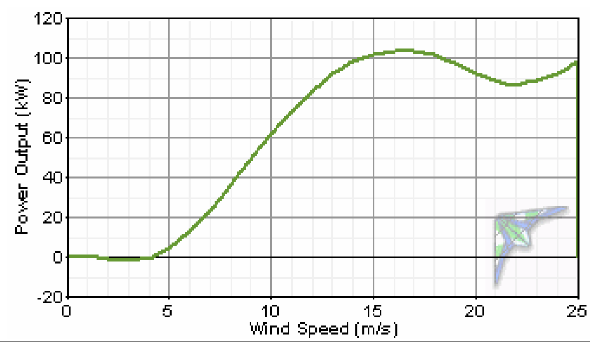
Entegrity eW-15: 65 kW rated power output, 15 meter rotor, stall-controlled (power curve provided by Entegrity Energy Systems). Available tower heights: 25 and 31 meters. Additional information is available at http://www.entegritywind.com/.



Vestas V15: 75 kW rated power output, 15 meter rotor, stall-controlled (power curve provided by Powercorp Alaska LLC). Available tower heights: 25, 31 and 34 meters. Additional information is available at http://www.pcorpalaska.com/.



Northwind 100/19: 100 kW rated power output, 19 meter rotor, stall-controlled (power curve provided by Northern Power Systems). Available tower heights: 25 and 32 meters. Additional information is available at http://www.northernpower.com/.



Turbine Power Output Comparison (100% turbine availability)

Turbine	Hub Height (m)	Hub Height Wind Speed (m/s)	Time At Zero Output (%)	Time At Rated Output (%)	Average Net Power Output (kW)	Annual Net Energy Output (kWh/yr)	Average Net Capacity Factor (%)
Southwest Skystream 3.7	10.7	7.72	13.9	22.7	0.92	8,059	51.2
Bergey Excel-S	24	8.82	8.3	15.1	4.63	40,508	46.3
Fuhrländer FL30	26	8.94	6.6	5.8	17.5	153,522	53.2
Entegrity eW-15 60 Hz	25	8.88	16.3	11.5	29.9	261,556	46.0
Vestas V15	25	8.88	20.1	6.6	30.3	264,644	40.4
Northern Power NW 100/19	25	8.88	16.3	8.1	42.3	369,639	42.3

Capacity Factor <20%	
Capacity Factor >20%, <30%	
Capacity Factor >30%, <40%	
Capacity Factor >40%, <50%	
Capacity Factor >50%	

Assumed turbine losses for predictions of average power output, annual energy output, and average capacity factor:

Downtime (%)	0
Array (%)	0
Icing/soiling (%)	0
Other (%)	0
Total (%)	0

Turbine Power Output Comparison (89% availability)

Turbine	Hub Height (m)	Hub Height Wind Speed (m/s)	Time At Zero Output (%)	Time At Rated Output (%)	Average Net Power Output (kW)	Annual Net Energy Output (kWh/yr)	Average Net Capacity Factor (%)
Southwest Skystream 3.7	10.7	7.72	13.9	22.7	0.82	7,198	45.7
Bergey Excel-S	24	8.82	8.3	15.1	4.14	36,182	41.4
Fuhrländer FL30	26	8.94	6.6	5.8	15.66	137,126	47.5
Entegrity eW-15 60 Hz	25	8.88	16.3	11.5	26.71	233,622	41.1
Vestas V15	25	8.88	20.1	6.6	27.03	236,380	36.0
Northern Power NW 100/20	25	8.88	16.3	8.1	37.76	330,162	37.8

Capacity Factor <20%
Capacity Factor >20%, <30%
Capacity Factor >30%, <40%
Capacity Factor >40%, <50%
Capacity Factor >50%

Assumed turbine losses for predictions of average power output, annual energy output, and average capacity factor:

Downtime (%)	7	
Array (%)	0	
Icing/soiling (%)	2	
Other (%)	2	
Total (%)	10.68	(factors are multiplicative)

Annual Fuel Cost Avoided for Energy Generated by Wind Turbine vs. Diesel Generator

Turbine	Annual Energy Output (kW-hr/yr)	Fuel Quantity Avoided (gallons)	Fuel Price (USD/gallon)							Turbine Hub Height (m)
			$1.75	$2.00	$2.25	$2.50	$2.75	$3.00	$3.25	
Southwest Skystream 3.7	7,198	600	$1,050	$1,200	$1,350	$1,500	$1,650	$1,800	$1,950	10.7
Bergey Excel-S	36,182	3,015	$5,277	$6,030	$6,784	$7,538	$8,292	$9,045	$9,799	24
Fuhrländer FL30	137,126	11,427	$19,998	$22,854	$25,711	$28,568	$31,425	$34,281	$37,138	26
Entegrity eW-15 60 Hz	233,622	19,468	$34,070	$38,937	$43,804	$48,671	$53,538	$58,405	$63,273	25
Vestas V15	236,380	19,698	$34,472	$39,397	$44,321	$49,246	$54,170	$59,095	$64,020	25
Northern Power NW 100/20	330,162	27,513	$48,149	$55,027	$61,905	$68,784	$75,662	$82,540	$89,419	25

Notes:

1. Nikolski electrical energy production efficiency assumed to be 12.0 kW-hr/gal
2. Assumes **89**% wind turbine availability with no diversion of power to a thermal or other dump load
3. Assumes linear diesel generator fuel efficiency (i.e., 1:1 tradeoff of wind turbine kW-hr to diesel genset kW-hr)

Temperature Conversion Chart °C to °F

°C	°F	°C	°F	°C	°F
-40	-40	-10	14	20	68
-39	-38.2	-9	15.8	21	69.8
-38	-36.4	-8	17.6	22	71.6
-37	-34.6	-7	19.4	23	73.4
-36	-32.8	-6	21.2	24	75.2
-35	-31	-5	23	25	77
-34	29.2	-4	24.8	26	78.8
-33	-27.4	-3	26.6	27	80.6
-32	-25.6	-2	28.4	28	82.4
-31	-23.8	-1	30.2	29	84.2
-30	-22	0	32	30	86
-29	-20.2	1	33.8	31	87.8
-28	-18.4	2	35.6	32	89.6
-27	-16.6	3	37.4	33	91.4
-26	-14.8	4	39.2	34	93.2
-25	-13	5	41	35	95
-24	-11.2	6	42.8	36	96.8
-23	-9.4	7	44.6	37	98.6
-22	-7.6	8	46.4	38	100.4
-21	-5.8	9	48.2	39	102.2
-20	-4	10	50	40	104
-19	-2.2	11	51.8	41	105.8
-18	-0.4	12	53.6	42	107.6
-17	1.4	13	55.4	43	109.4
-16	3.2	14	57.2	44	111.2
-15	5	15	59	45	113
-14	6.8	16	60.8	46	114.8
-13	8.6	17	62.6	47	116.6
-12	10.4	18	64.4	48	118.4
-11	12.2	19	66.2	49	120.2

Wind Speed Conversion Chart m/s to mph

m/s	mph	m/s	mph	m/s	mph
0.5	1.1	10.5	23.5	20.5	45.9
1.0	2.2	11.0	24.6	21.0	47.0
1.5	3.4	11.5	25.7	21.5	48.1
2.0	4.5	12.0	26.8	22.0	49.2
2.5	5.6	12.5	28.0	22.5	50.3
3.0	6.7	13.0	29.1	23.0	51.4
3.5	7.8	13.5	30.2	23.5	52.6
4.0	8.9	14.0	31.3	24.0	53.7
4.5	10.1	14.5	32.4	24.5	54.8
5.0	11.2	15.0	33.6	25.0	55.9
5.5	12.3	15.5	34.7	25.5	57.0
6.0	13.4	16.0	35.8	26.0	58.2
6.5	14.5	16.5	36.9	26.5	59.3
7.0	15.7	17.0	38.0	27.0	60.4
7.5	16.8	17.5	39.1	27.5	61.5
8.0	17.9	18.0	40.3	28.0	62.6
8.5	19.0	18.5	41.4	28.5	63.8
9.0	20.1	19.0	42.5	29.0	64.9
9.5	21.3	19.5	43.6	29.5	66.0
10.0	22.4	20.0	44.7	30.0	67.1

Distance Conversion m to ft

m	ft	m	ft
5	16	35	115
10	33	40	131
15	49	45	148
20	66	50	164
25	82	55	180
30	98	60	197

Selected definitions (courtesy of Windographer® software by Mistaya Engineering Inc.)

Wind Power Class

The wind power class is a number indicating the average energy content of the wind resource. Wind power classes are based on the average wind power density at 50 meters above ground, according to the following table. Source: Wind Energy Resource Atlas of the United States (http://rredc.nrel.gov/wind/pubs/atlas/tables/A-8T.html)

Wind Power Class	Description	Power Density at 50m (W/m^2)
1	Poor	0-200
2	Marginal	200-300
3	Fair	300-400
4	Good	400-500
5	Excellent	500-600
6	Outstanding	600-800
7	Superb	800-2000

Windographer classifies any wind resource with an average wind power density above 2000 W/m^2 as class 8.

Probability Distribution Function

The probability distribution function f(x) gives the probability that a variable will take on the value x. It is often expressed using a frequency histogram, which gives the frequency with which the variable falls within certain ranges or bins.

Wind Turbine Power Regulation

All wind turbines employ some method of limiting power output at high wind speeds to avoid damage to mechanical or electrical subsystems. Most wind turbines employ either stall control or pitch control to regulate power output.

A stall-controlled turbine typically has blades that are fixed in place, and are designed to experience aerodynamic stall at very high wind speeds. Aerodynamic stall dramatically reduces the torque produced by the blades, and therefore the power produced by the turbine.

On a pitch-controlled turbine, a controller adjusts the angle (pitch) of the blades to best match the wind speed. At very high wind speeds the controller increasingly feathers the blades out of the wind to limit the power output.

Results of Wind Monitoring at Sand Point
24 June, 2009

Report Outline

Project Overview/Summary of Results
Project Location
Project Instrumentation
Discussion of Wind Resource
Appendix

Project Overview/Summary of Results

As part of the NREL Native American Anemometer Loan Program an anemometers was installed near Sand Point, Alaska to assess the area's wind energy potential. This report describes the wind resource measured at this location. The monitoring period ran from 14 February 2004 to 6 July 2005.

The measured average power density and wind speed, measured at 20m (66ft), are 424 W/m^2 and 6.7 m/s (14.9 mph) respectively. This is consistent with the resource indicated by publically available wind maps. For example, the 3Tier wind map (Figure 4) (http://firstlook.3tiergroup.com/) estimates the average wind speed at the site (@ 20m AGL) at between 5.9 and 10.6 m/s. (13.1 mph – 23.6 mph)

The wind data for this site was processed using three different software packages. The first is a package, referred to as the NREL Package" that has been developed at NREL for internal use. The advantage of this software package it that it provides values for the power density. The values provided by this package will be used in the main body of the report. The next package, WindPro, has been the software used to provide the interim plots during the monitoring period. Windpro provides the capability to exclude zero's (for wind speed) when calculating the average wind speed and the analyzing the wind speed distribution. Finally, Windographer provides nice rose plots of both frequency versus wind direction and relative energy versus wind direction. The values provided by the NREL package will be used in the main body of the report, but occasionally, the Windpro and Windographer values will be provided as well. The Windpro plots are provided in the back of this report.

Project Location

The monitoring site is located just north of Sand Point, AK (N 55.34567 °, W 160.48832 °) at an elevation of 52m (170 ft). See Figure 1 through Figure 3. Figure 1 and Figure 2 also show the location of the reference site which provides long term wind data. This can be used to determine how closely the collected data matches the long term mean wind resource.

Project Instrumentation

The instrumentation consisted of an NRG Wind Explorer system. This included a cup anemometer, wind vane and data logger. The instruments were mounted at a height of 20m (66ft) on a tilt-up tubular tower. The collected data consisted of 10-minute average wind speed, including wind speed standard deviation and wind direction.

Figure 1: Project Location (Regional)

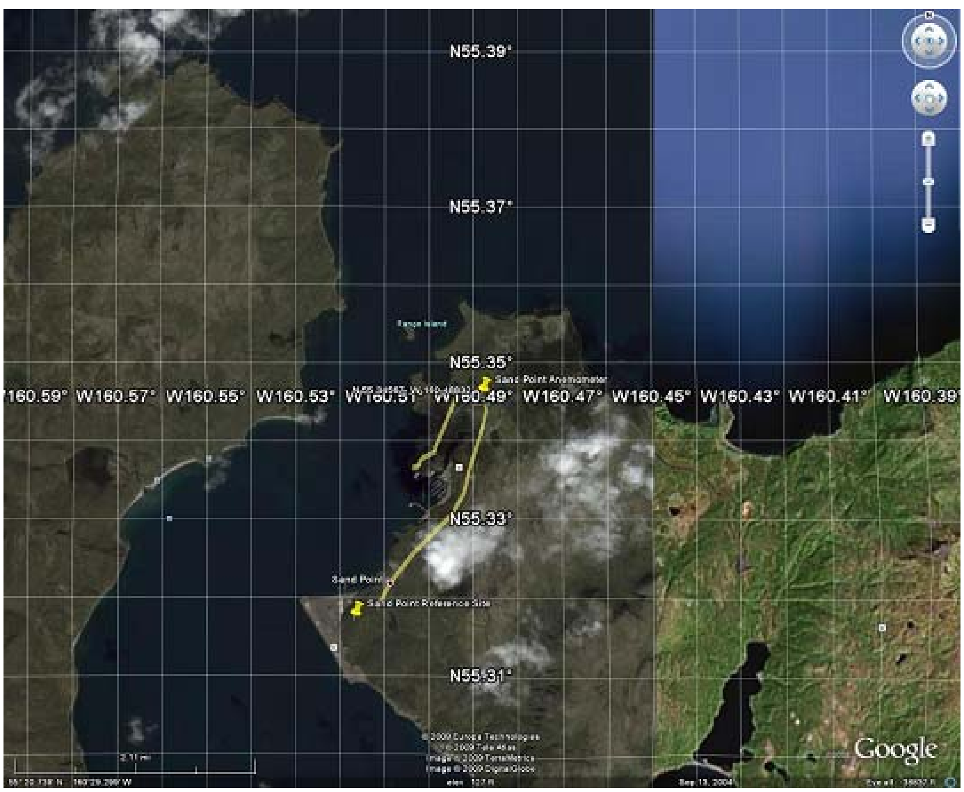


Figure 2: Project Location (Mid Scale)

Figure 3: Project Location (Close Up)

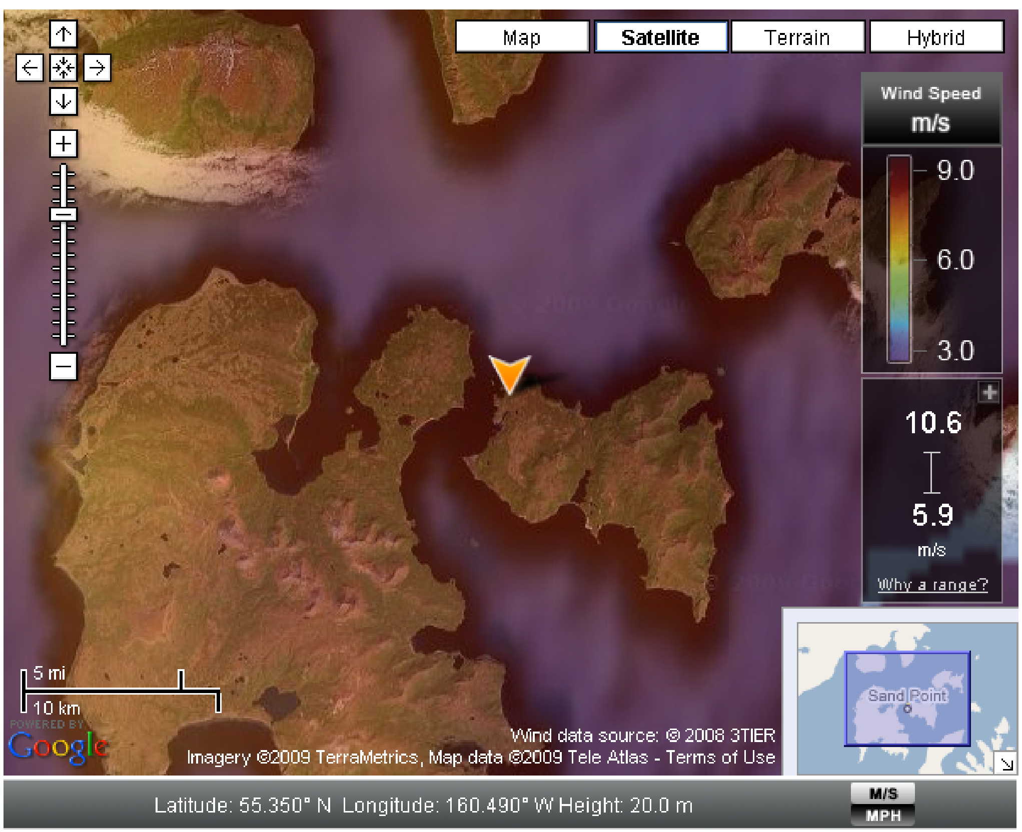


Figure 4: 3Tier Wind Map **(**Source: http://firstlook.3tiergroup.com/**)**

Discussion of Wind Resource

Figure 5 summarizes the collected wind data.

The values for the 50-meter wind speed and power density are conservative estimates using a wind shear factor of 0.15. The shear could well be higher in which case the average wind speed and power density (@ 50m AGL) will be higher.

	Average Wind Speed (m/s)	**Average Power Density (W/m^2)**
Average Annual Wind Speed & power density	6.7 m/s (14.9 mph)	424 W/m^2
Average wind speed & power density for best month (December)	8.2 m/s (18.2 mph)	694 W/m^2
Average wind speed & power density for worst month (July)	4.2 m/s (9.3 mph)	101 W/m^2
Estimated Resource @ 50 meters	7.6 m/s (16.9 mph)	640 W/m^2

Figure 5: Wind Data Summary

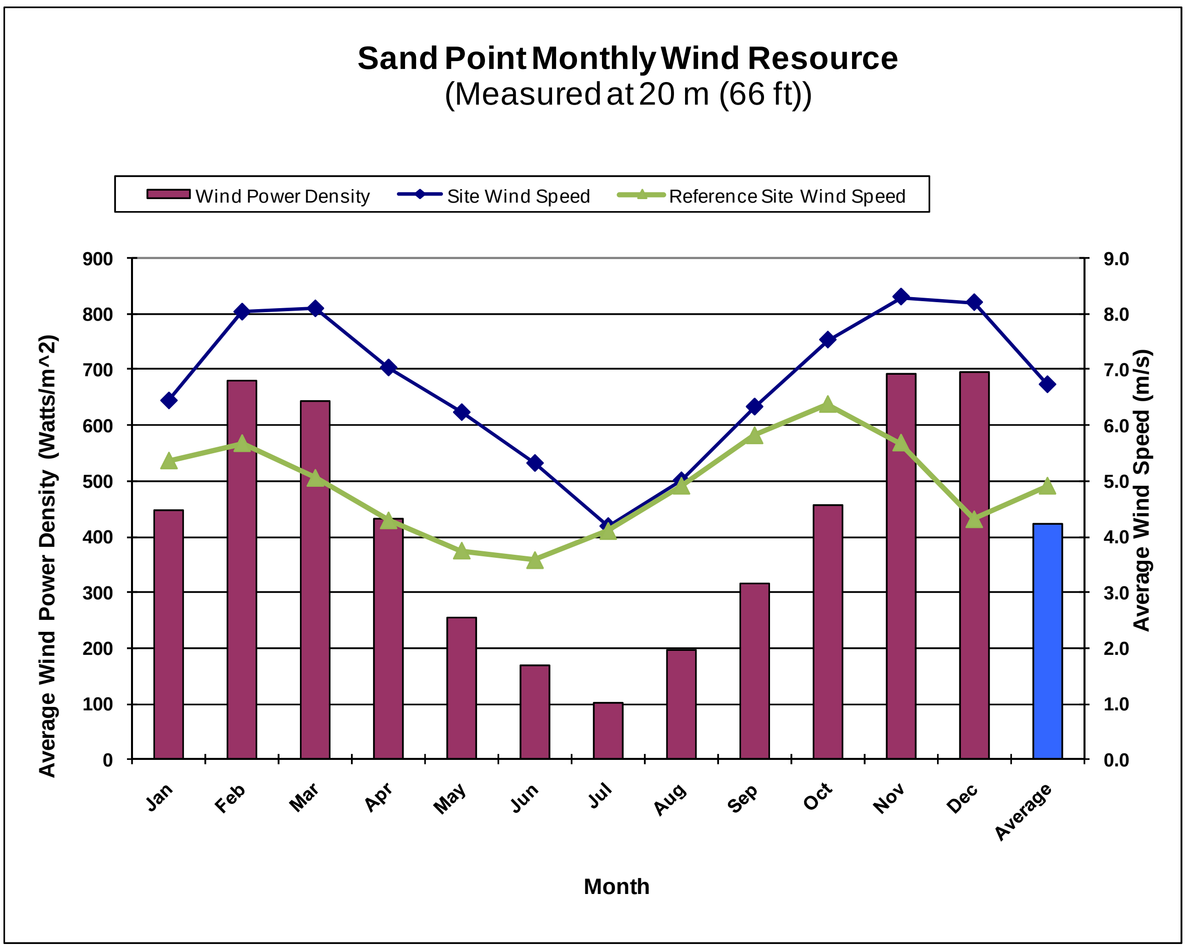


Figure 6: Monthly average and annual average wind power density and wind speed.

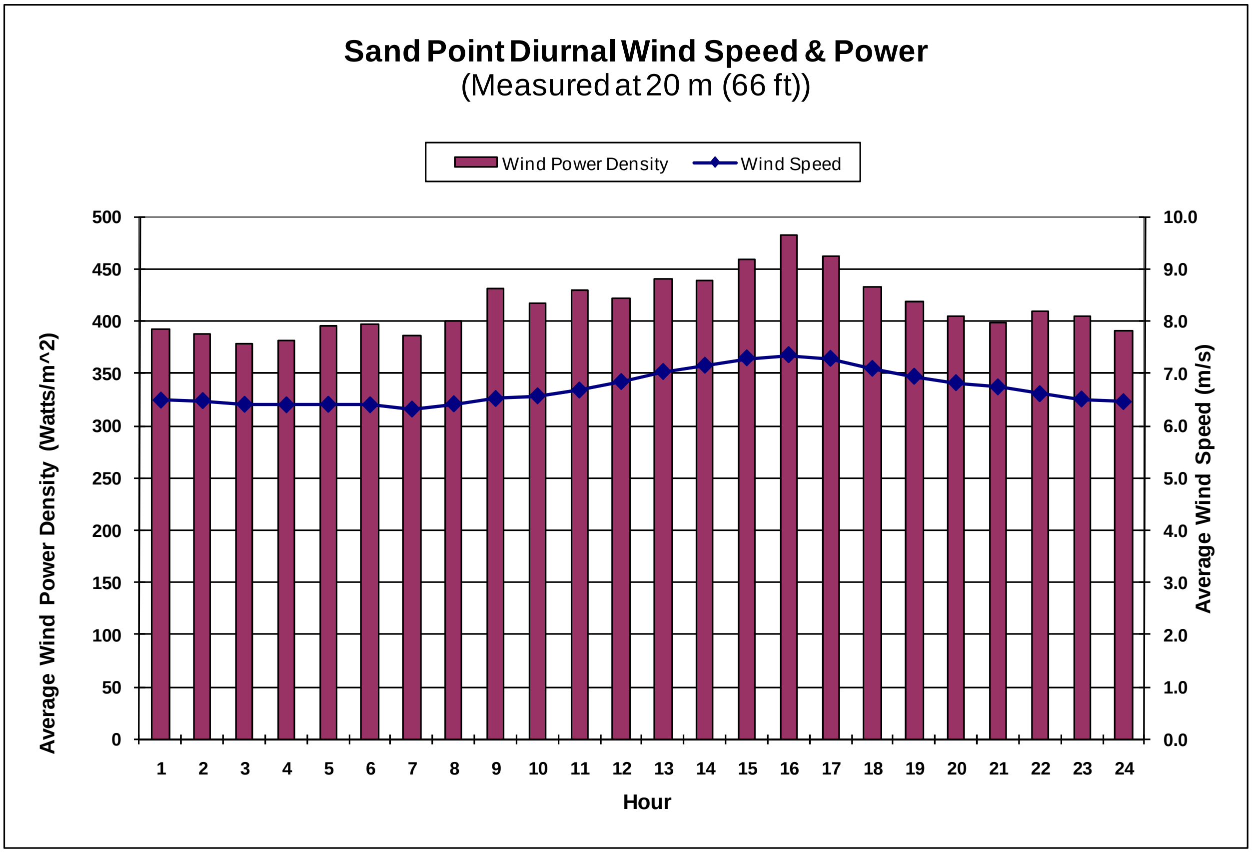


Figure 7: Average annual daily wind profile.

Speed and Power by Month

Figure 6 shows the monthly and annual average wind power density. The measured annual average power density is 424 W/m^2. The measured annual average wind speed is 6.7 m/s (14.9 mph). The winter months have the greatest wind resource while the early summer has the lowest wind resource. The wind resource at this site is extremely seasonal, with the average wind speed varying by a factor of two between the summer and winter and the average power density varying by a factor four. Figure 6 also shows the long term monthly average wind speeds for the reference site. This data usually gives a better indication of how the wind resource varies by season than does the collected data. In this case the measured data broadly follows the pattern of the reference site data. Compared to the long term data, the monitoring period data shows a more pronounced difference between the summer and winter wind speeds. Both the measured data and the reference data show a mid-winter dip in the monthly average wind speeds. For the measured data this dip occurs in January compared to December for the reference data. Finally, the lowest wind speed month in the collected data is July, compared to June for the reference site data.

Speed and Power by Hour

Figure 7 shows the annual average diurnal (daily) profile for the site. In general the winds are highest in the mid afternoon and weakest in the very early morning. (See Appendix B for monthly profiles). Compared to most other sites examined by this author, the diurnal profile at this site is weak. Be advised it is very possible that the diurnal profile may shift with increasing height.

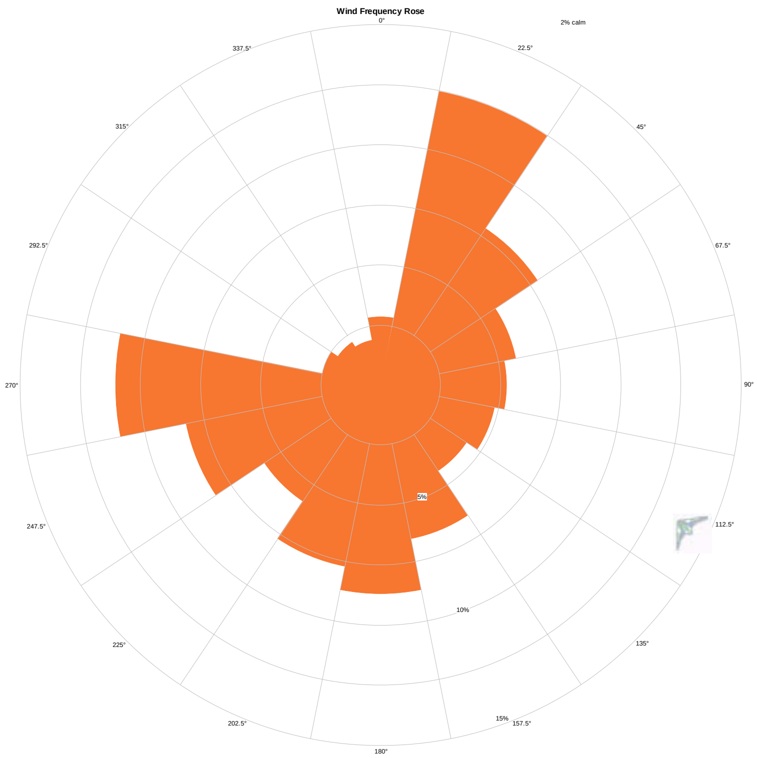


Figure 8A: Frequency by direction.

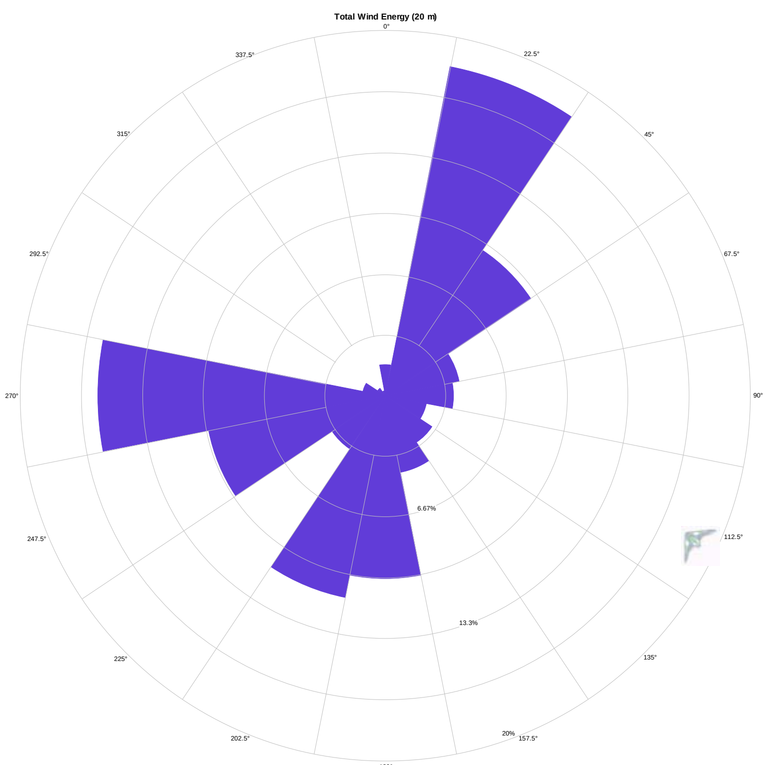


Figure 8B: Energy by direction.

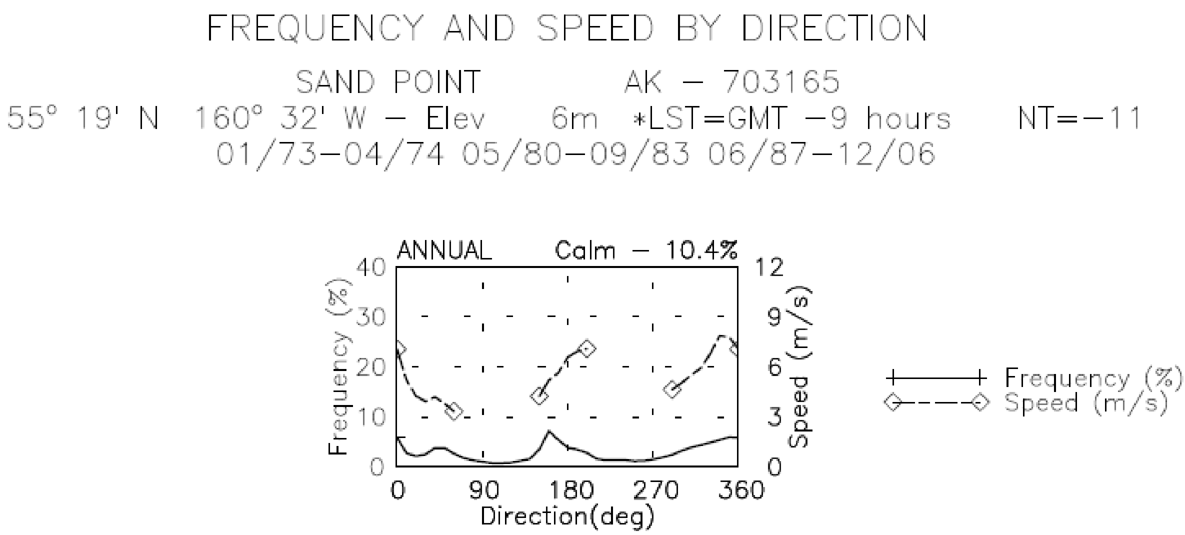


Figure 8C: Reference Site frequency and mean wind speed by direction

Frequency and Speed by Direction
Both Figure 8A and 8B show the prevailing & energetic winds coming from the NNE and the west. The most energetic winds come from NNE, with secondary peaks from the west and SSW. However, Figure 8C, which shows the frequency and mean wind speed rose for the long term reference site data, indicates that a significant portion of the winds come from the quadrant 270 – 360 degrees, (west – north). The lack of wind from this quadrant in the measured wind data is noteworthy to the NREL meteorologist who reviewed this report. A possible explanation for this observation is that the anemometer had poor exposure (for whatever reason) to the winds coming from this direction.

Frequency of Speed and Percent of Power by Speed
Figure 9 shows the annual frequency distribution of wind speed and power density. The line labeled PCTs shows the fraction of time that the wind falls within the specified bin. The line labeled PCTp shows the fraction of total annual energy contributed by winds of the indicated wind speed bin. On an annual basis, while over half of the time the wind speed is between 2 m/s and 9 m/s (61%), most of the wind energy is from winds with wind speeds from 7 to 15 m/s (64%). (See Appendix B).

The percentage of calms, 4.9%, while low, is a bit high for such a high wind speed site such as this one. This could be due to the strong seasonal wind profile of this site, with very strong fall, winter, & spring winds and light summer winds.

The best fit weibull distribution parameters for the measured data are k = 1.8 and c = 7.6. The k value indicates how widely the winds are distributed. The weibull k value of this site, at less than 2, is more typical of a continental inland site, than a coastal site such as this one. A possible explanation for the unusually low Weibull is the strong seasonal wind profile at this site.

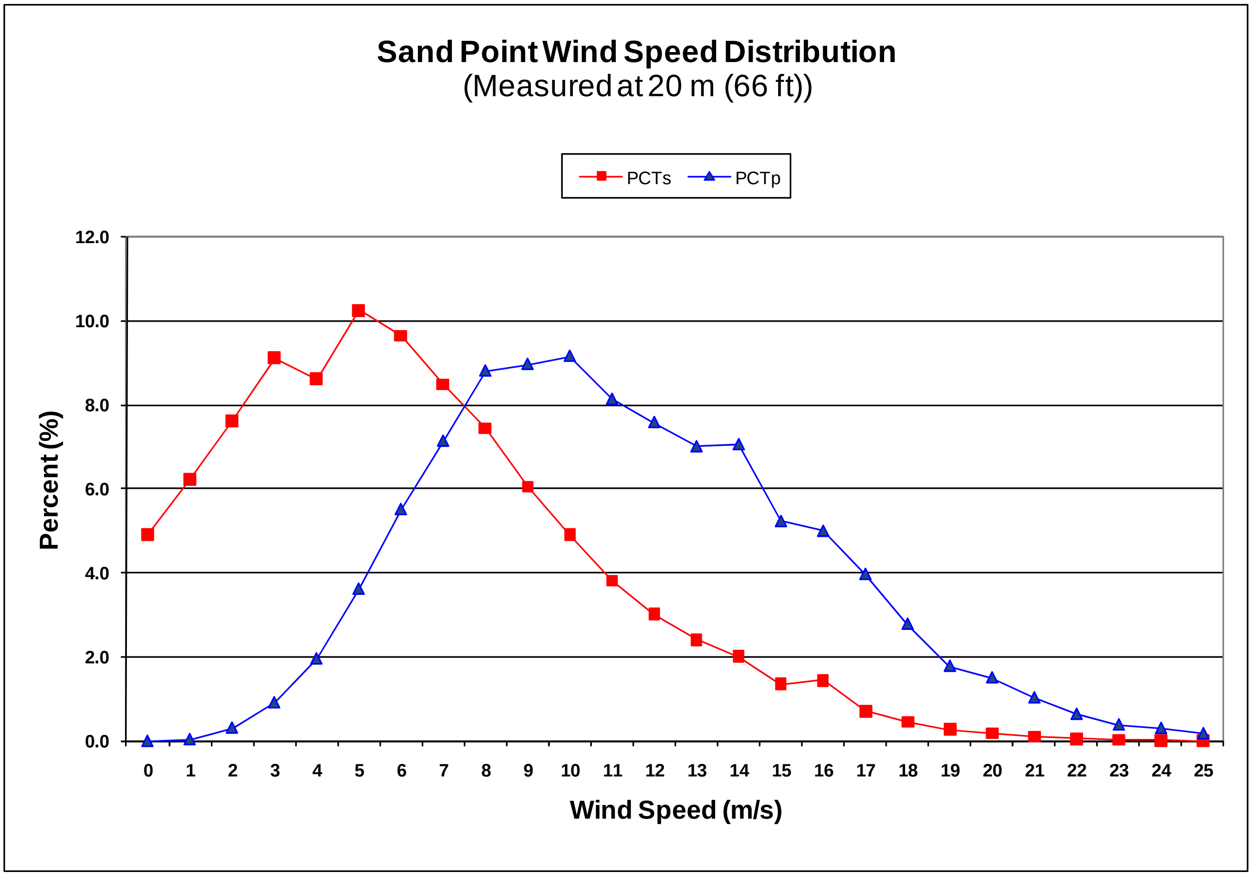


Figure 9: Annual wind and wind energy distribution.

Comparison of anemometer data with long term average data

An important consideration is the closeness with which the measured data reflects the long-term (multi-year) average wind resource. In other words, does the monitoring period data reflect a good year, a bad year or an average year? To answer this question long term data from a nearby reference site, Sand Point, was examined. For this site the multi year average wind speed was compared to the wind speed during the monitoring period. The results are given in the table and graph below.

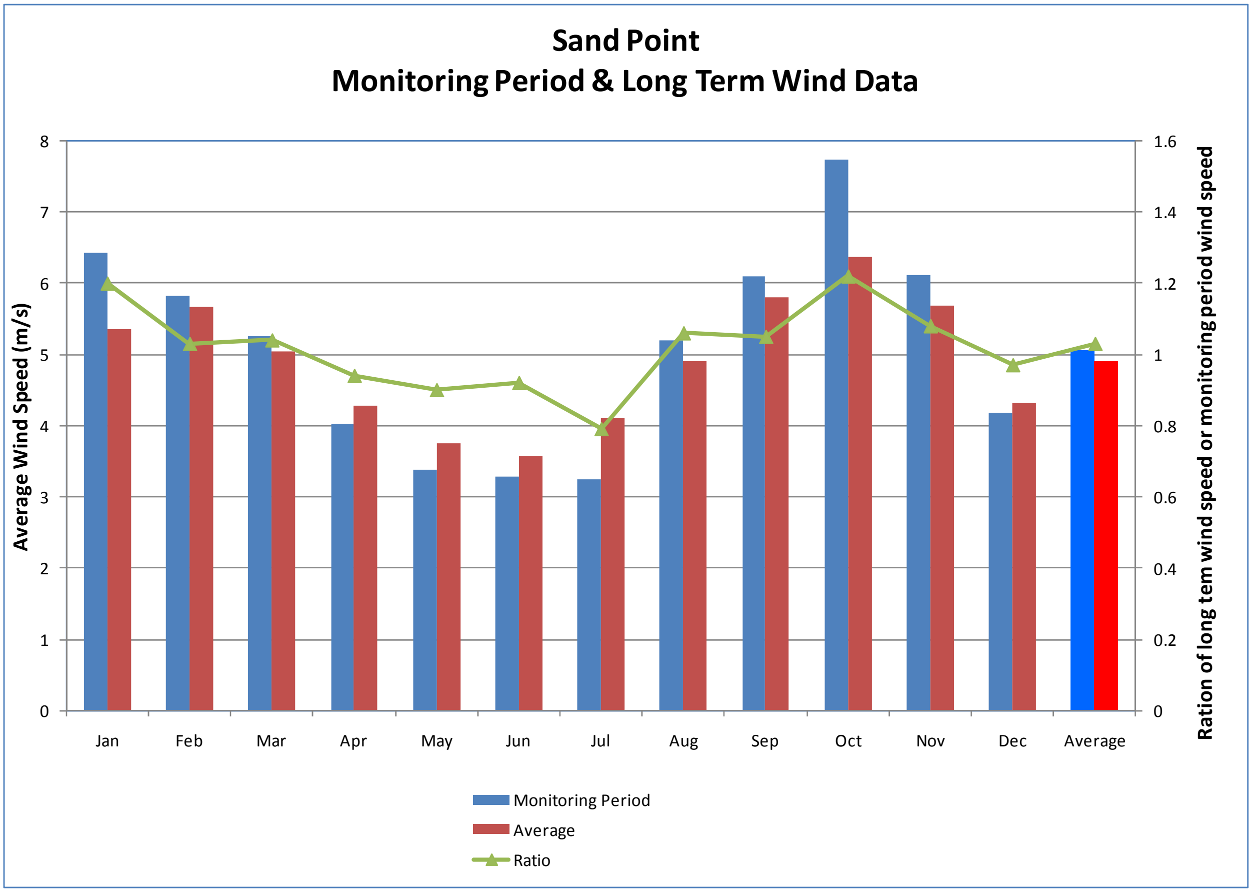


Figure 11: Comparison of long term data with monitoring period data

Figure 11 and Figure 12 show the monitoring period average wind speed compared to the long-term mean wind speed at the reference site. The data shows that during the monitoring period winds were higher than normal in the fall and winter and lower than normal in the spring and summer. The ratio of 1.03 indicates that overall, the monitoring period wind speeds at the reference station were slightly higher than the long-term mean wind speeds, however the difference is small (< 5%) This gives evidence that in general, the winds during the monitoring period are representative of the long term mean wind resource.

	Lat	Long	Monitoring Period	Long Term	Ratio
Sand Point	55.32	160.53	5.06	4.91	1.03
Monitoring Site	55.35	160.49			

Figure 12: Long term versus monitoring period wind data for reference stations.

Appendix A: Wind Data in Tabular Form

Table A1: Monthly average and annual average wind power density and wind speed.

Month	Wind Speed (monitoring site) (m/s)	Wind Power (monitoring site) (W/m^2)	Wind Speed (Reference Site) (Long Term) (m/s)
Jan	6.4	448	5.4
Feb	8.0	681	5.7
Mar	8.1	642	5.1
Apr	7.0	431	4.3
May	6.2	256	3.8
Jun	5.3	170	3.6
Jul	4.2	101	4.1
Aug	5.0	198	4.9
Sep	6.3	316	5.8
Oct	7.5	458	6.4
Nov	8.3	692	5.7
Dec	8.2	694	4.3
Average	6.7	424	4.9

Table A2: Average annual daily wind profile.

Hour	Wind Speed (m/s)	Wind Power (W/m^2)
1	6.5	393
2	6.5	388
3	6.4	379
4	6.4	382
5	6.4	395
6	6.4	398
7	6.3	387
8	6.4	401
9	6.5	431
10	6.6	418
11	6.7	429
12	6.8	421
13	7.0	440
14	7.2	439
15	7.3	460
16	7.4	482
17	7.3	462
18	7.1	433
19	6.9	419
20	6.8	406
21	6.7	398
22	6.6	410
23	6.5	404
24	6.5	392

Table A3: Frequency and Energy by direction.

	F%	%Pwr
Calm	4.9	
22.5	11.3	19.3
45	7.7	9.3
67.5	6.2	4.6
90	5.8	3.4
112.5	5.2	2.2
135	4.6	2.5
157.5	6.9	4.3
180	8.8	9.8
202.5	7.1	10.1
225	5.4	3.5
247.5	7.5	10.6
270	10.2	16.7
292.5	2.3	1.3
315	2.0	0.4
337.5	1.7	0.3
360	2.6	1.6

Table A4: Annual wind and wind energy distribution.

Wind Speed (m/s)	PCTs	PCTp
0	4.9	0.0
1	6.2	0.0
2	7.6	0.3
3	9.1	0.9
4	8.6	2.0
5	10.3	3.6
6	9.6	5.5
7	8.5	7.1
8	7.4	8.8
9	6.1	9.0
10	4.9	9.2
11	3.8	8.1
12	3.0	7.6
13	2.4	7.0
14	2.0	7.1
15	1.4	5.2
16	1.5	5.0
17	0.7	4.0
18	0.4	2.8
19	0.3	1.8
20	0.2	1.5
21	0.1	1.0
22	0.1	0.6
23	0.0	0.4
24	0.0	0.3
25	0.0	0.2

Appendix B: Interpretation of the Wind Data Charts

Introduction

This appendix is a guide to interpreting the wind data charts included in the report. Included are background information and an explanation of the meaning of the data in each chart.

The annual results given in the charts in this appendix will differ somewhat from the results given in the charts in the main body of the report. This is due to differences in how the data is processed. This is best described by using an example. Let us assume that 15 months of data was collected from a site, with the monitoring period running from 1 January 2003 to 31 March 2004. The annual average numbers given in the appendix simply provide the average of all the data collected. However this double counts the months of January, February & March. If these months tend to be windier than the rest of the year, then the wind resource will be over estimated.

The proper procedure is to average together the data from the double counted months before averaging the data to create annual averages. This is what has been done for the charts in the main body of the report.

The reason the software does not do this is that it was really designed to process multiyear data. If 9.5 years of data are processed, having 10 Januarys and 9 Julys creates negligible error. However, with only a little over a year of data, the double counted months can cause noticeable error.

Power Density versus Wind Speed

Wind turbines convert the kinetic energy of moving air into useful mechanical or electrical energy. The power of a column of moving air is given by the equation below.

$$P = 0.5\rho A v^3 \qquad \text{(Equation B - 1)}$$

Where

P	=	power in a column of air (watts)
ρ	=	density of air (kg/m^3) (Roughly ~ 1 kg/m^3)
A	=	cross sectional area of the column of air (m^2)
v	=	velocity of the air (m/s)

Thus the power a wind turbine can extract from the wind is proportional to the cross sectional area of the rotor, the density of the air, and the cube of the wind velocity. At a given location the air density typically doesn't change by more than 10%. Therefore the big variable is the wind speed. Annual average wind turbine production is very sensitive to the annual average wind speed.

A wind turbine cannot extract all the energy from the air stream moving past it. A wind turbine's extraction efficiency typically varies with wind speed. In their range of maximum conversion efficiency most of today's wind turbines extract about 40% - 50 % of the wind's energy.

Power density is simply the power divided by the cross sectional area. Power density is given in units of watts per meter squared. (watts/m^2)

$$\text{Power Density} = 0.5\rho v^3 \qquad \text{(Equation B - 2)}$$

The cubic dependence of wind power density upon velocity underscores the importance of accurately characterizing the wind at a given location. A small uncertainty in wind speed translates to a large uncertainty in wind turbine power production. For example a 5% uncertainty in wind speed leads to a 15% uncertainty in power output. The cubic relationship also makes it more difficult to predict the long-term performance of a wind turbine. More information is needed than simply the average wind speed. For example, imagine a location where the wind speed is a constant five meters per second. The average power density of a column of air with a 1m^2 cross section is then $0.5 * 1.0\ kg/m^3 * 1.0\ m^2 * 5\ (m/s)^3 =$ 62.5 watts. Over a year the total energy of that column would be 547.5 kWh (this is found by multiplying the average power density by the number of hours in a year, then dividing by 1000 to convert to kilowatts). Now imagine a location where half the time the wind speed is 3 m/s and the other half the time the wind speed is 7 m/s. The average wind speed is still 5 m/s but the average power density is now $0.5*1.0*1.0*(3^3 + 7^3)/2 = 92.5$ watts. This leads to an annual energy of 810 kWh.

Power density is listed in many of the graphs below because power density gives a better indication of wind turbine production than does wind speed alone. As can be seen from the graph titled "Speed and Power by Month," power density correlates to wind speed, but doesn't follow wind speed exactly.

Wind Speeds/Wind Directions
These first plots simply show the wind speed and direction for the monitoring period. Good data is shown with a solid line. Bad data is shown with a dotted line.

Speed and Power by Month
This graph gives the average wind speed and average power density for each month. This shows how the wind resource is distributed throughout the year.

Observations by Month
This graph shows the number of observations for each month. The greater the number of observations, the greater the probability the data is close to the long-term average resource.

Speed and Power by Hour
The top graph shows how the wind speeds and power densities are distributed by time of day over the whole year. The other 12 graphs show the same thing for each month. On top of each graph is an average wind speed and power density for the period in question.

Frequency and Speed by Direction
These graphs show how the winds are distributed by direction. The solid line shows the fraction of time that the wind comes from a particular direction. The dotted line shows the average wind speed of the winds coming from a particular direction. Above each graph the fraction of time that the wind is calm (below 1.0 m/s) is given. These graphs indicate the directions from which the strongest winds come. Special care should be taken to ensure the wind turbines have good exposure to winds from these directions.

Frequency of Speed and Percent of Power by Speed
These graphs show the distribution of wind speeds and power densities. The solid line indicates the fraction of time that the wind has a particular velocity. The solid line indicates the fraction of the total wind power contributed by winds at each wind speed.

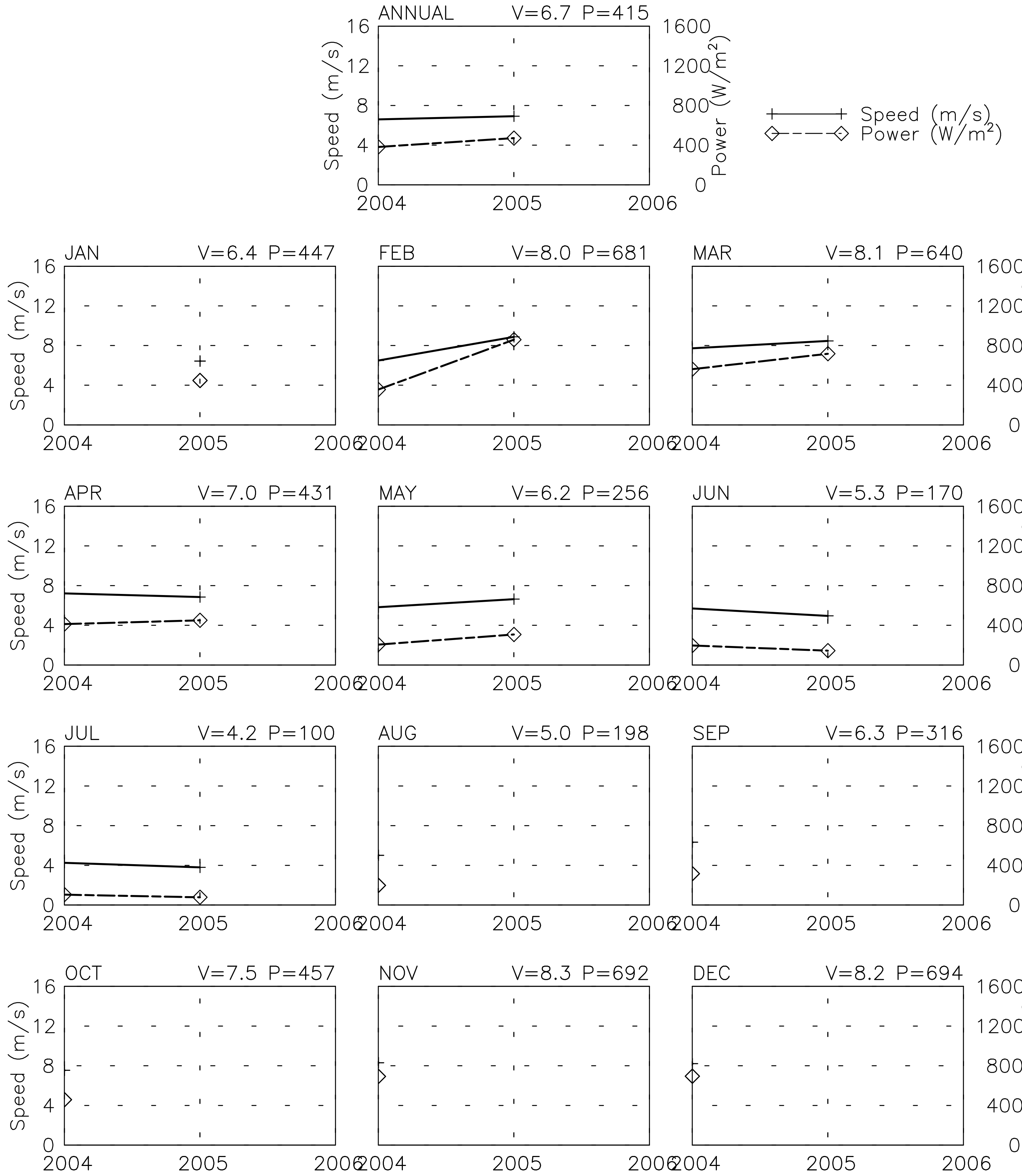
Appendix C: Wind Data Graphs
NREL Software Package

SPEED AND POWER BY YEAR

Sand Point 20m - 000291

55° 21' N 160° 29' W - Elev 52m LST=GMT+99 hours *NT=-11

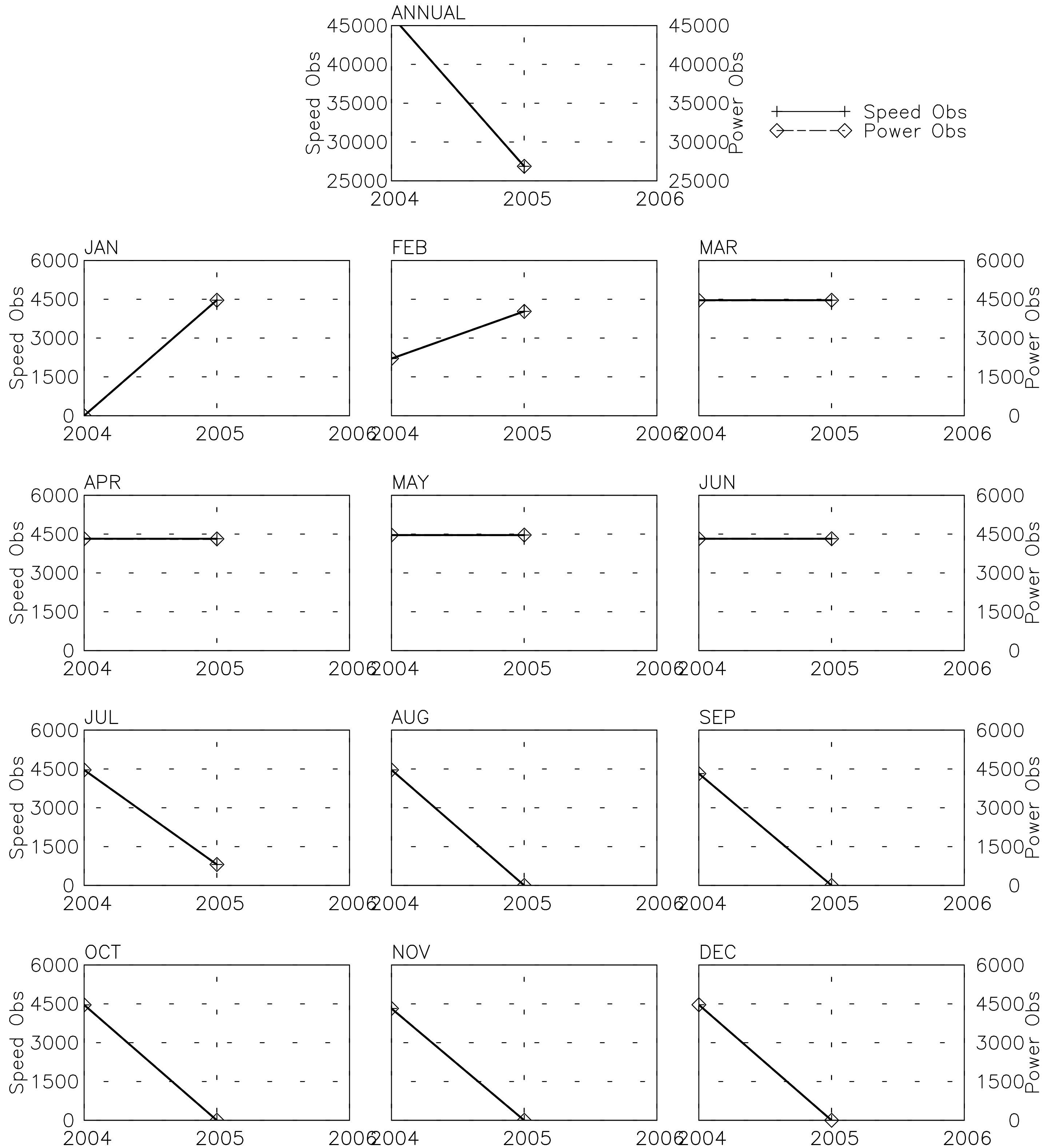
02/04-07/05



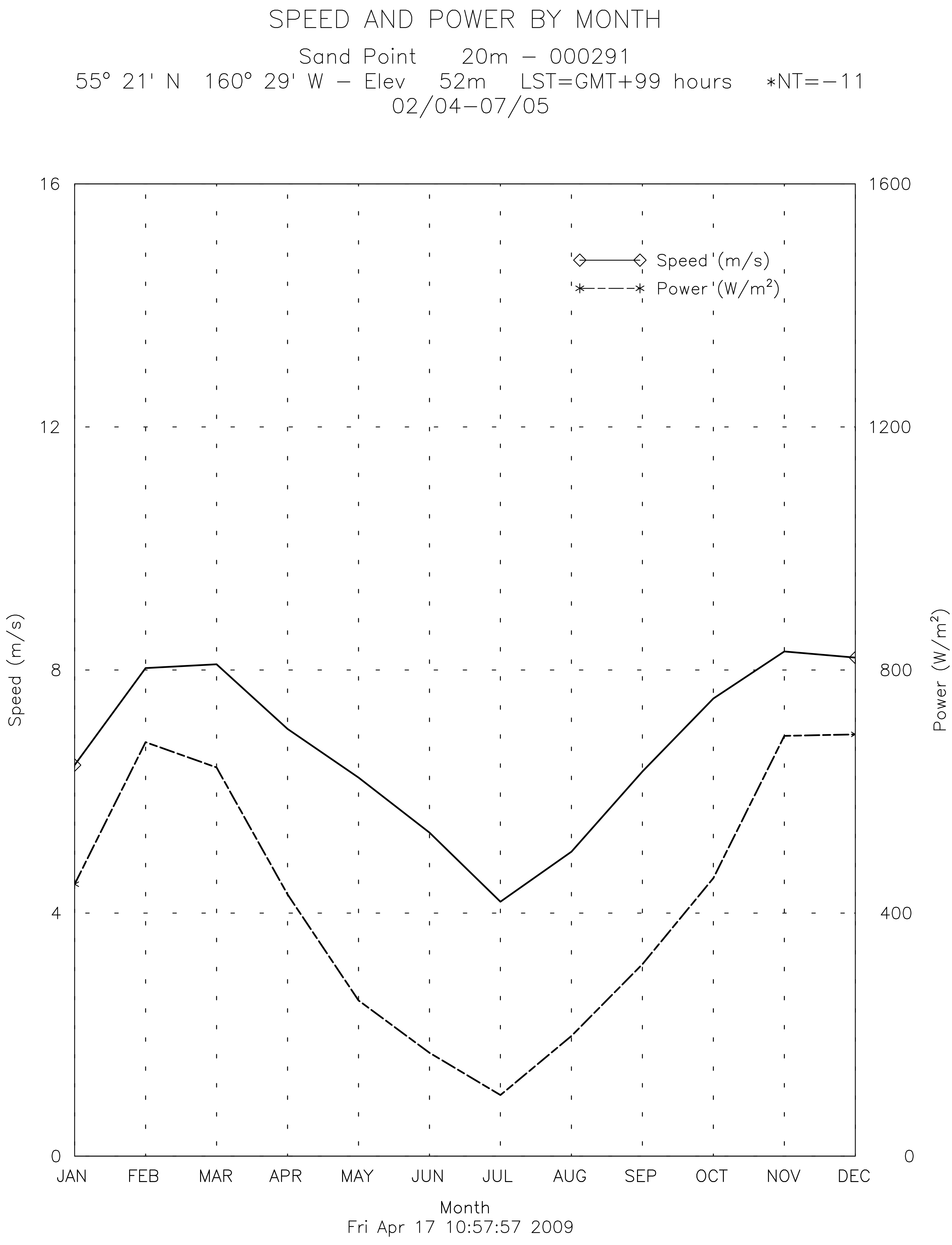
Fri Apr 17 10:57:56 2009

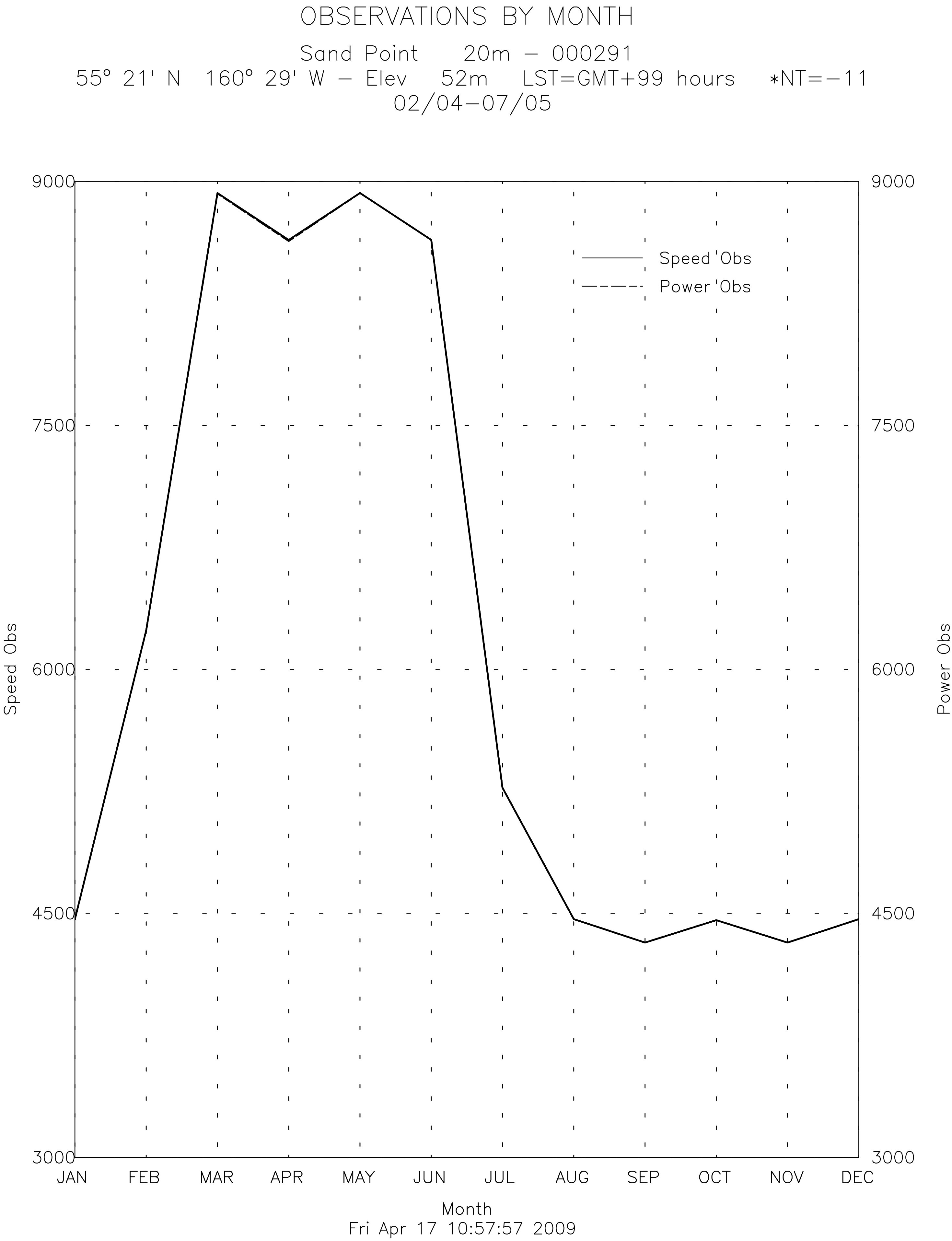
OBSERVATIONS BY YEAR

Sand Point 20m - 000291
55° 21' N 160° 29' W - Elev 52m LST=GMT+99 hours *NT=-11
02/04-07/05



Fri Apr 17 10:57:56 2009


SPEED AND POWER BY MONTH
Sand Point 20m - 000291
55° 21' N 160° 29' W - Elev 52m LST=GMT+99 hours *NT=-11
02/04-07/05
Speed (m/s)
Power (W/m²)
Speed (m/s)
Power (W/m²)
16
12
8
4
0
1600
1200
800
400
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Month
Fri Apr 17 10:57:57 2009

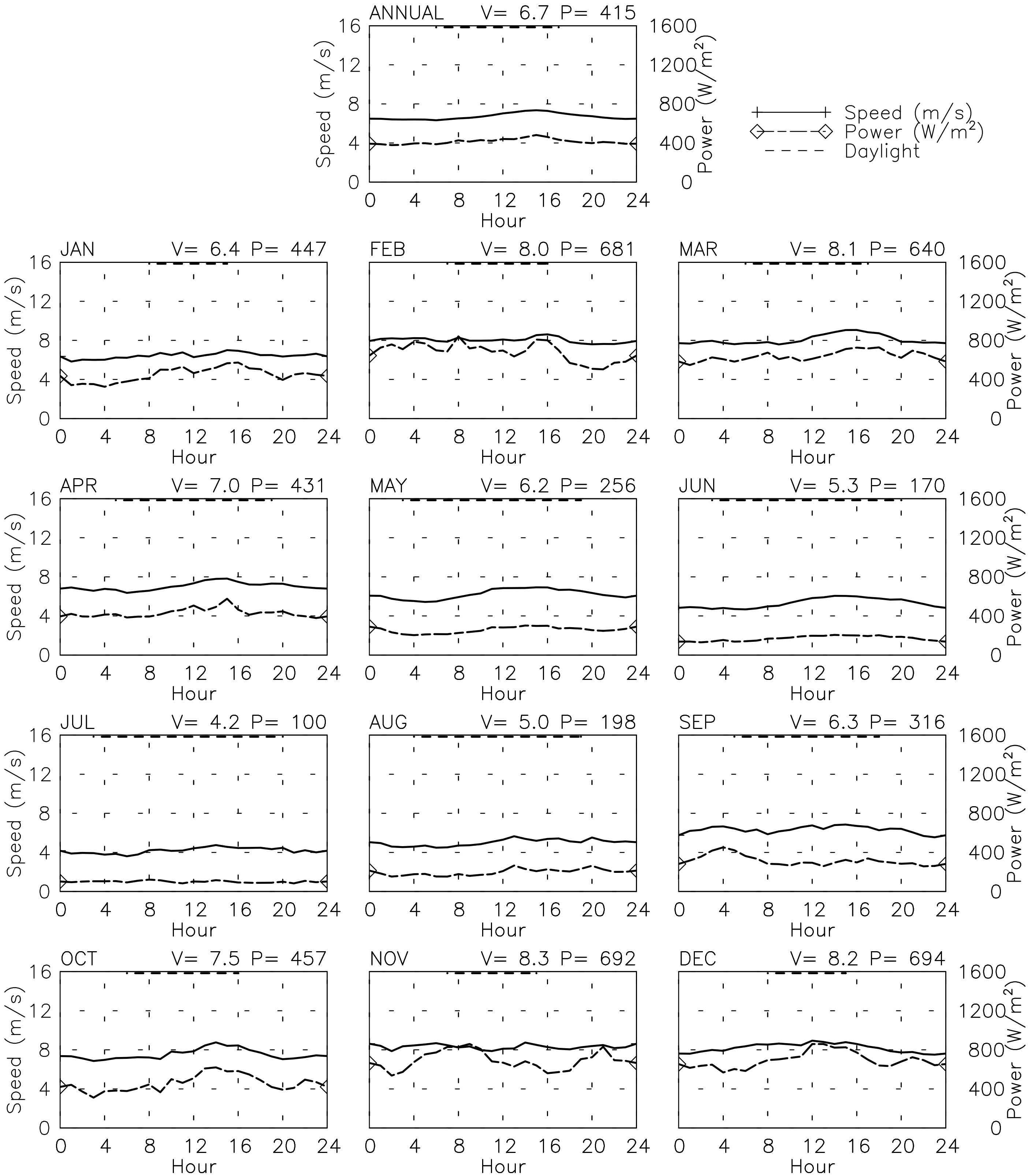

OBSERVATIONS BY MONTH
Sand Point 20m - 000291
55° 21' N 160° 29' W - Elev 52m LST=GMT+99 hours *NT=-11
02/04-07/05
9000
7500
6000
4500
3000
Speed Obs
Power Obs
Speed'Obs
Power'Obs
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Month
Fri Apr 17 10:57:57 2009

SPEED AND POWER BY HOUR

Sand Point 20m – 000291

55° 21' N 160° 29' W – Elev 52m LST=GMT+99 hours *NT=–11

02/04–07/05



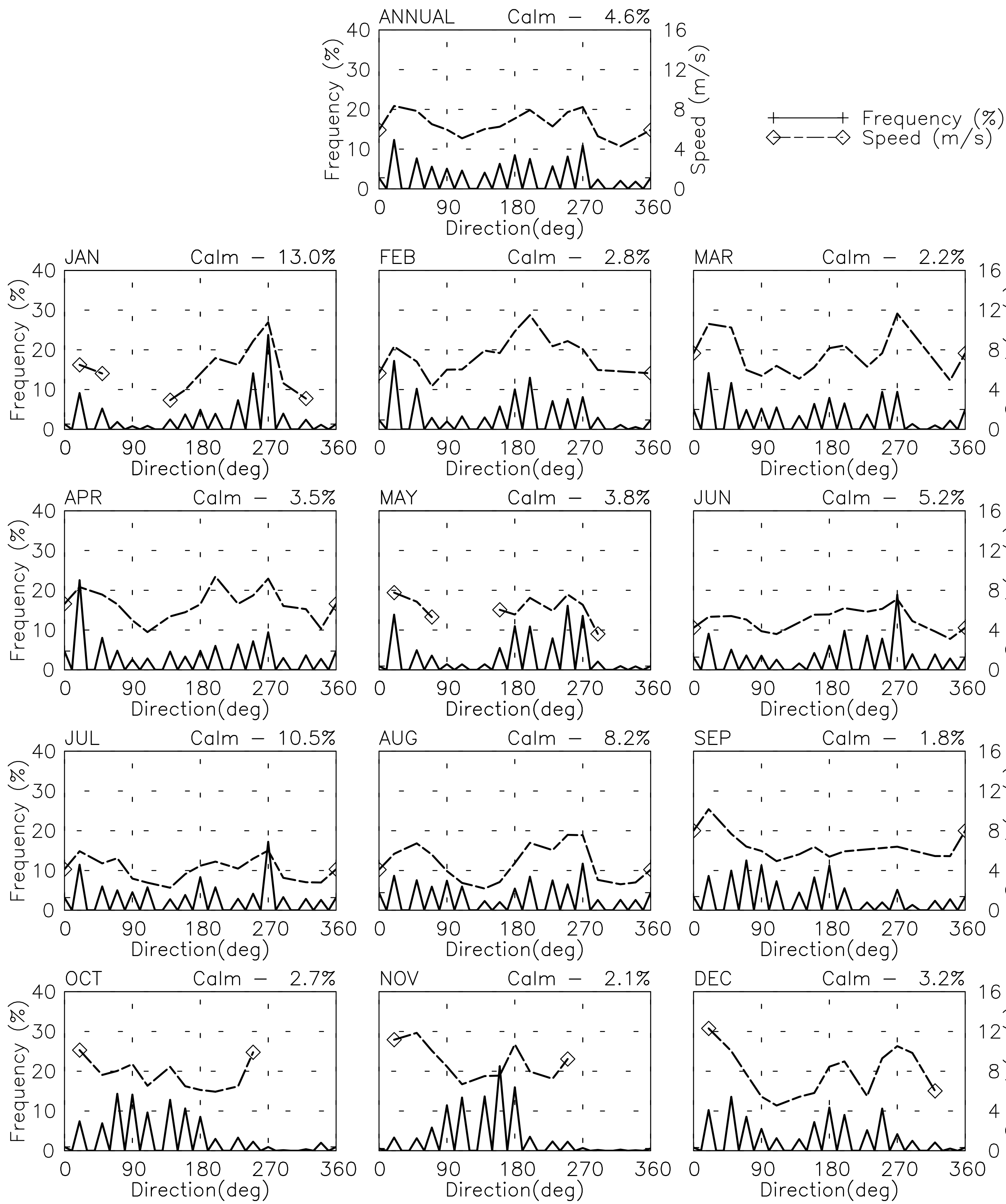
Fri Apr 17 10:57:57 2009

FREQUENCY AND SPEED BY DIRECTION

Sand Point   20m – 000291

55° 21' N 160° 29' W – Elev 52m LST=GMT+99 hours *NT=–11

02/04–07/05



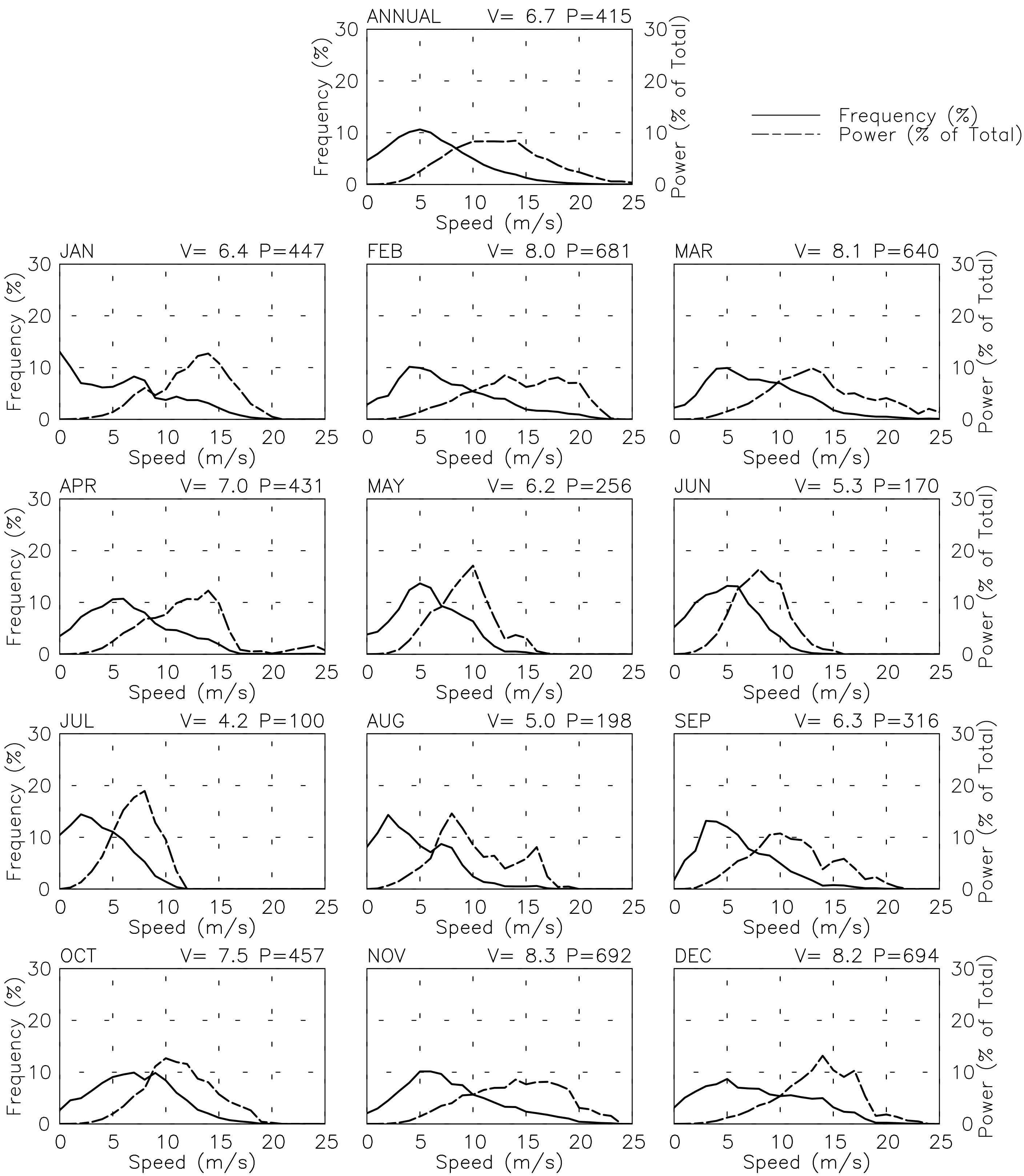
Fri Apr 17 10:57:57 2009

FREQUENCY OF SPEED & PERCENT OF POWER BY SPEED

Sand Point 20m – 000291

55° 21' N 160° 29' W – Elev 52m LST=GMT+99 hours *NT=–11

02/04–07/05



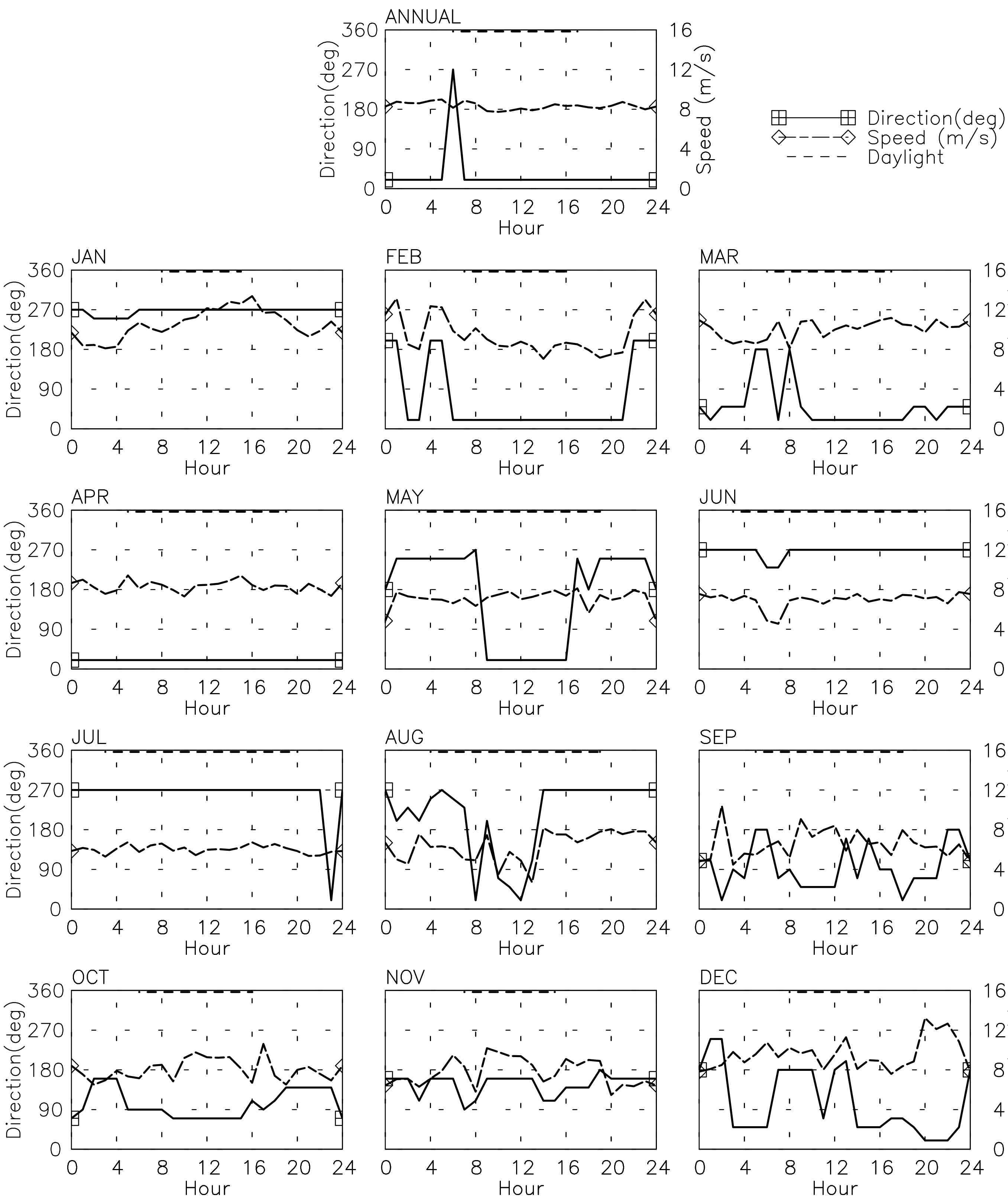
Fri Apr 17 10:57:57 2009

PREVAILING DIRECTION & SPEED BY HOUR

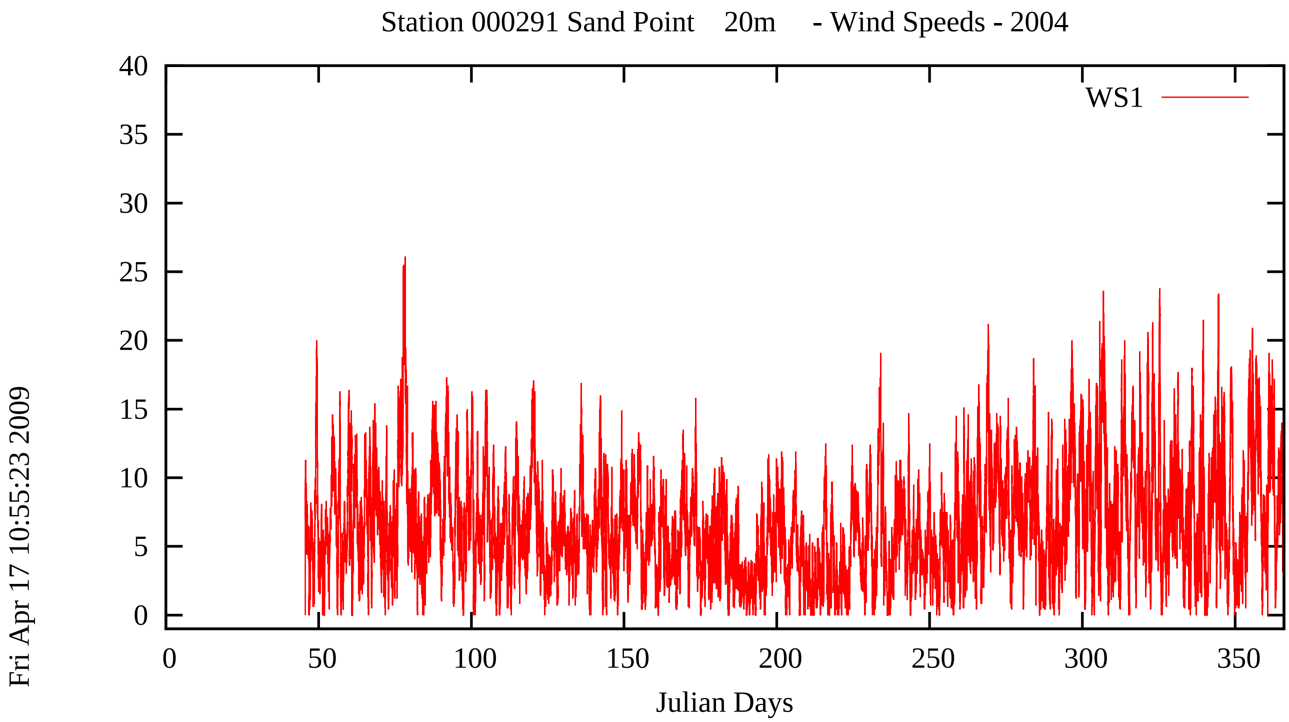
Sand Point 20m - 000291

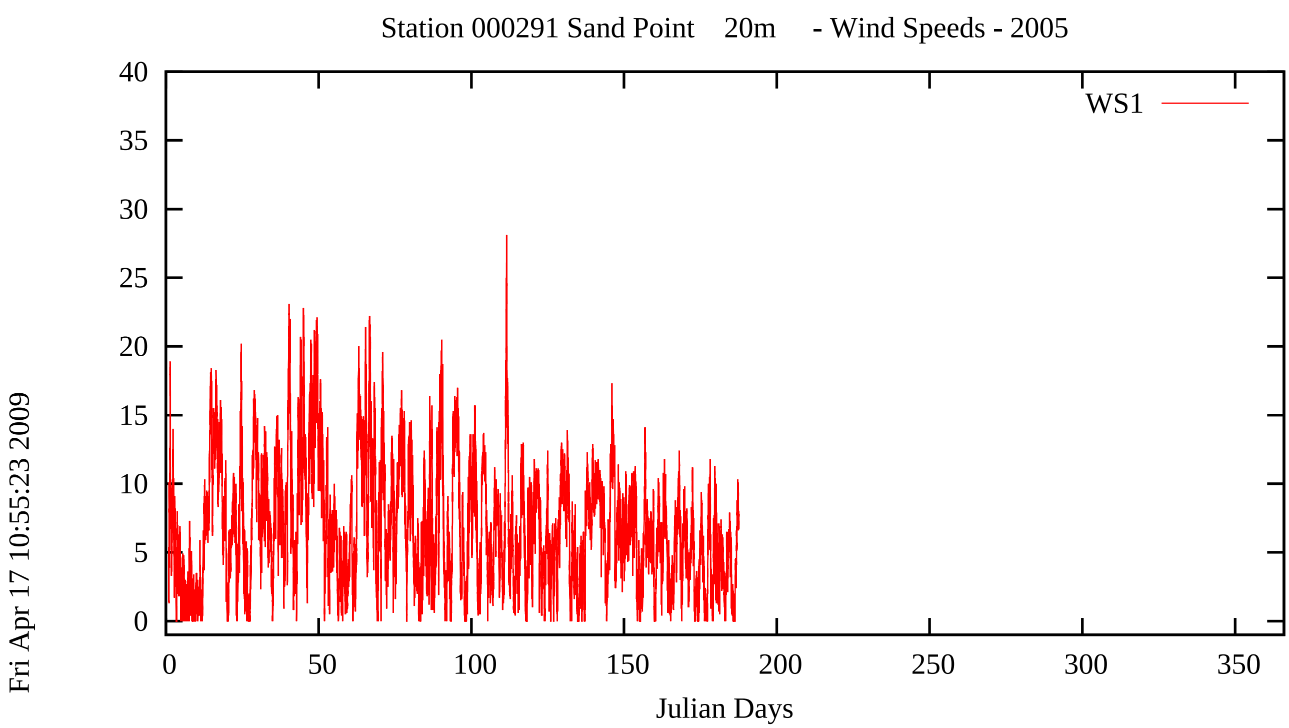
55° 21' N 160° 29' W - Elev 52m LST=GMT+99 hours *NT=-11

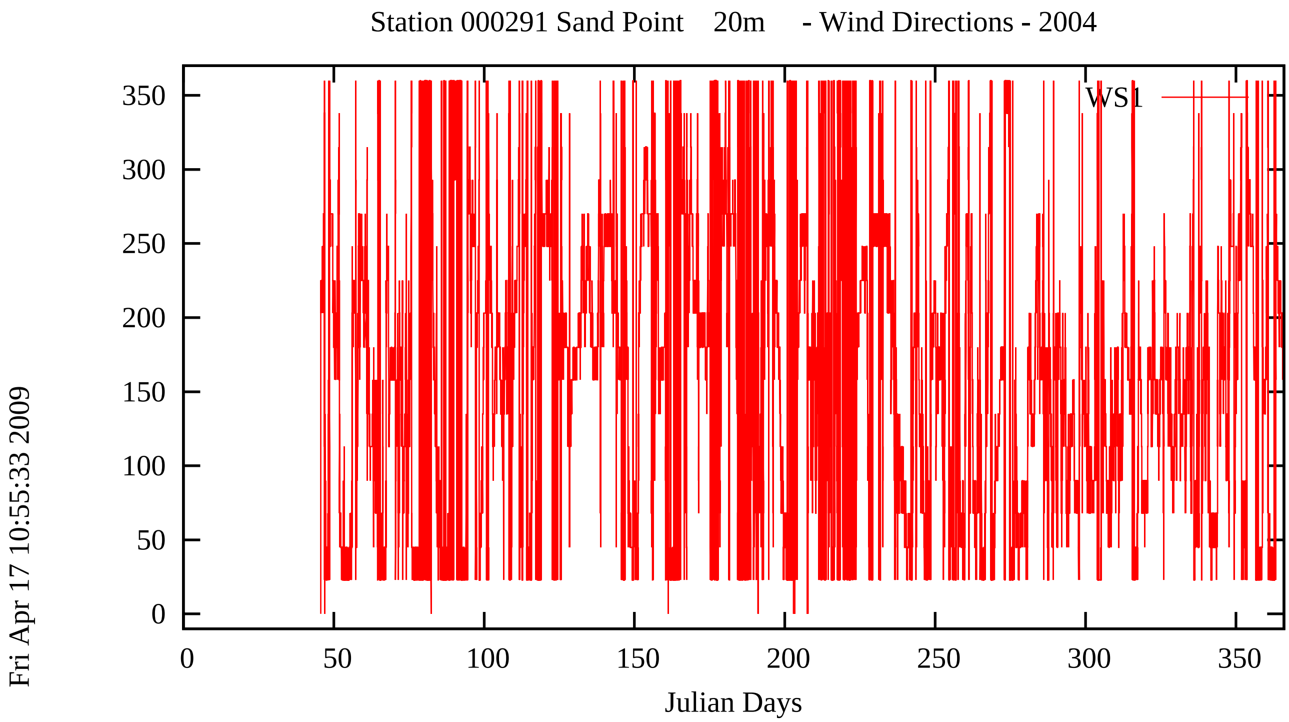
02/04-07/05

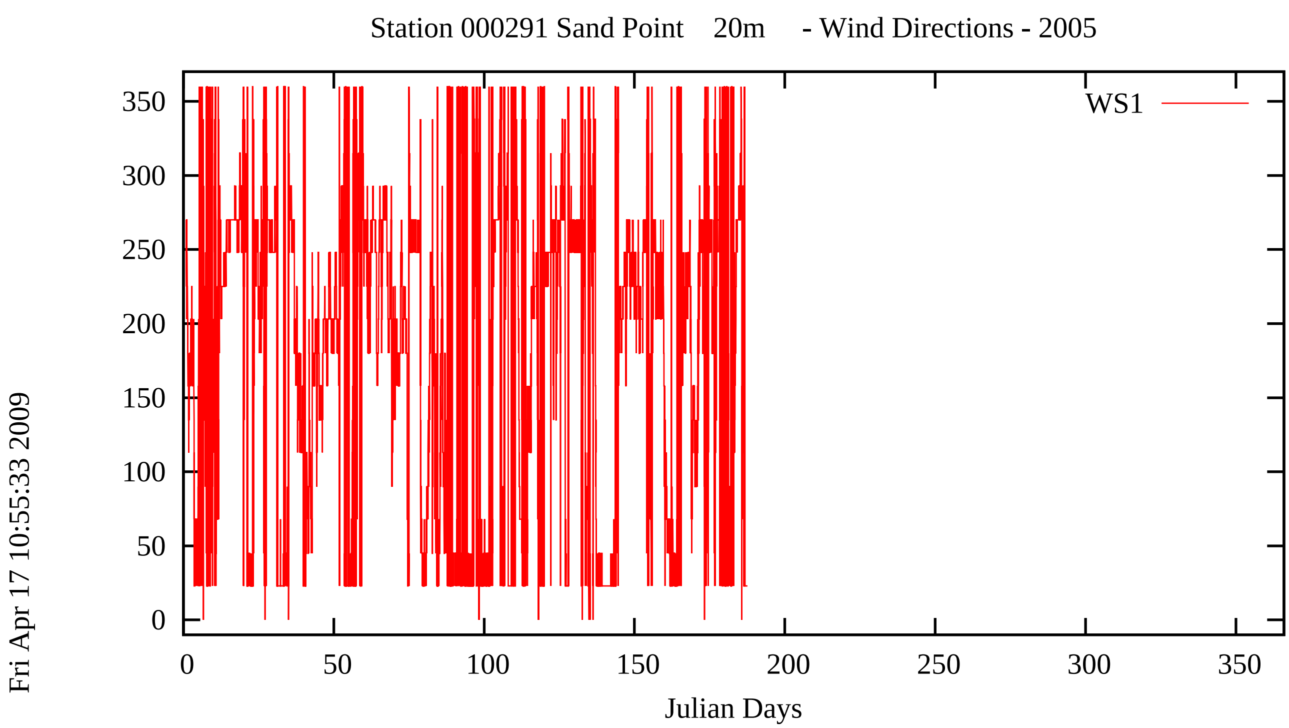


Fri Apr 17 10:57:58 2009


Station 000291 Sand Point 20m - Wind Speeds - 2004
WS1
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
Julian Days
Fri Apr 17 10:55:23 2009


Station 000291 Sand Point 20m - Wind Speeds - 2005
WS1
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
Julian Days
Fri Apr 17 10:55:23 2009


Station 000291 Sand Point 20m - Wind Directions - 2004
WS1
0
50
100
150
200
250
300
350
Julian Days
Fri Apr 17 10:55:33 2009


Station 000291 Sand Point 20m - Wind Directions - 2005
WS1
0
50
100
150
200
250
300
350
Julian Days
Fri Apr 17 10:55:33 2009

Appendix D: Wind Data Graphs
WindPro

Project:
Sand Point - TDX

Description:
Data from file(s)
Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 040315.N04
Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 040214.N04
Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 041015.N04
Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 050223.csv

Licensed user:
National Renewable Energy Laboratory
1617 Cole Blvd. (MS3811)
US-GOLDEN, CO 80401
+1 303-384-7027

Calculated:
10/7/2005 10:47 AM/

Meteo data report, height: 66.0 Feet

Name of meteo object: Sand Point - TDX

Data from: 2/14/2004 4:10 PM Data to: 7/6/2005 2:30 PM Observations: 73137 Observations per day: 144 Recovery rate: 100%

day	02/04	03/04	04/04	05/04	06/04	07/04	08/04	09/04	10/04	11/04	12/04	01/05	02/05	03/05	04/05	05/05	06/05	07/05
1		(142)	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144
2		(124)	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144
3		144	144	144	144	144	144	144	144	144	144	(125)	144	144	(129)	144	144	144
4		144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	(123)
5		144	144	144	144	144	144	144	144	144	144	144	144	144	144	(133)	144	(95)
6		144	144	144	144	144	144	144	144	144	(117)	144	144	144	144	(137)	144	(88)
7		144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
8		144	144	144	144	144	144	144	144	144	144	144	144	144	(113)	144	(126)	
9		144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	(115)	
10		144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
11		144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
12		144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
13		144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
14	(45)	144	144	144	144	144	144	144	144	144	144	144	144	144	144	(135)	144	
15	144	144	144	144	144	144	144	144	(138)	144	144	144	144	144	144	(132)	144	
16	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
17	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	(133)	144	
18	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
19	144	144	144	144	144	144	144	144	144	144	144	144	144	(136)	144	144	144	
20	144	144	144	144	144	144	144	144	144	144	144	(103)	144	144	144	144	144	
21	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
22	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	(107)	
23	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
24	144	144	144	144	144	144	(128)	144	144	144	144	144	144	(136)	144	144	144	
25	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
26	144	144	144	144	144	144	144	144	144	144	144	(128)	144	144	144	144	(122)	
27	144	144	144	144	144	144	144	144	144	144	144	(141)	144	144	144	144	144	
28	144	144	144	144	144	144	144	144	144	144	144	144	144	144	(110)	144	144	
29	144	144	144	144	144	144	144	144	144	144	144	144		144	144	144	144	
30		144	144	144	144	144	144	144	144	144	144	144		144	144	144	144	
31		144		144		(126)	144		144		144	144		144		144		
%	(100)	(100)	100	100	100	(100)	(100)	100	(100)	100	(99)	(98)	100	(100)	(98)	(99)	(98)	(91)

Project:
Sand Point - TDX

Description:
Data from file(s)
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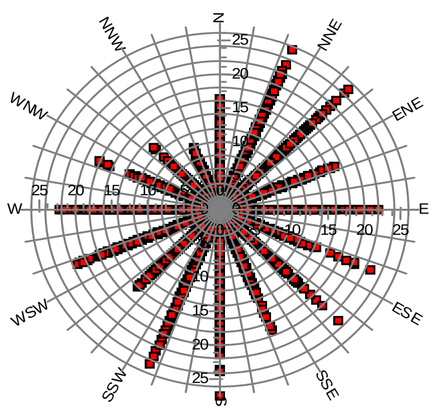
Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 040214.N04
Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 041015.N04
Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 050223.csv

Licensed user:
National Renewable Energy Laboratory
1617 Cole Blvd. (MS3811)
US-GOLDEN, CO 80401
+1 303-384-7027

Calculated:
10/7/2005 10:47 AM/

Meteo data report, height: 66.0 Feet

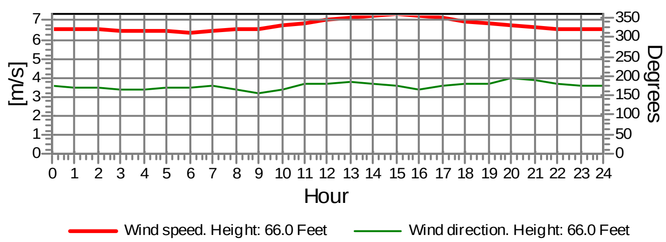
Name of meteo object: Sand Point - TDX

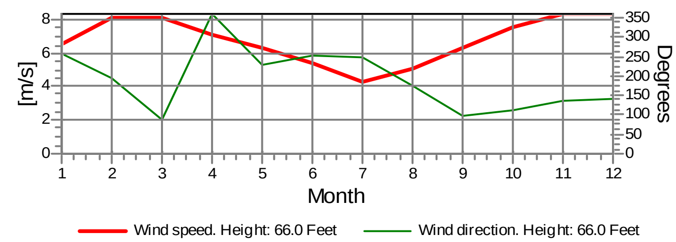


Wind speed [m/s]

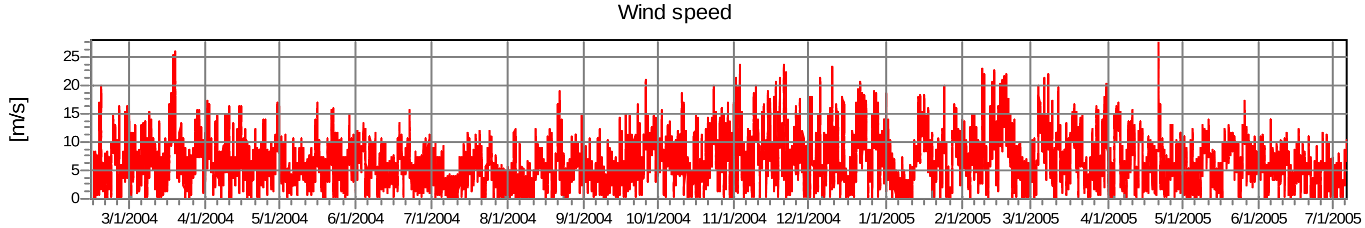
Monthly mean values of wind speed in m/s

Month	2004	2005	mean	mean of months
Jan		6.5	6.5	6.5
Feb	6.5	8.9	8.0	7.7
Mar	7.8	8.5	8.1	8.1
Apr	7.2	7.0	7.1	7.1
May	5.8	6.7	6.3	6.3
Jun	5.7	5.1	5.4	5.4
Jul	4.3	4.2	4.3	4.2
Aug	5.0		5.0	5.0
Sep	6.3		6.3	6.3
Oct	7.5		7.5	7.5
Nov	8.3		8.3	8.3
Dec	8.3		8.3	8.3
mean, all data	6.6	7.0	6.8	
mean of months	6.6	6.7		6.7

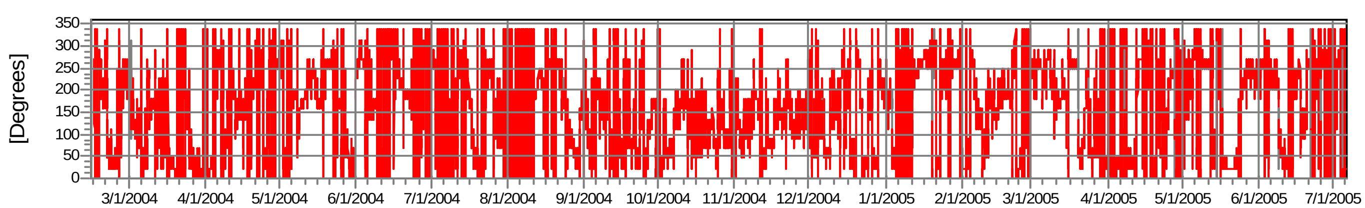




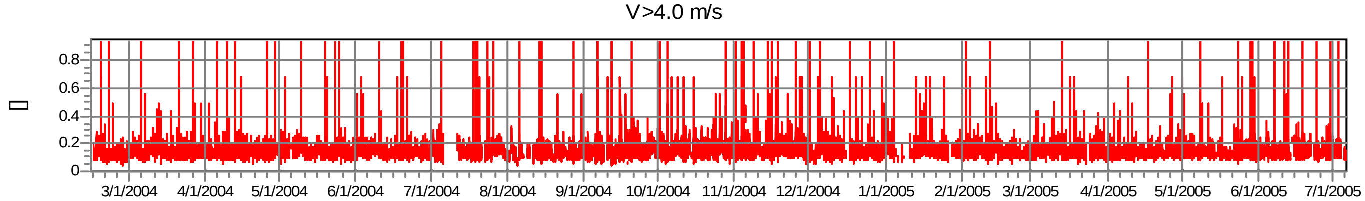
Wind speed



Wind direction



Turbulence intensity
V>4.0 m/s



Project:	Description:	Printed/Page
Sand Point - TDX	Data from file(s) Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 040315.N04 Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 040214.N04 Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 041015.N04 Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 050223.csv	10/7/2005 10:47 AM / 3 Licensed user: **National Renewable Energy Laboratory** 1617 Cole Blvd. (MS3811) US-GOLDEN, CO 80401 +1 303-384-7027 Calculated: 10/7/2005 10:47 AM/

Meteo data report, height: 66.0 Feet

Name of meteo object: Sand Point - TDX

Frequency

Wind speed	Sum	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.00 - 0.49	1,433	62	59	69	99	73	135	160	154	132	112	100	42	67	60	40	69
0.50 - 1.49	3,782	115	167	187	246	299	393	392	348	354	258	232	154	135	153	166	183
1.50 - 2.49	4,944	204	301	292	284	397	522	405	377	377	327	293	229	211	192	274	259
2.50 - 3.49	6,117	276	472	284	325	473	550	312	376	504	418	328	388	392	322	348	349
3.50 - 4.49	7,050	252	621	445	429	479	418	269	519	824	416	450	515	712	278	240	183
4.50 - 5.49	7,706	247	756	514	500	475	431	304	595	841	506	502	700	874	192	135	134
5.50 - 6.49	7,556	242	816	577	510	393	320	325	591	693	529	587	650	921	164	116	122
6.50 - 7.49	6,711	198	1,024	562	459	321	251	235	507	482	476	534	609	736	111	109	97
7.50 - 8.49	6,026	144	990	579	402	223	176	183	459	384	500	477	540	725	122	69	53
8.50 - 9.49	4,903	109	872	489	344	195	134	242	293	359	432	293	390	604	69	52	26
9.50 - 10.49	4,167	95	716	441	267	175	133	179	230	330	349	211	412	538	59	24	8
10.50 - 11.49	3,144	68	533	370	137	95	104	85	186	243	275	117	423	452	48	7	1
11.50 - 12.49	2,462	32	416	315	92	79	34	57	155	195	260	92	297	404	24	9	1
12.50 - 13.49	1,916	41	361	218	66	66	24	63	52	175	214	65	181	362	14	14	0
13.50 - 14.49	1,584	18	343	183	43	38	14	49	31	160	158	50	168	318	8	3	0
14.50 - 15.49	1,150	23	223	111	36	40	7	35	18	136	151	17	138	205	10	0	0
15.50 - 16.49	771	15	147	50	24	34	3	22	12	76	102	13	96	166	11	0	0
16.50 - 17.49	512	5	100	20	18	22	4	9	7	62	68	5	56	125	11	0	0
17.50 - 18.49	369	2	74	22	9	24	4	7	11	48	61	0	25	73	9	0	0
18.50 - 19.49	250	1	39	14	6	14	7	7	17	41	53	0	19	31	1	0	0
19.50 - 20.49	156	0	37	5	2	3	6	3	1	35	22	0	19	23	0	0	0
20.50 - 21.49	115	0	33	6	1	1	2	1	1	19	22	0	9	20	0	0	0
21.50 - 22.49	63	0	17	7	0	2	3	1	1	8	15	0	0	9	0	0	0
22.50 - 23.49	36	0	11	9	0	0	2	1	0	5	8	0	0	0	0	0	0
23.50 - 24.49	17	0	3	5	0	0	4	0	0	2	3	0	0	0	0	0	0
24.50 - 25.49	20	0	5	7	0	0	2	2	1	0	3	0	0	0	0	0	0
25.50 - 26.49	9	0	5	1	0	0	0	0	1	0	2	0	0	0	0	0	0
26.50 - 27.49	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
27.50 - 28.49	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sum	72,973	2,149	9,141	5,782	4,299	3,921	3,683	3,348	4,943	6,489	5,740	4,366	6,060	8,103	1,858	1,606	1,485

Turbulence

Wind speed	Sum	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.00 - 0.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.50 - 1.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.50 - 2.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.50 - 3.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.50 - 4.49	0.152	0.154	0.141	0.143	0.140	0.145	0.169	0.176	0.191	0.167	0.140	0.136	0.132	0.145	0.153	0.149	0.149
4.50 - 5.49	0.146	0.147	0.139	0.131	0.129	0.134	0.160	0.183	0.180	0.165	0.139	0.129	0.138	0.139	0.150	0.143	0.146
5.50 - 6.49	0.148	0.147	0.137	0.136	0.130	0.135	0.157	0.178	0.182	0.168	0.135	0.143	0.142	0.140	0.148	0.140	0.167
6.50 - 7.49	0.141	0.143	0.126	0.125	0.123	0.146	0.161	0.178	0.177	0.163	0.134	0.129	0.140	0.135	0.154	0.146	0.159
7.50 - 8.49	0.138	0.137	0.124	0.124	0.119	0.131	0.159	0.182	0.177	0.165	0.127	0.128	0.135	0.136	0.148	0.145	0.153
8.50 - 9.49	0.141	0.148	0.125	0.127	0.122	0.130	0.167	0.181	0.184	0.164	0.133	0.139	0.137	0.141	0.165	0.141	0.152
9.50 - 10.49	0.136	0.128	0.121	0.123	0.117	0.134	0.157	0.173	0.174	0.162	0.125	0.126	0.132	0.136	0.155	0.129	0.144
10.50 - 11.49	0.137	0.122	0.120	0.124	0.126	0.139	0.153	0.183	0.179	0.164	0.122	0.124	0.138	0.139	0.151	0.140	0.179
11.50 - 12.49	0.134	0.117	0.121	0.117	0.122	0.132	0.148	0.181	0.172	0.156	0.120	0.128	0.136	0.141	0.146	0.137	0.108
12.50 - 13.49	0.137	0.129	0.123	0.122	0.126	0.134	0.155	0.171	0.176	0.159	0.123	0.130	0.136	0.151	0.154	0.144	
13.50 - 14.49	0.136	0.116	0.122	0.118	0.134	0.131	0.164	0.176	0.180	0.150	0.119	0.134	0.141	0.148	0.163	0.136	
14.50 - 15.49	0.134	0.120	0.118	0.116	0.147	0.148	0.152	0.180	0.176	0.150	0.124	0.131	0.131	0.143	0.211		
15.50 - 16.49	0.132	0.119	0.114	0.115	0.143	0.142	0.157	0.172	0.177	0.144	0.118	0.119	0.134	0.141	0.164		
16.50 - 17.49	0.137	0.119	0.126	0.121	0.142	0.150	0.186	0.166	0.183	0.146	0.124	0.136	0.132	0.144	0.155		
17.50 - 18.49	0.135	0.133	0.122	0.108	0.121	0.151	0.151	0.173	0.177	0.147	0.118		0.128	0.147	0.157		
18.50 - 19.49	0.134	0.103	0.119	0.108	0.124	0.138	0.136	0.185	0.170	0.141	0.122		0.132	0.145	0.124		
19.50 - 20.49	0.132		0.123	0.107	0.124	0.125	0.165	0.177	0.181	0.135	0.118		0.128	0.150			
20.50 - 21.49	0.130		0.119	0.116	0.117	0.193	0.150	0.171	0.155	0.139	0.125		0.124	0.146			
21.50 - 22.49	0.126		0.122	0.110		0.102	0.156	0.159	0.145	0.134	0.118			0.144			
22.50 - 23.49	0.122		0.115	0.112			0.153	0.147		0.125	0.128						
23.50 - 24.49	0.136		0.110	0.139			0.155			0.131	0.137						
24.50 - 25.49	0.122		0.109	0.112			0.140	0.142	0.131		0.139						
25.50 - 26.49	0.114		0.105	0.117					0.116		0.135						
26.50 - 27.49	0.125									0.125							
27.50 - 28.49	0.106									0.106							
Sum	0.141	0.141	0.127	0.126	0.126	0.137	0.160	0.179	0.180	0.162	0.129	0.132	0.137	0.141	0.153	0.143	0.155

Project:
Sand Point - TDX

Description:
Data from file(s)
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Y:\5000\shared\Anemometer_Loan_Programs\WPA.NA.Loans\Sand Point - AK\wind data\Sand Point 050223.csv

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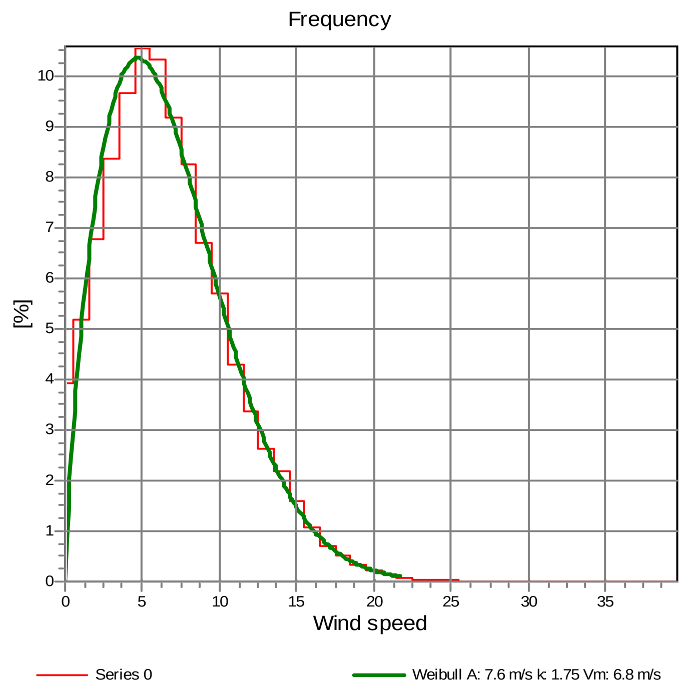
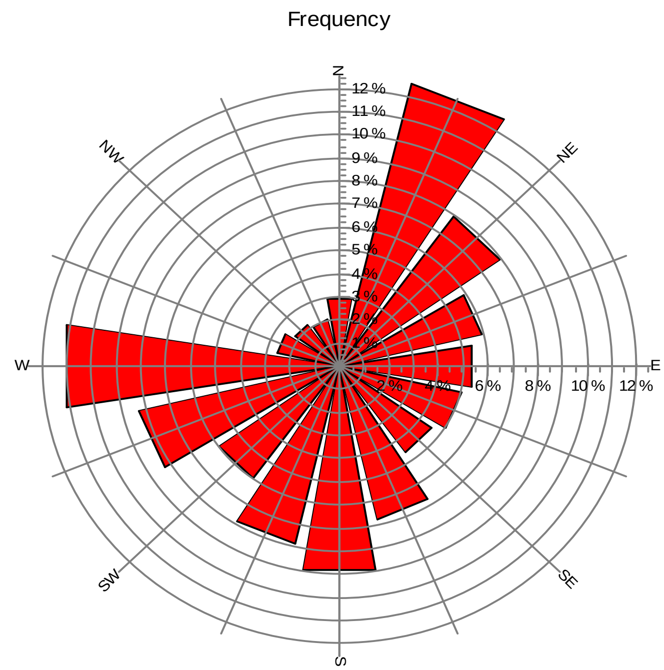
+1 303-384-7027

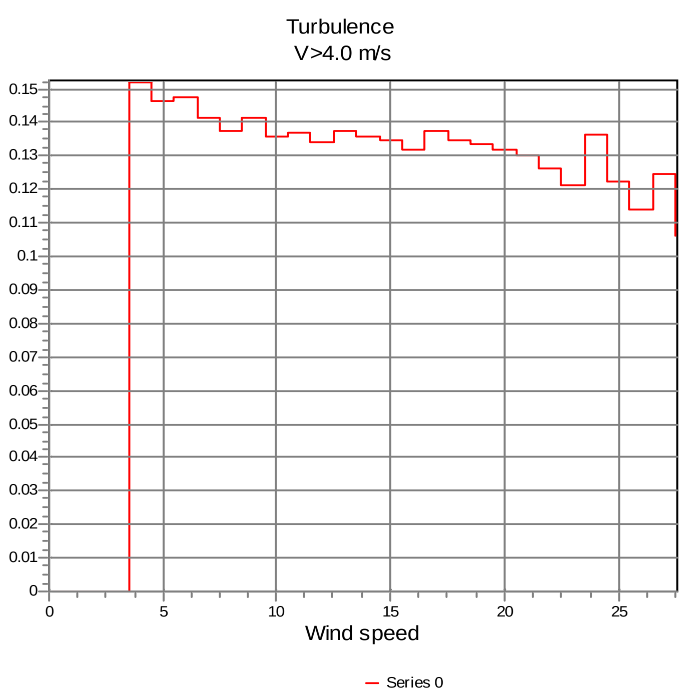
Calculated:
10/7/2005 10:47 AM/

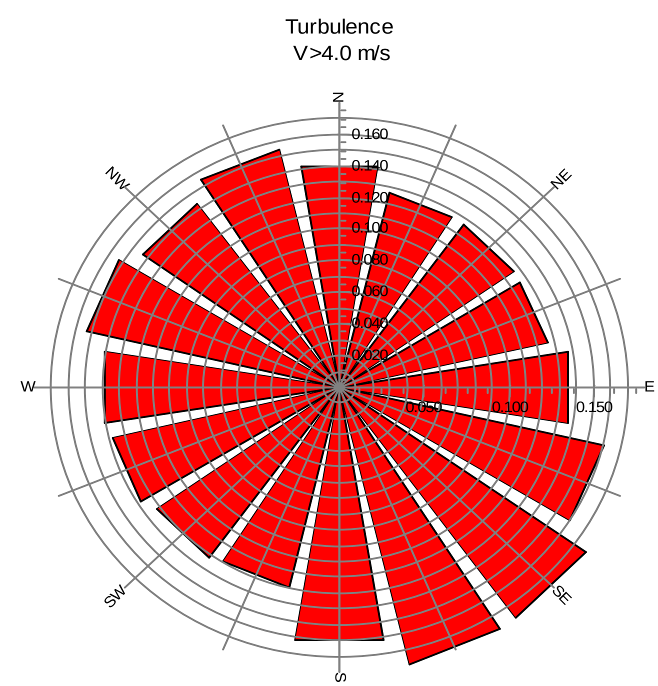
Meteo data report, height: 66.0 Feet

Name of meteo object: Sand Point - TDX









Project:
Sand Point - TDX

Description:
Data from file(s)
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Calculated:
10/7/2005 10:47 AM/

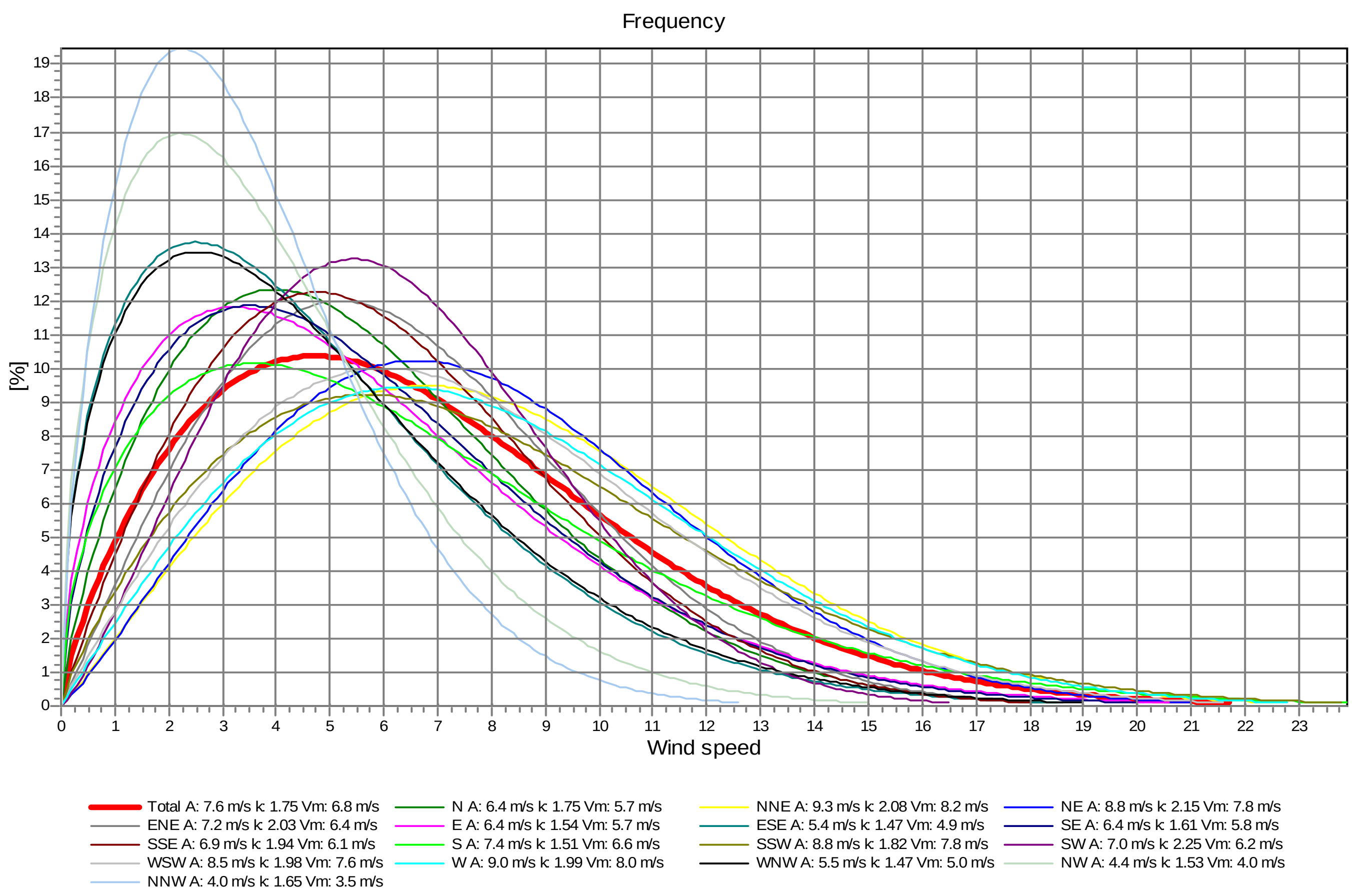
Meteo data report, height: 66.0 Feet

Name of meteo object: Sand Point - TDX

Weibull Data

k-parameter correction: 0.0080/m

Sector	A- parameter [m/s]	Mean wind speed [m/s]	k- parameter	Frequency	Frequency [%]	Wind shear
0-N	6.44	5.73	1.754	2.94	2.9	0.00
1-NNE	9.29	8.23	2.082	12.53	12.5	0.00
2-NE	8.82	7.81	2.154	7.92	7.9	0.00
3-ENE	7.23	6.41	2.033	5.89	5.9	0.00
4-E	6.36	5.72	1.542	5.37	5.4	0.00
5-ESE	5.40	4.89	1.474	5.05	5.0	0.00
6-SE	6.43	5.76	1.607	4.59	4.6	0.00
7-SSE	6.88	6.10	1.944	6.77	6.8	0.00
8-S	7.36	6.64	1.510	8.89	8.9	0.00
9-SSW	8.79	7.81	1.823	7.87	7.9	0.00
10-SW	7.04	6.23	2.250	5.98	6.0	0.00
11-WSW	8.52	7.55	1.982	8.30	8.3	0.00
12-W	9.05	8.02	1.988	11.10	11.1	0.00
13-WNW	5.51	4.99	1.469	2.55	2.5	0.00
14-NW	4.42	3.98	1.531	2.20	2.2	0.00
15-NNW	3.96	3.54	1.649	2.03	2.0	0.00
mean	7.65	6.81	1.747	100.00	100.0	0.00



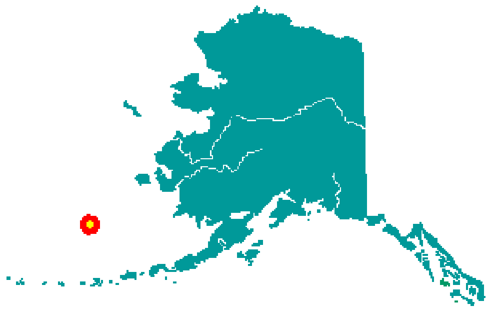
ALASKA ENERGY AUTHORITY

813 W. Northern Lights Blvd.
Anchorage, AK 99503
Phone: 907-269-3000
Fax: 907-269-3044
www.aidea.org/wind.htm

Wind Resource Assessment for ST GEORGE, ALASKA Site # 2401

Date last modified: 11/22/2005

Prepared by: Mia Devine



St.George Met Tower (right) and unidentified tower (left)

Latitude: (NAD27)	56˚ 35’ 11.6” N 56˚ 35.193
Longitude: (NAD27)	169˚ 36’ 52.7” W -169˚ 36.878

Elevation:	130 ft
Tower Type:	30-meter NRG Tall Tower
Monitor Start: Monitor End:	9/14/2004 In operation

INTRODUCTION

In September 2004 the Alaska Energy Authority, Aleutian/Pribilof Islands Association, TDX Power, and members of the community installed a 30-meter tall meteorological tower on Saint George Island. The purpose of this monitoring effort is to evaluate the feasibility of utilizing utility-scale wind energy in the community. This report summarizes the wind resource data collected to date and the long-term energy production potential of the site.

SITE DESCRIPTION

The community of Saint George is located on the northeast shore of Saint George Island. Saint George Island is located about 750 miles west of Anchorage and 250 miles northwest of Unalaska. Figure 1 shows the location of the met tower.

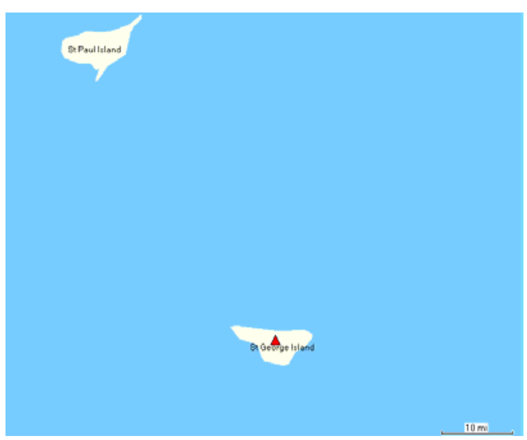


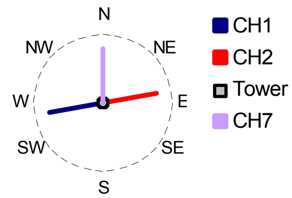
Figure 1. Map of Met Tower Site and Surrounding Area

Table 1 lists the types of sensors that were mounted on the met tower, the channel of the data logger that each sensor was wired into, and where each sensor was mounted on the tower.

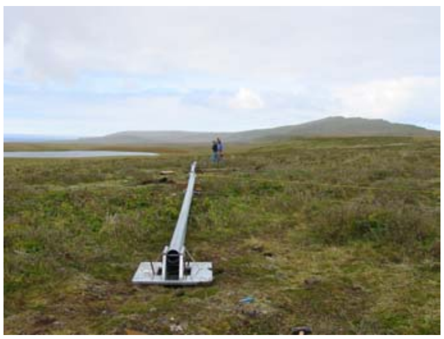
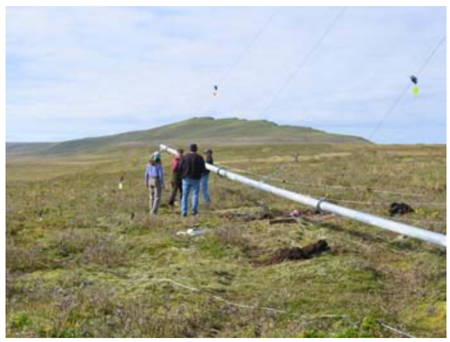
Table 1. Summary of Sensors Installed on the Met Tower

Ch #	Sensor Type	Height	Offset	Boom Orientation
1	#40 Anemometer	30 m	NRG Standard	260˚ True
2	#40 Anemometer	20 m	NRG Standard	80˚ True
7	#200P Wind Vane	30 m	True North	True North
9	#110S Temperature	5 m	0	-

Arial view of equipment on tower



The photos below illustrate the surrounding ground cover and any major obstructions, which could have an affect on how the wind flows over the terrain from a particular direction.



DATA PROCESSING PROCEDURES AND DEFINITIONS

The following information summarizes the data processing procedures that were performed on the raw measured data in order to create an annual dataset of "typical" wind speeds, which could then be used to calculate potential power production from wind turbines. There are various methods and reasons for adjusting the raw data, so the purpose of these notes is to document what was done in this situation. The raw data set is available on the Alaska Energy Authority website (www.akenergyauthority.org) so one could perform their own data processing procedures.

Units – Since most wind turbine manufacturer data is provided in metric units, those units are used here.

1 meter/second = 2.24 mph = 1.95 knots
1 meter = 3.28 feet
1 ˚C = 5/9 (˚F – 32)

Max/Min Test – All of the 10-minute data values were evaluated to ensure that none of them fell outside of the normal range for which the equipment is rated.

Tower Shadow – The tower itself can affect readings from the anemometer at times when the anemometer is located downwind of the tower. In this case, the 30-meter anemometer may record slightly lower values than the free stream velocity when the wind is coming from the east.

Icing – Anomalies in the data can suggest when the sensors were not recording accurately due to icing events. Since wind vanes tend to freeze before the anemometers, icing events are typically identified whenever the 10-minute standard deviation of the wind vane is zero (the wind vane is not moving) and the temperature is at or below freezing. Some additional time before and after the icing event are filtered out to account for the slow build up and shedding of ice.

Filling Gaps – Whenever measured met tower data is available, it is used. Two different methods are used to fill in the remaining portion of the year. First, nearby airport data is used if available. A linear correlation equation is defined between the airport and met tower site, which is used to adjust the hourly airport data recorded at the time of the gap. If neither met tower nor airport data is available for a given timestep, the software program Windographer (www.mistaya.ca) is used. Windographer uses statistical methods based on patterns in the data surrounding the gap, and is good for filling short gaps in data.

Long-term Estimates – The year of data collected at the met tower site can be adjusted to account for inter-annual fluctuations in the wind resource. To do this, a nearby weather station with a consistent historical record of wind data and with a strong correlation to the met tower location is needed. If a suitable station is not available, there is a higher level of uncertainty in the wind speed that is measured being representative of a typical year.

Turbulence Intensity – Turbulence intensity is the most basic measure of the turbulence of the wind. Turbulence intensity is calculated at each 10-minute timestep by dividing the standard deviation of the wind speed during that timestep by the average wind speed over that timestep. It is calculated only when the mean wind speed is at least 4 m/s. Typically, a turbulence intensity of 0.10 or less is desired for minimal wear on wind turbine components.

Wind Shear – Typically, wind speeds increase with height above ground level. This vertical variation in wind speed is called wind shear and is influenced by surface roughness, surrounding terrain, and atmospheric stability. The met tower is equipped with anemometers at different heights so that the wind shear exponent, α, can be calculated according to the power law formula:

$$\left(\frac{H_1}{H_2}\right)^{\alpha} = \left(\frac{v_1}{v_2}\right)$$

where H_1 and H_2 are the measurement heights and v_1 and v_2 are the measured wind speeds.

Wind shear is calculated only with wind speed data above 4 m/s. Values can range from 0.05 to 0.25, with a typical value of 0.14.

Scaling to Hub Height – If the wind turbine hub height is different from the height at which the wind resource is measured, the wind resource can be adjusted using the power law formula described above and using the wind shear data calculated at the site.

Air Density Adjustment – The power that can be extracted from the wind is directly related to the density of the air. Air density, ρ, is a function of temperature and pressure and is calculated for each 10-minute timestep according to the following equation (units for air density are kg/m^3):

$\rho = \dfrac{P}{R \times T}$, where P is pressure (kPa), R is the gas constant for air (287.1 J/kgK), and T is temperature in Kelvin.

Since air pressure is not measured at the met tower site, the site elevation is used to calculate an annual average air pressure value according to the following equation:

P = 1.225 – (1.194 x 10^{-4}) x elevation

Since wind turbine power curves are based on a standard air density of 1.225 kg/m3, the wind speeds measured at the met tower site are adjusted to create standard wind speed values that can be compared to the standard power curves. The adjustment is made according to the following formula:

$$V_{s\tan dard} = V_{measured} \times \left(\frac{\rho_{measured}}{\rho_{s\tan dard}} \right)^{\frac{1}{3}}$$

Wind Power Density – Wind power density provides a more accurate representation of a site's wind energy potential than the annual average wind speed because it includes how wind speeds are distributed around the average as well as the local air density. The units of wind power density are watts per square meter and represent the power produced per square meter of area that the blades sweep as they rotate around the rotor.

Wind Power Class – A seven level classification system based on wind power density is used to simplify the comparison of potential wind sites. Areas of Class 4 and higher are considered suitable for utility-scale wind power development.

Weibull Distribution – The Weibull distribution is commonly used to approximate the wind speed frequency distribution in many areas when measured data is not available. In this case, the Weibull distribution is used to compare with our measured data. The Weibull is defined as follows:

$$P(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} \exp\left(\frac{-v}{c}\right)^{k}$$

Where P(v) is the probability of wind speed v occurring, c is the scale factor which is related to the average wind speed, and k is the shape factor which describes the distribution of the wind speeds. Typical k values range from 1.5 to 3.0, with lower k values resulting in higher average wind power densities.

WIND DATA RESULTS FOR ST GEORGE MET TOWER SITE
Table 2 summarizes the amount of data that was successfully retrieved from the anemometers at the met tower site. There was minimal data loss due to icing or equipment failure.

Table 2. Data Recovery Rates for St George Met Tower Data

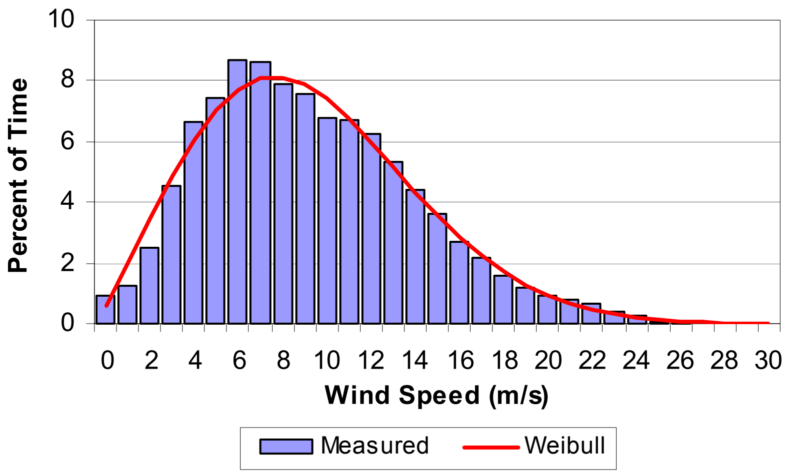
Month	% Data Recovered
January	100.0%
February	99.9%
March	99.7%
April	99.9%
May	100.0%
June	100.0%
July	100.0%
August	100.0%
September	100.0%
October	100.0%
November	100.0%
December	99.9%
Annual Avg	**100%**

Table 3 summarizes the wind resource data measured at the met tower site. As shown, the highest wind month is November and the lowest wind month is July. The annual average wind speed is 9.6 m/s (21.5 mph).

Table 3. Measured Wind Speeds at St. George Met Tower Location, 30-m Height (m/s)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0	10.4	9.1	9.8	10.8	8.3	7.0	5.9	8.3	10.1	11.4	13.2	11.3	9.6
1	10.2	9.6	9.7	10.5	8.4	6.9	6.0	8.4	10.2	11.5	13.2	11.3	9.7
2	10.1	9.6	9.5	10.5	8.4	6.9	6.1	8.2	10.3	12.1	13.4	11.2	9.7
3	9.8	9.0	9.4	10.4	8.5	6.9	6.0	8.6	10.2	12.3	13.2	10.8	9.6
4	9.8	9.2	9.3	10.4	8.4	6.9	5.7	8.6	10.3	12.0	12.5	11.0	9.5
5	9.7	9.4	9.2	10.3	8.2	7.2	5.5	8.7	10.5	12.0	11.7	11.0	9.4
6	9.5	9.7	9.2	10.3	8.1	6.9	5.7	8.6	10.8	11.8	11.6	11.1	9.4
7	9.6	9.5	9.5	10.3	8.2	6.7	5.8	8.5	10.9	11.6	11.7	11.0	9.4
8	9.5	9.4	9.5	10.1	8.3	6.7	6.1	8.3	10.8	11.4	11.8	10.9	9.4
9	9.6	9.1	9.1	10.2	8.4	6.6	6.2	8.4	10.8	11.2	12.0	10.4	9.3
10	9.5	9.0	9.2	10.3	8.2	6.7	6.3	8.5	10.8	11.1	12.4	10.5	9.4
11	9.4	8.7	9.2	10.2	8.6	6.8	6.6	8.7	11.1	11.4	12.6	10.5	9.5
12	9.6	8.5	9.3	10.1	8.7	6.9	6.8	8.8	11.4	11.2	12.5	10.5	9.5
13	10.0	8.9	9.4	10.1	8.7	7.1	6.9	8.7	11.4	11.6	12.4	10.4	9.6
14	9.8	9.2	9.7	10.4	9.1	7.1	6.9	8.6	11.4	11.8	12.3	10.4	9.7
15	9.8	9.5	9.8	10.4	9.1	7.2	7.1	8.4	11.4	12.0	12.3	10.4	9.8
16	9.6	9.6	10.0	10.4	8.9	7.0	7.0	8.5	11.2	12.1	12.1	10.3	9.7
17	9.4	9.8	9.9	10.2	8.8	6.9	7.0	8.4	11.1	12.1	12.1	10.4	9.7
18	9.4	9.7	9.6	10.2	8.6	6.9	7.0	8.3	11.0	12.0	12.4	10.6	9.6
19	9.3	9.4	9.4	10.2	8.6	6.8	6.9	8.5	11.0	11.8	12.5	11.0	9.6
20	9.7	9.6	9.4	10.1	8.5	6.6	6.6	8.9	10.7	11.6	12.5	10.9	9.6
21	10.1	9.5	9.7	9.9	8.4	6.7	6.4	8.8	10.6	11.7	12.2	11.1	9.6
22	10.1	9.2	9.9	9.8	8.3	6.7	6.4	8.4	10.4	11.7	12.5	11.2	9.6
23	10.4	9.1	10.3	10.0	8.3	6.7	6.0	8.3	10.3	11.7	12.4	11.3	9.6
Avg	9.8	9.3	9.5	10.3	8.5	6.9	6.4	8.5	10.8	11.7	12.4	10.8	9.6

A common method of displaying a year of wind data is a wind frequency distribution, which shows the percent of the year that each wind speed occurs. Figure 2 shows the measured wind frequency distribution as well as the best matched Weibull distribution (c = 11, k= 2.13).



Bin m/s	Measured Hours	Bin m/s	Measured Hours
0	83	18	140
1	112	19	106
2	221	20	79
3	400	21	68
4	580	22	55
5	651	23	37
6	760	24	22
7	757	25	9
8	691	26	4
9	661	27	1
10	594	28	0
11	586	29	1
12	546	30	1
13	465	31	1
14	387	32	0
15	317	33	0
16	239	34	0
17	189	Total:	8,760

Figure 2. Wind Speed Frequency Distribution of St George Met Tower Data, Sept 2004 – Oct 2005

The cut-in wind speed of many wind turbines is 4 m/s and the cut-out wind speed is around 25 m/s. The frequency distribution shows that a large percentage of the wind in Saint George occurs within this operational zone.

TEMPERATURE

The air temperature can affect wind power production in two primary ways: 1) colder temperatures lead to higher air densities and therefore more power production, and 2) some wind turbines shut down in very cold situations (usually around –25°C). The monthly average temperatures measured at the met tower are shown in Figure 3. The temperature never dropped below -15°C from mid September 2004 through the end of October 2005.

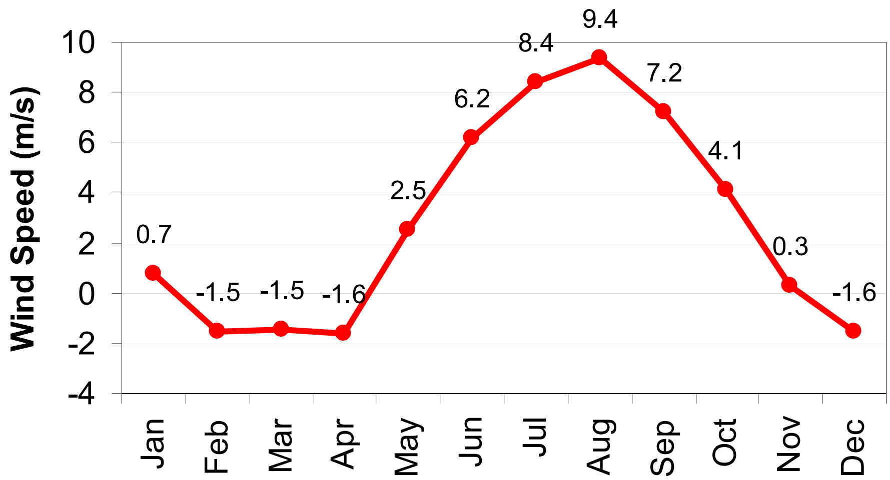
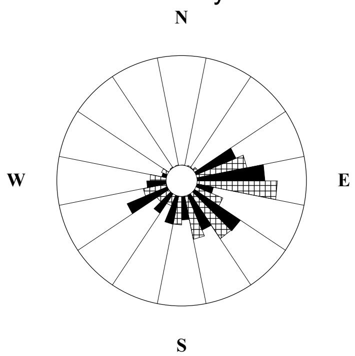


Figure 3. Monthly Average Air Temperatures at St George Met Tower Site

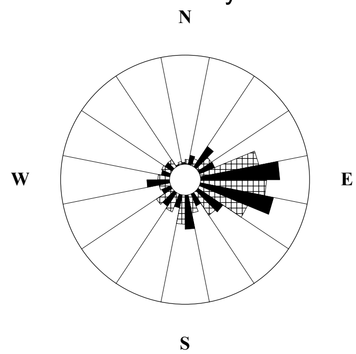
Table 4 shows the monthly wind roses for the year of data measured at the Saint George met tower.

Table 4. Monthly Wind Roses for Saint George Met Tower Site

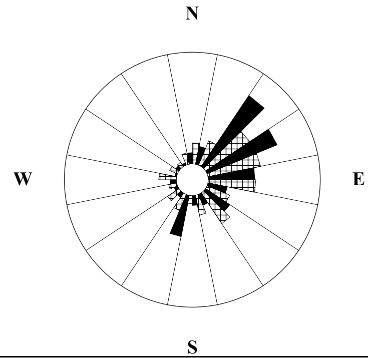
January



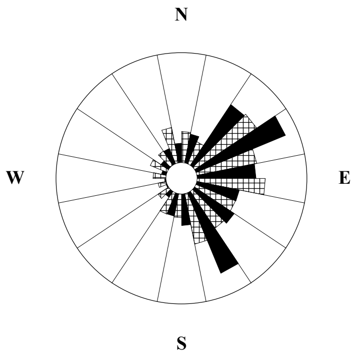
February



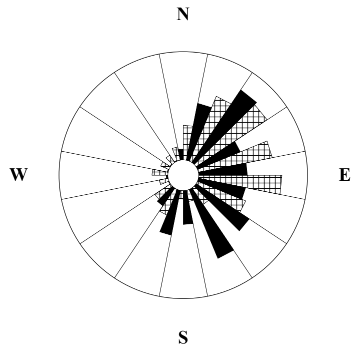
March



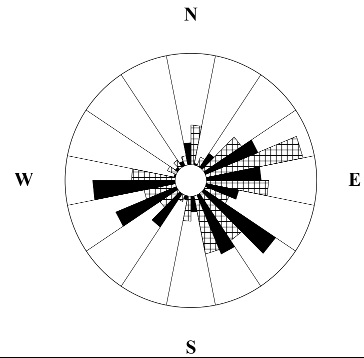
April



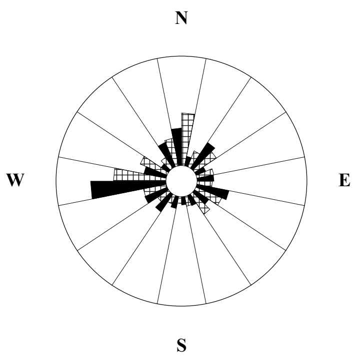
May



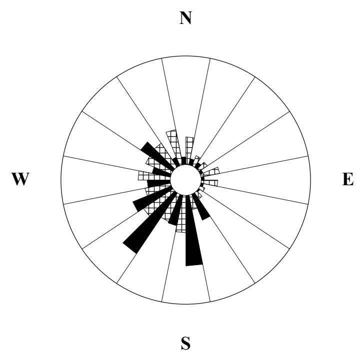
June



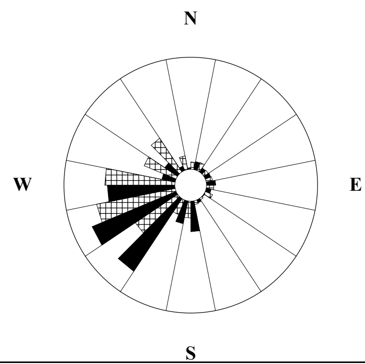
July



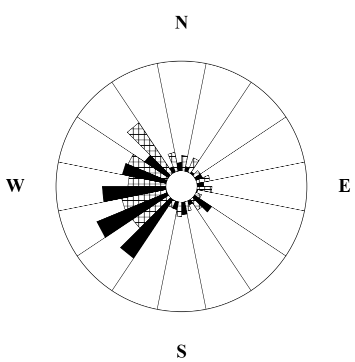
August



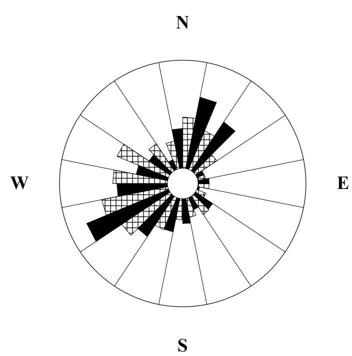
September



October



November



December

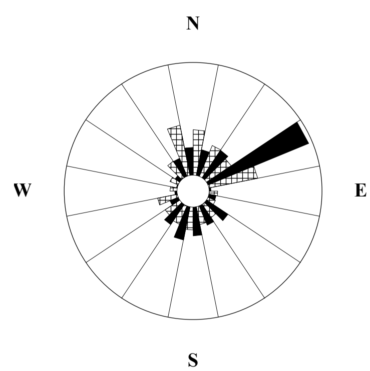


Table 5. Annual Wind Rose for Saint George Met Tower Site (Sept 2004 – Oct 2005)

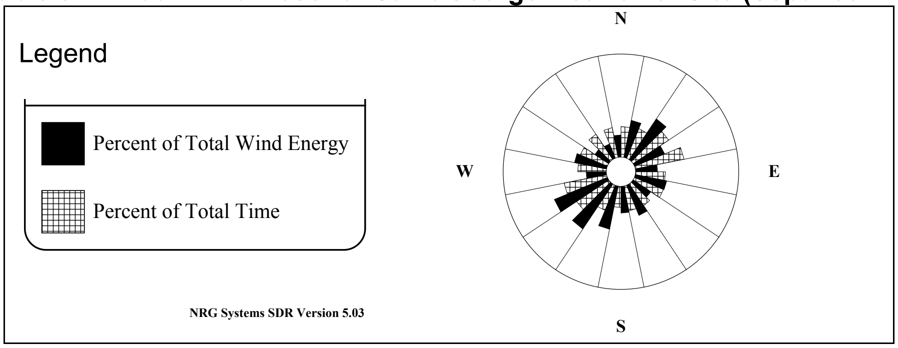


Table 6 summarizes the monthly turbulence intensity and wind shear at the met tower site. A turbulence intensity value of less than 0.10 is considered low and unlikely to contribute to excessive wear of wind turbines. Turbulence intensity is based on recordings of the 30-meter level anemometer. Wind shear is calculated between the 30-meter anemometer and the 20-meter anemometer. Due to the different directions those booms are facing, shear can only be calculated from certain directions when both anemometers are exposed to free stream wind speeds. Both turbulence intensity and wind shear are only calculated for wind speeds greater than 4 m/s. Figure 4 shows the turbulence intensity and wind shear by direction.

Table 6. Monthly Turbulence Intensity and Wind Shear at St George Met Tower Site

Month	Turbulence Intensity	20m to 30m Wind Shear
Jan	0.11	0.20
Feb	0.11	0.06
Mar	0.11	0.07
Apr	0.11	0.06
May	0.11	0.09
Jun	0.11	0.06
Jul	0.10	0.15
Aug	0.10	0.12
Sep	0.10	0.11
Oct	0.11	0.13
Nov	0.10	0.09
Dec	0.11	0.10
Annual Avg	**0.11**	**0.10**

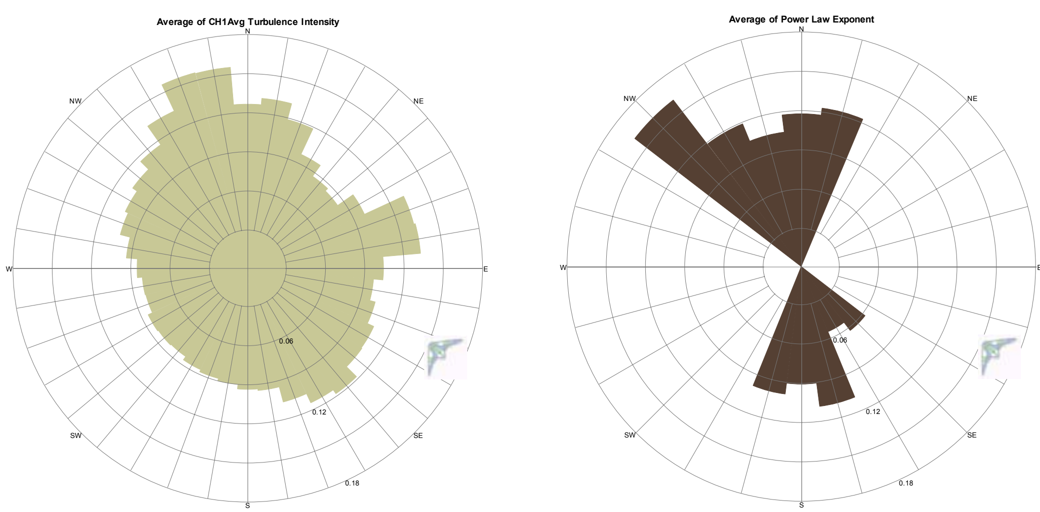


Figure 4. Turbulence Intensity and Wind Shear by Direction at St George Met Tower Site

LONG-TERM REFERENCE STATION

Wind data from the Saint George Airport weather station (shown in Figure 5), located about 15 miles southeast of the met tower site, serves as a long-term reference for the wind resource in the area. The Automated Surface Observing System (ASOS) was installed in September of 1996. The wind data is measured at a height of 10 meters above ground level and at an elevation of 38.1 meters.

Figure 5. ASOS Equipment in Saint George (source: Ed Doerr, NOAA)

Seven years of wind speed data from the Saint George ASOS are summarized in Table 7 and Figure 6. The average wind speed over the 7-year period is 7.5 m/s. The annual wind speed rarely deviates more than 3% above or below this long-term average.

Table 7. Monthly Wind Speeds at Saint George Airport, 10-m Height (m/s)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVE	% of long-term average
1998		7.2	7.1	8.6	6.9	6.0	4.6	6.0	7.7	7.1	8.2	9.7	7.2	96%
1999	9.0	10.2	9.5	7.8	6.5	6.6	6.1	5.6	5.8	7.5	9.1	8.2	7.6	102%
2000	9.2	10.1	8.1	7.1	5.2	6.4	5.0	5.0	7.2	7.8	8.9	7.1	7.3	97%
2001	9.4	9.9	7.2	8.1	6.3	5.9	5.5	5.3	6.5	8.0	9.1	10.9	7.7	102%
2002	9.6	7.4	8.7	8.6	7.5	5.9	4.9	6.1	7.7	8.5	7.3	6.1	7.4	98%
2003	9.6	7.9	8.2	7.7	6.9	5.4	5.9	6.0	6.4	8.7	9.6	10.0	7.7	102%
2004	9.4	9.4	6.5	7.8	7.4	5.5	4.5	5.4	6.2	10.0	10.0	9.2	7.6	101%
AVE	9.4	8.9	7.9	7.9	6.7	6.0	5.2	5.6	6.8	8.2	8.9	8.8	7.5	100%

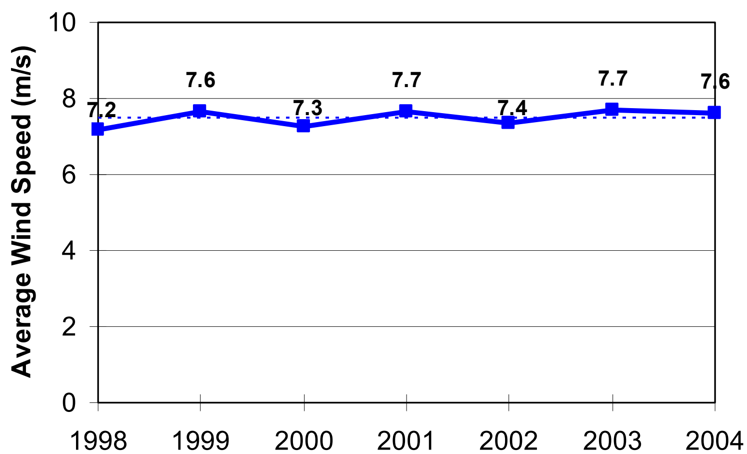


Figure 6. Annual Average Wind Speeds at Saint George Airport Weather Station, 10-m Height

Hourly wind speed measurements from the Saint George Airport weather station that are concurrent with recordings from the met tower site were purchased from the National Climatic Data Center. Data between these two sites was compared and a correlation coefficient of 0.87 was calculated (a value of 1 is perfect). This suggests that, although the actual wind speed values at the two sites are different, the pattern of wind speed fluctuations is similar between the sites. Figure 7 compares the met tower data with the ASOS data. Wind data from the Saint Paul Island ASOS, located about 45 miles to the northwest, is also included for comparison.

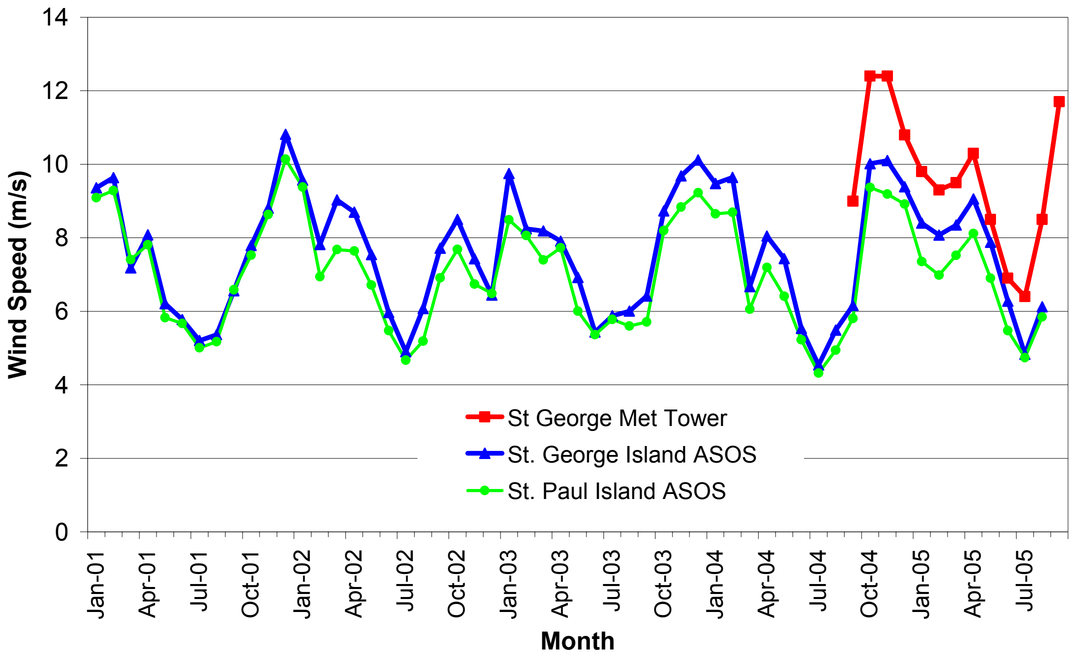


Figure 7. Comparison of Average Monthly Wind Speeds Between Met Tower and ASOS Measurements

A ratio of the short-term ASOS data to the long-term ASOS average was calculated for each month of the year. This ratio was then applied to adjust the met tower data to what could be expected at the site over the long term. Overall, the period of measured data was 3% windier than the estimated long-term average. Figure 8 and Figure 9 compare the measured data set to the long-term estimates. Table 8 presents the calculated long-term data set.

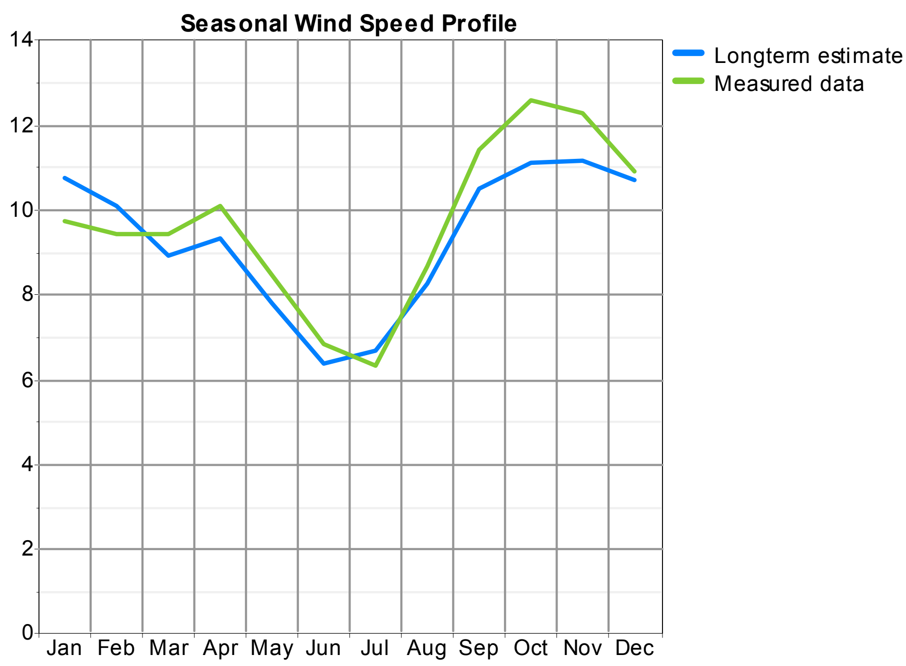


Figure 8. Monthly Average Wind Speeds at St George Met Tower Site, 30m Height

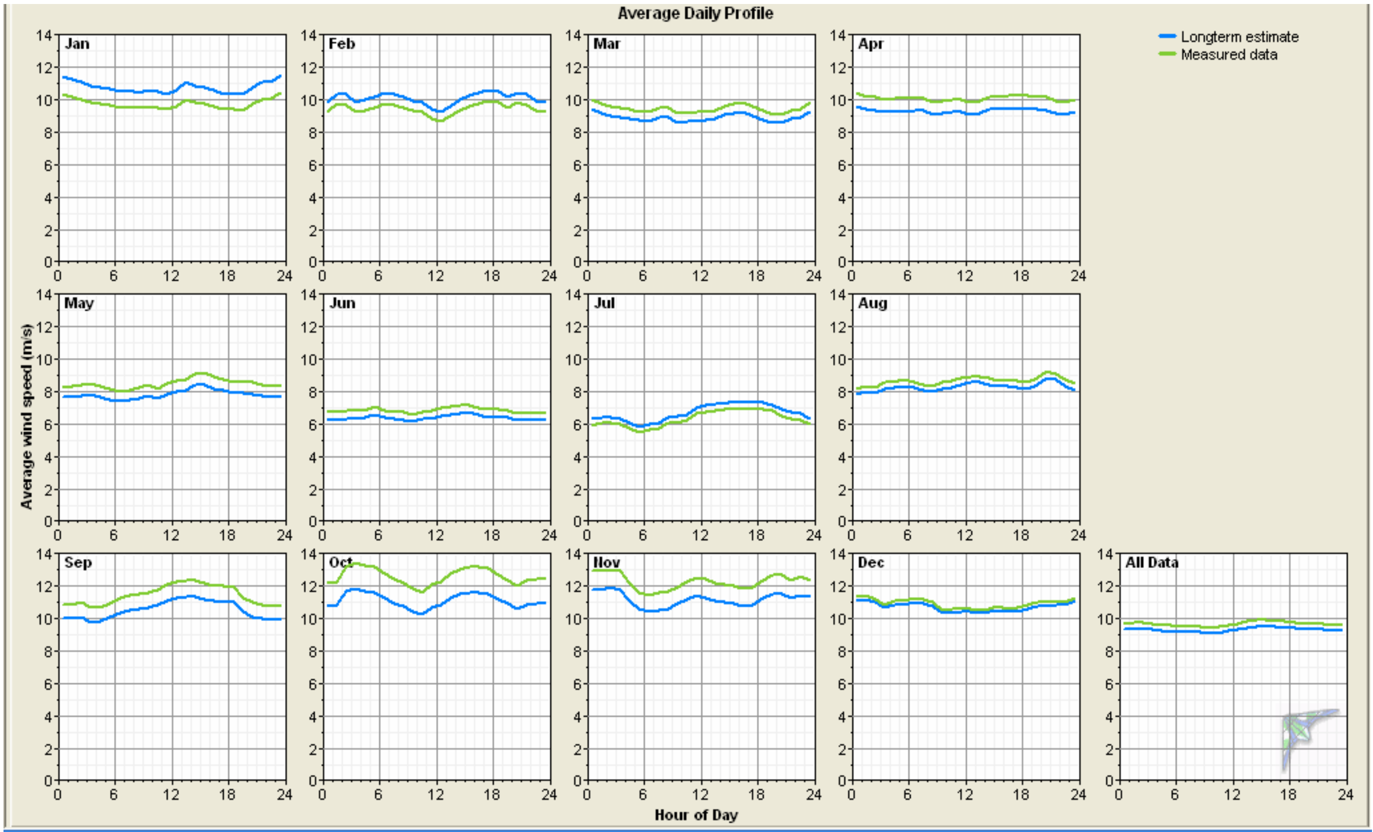


Figure 9. Diurnal Profiles of Wind Speeds at St George Met Tower Site, 30m Height

Table 8. Estimated Long-term Wind Speeds at St. George Met Tower Location, 30-m Height (m/s)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0	11.5	9.7	9.2	10.0	7.6	6.5	6.2	8.0	10.0	10.4	12.0	11.2	9.3
1	11.3	10.2	9.1	9.8	7.7	6.5	6.3	8.0	10.0	10.4	12.0	11.1	9.4
2	11.1	10.3	9.0	9.7	7.7	6.4	6.5	7.9	10.1	11.1	12.2	11.0	9.4
3	10.9	9.8	8.8	9.6	7.8	6.4	6.4	8.2	9.8	11.5	12.1	10.6	9.3
4	10.8	9.9	8.8	9.6	7.7	6.4	6.2	8.2	9.9	11.3	11.5	10.7	9.3
5	10.7	10.1	8.7	9.5	7.6	6.6	5.8	8.3	10.2	11.4	10.8	10.8	9.2
6	10.5	10.3	8.6	9.6	7.5	6.5	6.0	8.2	10.4	11.1	10.5	10.8	9.2
7	10.6	10.3	8.9	9.5	7.5	6.3	6.1	8.1	10.6	10.7	10.6	10.8	9.2
8	10.5	10.1	9.0	9.4	7.6	6.2	6.4	7.9	10.9	10.6	10.7	10.7	9.2
9	10.6	9.8	8.7	9.3	7.8	6.1	6.6	8.1	10.9	10.2	10.9	10.3	9.1
10	10.5	9.7	8.6	9.5	7.5	6.3	6.6	8.1	11.2	10.0	11.2	10.3	9.1
11	10.4	9.4	8.7	9.5	7.9	6.3	7.0	8.3	11.3	10.5	11.4	10.2	9.2
12	10.6	9.1	8.7	9.3	8.0	6.4	7.2	8.5	11.5	10.7	11.4	10.4	9.3
13	11.0	9.4	8.8	9.3	8.0	6.6	7.3	8.4	11.6	11.0	11.3	10.1	9.4
14	10.9	9.8	9.1	9.6	8.3	6.6	7.3	8.2	11.6	11.4	11.2	10.2	9.5
15	10.8	10.1	9.3	9.6	8.4	6.7	7.5	8.1	11.5	11.5	11.2	10.2	9.6
16	10.6	10.3	9.3	9.6	8.2	6.6	7.4	8.2	11.4	11.5	11.1	10.1	9.5
17	10.4	10.5	9.3	9.5	8.1	6.4	7.4	8.0	11.3	11.5	11.1	10.2	9.5
18	10.4	10.6	9.0	9.4	8.0	6.4	7.4	7.9	11.2	11.3	11.2	10.4	9.4
19	10.2	10.0	8.9	9.4	7.9	6.4	7.3	8.1	10.8	11.1	11.4	10.6	9.3
20	10.8	10.3	8.8	9.3	7.9	6.2	7.1	8.5	10.5	10.7	11.4	10.7	9.4
21	11.0	10.3	9.0	9.2	7.8	6.2	6.8	8.5	10.3	10.8	11.2	10.8	9.3
22	11.2	9.9	9.2	9.1	7.7	6.2	6.8	8.1	10.2	10.8	11.3	10.9	9.3
23	11.5	9.7	9.5	9.2	7.6	6.2	6.4	8.0	10.1	10.8	11.3	10.9	9.3
Avg	10.8	10.0	9.0	9.5	7.8	6.4	6.8	8.2	10.7	10.9	11.3	10.6	9.3

POTENTIAL POWER PRODUCTION FROM WIND TURBINES IN SAINT GEORGE

Table 9 lists a number of parameters that are typically used to characterize the power production potential of a particular site.

Table 9. Summary of Power Production Potential of Saint George Met Tower Site

Average Wind Power Density (30m height)	921 W/m^2
Wind Power Class	7+
Rating	Superior

Various wind turbines, listed in Table 12, were used to calculate the energy production at the met tower site based on the long-term wind resource data set. Although different wind turbines are offered with different tower heights, to be consistent it is assumed that any wind turbine rated at 100 kW or less would be mounted on a 30-meter tall tower, while anything larger would be mounted on a 50-meter tower. The wind resource was adjusted to these heights based on the measured wind shear at the site. Table 10 summarizes the estimated energy production from various wind turbines at the Saint George met tower site.

Table 10. Gross Annual Energy Production from Various Wind Turbines at St. George Met Tower Site (kWh)

Month	Proven 2.5kW	Proven 6kW	Bergey 10 kW	FL30	Entegrity	FL100	NW100	FL250	V27	V47
Jan	1,319	3,206	3,473	15,923	29,141	55,817	45,440	126,120	112,818	357,880
Feb	1,055	2,584	2,639	12,956	23,016	43,635	35,293	96,754	86,423	281,692
Mar	1,069	2,712	3,073	13,660	23,094	45,184	37,189	96,855	88,991	296,701
Apr	1,109	2,815	3,182	14,160	24,006	46,817	38,513	100,224	92,233	308,637
May	806	2,089	2,207	10,495	16,559	32,397	26,431	73,607	66,697	230,586
Jun	527	1,416	1,478	7,030	9,749	19,772	16,100	43,980	40,205	146,474
Jul	613	1,653	1,761	8,365	11,894	23,835	19,505	59,198	54,393	196,870
Aug	857	2,123	2,324	10,621	17,563	34,711	27,917	78,119	70,400	233,802
Sep	1,286	3,239	3,530	16,187	28,389	54,360	44,766	121,431	110,653	363,452
Oct	1,323	3,230	3,283	16,284	29,347	55,354	44,762	127,676	112,981	364,483
Nov	1,318	3,249	3,408	16,229	29,252	55,325	45,208	122,446	111,023	361,566
Dec	1,190	2,915	2,874	14,142	26,094	48,609	39,691	108,336	99,077	321,405
Annual	12,473	31,230	33,233	156,052	268,103	515,815	420,815	1,154,747	1,045,895	3,463,546
Annual kWh/m^2	1,299	1,312	863	1,173	1,515	1,482	1,482	1,688	1,825	1,996

Table 10 also lists the annual energy production per square meter of swept area (kWh/m^2). This allows one to directly compare the efficiency of one wind turbine against another, as shown in Figure 10.

Figure 10. Comparison of Power Production per Square Meter of Swept Area from Various Wind Turbines

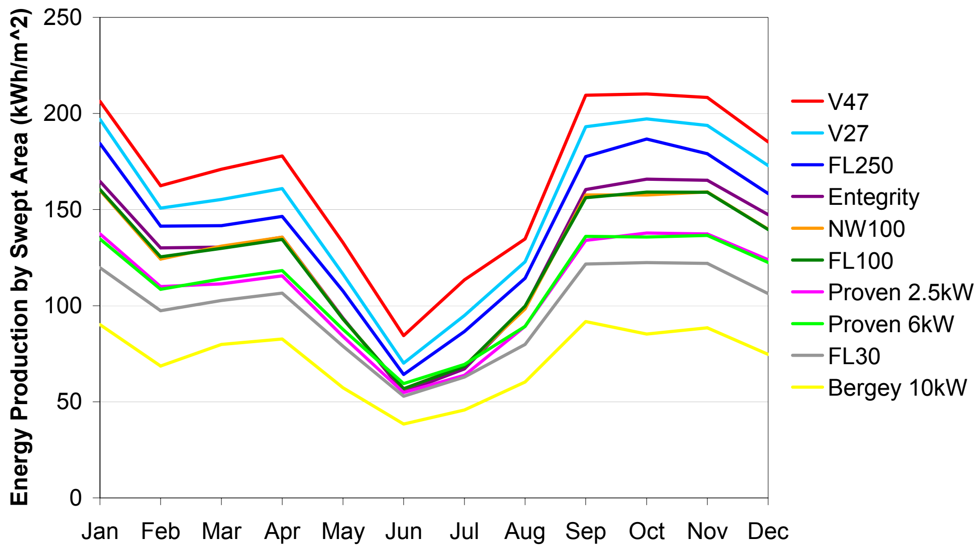


Table 11 summarizes the gross capacity factor of the different wind turbines per month. Gross capacity factor is the amount of energy produced based on the given wind resource divided by the maximum amount of energy that could be produced if the wind turbine were to operate at rated power during that entire period. The gross capacity factor could be further reduced by up to 10% to account for transformer/line losses, turbine downtime, soiling of the blades, icing of the blades, yaw losses, and extreme weather conditions.

Table 11. Gross Capacity Factor of Different Wind Turbines at Met Tower Site

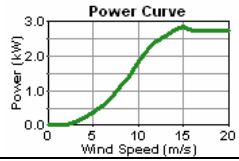
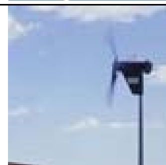
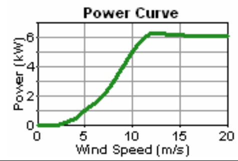
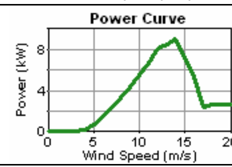
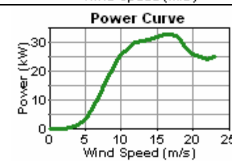
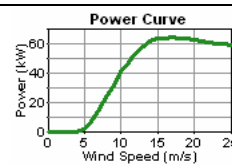
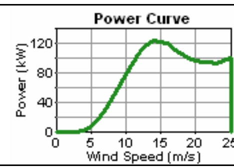
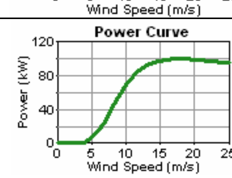
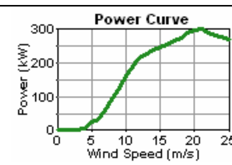
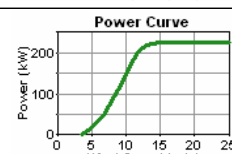
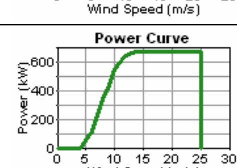
Month	Proven 2.5kW	Proven 6kW	Bergey 10 kW	FL30	Entegrity	FL100	NW100	FL250	V27	V47
Jan	71%	72%	47%	71%	59%	75%	61%	68%	67%	73%
Feb	63%	64%	39%	64%	52%	65%	53%	58%	57%	64%
Mar	57%	61%	41%	61%	47%	61%	50%	52%	53%	60%
Apr	62%	65%	44%	66%	51%	65%	53%	56%	57%	65%
May	43%	47%	30%	47%	34%	44%	36%	40%	40%	47%
Jun	29%	33%	21%	33%	21%	27%	22%	24%	25%	31%
Jul	33%	37%	24%	37%	24%	32%	26%	32%	32%	40%
Aug	46%	48%	31%	48%	36%	47%	38%	42%	42%	48%
Sep	71%	75%	49%	75%	60%	76%	62%	67%	68%	76%
Oct	71%	72%	44%	73%	60%	74%	60%	69%	67%	74%
Nov	73%	75%	47%	75%	62%	77%	63%	68%	69%	76%
Dec	64%	65%	39%	63%	53%	65%	53%	58%	59%	65%
Annual	57%	59%	38%	59%	46%	59%	48%	53%	53%	60%

CONCLUSION

This report provides a summary of wind resource data collected from mid September 2004 through October 2005 on Saint George Island, Alaska. The data was compared to long-term trends in the area. Based on correlations with the Saint George ASOS weather data, estimates were made to create a long-term dataset for the Saint George met tower site. This information was used to make predictions as to the potential energy production from various wind turbines at the site.

It is estimated that the long-term annual average wind speed at the site is 9.3 m/s at a height of 30 meters above ground level. Taking the local air density into account, the average wind power density for the site is 921 W/m^2. This information means that Saint George Island has at least a Class 7 wind resource, which is superior for wind power development.

Table 12. Wind Turbine Models Used in Power Production Analysis

Proven 2.5 kW http://www.provenenergy.com			Tower Height: 30 meters Swept Area: 9.6 m^2 Turbine Weight: 190 kg
Proven 6 kW http://www.provenenergy.com			Tower Height: 30 meters Swept Area: 23.8 m^2 Turbine Weight: 500 kg
Bergey 10 kW www.bergey.com			Tower Height: 30 meters Swept Area: 38.5 m^2 Weight: not available
Fuhrlander FL30 30 kW www.lorax-energy.com			Tower Height: 30 meters Swept Area: 133 m^2 Weight (nacelle & rotor): 410 kg
Entegrity 66 kW www.entegritywind.com			Tower Height: 30 meters Swept Area: 177 m^2 Weight (drivetrain & rotor): 2,420 kg
Fuhrlander FL100 100 kW www.lorax-energy.com			Tower Height: 30 meters Swept Area: 348 m^2 Weight (nacelle & rotor): 2,380 kg
Northern Power NW100/19 100 kW www.northernpower.com			Tower Height: 30 meters Swept Area: 284 m^2 Weight (nacelle & rotor): 7,086 kg
Fuhrlander FL250 250 kW www.lorax-energy.com			Tower Height: 50 meters Swept Area: 684 m^2 Weight (nacelle & rotor): 4,050 kg
Vestas V27 225 kW (refurbished, various suppliers)			Tower Height: 50 meters Swept Area: 573 m^2 Weight: not available
Vestas V47 660 kW www.vestas.com			Tower Height: 50 meters Swept Area: 1,735 m^2 Weight: not available

ALASKA ENERGY AUTHORITY

March 14, 2012

Patrick Pletnikoff, Mayor
St. George Municipal Electric Utility
P.O. Box 940
St. George Island, AK 99591-0940

RE: St. George Status Update

Dear Mayor Pletnikoff:

Per your request, the following is a summary status update of the power system projects for St. George.

Generator Upgrade and Logistics

The existing generator end that was in Dutch Harbor has been separated into two pieces enabling the Alaska Energy Authority (AEA) to fly the core to Anchorage to complete reliability upgrades which are done. The shell could not be flown due to weight constraints so it was barged and is currently en route to Anchorage and should arrive next week. It will be re-assembled and flown to St. George for installation on the existing low-time engine. Significant logistical obstacles have been overcome and, weather permitting, installation is planned for the second week in April.

New Power Module/Distribution/Wind Project

The Conceptual Design Report phase is nearing completion including the business plan which has been developed with community cooperation. The Final Design phase has started and is the production of all required contract documents required to build the project. These include design drawings and specifications, etc., required for the bidding and construction of the project.

The total project budget is $5,204,000. Of that amount, $1,700,000 has been designated to procure long-lead project items. AEA realizes the importance of this project and is doing everything possible to expedite the schedule for the benefit of the community. An additional $1,300,000 has been committed for an integrated wind turbine which is an important part of this project. Economic and design considerations have limited the project to one wind turbine; however, the system is designed for future integration of additional wind turbine assets. There will be four 210kw diesel generators housed in the largest power house module. This module will also contain the heat recovery system, switchgear, controls and a separate operator's office. This configuration accommodates future power demand as the community expands its port facilities and other end users. At this time, over $3,000,000 ($ 1,700,000 and $ 1,300,000) has been committed to the St. George project.

813 West Northern Lights Boulevard Anchorage, Alaska 99503 T 907.771.3000 Toll Free (Alaska Only) 888.300.8534 F 907.771.3044

A trip to St. George is planned in mid-April for a five to seven member design team. The purpose of the visit is to gather information on the electrical distribution system, heat recovery, and other design items. This trip will be coordinated with the generator upgrade installation if possible. Should the community desire, an informational meeting could be held to provide information and answer questions.

An updated schedule will be provided as information becomes available regarding additional funding, long lead procurement, barging and other logistical considerations.

Please contact me directly if you have any questions.

Sincerely,

ALASKA ENERGY AUTHORITY

Timothy J. Sandstrom for
Project Manager

TJS:mc

cc: File

Final Report Nikolski Wind-Diesel Project; Wind Turbine Installation
October 14, 2010

Provided by the Aleutian Pribilof Islands Association
Contract A 48 HECG
Written by Bruce Wright, Senior Scientist

Introduction: In 2005 the Aleutian Pribilof Islands Association (APIA) requested $2,674,680 for installation of high penetration wind diesel hybrid power plants in Sand Point, St. George and Nikolski with a thermal recovery system integrated into existing heating systems within the communities, such as the schools, community buildings and other large buildings that require significant heat in the winter**.** The project title was: HIGH PENETRATION WIND-DIESEL HYBRID POWER IN "THE BIRTHPLACE OF THE WIND": SAND POINT, ST. GEORGE, AND NIKOLSKI, ALASKA**.**

It was clear to APIA and their partners in the project that this wind diesel configuration would produce the greatest potential future savings for the community, the greatest leverage against increasing fuel prices and other liabilities associated with diesel only generation, and flexibility for future electric and thermal load growth within the communities.

The Nikolski specific component of this project was funded by the United States Department of Agriculture Rural Utilities Service Assistance to Rural Communities with Extremely High Energy Costs.

TDX Power completed the design and procured materials, equipment, labor, permits and supervision to construct a fully operational 65 kilowatt Wind Turbine Generator System (WTGS) and associated equipment and interconnect to the newly commissioned diesel fuel based power plant in Nikolski in accordance with the International Electrotechnical Commission (IEC) Wind Turbine Standards. This was accomplished by July 28, 2007. The fully functional turbine could not be connected to the power plant through the installed transmission line due to potentially significant incompatibility with the control panels. Umnak Power, TDX Power, APICDA and Alaska Energy Authority (AEA) worked with the control panel manufacturer on the design and engineering aspects, including financing and development of the new control panels. By August 2010, and after many extra trips to Nikolski, project extensions and additional costs, all construction phases of the project meet substantial completion. In September 2010 AEA accepted that the wind system as "Commissioned", AEA (Kris Noonan) took control of the software and CPI, and TDX Power has an O&M contract with Umnak Power to provide support services as required.

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Project Description: This project was funded the United States Department of Agriculture Rural Utilities Service Assistance to Rural Communities with Extremely High Energy Costs**.** The Grant Agreement was dated August 11, 2006 and was an agreement for receipt of High Energy Cost grant funds under section 19 of the Rural Electrification Act of 1936, as amended (7 U.S.C. 918a), between the United States of America, acting through the Administrator of the Rural Utilities Service (RUS), United States Department of Agriculture (USDA), (Grantor) and the Aleutian Pribilof Islands Association (Grantee) for the purposes of satisfactorily performing the Grant Project as described below.

The Wind Turbine Generator System Engineering, Procurement and Construction Agreement ("Agreement") was entered into on10th day of October 2006 by and among TDX Power Services LLC, an Alaska limited liability company, with its principal offices located at 4300 "B" Street, Suite 402, Anchorage, Alaska 99503 ("Contractor"), the Aleutian Pribilof Islands Association, Inc., an Alaska non-profit corporation, with its principal offices located in Anchorage, Alaska ("APIA" or "Association") and Umnak Power Company, an electric utility organized under the laws of the State of Alaska, with its principal offices located at Nikolski, Alaska ("Umnak"). Association, Umnak and Contractor are sometimes hereinafter referred to collectively as the "Parties" and individually as a "Party." (see **Appendix H: Wind Turbine Generator System Engineering, Procurement, and Construction Agreement**)

TDX Power completed the design and procured materials, equipment, labor, permits and supervision to construct a fully operational 65 kilowatt Wind Turbine Generator System (WTGS) and associated equipment and interconnect to the newly commissioned diesel fuel based power plant in Nikolski in accordance with the International Electrotechnical Commission (IEC) Wind Turbine Standards. This was accomplished by July 28, 2007. The fully functional turbine could not be connected to the power plant through the installed transmission line due to potentially significant incompatibility with the control panels. Umnak Power, TDX Power, APICDA and Alaska Energy Authority (AEA) worked with the control panel manufacturer on the design and engineering aspects, including financing and development of the new control panels. By August 2010, and after many extra trips to Nikolski, project extensions and additional costs, all construction phases of the project meet substantial completion. In September 2010 AEA accepted that the wind system as "Commissioned", AEA (Kris Noonan) took control of the software and CPI, and TDX Power has an O&M contract with Umnak Power to provide support services as required. Aspects of the project and the deliverables are described below.

Wind Feasibility Study: A wind power feasibility study supplements the APIA Grant Application to the Rural Utilities Service to fund wind diesel power projects in three remote Alaskan villages (see **Appendix F: Wind Power Feasibility Study Sand Point, St. George and Nikolski, Alaska**). A critical supplement to this report is a detailed model outlining various options for including wind power as a source of both electricity and heat in the three community power plants. Low, medium and high penetration options are addressed, with equipment options from two utility grade suppliers of wind turbines. In the high penetration model, excess electricity from the wind turbines would be used to create thermal energy and stored for immediate use for space heating or other beneficial application through a hot water storage and distribution system at the adjacent school.

Avian Study: The principal goals of baseline bird studies are to quantitatively describe the temporal and spatial use by birds of the study area and provide baseline information on avian species and their habitat sufficient to use in evaluating the probable impact of installation of a wind turbine. The specific goals of this work are to provide avian monitoring protocol training to local agent(s), collect avian data to determine bird activity at the delineated areas around the turbine site, record any dead or downed (injured) birds at the site that may be the result of collisions with the meteorological tower, and prepare avian monitoring reports including back-up information and complete avian data. Local resident(s) should to be trained to assist in collecting bird movement data and be provided the study protocols and training. The data collection will consist of two main types of sampling: visual surveys and audiovisual surveys. The emphasis of all sampling will be to quantify the movements of birds at the proposed windfarm location. All surveys will be accompanied by a standardized set of environmental data collected at the beginning of all sampling sessions: wind direction, wind speed, cloud cover, ceiling height, minimal horizontal visibility, light condition and precipitation.

Findings: The US Fish and Wildlife Service (USFWS) was consulted and they are not aware of any bald eagle nests in the area. The survey of local knowledge found that the area has no bald eagle nests (active and inactive), roosts and perches. The local knowledge survey data indicated no birds used the area of the proposed wind turbine site and no dead birds we observed near the met tower. This information was adequate to not require further avian studies and to allow the project to proceed.

Since the turbine has been installed there have been no observations of bird strikes or down or dead birds near the turbine. The USFWS provided protocols for handling dead or injured eiders, a species of concern. See **Appendix C: Protocol for Handling Sick, Injured, and Dead Spectacled and Steller's Eiders**

Foundation: TDX Power completed all the site assessment work necessary prior to installing the wind turbine, including an engineering evaluation and design for the foundation and tower, as appropriate for all site work to be accomplished within the approved budget. Geotechnical analysis of the soil at the site was better than expected. The soft loamy soil is underlain by a gravel base, providing a solid bottom for the foundation. The foundation was constructed over several days in June 2007. The foundation consists of a 20’ x 20’ x 2’ slab 6’ underground; (2) 48” x 5’ culverts filled with rebar and concrete; topped by a 20’ x 20’ x 8” concrete slab. A total of 68 cubic yards of concrete was used in the foundation.

The road to the site was too soft to bear the weight of the materials and required substantial work prior to hauling materials to the site. Due to the continually and rapidly increasing costs for transportation and supplies, the contingency amount of $8,080.00 proved inadequate to the requirements of the road repair.

The foundation was left to cure for one month prior to erection of the wind turbine.

Wind Turbine: The contractor purchased a 65 kilowatt Vestas V-15 wind turbine that was retrofitted within certain design parameters applicable to installation of a wind turbine in Nikolski, Alaska and shipped to the Nikolski project site. This was accomplished by TDX Power including installation, on July 28, 2007. The blades are new and are appropriate to the environment, coated heavily with a composite to prevent deterioration from the salty sea air. The turbine and tower were put together on site during the last week of July. The custom designed tilt-up design worked exactly as intended, coming down perfectly on the anchored bolts with less than one quarter inch of play.

Local Workforce: The Contractor utilized the local Nikolski workforce whenever possible. Multiple, simultaneous projects in Nikolski overburdened the small local labor force and required additional imported labor.

Guarantees, warranties, spares and maintenance manuals: Nikolski has the Vestas 65kW Wind Turbine Operations Manuals. The Nikolski-specific wind-diesel power plant operations and maintenance manuals were used to complete the training given during the integration with the power plant. TDX Power provided all guarantees and warranties. Spares are available in storage onsite. TDX Power will enhance the manuals over the two year site operations, maintenance, and support period. Due to the highly specialized nature of WTGS and integrated wind-diesel projects, and new technology development additional and continual training may be required and will be provided.

Construction and Integration: TDX Power has completed all construction aspects including all subsystems of the WTGS such as control and protection mechanisms, internal electrical systems, mechanical systems, support structures, foundations, interconnection to the existing Nikolski power plant, and control system compatibility and final calibrations for the control and internal electrical systems. Integration of the WTGS with the existing diesel power plant by TDX Power was completed upon completion of the remanufacturing of the third generator for the diesel power plant. See **APPENDIX B: Nikolski Wind – Diesel Power System Status Report, Aug. 27, 2010**

Safety: TDX Power has completed all construction-related aspects and has provided the appropriate level of protection against damage from all hazards from these systems during the planned WTGS lifetime and specific requirements for the safety of WTGS, including design, installation, maintenance, and operation under the Nikolski site environmental conditions. Turbine integration to the power plant was completed after control panel compatibility issues were finalized and connection to the power plant control systems was completed. WTGS system safety for operations and maintenance shall occur during the two years of operator supervision and training, with pre-training materials developed in conjunction with the control panel modifications and integration, which is currently occurring.

Commissioning: TDX Power, along with sub-contractor CPI, conducted the commissioning of the wind – diesel power system at Nikolski during the summer of 2010. A first trip provided test data of the main components and identified deficiencies in the control, communications and electrical heating configuration. The second trip addressed and corrected the communications and electrical heating configuration. The control deficiencies were addressed, but could not be completely corrected. Mostly stable operation of all system elements were confirmed over a two week test period. During the test period the wind turbine ran for over 70 hours. The system was left in an automatic run mode.

During the Commissioning tests data was collected via the SCADA package with verification of mostly stable system operation under a variety of wind conditions.

Although the hybrid power system was operational, it exhibited a number of fault conditions, which in some cases caused loss of power to the village. The faults were manually resettable from the powerhouse, but indicate a lower system reliability and robustness than is desirable. The faults are primarily a result of system control and communications delay deficiencies. Improved performance and reliability could be achieved if these deficiencies were addressed. The Nikolski IRA had TDX Power repair the diesel plant in November 2007. The IRA covered the cost themselves, with no funds used from this grant. See **APPENDIX B: Nikolski Wind – Diesel Power System Status Report, Aug. 27, 2010.**

Training: TDX Power has trained local residents to climb the turbine tower safely using proper climbing gear and how to provide maintenance to the turbine. Additional training by the Contractor shall be provided to local utility employees on operations and maintenance of the WTGS. The Contractor will provide ongoing support for a period of two years from date of substantial completion to assist with parts and materials, ongoing training, and annual maintenance, including a minimum of two site visits during the two year period**.** See **Guarantees, warranties, spares and maintenance manuals** and **Safety sections above** and **APPENDIX B: Nikolski Wind – Diesel Power System Status Report, Aug. 27, 2010**

No-Cost Extensions: Several delays in the project from unforeseen circumstances resulted in requests for no-cost extensions (see **Appendix D: No Cost Extension Request**). These were given by USDA. The use of no-cost extensions to extend this project and making all the funds available allowed for a successful project. The USDA should be commended for their flexibility in managing this project.

Quarterly Reports: APIA was responsible for the reporting on a quarterly basis for this project. This allowed for input from USDA and was used to keep all the interested and involved parties informed of the project's progress. An example quarterly report can be seen at **Appendix E. Quarterly Reports, APIA Progress Report on the Nikolski Wind-Diesel Project.**

Grant Conditions and Limitations: In **APPENDIX A: Grant Special Conditions or Limitations** are the specific terms of the grant between USDA/RUS and APIA. The other terms of the grant are standard federal requirements and APIA policy.

Conclusions: This grant did not address or have adequate funding planned for the control panel issue due to the repeated reassurances of the power plant manufacturer, despite concerns from the community and contractor well before power plant design and completion. Additionally, an un-maintained or under-maintained power plant operated outside of the specifications, that does not have total capacity due to the lack of a third genset, cannot provide the reliable backup and seamless exchange required for high penetration wind energy. Since high penetration cannot be achieved due to circumstances outside the contractor's control, a low penetration was installed. Additional and matching funds were provided by APICDA, Alaska Energy Authority, TDX Power and Umnak to cover cost overruns and bring this project to fruition. In the first few months of operation the community is seeing a near 50% decrease in their need for diesel for both running the power plant generators and heating the facilities that use the heat from thermal energy created from excess production from the wind turbine.

We hope the success of this project and the lessons learned will empower Rural Utilities Service (RUS), United States Department of Agriculture (USDA) to continue to support similar projects in Alaska and the nation.

We would like to thank the Alaska Energy Authority, Nikolski IRA Council and TDX Power staffs for all their hard work and dedication to this project. On many occasions they exceeded expectation and made this project a success.

APPENDIX A: Grant Special Conditions or Limitations

The Grantee agrees and accepts all the following Special Conditions or Limitations established for this Grant:

8.1. The Grantee shall carry out the project and construction activities as described in the project application and environmental report, as modified by the revised project implementation plan, schedule, and budget approved by RUS. Any further amendments or revisions, including any change in the designated project manager, must be approved in writing by RUS.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.2. The Grantee shall submit a revised final project implementation plan, budget, and schedule for RUS review and approval before any advance of grant funds.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.3 The grant term will run for up to three years from date agreement is executed and may be extended with approval of RUS.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time. To comply with term 8.5, this grant cannot be closed out before the turbine has successfully generated power to the community for one year's time, which cannot occur before the turbine is producing power, estimated to be December 2008.

8.4. This Grant Award does not require any contribution of matching funds, however, the Grantee shall report on the total project costs and the expenditure of any non-federal funds, and any project-related contributions or income in its periodic financial and progress reports.

Reporting of the APICDA and any other additional contributions must be made for the quarterly report for period ending September 30, 2007 and any other quarterly reports thereafter when contributions are applied, to satisfy this term.

8.5. The Grantee shall report on the expenditure of grant funds and other Federal and non-federal project funds in quarterly financial reports and progress reports and participation rates during project construction. The Grantee shall attach Form SF 269A "Financial Status Report (Short Form) to the quarterly reports. Quarterly reports shall be due 30 days from the end of each quarter ending March 31, June 30, September 30, and December 31 of each year. The last quarterly report of each calendar year shall serve as

the project annual report. The quarterly report filed after construction has been completed and all project construction expenditures finalized shall serve as the final quarterly report. A final project report evaluating project performance, and detailing final project expenditures, participation rates, and one full year of operating data including estimated energy produced, fuel savings, and/or cost savings associated with the project shall be filed one year after filing of the last quarterly report. At the request of the Grantee, RUS may extend the period for filing quarterly and annual reports.

This term is on schedule to be satisfied. No amendments or revisions are required at this time. The reporting on the year of data on energy produced and fuel and/or costs saved cannot occur until the power plant is fully operational, the turbine is connected to the power plant, the control issues are addressed, and the turbine successfully produces power for the community throughout a year. The grant ends on September 30, 2010.

8.6. The Grantee shall provide bonding and insurance coverage for the project as described in the grant proposal and consistent with USDA grant regulations at 7 CFR parts 3015, 3016, 3019, or their successors, as applicable.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.7. The Grantee shall request advances in writing from RUS using Standard Form 270, "Request for Advance or Reimbursement," and supporting documentation.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.8. The Grantee shall provide RUS with a copy of the audit prepared and submitted under the Single Audit Act of 1984 (31 U.S.C. 7051 et seq.) and 7 CFR Part 3052, or its successor, for any year in which Federal funds expended under this grant agreement total $500,000 or more. At the Grantee's option under 7 CFR 3052, it may elect to provide the Agency with a program-specific audit.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

APPENDIX B: Nikolski Wind – Diesel Power System Status Report, Aug. 27, 2010

Nikolski Wind – Diesel Power System
Status Report
Aug. 27, 2010

Prepared by TDX Power

Commissioned

TDX Power, along with sub-contractor CPI, conducted the commissioning of the wind – diesel power system at Nikolski during the summer of 2010. A first trip provided test data of the main components and identified deficiencies in the control, communications and electrical heating configuration. The second trip addressed and corrected the communications and electrical heating configuration. The control deficiencies were addressed, but could not be completely corrected. Mostly stable operation of all system elements were confirmed over a two week test period. During the test period the wind turbine ran for over 70 hours. The system was left in an automatic run mode.

During the Commissioning tests data was collected via the SCADA package as verification of mostly stable system operation under a variety of wind conditions.

Although the hybrid power system was operational, it exhibited a number of fault conditions, which in some cases caused loss of power to the village. The faults were manually resettable from the powerhouse, but indicate a lower system reliability and robustness than is desirable. The faults are primarily a result of system control and communications delay deficiencies. Improved performance and reliability could be achieved when these deficiencies are addressed.

These faults can be traced back to the following issues
- Control System
- Wind Turbine interface link to Control System

TDX has worked for the last year to complete the installation of the wind diesel power system using the major components provided by

wind turbine - Tribe
diesel gensets, controls and powerhouse - AEA / CPI
communication links and resistive heat elements - TDX
three phase distribution to turbine and lodge - TDX

We have commissioned all the components of that system. Remaining concerns are the responsibility of CPI, which promised to provide a functioning wind-diesel control system. TDX has never had responsibility for these components, the control code or its design and implementation.

Suggested Improvements

Improvements in system performance (efficiency, reliability and robustness) could be obtained by addressing the observed deficiencies listed below:.

Control System

- Power level signals inside the controller have a significant time delay: on the order of 3 to 5 seconds.
- Controller response to vary the electrical heat to balance wind turbine output is too slow.
  - Reverse power flow in powerhouse is worst-case example, which has occurred numerous times.
- Controller code does not provide sufficient system stability in turbulent wind environments.
- Controller allows sympathetic grid frequency oscillations that feed the diesels and the wind turbine.
- Diesel dispatch code (switching from one genset to the other) has suspect set-points and control algorithm for a wind-diesel configuration.

Wind Turbine interface link to Control System.

- Control code cannot automatically command the wind turbine to run or stop, only the wind turbine Web user interface in the powerhouse can do that.
- Control code cannot reset faults registered at the wind turbine.
- Wind turbine has experienced over speed trips while operating. This condition needs to be investigated to determine cause
  - Extreme High power events
  - Sensor fault
  - Interaction or instability with grid frequency

Recommended Actions

Taking action on the above items should correct the current deficiencies which in turn should lead to higher fuel savings and a more reliable, robust system. Testing and long-term performance observations should be compiled for validation and as a guide for continued performance. Maintenance and troubleshooting will be accomplished under a 5 year contract between Nikolski IRA Council and TDX Power.

APPENDIX C: Protocol for Handling Sick, Injured, and Dead Spectacled and Steller's Eiders

Protocol for Handling
Sick, Injured, and Dead Spectacled and Steller's Eiders

Reporting
All distressed, disabled, and dead spectacled and Steller's eiders found should be reported as soon as possible. Attempt to contact the following people in the order listed until you succeed in reaching someone (numbers are listed below in the *Contacts* section): Greg Balogh, Charla Sterne, Kim Trust, Ted Swem, Dan Mulcahy, Dave Dorsey, Cindy Palmatier, Robert Suydam Dr. Derrick Leedy, Fred Broerman.

Illegally Killed Birds
If you find eiders that appear to have been killed illegally, contact a Service Law Enforcement office immediately (see *Contacts* section). When possible, notification should occur before the dead birds are removed from the site.

Notification should include:
1. Species, number of birds, date, time and location found;
2. Suspected cause of death;
3. Circumstances under which found;
4. If known, the names of witnesses or suspects, and a description of any vehicles or boats involved (non-law enforcement individuals are not expected to conduct investigations to obtain information that is not readily available).

If a camera is available, photograph birds and other evidence such as shotgun shells or casings, and persons and vehicles involved. Note photo date, time, and location.

Note: If you observe an eider being killed illegally and recover the dead bird, please refer to "Note" section under shipping instructions.

Handling Injured or Sick Birds
For apparently minor injuries (e.g. small lacerations, web tears, minor stunning), you should release the bird on site if: (1) you are so advised; or (2) you are out of radio/phone contact and the bird meets ALL OF THE FOLLOWING CRITERIA.

<u>Criteria for determining whether bird should be released:</u>
1. Bird can stand and walk using both feet.
2. Bird can flap both wings and there is no apparent wing droop.
3. Bird is alert, active, holds its head up and reacts to stimuli.
4. Bird is not bleeding freely.

5. Wing and tail feathers have not been lost and are in good condition.
6. Bird is waterproof (water beads up on feathers).

Retain birds that do not meet ALL of the above criteria, provide preliminary and secondary field care and report the bird (see *Reporting* section)

Preliminary Field Care:
1. Transport the bird to camp in a manner that is least likely to further injure or stress it.
2. Minimize bird handling (wear rubber gloves to prevent loss of feather waterproofing).
3. Keep birds in a quiet place.

Secondary Field Care:
1. Attempt to contact one of the following people in the order listed: Greg Balogh, Charla Sterne, Kim Trust, Ted Swem, Angela Matz, Dan Mulcahey, Dave Dorsey, Cindy Palmatier, Robert Suydam Dr. Derrick Leedy, Fred Broerman. They will help determine whether the bird should be shipped to Anchorage, will arrange for shipping and subsequent care of the bird, and will arrange for pick-up in Anchorage.
2. Note recovery location, time, persons involved, and reason bird was recovered.
3. Keep bird in a cage or box with adequate ventilation and access to cool or cold fresh water. Overheating is a common problem with captive eiders. If bird is dry, be careful not to place bird in overly warm environment. Wet birds should be placed in a warm (not hot) place to dry off. If possible, place absorbent materials or a frame covered with fine mesh Dacron netting in the bottom of the container to minimize contact between bird and feces.
4. Food may be offered if bird is alert. Try moistened cat or dog food, boiled egg, or seafood.
5. Record when bird eats and drinks.
6. Minimize handling of the bird. Wear rubber gloves to prevent loss of feather waterproofing.

Sacrificing Birds
If the bird is seriously injured, sick or suffering (and appears to be dying) and you cannot reach the listed contacts, you may euthanize it. An endangered species permit and this protocol authorize this activity. If appropriate, and if you know how, you may take samples before and after sacrificing the bird (contact AFWFO regarding which samples are needed). Otherwise, continue treating the bird as directed above or as advised by a D.V.M. until shipment to Anchorage can be arranged (see *Shipping Birds* section). Birds suffering from toxicity (e.g., lead poisoning), gunshot wounds, head injuries, or broken bones should be shipped live to Anchorage as soon as possible (unless circumstances warrant euthanasia). Field biologists who anticipate that they may need to sacrifice birds should receive training prior to their field season. Contact AFWFO or Dr. Dan Mulcahy to arrange for training. In locations near veterinary facilities, birds

that warrant euthanasia may be transported to a veterinary office where the procedure can be administered professionally. [1]

Field Procedures for Sacrificing Birds

If you are trained and equipped, obtain blood samples before euthanizing the bird. Administer euthanasia away from the general public. The preferred field methods for euthanizing birds are cervical dislocation (breaking the neck) and decapitation.

Cervical Dislocation

Place the head, bottom of the bill down, on a flat, solid surface. Place a solid rod (stick, dowel, etc.) on the neck directly behind the head. Holding the rod firmly on the neck, seize the body in the other hand, and give a quick, definite, and strong yank backwards, without letting the head move. You should feel the neck stretch and break. A slow or tentative pull will not work. It may help to pull the bird's body up as well as backward. The bird may shudder or tremble for a minute. Repeat the procedure if necessary.

Decapitation

Use a large, heavy blade or ax. Cut through the neck in one stroke. This procedure is quick and minimizes suffering. However, it is messy and carries risk of injury to yourself.

Shipping Live Birds

Reporting

Attempt to contact one of the following people in the order listed: Greg Balogh, Charla Sterne, Kim Trust, Ted Swem, Angela Matz, Dan Mulcahey, Dave Dorsey, Cindy Palmatier. They will help determine whether the bird should be shipped to Anchorage, will arrange for shipping and subsequent care of the bird, and will arrange for pick-up in Anchorage.

Preparation

Stabilize and rehydrate birds (offer cool or cold water in a stable bowl) before shipping.

Shipping

Ship birds in a cat or small dog carrier. Place absorbent cardboard or shredded paper in the bottom (if you can fit a wooden frame to the bottom of the carrier and affix fine-mesh Dacron netting to it; that is even better). Do not ship with food or water. Block the front grate of the carrier with tape or cardboard to minimize stress to the bird (but ensure adequate ventilation). Tape the bird's records to the container. If you want the container back, include name and address for return. Clearly label the container with: LIVE BIRDS, U.S. Fish and Wildlife Service, Anchorage, AK. (907) 271-2778.

[1] Note that, in all likelihood, a village veterinarian will not be covered under an endangered species permit. His or her assistance would, technically, be in violation of the ESA. Presumably, in situations where the vet was acting as a good Samaritan for a permittee, we would exercise discretionary enforcement.

Expenses

Some airlines will carry the birds for free, often in the crew's compartment. They do this as a favor and should be approached with courtesy. If the bird is being sent to the Bird TLC, it may be helpful to use their name in the conversation. Also mention the threatened species status where appropriate. If payment is necessary, AFWFO or FFWFO will cover shipping expenses.

Shipping Dead Birds

Note: Law Enforcement Concern - If the bird died as a result of an illegal act, such as shooting, and the illegal act was directly observed by the individual collecting the dead bird, a law enforcement office should be contacted for shipping instructions. Desired samples can be taken prior to shipping the bird to a law enforcement office. However, in order to properly pursue any related investigation, it will be necessary for law enforcement to take custody of the dead bird/s as soon as possible.

Storage

Obtain desired samples as soon as possible (e.g., blood or tissues for approved recovery task). Keep the carcass refrigerated if the bird will be sent within 48 hours for necropsy or additional samples. Only freeze birds after samples are taken or if shipping delays are inevitable. When in doubt, refrigerate until you talk to appropriate person(s). In remote field camps, place carcass in a pit dug down to permafrost.

Packaging and Shipping

Wrap chilled carcass in absorbent material, if possible, and place in large ziplock or other waterproof plastic bag. Include a tag with complete information about the bird, its death and collection, and your name, address and phone number. Ship in an insulated container. Pack with frozen gel packs if available. Do not ship with wet ice. If it is obvious to you that the carcass will spoil during shipping, contact AFWFO or FFWFO prior to shipping for further instructions. Notify receiving person(s) of flight arrival time so the package will not sit at the airport. Avoid shipping to government offices on Thursdays or Fridays (There is no mail delivery there on Saturdays and Sundays).

Expenses

If needed, AFWFO/FFWFO will arrange for shipping and expenses.

Taking Samples

Sample needs change with time. Contact AFWFO/FFWFO for current sample needs and procedures.

Contacts

Greg Balogh AFWFO, Anchorage	(800) 272-4174 toll free (907) 271-2778 work (907) 345-9899 home
Charla Sterne, AFWFO, Anchorage	(907) 271-2781 work
Ted Swem FFWFO, Fairbanks	(907) 456-0441 work
Kim Trust, AFWFO, Anchorage	(907) 271-2783 work (907) 276-0005 home
Angela Matz, FFWFO, Fairbanks	(907) 456-0442 work
Dan Mulcahy, D.V.M., National Biological Service	(907) 786-3451 work (907) 694-2514 home
Dave Dorsey, Bird TLC volunteer	(907) 351-4968 cell
Cindy Palmatier, Bird TLC director	(907) 522-4573 home
Bird TLC/Arctic Animal Hospital	(907) 562-4852 clinic
Pet Emergency Treatment, Inc.	(907) 274-5636
Robert Suydam, N.S. Borough, Barrow	(907) 852-0350
Dr. Derrick Leedy, DVM, Nome	(907) 443-2800
Fred Broerman, Yukon Delta NWR, Bethel	(907) 543-3151
Law Enforcement, FWS, Fairbanks	(907) 456-0255 (877)-535-1795 toll-free (907)-456-0459
Law Enforcement, FWS, Nome	(907) 443-2479 (907) 443-2938 fax
Law Enforcement, FWS, Regional Office	(907) 786-3311 (907) 786-3313 fax
Law Enforcement, FWS, Anchorage	(907) 271-2828 (800) 858-7621 toll-free (907) 271-2827 fax

APPENDIX D: No Cost Extension Request
APPENDIX E. Quarterly Reports

APIA Progress Report on the Nikolski Wind-Diesel Project
Phase 1 Wind Turbine Installation
September 12, 2007

This report, written in Times New Roman 12 pt. font, cites the two documents below shown in Bold Arial 11 pt. font, and refers to the 'Section 8 Terms of the Grant' between USDA/RUS and APIA and the 'Scope of Work' between APIA and TDX Power:

United States Department of Agriculture
Rural Utilities Service
Assistance to Rural Communities with Extremely High Energy Costs
Grant Agreement

1. THIS GRANT AGREEMENT (Agreement) dated August 11, 2006 is an agreement for receipt of High Energy Cost grant funds under section 19 of the Rural Electrification Act of 1936, as amended (7 U.S.C. 918a), between the United States of America, acting through the Administrator of the Rural Utilities Service (RUS), United States Department of Agriculture (USDA), (Grantor) and the Aleutian Pribilof Islands Association (Grantee) for the purposes of satisfactorily performing the Grant Project as described below.

Wind Turbine Generator System Engineering, Procurement, and Construction Agreement

This Wind Turbine Generator System Engineering, Procurement and Construction Agreement ("Agreement") is entered into this 10th day of October 2006 by and among TDX Power Services LLC, an Alaska limited liability company, with its principal offices located at 4300 "B" Street, Suite 402, Anchorage, Alaska 99503 ("Contractor"), the Aleutian Pribilof Islands Association, Inc., an Alaska non-profit corporation, with its principal offices located at 201 East 3rd Avenue, Anchorage, Alaska ("APIA" or "Association") and Umnak Power Company, an electric utility organized under the laws of the State of Alaska, with its principal offices located at Nikolski, Alaska ("Umnak"). Association, Umnak and Contractor are sometimes hereinafter referred to collectively as the "Parties" and individually as a "Party."

The following are the specific terms of the grant between USDA/RUS and APIA. The other terms of the grant are standard federal requirements and APIA policy.

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8. The Grantee agrees and accepts all the following Special Conditions or Limitations established for this Grant:

8.1. The Grantee shall carry out the project and construction activities as described in the project application and environmental report, as modified by the revised project implementation plan, schedule, and budget approved by RUS. Any further amendments or revisions, including any change in the designated project manager, must be approved in writing by RUS.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.2. The Grantee shall submit a revised final project implementation plan, budget, and schedule for RUS review and approval before any advance of grant funds.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.3 The grant term will run for up to three years from date agreement is executed and may be extended with approval of RUS.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time. To comply with term 8.5, this grant cannot be closed out before the turbine has successfully generated power to the community for one year's time, which will not occur before September 30, 2008.

8.4. This Grant Award does not require any contribution of matching funds, however, the Grantee shall report on the total project costs and the expenditure of any non-federal funds, and any project-related contributions or income in its periodic financial and progress reports.

Reporting of the APICDA and any other additional contributions must be made for the quarterly report for period ending September 30, 2007, and any other quarterly reports thereafter when contributions are applied, to satisfy this term. (SEE Attachment A: Budget Estimate for APICDA Assistance)

8.5. The Grantee shall report on the expenditure of grant funds and other Federal and non-federal project funds in quarterly financial reports and progress reports and participation rates during project construction. The Grantee shall attach Form SF 269A "Financial Status Report (Short Form) to the quarterly reports. Quarterly reports shall be due 30 days from the end of each quarter ending March 31, June 30, September 30, and December 31 of each year. The last quarterly report of each calendar year shall serve as the project annual report. The quarterly report filed after construction has been completed and all project construction expenditures finalized

shall serve as the final quarterly report. A final project report evaluating project performance, and detailing final project expenditures, participation rates, and one full year of operating data including estimated energy produced, fuel savings, and/or cost savings associated with the project shall be filed one year after filing of the last quarterly report. At the request of the Grantee, RUS may extend the period for filing quarterly and annual reports.

This term is on schedule to be satisfied. No amendments or revisions are required at this time. The reporting on the year of data on energy produced and fuel and/or costs saved cannot occur until the power plant is fully operational, the turbine is connected to the power plant, the control issues are addressed, and the turbine successfully produces power for the community throughout a year.

8.6. The Grantee shall provide bonding and insurance coverage for the project as described in the grant proposal and consistent with USDA grant regulations at 7 CFR parts 3015, 3016, 3019, or their successors, as applicable.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.7. The Grantee shall request advances in writing from RUS using Standard Form 270, "Request for Advance or Reimbursement," and supporting documentation.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

8.8. The Grantee shall provide RUS with a copy of the audit prepared and submitted under the Single Audit Act of 1984 (31 U.S.C. 7051 et seq.) and 7 CFR Part 3052, or its successor, for any year in which Federal funds expended under this grant agreement total $500,000 or more. At the Grantee's option under 7 CFR 3052, it may elect to provide the Agency with a program-specific audit.

This term has currently been met and shall be for the life of the grant. No amendments or revisions are required at this time.

The following are the specific scope of work items of the contract between APIA and TDX Power. The other terms of the contract are standard federal requirements, customary business indemnifications and provisions, and APIA policy.

Exhibit A: Scope of Work

The Contractor shall procure or furnish the design, materials, equipment, labor, permits

and supervision to construct one fully operational 65 kilowatt Wind Turbine Generator System (WTGS) and associated equipment and interconnect to the newly commissioned diesel fuel based power plant in Nikolski in accordance with the International Electrotechnical Commission (IEC) Wind Turbine Standards.

TDX Power completed the above construction aspects by July 28, 2007, with two exceptions. The step-down transformer from the transmission line to the power plant was delivered inoperable and is being replaced under warranty. It will be installed as soon as it can be attained and transported to Nikolski; anticipated installation is late October, 2007. The fully functional turbine cannot be connected to the power plant through the installed transmission line because the plant is functionally inoperable in terms of control panel integration with only one working generator.

The Work shall include all subsystems of WTGS such as control and protection mechanisms, internal electrical systems, mechanical systems, support structures, foundations, and interconnection to the existing Nikolski power plant.

TDX Power has completed all construction aspects of this term with the following exceptions: control system compatibility and final calibrations for the control and internal electrical systems cannot be performed until the power plant is functionally operational.

A trench was dug from the wind turbine to the diesel plant and a 15 kV line was buried. The original route surveyed for this line had to be redirected when Arnold Dushkin, IRA Council President, noticed it passed too closely to two graves outside of the cemetery fence. While digging the trench near the diesel plant, liquid diesel fuel oozed out of the soil. There is a significant leak in the line from the day tank into the diesel plant.

This leak was reported to the Alaska Energy Authority by Umnak Power. An AEA technician returned and replaced the newly welded pipe joint, but the leak did not stop. Umnak Power notified AEA, who attested they fixed the leak. It is leaking inside the wall of the power plant and requires immediate attention. The Coast Guard will be notified.

Contractor shall ensure specific requirements for the safety of WTGS, including design, installation, maintenance, and operation under the Nikolski site environmental conditions. Its purpose is to provide the appropriate level of protection against damage from all hazards from these systems during the planned WTGS lifetime.

TDX Power has completed all construction-related aspects of this term. Turbine integration to the power plant shall be completed after generator repair and connection to the power plant control systems. WTGS system safety for operations and maintenance shall occur during the two years of operator supervision and training.

The Nikolski IRA has contracted with TDX Power to do the necessary repairs to their diesel plant that will allow interconnection with the wind turbine. The IRA will cover the cost themselves, with no funds used from this grant. The repairs are scheduled to begin at the end of

October.

The Contractor shall purchase a 65 kilowatt Vestas V-15 Wind Turbine (or approved equal) that has been retrofitted within certain design parameters applicable to installation of a wind turbine in Nikolski, Alaska and ship the Turbine and associated equipment to the Nikolski project site.

TDX Power completed this term, including installation, on July 28 2007.

The Vestas V-15 Wind Turbine was purchased in September from a farmer in Germany who was installing a larger wind turbine in its place. There are no new Vestas wind turbines in this size range available, except in India where they are manufactured for local use only.

The turbine was shipped from Germany to Halus Co. in San Francisco, CA for refurbishing. The design was altered to include a mechanism that automatically untwists the electric cables which run from the nacelle at the top to the turbine base. This will prevent stress on the cables from multiple changes in wind direction, as can happen in Nikolski.

The blades are new and are appropriate to the environment, coated heavily with a composite to prevent deterioration from the salty sea air.

The tower designed by Halus Co. and TDX Power was put together and tested in San Francisco prior to being disassembled and shipped to Nikolski.

The turbine and tower were put together on site during the last week of July. Early on July 28th erection of the turbine began. The wind was exceptionally cooperative with calm weather lasting the entire 12 hours it took to raise the tower. This alone is a miracle. The tilt-up design worked exactly as intended, coming down perfectly on the anchored bolts with less than one quarter inch of play.

The Contractor shall complete all site assessment work necessary prior to installing the wind turbine, including an engineering evaluation and design for the foundation and tower, as appropriate for all site work to be accomplished within the approved budget. The Parties acknowledge that the soil conditions may differ materially from what is expected. Accordingly the budget provides for a contingency amount ($8,080). The Parties agree that this contingency shall not be expended for any purpose other than differing site conditions until the completion of site excavation and final foundation design. After this time, such funds may be expended for discretionary changes to the Project.

TDX Power has completed this term.

Geotechnical analysis of the soil at the site was better than expected. The soft loamy soil is underlain by a gravel base, providing a solid bottom for the foundation. The foundation was constructed over several days in June, 2007. The foundation consists of a 20’ x 20’ x 2’ slab 6’ underground; (2) 48” x 5’ culverts filled with rebar and concrete; topped by a 20’ x 20’ x 8” concrete slab. A total of 68 cubic yards of concrete was used in the foundation.

The road to the site was too soft to bear the weight of the materials and required substantial work prior to hauling materials to the site.

The foundation was left to cure for one month prior to erection of the wind turbine.

Due to the continually and rapidly increasing costs for transportation and supplies, the contingency amount of $8,080.00 shall be designated for discretionary expenditure on the scheduled site maintenance and support.

The Contractor shall utilize the local Nikolski workforce whenever possible.

TDX Power has completed this term whenever possible. Multiple, simultaneous projects in Nikolski overburdened the small local labor force and required additional imported labor.

The Contractor shall provide an evaluation and written report on the integration of the WTGS with the existing diesel power plant, recommending modifications, if any, of the diesel controls and system operability where necessary.

This task will be completed upon repair of the diesel power plant and is not construction related. As noted at the bottom on page 2 of the contract, TDX Power will use reasonable efforts to complete the feasibility report of integrating the turbine to the power plant by December 31, 2007, however until the power plant is operational, it is unreasonable to anticipate that this will be accomplished by this date.

The Contractor shall procure or furnish to Umnak all guarantees, warranties, spares and maintenance manuals that are called for in the specifications or that are normally provided by a manufacturer. The maintenance manual shall include a catalog and price list of any equipment, materials, supplies, or parts used in inspection, calibration, maintenance, or repair of the equipment.

APIA and Nikolski have the Vestas 65kW Wind Turbine Operations Manuals. The Nikolski-specific wind-diesel power plant operations and maintenance manual cannot be written until the turbine has been successfully integrated into an operable power plant. TDX Power will provide all guarantees, warranties, and spares when TDX completes the training in Nikolski after integration of the turbine to an operable power plant. TDX Power will enhance the manuals over the two year site operations, maintenance, and support period. Due to: the highly specialized nature of WTGS and integrated wind-diesel projects; continually and rapidly increasing costs for materials, transportation, and freight; and new technology development; suppliers and costs cannot remain up to date.

Upon completion of the installation, the Contractor shall provide training to local utility employees on operations and maintenance of the WTGS. The Contractor shall provide ongoing support for a period of two years from date of Substantial Completion to assist

with parts and materials, ongoing training, and annual maintenance, including a minimum of two site visits during the two year period.

A trip to Nikolski, planned for September 24-27, for the purpose of a second tightening of bolts on the tower and a tower climbing safety class, was attempted. In addition, training was to be provided for basic diesel plant O & M to alternate plant operators in the community. The diesel plant training was to be paid for with funds from BIA. Due to bad weather the crew was delayed in Dutch Harbor for 3 days waiting to get into Nikolski. The engineer was able to get out to Nikolski for one hour on the 27^{th}. Time constraints prevented him from staying longer. He was able to diagnose the problems with the diesel plant and propose a plan of action to the IRA. The repairs are scheduled to be completed during the last week of October.

TDX Power cannot complete any other turbine or integration training until the power plant is operational. As noted above, the contingency amount ($8,080.00) must be designated for the two years of operations, maintenance, and support to accomplish the site visits and supplies needed.

Steps for Project Completion

1) Immediate concerns for continued power production from remaining generator #1

- Umnak Power needs a fuel delivery.
- The fuel leak from the day tank into the diesel plant must be repaired.
- The line from the tank farm to the diesel plant needs to be pressure tested. The oil saturated soil found when digging in front of the diesel plant is likely from a leak in the line, not from the leak in the wall of the diesel plant.
- The spill needs to be addressed, both inside and outside of the plant.
- The one functional diesel generator needs a major tune-up.
- The engine water pump and alternator belts need to be replaced with correct belts.
- Umnak Power must order additional generator oil and filters.
- Rubber radiator hoses must be replaced.
- The exhaust wall penetration needs repaired to prevent further water intrusion.
- Corroded cannon plug to wireless antennae needs to be replaced.
- Proper flashing needs to be installed on main door to power plant to prevent water intrusion during storms.
- A heat recovery system should be installed or the ventilation system needs to be repaired to prevent excessive heat in power plant.
- Hand operator switch must operate consistently to prevent main breaker use.
- Power plant operations and maintenance needs to be logged daily.
- Operations and Maintenance Protocol must be accomplished.

2) Umnak Power must replace two diesel generators in the existing power plant. The size of the new generators will be determined following a new current and anticipated load analysis. It is likely the largest generator will be increased to 120 kW. The current configuration of the diesel plant is inadequate for the growth of the community and increased activity at the APICDA lodge. Primary Party: Umnak Power. Estimated Costs: $100,000.00.

3) Power plant tool box needs full suite of appropriate tools.

4) Umnak Power, owner of diesel plant and wind turbine, needs an agreement that assigns TDX Power as Primary Operator of the wind-diesel power plant.

5) TDX Power will test existing controls for compatibility of high penetration wind energy.

APPENDIX F: Wind Power Feasibility Study Sand Point, St. George and Nikolski, Alaska

Executive Summary:

This report supplements the APIA Grant Application to the Rural Utilities Service to fund wind diesel power projects in three remote Alaskan villages. A critical supplement to this report is a detailed model outlining various options for including wind power as a source of both electricity and heat in the three community power plants. Low, medium and high penetration options are addressed, with equipment options from two utility grade suppliers of wind turbines. In the high penetration model, excess electricity from the wind turbines would be used to create thermal energy and stored for immediate use for space heating or other beneficial application through a hot water storage and distribution system at the adjacent school.

Recommendations:

TDX Power recommends installation of a high penetration wind diesel hybrid plant in Sand Point, St. George and Nikolski with a thermal recovery system integrated into existing heating systems within the communities, such as the schools, community buildings and other large buildings that require significant heat in the winter. While we acknowledge different perspectives on the economic analysis of such a project, it is clear to us this wind diesel configuration would produce the greatest potential future savings for the community, the greatest leverage against increasing fuel prices and other liabilities associated with diesel only generation, and flexibility for future electric and thermal load growth within the communities.

Some specific components of this recommendation include:

- In St. George, we recommend installation of Three Northwind 100 wind turbines. These wind turbines will tie directly into a new diesel powerhouse module with state of the art switchgears and controls, allowing the wind turbines to actually follow load with no diesel generation during high wind periods.

- In Nikolski, we recommend installation of a Fuhrlaender FL30 wind turbine. This turbine will work directly with a newly installed diesel power house module and will also provide both electricity and heat from thermal energy created from excess production from the wind turbine.

- In Sand Point, we recommend installation of a Fuhrlaender FL1000 wind turbine. This turbine will tie directly into the existing powerhouse through recently installed switchgear and controls specifically designed to accept wind power generation into the grid. Sand Point is the largest of the three communities and as a result the proposed wind diesel generation facility will produce the greatest amount of thermal energy. The system design being proposed will allow all diesel engines to turn off during high wind periods, with the wind turbines actually following load, and excess wind energy will provide thermal energy to the community school and health clinic.

- Completion of a detailed geotechnical analysis is required to confirm the technical feasibility and construction cost estimates for this project. This geotechnical analysis will be the first task completed in each community.

- Negotiation of firm support agreements from both Northern Power and Fuhrlaender have been discussed, including clearly defined warranty and turbine support parameters and costs for the first three years. These agreements should be finalized prior to equipment purchase.

- TDX Power recommends that APIA allow two summer construction seasons to complete installation of all systems in all three communities.

- TDX Power is pleased to serve as an EPC contractor for these projects and will provide appropriate guarantees for project milestones, timelines and budget.

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Installation Cost, Operational Economics & Maintenance Considerations for a Wind Power System Addition for the communities of Nikolski, Sand Point, and St. George, Alaska

Background

The Aleutian Pribilof Island Association (APIA) is interested in adding wind power generation to three of the communities it represent in rural, Alaska. In preparation for submission of a grant proposal to the Rural Utilities Services, APIA asked TDX Power to evaluate the cost and operating economics of integrating a wind energy generation component into the existing diesel power plants. APIA is aware that this type of wind/diesel hybrid integration now has considerable case history experience in Alaska and throughout the world. Properly located and designed, hybrid technology has successfully demonstrated the ability to significantly reduce fuel use and powerhouse maintenance through reduced engine run time. In order to evaluate the cost-benefit of wind integration in the diesel plants in these three communities, APIA also commissioned TDX Power to provide a detailed analysis of the expense and effect of adding wind generation to the planned generating facilities.

TDX Power is an Anchorage based engineering services and generation equipment provider and is the owner/operator of two regulated Alaska electric utilities, located in Sand Point and Prudhoe Bay. TDX also designed and constructed the largest high penetration, cogenerating wind/diesel system in Alaska, located on Saint Paul Island. The 500 Kilowatt Saint Paul hybrid plant has been awarded a variety of DOE innovation and advanced efficiency awards and has been successfully operational since 1999.

This report consists of five sections: 1) recommended hybrid system design, 2) projected installed cost of a wind generation system and its ancillary components, 3) projected impact of the wind generation system on the diesel plant's operating economics, 4) operations and maintenance program considerations and cost, and 5) Schedule and final observations.

Summary Wind/Diesel System Design

The decision path for high, medium, or low penetration includes analysis of the wind resource, the forecasted electric load and analysis of potential uses for thermal energy. The supplemental economic model, which incorporates results from multiple turbine manufacturers and configurations suggests a high penetration design provides superior cost/benefit performance compared to low or medium penetration configurations in all three communities and therefore focused its primary attention on it.

Based on the model, TDX Power recommends a high penetration wind diesel plant with coincident thermal energy generation design for the three generating facilities. The fact that all three communities possess Class 7 rated wind resource provides the primary basis for this recommendation. In such a design, total wind generating capacity exceeds the community peak power demand by between 30% and 70%. Through such capacity and configuration, the engine generators will literally be shut off during periods of relatively high wind speed, defined as above 16 miles per hour. Additionally and importantly, during high wind periods the high penetration design will produce excess electric energy which is converted to thermal energy and stored for use as space heating or other beneficial application through a hot water storage and distribution system.

In a low penetration design, the diesel units must continue to run regardless of wind speed. The wind generators run in constant parallel with the diesel units, which only serves to reduce load on the diesel generators. Such a configuration produces no cogenerated by-product, such as hot water. And in medium penetration design, there is minimal production of a cogenerated by product and relatively little wind-only mode operations, which struggles to justify its investment. By sizing sufficient wind turbine generating capacity to have "wind only" generation periods, as well as the simultaneous production of a beneficial thermal product, the high penetration design produces far greater total fuel avoidance, lower engine maintenance expense, and superior long term total system operating efficiencies compared to the low or medium penetration system. Accordingly, TDX focused its analysis on the high penetration example.

As proven in the Saint Paul Island example, and dozens of similar high penetration wind/diesel installations around the world, the high penetration design functions with utility grade reliability and efficiency when properly designed, deployed and maintained. Such a system is relatively simple, using standard components. The primary building blocks of a high penetration system include the wind generation equipment, microprocessor based sensors that simultaneously monitor instantaneous load and wind speed, specialized switchgear that allow the diesels and wind turbines to function together either in parallel or singly, and a hot water storage tank with associated thermal energy delivery infrastructure.

A properly developed high penetration facility operates in diesel mode during periods of no wind, in wind-diesel parallel during moderate wind speed periods, and in full diesel-off, wind-only mode during wind periods of approximately 16 mph or higher. In a typical configuration, the electronic signal to commence wind-only mode occurs when the wind energy system is capable of producing approximately 120% of operating demand or a fixed incremental of output above the community load, for at least one hour. During these higher wind periods, the engine generator shuts off automatically and wind turbines follow community load and, in addition, supply excess energy to the water storage tank. In lower wind periods, the diesel generators supply intermittent charge to the water tank to maintain minimum temperature, typically set between 150 and 190 degrees Fahrenheit. The heated water can then be pumped through a piping and radiator network to supply space heating, or used in other beneficial community use application such as swimming pools or commercial activity. The excess-to-load wind energy offsets or eliminates heating fuel requirements.

The installation and operational cost analysis provided in this report is based on the integration of three Northwind 100 wind generators into the planned St. George diesel plant, the Fuhrlaender FL 1000 wind turbine in Sand point, and the Fuhrlaender FL 30 turbine in Nikolski. All three turbines are utility grade and will be fully supported by the respective manufacturers.

Wind System Installation Cost
St. George
TDX Power estimates a total cost of $1,066,000 to fully construct and integrate a three unit, Northwind 100 wind generation facility, with an associated thermal storage and delivery system. This system will tie into a new diesel power house module that will be installed at the same time, to meet the 225 kw average electric load in the community. Funding for the diesel powerhouse has been secured from a separate source and is not part of the grant application to RUS. Following is an itemized breakdown of the major components included in the cost projection:

1. 3 Northwind 100 wind turbines = $765,000
2. Site construction = $260,000
3. Thermal storage and distribution infrastructure = $21,000
4. System components shipment from Seattle = $20,000

The cost analysis assumes three Northwind 100 machines, which would be supplied FOB the Port of Seattle and complete with all necessary subsystems including towers and controllers. TDX Power believes that the wind energy component of the new diesel power plant system must have at least 250 kilowatts of total gross capacity in order to achieve optimum wind-only mode, high penetration design results. As any less than three Northwind generators do not meet the capacity criteria, three are suggested and modeled.

The site construction estimate was supplied by Jim Saint George, an experienced civil contractor in western laska with experience installing wind turbines, and includes turbine foundations. The construction estimate was based on certain assumptions such as piling design foundations, and assumptions of probable soil and subsurface aquifer conditions. While the cost estimate seems reasonable under the circumstances, TDX cautions that geotechnical work has not been completed at the probable St. George location and subject to these further investigations, the construction cost estimate could change.

TDX Power understands the diesel power house module will have Kohler paralleling switchgear in a five section line up. This equipment contains circuit breakers and PLC based controls, a master control section and a section for feeder control. The Kohler system is controlled from a local touch screen and capable of remote operation via a standard WEB browser. The operator interface uses the Advantech touch screen for alarm display, alarm and status logging (500 events), user selectable remote alarms, digital synchronizer, digital real (KW) and reactive (KVAR) load sharing, system information and data display, manual synchronizing and operator control. The engine generator control cells, master section and sectionalizing cells are bussed together. The main buss is rated at 2,000 amps at a typical buss voltage of 480, 3-phase, 4-wire. The Kohler system has the ability to control and monitor a variety of diesel/generator equipment and provide operating personnel with the ability to operate in a total manual mode in the event of PC or PLC failure.

The thermal storage and hot water delivery system price is based on the assumption and recommendation of 8,000 gallons of storage capacity, to be located near or adjacent to the St. George school boiler house. The cost estimate includes the insulated storage tank and all necessary piping and pumps to circulate water at an average temperature of 170 degrees F. The hot water in the storage tank will replace or considerably offset fuel oil use for the school's thermal requirements.

A power plant site plan has been developed with three turbines sited around the power plant. The siting of the wind turbines is somewhat subjective at this point, pending a geotechnical evaluation. However, a rough estimate of where the wind turbines could be placed was prepared to provide a general idea of distances. Both Northern Power and Fuhrlaender wind turbines should have the minimum 2 1/2 - 3 rotor diameters between them, and no less than 10 diameters downwind. Based on data produced from a year's wind resource data from an on site annomometer, we have assumed the prevailing winds are westerly, south westerly.

Nikolski

TDX Power estimates a total cost of $241,000 to fully construct and integrate a single unit, Fuhrlaender FL30 wind generation facility, with an associated thermal storage and delivery system. This system will tie into a diesel power house module that was recently installed by the Alaska Energy Authority to support the average 25 kw electric load for the community. Following is an itemized breakdown of the major components included in the cost projection:

1. 1 Fuhrlaender FL30 wind turbine= $145,000
2. Site construction = $65,000
3. Thermal storage and distribution infrastructure = $11,000
4. System components shipment from Seattle = $20,000

The cost analysis assumes one Fuhrlaender FL30 wind turbine, which would be supplied FOB the Port of Seattle and complete with all necessary subsystems including tower and controllers.

The site construction estimate was also supplied by Jim Saint George, and includes turbine foundations. The construction estimate was also based on certain assumptions such as piling design foundations, and assumptions of probable soil and subsurface aquifer conditions. While the cost estimate seems reasonable under the circumstances, TDX again cautions that geotechnical work has not been completed at the probable Nikolski location and should be completed prior to construction.

The thermal storage and hot water delivery system price is based on the assumption and recommendation of 2,000 gallons of storage capacity, to be located near or adjacent to the school boiler house. The cost estimate includes the insulated storage tank and all necessary piping and pumps to circulate water at an average temperature of 170 degrees F. The hot water in the storage tank will replace or considerably offset fuel oil use for the school's thermal requirements.

The wind resource in Nikolski is so strong, that a siting recommendation from John Wade, a veteran wind power meteorologist, suggests the wind turbine should actually be placed in a semi protected location so that a prevailing wind direction can dominate over the rather typical turbid conditions. Based on a site visit with Mr. Wade, an optimal site has been identified to meet both wind resource and foundation requirements.

Sand Point

TDX Power estimates a total cost of $1,606,000 to fully construct and integrate a single unit, Fuhrlaender FL1000 wind turbine, with an associated thermal storage and delivery system. This system will tie into the existing diesel power house module with state of the art switchgear and controls designed to integrate with a wind turbine. Following is an itemized breakdown of the major components included in the cost projection:

1. 1 Fuhrlaender FL1000 wind turbine = $1,215,000
2. Site construction = $290,000
3. Thermal storage and distribution infrastructure = $61,000
4. System components shipment from Seattle = $40,000

The cost analysis assumes one Fuhrlaender FL1000 wind turbine, which would be supplied FOB the Port of Seattle and complete with all necessary subsystems including tower and controllers.

The site construction estimate was again supplied by Jim Saint George, and includes turbine foundations. The construction estimate was based on certain assumptions such as piling design foundations, and assumptions of probable soil conditions.

The thermal storage and hot water delivery system price is based on the assumption and recommendation of 20,000 gallons of storage capacity, to be located in the Sand Point school. The cost estimate includes the insulated storage tank and all necessary piping and pumps to circulate water at an average temperature of 170 degrees F. The hot water in the storage tank will replace or considerably offset fuel oil use for the school's thermal requirements.

Economic & Operational Impact of Wind Integration

TDX's analysis of the effect of wind generation on the existing diesel plants was based on a full year of local met tower wind speed measurement in St. George and sand point, and regional wind resource data for Nikolski. Unfortunately TDX was limited by partial electric load data for community load analysis in Nikolski and St. George, as the existing power generation systems were incapable of recording this data. Electric load data for Sand point was provided for an entire year on a ten minute interval. For St. George, electric load data was supplied for a single month, October 2004. Through this incremental data, however, TDX was able to create a multiplier formula which allows the October data to be extrapolated over an entire year with good accuracy.

St. George Weekday Hourly Load Profiles

Supplementing and integral to this report is a detailed spreadsheet model that calculates and presents the operational and economic impact of the wind generation systems on the existing (Sand Point and Nikolski) and proposed (St. George) diesel plants. The information which follows in this section summarizes certain data extracted from the St. George spreadsheet. To see the full presentation, all associated methodology and the support data, please refer to the CD which accompanies this report.

The overall TDX analysis logic assumed: 1) During periods of no wind, total power is supplied by the diesel generators, which also supply as-necessary intermittent charge to the thermal tank to maintain desired water temperature range. 2) In wind-diesel mode, additional load above village demand is provided based on the potential wind turbine output decrease due to normal real time variations and the desired preset margin. 3) The system's switch to wind-only mode occurs when excess wind generation (compared to actual village load) is greater than the suggested preset margin, approximately 120% of measured load, plus the potential wind turbine output decrease due to normal real time variations. 4) In wind-only mode all excess turbine generated energy is sent to the thermal storage tank.

Following is a summary of TDX's modeling results for total integrated hybrid system operations in St. George:

- Diesel only operations will consume 63,937 gallons of fuel oil annually, with total diesel plant production of 871.9 megawatt hours.
- Fully integrated with the three wind generators, the diesel operations consumption will be reduced to 38,214 gallons annually and total diesel plant production will be reduced to 514.4 megawatt hours.
- The hybrid integration reduces powerhouse fuel use by 40%.

The high penetration design allows excess energy production relative to village load during high wind speed periods. Again based on a full year, following is the amount of excess energy which would be diverted to the thermal storage tank:

- Total wind energy contribution to the thermal storage tank = 1239.9 mm Btu's
- Equivalent gallons of heating fuel supplied from wind energy = 11,653
- Net Gallons of heating fuel offset by the wind energy contribution = 11,037

The TDX model for the full year shows that adding the gross rated 300 Kilowatt wind energy component to the proposed St. George diesel plant would provide generating fuel savings of 40%, a reduction of projected consumption from 64,000 gallons to 38,000 gallons. In addition, the model shows the wind component would contribute a total of 719.6 megawatt hours, the equivalent of 11,653 gallons of fuel, to the thermal tank.

Operations and Maintenance

TDX expects that reduction of engine run time will have generally commensurate and proportional effect on diesel powerhouse maintenance expense. At minimum, the run time reduction caused by the contribution of the wind energy component will extend the otherwise expected intervals for scheduled, preventative top and bottom end inspections and maintenance.

O&M specific to the wind generation system, however, creates a new and critical category of operational responsibility and expense. Without a systematic preventative maintenance regime for the wind generators, performed by a knowledgeable and conscientious technician, TDX doubts the long term viability of such a project in these communities. Although TDX is confident that the Northwind 100 and the two Fuhrlaender turbines are of an advanced design capable of sustained duty in harsh environments, constant observation, basic care and the ability to immediately address alarm conditions is mandatory.

In TDX's experience in similar climate conditions, gearbox failure is the most common cause of catastrophic turbine failure and unscheduled downtime. This will not be a factor with the Northwind 100 as it uses a variable speed direct drive synchronous generator which eliminates a gearbox interface to the alternator. This arrangement should simplify the O&M program. Additionally, as the Northern units produce synchronous power, their use in this project would eliminate the need for a synchronous condenser, which is commonly used in hybrid designs to condition power produced by induction machines. Elimination of the condenser not only eliminates a key maintenance item, it eliminates approximately 15 Kilowatts of system parasitic load. These features of the Northern turbine will reduce operations complexities and some costs, but will in no way negate the need for systematic O&M procedures.

The key component of a successful maintenance program is human. TDX strongly suggests that someone within these communities be identified to address this job scope. The person needs to be of sufficient health to be able to routinely climb the towers, but otherwise age or gender should make no difference. Experience in the power generation field or experience with sophisticated equipment should not be a factor. TDX believes the main ingredients required to create a capable plant operator are attitude and training. The person who will succeed will want the job and the responsibility, and will be enthusiastic about learning. With the right person, TDX believes that approximately three weeks of factory training and two weeks on site training will enable the trainee to begin functioning professionally.

From such a beginning, based on TDX's experience with similar situations, the operator will require between one and two years of steady support, which in most cases can be provided by telephone. Such ongoing contact increases operator confidence, improves system performance and pays long term dividends in lower costs and less unscheduled downtime. Northern Power, TDX or a variety of other experienced companies could provide these support services at minimal expense. Ideally, the wind plant operator would also be responsible for the entire hybrid plant, including its thermal component. TDX estimates that such an employee would expect an annual salary in the $40,000 to $50,000 per year range.

In addition to training and support programs, TDX recommends an inventory of spare parts be maintained in the three communities. Also, equipment manufacturers publish rigid service interval recommendations, and strict observance is the key to reliability. On site spares are vital, and the inventory contributes to the operator's understanding of how equipment is actually being used.

TDX suggests that the type and quantity of spares on-hand should target equipment that is either subject to high stress cycles or equipment that significantly contributes to the system's peak performance and reliability. These target areas include:

- Critical engine and control system spares
- Engine control and master control cells
- Distribution feeder cell spares
- Wind turbine and ancillary control system spares
- Thermal storage system spares

Equipment failure is most likely to occur during initial start-up through approximately the first years' operation. Repair and most parts will be covered by manufacturer's warranties in this timeframe and the spares inventory should be adjusted based on events, experience and trends.

Operations through the second and third year typically involve scheduled component change, which should follow the recommended protocol specified by the manufacturer. As is typical with virtually all new power plants, the most critical time is the fourth and fifth year of operation. During this prone-to-failure period the parts inventory should be thoughtfully adjusted to address general local experience and historical failure trends.

TDX suggest a budget of $12,800 for an adequate spare inventory covering the first full year of hybrid operations in St. George, $8,600 in Nikolski, and $39,400 in Sand Point. Based on their involvement in all three communities, TDX Power is confident it will be a le to provide the necessary support outlined above. As the owner of the Sand Point utility, primary operator of the Nikolski utility, and neighbor to the remote St. George utility (TDX Power owns and operates the high penetration wind diesel power plant on the adjacent Pribilof Island of St. Paul) TDX Power is familiar with both logistics and personnel issues in all three communities.

Schedule & Final Observations

TDX Power recommends the following schedule for completing projects in these three communities:

November 2005 – January 2006: Geotechnical Analysis in all three communities
February 2006 – April 2005: Complete design engineering for all three communities, confirm turbine orders and availability.
May 2006 – July 2006: Initial site preparation in Nikolski and St. George.
August 2006 – October 2006 – Nikolski construction
November 2006 – March 2007 – Installation of St. George power house module
April 2007 – June 2007 – Wind turbine construction in St. George
July 2007 – September 2007 – Wind turbine construction in Sand Point

As the owner and operator of rural utilities in Alaska, TDX Power operates in compliance with RUS Electric Program Regulations and Bulletins. All work proposed for these projects will be consistent with these regulations.

The communities of St. George, Sand Point and Nikolski are remote Alaskan communities completely reliant on diesel fuel for electric power generation. Diesel fuel costs continue to rise dramatically in these communities, and TDX Power is confident the addition of wind power will significantly reduce the amount of diesel fuel consumed for power generation. The region's class 7 wind regime makes these communities prime candidates for wind power, and all three communities have the infrastructure and personnel required to support these projects.

APPENDIX G: Original Project Overview

Project Design

The Aleutian Pribilof Island Association (APIA) is interested in adding wind power generation to three of the communities it represents in rural Alaska. In preparation for submission of a grant proposal to the Rural Utilities Services, APIA asked TDX Power to evaluate the cost and operating economics of integrating a wind energy generation component into the existing diesel power plants. APIA is aware that this type of wind/diesel hybrid integration now has considerable case history experience in Alaska and throughout the world. Properly located and designed, hybrid technology has successfully demonstrated the ability to significantly reduce fuel use and powerhouse maintenance through reduced engine run time. In order to evaluate the cost-benefit of wind integration in the diesel plants in these three communities, APIA also commissioned TDX Power to provide a detailed analysis of the expense and effect of adding wind generation to the planned generating facilities.

TDX Power is an Anchorage based engineering services and generation equipment provider and is the owner/operator of two regulated Alaska electric utilities, located in Sand Point and Prudhoe Bay. TDX also designed and constructed the largest high penetration, co generating wind/diesel system in Alaska, located on Saint Paul Island. The 500 Kilowatt Saint Paul hybrid plant has been awarded a variety of DOE innovation and advanced efficiency awards and has been successfully operational since 1999.

This report consists of five sections: 1) recommended hybrid system design, 2) projected installed cost of a wind generation system and its ancillary components, 3) projected impact of the wind generation system on the diesel plant’s operating economics, 4) operations and maintenance program considerations and cost, and 5) Schedule and final observations.

Summary Wind/Diesel System Design

The decision path for high, medium, or low penetration includes analysis of the wind resource, the forecasted electric load and analysis of potential uses for thermal energy. The supplemental economic model, which incorporates results from multiple turbine manufacturers and configurations, suggests a high penetration design provides superior cost/benefit performance compared to low or medium penetration configurations in all three communities and therefore focused its primary attention on it.

Based on the model, TDX Power recommends a high penetration wind diesel plant with coincident thermal energy generation design for the three generating facilities. The fact that all three communities possess Class 7 rated wind resource provides the primary basis for this recommendation. In such a design, total wind generating capacity exceeds the community peak power demand by between 30% and 70%. Through such capacity and configuration, the engine generators will literally be shut off during periods of relatively high wind speed, defined as above 16 miles per hour. Additionally and importantly, during high wind periods the high penetration design will produce excess electric energy which is converted to thermal energy and stored for use as space heating or other beneficial application through a hot water storage and distribution system.

In a low penetration design, the diesel units must continue to run regardless of wind speed. The wind generators run in constant parallel with the diesel units, which only serves to reduce load on the diesel generators. Such a configuration produces no co-generated by-product, such as hot water. And in medium penetration design, there is minimal production of a co generated by product and relatively little wind-only mode operations, which struggles to justify its investment. By sizing sufficient wind turbine generating capacity to have “wind only” generation periods, as well as the simultaneous production of a beneficial thermal product, the high penetration design produces far greater total fuel avoidance, lower engine maintenance expense, and superior long term total system operating efficiencies compared to the low or medium penetration system. Accordingly, TDX focused its analysis on the high penetration example.

As proven in the Saint Paul Island example, and dozens of similar high penetration wind/diesel installations around the world, the high penetration design functions with utility grade reliability and efficiency when properly designed, deployed and maintained. Such a system is relatively simple, using standard components. The primary building blocks of a high penetration system include the wind generation equipment, microprocessor based sensors that simultaneously monitor instantaneous load and wind speed, specialized switchgear that allow the diesels and wind turbines to function together either in parallel or singly, and a hot water storage tank with associated thermal energy delivery infrastructure.

A properly developed high penetration facility operates in diesel mode during periods of no wind, in wind-diesel parallel during moderate wind speed periods, and in full diesel-off, wind-only mode during wind periods of approximately 16 mph or higher. In a typical configuration, the electronic signal to commence wind-only mode occurs when the wind energy system is capable of producing approximately 120% of operating demand or a fixed incremental of output above the community load, for at least one hour. During these higher wind periods, the engine generator shuts off automatically and wind turbines follow community load and, in addition, supply excess energy to the water storage tank. In lower wind periods, the diesel generators supply intermittent charge to the water tank to maintain minimum temperature, typically set between 150 and 190 degrees Fahrenheit. The heated water can then be pumped through a piping and radiator network to supply space heating, or used in other beneficial community use application such as swimming pools or commercial activity. The excess-to-load wind energy offsets or eliminates heating fuel requirements.

The installation and operational cost analysis provided in this report is based on the integration of three Northwind 100 wind generators into the planned St. George diesel plant, the Fuhrlaender FL 1000 wind turbine in Sand point, and the Fuhrlaender FL 30 turbine in Nikolski. All three turbines are utility grade and will be fully supported by the respective manufacturers.

Project Management

APIA will provide financial oversight for the project. The Aleutian Pribilof Islands Association, Inc. (APIA) is a federally recognized tribal organization of the Aleut people in Alaska. APIA was chartered in 1986 as a nonprofit corporation in the State of Alaska. APIA contracts with federal, state and local governments as well as secures private funding to provide a broad spectrum of services throughout the region.

APIA has applied for, received, and successfully managed funding from a variety of state and federal agencies including: Alaska Department of Environmental Conservation, Alaska Department of Community and Economic Development, U.S. Department of Defense, U.S. Department of Energy, U.S. Department of Environmental Protection, and the National Institute for Environmental Health Sciences.

Connie Fredenberg, Natural Resources Coordinator, will oversee this project for APIA. Connie has been working relentlessly on wind energy projects in the region for the past two years. She has secured funding from several sources to further the region's projects:

- **USFWS** - Avian Interaction with Wind Energy Development in the Aleutians
- **BIA –** Wind Energy Development and Training in the Aleutians
- **USDOE/Renewable Energy on Tribal Lands –** Feasibility Studies for Wind Energy in St. George, Sand Point, Nikolski, King Cove, Adak, and False Pass

In addition to attending both levels of the Wind Energy Application and Training Symposium offered by the USDOE/National Renewable Energy Lab and Alaska's Wind-Diesel Conference she has worked directly with the Alaska Energy Authority's Renewable Energy Program to install the anemometers in four communities: St. George, False Pass, King Cove, and Nikolski and to help train local people to monitor the data collecting devices. She has also worked with the local high school science programs to involve students in the wind energy projects and to provide instruction so students can perform the avian interaction monitoring requested by USFWS. In August of this year Connie is scheduled to attend a BIA training in Juneau, Alaska for performing NEPA studies.

APIA is involved in energy conservation efforts as well as alternative energy development. The organization assisted St. George in securing funding for PowerStat meters, a pre-pay metering device which allows for close monitoring and control of energy use by households and ensures collections by the utility.

The ultimate goal of APIA is to aid communities in reducing their dependence on imported fossil fuels. Rural Alaskan communities are the canaries in the coalmine for the fossil fuel economy and many canaries are in dire straits. The Aleutian Pribilof Islands Region is considered to be “the birthplace of the wind”. It makes sense that our limitless wind is the resource we should be exploiting for energy.

Contractor

APIA will contract the project construction to TDX Power, a wholly owned subsidiary of Tanadgusix Corporation (TDX) from St. Paul Island, Alaska. TDX is an ANCSA village corporation within the APIA region and a world leader in high penetration wind-diesel hybrid power generation. The Company is shareholder owned, part of the Alaskan fabric, and fully focused on Alaska’s future.

TDX Power is a well-regarded owner/operator of regulated Alaska electric utilities and non-regulated independent power facilities. The Company and its management have unusual depth and experience in the development, design, finance, construction and operation of high reliability renewable and fossil fuel based power generation plants in challenging environments. TDX also supplies custom mobile and stationary power equipment packages to the military market, and provides design, development, construction, operations and finance-consulting services to power project developers in the lower 48.

Created in 1999, TDX Power has grown rapidly by leveraging its management’s power industry experience and its parent’s strong balance sheet to build projects and acquire Alaska utilities. The Company has 15 full time employees in various key disciplines, has asset value in excess of $20 million, and annual recurring revenue of approximately $8 million. TDX Power’s primary asset base is its regulated utility operations in Sand Point and Deadhorse, Alaska, its fuel distribution business in Sand Point, and its non- regulated wind diesel power plant located on Saint Paul Island.

As demonstrated by the efficiency, reliability, safety, compliance and profitability history of the St. Paul wind diesel installation, as well as its other Alaska power generation and distribution facilities, TDX Power has the necessary depth, skills and experience to execute all power evaluation and engineering aspects of the APIA wind power project. Few companies or management teams have the level of power industry experience as TDX, particularly in the Aleutian environment.

TDX Power Key Personnel for the APIA Wind Project

TDX Power's management has a long record of accomplishment in the power industry. TDX Power's president, Bruce Levy, is a 25-year veteran of power project development, finance, and operations. TDX Power's CEO, Nick Goodman, manages the Company on a daily basis and is a well-known participant in the Alaska energy markets. Goodman is Chairman of the Renewable Energy Alaska Project (REAP), the state utility and trade group supporting development of renewable energy projects in Alaska, and is highly regarded by all the major Alaska banks, regulatory agencies and Alaskan energy institutions such as AIEDA, AEA and ADEC. The Company's chief operations officer, John Lyons, served 20 years as the Alaska Village Electric Cooperative's operations manager prior to joining TDX and has designed, built and managed the operations of over 100 energy plants in remote Alaska. TDX Power's CFO, Mike Froehlich, has extensive experience with electric utility accounting systems, insurance, construction financial management, FERC and RCA compliance and tax planning. The Company's Licensed Professional Engineering staff is among the most experienced in the industry.

TDX Power's management has long relationships and project experience with most of the world's leading small and medium sized wind power equipment suppliers. The Company's management is particularly close to Vestas, Northern Power, Fuhrlaender, Entegrity Wind Systems and Bergey. TDX expects to use a variety of these established relationships for the implementation of the APIA project.

Regulatory and Other Approvals

As the owner and operator of rural utilities in Alaska, TDX Power operates in compliance with RUS Electric Program Regulations and Bulletins. All work proposed for these projects will be consistent with these regulations.

In order to erect the anemometer towers approval had to be obtained from both USFWS and FAA. We foresee no further need to obtain additional approvals, as the anemometer towers are located on the same ground we intend to install the wind turbines.

Connie Fredenberg will be attending a BIA sponsored NEPA training in August of 2005 in order to be able to complete the required NEPA studies on this project.

Goals of the Project and Performance Measures

The communities of St. George, Sand Point and Nikolski are remote Alaskan communities completely reliant on diesel fuel for electric power generation. Diesel fuel costs continue to rise dramatically in these communities, and TDX Power is confident the addition of wind power will significantly reduce the amount of diesel fuel consumed for power generation. The region's class 7-wind regime makes these communities prime candidates for wind power, and all three communities have the infrastructure and personnel required to support these projects.

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St. George Weekday Hourly Load Profiles

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Following is a summary of TDX's modeling results for total integrated hybrid system operations in St. George:

- Diesel only operations will consume 63,937 gallons of fuel oil annually, with total diesel plant production of 871.9 megawatt hours.
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- The hybrid integration reduces powerhouse fuel use by 40%.

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In TDX's experience in similar climate conditions, gearbox failure is the most common cause of catastrophic turbine failure and unscheduled downtime. This will not be a factor with the Northwind 100 as it uses a variable speed direct drive synchronous generator that eliminates a gearbox interface to the alternator. This arrangement should simplify the O&M program.

Additionally, as the Northern units produce synchronous power, their use in this project would eliminate the need for a synchronous condenser, which is commonly used in hybrid designs to condition power produced by induction machines. Elimination of the condenser not only eliminates a key maintenance item, it eliminates approximately 15 Kilowatts of system parasitic load. These features of the Northern turbine will reduce operations complexities and some costs, but will in no way negate the need for systematic O&M procedures.

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From such a beginning, based on TDX’s experience with similar situations, the operator will require between one and two years of steady support, which in most cases can be provided by telephone. Such ongoing contact increases operator confidence, improves system performance and pays long-term dividends in lower costs and less unscheduled downtime. Northern Power, TDX or a variety of other experienced companies could provide these support services at minimal expense. Ideally, the wind plant operator would also be responsible for the entire hybrid plant, including its thermal component. TDX estimates that such an employee would expect an annual salary in the $40,000 to $50,000 per year range.

In addition to training and support programs, TDX recommends an inventory of spare parts be maintained in the three communities. Also, equipment manufacturers publish rigid service interval recommendations, and strict observance is the key to reliability. On site spares are vital, and the inventory contributes to the operator’s understanding of how equipment is actually being used.

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TDX suggest a budget of $12,800 for an adequate spare inventory covering the first full year of hybrid operations in St. George, $8,600 in Nikolski, and $39,400 in Sand Point. Based on their involvement in all three communities, TDX Power is confident it will be able to provide the necessary support outlined above. As the owner of the Sand Point utility, primary operator of the Nikolski utility, and neighbor to the remote St. George utility (TDX Power owns and operates the high penetration wind diesel power plant on the adjacent Pribilof Island of St. Paul) TDX Power is familiar with both logistics and personnel issues in all three communities.

Wind System Installation Cost
St. George
TDX Power estimates a total cost of $1,086,000 to fully construct and integrate a three unit, Northwind 100 wind generation facility, with an associated thermal storage and delivery system. This system will tie into a new diesel powerhouse module that will be installed at the same time, to meet the 225 kw average electric load in the community. Funding for the diesel powerhouse has been secured from a separate source and is not part of the grant application to RUS. Following is an itemized breakdown of the major components included in the cost projection:

5. 3 Northwind 100 wind turbines = $765,000
6. Site construction = $280,000
7. Thermal storage and distribution infrastructure = $21,000
8. System components shipment from Seattle = $20,000

The cost analysis assumes three Northwind 100 machines, which would be supplied FOB the Port of Seattle and complete with all necessary subsystems including towers and controllers. TDX Power believes that the wind energy component of the new diesel power plant system must have at least 250 kilowatts of total gross capacity in order to achieve optimum wind-only mode, high penetration design results. As any less than three Northwind generators do not meet the capacity criteria, three are suggested and modeled.

The site construction estimate was supplied by Jim Saint George, an experienced civil contractor in western Alaska with experience installing wind turbines, and includes turbine foundations. The construction estimate was based on certain assumptions such as piling design foundations, and assumptions of probable soil and subsurface aquifer conditions. While the cost estimate seems reasonable under the circumstances, TDX cautions that geotechnical work has not been completed at the probable St. George location and subject to these further investigations, the construction cost estimate could change.

TDX Power understands the diesel powerhouse module will have Kohler paralleling switchgear in a five-section line up. This equipment contains circuit breakers and PLC based controls, a master control section and a section for feeder control. The Kohler system is controlled from a local touch screen and capable of remote operation via a standard WEB browser. The operator interface uses the Advantech touch screen for alarm display, alarm and status logging (500 events), user selectable remote alarms, digital synchronizer, digital real (KW) and reactive (KVAR) load sharing, system information and data display, manual synchronizing and operator control. The engine generator control cells, master section and sectionalizing cells are bussed together. The main buss is rated at 2,000 amps at a typical buss voltage of 480, 3-phase, 4-wire. The Kohler system has the ability to control and monitor a variety of diesel/generator equipment and provides operating personnel with the ability to operate in a total manual mode in the event of PC or PLC failure.
The thermal storage and hot water delivery system price is based on the assumption and recommendation of 8,000 gallons of storage capacity, to be located near or adjacent to the St. George school boiler house. The cost estimate includes the insulated storage tank and all necessary piping and pumps to circulate water at an average temperature of 170 degrees F. The hot water in the storage tank will replace or considerably offset fuel oil use for the school's thermal requirements.

A power plant site plan has been developed with three turbines sited around the power plant. The siting of the wind turbines is somewhat subjective at this point, pending a geotechnical evaluation. However, a rough estimate of where the wind turbines could be placed was prepared to provide a general idea of distances. Both Northern Power and Fuhrlaender wind turbines should have the minimum 2 1/2 - 3 rotor diameters between them, and no less than 10 diameters downwind. Based on data produced from a year's wind resource data from an on site anemometer, we have assumed the prevailing winds are westerly, southwesterly.

Nikolski
TDX Power estimates a total cost of $261,000 to fully construct and integrate a single unit, Fuhrlaender FL30 wind generation facility, with an associated thermal storage and delivery system. This system will tie into a diesel powerhouse module that was recently installed by the Alaska Energy Authority to support the average 25 kw electric load for the community. Following is an itemized breakdown of the major components included in the cost projection:

5. 1 Fuhrlaender FL30 wind turbine= $145,000
6. Site construction = $85,000
7. Thermal storage and distribution infrastructure = $11,000
8. System components shipment from Seattle = $20,000

The cost analysis assumes one Fuhrlaender FL30 wind turbine, which would be supplied FOB the Port of Seattle and complete with all necessary subsystems including tower and controllers.

The site construction estimate was also supplied by Jim Saint George, and includes turbine foundations. The construction estimate was also based on certain assumptions such as piling design foundations, and assumptions of probable soil and subsurface aquifer conditions. While the cost estimate seems reasonable under the circumstances, TDX again cautions that geotechnical work has not been completed at the probable Nikolski location and should be completed prior to construction.

The thermal storage and hot water delivery system price is based on the assumption and recommendation of 2,000 gallons of storage capacity, to be located near or adjacent to the school boiler house. The cost estimate includes the insulated storage tank and all necessary piping and pumps to circulate water at an average temperature of 170 degrees F. The hot water in the storage tank will replace or considerably offset fuel oil use for the school's thermal requirements. The wind resource in Nikolski is so strong, that a siting recommendation from John Wade, a veteran wind power meteorologist, suggests the wind turbine should actually be placed in a semi protected location so that a prevailing wind direction can dominate over the rather typical turbid conditions. Based on a site visit with Mr. Wade, an optimal site has been identified to meet both wind resource and foundation requirements.

Sand Point

TDX Power estimates a total cost of $1,626,000 to fully construct and integrate a single unit, Fuhrlaender FL1000 wind turbine, with an associated thermal storage and delivery system. This system will tie into the existing diesel powerhouse module with state of the art switchgear and controls designed to integrate with a wind turbine. Following is an itemized breakdown of the major components included in the cost projection:

5. 1 Fuhrlaender FL1000 wind turbine = $1,215,000
6. Site construction = $310,000
7. Thermal storage and distribution infrastructure = $61,000
8. System components shipment from Seattle = $40,000

The cost analysis assumes one Fuhrlaender FL1000 wind turbine, which would be supplied FOB the Port of Seattle and complete with all necessary subsystems including tower and controllers.

The site construction estimate was again supplied by Jim Saint George, and includes turbine foundations. The construction estimate was based on certain assumptions such as piling design foundations, and assumptions of probable soil conditions.

The thermal storage and hot water delivery system price is based on the assumption and recommendation of 20,000 gallons of storage capacity, to be located in the Sand Point School. The cost estimate includes the insulated storage tank and all necessary piping and pumps to circulate water at an average temperature of 170 degrees F. The hot water in the storage tank will replace or considerably offset fuel oil use for the school's thermal requirements.

Schedule & Final Observations

TDX Power recommends the following schedule for completing projects in these three communities:

November 2005 – January 2006: Geotechnical Analysis in all three communities
February 2006 – April 2005: Complete design engineering for all three communities, confirm turbine orders and availability.
May 2006 – July 2006: Initial site preparation in Nikolski and St. George.
August 2006 – October 2006 – Nikolski construction
November 2006 – March 2007 – Installation of St. George powerhouse module
April 2007 – June 2007 – Wind turbine construction in St. George
July 2007 – September 2007 – Wind turbine construction in Sand Point

APPENDIX H: Wind Turbine Generator System Engineering, Procurement, and Construction Agreement

This Wind Turbine Generator System Engineering, Procurement and Construction Agreement ("Agreement") is entered into this ___ day of October 2006 by and among TDX Power Services LLC, an Alaska limited liability company, with its principal offices located at 4300 "B" Street, Suite 402, Anchorage, Alaska 99503 ("Contractor"), the Aleutian Pribilof Islands Association, Inc., an Alaska non-profit corporation, with its principal offices located at 201 East 3rd Avenue, Anchorage, Alaska ("APIA" or "Association") and Umnak Power Company, an electric utility organized under the laws of the State of Alaska, with its principal offices located at Nikolski, Alaska ("Umnak"). Association, Umnak and Contractor are sometimes hereinafter referred to collectively as the "Parties" and individually as a "Party."

Recitals

Whereas, the Association is a federally recognized non-profit tribal association of the Aleut people and includes among its members the village of Nikolski, located on Umnak Island in the Aleutian chain; and

Whereas, Umnak Power Company is the tribally owned electric utility for the community of Nikolski; and

Whereas, Chaluka Corporation, owner of the wind turbine generator site has granted Umnak Power Company approval to use said property for the installation of the wind turbine generator system pursuant to an authorization letter dated April 13, 2006 ("Authorization"); and

Whereas, the Association has received a grant for the purchase and installation of a re-conditioned and retrofitted wind turbine generator to supplement the existing diesel powered electric generating station that currently supplies electricity to the residents of Nikolski; and

Whereas, the Association has received all required approvals from the village government of Nikolski to serve as agent in the procurement and installation of the re-conditioned wind turbine generator; and

Whereas, Contractor has the required experience to procure and install the re-conditioned wind turbine generator; and

Whereas Contractor is prepared to provide the requested equipment and services on the terms set out below; and

Now therefore, in consideration of the mutual covenants contained herein, the sufficiency of which is acknowledged by all Parties, the Parties hereby agree as follows:

1. ***Scope of Work.*** The Contractor shall fully execute the Phase 1 Work described in the USDA Grant Proposal documents, attached as Exhibit D, and herein incorporated by reference, and within design parameters applicable to installation of a wind turbine in Nikolski, Alaska ("Site"). The Contractor shall be responsible for procuring or furnishing the design and for the construction of the Work consistent with the installation of one fully functioning 65kw Wind Turbine Generator System ("WTG") and associated equipment and interconnection to the newly commissioned diesel fuel based power plant in Nikolski, Alaska. The Contractor shall exercise reasonable skill and judgment in the performance of the Work that exhibits a good faith effort to meet all applicable wind energy industry safety, quality, and engineering requirements.

Contractor shall provide to the Association for its review and approval, design documents sufficient to establish the size, quality, and character of the Work; its structural, mechanical, and electrical systems; and the materials and such other elements of the Work to the extent required for a complete project.

Contractor agrees to design, procure, and install, on the terms set out below, one Vestas V-15 65 kilowatt remanufactured and retrofitted wind turbine ("Turbine"), associated equipment, and site work at the Site. Umnak Power represents and warrants that the Site is of sufficient size to accommodate the Turbine and associated equipment, and Umnak Power shall cause the Native Village of Nikolski to provide unrestricted access to the Site for purposes of evaluation and installation. The Turbine and associated equipment are described more fully in Exhibit B attached hereto. Contractor covenants that it will have good title to the Turbine and associated equipment (collectively the "Equipment"), and that there will be no liens or other encumbrances on such Equipment once it is installed. Specific tasks to be performed under this Agreement are specified in Exhibit A attached hereto.

The date of commencement of the Work shall be the date of this Agreement.

The Contractor shall keep the Association and Umnak informed of the progress and quality of the Work.

The Contractor is responsible for completion of the Work and shall maintain an adequate quality control system and perform such inspections as will ensure that the work performed under this Agreement conforms to the Scope of Work. The Contractor shall maintain complete inspection and testing records and make them available to the Association and Umnak.

Barring Force Majeure events, or delays caused by the Association or Umnak Power, Contractor will complete installation of the Turbine by September 30, 2007 ("Substantial Completion"). For purposes of this Agreement, "Force Majeure" means events (i) beyond the control of a Party (ii) that were not reasonably foreseeable (iii) that occurred without the fault or negligence of such Party, and which (iv) prevent or delay the performance of a Party's obligations hereunder.

Association and Umnak Power acknowledge that integration of the Turbine with the existing diesel generating facility will require additional time following the installation of the Turbine. Contractor agrees to use reasonable efforts to complete the evaluation and submittal of a written report of the feasibility of such integration by December 31, 2007.

2. Documentation; Progress Reports to the Association and Umnak Power. Contractor shall maintain and provide one copy to the Association and Umnak Power of all relevant documentation relating to the Turbine performance at commissioning. Documentation shall include turbine operations/maintenance manual, and results of the performance testing. Contractor will provide the Association with a monthly written update on the status of the Work and expenditures so that APIA can meet its reporting obligations to its funding agency.

Association and Umnak Power shall also have access to the Site to enable them to stay informed about the progress and quality of the Work at reasonable times, subject to advance notice, and compliance with Contractor's safety requirements. Neither the Association nor Umnak shall have control over, nor charge of, nor be responsible for, the construction means, methods, techniques, sequences, or procedures, nor for the safety precautions and programs in connection with the Work; these are solely the Contractor's rights and responsibilities.

Association and/or Umnak Power shall have the right to review and comment upon Contractor's submittals, including but not limited to design and construction documents, shop drawings and product data, but only for the limited purpose of checking for conformance with information given and the design concept. Such review shall be taken with reasonable promptness as to cause no delay in the Work. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of details, such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which shall remain the responsibility of the Contractor.

3. Independent Contractor. Contractor is an independent contractor (and is not the agent or representative of the Association or Umnak Power) in the performance of this Agreement. This Agreement shall not be interpreted or construed as (i) creating or evidencing any association, joint venture, partnership or franchise between the Parties, (ii) imposing any partnership or franchise obligation or liability on either Party, or (iii) prohibiting or restricting Contractor's performance of any services for any third party.

4. Terms of Payment and Delivery. The Association agrees to pay Contractor four hundred fifty four thousand seven hundred five dollars ($454,705) ("Contract Sum") for the Work.

Based on applications for payment submitted to the Association by the Contractor, the Association shall make progress payments against the Contract Sum to the Contractor as provided below.

The period covered by each application for payment shall be one calendar month, ending on the last day of the month.

The Contractor shall submit to the Association, before the first Application for Payment, a Schedule of Values allocated to various portions of the Work prepared in such form and supported by such data to substantiate its accuracy. This schedule shall provide the basis for reviewing the Contractor's Applications for Payment.

The Contractor shall submit to the Association an itemized Application for Payment for that portion of the Work completed as of the end of the period covered by the Application for Payment.

Payments shall be made for materials and equipment delivered and suitably stored at the Site for subsequent incorporation in the Work. If approved in advance by APIA, payment may similarly be made for materials and equipment suitably stored off the Site at a location agreed to in writing. Payment for materials and equipment stored on or off Site shall be conditioned upon compliance by the Contractor with procedures satisfactory to APIA to establish APIA's title to such materials and equipment or otherwise protect APIA's interest and shall include the costs of applicable insurance, storage, and transportation to the Site for such materials and equipment stored off the Site.

The amount of each progress payment shall be the Contract Sum properly allocated to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to the portion of the Work in the schedule of values, less retainage of ten percent (10%) on the Work.

The Association may withhold a payment in whole or in part to the extent necessary to protect the Association due to the Association's determination that the Work has not progressed to the point indicated in the Application for Payment or that the quality of Work is not in accordance with the design documents. Should the Association exercise this right, it shall escrow the disputed funds with a third party escrow agent acceptable to Contractor, and shall provide a written explanation for its determination.

The Contractor understands and agrees that this Agreement is based on an established budget, which is defined in Exhibit C, and herein incorporated by reference, and in no event shall the total amount invoiced for this Agreement exceed the Contract Sum, absent Force Majeure Events, or delays caused by the Association or Umnak Power.

Payments shall be due within 30 days of the Association's receipt of Contractor's invoice. Any amount not paid when due shall be subject to finance charges equal to 1% per month or the highest rate permitted by applicable usury law, whichever is less, determined from the date due until the date paid. Contractor may accept any check or payment in any amount without prejudice to Contractor's right to recover the balance of the amount due or to pursue any other right or remedy. No endorsement or statement on any check or payment or in any letter accompanying a check or payment or elsewhere shall be construed as an accord or satisfaction.

In the event payment is delayed more than sixty days from the due date, Contractor may suspend its performance under this Agreement without liability to the Association. In the event payments are not received within 90 days of the due date, Contactor may terminate this Agreement, and seek all available remedies at law or in equity against the Association, including its costs of demobilization from the site, any amounts owed to Vestas, and lost profit.

In the event the Association desires to change the scope of Work, it shall request a change order from Contractor. Contractor shall provide a written proposal in response to the request for the change order. Prior to implementing the change order, Contractor may insist on proof of funding from the Association to cover the cost of the change order.

Upon receipt of written notice from Contractor that the Work is ready for final inspection and acceptance, and upon receipt of final Application for Payment, the Association and Umnak Power shall promptly make such inspection and, when the Association finds the Work acceptable, in accordance with the design documents, and fully performed, the Association shall make final payment to the Contractor. Approval of the Work shall not be unreasonably withheld or delayed. Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Association to the Contractor no later than 30 days after Contractor has completed the Work.

5. ***Limited Warranties.*** The Contractor agrees to correct all Work performed under this Agreement which proves to be defective in workmanship or materials within a period of one year from the date of Substantial Completion

Turbine & Equipment Warranty. Contractor warrants to the Association and Umnak Power for a period of one year from the date of Substantial Completion of the Turbine and associated equipment installed in Nikolski that (i) it has good title to the Turbine, free of liens and encumbrances (ii) the Turbine as delivered shall comply in all material respects with the specifications and other requirements set forth in the scope of work set out in Exhibits A and B, and (iii) shall be free from defects in materials and workmanship (collectively "Defects"). Notwithstanding the foregoing, the warranty against Defects provided by Contractor shall be limited to the warranty provided by Halus as the vendor of the remanufactured turbine. Contractor shall provide Association and Umnak Power with a copy of such warranty, and will assign the warranty to them, assuming Halus will consent to such assignment. In the event assignment is not authorized by Halus, upon notification of a warranty claim, Contractor shall commence, or cause Vestas to commence, repair or replacement of the defective Work within a reasonable time after receipt of the claim, and continue the repair/replacement on an uninterrupted basis until the warranty work is completed to the reasonable satisfaction of the Association and Umnak Power, and the Defect is corrected.

With the assistance of the Umnak maintenance personnel, the Contractor shall direct the checkout and start-up operations, and adjusting and balancing of system and equipment readiness.

To the extent covered by the Vestas warranty, Contractor agrees as follows:

All components of the Turbine shall be warranted against Defects for a period of one year from the Substantial Completion date. Labor, parts, shipping, and travel costs to repair or replace any components of the Turbine covered by this warranty are included, but are subject to the following remote location terms:

a. Due to the remote location of the village of Nikolski, travel or shipping costs incurred for personnel, parts or equipment required for repair or replacement of parts covered by the limited warranty are to be shared between Contractor and Umnak Power in the following manner: Contractor will pay for personnel, parts or equipment travel or shipping expenses incurred due to warranty coverage to and from vendor's site and Anchorage, AK. Travel or shipping charges for personnel, parts, or equipment incurred due to warranty coverage from Anchorage, AK to the turbine site in the village of Nikolski are to be paid by Umnak Power.

b. In the case of warranty work involving labor and equipment within the scope of what Umnak Power can reasonably perform, Umnak Power agrees to make a good faith effort to perform needed repair or warranty work, with parts supplied by Contractor, subject to Contractor reimbursing Umnak Power for the reasonable cost of Umnak Power's labor to perform the warranty work.

c. Umnak Power agrees to perform regular scheduled maintenance on the Turbine according to the Vestas maintenance manual, a copy of which shall be provided by Contractor to Umnak Power.

d. Rights under this limited warranty are not assignable by the Association or Umnak Power without the approval of Contractor, which approval shall not be unreasonably withheld or delayed.

The Contractor further represents, warrants, and agrees as follows:

(i) The Turbine, upon completion of re-manufacturing, shall meet the specifications set out in Exhibit B hereto;

(ii) Contractor owns the Turbine and all components thereof, free and clear of all claims and liens of third parties; and has full right, power, and authority to convey the Turbine to the Association or Umnak Power without the consent or approval of any third-party.

The foregoing warranty does not cover:

a. Damage to the Turbine or any of its components caused by unauthorized use or service.

b. Damage to the Turbine or any of its components caused by faults relating to the electrical system to which the Turbine is connected, including but not limited to voltage, current and frequency ranges outside those specified in manufacturer (Vestas) product manual.

c. Damage to the Turbine or any of its components caused by acts of God, including but not limited to, hail, lightning, earthquakes, wind in excess of operating ranges specified in the Vestas product manual (but excluding any damage that could have been prevented by proper operation of Turbine shut off devices), hurricanes, tornados, volcanic eruptions, icing of any kind including but not limited to rime icing.

d. Damage to Turbine or any of its components caused by any form of intentional abuse or misuse including, but not limited to, theft or vandalism.

e. Damage to the Turbine or any of its components caused by any form of unintentional, reckless, or negligent abuse or misuse.

6. ***Exclusivity.*** The warranty and remedies set forth above are exclusive. Contractor makes no representation or warranty, express or implied, with regard to any services, results or other items under this Agreement (including, without limitation, any implied warranty of merchantability or fitness for a particular purpose or any implied warranty arising out of course of performance, course of dealing or usage of trade).

7. ***Warranty Service.*** In order to obtain warranty service, the Association or Umnak Power must notify Contractor within 15 days after the Association or Umnak Power becomes aware of any malfunction. Notice must be provided as set forth below.

8. ***Indemnification; Limitations on Contractor's Liability.*** Contractor shall indemnify and hold Association and Umnak Power harmless from liability resulting from the negligent acts or omissions of Contractor, its agents or employees pertaining to the activities to be carried out pursuant to this Agreement, including but not limited to any and all claims for real and/or personal property damage and/or bodily damage; provided, however, that Contractor shall not be required to indemnify or hold the Association and Umnak Power harmless from liability arising out of the negligence or willful malfeasance of or any person or entity not subject to Contractor's supervision or control.

In no event shall Contractor be liable for loss of use, loss of profits, business interruption or other consequential, indirect, special, incidental or punitive damages, however they may be caused. Contractor's total liability under this Agreement, for any reason, and arising from any cause, shall be limited to the Contract Sum.

The Association shall indemnify and hold Contractor and Umnak Power, its officers, directors, agents and employees harmless from and against any liability or loss arising from the performance of the Association's obligations under this Agreement, including those resulting from the negligent acts or omissions of the Association or the activities to be carried out by the Association pursuant to this Agreement.

Umnak Power shall indemnify and hold Contractor and the Association, its officers, directors, agents, and employees harmless from and against any liability or loss arising from the performance of the Umnak's obligations under this Agreement, including those resulting from the negligent acts or omissions of Umnak or the activities to be carried out by Umnak pursuant to this Agreement.

9. ***Notices/Contact Info.*** Unless notified in writing of a change, the contact info below shall apply for each Party. All notices required hereunder shall be in writing and shall be deemed to have been given when sent by registered or certified mail, postage prepaid and addressed to the last known address of the Party being notified.

a. Association: Aleutian Pribilof Islands Association, Inc.
201 East 3rd Avenue,
Anchorage, Alaska
Attn: Mr. Dimitri Philemonof

Email: dimitrip@apiai.org
Phone: 907-276-2700

b. Contractor: TDX Power Services LLC
4300 "B" Street, Suite 402
Anchorage, Alaska
Attn: Mr. Nick Goodman

Email: ngoodman@tdxpower.com
Phone: 907-278-2312

c. Utility: Umnak Power
PO Box 105
Nikolski, Alaska
Attn: Ms. Tanya Kyle

Email: ikotribeadmin@ak.net
Phone: 907-576-2225

10. ***Counterparts.*** This Agreement may be executed in two or more counterparts, each of which shall be deemed to be an original, but all of which together shall constitute but one and the same instrument. Executed counterparts transmitted by fax shall be binding on the Parties.

11. ***Successors and Assigns.*** This Agreement may not be assigned by any Party without the consent of the other Parties, except that Association may assign this Agreement as collateral for any financing used to purchase the Turbine without the consent of Contractor. The Association may assign its rights and responsibilities to Umnak Power without the consent of the Contractor. This Agreement shall be binding upon, and inure to the benefit of, the successors and assigns of the Parties.

12. ***Attorneys Fees.*** If any Party to this Agreement commences arbitration for the interpretation, enforcement, termination, cancellation, or rescission of this Agreement, or for damages for the breach of the same, the prevailing Party, as determined by the arbitrator, shall be entitled to its reasonable attorney fees and other costs incurred.

13. ***Interpretation.*** This Agreement has been negotiated by the Parties which are knowledgeable in the matters contained herein and the Parties represent to each other that they have either consulted with legal counsel, or have had the opportunity to do so, and thus, this Agreement is to be construed and interpreted in absolute parity, and shall not be construed or interpreted against any Party by reason of its participation in the drafting of the Agreement.

14. ***Severability.*** If any term or provision of this Agreement shall be determined to be illegal or unenforceable, all other terms and provisions in this agreement as well as the Agreement shall nevertheless remain effective and shall be enforced to the fullest extent permitted by law.

15. ***Exercise of Remedies**.* No failure on the part of either Party to exercise and no delay in exercising any right or remedy hereunder, at law or equity, shall operate as a waiver thereof.

16. ***Dispute Resolution.*** The Parties of this Agreement agree to submit any disputes arising from this Agreement to final and binding arbitration before a single arbitrator under the Commercial Rules of the American Arbitration Association. Any such arbitration proceeding shall be held in Anchorage, Alaska or other location mutually agreeable to all Parties. The Parties further agree that the arbitrator's fee shall be the mutual responsibility of the Parties, with each Party responsible for its share of the same. Each Party shall be responsible for the travel expenses of its own representatives and/or witnesses. The award of the arbitrator shall be binding on the Parties, and may be enforced in any court of competent jurisdiction

17. ***Applicable Law.*** The substantive laws of the State of Alaska and applicable federal laws shall govern the construction of this Agreement and the rights and remedies of the Parties hereto. Should any action or proceeding relating to this Agreement be commenced to enforce an arbitration award, or the obligation to arbitrate, the Parties agree to submit to the personal jurisdiction of any state or federal court sitting in the State of Alaska and hereby waive any claims that such forum is inconvenient or there is a more convenient forum located elsewhere.

18. ***Representations and Warranties.*** Each Party represents and warrants to the other Parties that the execution, delivery and performance of this Agreement have been duly authorized by all required company action, that the person executing this Agreement on behalf of such Party has full authority to do so, and that there are no third party consents required for the execution, delivery or performance of this Agreement by said Party. Association also represents and warrants that it has the required funds to pay for the Work, and that it has all required authorizations to serve as the agent of the Village of Nikolski under this Agreement.

Contractor acknowledges, represents, and agrees that it has not relied in any fashion on any representation or warranty by APIA or Umnak as to (i) the buildability or other feature of the Site, or (ii) the construction methods that can or will be employed.

19. ***Certain Covenants of Contractor**.* Contractor will provide the Association a certificate of insurance for general liability, auto, and worker's compensation insurance in amounts required by applicable state law. A completed W-9 Taxpayer I.D. Number Certification form and a copy of Contractor's current Alaska Business License will also be provided to the Association.

20. ***Complete Agreement.*** This Agreement constitutes the entire understanding of the Parties with respect to the subject matter hereof, and supersedes all prior written or oral understandings. This Agreement may only be modified by a written amendment executed by all Parties.

IN WITNESS WHEREOF, the Parties have executed this Agreement as of the day and year first above written.

AGREED on the dates appearing below.

TDX Power Services LLC

By: ___________________________________Date:______________

Nicholas Goodman
CEO

Aleutian Pribilof Islands Association, Inc

By: ___________________________________Date:______________

Dimitri Philemonof
President/CEO

Umnak Power Company

By: ___________________________________Date:______________

Arnold Dushkin
President Nikolski IRA Council

Exhibit A: Scope of Work

The Contractor shall procure or furnish the design, materials, equipment, labor, permits and supervision to construct one fully operational 65 kilowatt Wind Turbine Generator System (WTGS) and associated equipment and interconnect to the newly commissioned diesel fuel based power plant in Nikolski in accordance with the International Electrotechnical Commission (IEC) Wind Turbine Standards. The Work shall include all subsystems of WTGS such as control and protection mechanisms, internal electrical systems, mechanical systems, support structures, foundations, and interconnection to the existing Nikolski power plant.

Contractor shall ensure specific requirements for the safety of WTGS, including design, installation, maintenance, and operation under the Nikolski site environmental conditions. Its purpose is to provide the appropriate level of protection against damage from all hazards from these systems during the planned WTGS lifetime.

The Contractor shall purchase a 65 kilowatt Vestas V-15 Wind Turbine (or approved equal) that has been retrofitted within certain design parameters applicable to installation of a wind turbine in Nikolski, Alaska and ship the Turbine and associated equipment to the Nikolski project site.

The Contractor shall complete all site assessment work necessary prior to installing the wind turbine, including an engineering evaluation and design for the foundation and tower, as appropriate for all site work to be accomplished within the approved budget. The Parties acknowledge that the soil conditions may differ materially from what is expected. Accordingly the budget provides for a contingency amount ($8,080). The Parties agree that this contingency shall not be expended for any purpose other than differing site conditions until the completion of site excavation and final foundation design. After this time, such funds may be expended for discretionary changes to the Project.

The Contractor shall utilize the local Nikolski workforce whenever possible.

The Contractor shall provide an evaluation and written report on the integration of the WTGS with the existing diesel power plant, recommending modifications, if any, of the diesel controls and system operability where necessary.

The Contractor shall procure or furnish to Umnak all guarantees, warranties, spares and maintenance manuals that are called for in the specifications or that are normally provided by a manufacturer. The maintenance manual shall include a catalog and price list of any equipment, materials, supplies, or parts used in inspection, calibration, maintenance, or repair of the equipment

Upon completion of the installation, the Contractor shall provide training to local utility employees on operations and maintenance of the WTGS. The Contractor shall provide ongoing support for a period of two years from date of Substantial Completion to assist with parts and materials, ongoing training, and annual maintenance, including a minimum of two site visits during the two year period.

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Exhibit B: Specifications of V15 Wind Turbine

Tower
*Lattice mast
*74 ft high
*Hot-galvanized surface

Generators
*Induction generators
*Ratings
*Main generator: 65 kw
*Small generator: 12.6 kw
*480 VAC; 3-phase; 60 Hz

Yawing System
*Control: Windvane (electronic)
*Yawing speed: 72 degrees/min

Rotor
*50 ft diameter
*52.7 or 42.2 rpm rotational speed, clockwise
*Upwind orientation

Blades
*Glasfiber reinforced polyester
*1972 sq ft swept area

Operational Data
*Cut-in windspeed: 8.9 mph
*Cut-off windspeed: 62 mph
*Survival windspeed: 100 mph

Miscellaneous
*Entire assembly (turbine, rotor, tower) weighs approx. 16,700 lbs.
*Blades are fixed, but pitch can be adjusted to optimize performance for your site.
*Controller monitors turbine function and automatically shuts down in event of malfunction.
*When wind speed exceeds 62 mph, generator is taken off power network and brakes bring rotor to halt.

PERFORMANCE ESTIMATE

Wind Speed (mph)	Power Output (kw)
0-8.9	0
10	4
15	13
20	26
25	50
30	61
35	68
40	71
45	68
50	65

55	65
60	63

Exhibit C: Budget

Project Budget Estimate
Nikolski - Phase 1 - Wind Turbine Project
Price for One Vestas V-15 Wind Turbine Generator System Installed

Function	**Budget**
Design/Engineering	$ 7,500.00
Consulting - Contract	$ 15,000.00
Excavation and Civil	$ 12,500.00
Permitting	$ 5,000.00
Foundation Materials	$ 31,000.00
Foundation Construction	$ 24,000.00
Freight	$ 35,000.00
Tower Assembly (misc)	$ 9,500.00
Lattice Tower Assembly	$ 4,500.00
Tower Erected w/equipment	$ 7,500.00
Freight	$ 9,500.00
Turbine (Retrofitted)	$ 68,000.00
Turbine Assembly (misc.)	$ 6,500.00
Freight	$ 8,500.00
Halus Visit (John)	$ 4,500.00
Control and Grid Connect	$ 85,000.00
Mechanical/Thermal Tanks	$ -
Control/Electrical - Thermal use	$ -
Freight	$

	15,000.00
Start-Up and Functional Testing	\$ 8,600.00
(Halus and TDX Power)	
Crew (room & board)	\$ 11,500.00
Air fare - Nikolski (2 tech's, 4ea - RT)	\$ 8,300.00
Incidentals	\$ 3,750.00
Specialized Tooling and Equipment	\$ 7,500.00
Spare parts	\$ 2,500.00
Consumables (gear oil, grease, etc)	\$ 3,350.00
Equipment Fuel	\$ 2,500.00
Contingency	\$ 8,080.00
Site maint and support - 2 yr	\$ 50,125.00
Total Project Budget Estimate	**\$ 454,705.00**

Exhibit D: USDA Grant Proposal

Nikolski Wind Power Integration Project

The Nikolski Wind Power Integration Project is made up of two phases.

Phase 1, Wind Turbine Generator System: Utilizing the USDA/RUS grant of $474,475, Phase 1 includes the design and installation of one 65 kilowatt wind turbine generator system and interconnection to the newly commissioned, diesel fuel based power plant in Nikolski. The addition of one refurbished and retrofitted Vestas V15 (or approved equal) wind turbine generator system to the existing power generation system in Nikolski will dramatically decrease the total consumption of diesel fuel used to produce electricity. Phase 1 also includes an evaluation on the integration of the wind turbine generator system with the existing diesel power plant, recommending modifications, if any, to the diesel controls and system operability where necessary.

Phase 2, Thermal Heating System: Pending receipt of additional funding, Phase 2 will include the design, purchase, and installation of a thermal heating system to supply heat to the community center and school, derived from excess-to-load electricity generated by the wind turbine. The Contractor will provide all thermal tanks and components necessary for the thermal system. Phase 2 will also include modifying the controls of the existing diesel plant, if necessary, to provide a fully integrated system.

APIA will Contract with TDX Power for Phase 1, including procuring or furnishing the design, materials, freight, personnel, engineering, travel and related expenses necessary to install one fully operational 65 kilowatt wind turbine generation system with a tilt-up lattice tower and associated equipment, interconnect the turbine to the diesel plant, train operators, and provide maintenance assistance for two years following the installation of the wind turbine.

TDX Power anticipates Phase 1 construction during the summer of 2007. A Vestas V15 65 kilowatt wind turbine has been selected and is in the process of being retrofitted with certain design parameters unique to Nikolski. One specific design parameter includes a tilt up tower assembly, which will eliminate the need for a large crane during construction.

Upon completion of the Phase 1 installation, TDX Power will provide training to local utility employees on the operations and maintenance for the wind turbine. TDX Power will also provide ongoing support for a period of two years to assist with parts and materials, ongoing training, and annual maintenance.

The Contract between APIA and TDX Power may be modified to include Phase 2, if funding becomes available, to include the design, purchase, and installation of the thermal heating system.

The Contract between APIA and TDX Power may also be modified, if necessary and funding becomes available, to include testing and modifications of the diesel power plant controls based on the Phase 1 evaluation.

During the design phase of the diesel plant the Alaska Energy Authority/AEA assured Umnak Power, the Nikolski IRA, APIA, and the Denali Commission that the diesel plant controls would be "wind ready". The design of these controls has yet to be tested with the integration of wind energy, so that may or may not be the case. The AEA has offered cooperation with assessment of the controls, but has provided no commitment for funding modifications if they are necessary.

The Aleutian Pribilof Islands Community Development Association has expressed interest in contributing to a fund for the thermal heating system. Umnak Power is researching a plan for selling Green Tags to contribute toward funding for the thermal system and any modifications to the diesel plant controls that may be necessary.

Wright, B. A., B. Hirsch and J. Lyons. 2012. A Better Use of Wind Energy in Alaska and Applicability for Russian Villages. In; Biological Diversity and Ecological Problems in Priamurie and Adjacent Territories. Regional Scientific Work with International Participants, Far Eastern Federal University for the Humanities. Issue 3.

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Alaska boasts 149 small remote communities, over 120 of which operate on independent micro-grids, and most of the Alaska villages have a peak operating load of less than 200 kW. Using wind energy to offset electricity produced by diesel in these communities requires a sophisticated integration of energy dispatch, electronic switchgears, storage, controls, and distribution to create a functional and efficient hybrid system. Alaskan customers of these electrical hybrid systems can suffer system shortcomings including blackouts and sometimes increased costs to pay for these systems. The Alaska-sponsored PCE (power cost equalization) program provides subsidies to many remote and high energy cost communities to help equalize energy services with the more urban areas of the state. Because PCE is essentially a diesel subsidy to the local utility, wind and other renewable energy projects can work at cross-purposes to PCE depending on the resulting fuel and generation mix.

Some customers are trying to solve their energy issues by installing private wind projects and possibly disconnecting from the grid. Loss of customers from the grid adds a burden to the remaining customers and centralized utility since the grid and the entire associated electrical infrastructure, i.e., the fixed costs of providing electrical service to a community, must be maintained in an already marginal and high cost environment; these costs are absorbed by the remaining customers. The variability in wind, the associated integration problems and the need to lower energy costs in remote communities beg for a better use of fickle wind energy resources.

Hybrid systems with energy storage can offer a level of stability and higher penetration of intermittent renewable energy than systems without energy storage. Such storage can be in several forms including hot water and electrical storage. In Alaska, some hybrid systems using wind and hydro along with diesel are seeing great success such as on Kodiak Island, Alaska. Though still young in its deployment in the field, the use of electrical energy storage (EES) systems, if properly designed and installed, can also increase grid reliability and reduce maintenance costs on diesel engines and wind turbines. The Editorial, “Electrical Energy Storage for the Grid: A Battery of Choices” (B. Dunn, et al., Science, 18 November 2011, p.

928) describes use of electrical energy storage as supportive of deploying renewable energy projects. The village of Kokhanok, a remote settlement of 200 people located in remote Alaska, operates on one of these micro-grids with two reconditioned Vestas V-17 turbines rated at 90kW each on 85’ lattice towers. A synchronous condenser and grid forming inverter were installed, along with 336 kWh of nominal battery storage. Lead-acid battery banks were used in Kokhanok because they were less expensive up front, but the extended life of lithium batteries and the added expense of shipping lead-acid batteries from a remote site would favor the use of lithium batteries in some wind-diesel hybrid projects. The integration of these various system components is still ongoing, and not yet perfected, but holds tremendous promise for high penetration wind-diesel systems and over time, even “diesel off” operation.

For future projects in other remote Alaska communities, the higher energy density lithium ion batteries are attractive because shipping costs are so high and more energy can be stored per unit of weight with lithium ion. Based on electric vehicles’ technology development, lithium ion battery packs can weigh about 40 pounds each and are additive so that many can be tied together for charging and increase grid reliability while individual modules can be used to power equipment, 4 wheelers, boats, etc.

Although some success comes from energy storage, another solution is to use the wind energy in real-time to help offset the primary energy use in most Alaska villages, that of space heating. The Alaska Energy Authority has determined that about 55% of the energy used in Alaska villages is for heating homes and buildings. Using wind energy for space heating and heating domestic hot water can reduce integration and efficiency challenges associated with hybrid electrical systems and storage, especially in high penetration systems. A variety of techniques for using renewable wind energy can be deployed in homes and other buildings including heating insulated concrete slabs/floors with hot water or resistance coils; the mass acts like a heat storage device that can release its stored heat to the building even when the wind turbine is not producing energy. The costs of using concrete floors can be cost effective when compared more sophisticated systems.

When properly constructed and integrated into the overall system, heating floors in cold climates has some promising applications because of its thermal storage and slow release characteristics. For example, a newly poured concrete foundation could be poured on polystyrene board isolating the floor from heat-loss to the ground, and embedding PTEX piping or resistive heating in the concrete. Once connected to the wind-produced energy source, the concrete floor would become warm when the wind blows (and the turbine is operating) and begin cooling when the wind is calm. But the floor would retain its heat in the mass of the floor for long periods. If the wind resource is especially good, the wind system can be sized accordingly to allow for very high penetration into the conventional diesel grid and, by using heat production and thermal storage, high electrical integration and storage costs can be avoided by direct conversion to heat and thermal mass instead of just electricity for the grid.

A wind/thermal system for the government facilities at Cold Bay and King Salmon, Alaska are models of low to medium penetration with coincident thermal energy generation wind due to the locations having strong wind resource and the opportunity to optimize system economics through a significant offset of heating fuel consumption and electric energy. In the low to medium penetration design, it is anticipated total wind generating capacity may meet the facility's peak power demand and heating fuel requirements. Through such a configuration, the wind turbines will provide a significant heating fuel off-set by supplementing the thermal requirements, converting wind electric energy to thermal energy. The primary building blocks of the Cold Bay and King Salmon hybrid wind systems include the wind generation equipment, microprocessor based sensors that simultaneously monitor instantaneous load and wind speed, specialized controls that allow for seamless operation between the electric utility and, thermal electric nodes and hot water storage tanks with associated thermal energy delivery infrastructure as electric boiler system and energy storage.

In the typical Alaska village micro-grid connect wind energy system, the electric utility must continue to supply energy regardless of wind speed and wind energy contribution. Here, the wind generator(s) run in constant parallel with the utility, which serves to reduce the electric load at the facility. This configuration produces no cogenerated by-product such as hot water, as there is no excess energy. By integrating wind turbine generating capacity to achieve energy conservation as an aggregate of all energy, as well as the simultaneous production of a beneficial thermal, our conceptual design produces far greater total energy avoidance in terms of fuel savings and superior long term total system operating efficiencies. Accordingly, this design is focused on the low to mid penetration model with thermal electric integrating thermal storage nodes as its first priority use for wind generated energy. Secondarily, excess wind generated energy will be used to off-set electric energy consumption.

Russia has over 100,000 villages, and the Department of Renewable Energy of the Russian National Electric Utility has identified seventeen specific regions (out of 89 total) in Russia where it believes wind power development is particularly viable: Murmansk, Arkhangelsk, Karelia, Leningrad, Kaliningrad, Astrakhan, Volgograd, Krasnodar, Stavropol, Kalmykia, Dagestan, Komi, Magadan, Maritime, Kamchatka, Sakhalin, and Khabarovsk (E. Martinot. 1999. Renewable energy in Russia: markets, development and technology transfer. Renewable and Sustainable Energy Reviews; 3: 49-75). Use of wind energy is not new to Russia; The Danish government made Russia a gift of two *Micon* wind turbine generators rated at 250 kW each mounted in the village of Nikolskoye (Bering Island, Kamchatka Region). The wind turbine generators have been part of a diesel-wind hybrid system for years and saving up to 40% of diesel fuel usage. Heat is provided to the community by a central heating system that burns coal in the fall, winter and spring. Even this community, with its two large wind turbines, would benefit from a wind-powered home and building system as discussed above and could perhaps reduce coal use with effective application and integration of wind power into the hybrid system.

In 1997-1999 the US Department of Energy and the Russian Ministry of Fuel and Energy worked together on hybrid wind-diesel power systems; the National Renewable Energy Laboratory (NREL) supplied technical assistance to the project and the U.S. Agency for International Development (USAID), provided funding for the equipment and supplies. It may be time to re-establish a US-Russia wind energy program using new technologies and the strategies discussed above to provide electricity and heating to remote Russia (Gevorgian, V., K. Touryan, P. Bezrukikh, P. Bezrukikh Jr., and V. Karghiev. 1999. Wind-Diesel Hybrid Systems for Russia's Northern Territories. NREL/CP-500-27114).

Final Report: Weatherization and Energy Conservation Education and Home Energy and Safety Review in the Aleutian Islands

August 30, 2011

Provided by the Aleutian Pribilof Islands Association
Contract DE-EE0002524.000
Written by Bruce Wright, Senior Scientist

Introduction: The Aleutian Pribilof Islands Association (APIA) has been working to provide a comprehensive energy program for the Aleut Region, the Aleutian and Pribilof Islands. The program consists of identifying and promoting the use of renewable energy, but energy conservation always is longest lasting and most economical way of reaching our goal of reducing fossil fuel usage in the region. This project resulted from a proposal submitted under the Funding Opportunity Number: DE-PS36-09GO99022, CFDA Number: 81.087, Issue Date: March 16, 2009. The project began January 2010 and ended 6/30/2011. This final report describes some of the project challenges, the project objectives and how APIA was successful in meeting and exceeding the project objectives.

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King Cove resident learning about the advantages of using a low-flow shower head.

Project Description

Aleutian/Pribilof Islands Association, Inc. (APIA) hired three part-time local community members that desired to be energy technicians. The energy technicians were trained in methods of weatherization assistance, energy conservation and home safety. They developed a listing of homes in the region that required weatherization, and conducted on-site weatherization and energy conservation education and home energy and safety reviews in the communities of Akutan, False Pass, King Cove and Nelson Lagoon. Priority was given to these smaller communities as they tend to have the residences most in need of weatherization and energy conservation measures. Local residents were trained to provide all three aspects of the project: weatherization, energy conservation education and a home energy and safety review.

Background
The Aleutian/Pribilof Islands Association, Inc. is the federally recognized tribal organization of the Aleut people in Alaska. APIA's mission is to promote the overall economic, social, and cultural development of its beneficiaries, and to provide the best health care and social services possible for the Aleut people and all Native residents of the Aleutian/Pribilof Islands region. *Unanga* territory in Alaska encompasses the Aleutian Islands, the Pribilof Islands, and the Alaska Peninsula west of Stepovak Bay, a region of over 100,000 square miles. Our communities are the most remote in Alaska, and are not linked by a central road system. They are between 570 and 1200 air miles from Anchorage, the closest transportation center.

This project was funded by the Department of Energy (DOE) to service at least three Aleut communities, but APIA serviced four traditional *Unanga* (Aleut) communities including Akutan, False Pass, King Cove and Nelson Lagoon. The community members served by this project included, but were not limited to all Unanga tribal members and American Indian and Alaska Native residents.

In Akutan, Antone installed two compact fluorescent lights in this chandelier. The third is a burned out incandescent light, which was also replaced.

Project Objectives
To increase the human capacity for implementation of a Tribal Weatherization Assistance Program, four project objectives were identified.

Objective 1: Identify and hire three part-time local community members that desire to learn weatherization techniques as Energy Technicians.

Objective 2: Train Energy Technicians in methods of weatherization assistance and energy conservation.

Objective 3: Develop an active listing of regional residential homes that require weatherization.

Objective 4: Energy Technicians will perform weatherization on identified regional residential homes.

Once achieved, these goals and objectives build capacity among the tribes in the area of weatherization. Trained energy technicians will be more employable by APIA or the local Tribal Administration to perform weatherization services for the LIHEAP (Federal) or AKHAP (State of Alaska) weatherization programs, as well as contract with the Aleutian Housing Authority (AHA) to perform energy audits for units located in the region.


Boxes of energy savings supplies readied for shipment to the Aleutians.

Project Approach
This project will be administered from the Aleutian/Pribilof Islands Association's central office in Anchorage, where the Community Services and Administration departments are located. The APIA energy program manager, Bruce Wright, directed this project from the APIA central office in Anchorage. Travel consisted of Wright doing site visits and requiring energy technicians to secure training in Anchorage and Wasilla or to hold training sessions in their communities. Project success was measured by reports, communications from the energy technicians and site inspections.

Impact Indicators
1. Increase in partnerships established.
2. Increase in leveraged resources.
3. Increase in number of regional persons possessing core competencies for the Weatherization Assistance Program.

1 and 2. Increase in partnerships established and leverage resources: The Aleutian Housing Authority (AHA) learned of this project and submitted protest letters to the APIA CEO who followed up with a conciliatory letter and resulted in no further protests from AHA. Ultimately, AHA provided names of people who had some experience with the Housing Authority and construction savvy, and some were already trained in energy conservation. APIA hired three technicians with some AHA construction experience, but two energy technicians needed additional energy conservation training which was provided by this project.

Regional Tribes, and especially in the smaller communities, were contacted to determine if anyone was interested in becoming an energy technician for this project. A notice of employment was distributed to the Tribes and communities in the Aleut Region (see APPENDIX A). The communities of Nikolski and Atka did not have anyone available to work on the project; even the high school kids were predisposed with school and summer fishing jobs. A few people living in Anchorage were interested until the job requirements, salary, relocation parameters were discussed. Finally, five qualified people replied with interest in the energy technician position one each in the communities of Akutan, False Pass and Nelson Lagoon and two people from King Cove, one from each of the two Tribes. Based on meeting physical requirements (lifting and installations) and experience, three technicians were hired one from each Akutan, False Pass and King Cove. The Nelson Lagoon applicant was too busy to make a commitment to work for pay, but agreed to make installation of energy efficient supplies and accomplish the energy conservation education and safety review in his free time on weekends without pay.

The Belkofski Village Council of King Cove agreed to assist in arranging a home energy conservation meeting entitled Energy Efficiency Workshop (see APPENDIX D). The meeting was attended by a dozen people who attended the two day course. The topics covered were Building Science Basics, Airtightness, Ice Dams, Lighting and Appliances, Heating and Hot Water, Doors and Windows, Insulation and Ventilation. Air tightness and ventilation were especially of interest because people in the wet Aleutians have problems with windy damp weather and mold. The meeting was set up as a regional meeting, but only one person from outside King Cove attended; they were from Cold Bay. The meeting training was provided at no charge from the Alaska Craftsman Home Program, Inc, including the trainer. The funding for this was provided by the Alaska Housing Finance Corporation.

The Akutan technician, Antone Shelikoff and the Program Manager, Bruce Wright, traveled to Wasilla to attend the Energy Efficiency Workshop and earn energy efficiency certifications. The training was free of charge with funding from Alaska Housing Finance Corporation.

3. Increase in number of regional persons possessing core competencies for the Weatherization Assistance Program.

The energy technician from False Pass, Siri Goulette, already had certifications and was trained by the Alaska Housing Finance Corporation and worked for the Aleutian Housing Authority during the summer; she already had the core competencies. The technicians from King Cove, Raymond Dushkin, and Akutan and the 11 residents from Cold Bay and King Cove who attended the Energy Efficiency Workshop and received certifications increased their core competencies for the Weatherization Assistance Program. They also learned about the energy conservation weatherization programs operated by the state of Alaska.

Tasks Performed

Objective 1: Identify and hire three local community members that desire to learn weatherization techniques.

Activities:

1. Advertised available positions in appropriate venues.
2. Interviewed and hired individuals in Akutan, False Pass and King Cove. The Akutan energy technician traveled to Wasilla for a week training session. The King Cove energy technician was trained in King Cove at a workshop sponsored by this project and the Alaska Housing Finance Corporation. The False Pass energy technician had received all the training and energy certificates from previous work/training sponsored by the Aleutian Housing Authority.

The local energy technicians are community members from each of the villages, and they are now the local energy conservation expert with the capacity and expertise to better understand how local homes can be weatherized and people can conserve energy.

Recommendations:

The initial effort was to prioritize service to the smaller communities in the region. Additional funding is needed to provide these services to the remaining Aleutian and Pribilof Island communities.

Objective 2: Train Energy Technicians in methods of weatherization assistance.

Activities:

Trained the energy technicians; they attended an Energy Efficiency Workshop (see APPENDIX D). The topics covered were Building Science Basics, Airtightness, Ice Dams, Lighting and Appliances, Heating and Hot Water, Doors and Windows, Insulation and Ventilation. The meeting training was provided at no charge from the Alaska Craftsman Home Program, Inc, including the trainer. The funding for this was provided by the Alaska Housing Finance Corporation. The training included information on skills, safety precautions, and competencies needed to carry out the tasks, and this information was very useful in completing the home safety reviews accomplished by the energy technicians.

Objective 3: Develop an active listing of regional residential homes that require weatherization.

Activities:

1. A variety of techniques were used to contact home owners and the Akutan energy technician was particularly shy is making these contacts. With some coaching, he was finally comfortable with making contacts with all the Akutan residents and only one resident was a little gruff. All the residences in Akutan and False Pass were served, and about 80% of the residences were served in King Cove. Some of the homes needed levels of work beyond this project’s capabilities and these residences were referred to the Aleutian Housing Authority and some were directed to

apply for state of Alaska funding through the Alaska Housing Finance Corporation energy conservation programs (see http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm.

APIA has worked closely with the Aleutian Housing Authority lately to get home energy raters trained to rate homes in the Aleutian and Pribilof Islands. A home energy rating is a great educational tool that informs residents how to save energy and money and it's a requirement for some weatherization rebate programs (see http://www.ahfc.state.ak.us/energy/home_rebate.cfm).

Recommendations: Try to establish a cooperative working relationship with the local housing authority early in the project if not involve them in the project planning. This may help resolve territorial concerns and leverage resources.

Objective 4: Energy Technicians will perform weatherization on identified regional residential homes.

Activities:

1. The energy technicians were co-managed by the Tribal authority, usually the Tribe's IGAP coordinator and the APIA project manager. This allowed for buy-in by the local Tribes and in some cases allowed for use of local resources such as the space for training sessions.

2. All the residences in Akutan and False Pass were served, and about 80% of the residences were served in King Cove. Some of the homes needed levels of work beyond this project's capabilities and these residences were referred to the Aleutian Housing Authority and some were directed to apply for state of Alaska funding through the Alaska Housing Finance Corporation energy conservation programs (see http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm.

3. Compile data on all of the homes and public facilities in the service communities in order to determine further needed efforts.

Activities: All the residences in Akutan and False Pass were served, and about 80% of the residences were served in King Cove. Some of the homes needed levels of work beyond this project's capabilities and these residences were referred to the Aleutian Housing Authority and some were directed to apply for state of Alaska funding through the Alaska Housing Finance Corporation energy conservation programs (see http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm.

APIA has worked closely with the Aleutian Housing Authority lately to get home energy raters trained to rate homes in the Aleutian and Pribilof Islands. A home energy rating is a great educational tool that informs residents how to save energy and money and it's a requirement for some weatherization rebate programs (see http://www.ahfc.state.ak.us/energy/home_rebate.cfm).

The project manager was required to travel to the communities to do some on-the-job training of the appropriate methods of implementation and safety.

Energy Savings, Cost Savings and CO_2 Reduction

A total of 66 homes were served by this project. The below table lists the supplies installed in the homes and estimates of energy saved broken into groupings; water and hot water conservation, lights (CFLs and LEDs) and weather-stripping and other air infiltration control supplies:

Purchased Weatherization Product	Number	Energy Used
Water-saver shower heads	45	30% less
Toilet valve replacement kits	55	
Water pipe insulation kits (4 each)	73	
Toilet tank insulation liners	14	
Hot water tank insulation kits	36	

(together these save 200-1,400 KwH/yr/home) 200 KwH/yr x 66 homes = 13,200KwH/yr

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Purchased Weatherization Product	Number	Energy Used	Kilowatt Hour Saved Each	Kilowatt Hour Saved Total
CFLs and LEDs	882	81% less	61 watts	53.8kW

(Replacing a 100 watt incandescent light with a 23 watt CFL saves $65/yr.)
53.8kW x 24 hrs. x 365 days = 471.3 KwH/yr

Window shrink kits	48
Cans spray foam	299
Door draft stoppers	62
Duct and weatherproof tapes	88
Plastic vapor barrier rolls	32
Door thresholds	18
Foam tape weather-stripping	116
Caulking tubes (silicone and paintable)	356
Electric foam outlet sealers	820

These items can save 10-25% of heating costs (use 18%)
.18 x 66 homes x 10,896 kWh* X 8760= 11,345 KwH/yr

*average annual electricity consumption for a U.S. residential utility customer was 10,896 kWh

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No data was available to reasonably estimate savings from power strip and LED task light

Power strips**	72
LED task lights (rechargeable)	51

(**Alaskans spend more on powering home entertainment systems when they are off than when they are in use. This phantom power can be controlled by using power strips that are turned off when the equipment is not in use.)

ESTIMATED TOTAL ENERGY SAVED: 13,200KwH/yr + 471.3 KwH/yr + 11,345 KwH/yr = 25,016 KwH/yr.

Eventually these savings may evaporate as more and more electrical appliances and equipment get used in homes. This is referred to as Energy Efficiency and the Rebound Effect, where installing energy-efficient appliances leads to an increase in energy use, because being energy-efficient makes energy cheaper, or makes consumers feel less guilty about using energy.

Sources: http://en.wikipedia.org/wiki/Efficient_energy_use, http://www.davidsuzuki.org/issues/climate-change/science/energy/energy-conservation-and-efficiency/index.php, http://www.energysavers.gov/, http://www.hvackey.com/green-heating/home-heat-loss-learn-how-to-fight-back.html, http://ncseonline.org/nle/crsreports/energy/eng-80.cfm, http://www.nytimes.com/2011/03/08/science/08tier.html?_r=3&hp, http://www.stewartmarion.com/carbon-footprint/html/carbon-footprint-kilowatt-hour.html

Cost Savings and CO_2 Reduction
Some of the residents have said their monthly bills have decreased by 25% or more since the installation of CFLs and other weatherization measures were undertaken. These are not empirical

data and may simply reflect the timing of the project; most of the work was accomplished in spring when ambient light levels and temperatures increase in spring and summer.

If the total energy saved by installing these products is a 25% reduction (electrical and heating, both of which are usually produced by combustion of diesel fuel), and the average Alaska home produces 32,000 pounds of CO_2 each year, so we have saved about: 66 homes x 16 tons of CO_2 each year x .25 = 264 tons of CO_2 each year.

Conclusions:
Progress and financial reports were completed and submitted, and the project results are in this comprehensive final report. The results from this project will be presented at the annual Tribal Energy Program Review to be held in fall in Denver, Colorado.

We would like to thank the US Department of Energy, Tribal Energy for the opportunity to complete this energy conservation and energy education project and to the energy technicians for all their hard work and dedication to this project. On many occasions they exceeded expectations and made this project a success.

The initial effort was to prioritize service to the smaller communities in the region. Additional funding is needed to provide these services to the remaining Aleutian and Pribilof Island communities.

APPENDIX A: **Energy Technician Job Announcement**

Title: Need to hire energy technician for residential weatherization, energy and home safety review and training project in the Aleutian and Pribilof Islands

Period of Performance: FY 2009-2011

Conduction Organizations: Aleutian Pribilof Islands Association, Salary around $20/hr.

Project Description: APIA is doing on-site energy conservation and weatherization education in the communities of Akutan, Atka, False Pass, King Cove, Nelson Lagoon, Nikolski, Sand Point, St. George, St. Paul and Unalaska. Priority will be given to the residence most in need of weatherization and energy conservation measures. A local resident (energy conservation technician) will be taught about weatherization, energy conservation, the Alaska home energy audits and weatherization programs available for Alaskans. Assistance will be provided for applying for weatherization programs including completing application forms.

Energy Technician: The energy conservation technician will complete the Home owners Retrofit/Energy Conservation Class provided by the Alaska Craftsman Home Program and show competence in performing independent weatherization and energy conservation information to local home owners.

Contact: Bruce Wright, APIA, 907-222-4260 or brucew@apiai.org

The Energy Savers Tips booklet will be used as a guide and given to the home owners as an educational tool. You can request a copy of this booklet from APIA or you can find it at http://www.swamc.org/files/alaska_tips_final.pdf

APPENDIX B: Planning Estimated Energy Supplies Spreadsheet

Nelson Lagoon Weathe ######

Excel Spreadsheet

Name	LED Lights		Fluorescent Lights (Tubes x 2)		Doors Need Weather-strip	Windows Need Covering				Spray Foam	Water Heater Jackets		Rechargeable Drop lights	Outlets Need Insulation		Light Switches Need Insulation			Water Pipe Insulation		Power Strips	Saver Shower Heads	Under Door Weather Seal
	60w	200w	8'	4'		8'x 5'	6'x 6'	5'x 5'	4'x 4'		30 Gal	50 Gal		Single	oubl	Single	Double	Triple	1/2"x Ft	3/4"x Ft	6 Out +		
ine Gund	44	1		3	7	4			16		1		2	30	10	5	4	4	25	25	5	1	7
hard John	20	1		4	4	5	2	1	13		1		2	50	6	6	3		25	25	2	1	4
rman Joh	10	2		10	4		10		10		1		2	40	5	6			100	100	10	1	4
)an Johns	16	1			4		2		4		1		2	30	5	5	5		25	25	3	1	4
:en Brand	30	2			13						1		2	50	10	10	10		25	25	4	1	7
aig Rysew	16	1		2	4				2		1		2	20	6	4	4		50		4	1	4
eslie Carv	16	1			3						1		2						25	25	2	1	3
hn Nelsor	10	1		4							1		2						25	25	4	1	0
hn Nelson	30	1		10	4		2		10		1		2	40	10	5	5		100	100	4	1	4
olly Jacks	14	1			2			2	3		1		2						25	25	2	1	2
rbert Johr	14	1			3			2	3		1		2	10			1		25	25	3	1	3
'ian Hartr	14	1		10	2			2	8		1		2	20	10	5	5		25	25	5	1	2
ark McNe	20	5			2			2				1	2	20	10	5	5		50	50	4	1	2
like Neme	14	1			1			1	4		1		2	10			1		25	25	2	1	1
tay Johnsc	18	1			4						1		2						25	25	4	1	4
heo Chesl	20	1			3			6	8		1		2	10	5	5	5		25	25	2	1	3
m Snodgr	15	1			3				7		1			20		2	1		25	25	2	1	3
le Gunder	20	1		10	3		4		10		1		2	50	10	5	3	2	50	50	2	1	3
Bob Caho	14	1			2				10		1		2						50	50	3	1	2
:ch Gunde	20	1			2		4		7		1		2	30	10				25	25	3	1	2
'aul Schaa	20	1			2		2		12		1		2	15	4	4	3		25	25	4	1	2
eona Nels	20	1			3			3	6		1		2	20	4	4	4		25	25	2	1	3
rlene Nels	40	1		6	2			5	10		1		2	40	4	4	4		25	25	3	1	2
irold John	30	2			2			6	8		1	1	2	30	10		3		50	50	7	1	2
'asha (CH	7	1									1		2						25	25	2	1	0
Chip Shar	25	1		5	5			6	6		1		2			10	10		25	25	4	1	5

APPENDIX C: Energy Supplies – Estimated and Actual

Summary of Estimated Weatherization Items to be purchased and insta

666	60 watt LED Lights	$17.99 ea for 40w + $39.97 for 60w equivialent
44	200 watt LED Lights w/Exterior fixtures	75w @ $44.97 ea
115	36" Exterior Doors needing weather-stripping	17' for 3.88
9	8'x 5' Window Shrink Wrap Coverings	6.98
33	6'x 6' Window Shrink Wrap Coverings	6.98
47	5'x 5' Window Shrink Wrap Coverings	6.98
231	4'x 4' Window Shrink Wrap Coverings	10.98 for 9
29	30 Gallon Water Heater Blankets	- $25.37
3	50 Gallon Water Heater Blankets	- 25.37
66	Rechargeable Drop Lights	- 24.95
732	Foam Outlet Cover Insulators (single)	
161	Foam Outlet Cover Insulators (double)	
109	Foam Light Switch Cover Insulators (single)	
115	Foam Light Switch Cover Insulators (double)	
9	Foam Light Switch Cover Insulators (triple)	
1200	1/2" Foam Water Pipe Insulation (feet)	12' for $1.98
1100	3/4" Foam Water Pipe Insulation (feet)	12' for $1.98
137	Power Strips (6 Outlets or more)	$8 ea
34	Water Saver Shower Heads	12.75
107	Bottom of Door Weather Seal (fastened to internal side bottom of door)	12.30
2000	9/16" Arrow Staples	
2000	1/2" Arrow Staples	
312	Great Stuff Foam Sealant Cans	7.98 ea
20	Toilet Flapper Valve Replacement Kits	19.98
40	Indoor/Outdoor Weather Seal Tape (roll)	- 7.98
37	Foil Tape (roll)	6.58
10	Duct Tape (roll)	3.38
220	Durable Indoor/Outdoor Silicon Sealant (tube)	$6.57 ea
5000	Sq. Feet Husky Plastic Sheeting Vapor Barrier	3.5 mil, 10' x 25', $12.98 each

Actual purchases:	Water-saver shower heads	45
	CFLs and LEDs	882
	Window shrink kits	48
	Cans spray foam	299
	Water pipe insulation kits (4 each)	73
	Power strips	72
	Toilet valve replacement kits	55
	Toilet tank insulation liners	14
	Hot water tank insulation kits	36
	Door draft stoppers	62
	Duct and weatherproof tapes	88
	Plastic vapor barrier rolls	32
	Door thresholds	18
	Foam tape weather-stripping	116
	LED task lights (rechargeable)	51
	Caulking tubes (silicone and paintable)	356
	Electric foam outlet sealers	820

APPENDIX D: Energy Efficiency Workshop Announcement (King Cove)

Attention Residents of King Cove

Would you like to save money on your utility bill?

Is your home in need of some weatherization?

Would you like to learn how to conserve energy?

The ATC, Environmental Department is working with A.P.I.A. to help conserve energy in your home!! We have supplies and tips on how you can make your home more energy efficient!

And it's FREE!!!

If you would like more information about this project, you can call the ATC office at (907) 497-2648 and ask for AnnDee or Nadezda and we can make an appointment to provide you with assistance.

Tired of high heating bills?
Questions about the rebate program?

Learn how to do, or direct, your own energy efficient improvements!

Attend these 8 informative workshops FREE to the public

MUST Register
Class size is limited

Continuing Education Credits Available!

Thursday, January 20	
8:00am:	Building Science Basics
10:00am:	Airtightness
1:00pm:	Ice Dams
3:00pm:	Lighting & Appliances

Friday, January 21	
8:00am:	Heating & Hot Water
10:00am:	Doors & Windows
1:00pm:	Insulation
3:00pm:	Ventilation

Free!

Classes Held in King Cove
907-258-2247
www.achpalaska.com

Free!

Brought to you by:
Alaska Craftsman Home Program
Alaska Housing Finance Corporation

Alaska Housing FINANCE CORPORATION

APPENDIX E: Basic Home Energy Audits

The below self home energy audit will be reviewed with and given to the home owners and used as an educational tool.

Basic Home Energy Audits

You can easily conduct a home energy audit yourself. With a simple but diligent walk-through, you can spot many problems in any type of house. When auditing your home, keep a checklist of areas you have inspected and problems you found. This list will help you prioritize your energy efficiency upgrades.

Locating Air Leaks

First, make a list of obvious air leaks (drafts). The potential energy savings from reducing drafts in a home may range from 5% to 30% per year, and the home is generally much more comfortable afterward. Check for indoor air leaks, such as gaps along the baseboard or edge of the flooring and at junctures of the walls and ceiling. Check to see if air can flow through these places:

- Electrical outlets
- Switch plates
- Window frames
- Baseboards
- Weather stripping around doors
- Fireplace dampers
- Attic hatches

Also look for gaps around pipes and wires, electrical outlets, foundation seals and mail slots. Check to see if the caulking and weather stripping are applied properly, leaving no gaps or cracks, and are in good condition.

Inspect windows and doors for air leaks. See if you can rattle them, since movement means possible air leaks. If you can see daylight around a door or window frame, then the door or window leaks. You can usually seal these leaks by caulking or weather stripping them. Check the storm windows to see if they fit and are not broken. You may also wish to consider replacing your old windows and doors with newer, high-performance ones. If new factory-made doors or windows are too costly, you can install low-cost plastic sheets over the windows.

If you are having difficulty locating leaks, you may want to conduct a basic building pressurization test:

1. First, close all exterior doors, windows, and fireplace flues.
2. Turn off all combustion appliances such as gas burning furnaces and water heaters.
3. Then turn on all exhaust fans (generally located in the kitchen and bathrooms) or use a large window fan to suck the air out of the rooms.

This test increases infiltration through cracks and leaks, making them easier to detect. You can use incense sticks or your damp hand to locate these leaks. If you use incense sticks, moving air will cause the smoke to waver, and if you use your damp hand, any drafts will feel cool to your hand.

On the outside of your house, inspect all areas where two different building materials meet, including:

- All exterior corners
- Where siding and chimneys meet
- Areas where the foundation and the bottom of exterior brick or siding meet.

You should plug and caulk holes or penetrations for faucets, pipes, electric outlets and wiring. Look for cracks and holes in the mortar, foundation and siding, and seal them with the appropriate material. Check the exterior caulking around doors and windows, and see whether exterior storm doors and primary doors seal tightly.

When sealing any home, you must always be aware of the danger of indoor air pollution and combustion appliance "backdrafts." Backdrafting is when the various combustion appliances and exhaust fans in the home compete for air. An exhaust fan may pull the combustion gases back into the living space. This can obviously create a very dangerous and unhealthy situation in the home.

In homes where a fuel is burned (i.e., natural gas, fuel oil, propane or wood) for heating, be certain the appliance has an adequate air supply. Generally, one square inch of vent opening is required for each 1,000 Btu of appliance input heat. When in doubt, contact your local utility company, energy professional or ventilation contractor.

Insulation

Heat loss through the ceiling and walls in your home could be very large if the insulation levels are less than the recommended minimum. When your house was built, the builder likely installed the amount of insulation recommended at that time. Given today's energy prices (and future prices that will probably be higher), the level of insulation might be inadequate, especially if you have an older home.

If the attic hatch is located above a conditioned (heated) space, check to see if it is at least as heavily insulated as the attic, is weather stripped, and closes tightly. In the attic, determine whether openings for items such as pipes, ductwork, and chimneys are sealed. Seal any gaps with expanding foam, caulk or some other permanent sealant.

While you are inspecting the attic, check to see if there is a vapor barrier under the attic insulation. The vapor barrier might be tarpaper, Kraft paper attached to fiberglass batts or a plastic sheet. If there does not appear to be a vapor barrier, you might consider painting the interior ceilings with vapor barrier paint. This reduces the amount of water vapor that can pass through the ceiling. Large amounts of moisture can reduce the effectiveness of insulation and promote structural damage.

Make sure that the attic vents are not blocked by insulation. You also should seal any electrical boxes in the ceiling with flexible caulk (from the living room side or attic side) and cover the entire attic floor with at least the current recommended amount of insulation.

Checking a wall's insulation level is more difficult. Select an exterior wall and turn off the circuit breaker or unscrew the fuse for any outlets in the wall. Be sure to test the outlets to make certain that they are not "hot." Check the outlet by plugging in a functioning lamp or portable radio. Once you are sure your outlets are not getting any electricity, remove the cover plate from one of the outlets and gently probe into the wall with a thin, long stick or screwdriver. If you encounter a slight resistance, you have some insulation there. You could also make a small hole in a closet, behind a couch, or in some other unobtrusive place to see what, if anything, the wall cavity is filled with. Ideally, the wall cavity should be totally filled with some form of insulation material. Unfortunately, this method cannot tell you if the entire wall is insulated, or if the insulation has settled. Only a thermographic inspection can do this.

If your basement is unheated, determine whether there is insulation under the living area flooring. In most areas of the country, an R-value of 25 is the recommended minimum level of insulation. The insulation at the top of the foundation wall and first floor perimeter should have an R-value of 19 or greater. If the basement is heated, the foundation walls should be insulated to at least R-19. Your water heater, hot water pipes, and furnace ducts should all be insulated. For more information, see the insulation section (above).

Heating Equipment
Inspect heating equipment annually or as recommended by the manufacturer. If you have a forced-air furnace, check your filters and replace them as needed. Generally, you should change them about once every month or two, especially during periods of high usage. Have a professional check and clean your equipment once a year. Does the furnace appear old? Does it need to be replaced?

If the unit is more than 15 years old, you should consider replacing your system with one of the newer, energy-efficient units. A new unit would greatly reduce your energy consumption, especially if the existing equipment is in poor condition. Check your ductwork for dirt streaks, especially near seams. These indicate air leaks, and they should be sealed with duct mastic. Insulate any ducts or pipes that travel through unheated spaces. An insulation R-Value of 6 is the recommended minimum.

Oil Tank Survey
Inspect the oil tank and oil tank holder for rest, leaking and other problems. Make sure a filter is in place and operable.

Lighting
Energy for lighting accounts for about 10% of your electric bill. Examine the wattage size of the light bulbs in your house. You may have 100-watt (or larger) bulbs where 60 or 75 watts would do. You should also consider compact fluorescent lamps for areas where lights are on for hours at a time. Your electric utility may offer rebates or other incentives for purchasing energy-efficient lamps.

APPENDIX F: Akutan Log

Antone's Log:

Church:
Eleven CFLs Light blubs after installing bulbs four were uninstalled. The priest said the CFLs were too bright.

Home 1:
Nine CFL Light bulbs didn't need a vapor barrier. Update

Home 2:
Three CFL Light bulbs didn't need a vapor barrier, cleaned under the refrigerator the coils removed dust.

Home 3:
Eight CFLs Light bulbs didn't need a vapor barrier, one heater blanket, one low flow shower head, two power strips, one double draft stopper.

Home 4:
Seven CFL Light bulbs didn't need a vapor barrier, low flow shower head, heater blanket, one flash light City of Akutan snow removal person and repair man.

Home 5:
One CFL bulb didn't need a vapor barrier but the vapor was half done and I volunteered to install the other half, two window insulation kits, one heater blanket one flash light City of Akutan vehicle repair person.

Home 6:
Eleven CFL bulbs didn't need a vapor barrier, one heater blanket, one flashlight home owner is a carpenter and did not need to much help installing any of the energy efficient upgrades.

Home 7:
Five CFLs light bulbs didn't need a vapor barrier, one double draft stopper. Updated.

Home 8:
No CFLs didn't need a vapor barrier, one flash light home of a carpenter.

Home 9:
Five CFLs didn't need a vapor barrier, one double draft stopper a flash light. Updated

Home 10:
Six CFLs light bulbs didn't need a vapor barrier, one flash light City of Akutan's garbage collector.

Home 11:
One CFL bulb didn't need a vapor barrier, two power strips one double draft stopper a flash light Home owner has a broken blub in the outside light socket didn't know how to remove broken bulb.

Home 12:
Twenty six CFL bulbs used one insect CFL all together 27 CFLs no vapor barrier needed home owner was very happy with the CFLs one power strip also one flash light.

Home 13:
21 CFL's used no vapor barrier needed One insect bulb altogether 22 CFL's one flash light.

Home 14:
16 CFL light bulbs installed one flash light. Made an appointment to clean refrigerator coils.

Home 15:
Two CFL light bulb one flash light. Needs a new outside light fixture.

Home 16:
18 CFL's light bulbs two power serge strips one flash light. 4-4-2011

Home 17:
19 CFL's two power strips one flashlight forgot the photos. 4-11-2011

Home 18;
17 CFL's 3 power strips one flash light took before and after photos. 4-12-2011.

Home 19:
7 CFL's 1 flashlight 1 power strip.

Home 17:
Air leaks fixed used expanding foam one hole in the middle of the house, did some work under home.

Home 20:
6 CFL's one flash light one power strip.

Home 21:
One flashlight.

Home 22:
One flash light one power strip 8 CFL's.

Home 23:
One flash light one power strip 8 CFL's.

Home 24: Apartment 3
One power strip one flash light 6 CFL'S.

Home 25:
One flash light 17 CFLs bulbs.

Home 26:
One flash light 12 CFL's.

Home 27:
One flash light home has upgraded lights from this store.

APPENDIX G: False Pass Final

-----Original Message-----
From: siri goulette [mailto:sirielsa@yahoo.com]
Sent: Wednesday, June 22, 2011 11:34 AM
To: Cara Bethe
Subject: Re: Energy

Hello,

I have been working with members of the False Pass community informing and educating households of the importance of conserving energy. Over the last month I have been into houses, asking questions, and aiding in keeping the warmth in! I have had alot of questions asked of how to cut down costs. Some are as simple as just turning the lights off when not in use, or to keep the heater on a lower setting during the day.

When I arrive at a house and I tell the head of the house what I have, I am asked to perform thermal inspections around the windows and doors. You could see the surprise on their faces when they see how much heat is lost through doors and windows. They are even more surprised when I show up and have insulation, caulking, and strips for their houses.

With False Pass being a smaller community it was nice for me to spend as much time within the house showing and fixing the different heating problems.

There are 12 homes in False Pass. I informed the residents of all 12 houses, and gave out all necessary materials to those who needed and/or wanted to save in energy.

Siri Goulette

Adak Renewable Energy Reconnaissance Report

AEA REF Grant #2195450

August 29, 2011

Prepared for:
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Submitted by:
TDX Power
615 E 82nd Ave
Suite 200
Anchorage, AK 99518

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ABSTRACT

The city of Adak is located in western Alaska along the Aleutian chain. The city is a former US Naval base. The Alaska Energy Authority commissioned this reconnaissance report as a first step to define the renewable energy resources on Adak Island and identify the most likely projects that could reduce the community's reliance on diesel fuel for electricity and heating needs.

The report identifies hydroelectric power and wind power as viable renewable energy solutions, with further study required to select the best project. The geothermal resource remains largely unknown. The existing power system is in serious distress. Renewal or replacement of the power plant would be required in order to integrate a renewable resource into the utility's grid.

INTRODUCTION

Project Objective and Scope

TDX Power received a grant from the State of Alaska Renewable Energy Fund program to study the existing electrical infrastructure and evaluate the potential use of renewable energy resources for the community of Adak.

This reconnaissance report includes an evaluation of the available resources and recommends further engineering studies of the most promising resources for integration with the electric utility's existing diesel-generated power system.

Community Overview

The City of Adak is a remote community in the Aleutian Islands of Western Alaska. The community is situated on the northern coast of Adak Island, approximately 1200 miles southwest of Anchorage.

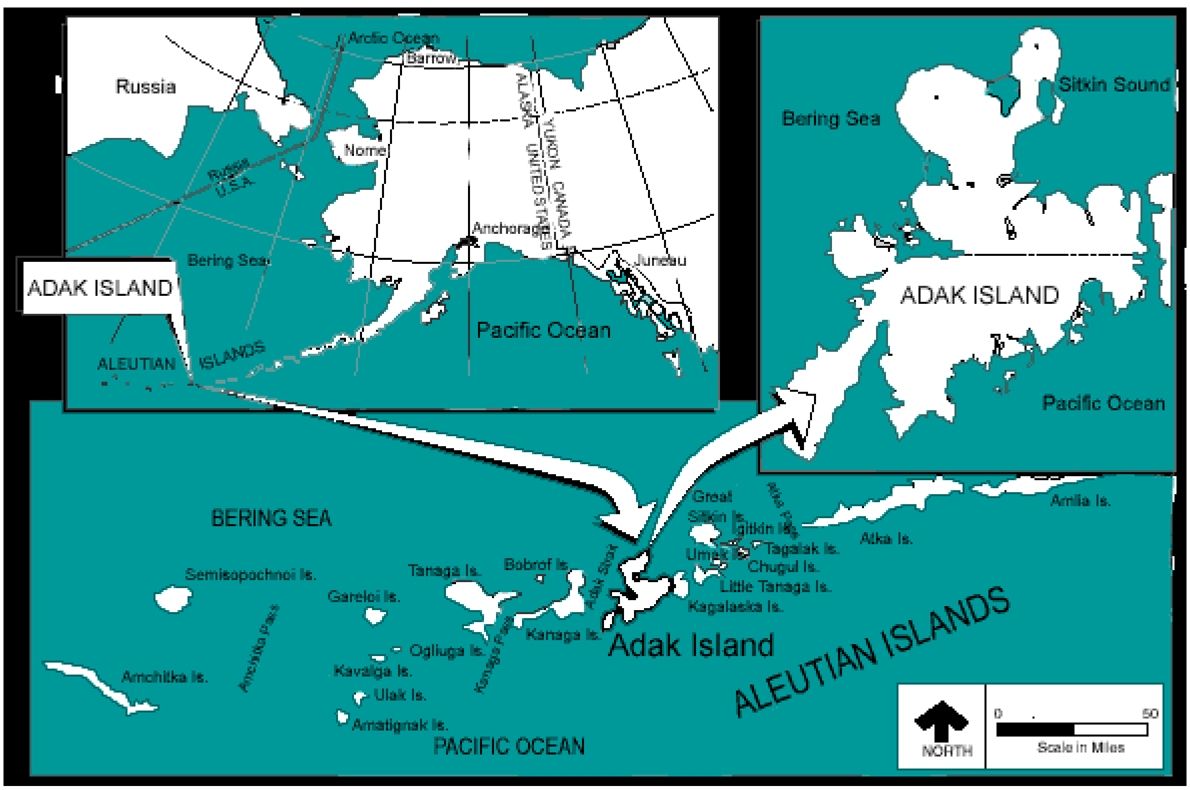

Figure 1 - Adak Map (source: US Navy)

Originally inhabited by Aleut people, Adak's major infrastructure was largely built by the US Navy during and after World War II, when up to 6000 military personnel and family members lived in Adak. The Naval Air Facility Adak (NAF-Adak) was closed and all military personnel were relocated by 1997.

As part of the military's departure, the US government transferred ownership of the land and assets to the Aleut Corporation. According to the 2010 US Census, the population of Adak is currently 326 people – a sharp decline since the days of active military operations. There are utility 195 customers in Adak, of which 105 are residential.

ELECTRIC UTILITY

The existing electrical infrastructure was built to support US Navy operations in Adak. With the closure of NAF-Adak, ownership of the electric utility was transferred to the local government and was later purchased by TDX Power.

The electricity market in Adak is regulated by the State of Alaska through the Regulatory Commission of Alaska. TDX Adak Generating, LLC, a subsidiary of TDX Power, owns and operates the utility under certificate number CPCN 684.

TDX Adak Generating reports that the current electrical load averages roughly 200 – 250kW, with recent annual sales of approximately 1.5 – 2.5 million kWh.

Including the Cost of Power Adjustment (COPA) filing dated April 25, 2011, the price of electricity currently averages $0.79/kWh for residential customers.

TDX Adak Generating ratepayers qualify for the State's power cost equalization program, which subsidizes residential customers and some community facilities. A special contract with Icicle Seafoods, the local fish processing plant, was submitted to the RCA for approval on June 10, 2011. Operation of the plant is expected to cause a dramatic spike in consumption during the peak fish processing months of February, March and April. Neither TDX Adak Generating nor Icicle Seafoods can provide an accurate estimate of the processing load since Icicle has self-generated in the past with a 2200kW genset. The peak fish processing load is expected to be between 1000 – 2000kW, with a more moderate 100kW load for the remainder of the year.

EXISTING INFRASTRUCTURE

The utility is in distress after years of inadequate maintenance. The existing electrical infrastructure is in various stages of disrepair. There is a major and urgent need for renewal and/or replacement both at the powerhouse and at the distribution level. TDX Adak Generating is evaluating options for renewal or replacement of the existing power plant to better serve the existing customers. This upcoming utility work would significantly affect any renewable energy project in Adak. Continued coordination with the utility will be a key factor for successful development of any renewable energy project.

POWER PLANT

The diesel generator based power plant is located on the south side of the airport – opposite the major loads. The power system was built in phases, beginning in the 1950s, to accommodate a growing military operation. The oldest switchgear section, the "2400 Volt Bus," contains three (3) Caterpillar 3516 engines (Generators 3, 4, and 5), each rated at 800kW, 2400 volts. These are the primary generators. Each genset has in excess of 30,000 hours runtime and all are due for complete overhaul.

Two newer switchgear sections, “East Bus” and “West Bus,” contain a total of eight (8) defunct Cooper Bessemer engines, each rated in excess of 2.2MW, 13.8kV. All of the Cooper Bessemer engines are out of service, disconnected, and are not expected ever to produce power again. Generator 6 – Caterpillar 3512, 1100kW, 480V – is tied into the West Bus through a transformer, but is currently out of service.

The 2400V Bus is connected to the East Bus with a step-up transformer (no backup), which is connected to the West Bus, so that Generator 6 could potentially provide backup in case the 2400V Bus fails.

The manually controlled generator switchgear includes Woodward governors and load-share modules. Fuel injection is mechanical. The governors and load-share modules, circa 1982, could potentially by reused in a new switchgear lineup, but more likely all new equipment would be installed.

DISTRIBUTION

Several feeders from the power plant serve the town loads. Several loads are tied to the West Bus (13.8kV). Other loads are tied to the 2400V Bus. But the majority of Adak’s load is served by a 13.8kV feeder tied to the East Bus and fed through a series of substations. Downstream transformers are used to step down to 2400 volts, or 6900 volts (in the case of the harbor).

Distribution wiring is mainly copper. Routing is largely buried, but significant sections of the city utilize overhead distribution. The effects of Adak’s harsh weather can be seen in the condition of transformers, power poles, and junction boxes, many of which do – or will soon – require replacement.

As can be expected with such an old system, changes over time have not been properly documented on the as-built drawings. Also, large sections of the distribution system have been disconnected and abandoned in place due to a lack of use.

RENEWABLE ENERGY OPTIONS

Adak is well situated to make use of local renewable energy sources. Located on the border between the Bering Sea and the North Pacific Ocean, Adak is home to strong, consistent winds. Located on a volcanic island, near-surface geothermal resources may be located nearby. Located on a mountainous hillside near several natural lakes, the potential clearly exists to develop hydroelectric power. These three resources are seen as the most likely candidates for immediate implementation in Adak. Figure 2 shows the areas that show the most promise for development for each resource.

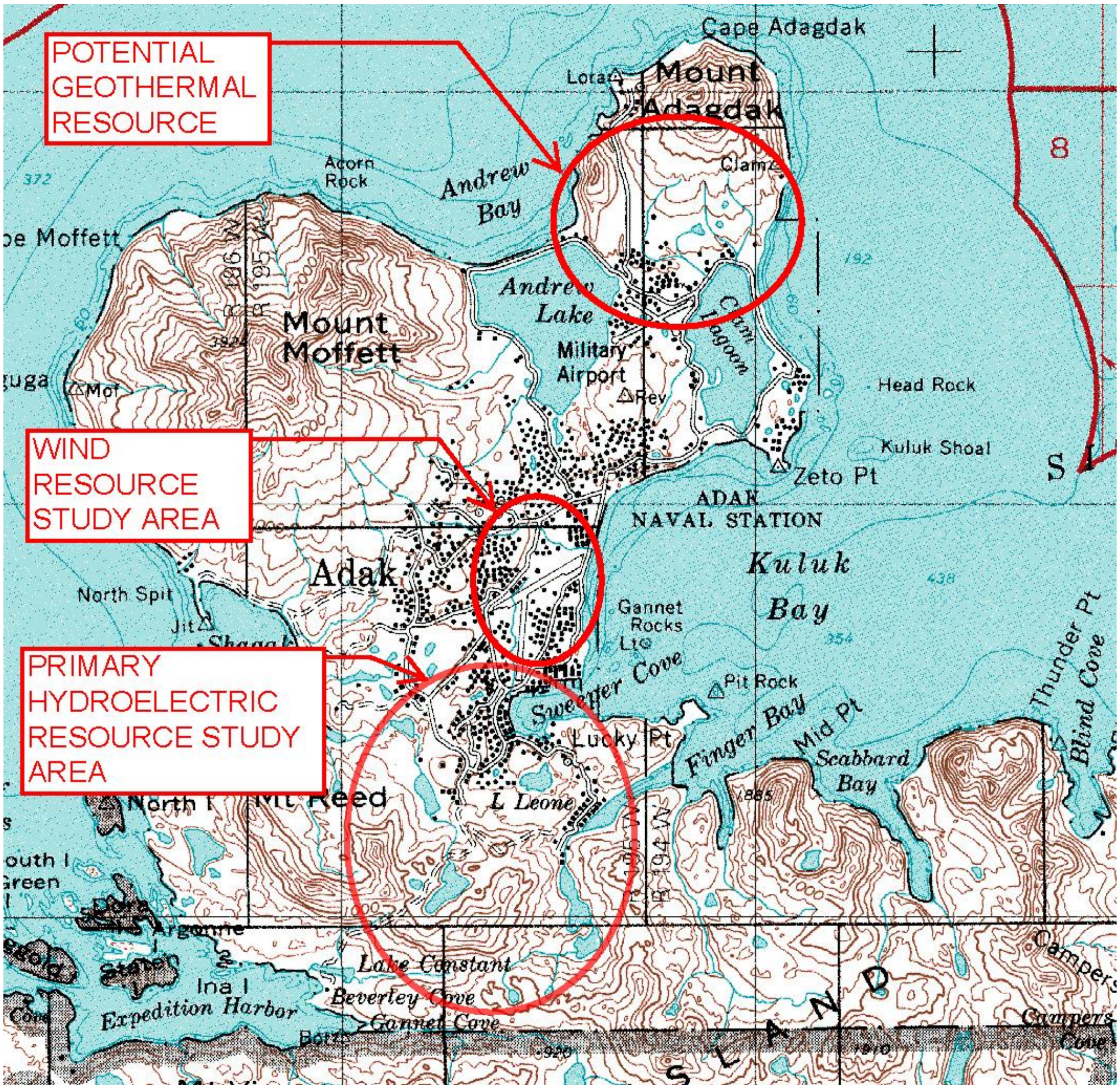

Figure 2 - Renewable Resources near the City of Adak

Although a formal survey has not yet been completed, all indications are that the community of Adak supports the development of renewable energy as a way of stabilizing and possibly reducing the cost of energy in their community. TDX has been working with the City of Adak and the Aleut Corporation to develop plans that address local views and concerns.

OTHER CONSIDERATIONS

The integration of renewable power systems with the existing infrastructure will need to be addressed in order to properly and efficiently size and control all generating assets. The utility's renewal and replacement strategy should consider integration with generating facilities outside the diesel power plant.

An emphasis on uncomplicated systems will help improve operating efficiency over the long term. Maintenance personnel in Adak do not have the breadth of technical or material resources that urban developers are accustomed to. The plant and integration design should consider local expertise and maintenance operations as critical components of a long-term project.

RECOMMENDATIONS

Further engineering studies are required to evaluate the various development options in more detail. Specific recommendations are included for additional wind and hydroelectric studies at the end of those resource assessments.

RECONNAISSANCE LEVEL ASSESSMENTS

HYDROELECTRIC

Hatch USA was hired to evaluate the hydroelectric potential on Adak. The studies were designed to accommodate the existing electrical load. A detailed analysis of potential projects can be found in Appendix A.

GEOTHERMAL

Roger Bowers Associates was hired to evaluate the geothermal potential on Adak. The Navy has reportedly drilled geothermal test wells north-west of the City of Adak. We have so far been unable to obtain the results of those tests. An analysis of potential projects can be found in Appendix B, based on the limited available data.

PERMITTING/LAND USE

Solstice Alaska Consulting was hired to evaluate permitting and land use issues related to development of hydroelectric and wind resources. Current knowledge of the geothermal resource does not provide the necessary groundwork for a detailed permitting discussion, and was therefore excluded from the analysis. The discussion of permitting issues can be found in Appendix C.

WIND RESOURCE ASSESSMENT

A wind resource assessment is currently being performed by TDX Power, as detailed below. The results shown are based on the initial findings of that study. Wind power has the potential to displace a large fraction of the 1.5 – 2.5 million kWh of annual diesel generation.

WIND RESOURCE

According to AEA's most recent State-wide wind energy map (2010), Adak has a Class 6 or Class 7 wind resource, i.e. very energetic. A wind resource assessment is currently underway to confirm anecdotal evidence and state-wide wind modeling results.

A 34-meter NRG anemometer tower was erected by the City of Adak in 2006. However the data logger was never installed and therefore no data was collected. The tower reportedly fell during a wind storm prior to the start of this project. The tower was largely salvaged and reused by TDX. The damaged tower sections were discarded. The tower was reinstalled in October 2010 with new sensors, stronger guy cables, and dead man foundations for each cable. The modified tower is approximately 30-meters tall.

The anemometer tower was installed in an open field near the existing power plant.

Figure 3 - Adak aerial view showing power plant and met tower

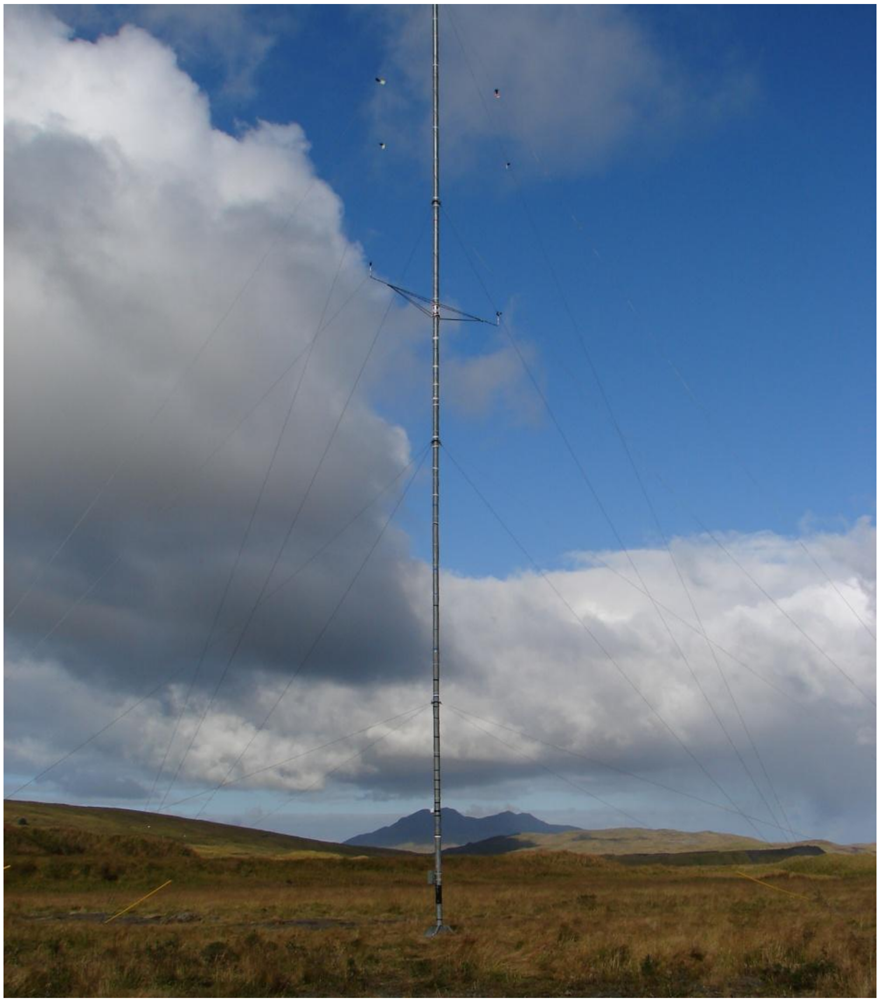

Figure 4 - Anemometer location

Approximately 6 months of data (17 October 2010 – 18 April 2011) have been collected to date. The data tend to confirm the earlier models of an excellent wind resource in Adak, although the wind power classification is 5-6, depending on hub height. The data indicate a mean wind speed of 7.15m/s (Class 5) at 28 meters (anemometer height); with a calculated mean speed of 8.0 – 8.2m/s (Class 6) at 50 meters. Measured monthly means are shown on the bar chart below.

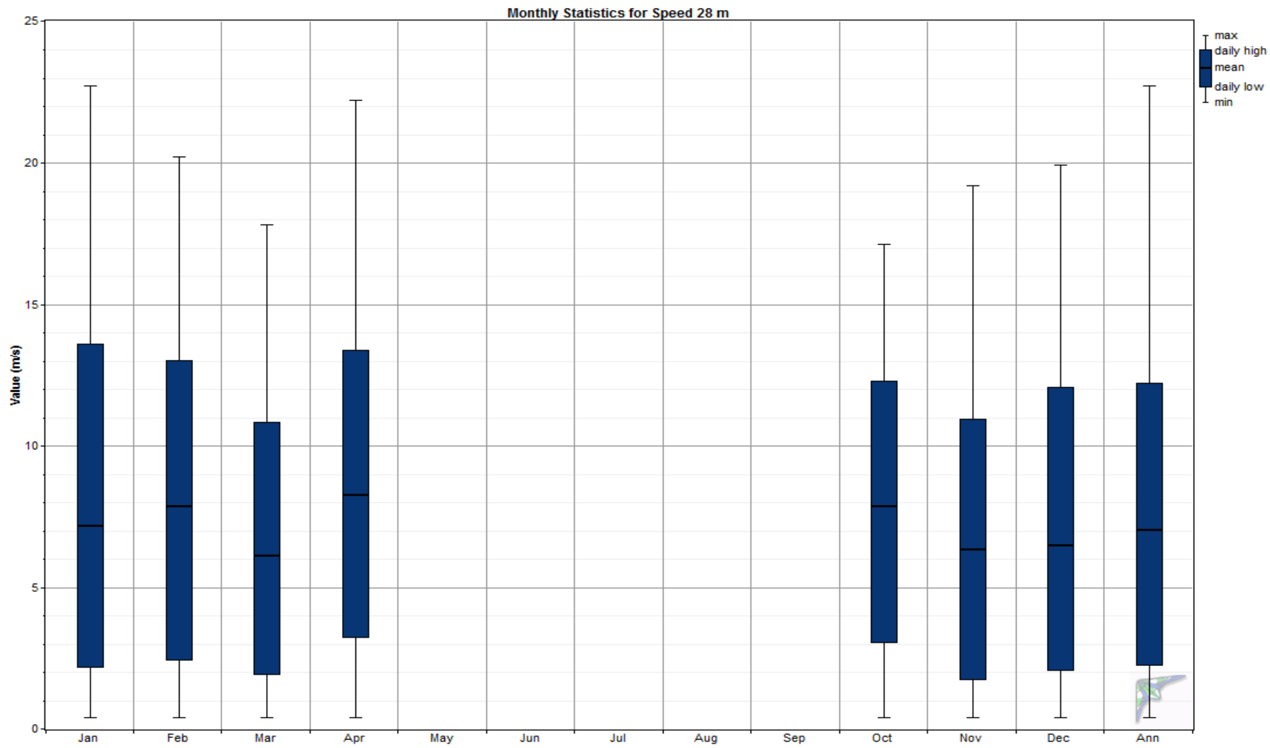

Figure 5 - Monthly wind speed data

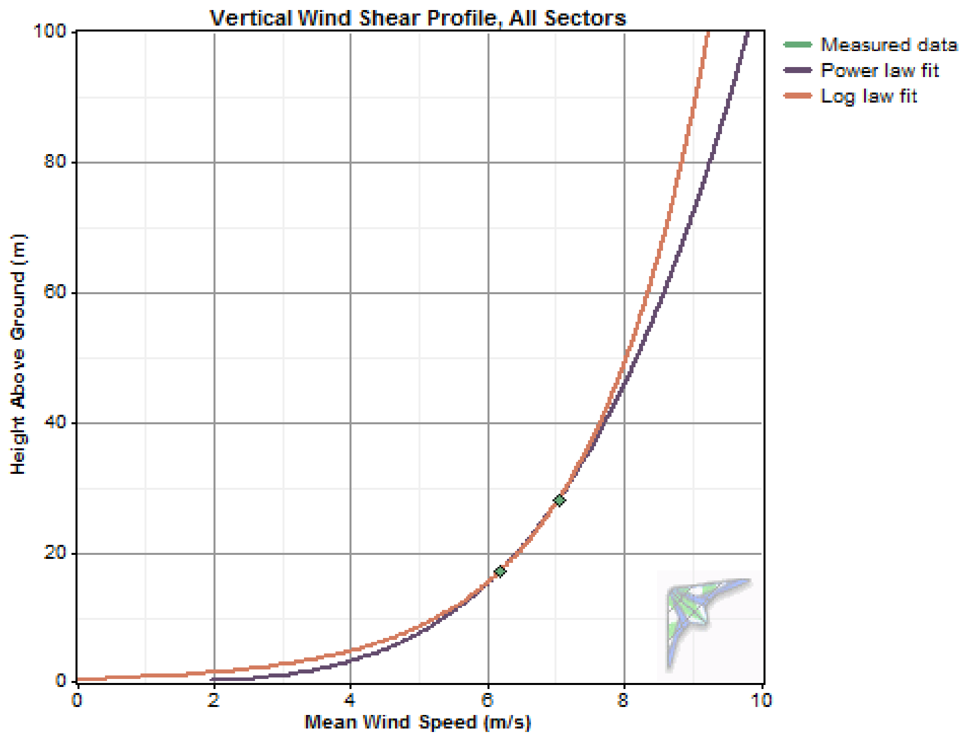

Figure 6 - Wind Shear profile. Power law exponent: 0.262

The primary power winds are out of the south and southeast, as shown on the wind energy rose below.

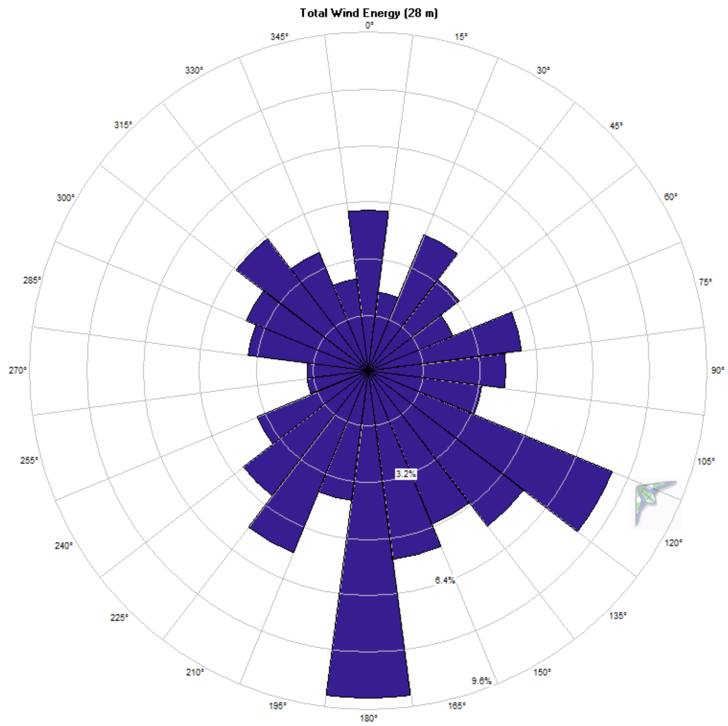

Figure 7 - Wind Energy Rose, showing primary power winds from south and southeast

The data also show high turbulence intensity, which must be fully evaluated during turbine selection and siting. Overall classification in accordance with International Electrotechnical Commission (IEC) Standard 61400-1 [2005] is turbulence Class A, with an average turbulence intensity at 15m/s of 0.155. The following graph shows the turbulence intensity of different segments of the wind resource, including several sectors that are above the Class A limit of 0.16. Figures 8 and 9 illustrate the turbulence intensity from all directions, and both indicate that turbulence is highest with north-east, south, and southwest winds.

The 50-year maximum 10-minute mean wind speed is estimated at 31.1m/s, with a 50-year maximum gust of 87.4 m/s, using the Gumbel distribution function.

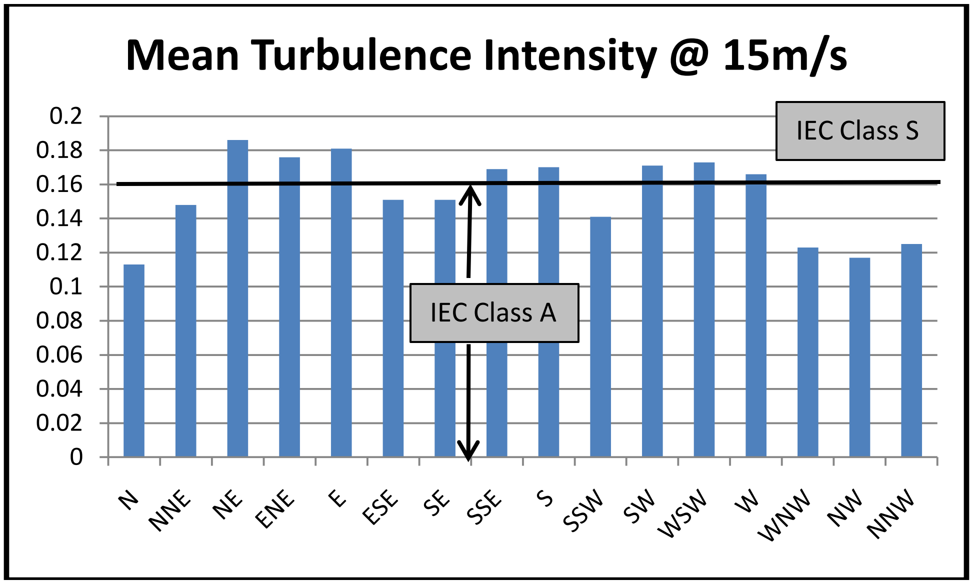

Figure 8 - Mean turbulence Intensity at 15m/s wind speed by direction

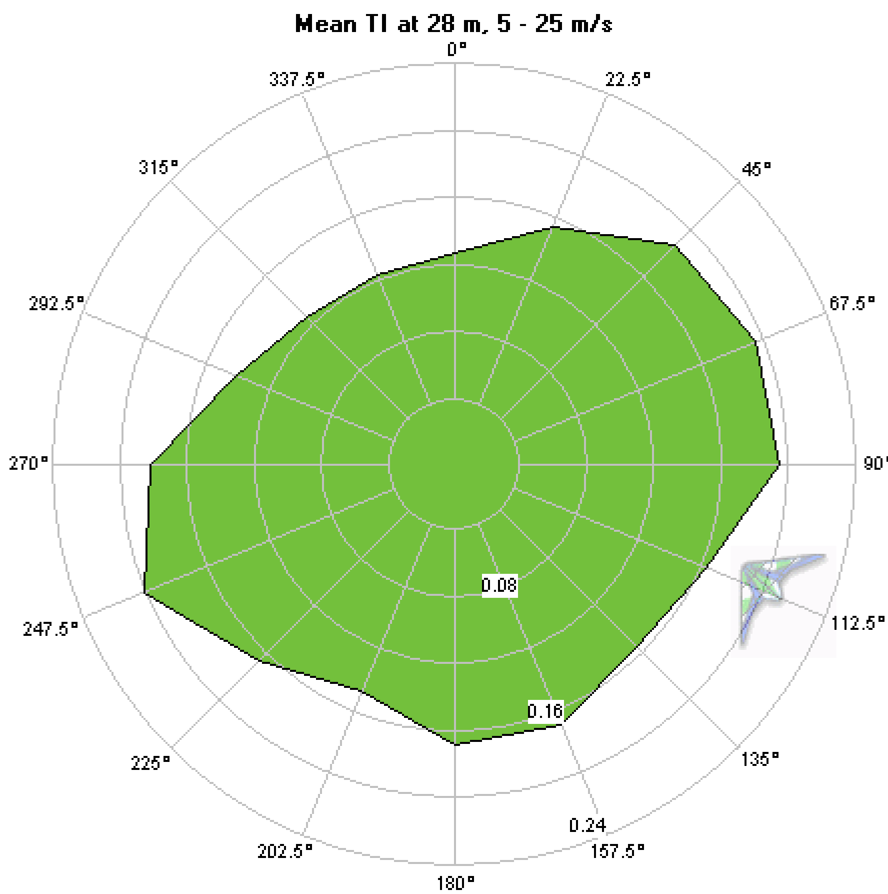

Figure 9 - Mean turbulence Intensity at 5-25m/s wind speed

Figure 10 shows the representative turbulence intensity as a function of wind speed. Relative to the IEC category standards, the measured turbulence in Adak increases with increasing wind speeds. This phenomenon may be due to a flow separation or vortex, likely caused by nearby topography such as a ridge or other terrain feature. As wind speed increases, the size of the vortex would increase and encompass the wind sensors.

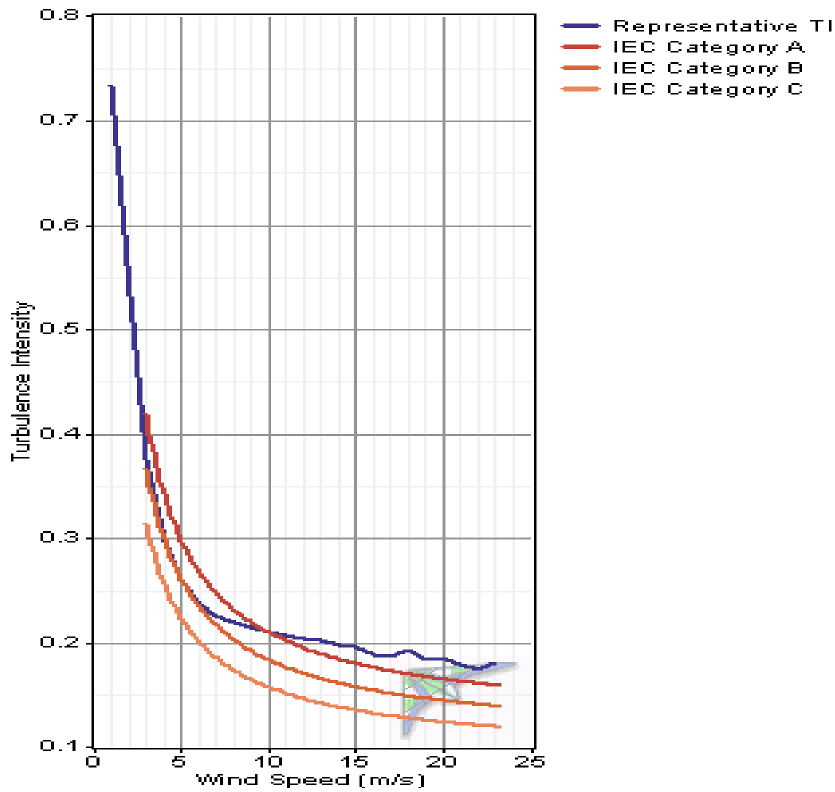

Figure 10 – Measured turbulence intensity as a function of wind speed. IEC turbine categories A B and C shown for reference

Turbine Siting

Based on the early wind study results, turbine siting should be selected with an emphasis on minimizing turbulence. Increased hub height or a turbine site further from significant terrain features would likely result in a higher energy yield, as well as lower terrain-induced turbulence. A location east or north east of the existing anemometer tower is recommended. However, a site visit would be required to confirm siting. Computational fluid dynamic modeling of topography and wind turbulence is recommended and additional wind measurements may be required at the new site to confirm modeling results.

Load Profile

The village electrical load profile was synthesized, since actual load data is generally unreliable and limited to mean daily values. The hourly load profile shape was created by scaling the load profile of similarly sized rural Alaskan communities to match Adak's annual electrical generation. The resulting profile has a load factor of 45%. Adak's actual load profile may vary significantly from this synthesized profile, and should be verified during further engineering studies.

The electrical load in Adak generally follows the same seasonal variation as other rural Alaskan communities – higher demand during winter, lower in the summer. However, the local fish processing facility operates seasonally and drastically alters that load during the two month peak season – February and March. The fish plant load is estimated based on information from the operator.

ESTIMATED ENERGY YIELD

Annual estimates of wind generated electricity were prepared for three cases. Cases A and B were designed to minimize complexity and therefore upfront capital costs. Case C shows the potential benefits of a project with a higher fraction of renewables, but also carries additional complication and grid integration costs.

- Case "A" is a single 100kW wind turbine, in conjunction with the existing array of diesel generator sets.
- Case "B" is a single 225kW wind turbine, in conjunction with the existing array of diesel generator sets.
- Case "C" is either a single 500kW wind turbine, or a combination of smaller turbines totaling 500kW, in conjunction with the existing diesel generator sets.

A performance comparison of these three cases is shown in the following table. The data shown in this table are based on preliminary estimates of both annual wind power generation, and annual electrical demand of 1.5 – 2.5 million kWh. Many factors discovered during further engineering studies may significantly alter the results.

Preliminary Annual Wind-Diesel Performance Estimates				
Case	**Wind turbine size**	**Annual yield wind only**	**Auxiliary Loads Electricity**	**Renewables Fraction (of primary load)**
	[kW]	[kWh]	[kWh]	[%]
A	100	255,000	40,000 [16%]	9%
B	225	630,000	180,000 [29%]	19%
C	500	1,285,000	600,000 [47%]	28%

Figure 11 - Wind turbine sizing options

In Case A, the rated turbine output only rarely approaches the synthesized village load, and therefore nearly all power is used to cover the normal (primary) load. In the case of larger turbines, more energy is used in secondary, auxiliary loads. Generally, electricity used for secondary loads is less valuable than that portion used for primary loads. Therefore, minimizing electricity used for auxiliary loads is likely to maximize the return on investment.

The school is a primary target for auxiliary loads due to its large size, location in the main district in town, and its many uses, including as health clinic and community building.

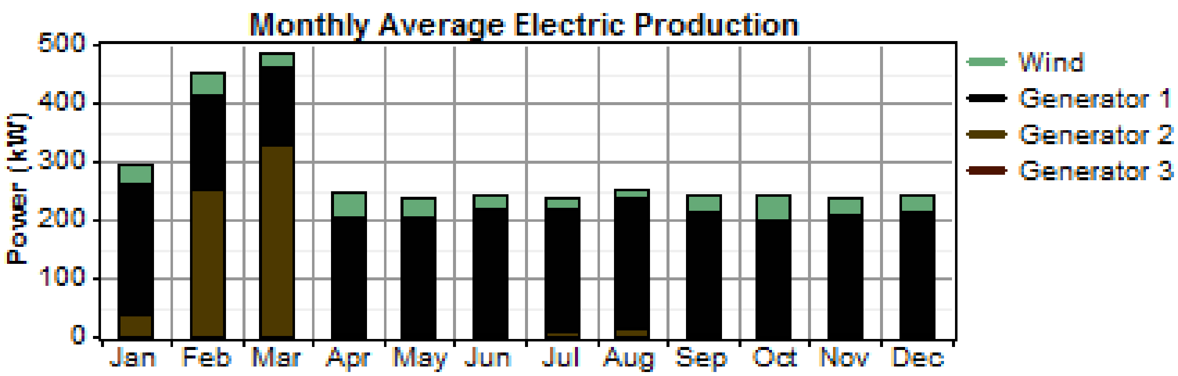

Figure 12 - Case "A" - Monthly generation from 100kW wind turbine

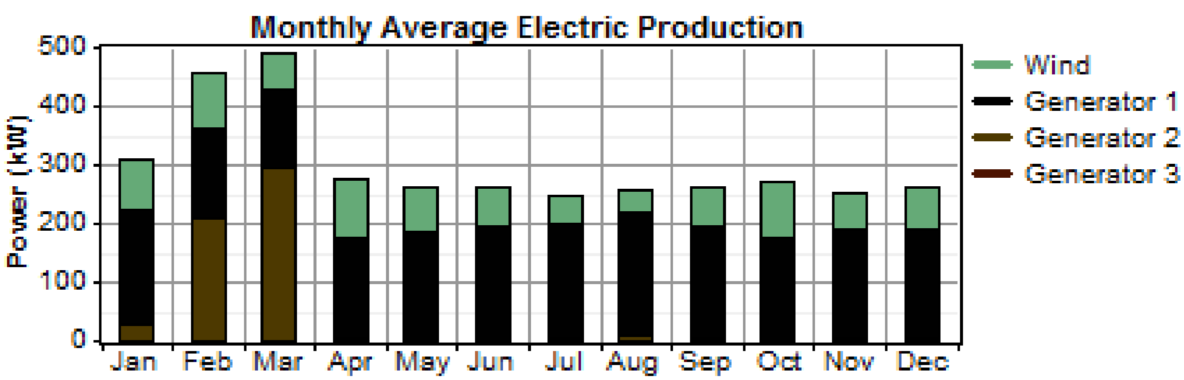

Figure 13 - Case "B" - Monthly generation from 225kW wind turbine

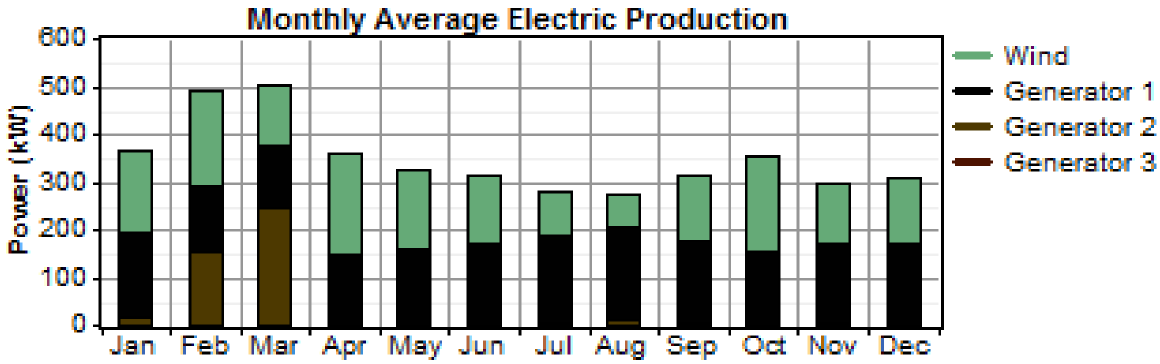

Figure 14 - Case "C" - Monthly generation from 500kW wind turbine

EXISTING INFRASTRUCTURE, INTEGRATION AND LOAD MATCHING

Utility scale wind development on Adak will require integration with the utility's generation and switching equipment. The existing power system was designed and built by the US Navy for a population of up to 6000 residents. The entire system – generation, switching, and distribution – is both grossly oversized for the existing load and in need of extensive renewal or replacement. An analysis of the integration should consider the utility's future plans for generation, switching and distribution repair or replacement. Preliminary options include full power plant replacement or relocation.

Construction of a wind energy project on Adak is not recommended without an upgraded or replaced diesel power plant that allows seamless integration and automatic switching of the wind turbine(s) and diesel gensets. A smaller diesel generator set will be required in order to maximize fuel savings.

It is likely that little or no distribution wiring will be required to connect a wind project to the grid, although the existing infrastructure would need to be evaluated for condition and reuse.

PERMITTING, LEGAL & REGULATORY

The major permitting hurdles expected in Adak are:

- Migratory and/or endangered birds;
- FAA approval
- Existing Hazardous waste (US Navy)

Further discussion of permitting and land use issues can be found in Appendix C.

Based on TDX's recent wind development experience within a Regulated Utility service area, the Regulatory Commission of Alaska is supportive of renewables development, whether owned by the utility, or a third party, if the cost of power is less than the utility's "avoided costs" – i.e. fuel costs. Nonetheless, the approval process for a special contract (power purchase agreement) can take 6 months, assuming no major hurdles are encountered. It is recommended that regulatory approval is obtained prior to construction of the project.

PROJECT DEVELOPMENT TIMELINE AND COST SCHEDULE: LICENSING, DESIGN, CONSTRUCTION; $/KWH

Development of a utility scale wind project on Adak would likely take 3 years, once an appropriate diesel power plant is built. This timeline includes engineering, permitting, procurement and installation. Regulatory approval, barge schedules, turbine and crane availability are all critical pieces that will affect this schedule.

Phase	Begin (Month)	End (Month)
Design replacement power plant with appropriately sized gensets	1	4
Build replacement power plant with appropriately sized gensets	5	12
Initial Engineering and Turbine Selection	13	3
Detailed Engineering	15	18
Permitting	15	18
Turbine Order	18	24
Turbine Delivery and Procurement of other materials	24	30
Shipping – materials and equipment	30	36
Installation	36	42
Startup & Commissioning	42	44

Figure 15 - Diesel and wind project development timeline

The University of Alaska Anchorage's Institute of Social and Economic Research (ISER) conducted a state-wide study of wind-diesel systems in 2010 called "Wind Diesel Systems in Alaska: A Preliminary Analysis," found here: http://www.iser.uaa.alaska.edu/Publications/researchsumm/wind-diesel_summary.pdf. The ISER study found wind development costs to be $4,000 - $15,000 per kW installed capacity. Larger sized projects tend to have somewhat lower prices due to economies of scale associated with the turbine installation. However, control and communication system complexity and price increases with turbine capacity, which can cancel out this decreasing price trend. Based on this finding and local conditions, project costs for Adak's Cases A, B, and C are assumed to be $6,000/kW.

The 'Diesel Saved' calculation assumes a diesel genset efficiency of 13kWh/gallon, which is reasonable once appropriately sized generator sets are installed that can operate efficiently down to partial load settings. The calculation also assumes that all 'auxiliary' loads provide useful heat to offset oil-fired boilers or furnaces, assumed to have a burner efficiency of 75%.

	Case A 100kW	Case B 225kW	Case C 500kW
Total Construction Cost	$600,000	$1,350,000	$3,000,000
Annual Diesel Saved (gallons)*	17,800	40,500	72,200

*Includes both diesel savings at power plant and heating oil savings from auxiliary loads.

Figure 16 - Construction cost and annual diesel savings estimates for wind project options

Assumptions

Assumptions and sources of error in this report include the following:

- Wind resource data has only been collected for 6 months. The study is ongoing.
- Detailed electrical load data is not available, and was synthesized to allow energy modeling. Actual load data may vary significantly from the synthesized data. The utility's recent addition of Icicle Seafoods processing plant to the electrical load will drastically change the utility's load profile. The plant load is currently unknown.
- Cost data is based on industry trends. Each specific component was not priced.

Conclusions – Wind Study

The wind study shows an energetic but turbulent wind resource at the current anemometer location. Successful wind development will hinge on proper siting, sizing, and turbine selection to minimize turbulence and maximize energy yield and revenue.

Next Steps – Wind Study

The next step is a more detailed wind study that addresses technical feasibility of wind power development, and should include the following tasks:

- Gather wind data from one complete year (through October 2011)
- Locate alternative turbine sites and evaluate turbulence and energy yield

- Investigate costs and benefits of high vs. low/modest wind power fractions relative to the electrical load, i.e. what size turbine would be appropriate.
- Identify potential auxiliary loads
- Continue to coordinate with utility operators regarding integration requirements and future plans.
- Refine project cost estimates

APPENDIX A

TDX Power
Adak Reconnaissance Study

Final Report

Prepared for:
TDX Power
Anchorage, Alaska

July, 2011

HATCH™

ISO 9001

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Terms, Acronyms, and Abbreviations

TERM	MEANING
AEA	Alaska Energy Authority
BTU	British Thermal Unit
cfs	Cubic feet per second
cyd	Cubic yards
ea	Each
FERC	Federal Energy Regulatory Commission
gal	Gallon
gpd	Gallons per day
gpm	Gallons per minute
HDPE	High density polyethylene
ID	Inside diameter
kVA	Kilo Volt-Amps
kW	Kilo Watt (1000 Watts)
kWh	Kilo Watt-hours
lb	Pound
mgd	Million gallons per day
mi	Mile
mmBTU	1 million BTU's
mo	Month
O&M	Operation and Maintenance
OD	Outside Diameter
SDR	Sidewall Diameter Ratio
sq ft	Square feet
sq mi	Square miles
sq yd	Square yard
TDX	Tanadgusix Corporation
TDX Power	Subsidiary of TDX, owner and operator of regulated utilities in Sand Point, Manley, Adak, and Prudhoe Bay.
USGS	United States Geological Survey

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1. Introduction

TDX Power is evaluating renewable energy options for the city of Adak, Alaska and has tasked Hatch with a reconnaissance level study of the hydroelectric possibilities. The general purpose of this report is to identify potential hydroelectric developments, make a general assessment about economic viability of a project, and report on existing information and issues that need additional work if it is determined that a hydroelectric project may be feasible.

It has been found that there are numerous hydroelectric generation possibilities on the island of Adak. This report identifies the different potential projects and performs a high level comparison of the options. While this report includes a brief analysis of the most likely option, most of the options should be vetted further before making a recommendation for future development.

The scope for this report is a desktop study to primarily analyze hydrology information and investigate hydroelectric potential using existing data. Included in the scope is an estimate of the energy available from the options with a matrix comparing cost and other factors. Finally, a preliminary calculation of storage utilization, useful energy, economic benefit, and range of cost is provided for a selected project.

1.1 Community Overview

Current Population: 326 (2010 U.S. Census Population)
Pronunciation/Other Names: (A-dack); formerly Adak Station
Incorporation Type: 2nd Class City
Borough Located In: Unorganized
School District: Aleutian Region Schools
Regional Native Corporation: Aleut Corporation
The community incorporated as a second-class city in April 2001.

1.1.1 Location:

Adak is the southern-most community in Alaska, on the latitude of Vancouver Island in Canada. The former Navy Air Facility Adak is located off the Alaskan mainland near the center of the Aleutian chain, approximately 1,200 miles west-southwest of Anchorage, Alaska. Flight time to Anchorage is three hours. Adak Island's coordinates are latitude 51°53'0" N, at longitude 176° 38'46" W. The Bering Sea surrounds the island to the north and the Pacific Ocean to the south. Adak is located in the Aleutian Islands Recording District. The area encompasses 122.4 sq. miles of land and 4.9 sq. miles of water.

1.1.2 History

The first inhabitants of Adak Island were the Aleuts. Archaeological evidence reflects occupation as early as 9,000 years ago. The Aleuts hunted whales, seals, otters and sea lions, as well as island birds, and fished Adak's freshwater streams and the surrounding seas. They lived in large, communal, subterranean structures of grass and earth built over driftwood or whalebone frames. The Aleuts developed technologies such as sophisticated kayaks and waterproof clothing to deal with the cool marine environment. Aleut settlements were often located in coves along freshwater streams. Remnants of prehistoric Aleut settlements remain on Adak today.

Russians first visited the Aleutian Islands in the early 1740s and were trading with the Aleuts by the 1750s. As recently as 1827, Adak was a busy trading settlement with a population of 193 Aleuts. By 1830, Russian settlers had occupied Adak and relocated the Aleuts to Russian settlements in Kodiak, the Pribilof Islands, and Sitka. Adak Island became part of the Alaska Territory, which was subsequently purchased from Russia by the United States in 1867. Even after the permanent Aleut villages were abandoned, seasonal and subsistence use of the island continued. By 1910, over hunting by outsiders had nearly depleted the once-abundant sea otter and fur seal populations. In 1913, Adak Island was included in the 2.9-million-acre Aleutian Islands National Wildlife Refuge (renamed the Alaska Maritime National Wildlife Refuge in 1980) established by the President. This refuge was set aside as a preserve and breeding ground for native birds and fur-bearing animals and as an important fisheries habitat. Seasonal and subsistence use of the island by the Aleuts continued up until the time of World War II, when Aleuts in the island chain were evacuated to internment camps.

1.1.3 Military Uses of Adak

Since the early 1940s, the northern half of Adak Island has been used for military operations. During World War II, Adak Island became the site of a military base operated by the Army Air Corps for defensive action against Japanese forces occupying Attu and Kiska Islands in the Aleutian chain. In the spring of 1944, Adak's population included at least 32,000 military personnel. In preparation for a major offensive on the Japanese-occupied islands of Kiska and Attu, as many of 90,000 troops on ship or shore were mobilized to the Aleutian arena. Since the war, the military presence on Adak has fluctuated, depending on United States defense policy and federal appropriations, and has generally not exceeded 6,000 persons.

After the war, the base was transferred to the U.S. Air Force (renamed Davis Air Force Base) and, according to Army Corps of Engineers records, encompassed all of Adak Island. The U.S. Air Force withdrew from Adak in 1950, and the Navy assumed all facilities on Adak Island. In 1953, only 15 officers and fewer than 200 enlisted men were assigned to the base. In 1959, Public Land Order No. 1949 withdrew land described as representing approximately 61,000 acres (the resurveyed land mass is 79,200 acres) of Adak Island (approximately the northern half) for use by the Navy.

By 1966, military and civilian personnel totalled almost 1,000, a number that stayed fairly steady through the 1970s. By 1981, the population had doubled by 2,000. In 1984, the Adak Naval Station was renamed Naval Air Station (NAS) Adak. By 1990, over 5,000 people were at the base, almost 3,000 of whom were military, the remainder composed of military dependents and civilian employees. In 1994, NAS Adak was designated as Naval Air Facility (NAF) Adak. As of February 1996, following military draw down and closure of Naval Security Guard Activity (NSGA), approximately 500 military and 50 civilian personnel were stationed on Adak. Subsequent to its listing under Base Realignment and Closure in July 1995, the military mission at Adak was ended on March 31, 1997. The Aleut Corporation purchased Adak's facilities under a land transfer agreement with the Department of the Interior and the U.S. Navy/Department of Defense. This agreement was finalized in March, 2004.

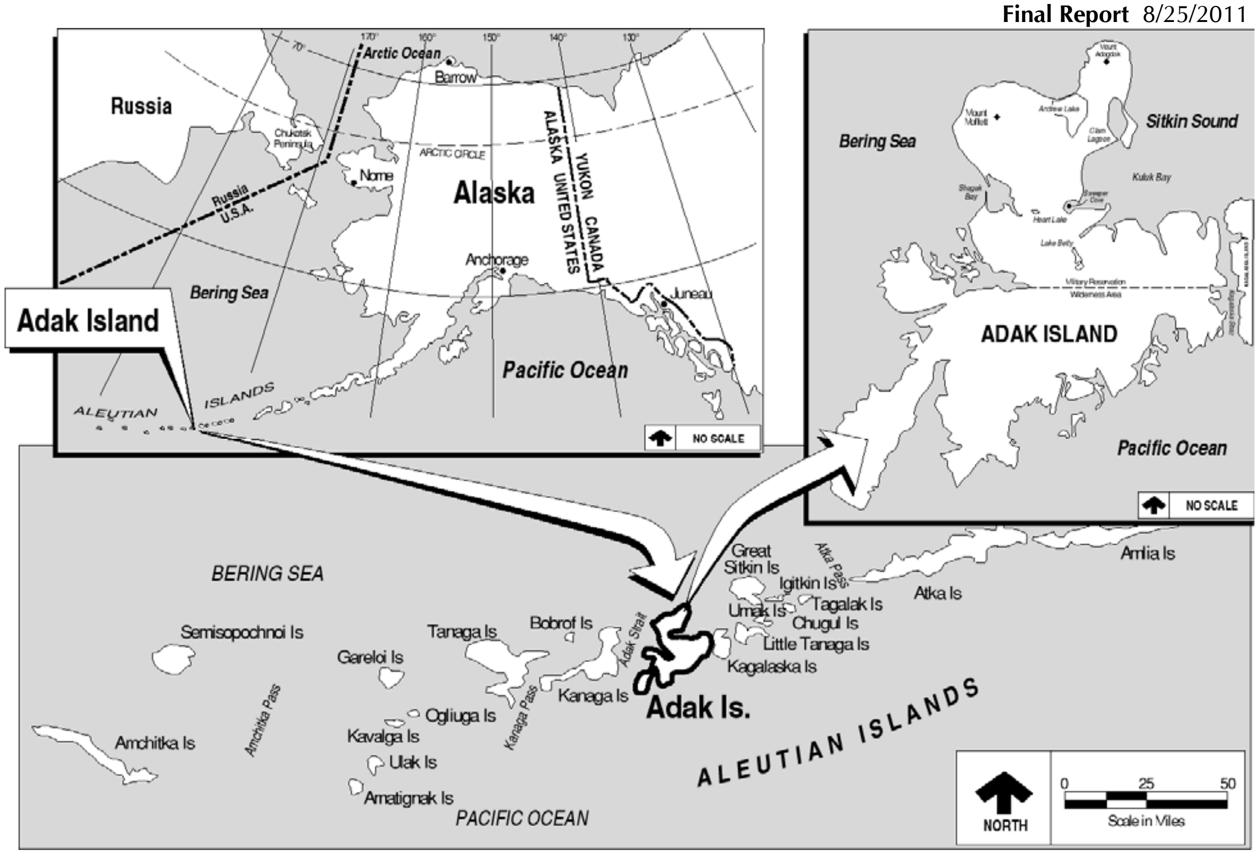

Figure 1 – Adak Location

1.1.4 Climate:

The maritime climate on Adak is characterized by persistently overcast skies, high winds, and frequent, often violent, cyclonic storms originating in the northern Pacific Ocean and Bering Sea. Weather can be localized, with fog, low ceilings, precipitation, and clear weather all occurring within a distance of a few miles. Storms can occur during any season, although the most frequent and severe storms occur during the winter.

Mean annual precipitation for Adak Island is about 66 inches, most of which falls as rain. Average monthly precipitation varies from a low of 3 inches in June and July to a high of 7 to 8 inches in November and December. Snowfall averages over 100 inches per year. Because of the relatively warm temperatures, snow rarely exceeds 1 to 2 feet in depth and is concentrated in the mountains.

Mean monthly temperatures vary from a low of 32.9° F in February to a high of 51.3° in August. The highest temperature recorded on Adak is 75° F (August 1956), and the lowest temperature is 3 degrees F, recorded in January 1963 and February 1964.

1.1.5 Land Ownership:

A land exchange between Aleut Corp., the U.S. Navy, and the Department of the Interior has transferred most of the naval facilities to the Aleut Corporation. A portion of the island remains within the national Maritime National Wildlife Refuge, managed by the U.S. Fish & Wildlife Service.

1.1.6 Facilities:

After World War II, the U.S. Navy developed facilities and recreation opportunities at Adak. A movie theater, roller skating rink, swimming pools, ski lodge, bowling alleys, skeet range, auto hobby shop, photo lab, and racquetball and tennis courts were developed. An $18-million hospital was built in 1990. As of 2009, all of these facilities are closed.

Substantially all of the infrastructure and facilities on Adak are owned by Aleut Corporation, who is currently developing Adak as a commercial center via their subsidiary companies. The former base has two areas with extensive development. The first is the "downtown" area of Adak, where NAF was located and which includes the airfield, port facilities, landfills, sewage treatment facilities, light industrial, administration, commercial, recreational, and residential areas. The second main developed area, formerly used by NSGA, includes the northern part of the island and areas around Clam Lagoon. The NSGA area is no longer used.

Water is derived from Lake Bonnie Rose, Lake De Marie, and Nurses Creek, stored in any of the seven water tanks throughout the community, and piped to facilities and housing units. The wastewater treatment system discharges through a marine outfall line to Kuluk Bay. Husky Road landfill is a class III permitted landfill.

Adak provides a fueling port and crew transfer facility for fishing fleets, and an airport, docks, housing facilities, restaurant, grocery store, and ship supply store are available. The seafood processing facility can process about 500,000 pounds of fish per day. In 2010, two residents held commercial fishing permits.

Adak Airport is a State of Alaska owned & maintained certificated airport. It has two asphalt paved runways; one measures 7,790' long by 200' wide, and the other runway measures 7,605' by 200' wide. Alaska Airlines operates passenger and cargo jet service. There are three deep water docks and fueling facilities. In 2009, the city was in the process of expanding the Sweeper Cove small boat harbor to include new breakwaters, a 315' dock, and new moorage floats. Adak has approximately 16 miles of paved roads, as well as gravel and dirt roads.

1.2 Previous Hydroelectric Studies

A previous study by Ebasco Services Inc. (Ebasco, 1980) looked at four sites:

- Sites 1 and 2 - run of river sites located on the west side of Mt. Moffett (not included in this report).
- Site 3 - Lake Bonnie Rose to Lake De Marie.
- Site 4 - Lake Betty to tidewater.

The reported states "Sites does not have economic hydropower development potential." It also noted that there were environmental concerns with salmon migration in streams with hydropower potential.

Information provided for sites 3 and 4 include the following:

Site	3	4
Intake Location	Lake Bonnie Rose	Lake Betty
Powerhouse Location	Lake De Marie	Tidewater
Average Annual Streamflow (cfs)	14.8	12.8
Total Head (feet)	200	200
Net Head (feet)	180	180
Installed Capacity (kW)	192	166

No other studies investigating hydroelectric potential in Adak have been found.

2. Geography

Adak Island was formed by extreme geologic events, including the tectonic collision of large sections (plates) of the earth's crust and resulting volcanic eruptions. Advancing and receding glaciers, frequent rainfall, and high winds have shaped Adak Island into a dramatic landscape of hills, valleys, cliffs, and floodplains. Very few areas of the island are flat, and grading to create flat areas could not be done easily.

The highest point on Adak Island is Mt. Moffett (elevation approximately 3,875 feet). Some coastal cliffs on the island rise 2,500 feet above sea level.

Island maps used in this report were developed from NASA's shuttle radar topography mission (SRTM) and from the USGS topographic map for Adak. Portions of higher quality topographic maps based off 1:50,000 scale U.S. Defense Mapping Agency maps of Adak (updated in 1974) were made available for use in preparing this report but authorization to reproduce them herein was not obtained. The following Figure shows the general topography and features of the island.

Figure 2 – Adak Topography

The upland topography of Adak is typical of the Aleutian Islands with rolling, steep terrain, volcanic features, and shallow, but often sharp crested, stream valleys. The vegetation primarily consists of grass with no trees or shrubs. Some exposed bedrock and areas of eroding volcanic soils can be found.

Several large lakes are formed in what are likely glacial carved depressions. These are primary candidates for hydropower development. The table below summarizes the lakes in the vicinity of the developed area of Adak.

Table 1 – Lake Summary

Sources	Elevation, ft	Basin Area (at outlet), sq mi	Surface Area, acres
Lake Bonnie Rose	739	1.55	139.2
Lake De Marie	234	3.59	86.7
Heart Lake	153	4.18	36.4
Lake Betty	159	4.43	136.6
Lake Leone	113	0.88	78.3
Mitt Lake	45	0.78	12.4

3. Geology

Adak Island was created during the last 60 million years by a complex set of geologic processes resulting from the collision of the North American and Pacific crustal plates. The resulting rock sequences consist primarily of volcanic rocks with some sedimentary rock. A relatively thin layer of unconsolidated material (generally less than 10 feet think) covers the entire island. Only the downtown area is known to have a thick sequence of unconsolidated material (greater than 100 feet). The northern region of Adak is dominated by the remnants of three volcanoes.

Throughout most of the project area, a 2 to 3 meter thick mantle of tephra blankets other surficial deposits and bedrock. A 1995 geologic map for the area indicates bedrock and tephra deposits in the area around Lake Bonnie Rose and Mitt Lake. The following is reported about the surficial deposits and bedrock in Adak (Waythomas, 1995):

> *Tephra deposits are usually 1.5 to 3.0 m thick and consist of thin beds of fine grained (mostly silt and clay size particles) ash and 3 to 5 beds of lapilli-sized (2-64 rnm) tephra. Locally interbedded with peat. Many of the ash layers are weathered to clay. Somewhat porous, but permeability is limited by fine particle size. Lapilli beds are more porous and permeable than the fine grained tephra layers. Locally water bearing, especially in low-lying areas.*
>
> *Areas of bedrock may include minor amounts of talus and colluviurn. In areas away from Mount Moffett and Mount Adagdak, most of the bedrock consists of Finger Bay Volcanics (Coats, 1956). These rocks are extensively fractured and faulted, and locally exhibit some weathering. Zones of bedrock where fracture density is high may be porous and permeable and may be water bearing.*

4. Site Control

Land ownership and use has not been investigated as part of this study. All of the projects considered in this report are located outside the US Fish and Wildlife Refuge boundary and are presumably entirely owned by the Aleut Corporation.

5. Environmental and Aquatic Resources

This report does not address in any detail the potential environmental impacts of the projects considered. A review of the ADF&G's catalog of anadromous habitat indicates that all of the project options are located on streams that have anadromous fish in their lower reaches. Approximate habitat locations based off the catalog are as follows:

- Lake Bonnie Rose – Lake De Marie - Heart Lake drainage: The upper limit of anadromous habitat is estimated at about elevation 100', reach about 1000' long.

- Lake Leone: The upper limit of anadromous habitat is estimated at elevation 60', reach about 630' long.
- Lake Betty: The upper limit of anadromous habitat is estimated at elevation 30', reach about 2200' long.
- Mt Reed Creek: The upper limit of anadromous habitat is estimated at elevation 250', reach about 1300' long (note: average gradient ~20%).
- Mt Moffett Creek: The upper limit of anadromous habitat is estimated at elevation 20', reach about 1500' long.

It is possible that the catalog is not entirely accurate with some reaches shorter or longer than stated. Also, the areas of habitat, wetted perimeter at various flows, slope, bed material, and usage by species would need to be investigated before making any conclusions about whether modification of flow regimes may have an impact to the aquatic resources.

A potential concern with excavation for installation of pipelines and foundation structures is the presence of contaminated sites and unexploded ordinance. Extensive information regarding site assessment and cleanup activities is available at the environmental cleanup and closure of the former Naval Air Facility, Adak, Alaska website (http://www.adakupdate.com/).

Water quality may be a concern in the design of pipe works and intake equipment. A report on the water system (Bristol, 2010) indicates that the water from Lake Bonnie Rose is "aggressive" with a low pH and a high amount of dissolved oxygen. Cathodic protection is strongly recommended for the water system.

6. Existing Infrastructure

6.1 Existing Generation

Power production data was provided by TDX for 2009 and 2010. This data consists of total monthly energy produced, total fuel used, and average power. Some anomalies exist in the reporting and for this report only the total monthly energy data is used. TDX Power supplied a synthesized hourly load data set for a single year based off this monthly data. This data is shown in the following figure.

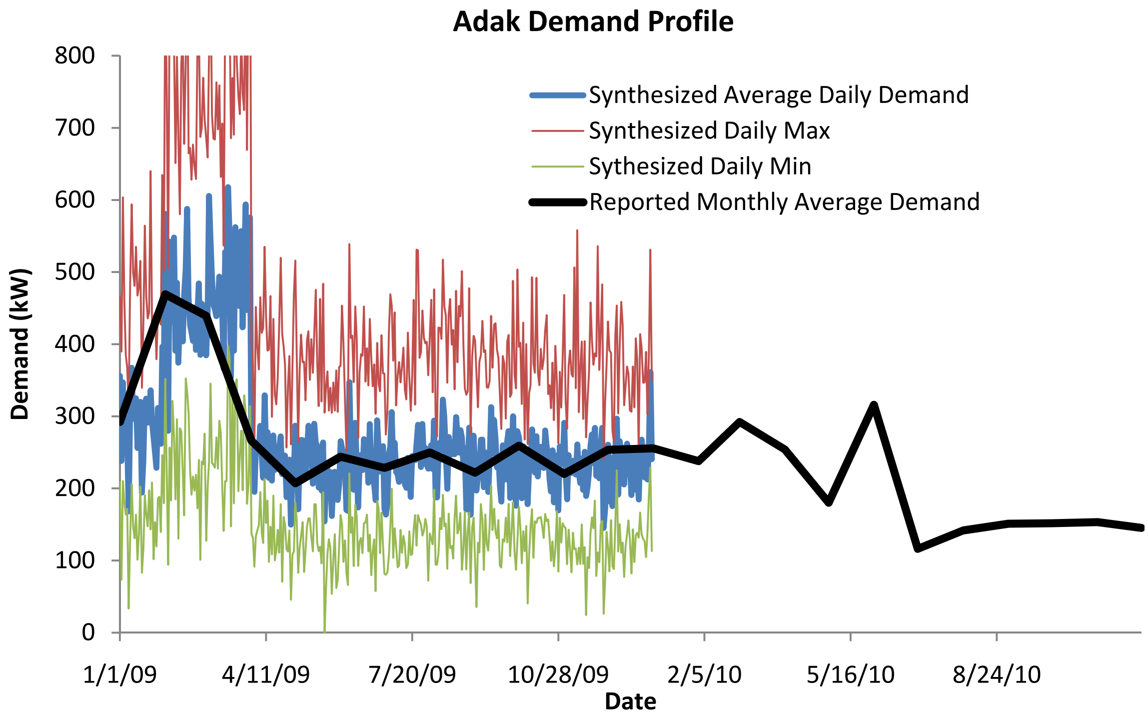

Figure 3 - Adak Demand Profile

From the limited data provided it appears that significant, sustained load changes may be occurring consisting of large jumps down in what is otherwise a flat annual load profile. This lack of consistency and the large magnitude of the changes make it difficult to estimate future loads without additional data from 2011, information on generation planning, and additional monitoring.

The existing generation equipment consists of oversized, for the current load, caterpillar 3516 diesel generators. TDX Power reports that one new high efficiency unit is being installed that will be sized for the current and expected future demand.

6.2 Water System

Lake Bonnie Rose and Lake De Marie have existing dams at their outlets for collection of water. As indicated in the Design Analysis Report for the water system (Bristol, 2010), the current source of raw water is from Lake Bonnie Rose.

There is an existing 10" or 12" pipeline, circa 1990's (Bristol 2010), that brings water from Lake Bonnie Rose to a PRV located at elevation 306' and set to 70 psi (PRV-1). There are numerous tanks and PRV's that serve various distribution areas. Water tank capacity on Adak is 3.7 million gals with 1.9 million gallons in use ("A" and "B" tanks). The Adak system operator has reported that the overflow elevation of tanks A and B is 235.8' and 231.9' respectively.

TDX Power reports, based on a discussion with the City of Adak Public Works Director, that water flow at PRV-1 is about 215 gpm (0.5 cfs). This includes continuous, unmetered overflow at the A-tanks. Actual water use is unknown. Domestic water use is presumed to be 215 gpm in the analysis for the selected hydroelectric power with storage option. Future modifications to the water system suggests construction of a new water treatment plant with design flows of 35 to 70 gpm (Bristol, 2010).

Water use with the fish plant online is estimated, by the public works director, to be up to 800 gpm (1.8 cfs). The water system report (Bristol, 2010) indicates there are plans to convert the fish processing service to raw water supply. No information on the timing or future supply source of this use has been obtained and it is not included in the hydropower analysis.

6.3 Competing Water Uses

The Aleut Corporation has applied to the DEC for the rights to drain water from Lake Bonnie Rose, Lake Betty and Lake De Marie. The reported use for the water is for bulk water export sales. The amount of water requested is up to 500,000 gallons per day (0.77 cfs) from each of the lakes. Since all the water from Lake Bonnie Rose and Lake De Marie, both part of the same drainage system, could be withdrawn from just the lower lake (lake De Marie), the separate requests for withdrawals from Lake Bonnie Rose and Lake De Marie seem to indicate that rapid and large draw down from the lakes is desired. However, there is also a significant amount of water storage tankage connected to both Lake Bonnie Rose and Lake De Marie that may be involved in the bulk water sales.

The method of filling a container vessel in the port, whether through rapid drawdown of the lakes or utilizing the tank system, will determine how hydroelectric operation would be curtailed during the filling process. Future coordination and more information on the bulk water sales plans will be required for determining the economic benefits of the hydroelectric project. The withdrawal of water for bulk water sales is not included in this analysis given the present uncertainty of the venture. It is noted that bulk water sales is not in total conflict with a hydroelectric project and with coordination could be an efficient operation and good partnership.

7. Hydrology

Short, steep-gradient streams draining radially from Mt. Moffett, Mt. Adagdak, and other upland areas characterize the surface water hydrology of the northern portion of Adak Island. Perennial flow is maintained by snowmelt in the mountains and seepage from the shallow surficial soils. Numerous lakes and sediment deposits occur along stream courses.

The USGS has measured stream flows at two locations on Adak Island in addition to numerous sites on Amchitka, two on Shemya, and one at Cold Bay. The following table summarizes the data for these sites.

Table 2 – USGS Stream Gauge Summary

				No. of Records w/ Data		Basin Area	Unit Flow (cfs/mi^2)	
Station ID	**Station Name**	**Begin Date**	**End Date**	**Days**	**Years**	**Sq Mi**	**Avg**	**Med**
15297610	RUSSELL C NR COLD BAY AK[1]	10/1/1981	6/23/2011	7663	21.0	30.9	8.2	6.7
15297617	SWEEPER C AT ADAK IS AK	10/1/1992	4/22/1996	1300	3.6	1.0	4.1	2.7
15297625	MOFFETT C AT ADAK IS AK	10/1/1993	4/22/1996	935	2.6	4.5	6.0	4.9
15297640	LIMPET C ON AMCHITKA IS AK	11/1/1967	9/30/1972	1796	4.9	1.7	3.1	2.1
15297650	FALLS C ON AMCHITKA IS AK	4/1/1968	2/19/1972	1420	3.9	1.0	2.1	1.6
15297655	CLEVENGER C ON AMCHITKA IS AK	4/1/1968	5/23/1974	2244	6.1	0.3	3.8	2.7
15297680	BRIDGE C ON AMCHITKA IS AK	11/1/1967	8/28/1974	2493	6.8	3.0	1.5	0.8
15297690	WHITE ALICE C ON AMCHITKA IS AK	4/1/1968	8/27/1974	2340	6.4	0.8	2.8	2.0
15297767	LK C AT SHEMYA AFB AK	11/21/1970	11/30/1972	741	2.0	1.0	1.8	1.4
15297773	GALLERY C AT SHEMYA AFB AK	11/22/1970	11/30/1972	740	2.0	1.0	0.9	0.8

Note 1: Gauging at Russell Creek was discontinued on 12/31/1986 and restarted on 10/1/1995.

The short data records for the Adak streams, only 3.6 years and 2.6 years for Sweeper Creek and Moffett Creek respectively, present a general concern that an average water year may not be represented. The Russell Creek drainage has data spans 30 years but is missing 9 years from the period 1987 to 1996. There is about a 7 month overlap between the Russell Creek data and the Adak gauges. However, comparison of the two data sets over this short time does not reveal any meaningful comparison regarding year to year variability.

An additional means of identifying adverse water years is through comparing rainfall data with streamflow measurements. The rainfall data for Adak is shown below.

Table 3 – Rainfall Data

ADAK, ALASKA-500026, Monthly Total Precipitation (inches)
File last updated on Oct 22, 2010
*** Note *** Provisional Data *** After Year/Month 199603
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5
Individual Months not used for annual or monthly statistics if more than 5 days are missing.
Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1949	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	6.45	7.30	7.93	12.96	34.64
1950	3.95	2.63	3.39	2.54	3.23	1.35a	2.44	6.42	10.04	5.58	2.54	7.65	51.76
1951	7.57	9.23c	4.65c	6.76g	4.20c	2.15b	3.42	3.22	4.22	10.62	8.65	11.63	69.56
1952	5.00a	5.86b	7.43a	2.48a	5.89a	9.38a	3.43	1.89	4.69	9.82	10.51a	2.54	68.92
1953	9.86	7.22	11.08	7.12	6.47	4.48	0.43a	5.78	5.49	6.41	12.92	4.37	81.63
1954	6.01	6.96	7.97a	2.44	16.10	5.62	4.79	4.59	7.75	6.79	6.12	13.78	88.92
1955	17.34	5.88	4.13	4.75	5.45a	3.20	5.11	2.33	4.80a	12.52a	11.66	13.47	90.64
1956	3.92	6.95	11.99	5.01a	6.82a	4.34	4.38	9.52	10.70	3.38a	5.51	9.46	81.98
1957	12.92	4.40	7.02	9.95	6.05	6.79	1.03b	2.71	5.21	7.10	4.68	8.78	76.64
1958	6.71	2.77	8.31	5.24	5.69	3.74	3.07	1.57	7.47	11.22	11.19	9.61	76.59
1959	3.13	7.15	7.38	3.88	5.25	3.80	2.50	4.44	7.44	7.15	7.23	4.62	63.97
1960	4.35	2.79	2.55	2.31	3.29	1.43	3.04	2.98	2.49	5.31	2.94	3.87	37.35
1961	5.74	2.81	2.33	2.26	2.82	2.97	4.86	2.41	4.74	6.85	7.85	4.90	50.54
1962	5.35	6.44	9.63	1.42	1.68	4.07	2.28	3.95	2.71	8.09	6.14	5.34	57.10
1963	5.30	1.97	8.67	3.79	5.98	3.52	2.17	0.00z	4.50	6.10	6.78	10.16	58.94
1964	4.30	6.10	7.10	6.87	1.12	2.50	2.15	3.68	11.30	5.87	7.12	8.65	66.76
1965	4.80	5.67	5.86	10.17	3.05	3.16	3.88	2.39	5.37	6.66	8.18	6.96	66.15
1966	5.71	8.21	2.57	4.43	5.76	1.36	2.16	6.72	3.76	3.02	11.65	6.72	62.07
1967	7.69	5.05	5.65	4.75	0.64	1.61	6.10	5.28	6.01	7.81	9.59	9.64	69.82
1968	8.89	3.75	3.67	4.99	1.34	1.91	2.37	2.49	3.10	4.95	6.65	8.09	52.20
1969	10.28	5.26	4.28	4.19	3.29	2.04	1.22	4.53	6.77	4.20	7.40	4.17	57.63
1970	6.10	3.76	3.39	6.25	1.55	1.92	2.81	4.75	0.00z	7.83	4.81	0.00z	43.17
1971	3.67	2.07	6.92	3.80	2.54	0.00z	3.41	2.25	6.72	5.47	10.62	0.00z	47.47
1972	6.20	2.93	3.43	2.57	3.01	3.02	2.33	3.78	0.00z	8.71	9.12	0.00z	45.10
1973	2.71	0.00z	6.06	0.00z	2.77	2.95	2.74	5.31	7.83	4.60	8.67	8.01	51.65
1974	5.58	3.78	3.76	5.89	5.37	1.63	4.66	7.34	4.57	3.02	9.89	6.71	62.20
1975	4.03	3.84	5.58	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	7.28	6.48	27.21
1976	3.92o	1.07q	3.89	3.34	2.60	1.55	3.56	3.81	4.56	7.49	3.16o	0.00z	30.80
1977	3.56	3.81	4.85	2.91	3.81	2.68	1.98	4.50	0.00z	6.07	4.98	5.87	45.02
1978	0.00z	4.44	3.99	3.93	3.37	3.17	1.84	2.99	0.00z	6.23	0.00z	8.19	38.15
1979	6.75	4.72	5.53	6.64	0.00z	3.04	2.86	0.00z	4.26	10.01	6.06	6.53	56.40
1980	0.00z	0.00z	6.44	4.36	3.53	3.46	1.68	5.34	4.55	5.66	9.21	5.90	50.13
1981	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00
1982	0.00z	0.00z	0.00z	0.00z	0.00z	3.74	4.92	4.53	6.21	4.08	8.34	4.21	36.03
1983	3.65	4.72	3.03	2.23	1.76	1.70a	2.35	3.60	4.74	7.66	7.34	6.59	49.37
1984	4.97	4.27	0.00z	4.55	2.74	1.67	1.76	0.00z	5.35	4.05	0.00z	6.79	36.15
1985	3.43	2.96a	4.77	3.65	3.71	3.37	1.34	0.00z	4.66	0.00z	0.00z	0.00z	27.89
1986	3.38	3.04	4.17	6.00	3.60	2.22	0.71	0.00z	4.74	0.00z	7.74	0.00z	35.60
1987	0.00z	3.96	0.00z	0.00z	1.92	4.88	0.00z	3.31	0.00z	7.47	0.00z	0.00z	21.54
1988	0.00z	2.80	4.66	2.92	4.43	0.00z	3.57	0.00z	0.00z	6.64	6.22	0.00z	31.24
1989	6.22	2.79	2.96	0.00z	2.76	0.00z	1.28	0.00z	7.34	3.30	0.00z	4.30	30.95

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1990	6.60	3.62a	6.11	1.97	4.36	0.90	2.47	6.20	5.01	2.58	3.10	0.00z	42.92
1991	11.39	1.75	6.94	3.79	3.55	3.48	2.76	2.93	7.12	4.64	0.00z	5.74	54.09
1992	0.00z	4.91	5.63	1.61	1.58	5.37	0.00z	3.42	6.35	6.92	6.14	7.54	49.47
1993	9.35	5.35	4.91	3.61	2.30	3.17	3.89	7.62	4.84	9.81	7.02	4.46	66.33
1994	5.66	6.31	3.84	1.43	2.69	2.87	2.48k	4.89f	3.76h	5.40k	3.38f	4.81k	22.80
1995	1.41k	4.10i	1.38d	3.54a	1.73i	0.67d	1.71c	3.45a	7.38f	6.32e	2.69	7.00g	19.76
1996	3.57f	3.51f	4.98g	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00z	0.00
1997 to	2010	No	Data										
MEAN	6.27	4.57	5.43	4.19	3.86	3.09	2.82	4.22	5.78	6.56	7.43	7.28	65.65
S.D.	3.05	1.81	2.34	2.05	2.53	1.66	1.30	1.79	2.01	2.30	2.55	2.80	13.77
SKEW	1.69	0.55	0.81	1.14	2.81	1.52	0.47	0.93	0.99	0.46	0.00	0.71	0.05
MAX	17.34	9.23	11.99	10.17	16.10	9.38	6.10	9.52	11.30	12.52	12.92	13.78	90.64
MIN	2.71	1.75	1.38	1.42	0.64	0.67	0.43	1.57	2.49	2.58	2.54	2.54	37.35
NO YRS	37	40	42	39	41	41	41	36	37	42	38	35	21

The lack of significant overlap between the rainfall data and Russell Creek, Sweeper Creek, and Moffett Creek prevents using the rainfall record for an evaluation of year to year variability in the streamflow records. However, a limited comparison can be made on a monthly basis. There appears to be a general lack of deviation in the observed rainfall and runoff measurements compared with the long term mean rainfall. Based on this limited comparison and the general lack of data, it is concluded that the measured runoff at Sweeper Creek and Moffett Creek are generally representative of long term average runoff quantities and patterns.

The two Adak sites, despite being only 4 miles apart, exhibit significantly different runoff characteristics. The typical annual runoff profile from Moffett Creek is has peaks and valleys inverted from that of Sweeper Creek. During the summer months Moffett Creek has higher unit runoff than during the winter months. Sweeper Creek is the opposite with higher runoff rates in the winter than in the summer. Moffett Creek also exhibits a higher amount of unit runoff overall on an annual basis.

A review of the other USGS gauged drainages along the Aleutian Islands and Alaska Peninsula exhibit a similar trend with Russell Creek having a significantly higher unit runoff and all of the remaining sites exhibiting runoff similar to Sweeper Creek. This dichotomy is illustrated in the following chart.

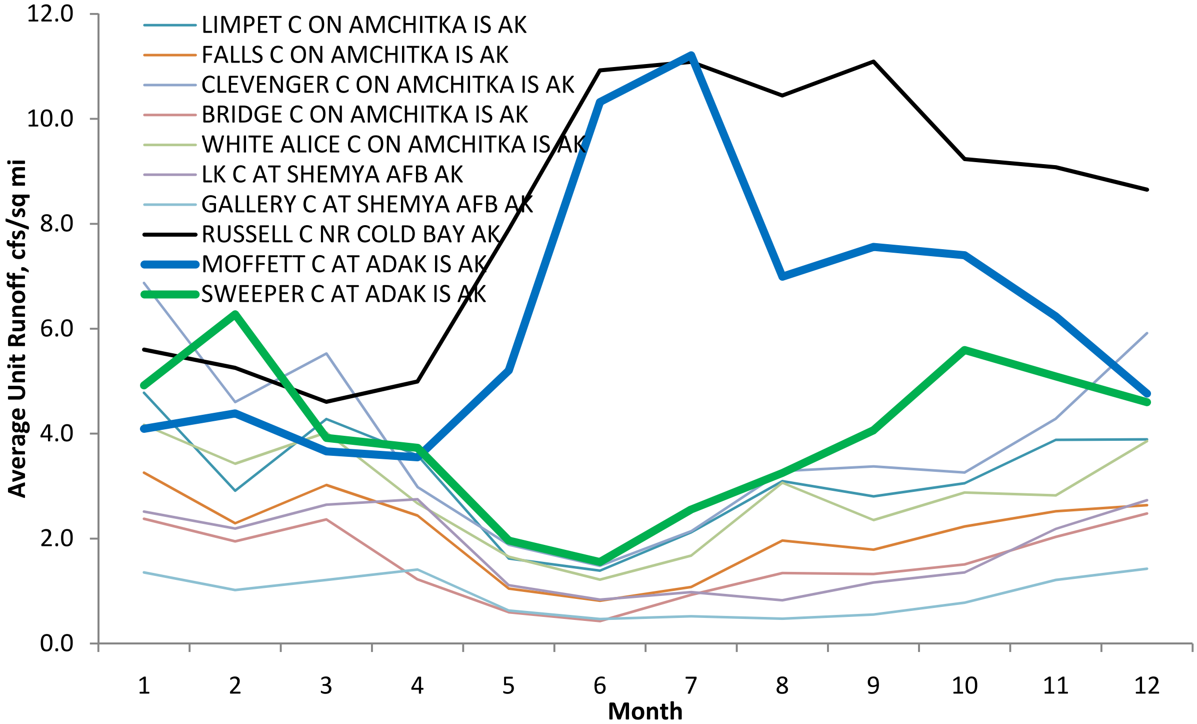

Figure 4 – USGS Monthly Average Streamflow Chart

A review of the locations of the drainages indicates that Moffet Creek and Russell Creek have catchment areas located in relatively high elevations with ridges and valleys whereas the other drainages are located in relatively flat and open areas. Notwithstanding other factors in the data sets, it is possible that the higher elevations, ridges, and valleys allow for snow drifting and accumulation that becomes a significant contributor to runoff in those drainages during the summer months. And during the winter months it is likely that the high altitude results in winter precipitation falling as snow and, with lower temperatures, results in reduced runoff.

The drainages for Mt. Reed Creek and Lake Bonnie Rose both have catchments with ridges and valleys at higher elevations and therefore the runoff in these basins is expected to be similar to the Moffet Creek drainage. The lower drainage areas of Heart Lake and Lake Leone are presumed to have runoff rates similar to the Sweeper Creek. And the mid altitude drainages of Lake De Marie and Lake Betty are expected to exhibit runoff rates that equal the average of the other two.

The procedure for determining runoff rates for drainages in this analysis was to calculate the daily average[1] unit flow from all years of the record for each of the Adak data sets. This resulted in two data sets, one for Moffett Creek and one for Sweeper Creek, containing an average year of daily unit runoff flows. Then, based on the general altitude for the basin, the unit runoff for each project option was calculated by combining the Moffett Creek and Sweeper Creek data sets appropriately and scaling by the appropriate basin area. The values to derive daily flows for each of the projects options are shown below.

[1] The average unit flow is appropriate if storage is utilized whereas for the run-of-river projects on Moffett Creek and Mt Reed Creek the median flow is used.

Table 4 – Project Streamflow Derivation

Source	Daily Unit Flow	Basin Area (sq mi)	Tributary Flow
Lake Bonnie Rose	25%*Sweeper Creek Average + 75%*Moffett Creek Average	1.55	
Lake De Marie	50%*Sweeper Creek Average + 50%*Moffett Creek Average	3.59 – 1.55	Lake Bonnie Rose
Heart Lake	100%*Sweeper Creek Average + 0%*Moffett Creek Average	4.18 – 3.59	Lake De Marie
Lake Betty	50%*Sweeper Creek Average + 50%*Moffett Creek Average	4.43	
Mt Reed	25%*Sweeper Creek Median + 75%*Moffett Creek Median	2.39	
Moffett	0%*Sweeper Creek Median + 100%*Moffett Creek Median	2.78	

The following table is the resulting monthly average flow for each of the project intake locations.

Table 5 – Derived Monthly Average Streamflows (cfs) for Each Project Location

Month	Lake Bonnie Rose	Lake De Marie	Heart Lake	Lake Betty	Mt Reed	Moffet
1	6.7	15.9	18.7	20.0	8.8	10.3
2	7.5	18.3	21.9	23.4	10.3	11.2
3	5.8	13.5	15.8	16.8	7.8	9.3
4	5.7	13.2	15.4	16.4	8.2	10.0
5	6.8	14.1	15.3	15.9	10.4	14.5
6	12.6	24.7	25.6	26.3	19.3	28.7
7	14.0	28.1	29.6	30.5	21.3	31.2
8	9.4	19.8	21.7	22.7	13.8	19.4
9	10.4	22.2	24.6	25.8	15.4	21.0
10	10.8	24.0	27.3	28.8	14.8	18.9
11	9.2	20.8	23.8	25.1	13.4	16.7
12	7.3	16.9	19.6	20.7	10.3	12.4
Average	8.8	19.3	21.6	22.7	12.8	17.0

8. Project Options and Initial Evaluation

Initial analysis found about 13 individual hydroelectric project configurations near Adak. A simple approach to comparing these individual options was adopted to identify the options with the best potential for development. The following discussion presents this approach. Not included in this analysis is the multitude of options possible when the individual projects are combined. Current loads appear to have dropped enough from historic levels such that a single hydroelectric development should meet the majority of demand. The table below summarizes the results of the initial project identification and assessment.

Table 6 – Project Options and Analysis Matrix

No	Source	Source Elev	Powerhouse Location	Powerhouse Elevation	Design Flow	Penstock Length	Penstock Diameter	Net Head	Power	Transmission Length	Cost Score	Energy Score	Environ Score	Average Score
		ft		ft	cfs	ft	in	ft	kW	ft	1 to 5	1 to 5	1 to 5	1 to 5
1	Lake Bonnie Rose	739	Lake DeMarie	249	10.6	5,517	16	443	318	2,519	2.3	3.1	3.5	2.9
2	Lake Bonnie Rose	739	Ocean	25	10.6	9,765	16	632	453	0	1.5	4.9	2.8	3.1
3	Lake Bonnie Rose	739	Ocean	25	10.6	15,032	18	644	462	7,390	0.0	5.0	2.0	2.3
4	Lake Bonnie Rose	739	Heart Lake	168	10.6	13,862	18	506	363	4,772	0.5	3.7	2.5	2.2
5	Lake DeMarie	234	Heart Lake	168	23.1	1,733	24	57	90	5,596	2.9	0.0	3.5	2.1
6	Lake DeMarie	234	Ocean	25	23.1	7,519	26	183	286	7,390	0.5	2.6	2.0	1.7
7	Lake Betty	159	Lake Betty PH	30	27.2	1,306	22	114	210	3,682	2.9	1.6	3.8	2.8
8	Lake Bonnie Rose	739	Exist PRV	300	3.5	0	10	358	85	0	5.0	0.7	4.5	3.4
9	Lake Bonnie Rose	739	Exist PRV	300	10.6	8,413	18	399	287	0	1.8	2.6	4.0	2.8
10	Lake Bonnie Rose	739	Mitt Lake	60	10.6	7,905	16	613	440	0	1.8	4.7	3.5	3.3
11	Heart Lake	153	Ocean	25	25.9	3,752	26	111	195	7,390	1.9	1.4	2.0	1.8
12	Mt Reed	400	Ocean	25	15.4	2,543	18	350	364	11,784	2.1	3.7	1.3	2.4
13	Moffet	400	Ocean	25	20.4	10,017	24	334	461	0	0.2	5.0	4.0	3.1

Scores shown in the table are ranked using a low number to representative a negative or detrimental aspect (such as high cost) and a high number to represent a positive aspect (such as high energy output or low environmental impact).

Some of the projects utilize the same source and destination elevation but have different pipeline routes and powerhouse locations. It is expected that many of the above options would prove feasibly impractical. Due to the desktop level of analysis and the number and complexity of issues, particularly the uncertainty related to aquatic resources, water supply, and demand, all of the options that are possible have been retained in this report for reference purposes in future feasibility efforts.

The initial analysis presented above does not include storage or useable energy (demand constrained) considerations. The design flow for each configuration, except option 8 using the existing pipeline, is selected as the average annual flow, as calculated previously for each basin, times 120%. The total annual energy production is based on the design flow times a capacity factor. The capacity factor for option 8 is 100% while the other options use a 60% capacity determined from energy analysis using the estimated daily hydrology data. Actual useful capacity factors will be dictated by system load, local hydrology, water system demands, bulk water sales (if any), environmental bypass flows, and storage capability. Transmission lengths were determined by the shortest distance from the powerhouse location to the nearest building group.

At this stage in the analysis the results are considered relatively accurate and should only be used for comparison among projects in this study and as a basis for future planning and analysis efforts. A project scoring system was developed for assessing and ranking each project based on cost, energy produced, and environmental attributes. The environmental factors assigned are based on estimated impacts to aquatic issues and the physical footprint of the project.

Scoring of cost is derived by calculating a cost factor that is based on the pipeline diameter, length, and transmission length. The project with the lowest cost factor has the highest score whereas the highest cost project has the lowest score. Similar to the cost scoring, the ranking of energy is derived by scoring the project with the highest energy output a 5 and the project with the lowest output a 0. Environmental scores are derived based on a qualitative evaluation of the amount of bypassed reach, the percentage of bypassed flows, and the amount of new trail required for the pipeline and transmission lengths combined.

The results show that two developments rank the highest:

- Option 8 - Utilizing the existing water system pipeline and installing a power recovery turbine in place of the PRV.
- Option 10 – Constructing a storage project utilizing Lake Bonnie Rose for the intake and locating a powerhouse on Mitt Lake.

9. Lake Bonnie Rose to Mitt Lake Project Analysis

Option 10, the configuration with an intake at Lake Bonnie Rose and a powerhouse at Mitt Lake, with more capacity and higher energy output, appears to be the most feasible option for meeting a majority of energy generation needs economically at this stage of analysis . Option 10 is also a storage project and is analyzed in more detail in this section. The additional analysis includes the impact of storage and the ability to meet the energy needs of the synthesized hourly demand. The estimated useable storage for the lake is the surface area times a depth of 5 feet. Also included in the analysis is a requirement to supply 0.5 cfs of water for domestic purposes.

The results indicate that Lake Bonnie Rose has daily and some seasonal storage value. The analysis of the performance using the hourly demand data and storage is an approximation that does not include varying efficiency, headloss, minimum diesel loading and run time, or ice and snow effects on storage. For this level of study, the results are generally adequate to test the viability of the concept and determine if feasibility efforts should be considered.

The results of the hourly energy analysis show that, for most of the year, the hydroelectric project could displace diesel generation entirely. The following chart shows the results of the analysis.

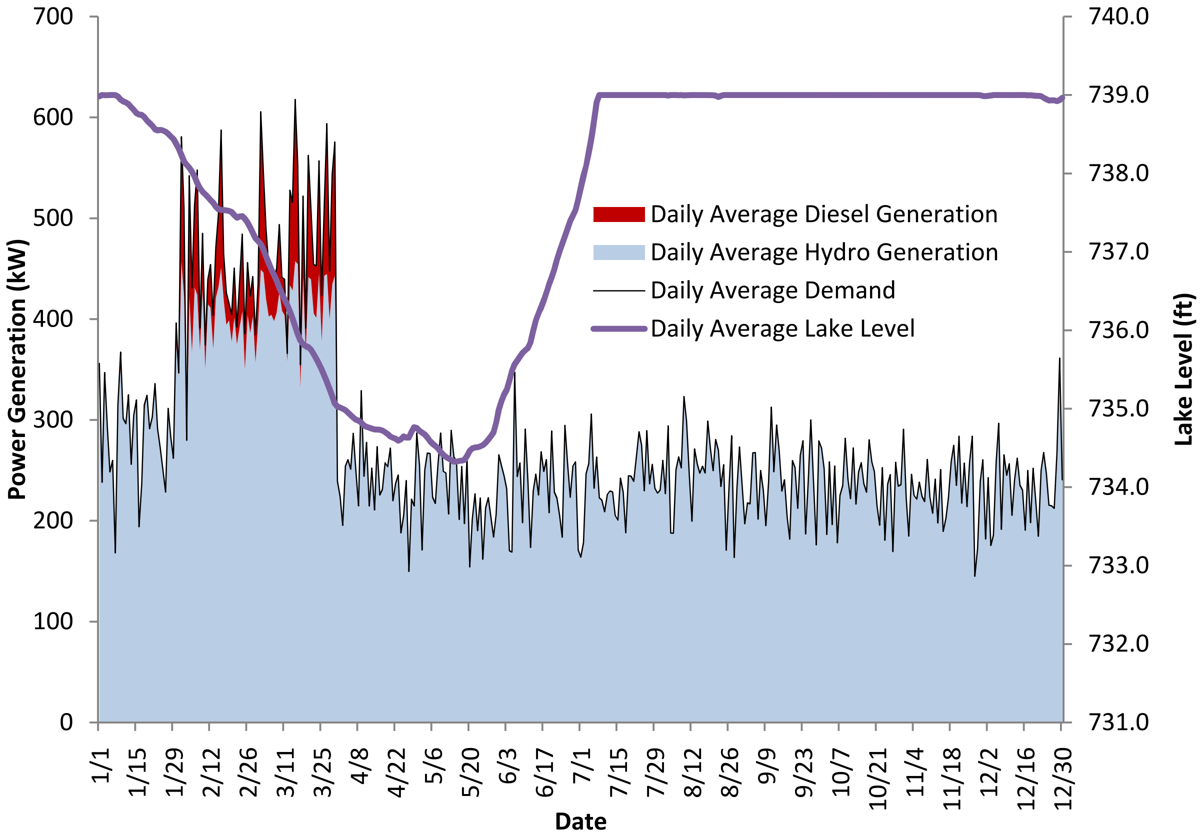

Figure 5 – Option 10 (Lake Bonnie Rose to Mitt Lake) Performance Chart

The table below shows the energy distribution with the hydroelectric project as part of the generation system and the estimated annual fuel savings.

Table 7 – Option 10 (Lake Bonnie Rose to Mitt Lake) Performance Summary

Parameter	Result
Available Energy from Hydroelectric	2,600,000 kWh
Hydroelectric Capacity Factor	67%
Annual Energy Demand	2,450,000 kWh
Fraction of Demand Met by Hydro	2,330,000 kWh
Fraction of Demand Met by Diesel	110,000 kWh
Estimated Diesel Efficiency	14 kWh/gal
Current Diesel Fuel Use	175,000 gal
Diesel Fuel Use with Hydroelectric	7,900 gal
Annual Fuel Savings with Hydro	167,100 gal

Using an estimated cost of diesel fuel in Adak of $4.50 per gallon, the annual savings in fuel would be about $750,000. Over a 30 year period with a discount rate of 3% this equates to a present value of about 14.7 million dollars. For comparison, it is estimated that the capital costs for similar rural hydroelectric projects should be in the range of about $7,500 per kW to $15,000 per kW. Thus, at 440 kW, option 10 is expected to cost from 3.3 million to 6.6 million dollars.

10. Recommendations

The preliminary analysis indicates that a hydroelectric project in Adak is economically viable. Many issues need to be examined in further detail including competing water uses and aquatic issues that could reduce power potential or drive up costs with a subsequent lowering of benefits. Full consideration of other resources and impacts is necessary to determine the best development scenario. Additional feasibility study is warranted to collect site specific data, perform visual inspection of the options, and refine the analysis to determine recommended project(s), conceptual designs, and costs. Recommendations include:

- Obtain current satellite image and perform a satellite photogrammetric or LIDAR survey over the entire project area (from Moffet drainage south to the Aleutian Wilderness boundary).
- Monitor and log 15 minute demand data to determine daily load fluctuations. Also log hourly or daily demand with peaks over a longer period.
- Investigate bulk water sale plans and coordinate development efforts for the water system and bulk sales.
- Install and maintain two or more stream gauges in Adak. At a minimum one should be placed at the outlet of Lake Bonnie Rose and one after Heart Lake.
- Investigate the additional permitting and mitigation required for the basin diversion of water.
- Investigate the existing dams and evaluate the storage potential.
- Perform feasibility level studies to further evaluate issues related to aquatic habitat, incorporate stream gauge work into the hydrology analysis, and develop more detailed project cost estimates, size and storage recommendations, and conceptual designs.
- Investigate future load growth (or decline), fish processor loads, and further evaluate demand requirements and the possible option of constructing multiple hydroelectric projects.

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APPENDIX B

Geothermal Potential of Adak Island, Alaska
A Preliminary Assessment
(Draft Report)

Introduction

The purpose of this report is to provide a preliminary assessment of the geothermal potential on Adak Island. Much work was done on the geothermal potential of Adak by the U.S. Navy. The Navy conducted numerous studies and drilled at least one test well to test for a viable geothermal resource. As part of this preliminary assessment, copies of the Navy's technical reports were requested and the Navy has agreed to supply the documents. However, as of the date of this draft report, the documents have not yet been received and hence this assessment does not include a summary of the Navy's findings.

It is believed that the studies conducted by the Navy and its contractors will form a solid basis for any new work to develop the geothermal resources on the island. Other studies referenced in this assessment show there are adequate indicators of a geothermal resource that could be developed to supply electricity to the island.

Potential resource size, location

Older reports show only one hot spring on the island. References of the hot spring, located at the shoreline on the east side of Andrew Bay, date back to the 1800's. Waring (1965) lists a lone hot spring on the island. Motyka, Liss, Nye, and Moorman (1993) show the Andrew Bay hot spring and a warm spring on the west side of the island (Figure 1). In their 1993 report, they list the Andrew Bay hot spring as having a surface temperature of 71°C (160°F) and calculated geothermometer temperatures as high as 157°C (315°F). The geothermometers are indicators of subsurface temperatures derived from chemical analyses of the geothermal waters.

The success of a geothermal resource is dependent on three primary factors: heat, fluid, and permeability. The temperatures have to be high enough to use existing technology. Fluid (water) is necessary to transport the heat (flow rate) to the surface, and permeability (usually faults and fractures in the rock) is necessary to provide the "plumbing" for the fluid.

The potential size of the resource is unknown until the Navy's work is evaluated and possible further field studies, including drilling, are conducted. However, if the subsurface resource temperatures approach 300°F, the resource does not have to be very large to generate enough electricity to supply the island's needs.

Based on available information, the primary target area for the potential geothermal resource is the northeast part of the island as shown in Figure 2. This target area is the peninsula formed by Mt. Adagda and borders Andrew Bay on the east.

Resource evaluation, design

At least one early reconnaissance geophysical survey was done an aeromagnetic survey by Zietz and Henderson (1949). The geology has been mapped by Coats (1956) and by Waythomas (1995). It is assumed that the Navy used these studies as a foundation for their work starting in the 1970's.

Additional mapping of the target area may be required, depending on the adequacy of the Navy surveys. It may also be beneficial to run some geophysical surveys using new technology. Such surveys would include high-resolution aeromagnetics and new sophisticated electrical resistivity surveys that have been developed in the past few years.

In 2005, Dinicola, Simonds, and Defawe issued a report on numerous shallow monitoring holes that were drilled as part of the environmental assessment of groundwater contamination at certain sites on the Naval Base. If these monitor wells are still open, it would be worthwhile to take temperature measurements in those holes. Another cost-effective method of geothermal exploration is to measure soil temperatures at shallow depths (approximately 3 feet). This type of survey can be used to detect shallow, hot-water upflow.

A final design for resource evaluation will have to wait on the review of the Navy's geothermal work on the island.

Required infrastructure

Infrastructure required for the development of a geothermal power plant includes wells, pipelines, power plant, power lines, and roads. The well field will consist of production and injection wells. The number of wells needed will depend on temperatures and flow rates. Insulated pipelines will be needed from the wells to the power plant, and from the power plant to the injection wells.

Many technical advancements have been made in binary geothermal power plants over the last five years. There are now several companies that manufacture modular units in a range of sizes. The power plant modules have to be sized to the resource, but a small plant adequate to fill the island's needs would be a simple installation. A small modular installation would have a small footprint, likely on the order of 100 feet by 100 feet, or less. Other necessary infrastructure such as roads and power lines, would be minimal.

Permitting, legal, regulatory, licensing issues

Geophysical, geochemical, and geological surveys generally do not require permits as long as they don't require road building or other surface-disturbing activities.

Temperature-gradient drilling will likely require permits from the State of Alaska. Drilling of test wells, production wells, and injection wells will also require state permits. Power plant construction, including the supporting infrastructure of roads, pipelines, and power lines will all require permits from various state agencies.

Integration with existing diesel plant

The present power load for the remaining inhabitants on the island is relatively small. An adequate geothermal resource and one or two small modular, binary power plants could easily replace the existing diesel power plant. Geothermal power is base load; it can generate electricity continuously and some plants are known to operate more than 98% of every year. Annual shutdown for maintenance work should be minimal, and the diesel plant can become a backup unit, rather than the primary generation.

If the geothermal resource is hot enough to generate electricity, and is located close enough to the village, then options should be explored to utilize the power plant effluent (cooled geothermal water) for space heating homes and buildings. This direct use of geothermal fluids for space heating has been used for hundreds of years. Such utilization of the power plant effluent would be dependent on various factors, including the effluent temperature, distance from the power plant to the buildings, and chemistry of the geothermal fluids.

An economic feasibility study of a geothermal power plant for Adak Island was conducted by Bruce (1979). This study is a useful starting point, but the economics have changed over the years and should be much more attractive today, thanks to the advancement in technology and the rising fossil fuel prices.

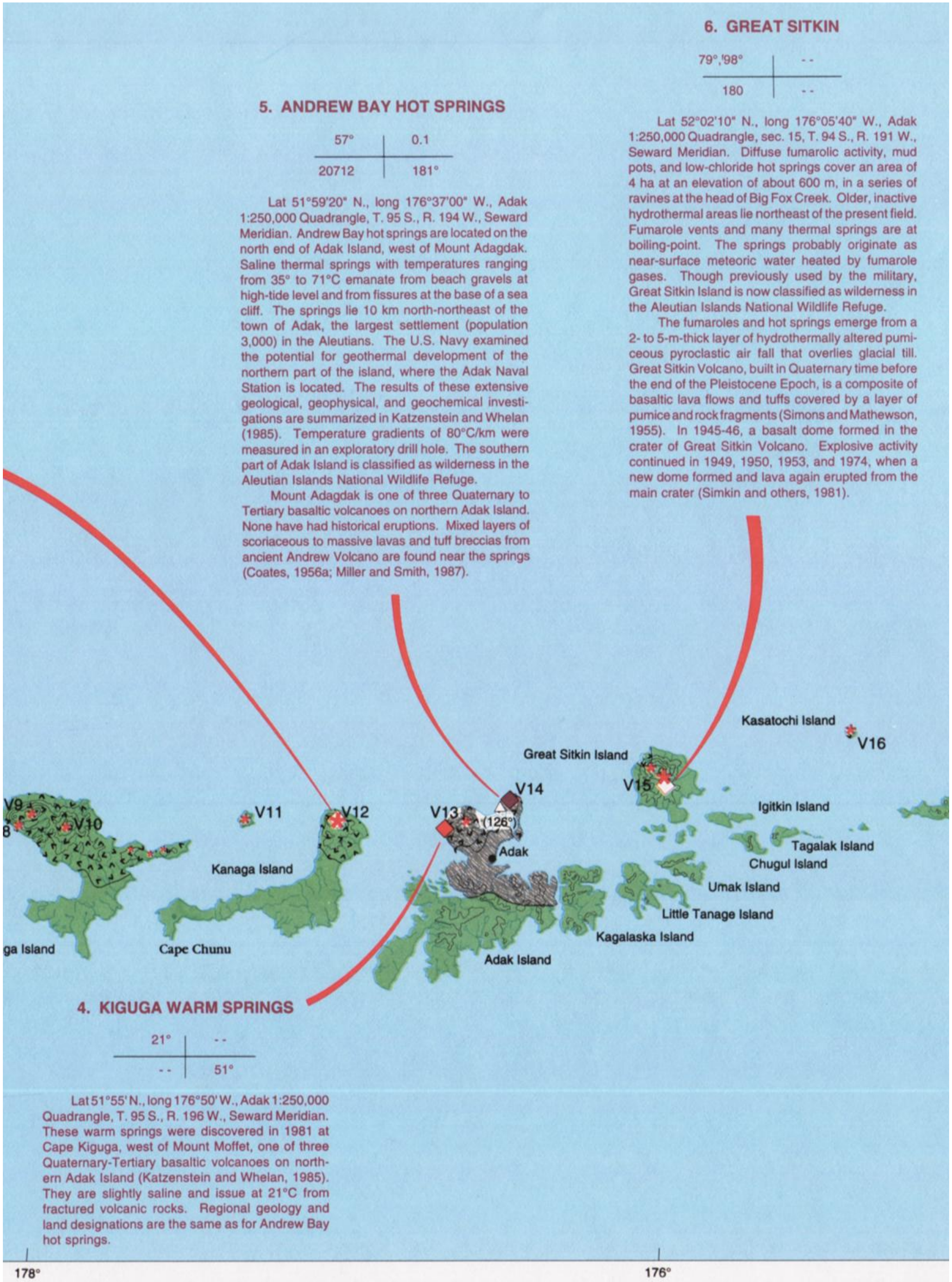

Figure 1. Geothermal springs (extracted from Motyka, et al, 1993).

Figure 2. Geothermal target area, northern Adak Island.

References

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APPENDIX C

Solstice Alaska Consulting, Inc.
Memorandum

Date: July 26, 2011

To: Martin Miller, TDX Power

From: Robin Reich and Colleen Miller

Subject: Adak Alternative Energy Permitting and Land Requirements

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Introduction
Solstice Alaska Consulting, Inc. (Solstice) was contacted to determine potential permit requirements for the development of potential renewable energy resources, including wind, hydroelectric, and geothermal, on Adak Island.

Our assumptions for the project are as follows:

Wind Option
TDX is considering installing a wind turbine on property near the airport in Adak. The project would include a 150-foot turbine constructed on a solid fill pad on property owned by the Aleut Corporation (S 10, T 96 S, R 195 W, Seward Meridian, 51° 52' 20.50" N/176° 39' 19.86" W). This project would include a powerline from the turbine to an existing power plant located approximately 500 feet from the turbine.

Geothermal Option
TDX is considering developing a geothermal power project on the north end of Adak Island near Mount Adagdak. It is unlikely that this project would be economically viable to develop; however, information on potential permitting needs is included in this memo.

Hydroelectric Options
Because preliminary analysis indicates that a hydroelectric project in Adak is economically viable, TDX is considering three hydroelectric feasibility options in Adak. After a detailed analysis of 13 potential hydroelectric options, the most feasible proposed hydroelectric option was determined to be a water storage project with an intake at Lake Bonnie Rose, a penstock that continues to a powerhouse near Mitt Lake, and a discharge to Mitt Lake.

Federal Permits and Authorizations
Below is a list of potential permits and authorizations that could be required for the development of alternative energy options in Adak. This list is based on our knowledge of the options, site characteristics, and permitting requirements. The list includes a short background on the regulated resource in the Adak area.

1. Wetlands (Section 404 and Section 10) Permit

Background
Section 404 of the Clean Water Act regulates discharge of dredged and fill material into waters of the United States, including wetlands. Section 10 of the Rivers and Harbors Act regulates construction, excavation, or deposition of materials in, over, or under ordinary high water of any navigable water of the United States. In short, any person, firm or agency (including federal, state and local government) planning to place structures or conduct work in navigable waters of the United States, or discharge (dump, place or deposit) dredged or fill material in waters of the U.S. must first obtain a permit from the U.S. Army Corps of Engineers (USACE).

Based on the *Aleutians West Coastal Resource Service Area Coastal Management Plan*, wetlands under the jurisdiction of the USACE are common throughout the western Aleutian Islands. U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory mapping has not been completed for Adak, and it is unlikely that wetlands have been formally delineated and mapped in the area. Also, navigable marine waters exist in the Adak area.

Potential Permitting Requirements
Hydroelectric, Wind, and Geothermal Options: It is likely that a wetland permit would be required for all proposed renewable energy projects; however, it is recommended that prior to submitting an application, a preliminary wetlands jurisdictional determination is completed to determine the extent of wetlands in the project area. A USACE wetland permit would be required if the project requires dredging or the placement of fill in wetlands. Also, a wetlands permit would be required if any project components were placed below ordinary high water of any navigable stream.

If the project is constructed in undisturbed areas, it is likely that a wetlands survey and the submittal of a preliminary jurisdictional determination and a wetland permit application would be required. Potential impacts to wetlands could be reduced by constructing the project within previously disturbed areas and by incorporating existing infrastructure.

Responsible Agency: USACE

Statutes: Section 404 of the Clean Water Act (1977) and Section 10 of the Rivers and Harbors Act (1890)

Timing*:* A 30 day public review is required for all projects requiring an Individual Permit.

Contact*:* Section USACE, Regulatory Branch
P.O. Box 6898
Elmendorf AFB, AK 99506-6898
Phone: 907.753.2724
Fax: 907.753.5567

2. National Historic Preservation Act Section 106 Consultation

Background
Section 106 of the National Historic Preservation Act (NHPA) requires Federal agencies or Federal actions (e.g. a federally-issued permit) to take into account the effects of their undertakings on historic properties. The project must consult the Alaska Department of Natural Resources (ADNR) State Historic Preservation Office (SHPO) regarding potential impacts to cultural and historic resources in the vicinity of the project.

There is the potential to find cultural or historic resources in the Adak project area. Archeological evidence indicates that the Aleuts occupied the island as early as 9,000 years ago. Remnants of prehistoric Aleut settlements remain on the island. Russians first visited the island in the mid-1700s and began trading with the Aleuts. Since the early 1940s, the northern half of Adak Island has been used for military operations, and the military was present until 1997.[1] Based on the high probability of finding cultural and historic sites on Adak associated with Alaska Natives and the U.S. military, it is recommended that the project consult with the SHPO.

Potential Permitting Requirements
Hydroelectric, Wind, and Geothermal: Since there is the potential that there are cultural or historic resources in alternative energy project option areas, to make the permitting process more efficient, consultation with the SHPO should occur during the permitting process. The project could wait for the federal permitting agencies to complete this consultation as a part of their process; however, Solstice has found that completing the NHPA consultation with the SHPO helps to move the permitting process forward.

If the project is constructed in undisturbed areas, it is likely that a cultural resources survey would be required and the SHPO would require the submittal of a finding of effects letter. If the project would result in impacts to buildings more than 50 years old, it is likely that SHPO would require the submittal of a finding of effects letter. Potential impacts to cultural resources could be reduced by constructing the project within previously disturbed areas and by incorporating existing infrastructure, such as road right-of-ways.

Responsible Agency*:* ADNR SHPO

Statute*:* Section 106 of the National Historic Preservation Act (1966)

Timing*:* SHPO is required to respond within 30-days of the submittal of a findings letter. If no response is received, the project can assume there would be no impacts to historic properties.

[1] URS Corp. and US Navy. Adak Update: Environmental cleanup and closure of the former Naval Air Facility, Adak, Alaska. 2009. Accessed on June 17, 2011 at: http://www.adakupdate.com/index.html

Notes: The SHPO could request a field survey for cultural resources, which could increase the timing on this process. The SHPO could also find that the project could impact cultural resources. If this is the case, further consultation would be needed.

Contact: Judith Bittner, State Historic Preservation Officer
550 West 7th Avenue, Suite 1380
Anchorage, AK 99501
Phone: 907.269.8721
Fax: 907.269.8908
judy_bittner@dnr.state.ak.us

3. Endangered Species Act Clearance

Background
If a project involves a Federal action (e.g. a Federal permit, funding, or action on Federal lands), a consultation required by Section 7 of the Endangered Species Act (ESA) must be performed for any activities that may affect species or critical habitat of species formally listed as threatened or endangered.

The following ESA-listed species may be found in the project area: Aleutian shield fern, an endangered species managed by the USFWS; the northern sea otter and Steller's eider, threatened species managed by the USFWS; and the Steller sea lion, fin whale, humpback whale, sperm whale, blue whale and north Pacific right whale, endangered species managed by the National Marine Fisheries Service (NMFS). Critical habitat for Aleutian shield fern has not been established, but it is possible that the ferns are located within project option areas. Critical habitat for Steller sea lion surrounds Adak Island, but no haul out or rookery sites are in the vicinity of the project options. Critical habitat for northern sea lions in the area is from mean high tide seaward. Critical habitat for the whale species is also off shore. (Sea otters, Steller sea lions, and whale species are also regulated under the MMPA, which has separate consultation requirements that could occur concurrently with this process.)

Potential Permitting Requirements
Hydroelectric, Wind, and Geothermal: To make any federal permitting process for this project more efficient, consultation with the USFWS and the NMFS regarding impacts to listed threatened or endangered species is recommended to assist in moving the permitting process forward. The project could wait for the permitting agencies to complete this consultation as a part of their process; however, Solstice has found that completing the ESA consultation helps to move the permitting process forward.

Responsible Agency: USFWS, NMFS

Statutes: Section 7 of the Endangered Species Act (1973)

Timing: The USFWS has 30 days to respond to a findings letter sent by the Federal action agency or project proponent on behalf of the agency.

Contact: Ellen Lance,
U.S. Fish and Wildlife Service
Branch Chief, Endangered Species
605 West 4th Avenue, Rm G-61
Anchorage, Alaska 99501
Phone: 907.271.1467
Ellen_Lance@fws.gov

Brad Smith
NOAA Fisheries
Protected Resources
222 West 7th Ave.
Anchorage, AK 99517
Phone: 907.271.3023
Brad.Smith@NOAA.gov

4. Federal Aviation Administration Determination of No Hazard to Air Navigation

Background
Federal Aviation Administration (FAA) Advisory Circular 70/7460-1K states that any person/organization who intends to construct any of the following must notify FAA:

- any construction or alteration exceeding 200 ft above ground level
- any construction or project:
  - within 20,000 ft of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 ft
  - within 10,000 ft of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 ft
  - within 5,000 ft of a public use heliport which exceeds a 25:1 surface

The Adak Airport and its surrounding regulated airspace is located in the heart of the community of Adak.

Potential Permitting Requirements
Wind: An aeronautical study number has been applied to the project: 2011-WTW-6362-OE for the proposed location of the wind turbine. FAA will issue a determination of No Hazard to Air Navigation or Presumed Hazard to Air Navigation, depending on the outcome of their analysis. It may be necessary to lower the height of the turbine or change the location of the turbine if the FAA determines that the construction of the turbine would result in a hazard to air navigation.

Hydroelectric and Geothermal: There would likely be no FAA permitting requirements associated with a hydroelectric or geothermal project.

Responsible Agency: Federal Aviation Administration

Statutes: Title 14 of the Code of Federal Regulations CFR Part 77

Timing: The FAA usually addresses permit applications within one month.

Notes: If the FAA issues a Notice of Presumed Hazard to air navigation determination, the height or location of the turbine may need to be changed.

Contact:

Chris Cody
Wind Turbines
AJV-15, Obstruction Evaluation Group
1601 Lind Avenue, SW
Renton, WA 98055
Phone: 404.305.7083
Fax: 404.305.7080
Chris.Cody@faa.gov

Robert van Haastert
Supervisor, Obstruction Evaluation Group, AJV-15
FAA Alaskan Regional Office
222 W. 7th Ave., #14
Anchorage, AK 99513
Phone: 907.271.5863
Fax: 907.271.2850
robert.van.haastert@faa.gov

5. Essential Fish Habitat Consultation

Background

The Magnuson Stevens Fishery and Conservation and Management Act (MSFCMA) defines Essential Fish Habitat (EFH) as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The MSFCMA directs federal agencies to consult with NOAA Fisheries when any activities may have an adverse effect on EFH. An adverse effect is defined as "any impact which reduces quality and/or quantity of EFH." An impact can be direct, indirect, site-specific or habitat-wide, including individual, cumulative, or synergistic consequences and actions.

The marine waters surrounding Adak provide EFH for the following species: walleye pollock, squid, skate, sculpin, rock sole, and northern rockfish. No Habitat Areas of Particular Concern are found at the project location. Anadromous streams are also considered EFH for salmon species. Based on Alaska Department of Fish and Game's (ADF&G) *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes*, there are about 12 anadromous streams around the community of Adak. (See Section 7 of this memo for more details on anadromous streams.)

Potential Permitting Requirements
Hydroelectric and Geothermal: To make the permitting process more efficient, consultation with NOAA Fisheries regarding impacts to EFH is recommended to assist in moving any federal permitting process forward. The project could wait for the permitting agencies to complete this consultation as a part of their process; however, Solstice has found that completing the EFH consultation helps to move the permitting process forward. If a hydroelectric project is pursued and the project involves a trans-basin discharge, consultation with NOAA Fisheries regarding potential impacts to salmon would be required. Potential impacts to EFH could be minimized by avoiding a trans-basin water discharge.

Wind: There would likely be no EFH issues associated with a wind project.

Responsible Agency: NOAA Fisheries

Statutes: The Magnuson Stevens Fishery and Conservation and Management Act

Timing: It is expected that NOAA Fisheries would respond to a findings letter sent by the Federal action agency or project proponent on behalf of the agency within 30 days.

Contact:

Geothermal:
Jeanne Hanson, Field Office Supervisor
NOAA Fisheries
Habitat Conservation
222 West 7th Avenue, Room 517
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Phone: 907.271.3029
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Juneau, AK 99802-1668
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Susan.walker@noaa.gov

State Permits and Authorizations

6. Coastal Zone

Background
The Alaska Coastal Management Program (ACMP) ended on July 1, 2011 and the local coastal management plans are without statutory authority and are therefore unenforceable. Municipal coastal

districts will need to make policy decisions on whether to retain their local coastal management plans within their municipal code or ordinance, and how that plan will be implemented through the local permitting process. Although the currently approved plans will be without statutory authority and will be unenforceable at the State and Federal level, a municipal coastal district may choose to retain its plan and implement it solely at the local level.

7. Fish Habitat (Title 16) Permit

Background
The ADF&G has statutory responsibility for protecting freshwater anadromous fish habitat and providing free passage for anadromous and resident fish in fresh water bodies. Any activity or project that is conducted below the ordinary high water mark of an anadromous fish stream requires a Fish Habitat Permit.

Approximately 12 streams around the community of Adak have spawning and rearing habitat for coho, chum, sockeye and pink salmon and Dolly Varden. These streams have been included in *the Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes*. A map showing the location of anadromous streams listed in the Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes, Effective June 1, 2011 is attached (Figure 1).

Potential Permitting Requirements
Hydroelectric: Because the development of a hydroelectric project in Adak could involve impacts to anadromous fish streams, it is likely that a Fish Habitat Permit would be needed. A Fish Habitat Permit is needed for any work in an anadromous stream.

If a hydroelectric project is pursued and the project involves a trans-basin discharge, it is likely that the ADF&G would have significant concerns and would require a fish habitat study to be conducted in the project area. It may also be necessary to conduct a hydrology study to determine the project effects of reduced stream flow on fish. ADF&G may require mitigation for impacts to fish habitat. Potential impacts to anadromous streams could be minimized by avoiding a trans-basin water discharge; however, a fisheries field study and Fish Habitat Permit would likely be required for any alternative that is carried forward.

The Aleut Corporation is preparing a Fish Resource report to submit to ADNR as a requirement prior to the granting of water rights. If this report is available to the public, it may contain useful information for the hydroelectric project option.

Wind: It is likely that the development of a wind project in Adak would avoid impacts to anadromous streams; therefore, a Fish Habitat Permit would not be required.

Geothermal: Not enough information is available to determine whether the development of a geothermal project would impact anadromous streams.

Responsible Agency*:* Alaska Department of Fish and Game, Division of Habitat

Statutes*:* AS 16.05.841-871 (Fish and Game, Fish and Game Code)

Timing*:* For simple projects, ADF&G typically processes Fish Habitat Permits within one month. Trans-basin hydroelectric project permitting could take up to 6 months.

Contact: Monte Miller
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, AK 99518-1599
Phone: 907.267.2312
monte.miller@alaska.gov

8. Water Rights

Background
A project must establish water rights if it plans on diverting, impounding, or withdrawing a "significant" amount of water for use. A significant amount is defined as:

- Consumptive use of more than 5,000 gallons of water from a single source in a single day
- The regular daily or recurring consumptive use of more than 500 gallons per day (gpd) from a single source for more than 10 days per calendar year
- The non-consumptive use of more than 30,000 gpd from a single source
- Any water use that may adversely affect the water rights of other appropriators or the public interest.

A water right is a legal right to use surface or ground water under the Alaska Water Use Act (AS 46.15). A water right allows a specific amount of water from a specific water source to be diverted, impounded, or withdrawn for a specific use. When a water right is granted, it becomes appurtenant to the land where the water is being used for as long as the water is used. If the land is sold, the water right transfers with the land to the new owner, unless ADNR approves its separation from the land.

To obtain water rights in Alaska, the applicant must submit an application for water rights to the ADNR office in the area of the water use. After the application is processed, the applicant may be issued a permit to drill a well or divert the water. Once the applicant has established the full amount of water that would be used beneficially and complied with all of the permit conditions, a certificate of appropriation may be issued. This is the legal document that establishes water rights.

No water rights have been established on the island of Adak; however, several entities have applied for water rights within the project vicinity (Township 96 South, Range 195 West, Seward Meridian). The following table summarizes the parties who have applied for water rights and the status of the application.

Entity	Application Date	LAS No.	Type of Water Rights	Section(s)	Status (Date)
Aleut Enterprise Corporation	1/14/2000	23026	subsurface	36	CLOSED (2/9/2010)
Aleut Enterprise Corporation	1/14/2000	23027	subsurface	33, 34	CLOSED (2/9/2010)
Aleut Enterprise Corporation	1/14/2000	23028	subsurface	23, 28	CLOSED (2/9/2010)
Adak Reuse Corporation (transferred to City of Adak)	9/9/2000	23305	subsurface	20	Application Received (9/9/2000)
Adak Reuse Corporation (transferred to City of Adak)	9/9/2000	23306	subsurface	34	Application Received (9/9/2000)
Aleut Corporation	7/13/2010	27733	Surface	34	Application Received (7/13/2010)
Aleut Corporation	7/13/2010	27735	Surface	21	Application Received (7/13/2010)
Aleut Corporation	7/13/2010	27736	Surface	35	Application Received (7/13/2010)
Alaska Department of Natural Resources	7/1/1992	27979	Instream Reservation	26	Application Received (7/1/1992)
Alaska Department of Natural Resources	7/1/1992	27980	Instream Reservation	20	Application Received (7/1/1992)

The Adak Reuse Corporation was dissolved, and all water rights applications have been transferred to the City of Adak. It is unclear why the Adak Reuse Corp applied for subsurface water rights.

The City of Adak has applied for the rights to 950,000 gallons/day for drinking water. It may be possible to run water through a hydroelectric system, and then treat that water for drinking water. This would have to be approved by Alaska Department of Environmental Conservation (ADEC).

The Aleut Corporation has plans to develop a commercial resource development project that would export potable water to overseas markets, and they have applied for water rights for Lake Bonnie Rose, Lake De Marie, and Lake Betty. The water would be transported to the Adak dock via existing transmission pipes and loaded onto ships with food-grade tanks. There would be no water treatment before transport and no dock storage for untreated water. A public notice was published for this project on 7/26/2010 by the State of Alaska Department of Natural Resources, Division of Coastal and Ocean Management for this project to export potable water to overseas markets. This project would use the existing transmission lines from Lake Betty and Lake De Marie to withdraw and transport water. According to Krissy Plett, ADNR, the penstock from Lake Betty would need to be completely replaced. The penstock from Lake De Marie would need to be repaired.

Solstice is on the "interested parties" list for this permit application, and will be notified by email when the background reports (including a fisheries report) are submitted and the public notice for the water rights application is published.

Potential Permitting Requirements
Hydroelectric and Geothermal: TDX would have to secure water rights in order to operate a hydroelectric project. It is recommended that TDX cooperate with the City of Adak and/or the Aleut Corporation when determining the amount of water that would be required during hydroelectric generation. It may be possible to use the same water for both hydroelectric generation and drinking water for the community or transport to overseas markets. However, TDX would be required to obtain water rights from ADNR for the amount of water to be used for hydroelectric and geothermal generation, and ADEC would have to approve the use of water for both power generation and drinking water.

Wind: It is unlikely that a wind project would require water rights.

Responsible Agency: State of Alaska Department of Natural Resources Division of Mining, Land, and Water

Statute: Alaska Water Use Act (AS 46.15)

Timing: Securing water rights for a hydroelectric project could take up to 6 months. The Water Resources Section should be contracted for a pre-application meeting prior to preparing and submitting an application. Issuance of a water use permit requires a 30-day agency and public review after the application is determined to be complete by ADNR. Once the project is constructed and the full amount of water that would be used is determined, a certification is issued for water rights.

Fee: An application filing fee is required for water rights permit applications. The fee varies with proposed water consumption.

Contact: Krissy Plett
Department of Natural Resources Division of Mining, Land and Water
550 W 7th Ave Ste 1020
Anchorage, AK 99501-3579
Phone: 907.269.8641
kristina.plett@alaska.gov

9. Land Ownership

Background
TDX must gain site control before constructing any alternative energy option on Adak Island. The entity that owns the project location could grant a lease, an easement, or a sale of the property depending on what would be installed on the land.

The Aleut Corporation, the City of Adak, and the USFWS own the majority of the land on Adak Island. The Adak Naval Air Station officially closed on March 31, 1997, and a land exchange between Aleut Corporation, the U.S. Navy, and the Department of the Interior transferred most of the naval facilities to the Aleut Corporation. A portion of the island, primarily away from the community, is within the Maritime National Wildlife Refuge, managed by the USFWS. The community formed a second-class city government in April 2001, and the City owns most of land within the city limits.[2]

Adak Airport is a State of Alaska owned and maintained certificated airport within city limits. It has two asphalt paved runways; one measures 7,790 feet long by 200 feet wide, and the other runway measures 7,605 feet by 200 feet wide.

Currently, TDX owns the equipment at the power plant, but leases the building and land from the City of Adak.

Potential Permitting Requirements

Hydroelectric: It is likely that hydroelectric options would be on Corporation and City land. It is unlikely that the hydropower alignments would affect refuge land.

Wind: The wind turbine option would be located on land owned by the Aleut Corporation. It would be necessary to obtain site control, most likely a lease, from the Aleut Corporation for the placement of the wind turbine. TDX would need to work with the Corporation and the City to establish an easement for the power line between turbine and the power plant.

Geothermal: It is likely that the geothermal option would be location on Aleut Corporation lands. If the potential geothermal resource is on Maritime National Wildlife Refuge land, it is not recommended that this option is pursued.

Timing: Acquiring site control can be a long process. It is recommended that moving forward with site control negotiations begin immediately following selection of an alternative energy option.

Notes: Because of significant environmental and legal requirements associated with project development on refuge lands, Solstice recommends avoiding land within the Alaska Maritime National Wildlife Refuge.

Contact: Aleut Corporation
4000 Old Seward Highway, Ste. 300
Anchorage, Alaska 99503
Phone: 907.561.4300
Fax: 907.563.4328
receptionist@aleutcorp.com

[2] State of Alaska Department of Commerce, Community, and Economic Development Community and Regional Affairs. Alaska Community Database Community Information Summaries. 2011. Adak. Accessed on June 17, 2011 at: http://www.dced.state.ak.us/dca/commdb/CIS.cfm

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Danielle_jerry@fws.gov

10. Contamination

Background
Projects that would be constructed on lands that are considered contaminated must be coordinated with the agency responsible for their cleanup. In the case of Adak, the cleanup effort is lead by the U.S. Navy.

According to the U.S. Navy Adak Update webpage [http://www.adakupdate.com/envrest.html], 32 contaminated sites exist on Adak, including Solid Waste Management Units or landfills, unexploded ordnance areas, and polychlorinated biphenyl (PCB) spill sites, which have contaminated groundwater, surface water, sediments, and soil.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), otherwise known as Superfund; enacted in 1980, provides for liability, compensation, cleanup and emergency response for hazardous substances released to the environment.[3] The Adak Naval Air Station is listed as a superfund site, and cleanup is currently underway.[4] Additional information is available on the Adak Update website, which is managed by the Navy.

Environmental restoration projects began on Adak under the Navy Assessment and Control of Installation Pollutants program with an initial assessment study (IAS) in 1986. In 1988, site inspections were conducted at areas identified in the IAS. In 1989, a Resource Conservation and Recovery Act (RCRA) facility assessment (RFA) was completed by the U.S. Environmental Protection Agency (EPA)

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[3] Environmental Protection Agency. 2011. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Accessed on June 17, 2011 at: http://www.epa.gov/agriculture/lcla.html#Summary%20of%20CERCLA

[4] Environmental Protection Agency. 2007. Cleanup in Region 10: Adak Naval Air Station. Accessed on June 17, 2011 at: http://yosemite.epa.gov/r10/cleanup.nsf/1a16218b78d8c4d58825674500015b42/2588a83be2a7af12882565070000c34e!OpenDocument

under the RCRA corrective action program. Adak was proposed for the EPA's National Priorities List (NPL) in October 1992 and it was officially placed on the NPL in May 1994. Clean-up activities have been ongoing.

Potential Permitting Requirements

Hydroelectric, Wind, and Geothermal: The potential for contamination should also be determined and considered when exploring any renewable energy options. It is recommended that TDX contact the Navy prior to finalizing an alignment or site for a renewable energy project to attempt to avoid any site and to ensure that the Navy approves of the location of ground-disturbing activities. An online dig permit application can be filled out at this website: [http://www.adakupdate.com/ICs/digpermit_rev.html].

Responsible Agency: U.S. Navy, Environmental Protection Agency, Alaska Department of Environmental Conservation

Timing: It is unknown at this time how long the consultation process with the U.S. Navy would take regarding contamination.

Contact: Naval Facilities Engineering Command Northwest
Code EV3 1101 Tautog Circle
Silverdale, WA 98315-1101
Telephone: 1-866-239-1219
Fax: (360) 396-0857

Megan Dooley
Alaska Department of Environmental Conservation, Contaminated Site
555 Cordova St
Anchorage, AK 99501
907.269.3056
meghan.dooley@alaska.gov

11. Water Quality Certification

Background

In accordance with Section 401 of the Clean Water Act, any applicant for a federal license or permit to conduct an activity that might result in a discharge into waters of the U.S., including wetlands, must also obtain certification from the ADEC that the discharge will comply with the Clean Water Act, the Alaska Water Quality Standards, and other applicable State laws. By agreement between the USACE and ADEC, an application for a wetland permit may also serve as an application for ADEC 401 water quality certification.

Potential Permitting Requirements

Hydroelectric, Wind, and Geothermal: It is likely that a wetland permit would be required for all proposed renewable energy projects; therefore, a Water Quality Certification would be required for all proposed renewable energy projects. The USACE wetland permit application serves as the application for the ADEC 401 water quality certification, so no additional steps are required.

Responsible Agency: Alaska Department of Environmental Conservation

Statute: Section 401 of the Clean Water Act

Timing: This process occurs concurrently with the USACE wetland permit application process

Contact: William Ashton
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555 Cordova St
Anchorage, AK 99501
(907)269-6283
william.ashton@alaska.gov

Attachments: Figure 1: Anadromous Streams

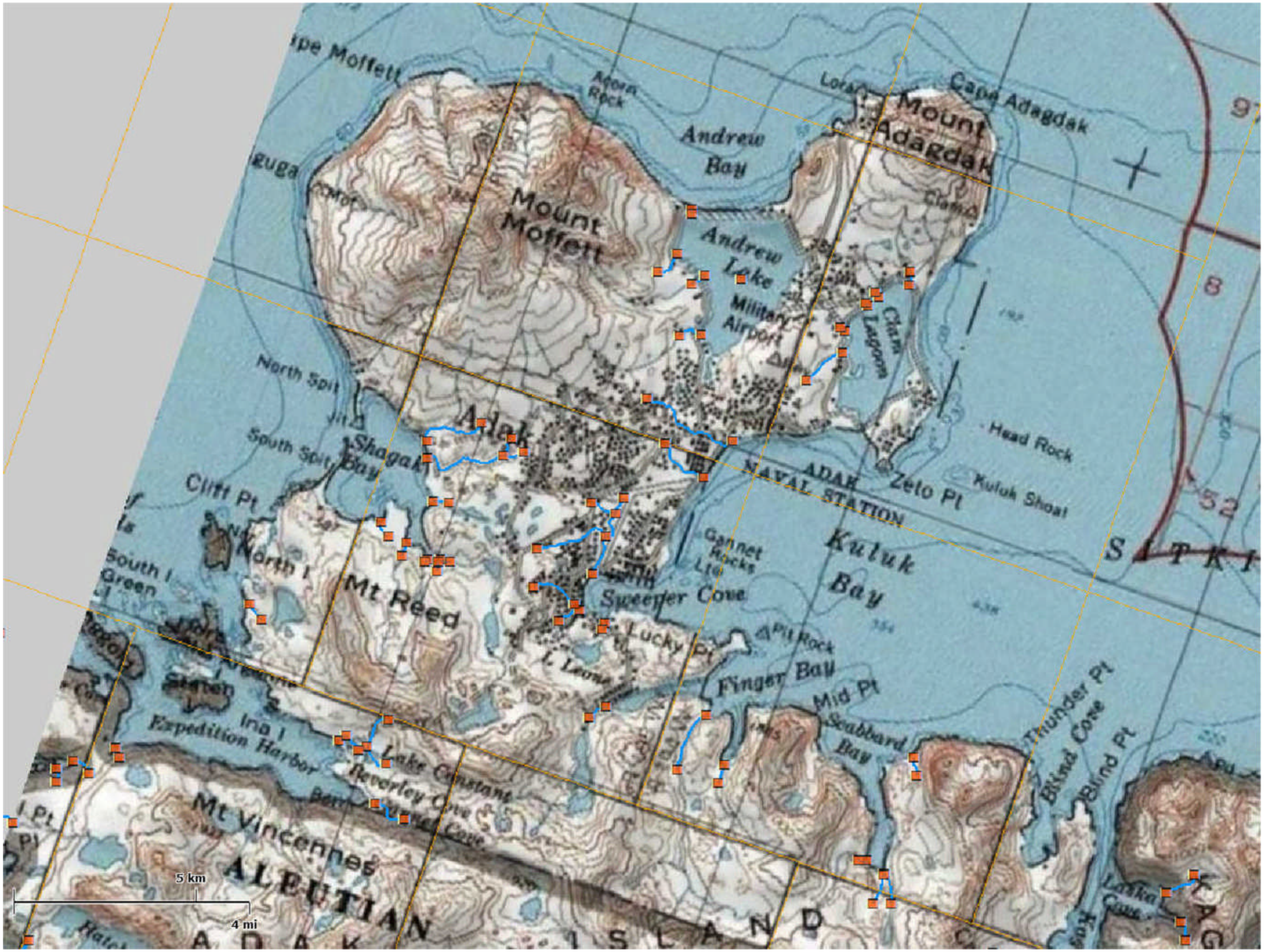

Figure 1: Adak Alternative Energy Permitting and Land Requirements
Anadromous streams

Draft Environmental Assessment

Sand Point Wind Installation Project
Sand Point, Alaska

DOE/EA -1584

U.S. Department of Energy Golden Field Office
1617 Cole Boulevard Golden, Colorado 80401-3305

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ACRONYMS AND ABBREVIATIONS

ACMA	Alaska Coastal Management Act
ACMP	Alaska Coastal Management Program
AEA	Alaska Energy Authority
AEB	Aleutians East Borough
AEBCMP	Aleutians East Borough Coastal Management Plan
agl	above ground level
ANCSA	Alaska Native Claims Settlement Act
APIA	Aleutian Pribilof Islands Association
AWE	Aleutian Wind Energy
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practices
CCDP	Comprehensive Community Development Plan
CEC/CDFG	California Energy Commission and California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CZMA	Coastal Zone Management Act
dB	decibel
dBA	A-weighted decibel scale
DEC	Department of Environmental Conservation
DOD	Department of Defense
DOE	Department of Energy
EA	Environmental Assessment
EERE	Energy Efficiency and Renewable Energy
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
ft	feet
ft^2	square feet
ft/s	feet per second
GEC	Global Energy Concepts
GPS	global positioning system
kW (h)	Kilowatt (hour)
lbs	pounds
LED	light emitting kiode
m	meter
m^2	square meter
MET	meteorologic station
m/s	meters per second
mph	miles per hour

ACRONYMS AND ABBREVIATIONS (Continued)

MW	Megawatt
MWh	Megawatt hour
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
PCE	Power Cost Equalization Program
RFFA	reasonably foreseeable future action
RSA	rotor sweep area
SHPO	State Historic Preservation Officer
SWPPP	Stormwater Pollution Protection Plan
TDX	Tanadgusix Corporation
TSPG	TDX Sand Point Generating
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
W/ft^2	watt per square feet

1.0 INTRODUCTION

Based on an action by the U.S Congress, the U.S. Department of Energy (DOE) has funding available to support the Alaska Energy Authority (AEA)'s Alaska Wind Energy Program. AEA is dedicated to support design and construction of wind energy power plants, wind feasibility demonstration, and methods necessary for widespread adoption of alternative energy systems in rural Alaska (AEA, 2009). AEA proposes to provide funding received from DOE to Aleutian Wind Energy, LLC (AWE) to support the installation of a wind power generation system at the existing Tanadgusix Corporation (TDX) Power generation facility in Sand Point, Alaska. The funding of this project constitutes a major federal action, therefore, DOE is required to evaluate the potential environmental impacts in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ), and the DOE NEPA implementing regulations. In compliance with NEPA (42 United States Code [U.S.C.] § 4321 et seq.) and the DOE's NEPA implementing regulations (10 Code of Federal Regulations [CFR] Part 1021) and procedures, this Environmental Assessment (EA) examines the potential environmental impacts of DOE's Proposed Action, No Action Alternative, Applicant Committed Measures, and Residual Impacts.

1.1 NATIONAL ENVIRONMENTAL POLICY ACT AND RELATED PROCEDURES

In accordance with the DOE NEPA implementing regulations, DOE is required to evaluate the potential environmental impacts of DOE facilities, operations, and related funding decisions. In compliance with these implementing regulations and procedures, this EA:

- Examines the potential environmental impacts of the proposed project, as well as a No Action Alternative;
- Identifies unavoidable adverse environmental effects of the Proposed Action;
- Describes the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- Characterizes any irreversible and irretrievable commitments of resources that would be involved should the proposed action be implemented.

These requirements must be met before a final decision is made to proceed with any proposed Federal Action that could cause adverse impacts to human health or the environment. This EA is intended to meet DOE's regulatory requirements under NEPA and provide DOE with the information needed to make an informed decision associated with the installation of the proposed wind-diesel hybrid power generation system.

This EA evaluates the potential individual and cumulative effects of the Proposed Action. No other action alternatives are analyzed. For purposes of comparison, this EA also evaluates the impacts that would occur if DOE did not provide funding to support the installation of the wind power generation system (the No Action Alternative).

1.2 BACKGROUND

AEA's Wind Energy Program provides information and technical assistance, wind-monitoring equipment, and educational opportunities for Alaskans interested in wind power. AEA issued a competitive solicitation for wind development projects in Alaska and has selected a proposal from TDX Sand Point Generating (TSPG) as a potential recipient of the DOE funding. TSPG is a wholly owned subsidiary of TDX Power. TDX Power has experience installing and operating a "high penetration" wind power system in rural Alaska (Saint Paul Island, AK). A high penetration wind power system is one that is capable of generating a large proportion of the electrical demand for the local electrical grid relative to the existing generation capacity. As of the date of this document, TSPG has assigned all of its rights, title and interest, and any amendments and supplements, to AWE. AWE would be responsible for the installation of two wind turbines and the integration of these machines with the balance of the Sand Point power system.

Sand Point currently operates on electricity produced from diesel-powered generators. The cost of electricity is subsidized by the State of Alaska through the Power Cost Equalization Program (PCE). However, despite the subsidy, the rising cost of imported diesel is economically affecting communities throughout Alaska. In an effort to find a cost-effective solution to the unpredictable future price and availability of diesel, AWE and the AEA have collaborated to develop a wind power project in Sand Point. Information such as total power consumption in Sand Point, future changes in Sand Point power requirements, equipment operations and output, and economics were considered in determining the proposed need for the wind system specifications. TDX's proposed high penetration wind turbine project involves the installation of two 500 kilowatt (kW) Vestas V39 wind turbines. Adding the two 500 kW wind turbines to the existing Sand Point diesel plant would significantly reduce the amount of diesel used to produce electricity in the area.

TDX determined the cost effectiveness of this proposed project based on wind speed data supplied by the National Renewable Energy Laboratory (NREL). Wind resources are expressed in wind power classes ranging from Class 1 to Class 7, with each class representing a range of mean wind power density (watt per square foot [W/ft^2]) or equivalent mean speed (feet per second [ft/s]) at 165 feet above the ground. The measured annualized average wind speed (@ 61 feet [ft] [20 meters (m)] above ground level [agl]) is 21 ft (6.8 m)/s. Using a shear of 0.14 this gives a 152 ft (50 m) average wind speed of 23.5 ft (7.7 m)/s. This is between Class 5 and Class 6, which would be a very good wind source (T. Jimenez, NREL, National Wind Technology Center, personal communication with B. Wright, Aleutian Pribilof Islands Association [APIA] 2009) (Appendix A). The DOE Energy Efficiency and Renewable Energy (EERE) Wind Program website states that areas designated Class 4 or greater are suitable for wind power production using currently available wind turbine technology (DOE, 2009).

1.3 PURPOSE AND NEED

The DOE's Wind & Hydropower Technologies Program is managed in accordance with the National Energy Policy. The U.S Congress and DOE's Wind and Hydropower Technologies Program supports wind power in an effort to stimulate rural economic development, displace harmful emissions created by traditional fuels, diversify the Nation's options for low-cost electricity generation, and increase energy and national security. The Proposed Action and the decision to provide federal funding for AWE's wind turbine installation project are intended to support the National Energy Policy and to continue deployment of wind generated power in rural Alaska.

The Proposed Action would provide a cost effective and clean source of electricity, reduce overall diesel fuel consumption, and decrease air emissions associated with the consumption of diesel fuel. TDX projects that the Proposed Action would produce 1 megawatt (MW) of renewable power, which would decrease diesel fuel consumption by an estimated 130,000 gallons/year under normal operating conditions. As recent prices of diesel in Sand Point have fluctuated between $4 and $5 per gallon, such a decrease in consumption would result in reduced fuel costs of $520,000 - $650,000 per year. The Environmental Protection Agency (EPA) estimates that one gallon of diesel can produce 22.2 pounds (lbs) of carbon dioxide (CO_2); hence about 1,443 tons of CO_2 emissions per year would be avoided if the Proposed Action is implemented.

1.4 PUBLIC SCOPING AND CONSULTATION

Federal, state, municipal, borough, tribal, and regional organizations have been contacted regarding the Proposed Action and DOE's NEPA review process via e-mail, hard copy, telephone, and/or by face-to-face meetings (Appendix B). Individuals and organizations contacted were provided with proposed project information and an opportunity to comment.

The APIA, with funding from the Bureau of Indian Affairs (BIA), has conducted elements of the scoping process on behalf of DOE. Representatives from APIA visited Sand Point between December 4 and 7, 2006, to view the proposed site and meet with community members and leaders. Information regarding the Proposed Action and EA process was presented to the public via door-to-door visits and public information meetings (Appendix C). Prior to visiting Sand Point, notifications with simulated photos of the wind turbine installation and information pertaining to the upcoming visit and community meeting were displayed in various locations. Posters referencing the Proposed Action were first displayed December 1, 2006. These posters were located at the Sand Point City Airport, the Sand Point City Office Building (which also serves as the offices for the Qagan Tayagungin Tribe and the Pauloff Harbor Tribe), the Sand Point Post Office, the health clinic, Sand Point Electric, Shumagin Corporation, Shumagin Pub, Alaska Commercial Store, the Aleutian China Restaurant, Sand Point School, and the Aleutians East Borough Offices. An initial radio announcement concerning the upcoming visit and community meeting was made on the local Sand Point radio station (KSDP) December 1, 2006. Regular KSDP announcements continued.

Representatives of APIA visited offices and places of business in Sand Point, including the Alaska Commercial Store, Aleutians East Borough, the Aleutians East School District Offices, and the Sand Point City Offices between December 5 and 7, 2006. Information about the proposed project and the EA process was presented at public meetings including a Sand Point Community Meeting on December 6, 2006 and an APIA Board of Directors meeting on December 9, 2006. Fifty-three comments were collected during the scoping process (Appendix C). As reflected by the comments collected from residents, businesses, Tribes, and borough and municipal leaders, there is strong public support for the Proposed Action.

In addition, DOE has consulted with federal and state agencies regarding the potential environmental impacts associated with the Proposed Action (Appendix D). Specifically, DOE sent consultation letters to the United States Fish and Wildlife Service (USFWS), the State Historic Preservation Officer (SHPO) of Alaska, and the Department of Defense (DOD), including the Department of the Air Force, the Federal Aviation Administration (FAA), and the Alaska Department of Natural Resources (regarding the Alaska Coastal Management Program [ACMP]). Copies of the correspondence received from these agencies are included in Appendix E.

Issues raised by government organizations and the public that are addressed in this EA include, but are not limited to:

- potential avian impacts (e.g., impacts to bald eagles and threatened Steller's eiders);
- potential hazards to air navigation; and
- potential socioeconomic impacts.

1.5 ENVIRONMENTAL JUSTICE

In 1994, the President issued an Executive Order to focus federal attention on the environmental and human health conditions in minority and low income communities with the goal of achieving environmental justice. The purpose of environmental justice is to ensure that no segment of the population, regardless of race, ethnicity, or income, bears disproportionately high and adverse environmental effects.

The total population of Sand Point in 2000 was 952, with a density per square mile of 122. The estimated population in 2007 was 893, an approximate 6% decrease. The highest percentage of Sand Point residents is Alaskan Natives at 42.3%, followed by white at 27.7%, Asian at 23.2%, and Hispanic or Latino at 3.6%. African American, Pacific Islanders, and other races or mixes of races and ethnicities make up the remaining 3.2% of the population in the community. At the time of the 2000 census, the per capita income in Sand Point was $21,954 as compared with $21,587 nationally.

The proposed project would not have any adverse effects with regard to environmental justice issues. Conversely, the project would lead to a decrease in the consumption of diesel fuel and would ideally keep electricity costs from escalating. The potential benefits from the proposed project would be distributed equally to all Sand Point residents. The proposed project is not expected to result in unfair or unequal treatment of any low income or impoverished communities or populations.

1.6 CONSIDERATIONS NOT CARRIED FORWARD FOR ANALYSIS

The following issues are commonly discussed in EAs for various DOE projects. However, for the reasons discussed below, the proposed project is not expected to have any measurable effects on the given resources and have not been carried forward for analysis of effects in Chapter 3.

- Air quality

  The proposed construction of the wind power system would result in some exhaust emissions from construction equipment and fugitive dust from exposed soils during the short construction phase of the project. This temporary source of air emissions would not require any permits or affect the ability of Sand Point to meet all clean air standards. Sand Point is currently in attainment for all EPA criteria pollutants (Alaska Department of Environmental Conservation [DEC], 2009). Fugitive dust would be minimized by watering the exposed bare solid surface of the construction site during periods of dry weather. The Proposed Action would decrease diesel fuel consumption by an estimated 130,000 gallons/year under normal operating conditions and therefore reduce emissions proportionally. Air quality was not identified as an issue during the scoping process.

- Climate

  The operation of the wind turbines would result in less greenhouse gas emissions due to the displacement of diesel fuel by renewable wind energy. Reduction of greenhouse gas emissions could potentially have a positive residual impact on the regional climate. However, the potential impact of an incremental change in emissions from one point source is likely to be negligible and cannot be estimated at this time.

- Water resources (including wetlands)

  There are no surface water sources such as streams or drainage channels that are located on the proposed project site or that could be affected by the construction and operation of the wind turbines. The proposed project would have no components that could alter or affect groundwater flows or quality.

The USFWS, National Wetlands Inventory (NWI) maps of the area were consulted and no wetlands or surface water bodies were identified on or near the two proposed sites. A subsequent wetlands site visit found no wetland indicators on either of the two proposed sites and classified them as upland sites (B. Wright, APIA, Senior Scientist, personal communication). There would be no placement of fill in jurisdictional wetland on either of the two turbine sites or their access roads.

- Geologic Resources

  Geology of Popof Island is comprised of primarily igneous rock of volcanic origin and the bedrock near Sand Point consists of tertiary extrusions of dacitic or andesitic rock (Richle, 1999). Weathered bedrock underlies much of the area. There is no permafrost in this region. No issues were identified for geology during the scoping process.

- Essential Fish Habitat

  There are no anadromous fish streams near the proposed project site and there are no components of the project that would require alterations to, or crossings of, water bodies that affect anadromous fish streams. There are also no components of the project that would affect intertidal or marine habitats that could be essential fish habitat.

- Mammals

  There are a number of terrestrial mammals that occur on Popof Island, including introduced bison and native populations of smaller species. Domestic dogs and cats may play a potential role in scavenging birds that collide with the wind turbines, thus making it more difficult for an avian monitoring program to evaluate collision mortality (if it occurs). However, habitat loss due to the project would be negligible for all mammal species based on the small area affected and abundance of similar habitat in the vicinity of Sand Point and on Popof Island. No further adverse effects are likely from the construction and operation of the wind turbines. However, there have been documented mortalities of bats from turbine collisions in other parts of the country but there is only one species of bat in Southwestern Alaska, the little brown bat (*Myotis lucifugus*), and it is not known to occur regularly in the Sand Point area, if at all. There are a number of marine mammal species in the waters around Sand Point but there is no marine component of the project and therefore no mechanism for potential effects on marine mammals.

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2.0 ALTERNATIVES

2.1 PROPOSED ACTION

DOE is proposing to provide funding to support the installation of a high penetration wind system at the TSPG power plant in Sand Point, Alaska. Two 500 kW Vestas V39 wind turbines would be installed if the Proposed Action is implemented (Figure 2-1).

The proposed turbine sites are at similar elevation of approximately 164 ft and are approximately 1/3 mile from marine waters. Each wind turbine would be mounted on a 131 ft (40 m), free-standing, monopole unsupported by guy wires (Figure 2-2). The towers would be approximately 335 ft apart. Each turbine has three blades with a rotor diameter of 128 ft (39 m), producing a rotor-swept area of 12,852 square feet (ft^2) (1,194 square meters [m^2]). The wind turbines would be integrated with the existing diesel generator into the power distribution system so no new power transmission lines or other support structures would be needed.

2.1.1 Project Location

Sand Point, Alaska is situated on the northwestern shore of Popof Island, south of the Alaska Peninsula, on a hilly peninsula adjacent to Popof Strait and Humboldt Harbor, approximately 570 air miles southwest of Anchorage. Sand Point lies at approximately 55° 20' N Latitude, 160° 30' W Longitude, within Section 08, Township 56 South, Range 73 West of the Seward Meridian. Sand Point has a maritime climate with cool summers and mild winters. Mean monthly summer temperatures range from 45.5º to 55.7º F. Mean monthly temperatures in winter range from 29.1 to 36.6º F. Mean annual precipitation is 44.7 inches per year.

The existing power plant and proposed wind energy project are located in the Industrial Subdivision No.2, Lots 1, 2A, and 3, Plat No. 85-1, Aleutian Island Recording District (Figure 2-3). The Proposed Project location is adjacent to Sand Point residential and commercial areas, approximately 1/3 mile from coastal waters, and 2.1 miles north of the Sand Point airport. This location is accessible via the Sand Point local service road.

The Proposed Project would have Turbine 1 located in a vacant lot currently owned by Trident Seafoods (Lot 3). TDX Power has negotiated a lease agreement with Trident for use of the vacant lot. Turbine 2 would be located in Lot 1, approximately 335 ft southeast of Turbine 1. The global positioning system (GPS) coordinates for Turbine 1 would be 55° 20’ 42.84” N, 160° 29’ 25.34” W and 55° 20’ 38.00” N, 160° 29’ 21.00” W for Turbine 2.

Figure 2-1. Location of project area and proposed wind turbine sites in Sand Point, Alaska.

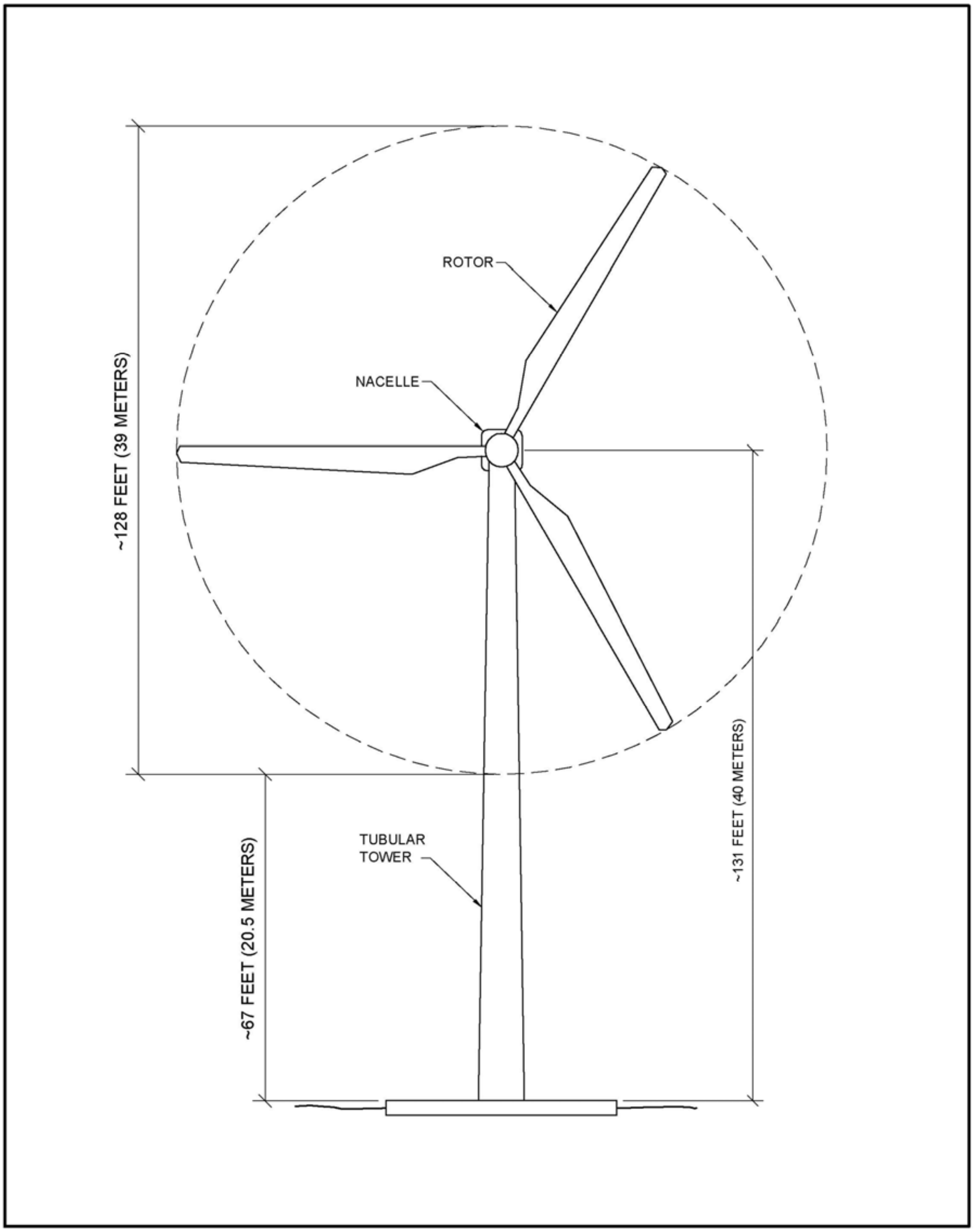

Figure 2-2. Schematic of a wind turbine of similar size to the proposed Vestas 39.

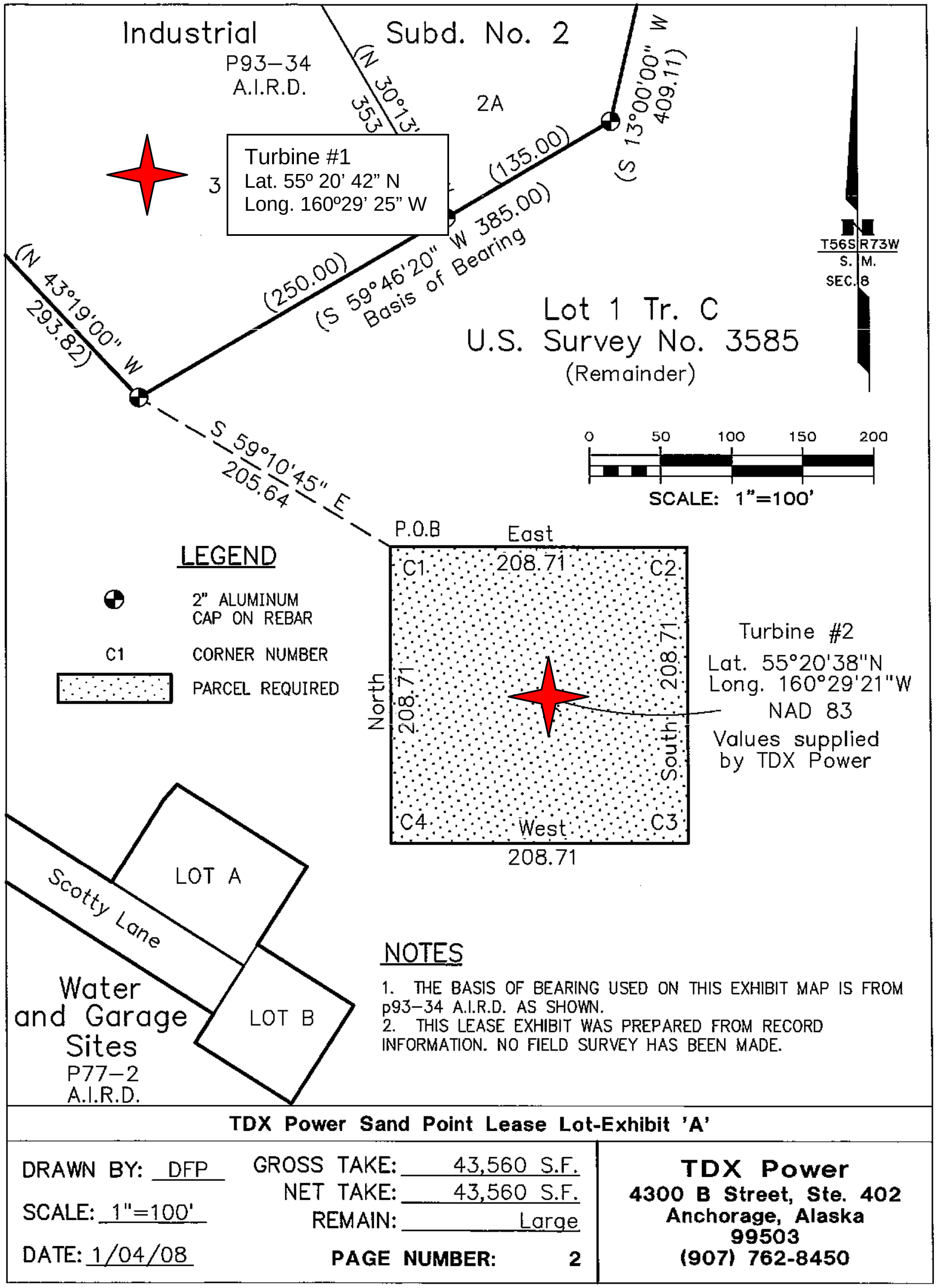

Figure 2-3. Proposed locations for Turbines 1 and 2.

2.1.2 Existing TDX Sand Point Generating Operations

TSPG and Sand Point electrical systems are isolated grid power systems. Fiscal year generation requirements in Sand Point amounted to 4,136 megawatt hours (MWh) in 2005 and 4,059 MWh in 2007. With additional load from the recently completed health clinic and the potential addition of Trident Seafoods to the grid, annual generation requirements are projected to increase to 4,779 MWh. Spread over 8,760 operational hours in a year, average projected generation requirements would be 546 kW per hour. The peak hourly demand in 2005 was 776.9 kW.

The existing power plant is a pre-designed insulated building made of structural steel. The power plant has a 480-volt switchgear that includes a breaker for each diesel-powered generator unit and a breaker for each of the outgoing feeder lines to the distribution system. The power plant also includes five generator sets that are mechanically installed and connected to a common bus. The generator set control system consists of seven cubicles of automated control assemblies. The diesel tank farm is situated 35 ft from the southwest corner of the structure and consists of two above-ground, double-wall steel tanks with under-ground feed and overflow return lines. The fuel transfer system consists of a 500-gallon steel day tank situated inside the power plant. The main fuel header feeds the day tank from an automatic float control. The secondary fuel header branches off to feed the engine/generator set. Diesel fuel for the power generating system is trucked 1.5 miles to the facility from a nearby seafood processing plant.

A plate and frame heat exchanger/heat recovery circuit is incorporated into the existing power generation system to provide space heat and domestic hot water for the adjacent office/apartment building. A conventional oil-fired boiler is located in the office/apartment building to act as a standby to the heat recovery system. Piping from the power generation system to the office building is underground.

2.1.4 Integration of Wind Power with Existing Diesel Power

AWE proposes to integrate a high penetration wind power production system with the existing Sand Point diesel-generator power plant. Since wind velocities are variable over time, power produced by wind turbines may fluctuate substantially over short periods. Wind-diesel hybrid systems therefore require active system controls to increase or reduce diesel-generated power quickly to accommodate the changes in wind power and keep power levels consistent. Without such active controls, wind-generated power could potentially exceed the load demand at high wind speeds, causing the engines to be back-driven and the power distribution system to become unstable.

The proposed power system would operate in diesel mode during periods of no wind, in wind-diesel parallel mode during moderate wind speed periods, and in full diesel-off, wind-only mode during high wind periods. When the diesel generator is shut off, a synchronous condenser provides reactive power to the grid to maintain voltage stability. Because the diesel generators cannot absorb significant excess wind turbine power, power control requires the addition of an active load element, herein defined as a secondary load tank (a hot water storage system). During wind-only operating mode, the secondary load tank acts as a load-shedding sink for all excess-to-load wind energy as it occurs during high wind conditions. Typically heated to 170-190°F, the fluid mixture of water and additives can then be pumped from the power house through a radiator network, reducing or in some cases eliminating the need for furnace fuel.

To apply this design in Sand Point, AWE would use two fully reconditioned 500 kW Vestas V39 wind turbines, the existing Caterpillar 3512 diesel generator currently in service, and a new Caterpillar 3456 diesel generator. The power plant switchgear was upgraded in 2004, so only minor modifications to the control system would be required. The addition of two V39 wind turbines into the existing facility would require the integration of several hardware components and control cabinets inside the power plant. Space would be required for the synchronous condenser and controller, a wind system controller, and the secondary load tank. One Caterpillar 379 standby diesel generator from the power plant would be removed to make room for this equipment. The control cabinets would be located in an enclosed area in close proximity to the wire trough, engines, and synchronous condenser. In addition, the secondary load tank would be located close to the power plant to ensure a quick response between the tank and the secondary load controller.

The proposed power system would consist of the following components (Figure 2-4):

- two 500 kW Vestas V39 wind turbines;
- one low load, high efficiency Caterpillar D-3456 diesel generator;
- one synchronous compensator to provide reactive power support;
- one demand device and automated load control;
- one thermal tank secondary load control and binary load control for the power plant; and
- one supervisory management control.

2.1.5 Construction and Installation

The construction and installation phase of the Proposed Action would begin after all required authorizations are obtained from DOE and any other federal, state, or local regulatory agencies. The turbines have been purchased by AWE and are waiting for a retrofit prior to final installation. The wind turbine installation, including site preparation, erection, and final commissioning, power plant systems upgrades, new generator installation, and overall systems tie-in and start-up is planned to be completed within four months of project start. Final project close out and operator training would be expected to be completed within one month of the wind turbine installation.

Each proposed turbine site would require 64 ft^2 for the turbine foundations and would require some clearing of vegetation prior to installation. A single access road less than 1/4 mile long would cross the lot owned by TSPG and lead to both turbines. Turbine 1 would be constructed on Lot 3, which is currently vacant and leased by TDX. This location is approximately 335 ft away from the Turbine 2 site, which has previously been partially cleared for the installation of an anemometer tower. Turbine 2 would be placed on the existing anemometer location. The total site area that would be affected by the construction and installation phase is approximately two acres.

TDX would use a construction crane to remove two old, non-functioning wind turbines and their support towers (known as the Harry Foster towers) on adjacent property. As these towers are often used by perching birds, including bald eagles, their removal would help mitigate potential bird collisions and improve safety considerations at the site (see Section 3.5).

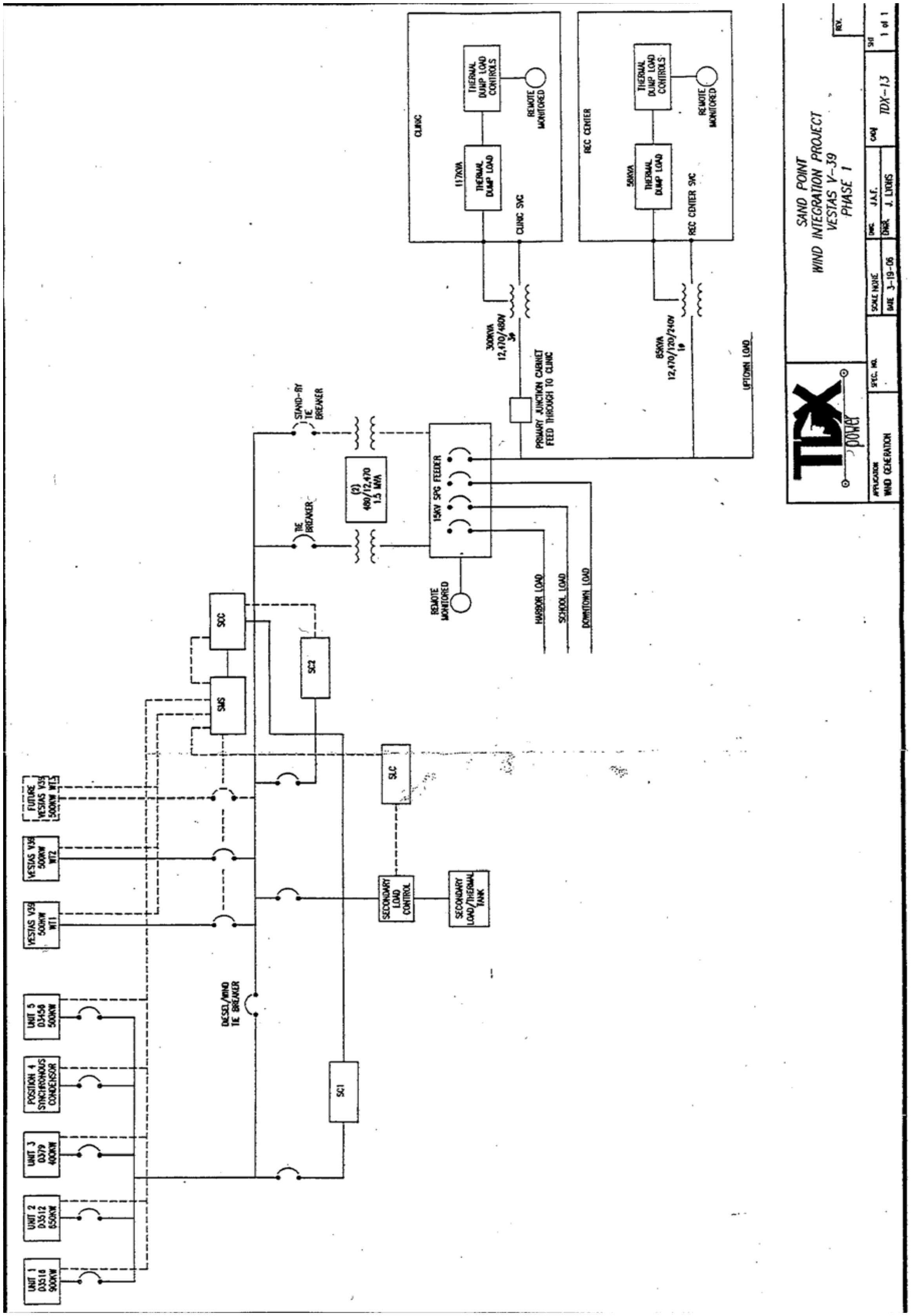

Figure 2-4. TDX electrical integration schematic

2.1.6 Wind Turbine Operation

As verified by TDX Power's Saint Paul Island project, the high penetration design has been demonstrated to function with utility grade reliability and efficiency. Experience shows equipment failure is most likely to occur during initial start-up through to the end of the first year of operation. Operations through the second and third years typically involve scheduled component changes, which would follow the recommended protocol specified by the manufacturer. Often for new generation facilities, the most critical period for equipment maintenance occurs in the fourth and fifth year of operation. During this period, the AWE would adjust parts inventory to address local experience and historical failure trends. The long-term operation and maintenance required for the wind component addition in Sand Point would create a critical new consideration for the utility. Without a systematic maintenance regime performed by knowledgeable technicians, total system performance would rapidly degrade. In addition to ongoing training and support programs, AWE would maintain a full inventory of spare parts.

AWE signed a turbine purchase contract that includes:

- installation according to manufacturer guidelines;
- on-site start-up performed by turbine vendor, which includes testing and configuration of all turbine sensors, motors, generators, and controllers; and
- regularly-scheduled maintenance.

2.2 PERMITS AND AUTHORIZATIONS

Prior to construction, the AWE/TXD would ensure compliance with all required federal and state permits and approvals (Table 1-1).

Table 1-1. Required agency permits and approval types

Agency	***Permit/Approval Type***
Federal	
U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act (ESA), Section 7 Consultation
Federal Aviation Administration (FAA)	FAA Aeronautical Determination
Environmental Protection Agency (EPA)	National Pollutant Discharge Elimination System (NPDES) Construction General Permit
State	
ADNR, State Historical Preservation Office (SHPO)	National Historic Preservation Act (NHPA), Section 106 Review
Department of Environmental Conservation (DEC)	Stormwater Pollution Protection Plan (SWPPP)

2.2.1 Air Safety Determination

Due to the proximity of the local airport, the FAA and the DOD were contacted for comments and approvals (Appendix D).

The FAA made a "Determination of No Hazard to Air Navigation" for the installation of Turbine 1. The aeronautical study revealed, "*The structure would have no substantial effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities.*" This determination was made provisional based on the conditions that the turbine be painted white and equipped with synchronized red lights in accordance with FAA Advisory circular 70/7460-1K, Obstruction Marking and Lighting (Chapters 4, 12, and 13), which specifies that each tower would have two bright red lights located at the top of the tower that flash 40-60 times per minute at night and during low light conditions. After subsequent review and consultation, it was determined that the additional proposed Turbine 2 would not interfere with air traffic as long as the same paint and lighting conditions specified for Turbine 1 are implemented. Both of these determinations are according to an Obstruction Evaluation/Airport Airspace Analysis, located on the Internet at https://oeaaa.faa.gov/oeaaa/external/portal.jsp. The determinations for Turbine 1 and Turbine 2 were completed on April 12, 2007 and May 17, 2007, respectively. Extensions for these determinations were granted on October 21, 2008.

The U.S. Air Force has coordinated a review of the proposed installation of one 500 kW wind turbine in the community of Sand Point. As a part of this review, the DOD consulted the Air Force's Headquarters Range and Air Space Division, which concluded that the proposed installation would have no impact on military training conducted by DOD components. Because the DOD reviewed only Turbine 2 during the initial consultations, a review of Turbine 1's potential impacts on military training would be completed within the 30-day review period for this EA.

2.3 No Action Alternative

Under the No Action Alternative, AWE/TDX would continue to produce electricity from the existing diesel generators and therefore the potential fuel and economic savings associated with the wind-diesel hybrid system would not be realized. AWE/TDX would explore alternative energy technologies when funds become available.

2.4 Applicant Committed Measures

The applicant has made commitments to avoid or minimize impacts to the environment in constructing and operating the proposed project including:

- Areas of bare soil would be revegetated with native plant materials after construction to minimize soil erosion. Silt fences would be used as necessary to prevent runoff from disturbed areas from affecting adjacent areas.
- TDX will conduct post-construction surveys to assess the potential for bird collisions with the wind turbines and notify the USFWS immediately if any Endangered Species Act (ESA)-listed species are found during the post-construction mortality surveys and will consult with them regarding the need for any additional applicant committed measures.
- Anti-perching devices will be placed on each turbine nacelle (if necessary) to discourage perching or nesting on the turbines, which would greatly increase the potential for bird collisions.
- Anti-perching devices will be installed on electric poles in adjacent areas to discourage perching and reduce the potential for electrocution, especially for bald eagles.
- The turbine towers will not have external ladders or other structures that would allow birds to perch anywhere near the turbine blades.
- TDX would remove the old Harry Foster towers at the time of construction, thus removing one of the most well-used perches for bald eagles and other resident birds in the area.
- Structures with guy wires will be avoided. The turbine towers will be self-supporting monopoles.
- Electric transmission lines from the wind turbines to the TDX power plant will be buried below ground.
- Lighting on the turbine towers will be limited to what is necessary for aviation safety, as determined by the FAA.
- A post-construction monitoring plan will be implemented for one year, starting immediately after construction, to determine if birds are killed by collisions with the turbines.

- If any historical or cultural resources are identified which have potential conflicts with the project, applicant committed measures will be developed to minimizing the potential impacts.
- All construction operations would occur during normal working hours.
- The construction and operation of the Proposed Action will comply with all required regulatory statutes set forth by federal, state, and local regulatory agencies, including FAA Advisory circular 70/7460-1K.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 LAND USE

3.1.1 Affected Environment

The Aleutians East Borough (AEB), of which Sand Point is the Borough Seat, includes approximately 15,000 square miles of the lower Alaska Peninsula and islands, and six communities within the Aleutian Islands chain. The year-round population of the AEB is approximately 2,500 with a seasonal influx for seafood processing. Commercial fishing provides the backbone of the AEB economy.

Land ownership on Popof Island is a mix of City, Alaska Native Corporation, and private. The Shumagin Corporation (the village Alaska Native Claims Settlement Act [ANCSA] Corporation) is the primary landowner in Sand Point. Sand Point's overall land use pattern has been shaped by its origins as a fishing community.

The existing power plant and proposed wind energy project sites are located in the Industrial Subdivision No.2, Lots 1, 2A, and 3, Plat No. 85-1, Aleutian Island Recording District. This location is accessible via the Sand Point local service road. The proposed wind turbines are located approximately two miles north of the Sand Point airport.

3.1.2 Environmental Consequences

3.1.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide the funding to AWE/TDX for the Sand Point Wind Project and it would not be built as a part of a Federal Action. There would be no additional impacts to existing land uses as a result of the No Action Alternative.

3.1.2.2 Proposed Action

In assessing land use impact, the Proposed Action was evaluated for consistency with land use plans and guidance, and compatibility with current and future land uses. The goal of this project was deemed consistent with the "City of Sand Point Comprehensive Community Development Plan (CCDP)" of September 2004, where Goal C is to, "Develop efficient and alternative energy supply and distribution systems" (URS Corp., 2004: 12).

Applicant Committed Measures

The Proposed Action would begin after all required authorizations are obtained from DOE and other federal, state, and local regulatory agencies. Each agency may require land use applicant committed measures as conditions of their authorizations or permits. No additional applicant committed measures or monitoring is recommended.

Residual Impacts

A total of two acres would be disturbed during the construction phase of the Proposed Action. Because the installation of the Proposed Action corresponds with the goals set forth by the CCDP there would be no residual impacts to land use and community development planning for the City of Sand Point.

3.2 COASTAL ZONE RESOURCES

3.2.1 Affected Environment

In 1972, the United States Congress passed the Coastal Zone Management Act (CZMA) to promote the orderly development and protection of the country's coastal resources. The CZMA established a voluntary partnership among the federal government, coastal states, and local governments to develop individual state programs for managing coastal resources. In 1977, the State of Alaska passed the Alaska Coastal Management Act (ACMA) and joined the partnership envisioned by the CZMA.

Sand Point is within the Port Moller district in the Southwest Region of the Alaska Coastal Zone. The coastal resources of Sand Point have been identified and analyzed in the Aleutians East Borough Coastal Management Plan (AEBCMP). The AEBCMP was developed in 1985 and was most recently updated in 2005 (AEB, 2005).

The AEBCMP includes a resource inventory and a resource analysis encompassing Sand Point's coastal resources. The resource inventory describes major land and water uses, natural resources, cultural resources, and land ownership. The resource analysis also includes a discussion of demands on coastal resources and habitats, conflicting uses, and sensitivity of uses and resources to development impacts. The AEBCMP resource inventory addresses energy resources that exist in the coastal zone and specifically addresses wind power generation. It further identifies potential barriers to the development of wind energy in the coastal district that include anticipated conflicts with migratory birds and endangered species and their designated Critical Habitat (see Sections 3.4 and 3.5). The Proposed Action site is not designated in the AEBCMP as important habitat, critical habitat, refuge, or sanctuary.

3.2.2 Environmental Consequences

3.2.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide the funding to AWE/TDX for the Sand Point Wind Project and it would not be built as a part of a Federal Action. There would be no additional impacts to coastal zone resources as a result of the No Action Alternative.

3.2.2.2 Proposed Action

An ACMP Coastal Project Questionnaire and a Certification Statement were submitted to the State of Alaska Department of Natural Resources April 4, 2007. A reply letter dated April 20, 2007, states that, "Based upon the information you have supplied, your proposed project does not require a State review for consistency with the Alaska Coastal Management Program (ACMP)."

Applicant Committed Measures

The construction and operation of the proposed wind system will be consistent with the AEBCMP. No additional applicant committed measures or monitoring is recommended at this time.

Residual Impacts

The construction and operation of the Proposed Action would not result in residual impacts to coastal resources.

3.3 VEGETATION AND SOILS

3.3.1 Affected Environment

The majority of the vegetation found on Popof Island in the Sand Point area is heath or dry shrub tundra. This is mainly composed of low and dwarf shrubs such as crowberry (*Empetrum nigrum.*), Labrador tea (*Ledum palustre*), and kinnikinnick berry (*Arctostaphylos uvi-ursa*). Taller shrubs include Sitka alder (*Alnus sinuate*), and several species of willows (*Salix spp*.). Sedges (Family *Cyperaceae)*, mosses, lichens, and a variety of native and non-native grasses grow throughout the area and provide ground cover. Except for a few Sitka spruce trees (*Picea sitchensis*), Popof Island is essentially treeless. Areas along the shoreline contain beach rye grass (*Loliumn arenaria*), beach arnica shrubs (*Arnica unalaschcensis*), alders (*Alnus spp*.), and low/prostrate willows (*Salix polaris*) (URS Corp., 2004).

The proposed site is located in a coastal tundra upland area. It consists mainly of low-growing alder thickets and a variety of grasses and forbs. These may include tufted hair grass (*Deschampsia caespitosa)*, Wainwright slender wheatgrass (*Agropyron pauciflorum)*, and alpine bluegrass (*Poa alpina)* with an additional mix of non-native plant species. Alder thickets are prevalent within the project site location and are typically found in the Alaska Peninsula coastal upland areas. Alders are sturdy and fast growing, even in acidic and disturbed sites.

Surficial soils are classified as dystric cryandepts and are typically located on hilly to steep terrain (Reiger et al., 1979). These are well-drained, thixotrophic (becoming fluid when disturbed) ashy soils consisting of deep to moderately-deep volcanic ash over glacial till or cinders. A thin layer of organic material of decomposed alder leaves and grass typically covers the surface.

3.3.2 Environmental Consequences

3.3.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide funding for the Sand Point Wind Project and the project would not be built as a Federal Action. There would be no additional impacts to vegetation or soils at the proposed turbine sites as a result of the No Action Alternative.

3.3.2.2 Proposed Action

Under the Proposed Action, approximately two acres would be cleared of vegetation or disturbed by the construction and installation of the two wind turbines. The shrub-tundra habitat that would be affected by this action is neither rare nor unique to the area and does not contain any critical habitat for any federally-listed threatened or endangered species. The area affected by the turbine foundations would be 64 ft^2 for each turbine. Access roads to the turbines would result in a permanent loss of approximately 0.2 acres of native vegetation, a portion of which has been previously disturbed.

Potential effects on the soil would include the increased erosion from loss of vegetation from clearing the site for the construction of the foundations and access road. However, the relatively low gradient of the sites would preclude soil erosion as a major issue and the potential for adverse effect on the soils is low.

Applicant Committed Measures

The operation and construction of the Proposed Action will comply with all required regulatory statutes set forth by DOE and other federal, state, and local regulatory agencies. Best Management Practices (BMPs) would be used as appropriate. Areas of bare soil will be revegetated with native plant materials after construction to minimize soil erosion. Silt fences would be used as necessary to prevent runoff from disturbed areas from affecting adjacent areas. No additional applicant committed measures or monitoring is recommended at this time.

Residual Impacts

Although portions of the sites would likely revegetate, the area affected by the turbine foundations and the access road would result in a permanent loss of approximately 0.2 acres. The remainder of the affected area would be maintained by mechanical cutting of brush to keep vegetation in a relatively low stature to facilitate documentation of bird collision mortality.

With the use of BMPs during construction and revegetation of the exposed soil following construction, impacts to the native soils in the area would be minor.

3.4 THREATENED AND ENDANGERED SPECIES

3.4.1 Affected Environment

The ESA protects federally-listed threatened and endangered plant and animal species and their critical habitats. Endangered species are those that are in danger of extinction throughout all or a significant portion of their range. Threatened species are those that are likely to become endangered in the near future throughout all or a significant portion of their range. There are several marine bird and mammal species that are protected under the ESA that occur in the Sand Point area.

Steller’s eider (*Polysticta stelleri*) (Alaska breeding population) is currently listed as threatened. They are highly dependant on the health of lagoons and bays that promote the growth of eelgrass beds. Eelgrass communities are among the most diverse and productive in the world, providing food and nursery areas for fish, crabs, and many other invertebrates. The invertebrates, in turn, provide an essential food base for Steller's eider and other species (USFWS, 2009). The Consultation Guide for Alaska’s Threatened and Endangered Species (USFWS, 2004) states that Sand Point is located in a molting and wintering range for Steller’s eider and that more than 1,000 eiders may winter in the marine waters surrounding Popof Island in any given year. Sand Point is not in designated critical habitat for Steller’s eider, although the Nelson Lagoon critical habitat area is located approximately 50 miles from Sand Point on the north side of the Alaska Peninsula (USFWS, 2004).

The short-tailed albatross (*Phoebastria albatrus)*, is listed as endangered under the ESA. Although the short-tailed albatross has been seen along the Gulf of Alaska shelf south of Popof Island, it is a highly pelagic species that occurs almost exclusively in open waters well away from the coast (USFWS, 2004).

Several species of ESA-listed marine mammals occur in the waters surrounding Sand Point. The waters around Sand Point are designated critical habitat for the western stock of Steller sea lions (*Eumetopias jubatus*), which is listed as endangered (NMFS, 1993). Several species of endangered whales could also occur, although there are no designated critical habitats for these species near Sand Point. The southwest stock of northern sea otter (*Enhydra lutris kenyoni),* is listed as threatened. The USFWS has proposed critical habitat for this population in nearshore waters, including Humboldt Harbor adjacent to Sand Point (USFWS, 2008). The USFWS would review public and other agency comments on the proposal before finalizing the critical habitat designation.

The USFWS has oversight responsibility for ESA-listed birds and sea otters. The National Marine Fisheries Service (NMFS) has oversight responsibility for ESA-listed Steller sea lions and whales.

3.4.2 Environmental Consequences

3.4.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide funding for the Sand Point Wind Project and the project would not be built as a Federal Action; therefore, there would be no impacts to ESA-listed species or their critical habitat as a result of the No Action Alternative.

3.4.2.2 Proposed Action

The proposed wind turbine installation site is at an elevation of 164 ft and approximately 1/4 mile from the closest marine waters; there is no marine component to the project. The project would therefore be unlikely to have any effects on any ESA-listed marine mammals or their critical habitats.

The two listed bird species are also marine species and rarely, if ever, fly over land except during the nesting season. Short-tailed albatross nest in Japan, while Steller's eiders nest in tundra on Alaska's northern coast and Yukon-Kuskokwim Delta as well as northern Russia (USFWS, 2004). It is therefore unlikely that either species would collide with inland/upland structures in Sand Point, including the proposed wind turbines.

In fulfillment of their obligations under Section 7 of the ESA, DOE initiated informal consultation with the USFWS regarding the potential impacts of the proposed project on listed species. In a letter dated March 10, 2009, DOE described the proposed project and assessed the potential effects on listed species. In their reply, dated March 11, 2009, USFWS concurred that the proposed project was "not likely to adversely affect" Steller's eiders or their critical habitat and "would have no adverse affect" on any other listed species (Appendix D).

Applicant Committed Measures

The USFWS has recommended that TDX conduct post-construction surveys to assess the potential for bird collisions with the wind turbines (see Section 3.5). These surveys would help reduce uncertainty regarding potential adverse effects to listed species. TDX would notify the USFWS immediately if any ESA-listed species are found during the post-construction mortality surveys and would consult with them regarding the need for any additional applicant committed measures.

Residual Impacts

The proposed project is not expected to have any residual impacts on any ESA-listed species.

3.5 BIRDS

3.5.1 Affected Environment

In response to public scoping, including recommendations of the USFWS (E. Lance, personal communication, April 14, 2007), and in compliance with DOE procedures, an avian monitoring program was implemented during the pre-construction phase of the Proposed Action. The program includes observations of all bird species near the proposed turbine sites, with particular concern regarding the vulnerability of bald eagles to potential turbine strikes, and a search for bird carcasses near the existing meteorological station (MET) tower. The pre-construction surveys are designed to determine the prevalence and behavior of birds, including bald eagles, in the immediate vicinity of the proposed turbine locations. This program is intended to help the project avoid violating the provisions prohibits bird mortality ("take") in the Migratory Bird Treaty Act (16 U.S.C. §§ 703-712) and the Bald and Golden Eagle Protection Act of 1972 (16 U.S.C. 668-668c).

Trained avian monitoring technicians have been responsible for making avian and carcass/scavenger observations as established in the avian monitoring program protocol (Appendix E). Table 3-1 summarizes the results of observations made from December 6, 2006 through August 17, 2007 and from October 20, 2008 through March 25, 2009.

Table 3-1. Summary of bird observations[1] from the proposed wind turbine site by season[2].

Species	Winter (n=23)	Spring (n=9)	Summer (n=8)	Fall (n=10)
Bald eagle	1.48	0.89	0.75	0.50
Black-billed magpie	0.70	0.44	0.38	0.60
Common raven	0.26	0.22	0	0.10
Northwest crow	1.17	0	0	0
Passerine spp.	0.09	0	1.00	0.60
Gull spp.	0	0.22	0.13	0

Note: Data are mean numbers of birds seen per observation period during each season
[1] This table includes all observations up to March 25, 2009
[2] Winter = November through March, Spring = April through May, Summer = June and July, Fall = August through October
n = number of observation periods

The marine waters off Popof Island support a variety of marine birds such as loons, grebes, alcids, gulls, and sea ducks. With the exception of gulls, these species rarely, if ever, fly over land except at their nesting grounds.

Bald eagles are common residents of the Sand Point area and are protected under the Bald and Golden Eagle Protection Act. This act prohibits anyone, except under permit from the Secretary of the Interior, from "taking" bald eagles, their eggs, nests, or any other parts of the birds. The Act defines "take" as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb." Because of the absence of trees in this region, bald eagles are ground-nesters and nest along the coast using rock pinnacles (sea stacks) and other area inaccessible to land predators. Because the project site is inland from the coast and within a developed area, nesting bald eagles are not a concern for this project.

3.5.2 Environmental Consequences

3.5.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide funding for the Sand Point Wind Project and the project would not be built as a Federal Action. There would be no additional impacts to birds as a result of the No Action Alternative.

3.5.2.2 Proposed Action

The avian monitoring program results indicate that very few species of birds appear to use the proposed installation site on a regular basis. Bald eagles have been seen in small numbers in the area, usually perched on the old, dysfunctional, wind turbines across the road from the proposed installation site (known as the Harry Foster towers or Foster windmills). Black-billed magpies, northwestern crows, and common ravens were often observed landing on the ground at the proposed installation site or on the anemometer tower guy wires. No bird or bat mortalities were documented near the MET from the carcass searches during the pre-construction avian monitoring program. The avian monitoring program did not produce sufficient data to characterize flight patterns (elevations and directions) for any species in the project area. However, all of the observed species are common residents in populated areas throughout Alaska and antidotal observations suggest they generally habituate to and avoid collisions with various human structures, such as communication towers and electric power lines.

Bureau of Land Management (BLM) recently completed a Programmatic Environmental Impact Statement on wind power development in the western states, excluding Alaska (BLM, 2005). No similar document has been prepared for Alaska. The BLM document compared bird abundance and post-construction mortality studies at numerous existing wind farms across the country and found that there was little correlation between species that are present in an area and those that are killed in collisions with wind turbines. The document concluded that not all species are prone to collisions at wind farms, probably through a combination of their typical flight patterns, their abilities to perceive the turbines, and their abilities to avoid the turbines. The BLM document notes that no bald eagles have been reported to be killed at any wind power farm in the western states. Corvids (ravens, crows, and magpies) are also apparently able to avoid collisions judging by their common frequency of occurrence versus their rare frequency of mortality. Erickson et al. (2001) also compared bird mortality rates at various wind developments and found a similar pattern: no bald eagles killed and relatively few ravens killed.

The proposed turbine site is approximately 1/3 mile from coastal waters and sits at an elevation of 164 ft, making it unlikely for any marine species to use the area near the turbine sites. No waterfowl or seabird species were observed at the proposed project site during the avian monitoring program. The proposed turbine sites are not within a major migration corridor and there are no major waterfowl staging areas nearby.

Wind turbines are known to cause some degree of mortality to individual birds. The national average collision-related mortality for birds at wind farms is low (<3 birds/turbine/yr; Erickson et al., 2001). Collision mortality rate for birds based on rotor sweep area (RSA) for western and Midwestern wind farms is 1.1 to 5.6 birds/3,000 m^2 and as measured by MW of the turbines, the collision mortality rate ranges from 0.9 to 4.7 birds/MW (Erickson, 2003). The two Vestas 39 wind turbines are rated at 500 kW and have a RSA of 12,863 ft^2 (1,195 m^2), therefore the mortality rate would be expected to be between 0.5 and 2 birds /turbine/year base on the RSA and between 0.5 and 2.4 birds/turbine/year based on MW.

Based on the location of these two turbines inland from the coast and at a higher elevation, the low occurrence of birds in the general area from the avian monitoring program, and the low susceptibility to collision-related morality for the common birds that use the area (i.e. bald eagles and corvids), avian collision mortality as a result of the Proposed Action is expected to be low and not adversely affect any local bird populations.

Applicant Committed Measures

The USFWS has published interim guidelines for wind power projects to minimize the potential risks of bird fatalities due to collisions (USFWS, 2003). Many of these guidelines pertain to siting considerations and are more pertinent to much larger projects. However, the following recommendations would be implemented:

- Anti-perching devices would be placed on each turbine nacelle (if necessary) to discourage perching or nesting on the turbines, which would greatly increase the potential for bird collisions.
- Anti-perching devices would be installed on electric poles in adjacent areas to discourage perching and reduce the potential for electrocution, especially for bald eagles.

- The turbine towers would not have external ladders or other structures that would allow birds to perch anywhere near the turbine blades.
- TDX would remove the old Harry Foster towers at the time of construction, thus removing one of the most well-used perches for bald eagles and other resident birds in the area.
- Structures with guy wires would be avoided. The turbine towers would be self-supporting monopoles.
- Electric transmission lines from the wind turbines to the TDX power plant would be buried below ground.
- Lighting on the turbine towers would be limited to what is necessary for aviation safety, as determined by the FAA.
- A post-construction monitoring plan would be implemented for one year, starting immediately after construction, to determine if birds are killed by collisions with the turbines.

The post-construction monitoring plan would sample for potential seasonal variations in bird collisions, with an emphasis on the fall and spring migration seasons when bird activity is expected to be highest. Searches would be conducted at a frequency that minimizes the potential for bias from scavengers. The following elements would be incorporated into the post-construction monitoring plan:

- Surveys would be conducted two times per week in three consecutive weeks during spring and fall sampling periods and one time per week in four consecutive weeks during winter and summer sampling periods.
- The spring sampling period would consist of six surveys during the main migration season (~April 15 to ~May 31).
- The summer sampling period would consist of four surveys during the main breeding season (~June 1 to ~August 10).
- The fall sampling period would consist of six surveys during the main migration season (~August 11 to ~October 10).
- The winter sampling period would consist of four surveys during the non-breeding season (~October 11 to ~April 14).
- Surveys would be conducted by trained observers who would record their name, date, time, and standard weather variables.
- Each survey would include a search for dead or injured birds beneath each turbine tower, conducted on foot by slowly walking transect lines approximately 25-30 ft apart, looking about 12-15 ft on both sides of the transect line. Each set of transects would cover a search area defined as one-half of the maximal height of the rotor-swept area (California Energy Commission and California Department of Fish and Game [CEC/CDFG], 2007), which is about a 100 ft radius around each tower (tower height is about 130 ft agl and the turbine blades are about 130 ft in diameter, thus putting the upper reach of the turbine blades at 195 ft agl). This search pattern is estimated to require about 40 minutes for each tower.
- If any bird is found, data would be collected on its position relative to the tower, species (if possible), condition of the carcass, and evidence of scavenging. AWE/TDX would establish a file for all search results, including records for searches when no birds were found.

Residual Impacts

The USFWS recognizes that there may be some bird collisions with wind turbines even if all of their recommended applicant committed measures are followed (USFWS, 2003). Given the relatively low numbers of species and birds that have been observed to use the project area, the potential for future bird fatalities as a result of the Proposed action is considered to be very low. The actual level of collision-related mortalities would be monitored by conducting a post-construction monitoring study at the wind turbines to determine the numbers and species of birds killed by collisions with the wind turbines or towers. If post-construction monitoring indicates that bird collision rates are higher than expected or occur under particular conditions or seasons, additional applicant committed measures would be taken to reduce residual effects.

3.6 CULTURAL RESOURCES

3.6.1 Affected Environment

Cultural resources are the nonrenewable physical remains of past human activity and are protected under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, the Archaeological Resources Protection Act of 1978, as amended, and other laws and regulations. Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on "historic properties", which include those cultural resources (prehistoric, historic, and ethno-historic) that are listed in or eligible for listing in the National Register of Historic Places (NRHP).

The majority of the known archaeological resources of the Alaska Region date between roughly 11,500 years before present and the arrival of the Russians and Europeans (circa AD 1750). Prehistoric interactions during this period are characterized by sites reflecting the movement of people, ideas, and goods back and forth across the Bering Strait. The area that is now Sand Point was influenced by this cultural exchange.

The Aleuts subsisted by open-water hunting and fishing and occupied a large area ranging from the tip of the Alaska Peninsula westward throughout the Aleutian Islands. The Aleut Tradition of maritime hunters developed over time and remained strong until the invading Russians disrupted many Native communities in the late 18th century. Historic and ethno-historic settlements of the Native peoples of Alaska are part of a remembered past and often have traditional cultural value to Native Alaskans. Many traditional lifestyles, with various modifications, continue today.

For this proposed project, tribes and/or individuals were contacted and their comments were solicited regarding any potential conflicts with historical and cultural resources. Connie Fredenberg and Bruce Wright, both of APIA, visited all three tribal offices in this region and spoke with Council Presidents, Tribal Administrators, and Environmental Coordinators on December 5, 2006. The proposed project has been discussed at APIA board meetings for over two years. All of the Tribes that may have concerns are represented on the APIA board. One response has been received as a result of these contacts.

The President of the local Qagan Tayagungin Tribe commented that the area is not considered to possess any unique ethnic cultural value and is not used for subsistence or religious purposes. This is the only Tribe in the area that is originally from Sand Point. The Pauloff Harbor Tribe is originally from Sanak Island and the Unga Tribe is from the Shumagin Islands.

A Class I records search was conducted by APIA at the Alaska Office of History and Archaeology to determine the nature and extent of prior archaeological investigations in the Sand Point area. An area within two miles of three different potential turbine sites (all within the community of Sand Point) was examined. Extensive land surveys have been undertaken near the project area for road and housing construction and one historic property, outside the project area by nearly 1/2 mile, was noted. The property is a Russian Orthodox Church, which was listed in the National Register as part of a Thematic Nomination for the Russian Orthodox Church on June 6, 1980. There is also a dilapidated modern cabin on the north side of Mud Bay, more than one mile away from the chosen site, which was recorded in

1989. There are other reported archaeological sites on Popof Island, but they are located a minimum of four miles from the proposed project area.

3.6.2 Environmental Consequences

3.6.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide funding for the Sand Point Wind Project and the project would not be built as a Federal Action. There would be no ground disturbance at the site and, therefore, no impacts to any cultural resources as a result of the No Action Alternative.

3.6.2.2 Proposed Action

Cultural resource concerns specific to the proposed project area were discussed in a meeting between APIA and Ms. Joan Dale, staff archaeologist with the Alaska Office of History and Archaeology, in September 2006. Ms. Dale stated that the proposed project area is likely devoid of any unrecorded historic properties and is considered low in cultural resource sensitivity. This opinion is based upon the disturbed nature of the area and the lack of findings from previous cultural resource studies in the project vicinity.

On February 1, 2007, DOE sent a letter to Ms. Judith E. Bittner, Alaska SHPO requesting concurrence with a Finding of No Historic Properties Affected for the proposed project site. This request was based on the findings of the Class I records search and the other consultations described above. A response from the SHPO was received on March 9, 2007, stating concurrence with DOE’s recommendation (File 3130-1R Dept. Energy).

Applicant Committed Measures

With respect to resources of Native Alaskan traditional cultural significance, the Native Alaskan community has been informed of the project during the scoping process and their input has been solicited, as described above. DOE is making this EA available to the individual Tribes on the APIA board that may have concerns, along with a request for formal consultation regarding this project. DOE expects a response within the 30-day review period for this EA. If any historical or cultural resources are identified which have potential conflicts with the project, applicant committed measures will be developed to minimizing the potential impacts.

The operation and construction of the Proposed Action would comply with the regulatory statutes set forth under NHPA to protect cultural resources; no additional applicant committed measures or monitoring is recommended at this time.

Residual Impacts

At this time, the Proposed Action is not anticipated to result in any unavoidable adverse residual impacts to identified cultural resources.

3.7 NOISE

3.7.1 Affected Environment

The most common unit of measure used to describe the magnitude of sound levels is the decibel (dB). Sound levels are often stated in terms of decibels on the A-weighted scale (dBA), which is weighted to reflect the sound frequency range of human hearing.

The dBA scale is used extensively in the United States (U.S.) to measure community and transportation sound levels, which decrease with distance from the source. Typical sound levels include about 110 dBA for construction noise, 90 dBA for a heavy truck accelerating, 60 dBA for a conversation, and 50 dBA for a quiet office.

Global Energy Concepts (GEC) was contracted to perform a visual and sound impact analysis report for the proposed project (GEC, 2006, Appendix F). Since background noise measurements had not been taken at the turbine site, GEC modeled three background levels: 40 dBA, 50 dBA, and 60 dBA. Both low wind speed and high wind speed impacts were modeled using wind speeds of 4.0 meters per second (m/s) (9 miles per hour [mph]) and 8.0 m/s (18 mph), respectively, at a height of 10 m (33 ft) agl.

3.7.2 Environmental Consequences

3.7.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide funding for the Sand Point Wind Project and the project would not be built as a Federal Action. There would be no additional noise impacts at the project site as a result of the No Action Alternative.

3.7.2.2 Proposed Action

During construction of the turbine towers, sound frequencies and levels would depend on the specific construction equipment used, the amount of equipment operating simultaneously, and hours of operation. It is anticipated that typical construction equipment would be used and that the hours of operation would occur only during normal working hours. In addition, it is anticipated that the construction activities would occur over a relatively short period.

The GEC report states that when operating, wind turbines produce a "swishing" or "whooshing" sound as their rotating blades encounter turbulence in the passing air, as well as some sounds from the mechanical parts such as the gearbox, generator, and cooling fans. At a distance of approximately 600 to 900 feet, the sounds generated by a wind turbine are frequently masked by the "background noise" of winds blowing through alders and brush or moving around obstacles. Wind turbines are typically quiet enough for people to hold a normal conversation while standing at the base of the tower (GEC, 2006).

The GEC report identified three representative receptor sites (structures or areas where people are often or consistently gathered and that may be affected by chronic sound levels) that would have potential impacts from the Proposed Action. One site is the local schoolhouse (H1) and the other two (H2 and H3) are private residential properties (Figure 3-1). The closest receptor site location is identified as H2 and is approximately 1/4 mile from the project location.

The findings of the sound impact analysis indicate that the wind turbines would produce sound levels of no more than 60 dBA at the project boundaries. The study also evaluated expected changes in sound level at the three receptor sites and concluded that the change to the background sound levels at these locations would be minimal. However, due to its close proximity to the wind turbines, the H2 receptor has the potential to be impacted by sounds from the wind turbines, depending on existing background noise conditions. If background sound power levels are 40 dBA, the H2 receptor would experience a 6 dBA increase in sound pressure level due to the wind turbines, which could represent a "noticeable difference" to the homeowner. Whether or not this difference is considered an annoyance is subjective. However, if the background sound of the wind, diesel power plant, or other community activities is 50 dBA, the additional sound from the wind turbines would not be perceptible.

Community sentiment (Appendix C) was gauged regarding the expected noise level of wind turbines at the Sand Point Electric Utility site. Opinion was unanimously in favor of installing the turbines.

Applicant Committed Measures

Manufactures of construction equipment are required to adhere to noise standards. These standards make it unlikely that excessive noise would be generated from the construction operations. All construction operations would occur during normal working hours. No other applicant committed measures are recommended at this time.

Residual Impacts

Daily turbine operation is expected to generate residual noise impacts. However, based on the GEC sound analysis report, the noise levels would be low to potential receptor sites (GEC, 2006) and would be considered to have minor impact.

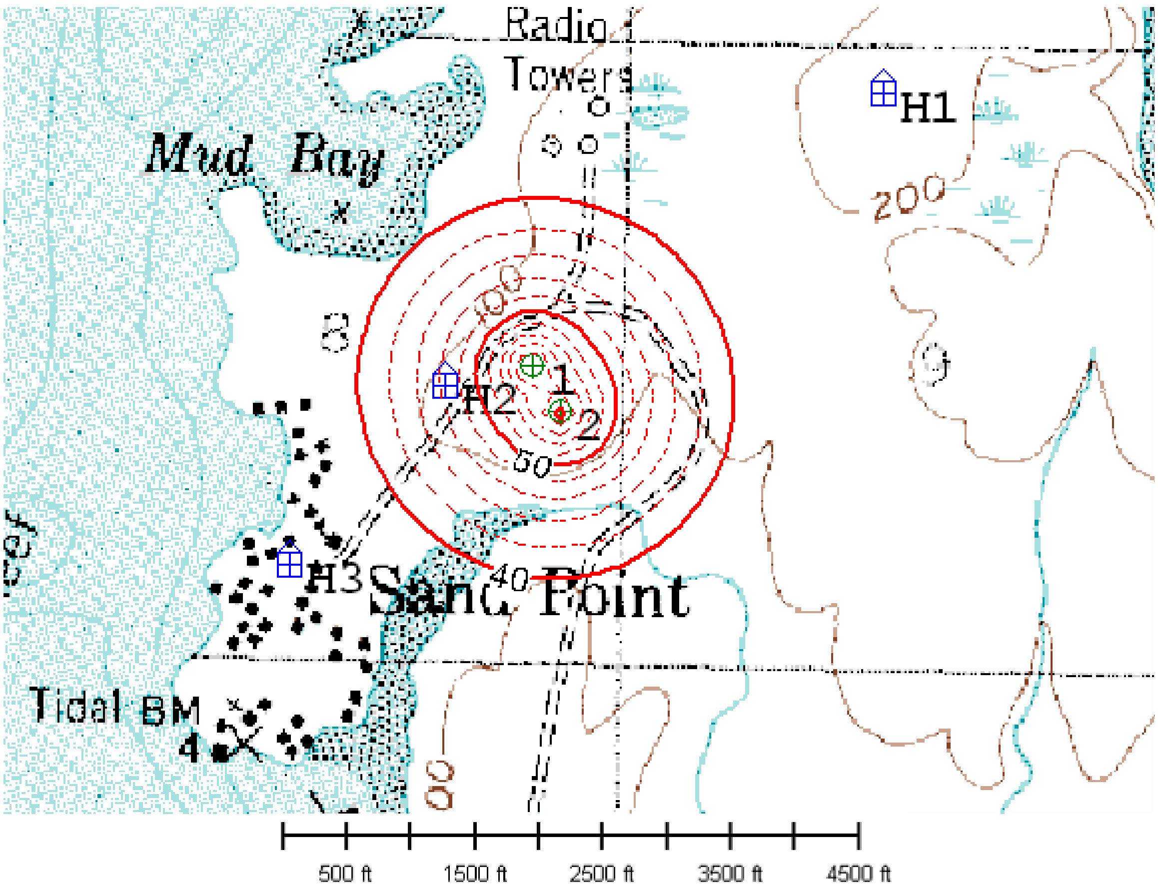

Figure 3-1. Locations of the proposed turbines (1 and 2), the representative receptor sites (H1 – H3), and projected sound levels under typical operating conditions. At the base of each turbine, sound levels are projected to reach approximately 58 dBA. The solid red circles indicate the distances from the turbines where the sound levels would attenuate to 50 dBA and 40 dBA.

3.8 VISUAL ENVIRONMENT

3.8.1 Affected Environment

The proposed wind turbines would be located on a relatively high point (164 ft elevation) and the view from the site generally provides a 360-degree perspective of portions of the City of Sand Point, Humboldt Harbor, and the nearby mountains. This tower would have a hub height of 131 ft and the rotors would be 128 ft in diameter, therefore, the height at the top of the blade (top of the sweep area) would be approximately 195 ft agl. Both turbines would be visible from most of the area surrounding Sand Point and add a strong vertical element to the landscape. There are no existing functioning wind turbines in Sand Point but an anemometer is present on the TDX property nearby. In addition, there are two old wind generator towers on the property of Harry Foster near the proposed site locations.

GEC was contracted to perform a visual impact analysis report for the proposed project (GEC, 2006). Photographs taken from various reference points throughout Sand Point (Figure 3-2) were used to create photo simulations of the proposed turbine installation from various viewpoints and oriented toward the proposed turbine site (Figures 3-3 to 3-7).

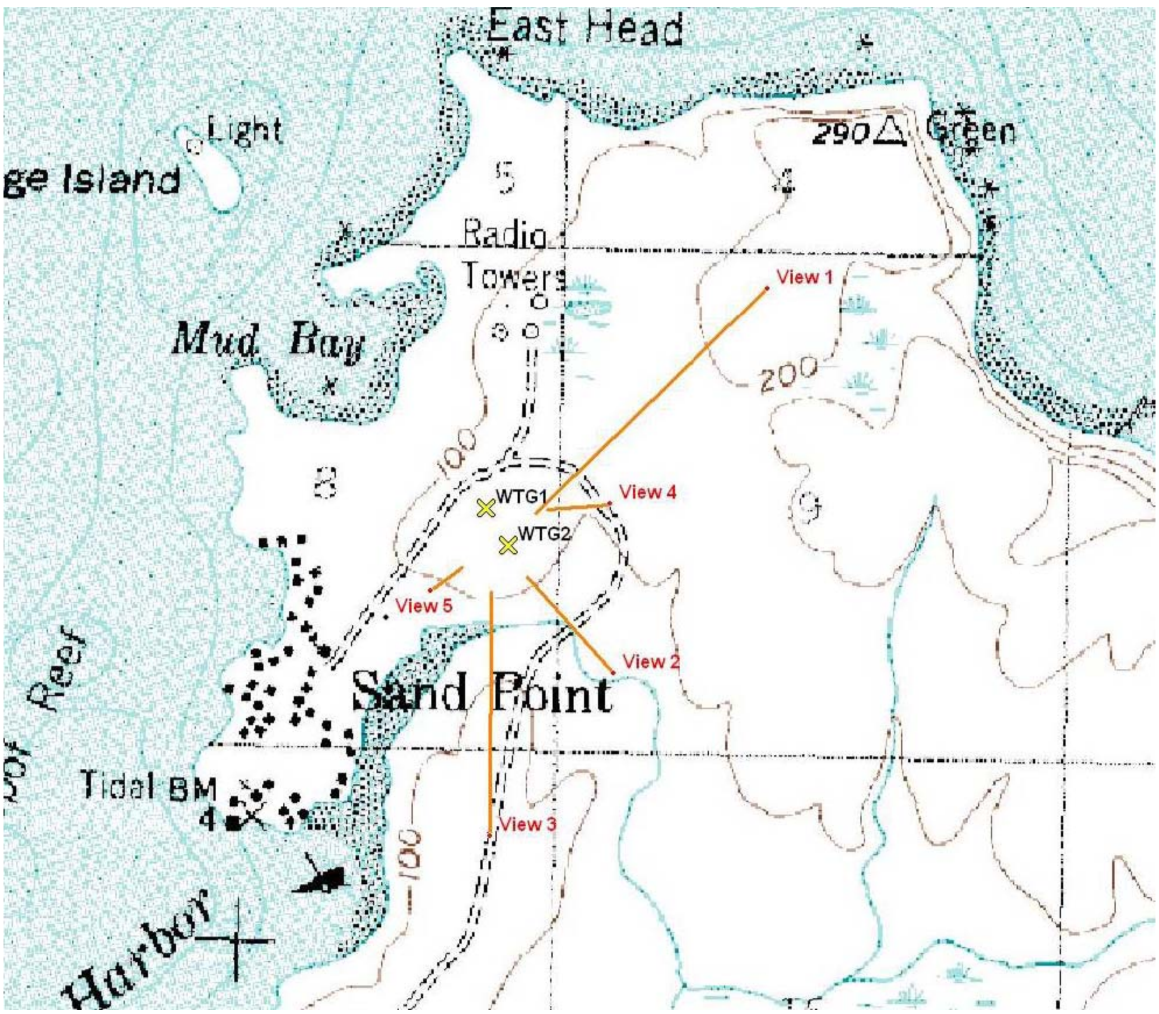

Figure 3-2. Locations of the proposed wind turbines and the viewpoints used in the visual impacts study (GEC, 2006).

3.8.2 Environmental Consequences

3.8.2.1 No Action Alternative

Under the No Action Alternative, DOE would not provide funding for the Sand Point Wind Project and the project would not be built as a Federal Action. There would be no additional visual impacts to the project site as a result of the No Action Alternative.

3.8.2.2 Proposed Action

The wind turbines would be visible from much of the area surrounding the Sand Point community. Visual simulations from five viewpoints around the community are presented in Figures 3-2 though Figure 3-7. The wind turbine's visibility could be influenced by the color choice, which at this point would be the commercial standard off-white. However, only one turbine of the two turbines is visible from a residential area, located less than 1/4 mile southwest of the proposed turbine sites because this area is slightly below the hill on which the turbines would be located. The furthest viewpoint, (view 3) a little over 1/2 mile to the northeast at the school, shows both turbines would be clearly visible from this distance. No photo simulations were created from viewpoints west, northwest, and north of the proposed turbine locations because these areas are uninhabited.

Figure 3-3. Photo simulation from the southwest corner of the school looking southwest (View 1)

Figure 3-4. Photo simulation from the south side of the pump house pond looking northwest (View 2)

Figure 3-5. Photo simulation from power pole #43 looking north (View 3)

Figure 3-6. Photo simulation from the SDP Fisheries building looking west (View 4)

Figure 3-7. Photo simulation from residential area southwest of the turbine site looking northeast (View 5)

Both towers would also comply with FAA Advisory circular 70/7460-1K, Obstruction Marking and Lighting, which recommends air-safety markings and lighting schemes for structures such as wind turbines. The FAA has determined that both towers should be white and have synchronous flashing red lights to make them easily visible to local aircraft. This would also increase visibility of the turbines from all viewpoints, especially at night and during inclement weather.

Applicant Committed Measures

The construction and operation of the Proposed Action would comply with all required regulatory statutes set forth by federal, state, and local regulatory agencies, including FAA Advisory circular 70/7460-1K. No additional applicant committed measures or monitoring is recommended at this time.

Residual Impacts

The wind turbines would create residual visible impacts from numerous points in the community. Community sentiment was gauged regarding the visual impacts of wind turbines at the Sand Point electric utility site and no issues were raised (see Appendix C). Public opinion was unanimously in favor of installing the turbines. The residual visual impacts are therefore considered minimal.

3.9 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-term use of the environment, as used here, is that used during the life of the project, whereas long-term productivity refers to the period of time after the project as been decommissioned, the equipment removed, and the land reclaimed and stabilized. The short-term use of the project area for the Proposed Action would not affect the long-term productivity of the area. If it is decided at some time in the future that the project has reached its useful life, the turbines, towers, and foundations could be decommissioned and removed, and the sites reclaimed and revegetated to resemble a similar habitat to the pre-disturbance conditions. The installation of wind turbines at these two sites would not preclude using the land for purposes that were suitable prior to this project.

3.10 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

An irreversible and irretrievable commitment of resources is defined as a permanent reduction or loss of a resource that, once lost, cannot be regained. The primary irretrievable and irreversible commitment of resources for the Proposed Action would be the labor, materials, and energy expended in clearing the site and constructing the two wind turbines. Other commitments include the loss of productivity of the sites (primary production and wildlife habitat) and the loss of an unknown number of birds due to collision with the turbines. These commitments of resources would extend for the duration of the project.

3.11 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts associated with the Proposed Action include:

- Long-term loss of approximately 0.2 acres of vegetation resulting from the construction of two tower foundations and the access road to the sites.
- Increase in noise levels during construction of the foundations and erecting of the wind towers.
- Increase in noise levels to residents living close to the turbine sites.
- Addition of two dominant vertical elements into the existing Sand Point viewshed.
- Potential direct impact to birds from collision with the wind turbine.

These impacts are both temporary, in the case of the construction noise, and long-term in regards to the visual impacts and the impact to birds from collisions. Overall, impacts of the Proposed Action on the environment are considered negligible.

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4.0 CUMULATIVE EFFECTS

Cumulative impacts result from the incremental impacts of an action that is added to other past, present, and reasonably foreseeable future actions (RFFAs), regardless of who is responsible for such actions. Cumulative impacts may result from individually minor, but collectively significant, actions occurring over a period of time (40 CFR 1508.7). The process of assessing cumulative effects therefore requires the agency to put the potential impacts of the proposed project into the context of the existing baseline conditions and projected impacts from other RFFAs. The baseline conditions in Sand Point and the potential impacts of the project are described in Chapters 1, 2, and 3 of this document. Past and present actions that have contributed to effects on birds have included the 200-ft tall former U.S. Navy communication towers north of town, and the local KSDP Radio Station tower (K. Ketherington, KDSP Radio, personal communication, 2009). The KSDP tower is a 200-ft guyed lattice AM transmitter tower and is illuminated in the evenings and during foul weather conditions with a newly installed light emitting diode (LED) beacon at the top of the tower and three mid-level LED sidelights. Two relatively small, single wind generators, referred to as “Harry Foster’s Windmills” are the only previously installed wind generators in the area. These towers are not currently functioning and would be taken down as applicant committed measure for the Proposed Action.

RFFAs are defined as those projects or actions that have progressed beyond the speculative stage, generally including only those projects that are listed in official planning documents, have funding secured, initiated permitting processes, or begun implementation. According to the AEB website (AEB, 2009), there are several major construction projects that have recently been completed in Sand Point, including a new medical/dental clinic, a runway extension at the airport, a harbor expansion and new wharf, and a new water treatment plant. According to Paul Day, City Administrator for Sand Point (P. Day, City of Sand Point, personal communication, 2009) RFFAs in Sand Point include a new proposed seafood processing plant and planned installation of cell towers for wireless service for the area. The website for the Shumagin Corporation (Shumagin Corporation, 2009), the local Alaska Native Corporation that is the primary landowner on the island, describes ongoing shareholder activities and commercial use of their stone quarries but does not list any future projects that are proceeding toward development. The Local Radio station, KSDP, is proposing to install a small 10 kW wind turbine, mounted on a 78 ft guyed pole tower, to generate capacity sufficient to sustain the radio station requirements. This would be located near the radio tower (http://apradio.org/combination-power-generation-and-back-up-system/). DOE is unaware of any other RFFAs within the general project area that could contribute to any cumulative impacts.

The analysis of environmental consequences in Chapter 3 indicates that, relative to the existing baseline conditions, the proposed project would have minimal impacts on land use, coastal zone resources, vegetation and soils, threatened and endangered species, noise, and the visual landscape. The Proposed Action would have negligible contribution to the overall cumulative effect.

Past and present actions that have contributed to collision hazards for bird include the old communication towers and the KSDP towers, and Foster’s wind generators. The only RFFA that would contribute to the some risk of collision mortality is a proposed 10 kW wind generator project for the local radio station. The Proposed Action would contribute to the cumulative effect on bird collision mortality; however, the overall cumulative effect would be nominal.

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APPENDIX A

SAND POINT WIND DATA

Appendix A. Sand Point Wind Data

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Project:
Sand Point - TDX

Description:
Data from file(s)
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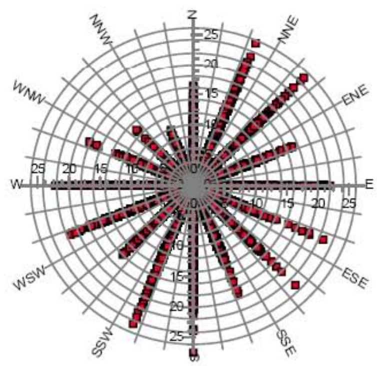
1617 Cole Blvd. (MS3811)
US-GOLDEN, CO 80401
+1 303-384-7027

Calculated:
10/7/2005 10:47 AM/

Meteo data report, height: 66.0 Feet

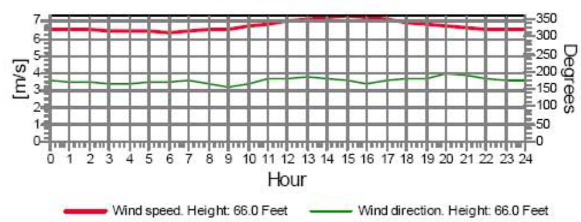
Name of meteo object: Sand Point - TDX

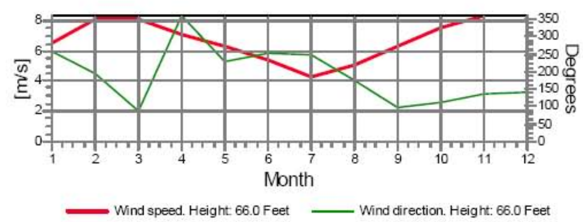


Wind speed [m/s]

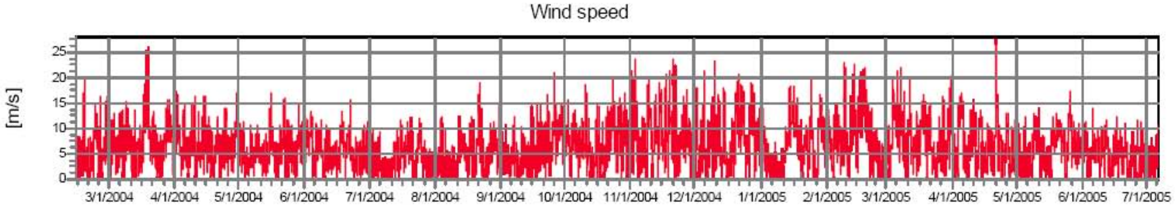
Monthly mean values of wind speed in m/s

Month	2004	2005	mean	mean of months
Jan		6.5	6.5	6.5
Feb	6.5	8.9	8.0	7.7
Mar	7.8	8.5	8.1	8.1
Apr	7.2	7.0	7.1	7.1
May	5.8	6.7	6.3	6.3
Jun	5.7	5.1	5.4	5.4
Jul	4.3	4.2	4.3	4.2
Aug	5.0		5.0	5.0
Sep	6.3		6.3	6.3
Oct	7.5		7.5	7.5
Nov	8.3		8.3	8.3
Dec	8.3		8.3	8.3
mean, all data	6.6	7.0	6.8	
mean of months	6.6	6.7		6.7

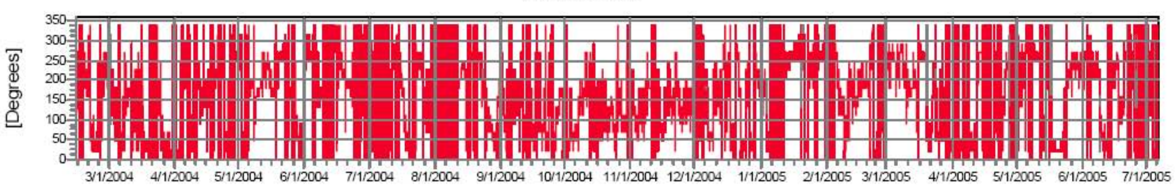




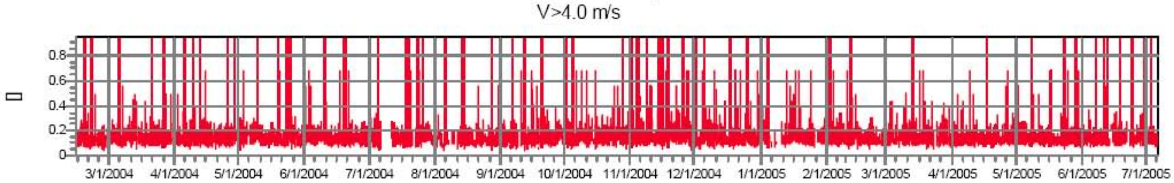
Wind speed



Wind direction



Turbulence intensity
V>4.0 m/s



WindPRO version 2.4.0.62 Apr 2004

Project:
Sand Point - TDX

Description:
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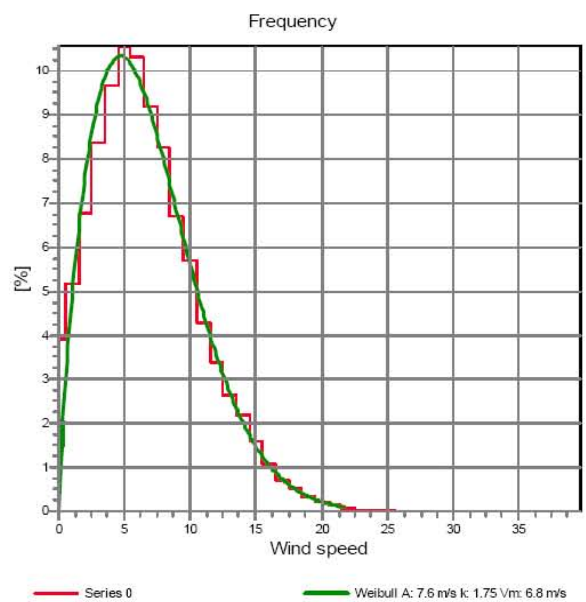

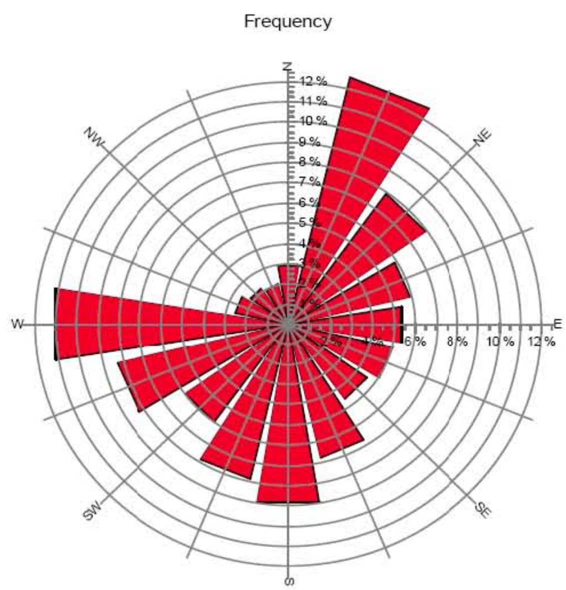

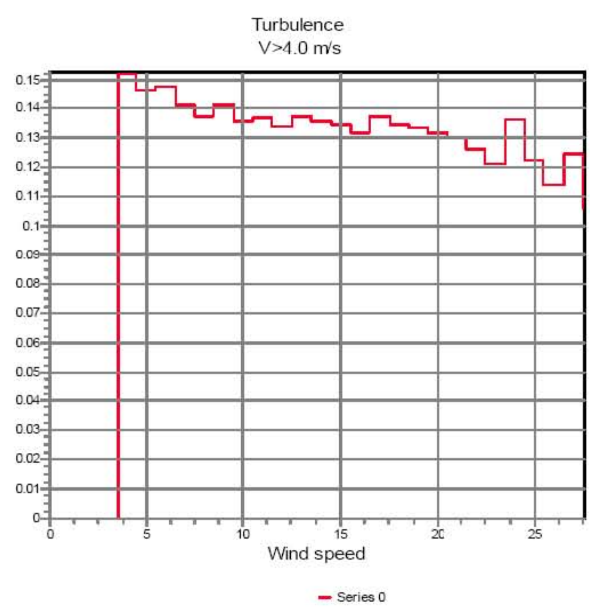

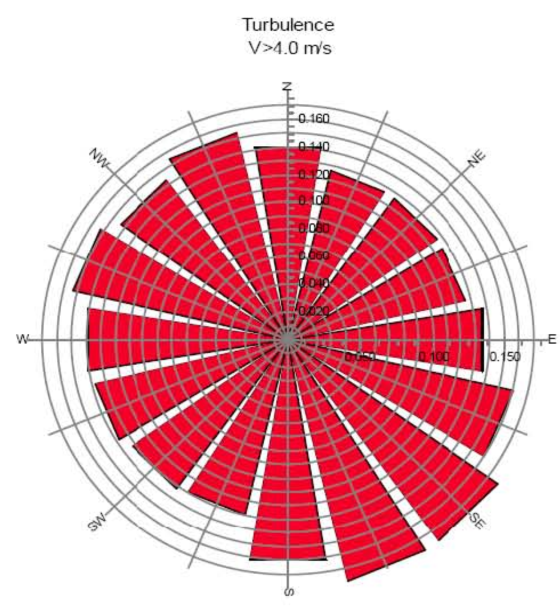

WindPRO is developed by EMD International A/S, Niels Jernesvej 10, DK-9220 Aalborg Ø, Tlf. +45 96 35 44 44, Fax +45 96 35 44 46, e-mail: windpro@emd.dk

Project:
Sand Point - TDX

Description:
Data from file(s)
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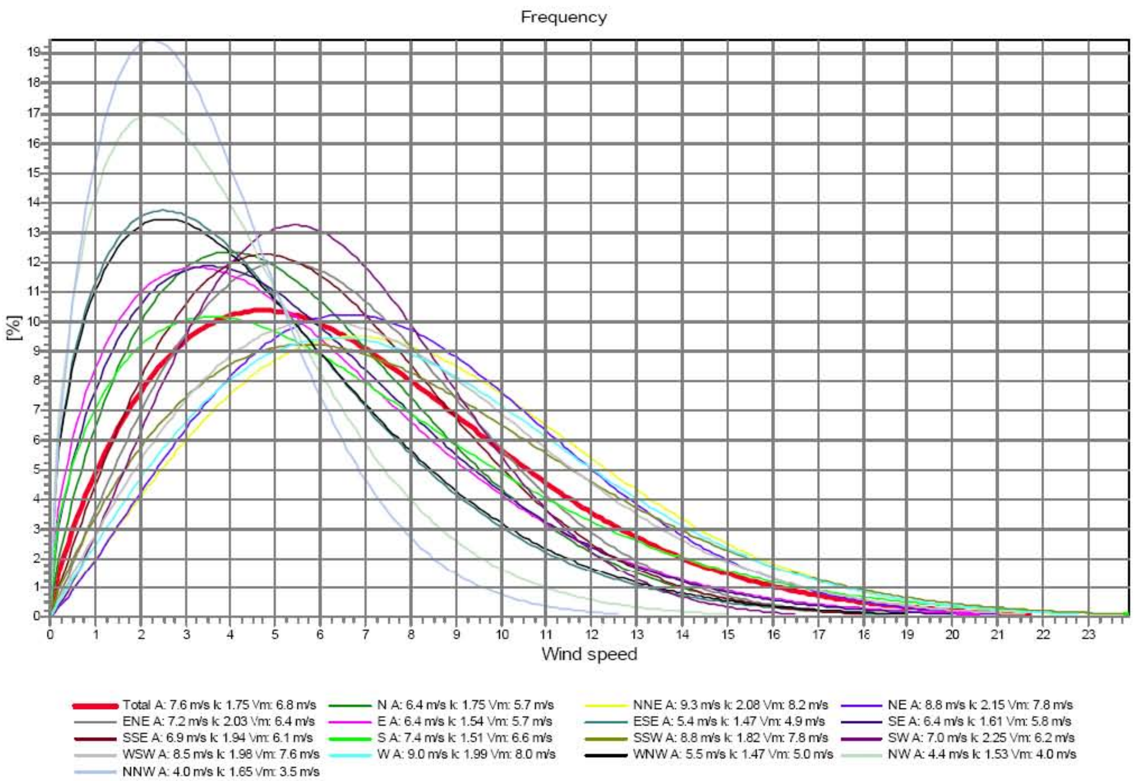
Meteo data report, height: 66.0 Feet

Name of meteo object: Sand Point - TDX

Weibull Data

k-parameter correction: 0.0080/m

Sector	A- parameter [m/s]	Mean wind speed [m/s]	k- parameter	Frequency	Frequency [%]	Wind shear
0-N	6.44	5.73	1.754	2.94	2.9	0.00
1-NNE	9.29	8.23	2.082	12.53	12.5	0.00
2-NE	8.82	7.81	2.154	7.92	7.9	0.00
3-ENE	7.23	6.41	2.033	5.89	5.9	0.00
4-E	6.36	5.72	1.542	5.37	5.4	0.00
5-ESE	5.40	4.89	1.474	5.05	5.0	0.00
6-SE	6.43	5.76	1.607	4.59	4.6	0.00
7-SSE	6.88	6.10	1.944	6.77	6.8	0.00
8-S	7.36	6.64	1.510	8.89	8.9	0.00
9-SSW	8.79	7.81	1.823	7.87	7.9	0.00
10-SW	7.04	6.23	2.250	5.98	6.0	0.00
11-WSW	8.52	7.55	1.982	8.30	8.3	0.00
12-W	9.05	8.02	1.988	11.10	11.1	0.00
13-WNW	5.51	4.99	1.469	2.55	2.5	0.00
14-NW	4.42	3.98	1.531	2.20	2.2	0.00
15-NNW	3.96	3.54	1.649	2.03	2.0	0.00
mean	7.65	6.81	1.747	100.00	100.0	0.00



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APPENDIX B

AGENCY CONTACT

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Sand Point Wind Installation Project Contact List

Sand Point Community

City - City of Sand Point, Mayor Glen Gardner
P.O. Box 249 Sand Point, AK 99661 Phone 907-383-2696 Fax 907-383-2698 E-mail sptcity@arctic.net

Electric Utility - TDX Power, CEO Nick Goodman 4300 B Street, Suite 402 Anchorage, AK 99503-5946 Phone 907-278-2312 Fax 907-278-2316 E-mail ngoodman@tdxpower.com

Village Corporation -Shumagin Corporation
P.O. Box 189 Sand Point, AK 99661 Phone 907-383-3525 Fax 907-383-5356 E-mail rweller@arctic.net
Village Council - Qagan Tayagungin Tribe of Sand Point, President Dorothy McCallum
P.O. Box 447 Sand Point, AK 99661-0447 Phone 907-383-5616 Fax 907-383-5814 E-mail qttadmin@arctic.net

Pauloff Harbor Tribe, President William Dushkin PO Box 97 Sand Point, AK 99661 Phone 907-383-6075 Fax 907-383-6094 E-mail pauloff@arctic.net

Unga Tribe, President Bruce Foster PO Box 508 Sand Point, AK 99661 Phone 907-383-2415 Fax 907-383-5553 E-mail ungatribe@arctic.net

Regional Organizations

Borough - Aleutians East Borough, Mayor Stanley Mack 3380 C Street, Suite 205 Anchorage, AK 99503 Phone 907-274-7555 Fax 907-276-7569 E-mail developmentdirector@aleutianseast.org, admin@aleutianseast.org Web http://www.aleutianseast.org

Regional Native Corporation - Aleut Corporation 4000 Old Seward Hwy., Suite 300 Anchorage, AK 99503 Phone 907-561-4300 Fax 907-563-4328 E-mail info@aleutcorp.com Web http://www.aleutcorp.com

Regional Native Health Corporation - Eastern Aleutian Tribe 3380 C Street, Suite 100 Anchorage, AK 99503-3949 Phone 907-277-1440 Fax 907-277-1446 E-mail lcdevlin@gci.net Web http://easternaleutiantribes.org

Native Housing Authority - Aleutian Housing Authority 4000 Old Seward Hwy. #202 Anchorage, AK 99503 Phone 907-563-2146 Fax 907-563-3105 E-mail jacques@aleutian-housing.com

Regional Development - Southwest Alaska Muni. Conf. 3300 Arctic Blvd. #203 Anchorage, AK 99503 Phone 907-562-7380 Fax 907-562-0438 E-mail wayers@swamc.org Web http://www.southwestalaska.com

State Agencies

Judith Bittner State Historical Preservation Office 550 W. 7th Ave, Suite 1310 Anchorage, Ak, 00501-3565

Federal Agencies

Ellen Lance,
Endangered Species Biologist

U.S. Fish and Wildlife Service Endangered Species Division 605 W. 4th Avenue Anchorage Ak, 99501 E-mail Ellen.lance@fws.gov 901 271-1467

Tim Langer, Ph.D. Endangered Species Biologist
U.S. Fish and Wildlife Service Endangered Species Division 605 W. 4th Avenue Anchorage AK, 99501 E-mail Tim.langer@fws.gov 901 271-3063

Clare R. Mendelsohn Regional Coordinator – Region 10 Department of the Air Force. Air Force Center for Environmental Excellence Regional Environmental Office 50 Freedmont St. Suite 2450 San Franciisco, CA

William Marritt
Federal Aviation Administration
Air Traffic Air Space Branch – ASW 520
2601 Meacham Blvd.
For Worth, TX 26137-0520
William.marritt@faa.gov
718 553-2560

Rob Van Haastert Federal Aviatiion Administration Air Traffic Air Space Branch – ASW 520 2601 Meacham Blvd. For Worth, TX 26137-0520 E-mail Robert.van-haastert@faa.gov

Earl Newalu Specialist Federal Aviation Administration Air Traffic Air Space Branch – ASW 520 2601 Meacham Blvd. For Worth, TX 26137-0520 E-mail earl.newalu@faa.gov 770 909-4401

APPENDIX C

PUBLIC COMMENTS

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Sand Point, Alaska
Public Comments Regarding Proposed Wind Turbine Installation
December 5 - 9, 2006

Summary of Methods

Bruce Wright, Senior Scientist with Aleutians Pribilof Island Association, Inc. conducted a series of meetings in Sand Point, Alaska, to solicit comments on the proposed between December 5 through 9, 2006.

Informational bulletins were posted by a local representative with simulated photos of the installation and information regarding the visit and community meeting. Posters were places December 1, 2006 at The Airport, City Office Building (which also is the offices for Qagan Tayagungin Tribe and Pauloff Harbor Tribe), Post Office, Clinic, Sand Point Electric, Shumagin Corporation, the Shumagin Pub, Alaska Commercial Store, Chinese Restaurant, Sand Point School and Aleutians East Borough Offices.

Regular announcements regarding the upcoming visit and community meeting were made on KSDP radio in Sand Point beginning December 1, 2006. Over the course of the next 3 days, the following information was presented to community members on behalf of the USDOE:

> *TDX Power intends to install two 500kW Vestas Wind Turbines near the existing diesel generating plant in Sand Point. The Alaska Energy Authority/ AEA awarded TDX a grant towards the installation. The funding to AEA would be provided by USDOE, a federal agency. Federal funding triggers the National Environmental Policy Act/ NEPA. One requirement of NEPA is for the public to be informed of the plan and given the opportunity to comment on the plan.*
>
> *The Aleutian Pribilof Islands Association/ APIA, with funding from the Bureau of Indian Affairs, would assist USDOE with the NEPA process. Because these wind turbines are the largest to be installed in Alaska to date, APIA has contracted with Global Energy Concepts/ GEC for a "Sight and Sound Analysis" of the proposed installation to allow residents to "see" exactly how these turbines would look in the community. The sound analysis describes the level of noise to be expected from the installation.*

Comments on the proposed wind generation project were solicited on several occasions:

- December 5 - Alaska Commercial Store and various offices and places of business in Sand Point.

- December 6 - Community Meeting on the project was held at the Sand Point City Chambers,
- December 7 - Aleutians East Borough, Aleutians East School District Offices and Sand Point City Office
- December 9 - APIA Board of Directors Meeting

On these occasions, a total of 53 residents of Sand Point were presented with the five simulated photos, animations of the five photos, and a description of the sound analysis. Included in these residents are: Glen Gardner, Mayor of the City of Sand Point; Stanley Mack, Mayor of Aleutians East Borough; David Osterback, President of the Qagan Tayagungin Tribe; Bruce Foster, President of the Unga Tribe; Arlene Gundersen, Administrator of the Pauloff Harbor Tribe.

Copies of the GEC report "Photo Simulations and Sound Impact Analysis for Sand Point Wind Power Project" were made available to any residents who requested a copy and copies were left with The City of Sand Point, Qagan Tayagungin Tribal Office, Pauloff Harbor Tribal Office, Unga Tribal Office, Aleutians East Borough Office, Aleutians East Borough School District Office, and the Sand Point Medical Clinic.

A summary of comments received on the Sand Point Wind Installation Project from Sand Point Residents are provided below:

Opinions Collected from Visiting Offices and Places of Business
12/5/06

1. Put 'em up!
Wayne Hodges, Hodges B&B PO Box 247 Sand Point, AK 99661

2. I agree. Put 'em up. It sounds like money in my pocket.
Edie Hodges, Hodges B&B PO Box 247 Sand Point, AK 99661

3. I'm all for wind energy.
Kathleen Harper, High School Teacher PO Box 192 Sand Point, AK 99661

4. I'm all for them.
Nellie Roehl, Secretary for Pauloff Harbor Tribe PO Box 424 Sand Point, AK 99661

5. I wouldn't mind looking at them.
Ilene Dushkin, Environmental Assistant for Pauloff Harbor Tribe PO Box 382 Sand Point, AK 99661

6. I don't mind at all!
Michael Kochuten, Air Quality Technician for Pauloff Harbor Tribe PO Box 13 Sand Point, AK 99661

7. I'm all for it, but hope that the savings get passed on to the customer and not just make TDX richer.
Anne Morris, Environmental Coordinator for the Pauloff Harbor Tribe PO Box 382 Sand Point, AK 99661

8. I think they would be a small inconvenience for the benefit they would provide to the community.
Arlene Gundersen, Administrator for the Pauloff Harbor Tribe PO Box 51 Sand Point, AK 99661

9. I'm all for it.
Jay Moon, Fisherman PO Box 263 Sand Point, AK 99661

10. They should've been here yesterday.
Charles Jackson, Fisherman PO Box 54 Sand Point, AK 99661

11. Order 10 more of them.
Representative Carl Moses PO Box 389 Sand Point, AK 99661

12. I'd like to see them.
Laresa Moses, Business Owner PO Box 389 Sand Point, AK 99661

13. They should look at putting some up by the school, too. It's a good wind spot. Insulate the wires so they (eagles) don't get electrocuted. If they could make the dump so the eagles couldn't eat from it, there would be less eagles. During the peak fishing time in June and July, there's a lot of birds down by the fish plant.
Andrew Gilbert, Janitor PO Box 395 Sand Point, AK 99661
14. I think it's a great idea. Energy costs are outrageous – it's a great thing to do.
Lucinda McGlashan, Administrator Qagan Tayagungin Tribe PO Box 394 Sand Point, AK 99661

15. I think it's a great idea, especially if they can reduce the price of our electricity.
Dana Osterback, Environmental Coordinator for Qagan Tayagungin Tribe PO Box 144 Sand Point, AK 99661

16. I'm for anything that lowers the price of energy.
Michael Gundersen PO Box 115 Sand Point, AK 99661

1 *I've always wondered why they didn't have them here in the first place. Great idea.* Jim Newman, Clinic Director PO Box 107 Sand Point, AK 99661
2 *Finally, somebody using their brains and making a future my children and grandchildren. I thank you and my son thanks you.*

Angel Bravo, self-employed welder PO Box 228 Sand Point, AK 99661

19. Good idea. They look good, definitely not an eyesore.
Dustin Stroud, Bartender PO Box 37 Sand Point, AK 99661

20. Thumbs up. Good idea.
David Cabot PO Box 361 Sand Point, AK 99661

21. I have no problem with them. I'm all for them. I've seen wind farms in England and they look fine and aren't too noisy.
Jenny Wood PO Box 212 Sand Point, AK 99661
22. I'm all for them. I think it's a good thing.
Nick Skyles PO Box 212 Sand Point, AK 99661

Opinions Collected from the Alaska Commercial Store, 4pm – 5:30 pm 12/6/06

In Favor:

1 Fritz Bjornstad

2 Gloria Gronholdt
3 Robert Dushkin
4 Bruce Lee
5 Taylor Lundgren
6 Jessica Nunez
7 Joanna Ludvick
8 Edee Jacobsen
9 Diana Holmberg
10 Leonard Holmberg
11 Paula Cabot
12 Andrew Gundersen
13 Joe Ludvick
14 Rayette McGlashan
15 Dennis McGlashan, Jr.
16 Carmen Holmberg
17 Lou Kuchenoff
18 *I can't wait. They should've done this back in the 1980's!*

Jason Bjornstad PO Box 58 Sand Point, AK 99661

41. I'm surprised there aren't more of these in rural Alaska.
Robbie Gilmour PO Box 296 Sand Point, AK 99661

Opinions Collected from Community Meeting Sand Point City Chambers December 6, 2006
The meeting was attended by 7 residents, 5 of whom had already commented.

42. I want to see the savings passed on to the consumer. Commercial users should be included in the tariff. Or credit the profit from the commercial users to the residential consumers. The local people don't benefit from the commercial users.
Dick Jacobsen, Aleut Corporation Board Member Sand
Point, AK 99661

43. It's a good thing – good for the community. The cost of energy needs to go down. The money is well spent.
Kells Hetherington, General Manager KSDP Radio Sand
Point, AK 99661

Opinions Collected Aleutians East Borough, Aleutians East School District Offices and Sand Point City Office December 7, 2006

44. Anything that uses less diesel is a good thing out there. I like the benefit to the Clinic and the Rec Center with heat.
Tina Anderson, Aleutians East Borough Clerk Sand
Point, AK 99661

45. I am all in favor of developing our wind resource. We certainly have an abundant supply.
Stanley Mack, Mayor of Aleutians East Borough Sand
Point, AK 99661

46. I am for it and don't see a huge problem with noise. As for an eyesore, if it reduces the price of electricity – no problem.
Cherilyn Lundgren, AEB School District PO Box 216 Sand Point, AK 99661

47. I think they look good and that the community is looking ahead. We have all kinds of towers, these aren't going to be a problem. And if we can save money, everyone would see money when they see them.
Bill Burr, AEB School District PO Box 63 Sand Point, AK 99661

1 *It's a good idea. Let's bring the cost of electricity down*. Glen Gardner, Mayor City of Sand Point PO Box 444 Sand Point, AK 99661
2 *They look fine.*

Krista Galvin, Administrative Assistant City of Sand Point PO Box 171 Sand Point, AK 99661
50. I think it's a great idea. I help my grandma pay her electric bill.
John Gardner IV Sand Point, AK 99661

51. I think it's a great idea.
Patricia Curtis PO Box 464 Sand Point, AK 99661

Opinions Collected at APIA Board of Directors Meeting December 9, 2006

52. It's a good idea. We've got to do something about the price of electricity.
David Osterback, President Qagan Tayagungin Tribe Sand Point,
AK 99661

53. I'm all for it. We've had them in Sand Point before, I just hope these ones work.
Bruce Foster, President Unga Tribe Sand Point,
AK 99661

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APPENDIX D

AGENCY SCOPOING COMMENTS AND CONSULTATION

U.S. Fish and Wildlife Service
Endangered Species Act

Section 7 Consultation

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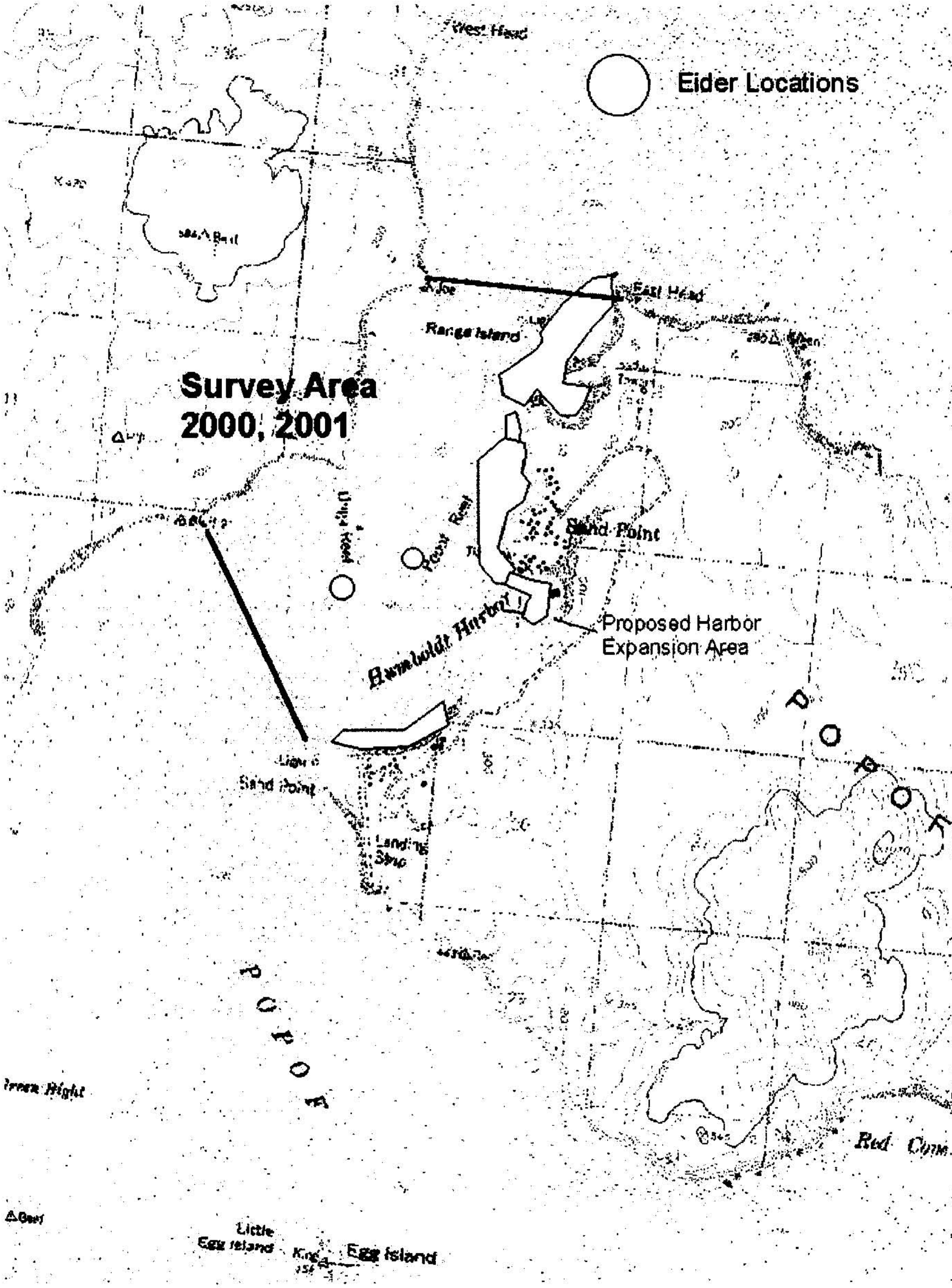
From: Ellen_Lance@fws.gov [mailto:Ellen_Lance@fws.gov]
Sent: Monday, May 22, 2006 2:35 PM
To: Constance Fredenberg
Subject: Sand Point

Connie,
I'm emailing with information regarding the TDX proposal to install 2-600kW Vestas turbines in Sand Point, presumably at the same location that the MET tower was installed in 2004,

Steller's eiders winter all around Sand Point in abundances nearly reaching 1000 individuals. We don't know anything about thei nocturnal movements through the area, but flights over Lot 3, where the MET tower was installed are unlikely.

We recommend that you and the folks from TDX review the Service's guidelines for siting wind turbines at http://www.fws.gov/habitatconservation/wind.pdf. Further, the FWS, Alaska Region has modified this guidance for Alaska . We suggest you strongly consider preconstruction surveys to determine the prevalence and behavior of bald eagles in the immediate vicinity of the proposed turbine location.



If you need further assistance, don't hesitate to contact me.

Best,
Ellen

Ellen W. Lance
Endangered Species Program
USFWS/AFWFO
605 W. 4th Ave. Rm G-61
Anchorage, AK 99501
(907) 271-1467

Aleutian/Pribilof Islands Association, Inc.

1131 E. International Airport Rd.
Anchorage, Alaska 99518-1408
Phone (907) 276-2700
Fax (907) 279-4351

February 27, 2009

Ms. Ellen Lance
U.S. Fish and Wildlife Service
Endangered and Threatened Species Division
605 West 4th Avenue, Suite 60
Anchorage, Alaska 99501

Re: Request for informal ESA Section 7 consultation on the proposed Sand Point Wind Energy Project

Dear Ms. Lance,

Aleutian Pribilof Island Association, on behalf of the U.S Department of Energy (DOE), is submitting this letter to initiate informal ESA Section 7 consultation on the proposed Sand Point Wind Energy Project in Sand Point, Alaska. The DOE has provided funding to the Alaska Energy Authority (AEA) Alaska Wind Energy Project. AEA proposes to provide funding received from DOE to Aleutian Wind Energy, LLC (AWE) to support the installation of a wind power generation system at the existing TDX Power generation facility in Sand Point, Alaska. Because of this federal funding, DOE is required to evaluate the potential environmental impacts of its facilities, operations, and related funding decisions in accordance with the National Environmental Policy Act (NEPA) and DOE NEPA implementing regulations. DOE has initiated the NEPA process and will soon complete an Environmental Assessment (EA) to document the potential environmental impacts of the proposed project, including potential effects on threatened and endangered species. In fulfillment of our obligations under Section 7 of the Endangered Species Act (ESA), we are supplying the following information about the project and our analysis of potential effects to ESA-listed species under the regulatory authority of the USFWS. We request that you review this information and provide us with a determination of whether the proposed project is or is not likely to have adverse effects on listed species under your authority.

Project Description

DOE is proposing to provide funding to support the installation of two 500 kW Vestas V39 wind turbines at the existing electrical power plant in Sand Point, AK. The proposed turbine site is at an elevation of 164 ft and is approximately 1/3 mile from marine waters (Figure 1). The wind turbines would be mounted on towers that are 131 feet (40 meter) tall and are free-standing, monopoles with no guy wires (Figure 2). The towers would be approximately 400 feet apart. Each turbine has three blades with a rotor diameter of 128 ft (39 m), producing a rotor-swept area that is 12,852 ft^2 (1,194 m^2). The wind turbines would be integrated with the existing diesel generator and power distribution system so no new power transmission lines or other support structures would be needed.

The FAA made a "Determination of No Hazard to Air Navigation" for the installation of the turbines provided that the turbines are painted white and equipped with synchronized red lights in accordance with FAA Advisory circular 70/7460-1K, Obstruction Marking and Lighting. These safety systems are intended to make the towers easily visible to local aircraft and would thus increase visibility from all approaches, especially at night and inclement weather.

The proposed project would reduce overall diesel fuel consumption and decrease air emissions associated with the consumption of diesel fuel. The two wind turbines could produce 1 megawatt (MW) of power under favorable winds, which would decrease diesel fuel consumption by an estimated 130,000 gallons/year under normal operating conditions. The EPA estimates that one gallon of diesel can produce 22.2 lbs of CO_2; hence about 1,443 tons of greenhouse gas emissions per year will be avoided if the proposed project is implemented.

ESA-listed Species

According to the Consultation Guide for Alaska's Threatened and Endangered Species (USFWS 2004), there are currently three listed species under the jurisdiction of the USFWS that occur in the Sand Point area.

Steller's eider (*Polysticta stelleri*) (Alaska breeding population) is currently listed as threatened under the ESA. They are highly dependant on nearshore marine waters, especially those with eelgrass beds that provide an essential food base for Steller's eider and other species (USFWS 2009). The Consultation Guide for Alaska's Threatened and Endangered Species (USFWS 2004) states that Sand Point is located in a molting and wintering range for Steller's eider and that more than 1,000 eiders may winter in the marine waters surrounding Popof Island in any given year. Sand Point is not in designated critical habitat for Steller's eider, although the Nelson Lagoon critical habitat area is located approximately 50 miles from Sand Point on the north side of the Alaska Peninsula (USFWS 2004).

The short-tailed albatross (*Phoebastria albatrus*), is listed as endangered under the ESA. Although they have been seen along the Gulf of Alaska shelf south of Popof Island, this is a highly pelagic species that occurs almost exclusively in open waters well away from the coast (USFWS 2004).

The southwest stock of northern sea otter (*Enhydra lutris kenyoni*), is listed as threatened under the ESA. The USFWS has proposed critical habitat for this population in nearshore waters, including Humboldt Harbor adjacent to Sand Point (USFWS 2008). The USFWS will review public and other agency comments on the proposal before finalizing the critical habitat designation.

Potential Impacts and Proposed Mitigation Measures

The USFWS has issued interim guidelines to minimize wildlife impacts from wind turbines (USFWS 2003). These guidelines discuss several measures that should be taken during the planning stages of a project, including careful consideration of where wind towers would be sited and pre-construction surveys to assess avian use of the proposed development. Both of these recommendations have been implemented for the proposed Sand Point project.

The proposed wind turbine installation site is at an elevation of 164 ft and approximately 1/3 mile from the closest marine waters. There are no bluffs or other nearby land features that would create consistent updrafts that attract soaring species. The setback away from the coast is very important with regard to the two listed bird species in the area, both of which are closely tied to marine habitats and rarely, if ever, fly over land except during the nesting season. Short-tailed albatross nest in Japan. Steller's eider nest in tundra on Alaska's northern coast and the Yukon-Kuskokwim Delta as well as northern Russia (USFWS 2004). It is therefore unlikely that either species would collide with inland/upland structures in Sand Point, including the proposed wind turbines.

In response to public scoping, including recommendations of the USFWS, an avian monitoring program for the proposed site was implemented from 6 December 2006 through 17 August 2007 and from 20 October 2008 to the present. No waterfowl or any other marine bird species have been recorded at the proposed installation site during these observation periods.

The USFWS guidelines also recommend post-construction monitoring to assess actual collision rates. The project proponents in Sand Point, TDX Sand Point Generating (TSPG), have committed to developing and implementing a post-construction monitoring program to determine if there are any inadvertent avian mortalities due to collisions with the wind turbines and, if so, whether there are any discernable patterns to those mortalities (i.e. if they occur at consistent times or weather conditions). The post-construction monitoring program will include regular walking surveys around the towers and surrounding areas to look for carcasses/feathers and signs of scavenging that may mask collision mortalities. Because bird collisions are more likely during periods of limited visibility (e.g. foggy weather or at night), the surveys will be conducted in the morning and/or after periods of inclement weather. Although the frequency of the surveys is still to be determined, they will include a substantial effort during seasonal migration periods and during the fall and winter months when Steller's eiders are in the Sand Point area. If any potential eider collisions are detected during the surveys, TSPG will notify the USFWS immediately and consult on the appropriate level of response.

In regard to the endangered sea otter population, there is no marine component to the project and no mechanism for potential effects on marine habitats. The project would therefore be unlikely to have any effects on any listed marine mammals or their critical habitats.

Conclusions

The proposed project would take place in an area where three ESA-listed species could occur that are under the care of the USFWS. Short-tailed albatross and the southwest stock of northern sea otter are unlikely to be adversely affected by the proposed project. Steller's eiders occur in nearshore waters around Sand Point, especially in fall and winter months, but rarely fly over land except to nest, which they do not do around Sand Point. It is therefore extremely unlikely that Steller's eiders would be adversely affected by the proposed wind turbines at the proposed inland/upland site. Post-construction monitoring will help determine actual collision rates and the USFWS will be notified if any Steller's eiders are found. The proposed project has no marine components and therefore no mechanism for potential effects on marine habitats of any of these species.

We request your review of the proposed action with respect to ESA compliance and concur with our finding of no adverse affect to listed species. Should you require additional information, please contact me at 907 222-4260 or via email at brucew@apiai.org. I would like to thank you for your time and assistance, and I look forward to return reply and working with you on this project.

Sincerely,

Bruce Wright
Aleutian Pribilof Island Association, Inc

cc: James Jensen, Alaska Energy Authority
Steve Blazek, U.S.Department of Energy
Jennifer Zabel, U.S. Department of Energy

Attachments – Figure 1. Location of Proposed Wind Turbines in Sand Point, Alaska.
Figure 2. Visual Simulation of Vestas 39 Wind Turbines, Sand Point, Alaska.

References Cited

United States Fish and Wildlife Service (USFWS), 2004. Alaska's Threatened and Endangered Species. Anchorage Fish and Wildlife Field Office, Anchorage, Alaska. 63 pp. Available online: http://alaska.fws.gov/fisheries/endangered/consultation_guide.htm

USFWS, 2003. Interim guidelines to avoid and minimize wildlife impacts from wind turbines. Memorandum to the USFWS regional directors from the Deputy Director, 13 May 2003. Available online at: http://www.fws.gov/habitatconservation/Service%20Interim%20Guidelines.pdf

USFWS, 2008. Federal Register, Dec. 16, 2008. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Southwest Alaska Distinct Population Segment of the Northern Sea Otter (Enhydra lutris kenyoni); Proposed Rule. 73 FR 76453-76469.

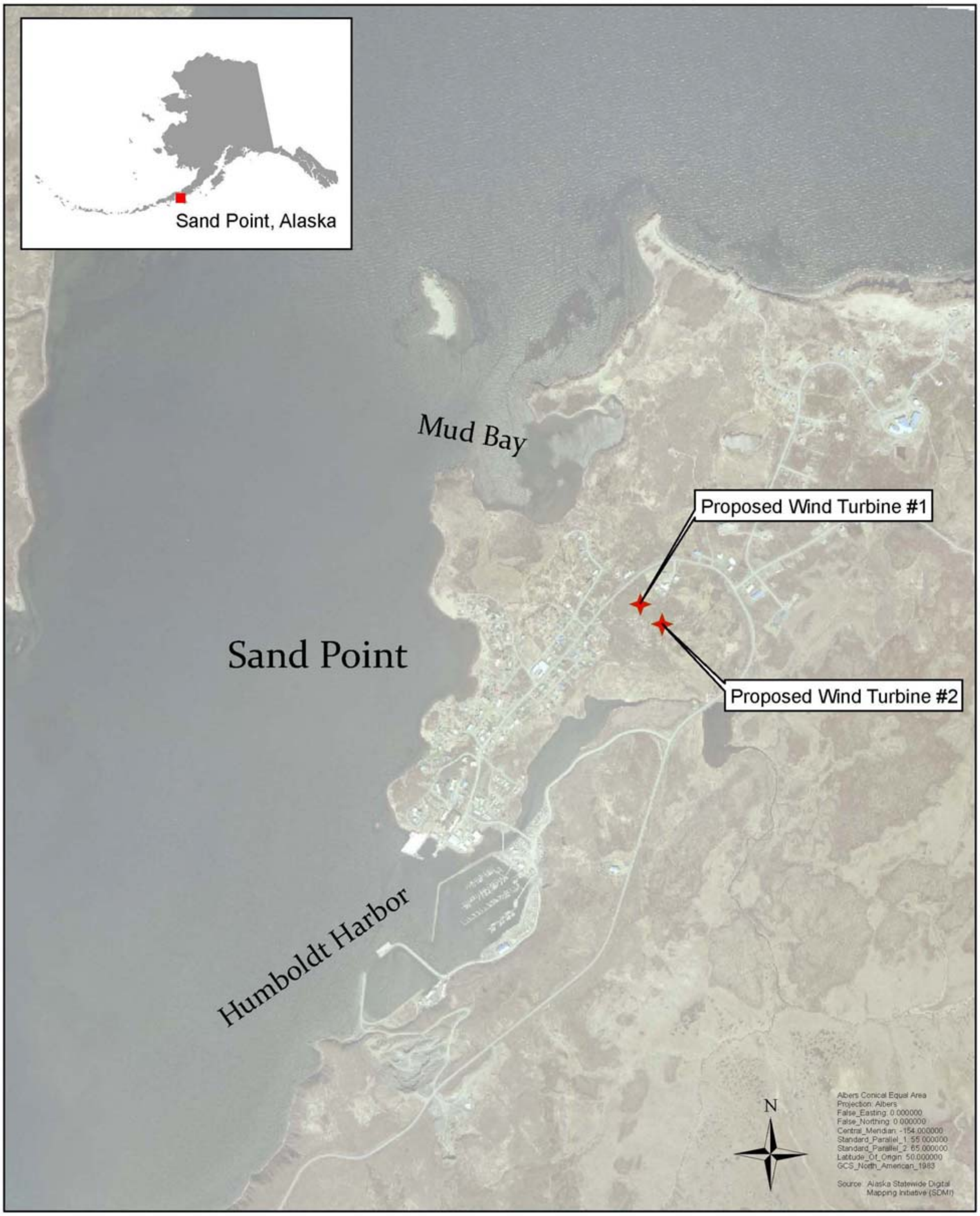
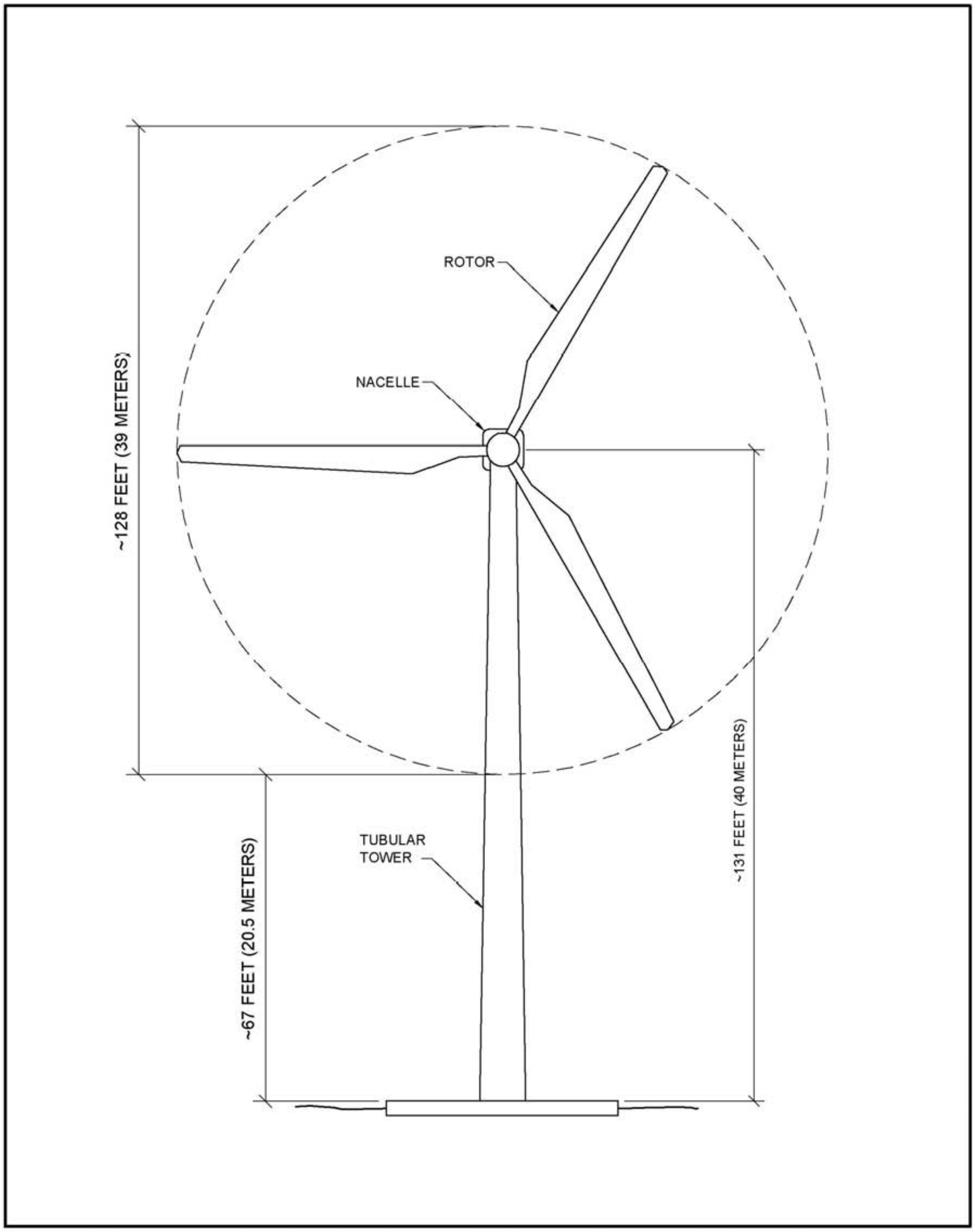


Figure 1. Location of project area and proposed wind turbine sites in Sand Point, Alaska. Figure 2. Schematic of a wind turbine of similar size to the proposed Vestas 39.



United States Department of the Interior

FISH AND WILDLIFE SERVICE Anchorage Fish and Wildlife Field Office 605 West 4th Avenue, Room G-61 Anchorage, Alaska 99501-2249

in reply refer to AFWFO

March 11,

2009 Bruce Wright Aleutian Pribilof Island Association, Inc. 1131 E. International Airport Road Anchorage, Alaska 99518-1408

Re: Sand Point Wind Energy Project (*Consultation number 2009-0057*)

Dear Mr. Wright,

On March 2, 2009, we received your letter requesting informal Section 7 consultation on the proposed Sand Point Wind Energy Project in Sand Point, Alaska. The US Department of Energy (DOE) has provided funding to the Alaska Energy Authority (AEA) Alaska Wind Energy Project. AEA proposes to provide funding received from DOE to Aleutian Wind Energy, LLC (AWE) to support the installation of a wind power generation system. The proposed system is two 500 kW Vestas V39 wind turbines located at the existing TDX Power generation facility in Sand Point, 164 feet above sea level and approximately 1/3 mile from marine waters.

As stated in your biological evaluation, North American breeding Steller's eiders (*Polysticta stelleri*), listed as threatened in 1997, are found in the action area. Sand Point is located in a molting and wintering range for Steller's eiders and more than 1,000 may winter in the marine waters surrounding Popof Island in any given year. Sand Point is not in designated critical habitat, but critical habitat at Nelson Lagoon is located 50 miles from Sand Point on the north side of the Alaska Peninsula. In response to public scoping, including recommendations of the Service, an avian monitoring program for the proposed site was implemented from 12/6/06 to 8/17/07 and 10/20/08 to present. No waterfowl or any other marine bird species have been recorded at the proposed installation site during these observations periods.

Your letter also mentioned northern sea otters (*Enhydra lutris kenyoni*) and short-tailed albatross (*Phoebastria albatrus*). Because proposed critical habitat for sea otters is nearshore maritime waters up to 20 meters deep (11 fathoms, 66 feet), and short-tailed albatross is a highly pelagic species that occurs almost exclusively in open U.S. waters well away from the coast, we expect no adverse effects as a result of this proposed project for either species.

On March 5, 2009, we discussed the project during a conference call with Ellen Lance (USFWS) and David Erikson (URS Corporation). We discussed the post-monitoring program, which will include regular walking surveys around the towers and surrounding areas to look for carcasses/feathers and signs of scavenging that may mask collision mortalities. Also, because

bird collisions are more likely during periods of limited visibility (e.g., foggy weather or at night), the surveys will be conducted in the morning and/or after periods of inclement weather. We understand that the proposed monitoring period is once per week for 3 weeks. We recommended that a scavenging trial is done with specific pathogen free quail and that the survey intervals are appropriate given the removal rates observed during this study. Once the survey interval is determined, you offered that surveys should be done in consecutive days at the beginning to verify trial results.
Mr. Bruce Wright

We also discussed the old decommissioned turbines in the action area that may be used as perch sites. You replied in an email later that day that the old wind towers near the site would likely be dismantled while the large crane is in town for the erection of the new wind towers. Furthermore, you indicated that local residents have expressed a desire to have the old towers removed. We discussed what would happen to the two new turbines that are proposed to be constructed. You also responded later that day via email that the turbines would be used for their operational life and at that time would be reconditioned or repaired to continue operating. When new technology comes along, the older model turbines would be replaced with the new ones.

As stated in your letter, if any potential eider collisions are detected during the surveys, TDX Sand Point Generating (TSPG) will notify my office immediately (907-271-2778) and consult on the appropriate level of response. Since you have built measures into your proposed work to avoid the risk of Steller's eiders colliding with turbines, and because of your post-construction monitoring and reporting program, we believe the probability that this action will result in the taking of listed species is discountable. As a result, the Service concurs with your determination that the proposed action is not likely to adversely affect listed species or adversely modify critical habitat. Preparation of a biological assessment or further consultation under section 7 of the ESA is not necessary at this time. In view of this, requirements of section 7 have been satisfied. However, obligations under the ESA must be reconsidered if new information reveals project impacts that may affect listed species or critical habitat in a manner not previously considered, if this action is subsequently modified in a manner which was not considered in this assessment, or if a new species is listed or critical habitat is determined that may be affected by the identified action.

This letter relates only to federally listed or proposed species, and/or designated or proposed critical habitat, under our jurisdiction; namely, the Aleutian shield fern (*Polystichum aleuticum*, listed as endangered in 1988), spectacled eider (*Somateria fischeri,* listed as threatened in 1993), North American breeding Steller's eider (*Polysticta stelleri,* listed as threatened in 1997), the southwest distinct population segment of northern sea otter (*Enhydra lutris kenyoni,* listed as threatened in 2005), short-tailed albatross (*Phoebastria albatrus*, listed as endangered in 2000), polar bear (*Ursus maritimus*, listed as threatened in 2008), and Kittlitz's murrelet (*Brachyramphus brevirostris,* listed as a candidate species in 2005). This letter does not address species under the jurisdiction of the National Marine Fisheries Service, or other legislation or responsibilities under the Fish and Wildlife Coordination Act, Clean Water Act, National Environmental Policy Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, or Bald and Golden Eagle Protection Act.

Thank you for your cooperation in meeting our joint responsibilities under section 7 of the ESA. If you have any questions, please contact me at (907) 271-3063 and refer to consultation number 2009-0057.

Sincerely,

Tim Langer, Ph.D.
Endangered Species Biologist

T:\s7\2009 sec 7\NLAA\20090057 s7 letter.pdf

Federal Aviation Administration Correspondence

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study N
2006-AAL-563-OE

Issued Date: 01/25/2007

Nicholas Goodman
Aleutian Wind Energy, LLC
4300 B Street, #402
Anchorage, AK 99503

send to Keith & Laura ✓

**** NOTICE OF PRESUMED HAZARD ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine AWE #1
Location:	Sand Point, AK
Latitude:	55-20-42.84 N NAD 83
Longitude:	160-29-25.34 W
Heights:	120 feet above ground level (AGL)
	280 feet above mean sea level (AMSL)

Initial findings of this study indicated that the structure as described exceeds obstruction standards and/or would have an adverse physical or electromagnetic interference effect upon navigable airspace or air navigation facilities. Pending resolution of the issues described below, the structure is presumed to be a hazard to air navigation.

If the structure were reduced in height so as not to exceed 109 feet above ground level (269 feet above mean sea level), it would not exceed obstruction standards and a favorable determination could subsequently be issued.

To receive a favorable determination at the originally submitted height, further study would be necessary.
Further study entails distribution to the public for comment, and may extend the study period up to 120 days.
The outcome cannot be predicted prior to public circularization.

If you would like the FAA to conduct further study, you must make the request within 60 days from the date of issuance of this letter.

NOTE: PENDING RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE, THE STRUCTURE IS PRESUMED TO BE A HAZARD TO AIR NAVIGATION. THIS LETTER DOES NOT AUTHORIZE CONSTRUCTION OF THE STRUCTURE EVEN AT A REDUCED HEIGHT. ANY RESOLUTION OF THE ISSUE(S) DESCRIBED ABOVE MUST BE COMMUNICATED TO THE FAA SO THAT A FAVORABLE DETERMINATION CAN SUBSEQUENTLY BE ISSUED.

IF MORE THAN 60 DAYS FROM THE DATE OF THIS LETTER HAS ELAPSED WITHOUT ATTEMPTED RESOLUTION, IT WILL BE NECESSARY FOR YOU TO REACTIVATE THE STUDY BY FILING A NEW FAA FORM 7460-1, NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION.

Rob Van-Hastaart
383-6000
271-5863

If we can be of further assistance, please contact our office at (718)553-2560. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2006-AAL-563-OE.

Signature Control No: 492326-522506 (NP

William Merritt
Specialist

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2006-AAL-563-OE

Issued Date: 04/12/2007

Nicholas Goodman Aleutian Wind Energy, LLC 4300 B Street, #402 Anchorage, AK 99503

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine AWE #1
Location:	Sand Point, AK
Latitude:	55-20-42.84 N NAD 83
Longitude:	160-29-25.34 W
Heights:	120 feet above ground level (AGL) 280 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe
and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities.
Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a
hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory
circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights
Chapters 4,12&13(Turbines).

It is required that the enclosed FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed
and returned to this office any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part I)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part II)

See attachment for additional condition(s) or information.
This determination expires on 10/12/2008 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

Page 1 of 6

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before May 12, 2007. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted in triplicate to the Manager, Airspace and Rules Division - Room 423, Federal Aviation Administration, 800 Independence Ave., Washington, D.C. 20591.

This determination becomes final on May 22, 2007 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Office of Airspace and Rules via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

A copy of this determination will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

If we can be of further assistance, please contact William Merritt, at (718)553-2560. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2006-AAL-563-OE.

Signature Control No: 492326-100014847 (DNH) Kevin P. Haggerty Manager, Obstruction Evaluation Service

Attachment(s)
Additional Information
Map(s)

7460-2 Attached

Aditional information for ASN 2006-AAL-563-OE

Aeronautical study number 2006-AAL-563-OE

Proposal: To construct a wind turbine to a height of 120 feet above ground level (AGL), 280 feet above mean sea level (AMSL).

Location: The proposed structure would be located 2.14 nautical miles (NM), north of Sand Point Airport (SDP), Sand Point, Alaska.

Federal Aviation Regulation (FAR) Part 77 Obstruction Standards Exceeded:

Section 77.23(a)(5) airport surfaces, by penetrating...

Section 77.25(b) SDP conical surface by 11 feet, a height that exceeds the takeoff or landing area of an airport, as applied to SDP.

Negotiation: Negotiation was attempted with the proponent, but site availability and wind patterns dictated this specific location and height.

Circularized: This aeronautical study was given public notice on February 25, 2007.

Aeronautical Objections Received: None were received.

Aeronautical Study Results:

Sand Point Airport is a publicly owned, public use airport, located 2 miles southwest of Sand Point, Alaska, on the Alaska Peninsula. The airport has a single hard-surfaced runway. Runway 13/31 is 5,213 feet in length and lighted with medium intensity runway lights and Visual Approach Slope Indicator (VASI) lights.

An NDB/DME non precision instrument approach is available to Runway 31. Runway 13 has an NDB, NDB/DME and RNAV(GPS) non precision instrument approach procedure. Special IFR alternate minimums apply on all procedures. Special takeoff minimums are applicable to each runway with a departure procedure for each runway. The six single engine aircraft based at the airport account for 40 percent of the airport's 39 average weekly operations. Air taxi and commuter operations account for slightly for than 40 percent of this total, while transient general aviation account for the remainder.

The wind turbine would not adversely impact any plan on file for Sand Point Airport.

The proposed structure would adversely impact the Sand Point Airport traffic pattern airspace. FAA Handbook 7400.2E, Procedure for Handling Airspace Matters, Chapter 6, paragraph 6-3-8d, state that any structure that would exceed a Part 77 obstruction standard is considered to have an adverse effect on the airport traffic pattern airspace. There would be substantial adverse effect if a significant volume of VFR aeronautical operations were affected. A standard left-hand traffic pattern is flown to Runway 31. A nonstandard right-hand traffic pattern is flown to Runway 13, thus keeping aircraft over water and away from the higher terrain inland and east of the airport. This proposed structure nearly two nautical miles east of the Runway 13 final approach course is well beyond the dimensions of any Category A, B, C and D type aircraft traffic pattern airspace. When properly obstruction marked and lighted this wind turbine will be able to be seen and avoided. There would not be a substantial adverse effect to VFR operations at Sand Point Airport.

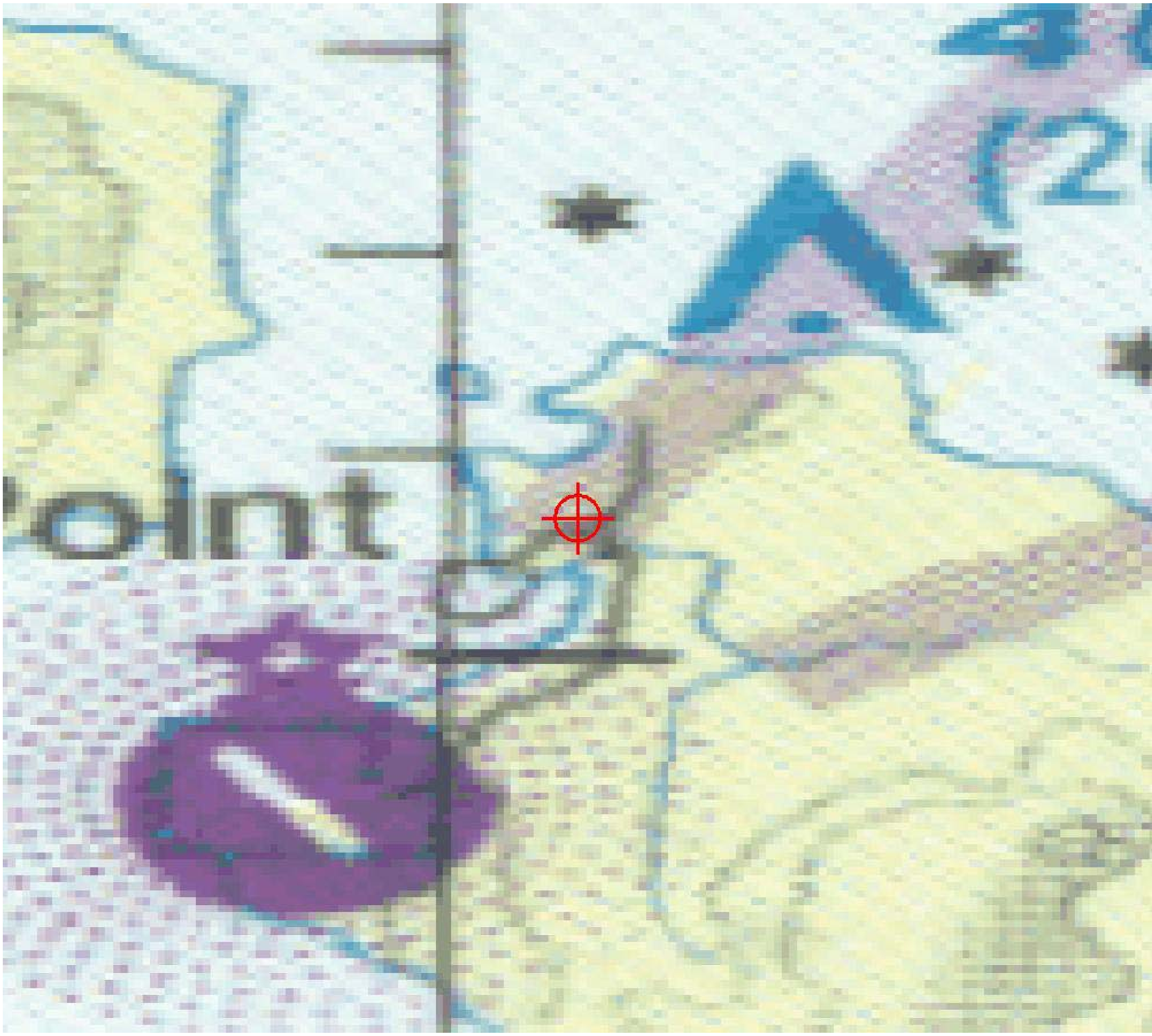
The structure would not adversely impact any present or future VFR or IFR terminal procedure. Runway 31 departures climb via 314 bearing from the Borland (HBT) NDB/DME to 1,800 feet before then making a climbing right turn - well above this proposed wind turbine.

The proposed structure would not impact any VFR or IFR en route procedure.

The structure would not have a cumulative impact on any existing or planned airport.

The structure would exceed obstruction standards and should be obstruction lighted in accordance with FAA AC 70/7460-1K, Change 2, Chapters 4, 12 and 13, white paint/red obstruction light system.

Sectional Map for ASN 2006-AAL-563-OE



Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2006-AAL-563-OE

Issued Date: 10/21/2008

Nicholas Goodman Aleutian Wind Energy, LLC 4300 B Street, #402 Anchorage, AK 99503

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

Structure:	Wind Turbine AWE #1
Location:	Sand Point, AK
Latitude:	55-20-42.84N NAD 83
Longitude:	160-29-25.34W
Heights:	120 feet above ground level (AGL)
	280 feet above mean sea level (AMSL)

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before November 20, 2008. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Branch, Federal Aviation Administration, 800 Independence Ave SW, Washington, D.C. 20591.

This extension becomes final on November 30, 2008 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 04/21/2010 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

A copy of this extension will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

 If we can be of further assistance, please contact our office at (770) 909-4401. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2006-AAL-563-OE.

Signature Control No: 492326-103458448 (EXT) Earl Newalu Specialist

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2007-AAL-66-OE
Prior Study No.
2006-AAL-564-OE

Issued Date: 05/17/2007

Nicholas Goodman Aleutian Wind Energy, LLC 4300 B Street, #402 Anchorage, AK 99503

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine AWE #2 REVISED
Location:	Sand Point, AK
Latitude:	55-20-38.00 N NAD 83
Longitude:	160-29-21.00 W
Heights:	120 feet above ground level (AGL)
	284 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe
and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities.
Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a
hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory
circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights
Chapters 4,12&13(Turbines).

It is required that the enclosed FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part I)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part II)

See attachment for additional condition(s) or information.
This determination expires on 11/17/2008 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

Page 1 of 6

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before June 16, 2007. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted in triplicate to the Manager, Airspace and Rules Division - Room 423, Federal Aviation Administration, 800 Independence Ave., Washington, D.C. 20591.

This determination becomes final on June 26, 2007 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Office of Airspace and Rules via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

A copy of this determination will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

If we can be of further assistance, please contact William Merritt, at (718)553-2560. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2007-AAL-66-OE.

Signature Control No: 505775-100527735 (DNH) Kevin P. Haggerty Manager, Obstruction Evaluation Service

Attachment(s)
Additional Information
Map(s)

7460-2 Attached

Aditional information for ASN 2007-AAL-66-OE

Aeronautical study number 2007-AAL-66-OE

Proposal: To construct a wind turbine to a height of 120 feet above ground level (AGL), 284 feet above mean sea level (AMSL).

Location: The proposed structure would be located 2.1 nautical miles (NM), north of Sand Point Airport (SDP), Sand Point, Alaska.

Federal Aviation Regulation (FAR) Part 77 Obstruction Standards Exceeded:

Section 77.23(a)(5) airport surfaces, by penetrating...

Section 77.25(b) SDP conical surface by 28 feet, a height that exceeds the takeoff or landing area of an airport, as applied to SDP.

Negotiation: Negotiation was attempted with the proponent, but site availability and wind patterns dictated this specific location and height.

Circularized: This aeronautical study was given public notice on April 5, 2007.

Aeronautical Objections Received: None were received.

Aeronautical Study Results:

Sand Point Airport is a publicly owned, public use airport, located 2 miles southwest of Sand Point, Alaska, on the Alaska Peninsula. The airport has a single hard-surfaced runway. Runway 13/31 is 5,213 feet in length and lighted with medium intensity runway lights and Visual Approach Slope Indicator (VASI) lights.
An NDB/DME non precision instrument approach is available to Runway 31. Runway 13 has an NDB, NDB/DME and RNAV(GPS) non precision instrument approach procedure. Special IFR alternate minimums apply on all procedures. Special takeoff minimums are applicable to each runway with a departure procedure for each runway. The six single engine aircraft based at the airport account for 40 percent of the airport's 39 average weekly operations. Air taxi and commuter operations account for slightly for than 40 percent of this total, while transient general aviation account for the remainder.

The wind turbine would not adversely impact any plan on file for Sand Point Airport.

The proposed structure would adversely impact the Sand Point Airport traffic pattern airspace. FAA Handbook 7400.2E, Procedure for Handling Airspace Matters, Chapter 6, paragraph 6-3-8d, state that any structure that would exceed a Part 77 obstruction standard is considered to have an adverse effect on the airport traffic pattern airspace. There would be substantial adverse effect if a significant volume of VFR aeronautical operations were affected. A standard left-hand traffic pattern is flown to Runway 31. A nonstandard right-hand traffic pattern is flown to Runway 13, thus keeping aircraft over water and away from the higher terrain inland and east of the airport. This proposed structure nearly two nautical miles east of the Runway 13 final approach course is well beyond the dimensions of any Category A, B, C and D type aircraft traffic pattern airspace. When properly obstruction marked and lighted this wind turbine will be able to be seen and avoided. There would not be a substantial adverse effect to VFR operations at Sand Point Airport.

The structure would not adversely impact any present or future VFR or IFR terminal procedure. Runway 31 departures climb via 314 bearing from the Borland (HBT) NDB/DME to 1,800 feet before then making a climbing right turn -well above this proposed wind turbine.

The proposed structure would not impact any VFR or IFR en route procedure.

The structure would not have a cumulative impact on any existing or planned airport.

The structure would exceed obstruction standards and should be obstruction lighted in accordance with FAA AC 70/7460-1K, Change 2, Chapters 4, 12 and 13, white paint/red obstruction light system.

Sectional Map for ASN 2007-AAL-66-OE

Federal Aviation Administration	Aeronautical Study No.
Air Traffic Airspace Branch, ASW-520	2007-AAL-66-OE
2601 Meacham Blvd.	Prior Study No.
Fort Worth, TX 76137-0520	2006-AAL-564-OE

Issued Date: 10/21/2008

Nicholas Goodman Aleutian Wind Energy, LLC 4300 B Street, #402 Anchorage, AK 99503

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

Structure:	Wind Turbine AWE #2 REVISED
Location:	Sand Point, AK
Latitude:	55-20-38.00N NAD 83
Longitude:	160-29-21.00W
Heights:	120 feet above ground level (AGL)
	284 feet above mean sea level (AMSL)

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before November 20, 2008. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Branch, Federal Aviation Administration, 800 Independence Ave SW, Washington, D.C. 20591.

This extension becomes final on November 30, 2008 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 04/21/2010 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

A copy of this extension will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

 If we can be of further assistance, please contact our office at (770) 909-4401. On any future correspondence
concerning this matter, please refer to Aeronautical Study Number 2007-AAL-66-OE.

Signature Control No: 505775-103458386 (EXT) Earl Newalu Specialist

Page 2 of 2

State Historic Preservation Office (SHPO) Correspondence

Aleutian/Pribilof Islands Association, Inc.

201 E. 3rd Avenue
Anchorage, Alaska 99501
Phone (907) 276-2700
Fax (907) 279-4351

Ms. Judith E. Bittner
State Historical Preservation Office
Alaska Division of Parks and Outdoor Recreation
550 W. 7th Avenue, Suite 1310
Anchorage, AK 99501-3565

September 14, 2006

Dear Ms. Bittner:

The Aleutian Pribilof Islands Association (APIA), the non-profit organization serving the thirteen tribes of the Aleutian a Pribilof Islands region. We are presently assisting the electric utilities in four (4) communities with projects to integrate wi energy with diesel power plants, significantly reducing the need for diesel fuel. One of our duties is to obtain t environmental assessment documentation required prior to developing the projects.

Sand Point's Electric Utility has been partially funded by the Alaska Energy Authority through a grant from the USDOE install (2) 500 kW wind turbines in the summer of 2007. USDOE requires proof of SHPO approval before the funds can released. This is our most pressing concern.

St. George has completed the study phase and is searching for funds to install (2) 225 kW wind turbines and a new die power plant at the same location.

False Pass and King Cove are nearly complete with the feasibility studies and will soon decide on whether to pursue wi energy based on the results of these studies.

I visited the State Historical Preservation Office in Anchorage on September 12th to confer with Joan Dale, who was or again very helpful. After going over many maps Ms. Dale determined that there are no areas of potential effect on histori sites at any of the proposed locations in the four communities.

In optimistic anticipation that we will obtain funding to move forward with all of these projects, may we get a letter from yo office stating your approval for all of these sites?

Enclosed is a copy of the AHRS User Agreement signed by Ms. Dale on March 9 of this year when we looked at t community of Nikolski. Also enclosed are maps of the proposed locations in Sand Point, St. George, False Pass and Ki Cove.

Thank you,

Connie Fredenberg

Connie Fredenberg

AHRS USER AGREEMENT

Office of History and Archaeology
Division of Parks and Outdoor Recreation
Department of Natural Resources
State of Alaska

Statement of Policy: Access to historic, prehistoric, and paleontological site location information contained in the Alaska Heritage Resources Survey is closed to the general public AS 40.25.120(a)(4) (Alaska State Parks Policy and Procedure 50200). Authorized users are representatives of federal, state, or local governments on official business; researchers engaged in legitimate scientific research; individuals or representatives of organizations conducting cultural resource surveys aimed at protection of such information or sites; or such individuals determined by the Chief of the office maintaining the Alaska Heritage Resources Survey as having a legitimate need for access. Users requiring use of large blocks of data will be asked to obtain permission of large area land owners or managers for to receive data from their land.

The undersigned agrees to abide by the following conditions in order to obtain all or a portion of the site listings of the Alaska Heritage Resources Survey. Access to and distribution of site locational information will be limited to the applicant's use in legitimate scientific research or governmental planning, will be held in a secure place, and will not be redistributed to others.

User Name: Connie Fredenberg

Affiliation: APIA / Nikolski Project - Wind Turbine

Address: 201 E 3rd Ave.
Anchorage, AK 99501

Signature: Connie Fredenberg Date: 3-9-06

OFFICE OF HISTORY AND ARCHAEOLOGY

[X] Approved [ ] Disapproved Date: 3/9/2006

Signature: Rachel Van Dale

Ø - APE

SAND POINT

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- 1:250K Topo Maps
- Automatic selection

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- Large

View Scale
1 : 50,000

Coordinate Format

Map Datum
NAD27

Show target
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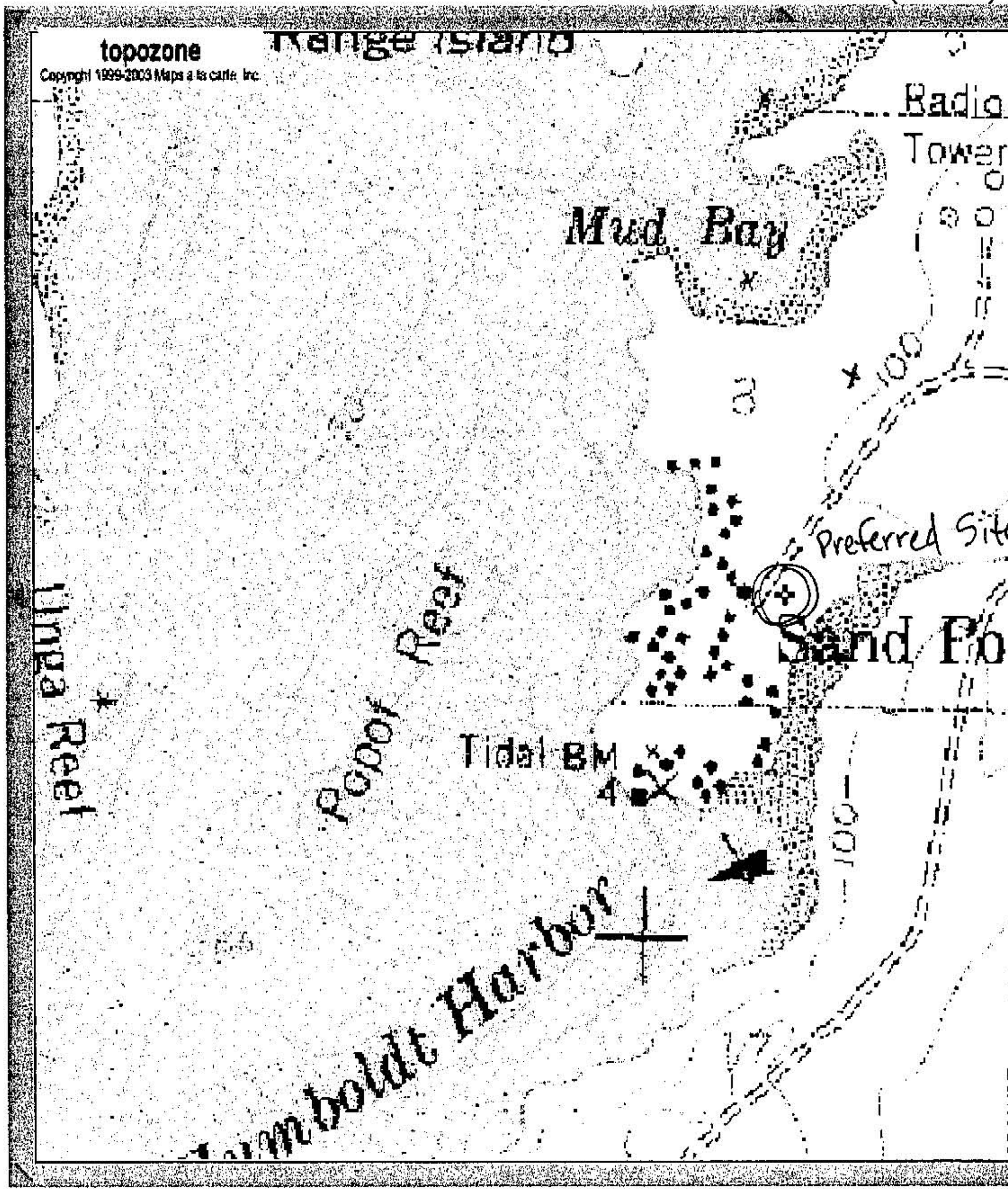

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- 1:250K Topo Maps
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- Large

View Scale

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Coordinate Format

UTM

Map Datum

NAD27

Show target

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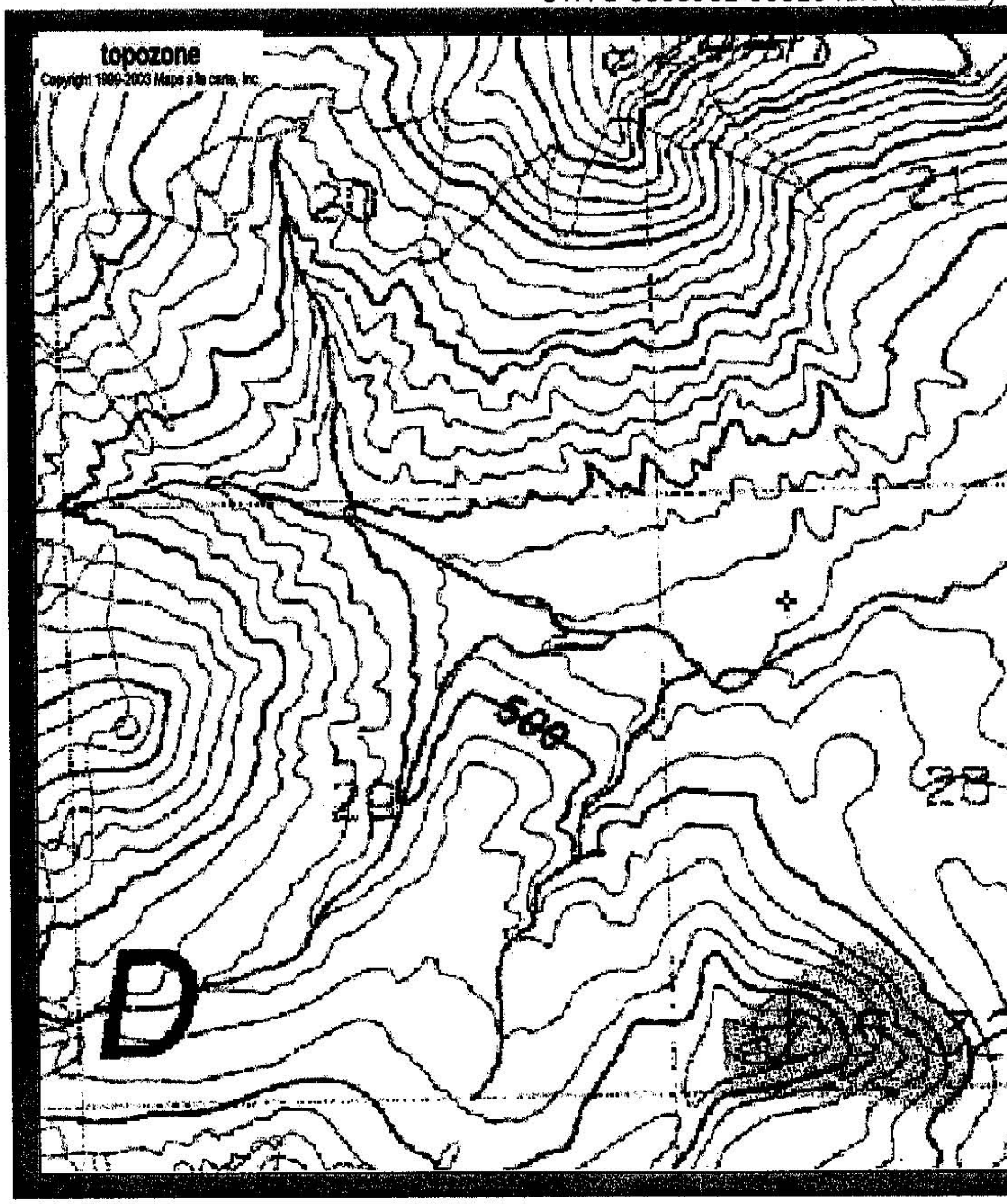

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FRANK H. MURKOWSKI, GOV

DEPARTMENT OF NATURAL RESOURCES

550 W 7th Ave, SUITE 1310
ANCHORAGE, ALASKA 99501-35
PHONE: (907) 269-8721
FAX: (907) 269-8908

DIVISION OF PARKS AND OUTDOOR RECREATION
OFFICE OF HISTORY AND ARCHAEOLOGY

September 27, 2006

RECEIVED
SEP 29 2006
Aleutian Pribilof Islands Association, Inc.

File No. 3130-1R Dept. of Energy
3130-2R AEA

SUBJECT: Installation of Wind Turbines, Sand Point
St. George, False Pass and King Cove Wind Turbines, Scoping

Connie Fredenberg
Alternative Energy Coordinator
Aleutian/Pribilof Islands Association, Inc.
201 E. 3rd Ave.
Anchorage, AK 99501

Dear Ms. Fredenberg,

We have reviewed the proposed installation of two wind turbines in Sand Point, Alaska for potential impacts to historic and archaeological resources under Section 106 of the National Historic Preservation Act. According to the Alaska Historic Resources Survey database, there are no reported archaeological sites within the "preferred site" project area that was defined in your letter of 9/27/06. Therefore, the State Historic Preservation Office concurs with your finding of no historic properties affected for the Sand Point project.

The above referenced letter also contains scoping information for installation of wind turbines in St. George, False Pass and King Cove. Once a definite scope-of-work, location, and funding source has been determined, each project should then be resubmitted to our office. For future Section 106 submittals, please include the federal agency contact information.

Please contact Margie Goatley at 269-8722 if you have any questions or if we can be of further assistance.

Sincerely,

Judith E. Bittner
State Historic Preservation Officer

JEB:mmg

Department of the Air Force
Correspondence

DEPARTMENT OF THE AIR FORCE
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
REGIONAL ENVIRONMENTAL OFFICE, WESTERN REGION
50 FREEMONT, SUITE 2450
SAN FRANCISCO, CALIFORNIA 94105-2196

9 February 2007

Martina Dabo
Alaska Energy Authority
813 West Northern Lights Blvd.
Anchorage, AK 99503

Dear Ms Dabo;

The Department of the Air Force has coordinated a review of the proposed installation of a 500 kW wind turbine in the community of Sand Point, Alaska (55-20-42.84N, 160-29-25.34W, 160ASL). As a part of the review we have consulted with the Department of Defense Long Range Radar Program Office, Air Space Managers stationed at Elmendorf Air Force Base who conducted a review in association with the Pacific Air Force Major Command, and the Department of the Navy.

Based upon the received replies, the Western Regional Environmental Office in consultation with the Air Force's Headquarters Range and Air Space Division concludes that the proposed installation will have no impact on military training conducted by the Department of Defense components. We have received early indications of negligible impacts to long range radar, however in the absence of receipt of a final response we suggest you contact Mr. Kenneth Kingsmore at the DoD/DHS Joint Program Office at kingsmkh@langley.af.mil or 757-764-4392 to confirm.

This determination is limited to an assessment of the project for possible impacts on military training. Your agency may have other obligations for compliance with other local, state, or federal agency requirements, including but not limited to the Federal Aviation Administration.

Thank you for the opportunity to review and comment on this project proposal. If you have any questions concerning these comments, please contact Mr. Gary Munsterman, Planning Coordinator, at 415-977-8884 or gary.munsterman@brooks.af.mil.

Sincerely

CLARE R. MENDELSOHN
DoD Regional Environmental Coordinator,
Region 10

APPENDIX E

BIRD AND BAT MONITORING STUDIES

Appendix E

Avian and Bat Monitoring Studies
and Proposed Mitigation
Sand Point Wind Installation Project

Pre-Construction Monitoring

Survey Protocols

A pre-construction avian monitoring program was conducted from December 6, 2006 through August 17, 2007 and again from October 20, 2008 through March 25, 2009. The purpose of this study was to collect baseline data on the level of bird use in the area and to determine if the site was an appropriate area for siting wind turbines. The avian monitoring program employed several residents familiar with local bird species to make observations at or near the proposed wind turbine sites using the following general protocol. Emphasis was placed on observations of bald eagles since they have special status under the Bald and Golden Eagle Protection Act (16 U.S.C 668, as amended).

(1) Observations were made weekly if possible throughout the year; include spring and fall migration periods, and at different times of day. The observer recorded the date, time of observations, observer's name, weather conditions, and visibility.

(2) The site was approached in a vehicle and stopped about 100 meters (m) from the guyed meteorological (met) tower; the observer spent 30 minutes in vehicle and record any birds, predators, or scavengers seen. Data on animals was collected to determine the scavenging of carcasses of birds killed by the tower.

(3) All birds sighting were recorded during the observation period(s), including numbers, approximate flight altitudes, and flight behaviors in relation to the met tower and proposed wind turbine site.

(4) After the ½-hour observation period was finished, and the observer exited the auto and walked the area under the MET tower (proposed location of Turbine 1) up to 50 m (150 feet) from MET tower or as permitted by thick vegetation to search for dead birds and evidence of scavenging; noting any tracks in the snow or dirt, including snowshoe hare, dog tracks, and any other signs of predators (e.g., scat). Bird observations were also recorded as outlined above.

(5) All observations of dead or downed birds would have been recorded and their location recorded on an area map. Photographs of the dead bird(s) would have been taken to help determine the cause of death, and the location would have been revisited daily to determine when/if it was scavenged.

Results

Pre-construction monitoring will continue until the wind turbines are erected. Results will be regularly sent to the U.S. Fish and Wildlife Service (USFWS). Table 1 tabulates the numbers of different species recorded for all observation periods. A summary of results by season is presented in Table 2.

Table 1. Observation data from the pre-construction avian monitoring program.

Date	Bald eagle	Black-billed magpie	Common raven	Northwestern crow	Gull spp.	Passerine spp.
12/6/2006	3		6			
2/26/2007		2				
3/28/2007	1	1				
3/28/2007	1					
5/15/2007	2					
5/15/2007	2	1	2			
5/16/2007						
5/17/2007	1					
5/24/2007						
5/24/2007		3			2	
5/29/2007						
5/29/2007	1					
5/29/2007	2					
7/17/2007						2
7/18/2007	1					
7/18/2007	2					
7/18/2007	1	1			1	2
7/20/2007						
7/23/2007						1
7/24/2007	2					
7/30/2007		2				3
8/2/2007	1					
8/3/2007						
8/6/2007						
8/8/2007						
8/10/2007	3					
8/14/2007	1					
8/15/2007		2				
8/17/2007						

Date	Bald eagle	Black-billed magpie	Common raven	Northwestern crow	Gull spp.	Passerine spp.
Break in observations						
10/20/2008						
10/27/2008		4	1			6
11/4/2008		1		1		
11/12/2008		2		1		
11/18/2008	1			7		
11/26/2008	1					
12/5/2008						
12/12/2008	1	2				
12/16/2008						
12/24/2008	1					
12/31/2008		1		8		
1/9/2009				3		
1/16/2009				1		
1/22/2009						
2/6/2009		1				
2/13/2009		1		1		
2/19/2009	3	1				
2/27/2009	7	1		2		
3/6/2009	1					
3/20/2009	1			1		
3/25/2009	2	1		2		2

Note: Multiple records for the same day indicate observations were made at different times of day. Cells with no numbers are 0 by default.

Table 2. Summary of pre-construction bird observations[1] from the proposed wind turbine sites by[2] season.

Species	Winter (n=23)	Spring (n=9)	Summer (n=8)	Fall (n=10)

Bald eagle	1.48	0.89	0.75	0.50
Black-billed magpie	0.70	0.44	0.38	0.60
Common raven	0.26	0.22	0	0.10
Northwest crow	1.17	0	0	0
Passerine spp.	0.09	0	1.00	0.60
Gull spp.	0	0.22	0.13	0

Note: Data are mean numbers of birds seen per observation period during each season

[1] This table includes all observations up to March 25, 2009 [2] Winter = November through March, Spring = April through May, Summer = June and July, Fall = August through October n = number of observation periods

Proposed Mitigation

The USFWS has published interim guidelines for wind power projects to minimize the potential risks of bird fatalities due to collisions (USFWS 2003). Many of these guidelines pertain to siting considerations and are more pertinent to much larger projects. However, the following recommendations will be implemented:

Anti-perching devices will be placed on each turbine nacelle (if necessary) to discourage perching or nesting on the turbines, which would greatly increase the potential for bird collisions.

Anti-perching devices will be installed on electric poles in adjacent areas to discourage perching and reduce the potential for electrocution, especially for bald eagles.

The turbine towers will not have external ladders or other structures that would allow birds to perch anywhere near the turbine blades.

AWE/TDX will remove the old Harry Foster towers at the time of construction, thus removing one of the most well-used perches for bald eagles and other resident birds in the area.

The turbine towers will be self-supporting monopoles.

Electric transmission lines from the wind turbines to the TDX power plant will be buried below ground.

Lighting on the turbine towers will be limited to what is necessary for aviation safety, as determined by the FAA.

A post-construction monitoring plan will be implemented for one year to determine if any birds are killed by collisions with the turbines.

Post-Construction Monitoring

The post-construction monitoring plan was developed to document avian and bat mortality related to the operation of the two wind turbines. Because birds are protected under the Migratory Bird Treaty Act (16 U.S.C 703-712) post-construction studies will be conducted to quantify the number and types of birds (or bats) killed by the two wind turbines. If fatality rates from the wind turbines are greater than anticipated, or if high number of fatalities occur under conditions such as fog, heavy rain, high winds, or during specific season, these data can be used to modify operation of the wind turbines to reduce incidence of collisions. This information will capture an example of collision-mortality rates of wind turbines in a northern coastal environment, such as Sand Point.

Schedule

Post-construction monitoring will be initiated following installation and testing of the wind turbines when they are under normal operation. Aleutian Wind Energy, LLC (AWE) and TDX Power (TDX), the proponents of the Sand Point Wind project, will retain a professional Avian Contractor to oversee the implementation of the Post-Construction Monitoring Plan (Plan) and will hire and train local observers to conduct the field work. This Plan will sample for potential seasonal variations in bird collisions, with an emphasis on the fall and spring migration seasons when bird activity is expected to be highest. Surveys will be conducted two times per week for three consecutive weeks during the spring and fall sampling periods, and one time per week for four consecutive weeks during winter and summer sampling periods. Post-construction monitoring will be conducted for one calendar year.

Observation and Survey Protocols

Observation will be conducted by trained observers and the observer name, date, time, and standard weather variables will be recorded. Observations will be a minimum of one hour duration from a blind. An automobile may be used. Following the observation period, a bird strike and predator/scavenger survey will be conducted. Each survey will include a search for dead or injured birds (or bats) beneath each turbine tower. The surveys will be conducted on foot by slowly walking transect lines approximately 25 to 30 feet apart, and looking about 12 to 15 feet on both sides of the transect line. Each set of transects will cover a search area defined as one-half of the maximal height of the rotor-swept area (California Energy Commission and California Department of Fish and Game [CEC/CDFG] 2007) or a radius of about 100 feet around each tower. The tower height is about 130 feet above ground level (agl) and the turbine blades are about 130 feet in diameter, thus putting the upper reach of the turbine blades at 195 feet agl. This search pattern is estimated to take about 40 minutes to complete for each tower. Searches will be conducted at a frequency that minimizes the potential for bias from carcasses lost to scavengers.

Standard data collected during each survey will include:

Survey date
Weather during observation and the previous 24 hours
Observer name
Start and stop times
Turbine number and activity (turbine speed, direction of hub)
Search area conditions (i.e. ice, snow, bare ground, green vegetation)

If any bird or bat carcass is found, the following data will be collected.

Position relative to the wind tower, including distance, and location on the sample grid
Species (if identifiable), condition of the carcass, injury type, and evidence of scavenging
Cause of death (i.e. killed by the turbine) and evidence of cause of death
Approximate length of time the carcass has been there (i.e. days, weeks, months)

Carcasses will be collected, labeled, bagged, and placed in a freezer for later analysis. Some of the carcasses each season will be left in place to determine how long the carcass remains and to ascertain the scavenging rate, which would then be applied to the overall mortality rate. No carcasses will be brought in (i.e frozen feeder quail) to conduct the scavenging study as this may promote scavenger habituation and potential for additional bird strikes.

If a carcass of protected species, such as a bald eagle or Steller’s eider is found, a call will be made to the USFWS in Anchorage within one business day to report the incident.

AWE/TDX will establish a file on site for all of the raw data sheets from searches and scavenging studies. Data sheets will be sent monthly to the Avian Contractor.

Spring

Spring migration sampling is an important time period for collision studies because birds are migrating from wintering areas to nesting grounds and bird numbers are more concentrated than at other times of the year. The spring sampling period will consist of six surveys during the main migration season (approximately April 15 to May 31).

Summer

During the breeding season, birds are generally oriented to the specific breeding areas. Local breeders move between feeding areas and nest sites. Young inexperienced birds are leaving the nest and are thought to be more susceptible to collisions than adults. The summer sampling period will consist of four surveys during the main breeding season (approximately June 1 to August 10).

Fall

Fall migration is generally more protracted in time than spring migrations because of the migration timing of the different species in this region of Alaska. Shorebirds and songbirds tend to migrate earlier than waterfowl and seabirds. Fall migration typically has higher numbers of migrants due to the addition of young-of-the-year to the population. The fall sampling period will consist of six surveys during the main migration season (approximately August 11 to October 10).

Winter

The winter season represent the period of lowest bird activity for species and numbers. The winter sampling period will consist of four surveys during the non-breeding season (approximately October 11 to April 14).

Reporting

The Avian Contractor will submit a letter report at the end of each seasonal sampling effort. This report will present the survey data and the sample effort for that period including the species and number of carcasses found and disposition of the samples.
At the end of the last seasonal survey event, a summary report will be developed reporting on all survey effort. This report will be submitted to AWE/TDX for review and comment. The final report will be sent to the Department of Energy (DOE) and USFWS for review and comment on the draft report. Comments responses will be formulated, and a final report submitted to DOE and USFWS.

Mitigation

If bird mortality from collisions with the wind turbines is greater than the highest recorded mortality rate for wind farms, 4.45 birds per turbine per year (BLM 2005). Mitigation measures would be implemented to try and reduce the mortality rate. Some possible mitigation measure would include:

Clearing brush or planting additional vegetation (such as grasses) around the towers, which every is appropriate to discourage bird use of the immediate area

Changing the turbine lighting with FAA approval to make them less of an attractant

Adding white strobe light to make the towers more visible under low light conditions and during adverse weather.

Feathering the rotors to slow the turbine speed during critical periods

Idling the turbines during certain specific critical time periods demonstrated to have high collision rate

Idling the turbines during seasonal periods such as spring migrations if major mortality events are documented

Mitigation measures will depends on the results of the mortality study, the species most affected, the season, and the site specific weather conditions contributing to mortality. Coordination with the USFWS and DOE will be initiated prior to implementing any mitigation measure.

Mitigation measures will be sequential with the most severe (feathering and idling) being used as a last resort. If migration measures are implemented, additional mortality monitoring will need to be conducted to determine if the measures are effective in lowering the mortality rate.

References

Bureau of Land Management. 2005. Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States. Prepared by Argonne National Laboratory for BLM, Washington, D.C..

CEC/CDFG (California Energy Commission and California Department of Fish and Game). 2007. California guidelines for reducing impacts to birds and bats from wind energy development. California Energy Commission and California Department of Fish and Game, Report No. CEC-700-2007-08-CTF. 125 pp.

USFWS, 2003. Interim guidelines to avoid and minimize wildlife impacts from wind turbines. Memorandum to the USFWS regional directors from the Deputy Director, 13 May 2003. Available online at: http://www.fws.gov/habitatconservation/Service%20Interim%20Guidelines.pdf

APPENDIX F

VISUAL AND SOUND REPORT

GLOBAL ENERGY CONCEPTS

THE Wind Resource

Photo Simulations and Sound Impact Analysis for Sand Point Wind Power Project

APIA1-001

CONFIDENTIAL

November 30, 2006

Prepared for:

Aleutian/Pribilof Islands Association
201 East 3rd Avenue
Anchorage, AK 99501

1809 7th Avenue, Suite 900, Seattle, Washington 98101 Phone: (206) 387-4200 Fax: (206) 387-4201
www.globalenergyconcepts.com

Approvals

Mia Devine November 30, 2006 Prepared by Mia Devine Date

Kevin J. Smith November 30, 2006 Reviewed by Kevin J. Smith Date

Revision Block

Revision	**Release Date**	**Summary of Changes**
Original	November 30, 2006	

Visual and Sound Impact Analysis for Sand Point Wind Power Project APIA1-001

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Introduction

The Aleutian/Pribilof Islands Association (APIA) contracted with Global Energy Concepts, LLC (GEC) to create photo simulations and perform a sound impact analysis for the proposed Sand Point wind power project located in the East Aleutian Borough of Alaska. The proposed wind power project consists of two Vestas V39 500 kW wind turbines that will be installed on 40-m tubular towers. This report presents five photo simulations and findings from the sound impact analysis.

The findings of the sound impact analysis indicate that the wind turbines will produce sound levels of no more than 60 decibels on the A-weighed scale (dBA) at the project boundaries. The study also evaluated expected changes in sound level at nearby locations, and concluded that at these locations the change to the background sound levels would be minimal.

Photo Simulations

The proposed wind turbine coordinates, photographs, and GPS coordinates of various reference points throughout Sand Point were provided by TDX Power and were used to create photo simulations of the proposed wind farm from various vantage points throughout the community. GEC has not visited the site.

WindFarm Version 4.0.2.3 software by ReSoft Ltd. was used to create all photo simulations. The following information was taken into account when creating the photo simulations:

Wind direction data from the meteorological tower in Sand Point indicate two primary wind directions: north-northwest and south-southwest. Therefore, the wind turbines in each photo are oriented to the north-northwest.

The angle of rotation of the blades for each turbine is random (i.e., the tips of the blades of all turbines are not pointed straight up at the same time). This more closely matches reality as there is a low probability that the rotation of the blades would be synchronized.

The angle of the sun, light intensity level, and shadows on the turbines were adjusted to most closely match the local conditions at the time the photo was taken.

Coordinates of the proposed wind turbines are listed in Table 1. If the final turbine locations are modified from these original coordinates, the photo simulations may no longer be valid.

Table 1. Coordinates of Proposed Wind Turbines in Sand Point, Alaska

	UTM Zone 4, NAD83		Elevation (m)
Description	**Easting**	**Northing**	
Turbine #1	405490	6134190	56
Turbine #2	405560	6134074	59

Visual and Sound Impact Analysis for Sand Point Wind Power Project APIA1-001

Figure 1 illustrates where each photo was taken with respect to the proposed wind project location. The five photo simulations are provided in Figure 2 through Figure 7. The JPEG images as well as animations of each image will be provided to APIA electronically.

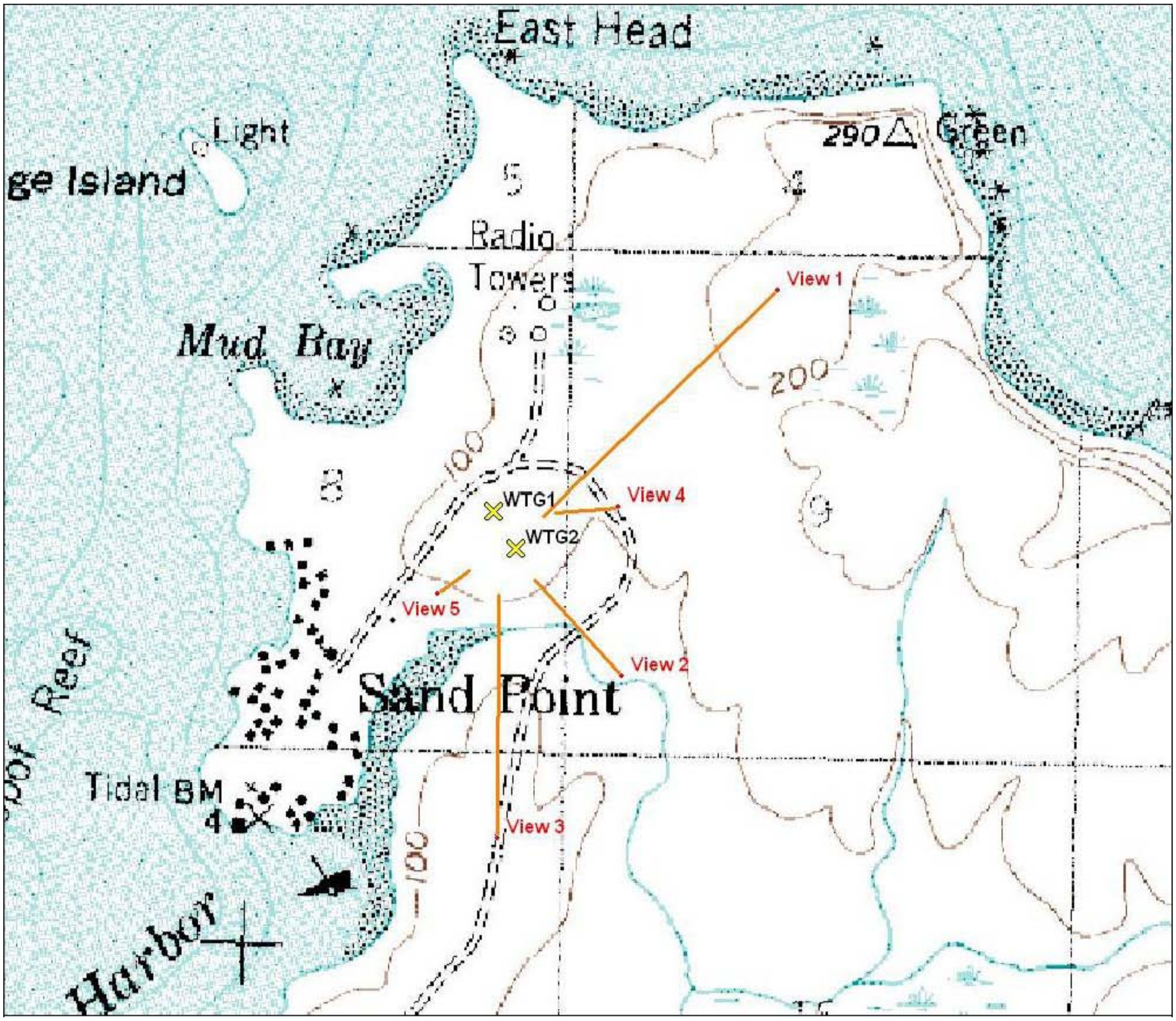


Figure 1. Map of Wind Farm Site and Viewpoints from Which the Photos Were Taken
Visual and Sound Impact Analysis for Sand Point Wind Power Project APIA1-001

Figure 2. Photo Simulation from the Southwest Corner of the School (View 1)

Figure 3. Photo Simulation from the South Side of the Pump House Pond (View 2)
Visual and Sound Impact Analysis for Sand Point Wind Power Project APIA1-001

Figure 4. Photo Simulation from Power Pole #43 (View 3)

Figure 5. Photo Simulation from the SDP Fisheries Building (View 4)
Visual and Sound Impact Analysis for Sand Point Wind Power Project APIA1-001

Figure 6. Photo Simulation from the SDP Fisheries Building (View 4)

Figure 7. Photo Simulation from Housing to the Southwest of the Wind Farm Site (View 5)

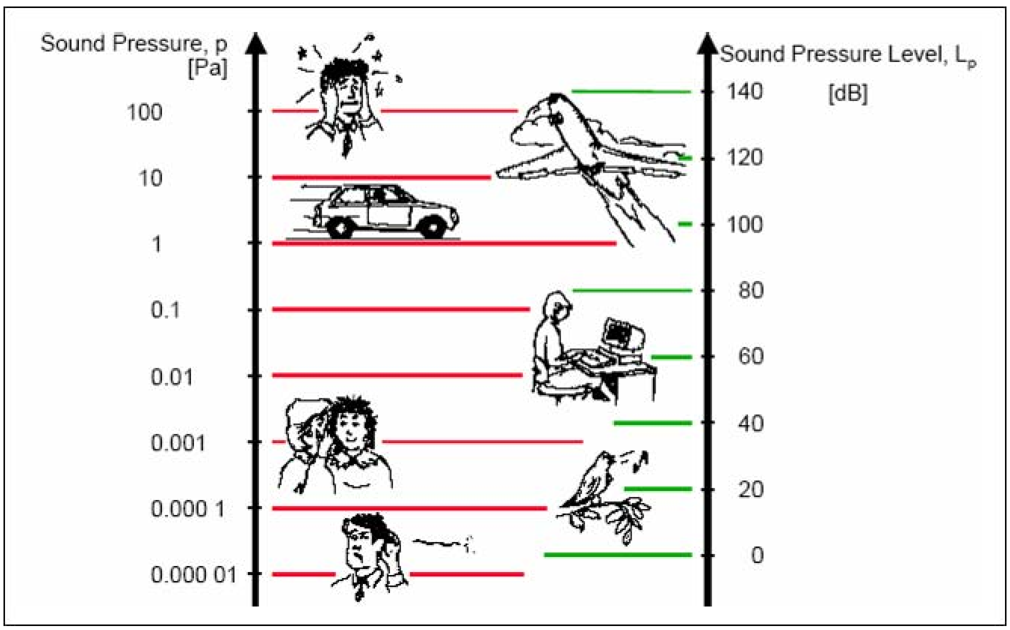
Visual and Sound Impact Analysis for Sand Point Wind Power Project APIA1-001

Sound Impact Analysis

Sound moves through air as waves of pressure fluctuations caused by vibrations. As sounds move away from their source, the sound pressures decrease because the sound is spread over an increasing area and attenuated (dissipated) by obstructions, obstacles, and the atmosphere. The most common unit of measure used to describe the magnitude of sound levels is the decibel (dB). Sound levels are often stated in terms of decibels on the A-weighted decibel scale (dBA), which is weighted to reflect the response of the human ear by attenuating, or discounting, some of the noise in the low- and high-frequency ranges to which the human ear is less responsive.

Sound pressure levels differ from sound power levels. Sound power levels are characteristic of a sound source. This sound power rating is a property of the equipment and is not dependent on distance from the source or environmental factors.

Sound pressure levels are what is perceived by the human ear and vary with distance from the source. Typical sound pressure levels include about 110 dBA for construction noise, 90 dBA for a heavy truck accelerating, 60 dBA for a conversation, and 50 dBA for a quiet office. Figure 8 illustrates sound pressure levels of common noise sources.



(Source: Bruel & Kjaer Instruments)

Figure 8. Range of Sound Pressure Levels from Common Sources

The dBA scale is logarithmic, so individual dBA ratings for different sources cannot be added directly to calculate the sound level for combined sources. For example, two sources, each producing 50 dBA will, when added together logarithmically, produce a combined sound level of 53 dBA. In typical situations, a 3 dBA change in sound level is considered a just-perceivable difference, while a 10 dBA change is considered an approximate doubling of perceived loudness.

Table 2. Perception of Changes in Sound Pressure Level

Change in Sound Level (dB)	Change in Perceived Loudness
1	Cannot be perceived
3	Just perceptible
5	Noticeable difference
10	Twice (or ½) as loud
15	Large change
20	Four times (or ¼) as loud

(Source: Bruel & Kjaer Instruments)

When operating, wind turbines produce a “swishing” or “whooshing” sound as their rotating blades encounter turbulence in the passing air, as well as some sounds from the mechanical parts such as the gearbox, generator, and cooling fans. At a distance of several hundred meters (approximately 600 to 900 ft), the sounds generated by a wind turbine are frequently masked by the “background noise” of winds blowing through trees or moving around obstacles. Wind turbines are typically quiet enough for people to hold a normal conversation while standing at the base of the tower. If mechanical sounds are significant, it usually means something in the nacelle needs maintenance or repair.

Acoustic Modeling

Wind turbines are often rated at a particular sound power level which is calculated from measurements performed according to a standard (such as International Electrotechnical Commission Standard IEC 61400-11). The acoustic reference conditions for the IEC 61400-11 standard are when the wind speed is 8.0 m/s (18 mph) measured at a height of 10 m (33 ft) above ground level. Assuming a site average vertical wind shear coefficient of 0.14, the reference condition is equivalent to a wind speed of 9.7 m/s (22 mph) at a 40-m turbine hub height. At higher wind speeds, sounds from the wind turbine become less noticeable because background noise associated with the wind itself increases and tends to cover or mask that being generated by the turbine.

The WindFarm software was used for the sound impact analysis. This software contains a database of various wind turbine models and technical specifications for each. It also allows the user to modify any default specifications. According to the WindFarm database, the Vestas V39 wind turbine produces a sound power level of 101 dBA during the acoustic reference conditions defined by the IEC 61400-11 standards. It should be noted, however, that the wind turbines to be installed in Sand Point have already been in operation at another location for a number of years. It is unknown how the aging of the turbine or the remanufacturing process might affect the sound rating of these turbines. Results from field measurements performed in 1995 were provided by the turbine supplier and indicate a sound power level of 97.8 dBA at the IEC 61400-11 reference conditions. The sound power level of a turbine is usually warranted by the manufacturer not to exceed a maximum level of 104 dBA at the reference conditions. Therefore, for this analysis, GEC assumes that 101 dBA is a reasonable estimate of the sound power level of these turbines.

In the sound analysis model, the generated sound is represented as a point source at the wind turbine's hub, which is consistent with how the turbine sound power level ratings are typically defined. This approximates the sound pressure waves produced by the blades over their entire path of travel. Sound will decrease over distance due to other factors such as atmospheric damping, terrain absorption, and interference of obstacles; however, the primary mechanism for the decrease of sound is distance attenuation. There is no assumed change of sound due to vegetation, obstacles, or sound being propagated by the wind. Background noise is not taken into account in the model. The model assumes an attenuation coefficient of 0.005 dBA/m. This is equivalent to typical sound attenuation with distance due to the divergence of sound energy (about 6-8 dBA per doubling of distance) up to a distance of 400 m (1300 ft) from a turbine.

Impact on the Community

As described above, GEC performed sound impact modeling based on the rated turbine sound power level of 101 dBA at the acoustic reference conditions. Figure 9 represents the resulting sound contour map of the project area.

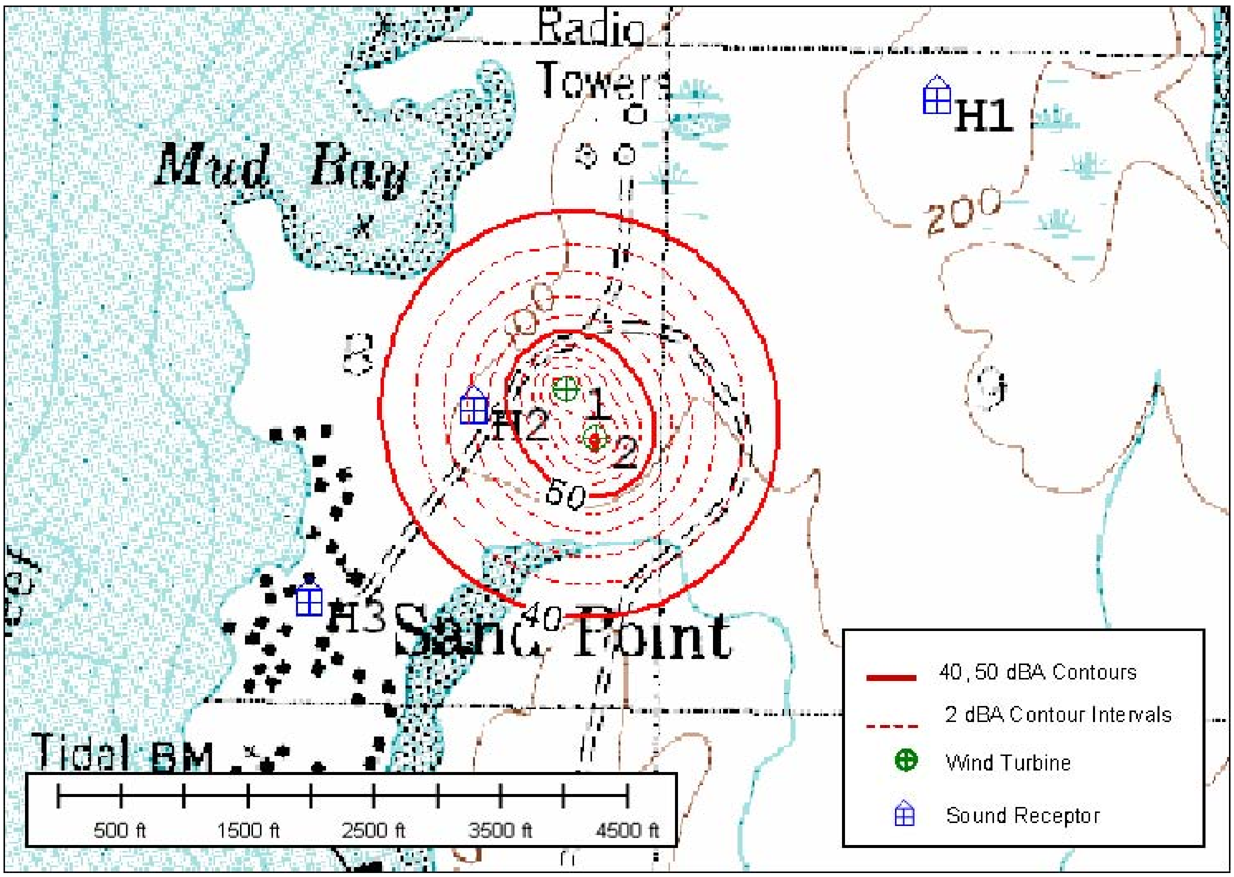


Figure 9. Sound Contour Map for Sand Point Project Area at Reference Conditions: 8 m/s Wind Speed at 10-m Height

As shown, when standing 400 to 500 ft away from either turbine, the calculated sound pressure level is 50 dBA, equivalent to a quiet office setting. When standing immediately beneath the turbines, the maximum sound pressure level is 58 dBA.

Visual and Sound Impact Analysis for Sand Point Wind Power Project APIA1-001

Impacts on Identified Receptors

In addition to modeling the expected sound levels from the turbines, GEC analyzed the incremental change in sound levels that is expected to be perceived by observers at nearby locations around Sand Point. Three sound receptors are shown on the map in Figure 9. H1 represents the location of the school while H2 and H3 represent different housing areas.

Both background noise and turbine noise will vary with wind speed. Noise from a wind turbine will likely be most noticeable at low wind speeds (8-10 mph) during which the wind turbines are just beginning to operate and the background noise is at the lowest levels. At higher wind speeds, turbine noise tends to be masked by the sound generated by the wind. Both low wind speed and high wind speed impacts were modeled using wind speeds of 4.0 m/s (9 mph) and 8.0 m/s (18 mph), respectively, at a height of 10 m (33 ft) above ground level.

Since background noise measurements have not been taken at the site, GEC modeled three different background levels: 40 dBA, 50 dBA, and 60 dBA. The sound impact due to the wind turbines on each receptor was combined with the background noise levels to provide an estimate of the total sound level at each receptor for both the 4 m/s and 8 m/s wind speed conditions. The results are shown in Table 3.

Table 3. Sound Impacts for Varying Background Noise Levels and Wind Speeds

Receptor ID	4 m/s Wind Speed (10-m height)			8 m/s Wind Speed (10-m height)		
	Background Sound Levels (dBA)	Turbine Sound Impact (dBA)	Turbines and Background Combined (dBA)	Background Sound Levels (dBA)	Turbine Sound Impact (dBA)	Turbines and Background Combined (dBA)
H1	40	27	40	40	29	40
	50	27	50	50	29	50
	60	27	60	60	29	60
H2	40	44	46	40	46	47
	50	44	51	50	46	52
	60	44	60	60	46	60
H3	40	32	41	40	34	41
	50	32	50	50	34	50
	60	32	60	60	34	60

These results show that the change to the background noise levels at the H1 and H3 receptors would not be significant across the range of operating wind speeds. However, due to its close proximity to the wind turbines, the H2 receptor has the potential to be impacted by sounds from the wind turbines, depending on existing background noise conditions. If background sound power levels are 40 dBA, the H2 receptor would experience a 6 dBA increase in sound pressure level due to the wind turbines, which could be a “noticeable difference” to the homeowner. Whether or not this difference is considered an annoyance is subjective. However, if the background sound of the wind, diesel power plant, or other community activities is 50 dBA, the additional sound from the wind turbines would not be perceptible.

Application Forms and Instructions

The following forms and instructions are provided to assist you in preparing your application for a Renewable Energy Fund Grant. An electronic version of the Request for Applications (RFA) and the forms are available online at: http://www.akenergyauthority.org/RE_Fund-IV.html

Grant Application Form	GrantApp4.doc	Application form in MS Word that includes an outline of information required to submit a complete application. Applicants should use the form to assure all information is provided and attach additional information as required.
Application Cost Worksheet	Costworksheet4.doc	Summary of Cost information that should be addressed by applicants in preparing their application.
Grant Budget Form	GrantBudget4.doc	A detailed grant budget that includes a breakdown of costs by milestone and a summary of funds available and requested to complete the work for which funds are being requested.
Grant Budget Form Instructions	GrantBudgetInstructions4.pdf	Instructions for completing the above grant budget form.

- If you are applying for grants for more than one project, provide separate application forms for each project.
- Multiple phases for the same project may be submitted as one application.
- If you are applying for grant funding for more than one phase of a project, provide milestones and grant budget for completion of each phase.
- If some work has already been completed on your project and you are requesting funding for an advanced phase, submit information sufficient to demonstrate that the preceding phases are satisfied and funding for an advanced phase is warranted.
- If you have additional information or reports you would like the Authority to consider in reviewing your application, either provide an electronic version of the document with your submission or reference a web link where it can be downloaded or reviewed.

REMINDER:

- Alaska Energy Authority is subject to the Public Records Act AS 40.25, and materials submitted to the Authority may be subject to disclosure requirements under the act if no statutory exemptions apply.
- All applications received will be posted on the Authority web site after final recommendations are made to the legislature.
- In accordance with 3 AAC 107.630 (b) Applicants may request trade secrets or proprietary company data be kept confidential subject to review and approval by the Authority. If you want information is to be kept confidential the applicant must:
    - o Request the information be kept confidential.
    - o Clearly identify the information that is the trade secret or proprietary in their application.
    - o Receive concurrence from the Authority that the information will be kept confidential. If the Authority determines it is not confidential it will be treated as a public record in accordance with AS 40.25 or returned to the applicant upon request.

SECTION 1 – APPLICANT INFORMATION

Name (*Name of utility, IPP, or government entity submitting proposal)*			
City of False Pass Electric Utility			
Type of Entity: **Local Government**			
Mailing Address **P.O. Box 50** **False Pass, AK. 99583**		**Physical Address** **100 Main Street** **False Pass, AK 99583**	
Telephone **907-548-2319**	**Fax** **907-548-2214**	**Email** **cityoffalsepass@ak.net**	

1.1 APPLICANT POINT OF CONTACT / GRANTS MANAGER

Name **Ted Meyer**		**Title** **Community Development Coordinator**
Mailing Address **3380 C Street, Suite 205** **Anchorage, AK 99503-3952**		
Telephone **(907)274-7555**	**Fax** **(907)276-7569**	**Email** **tmeyer@aeboro.org**

1.2 APPLICANT MINIMUM REQUIREMENTS

Please check as appropriate. If you do not to meet the minimum applicant requirements, your application will be rejected.

1.2.1 As an Applicant, we are: *(put an **X** in the appropriate box)*

	An electric utility holding a certificate of public convenience and necessity under AS 42.05, or
	An independent power producer in accordance with 3 AAC 107.695 (a) (1), or
X	A local government, or
	A governmental entity (which includes tribal councils and housing authorities);
Yes	1.2.2. Attached to this application is formal approval and endorsement for its project by its board of directors, executive management, or other governing authority. If the applicant is a collaborative grouping, a formal approval from each participant's governing authority is necessary. (Indicate Yes or No in the box)
Yes	1.2.3. As an applicant, we have administrative and financial management systems and follow procurement standards that comply with the standards set forth in the grant agreement.
Yes	1.2.4. If awarded the grant, we can comply with all terms and conditions of the attached grant form. (Any exceptions should be clearly noted and submitted with the application.)
Yes	1.2.5 We intend to own and operate any project that may be constructed with grant funds for the benefit of the general public.

SECTION 2 – PROJECT SUMMARY

This is intended to be no more than a 1-2 page overview of your project.

2.1 Project Title – (Provide a 4 to 5 word title for your project)

Type in your answer here and follow same format for rest of the application.

False Pass Wind Energy Project

2.2 Project Location –

Include the physical location of your project and name(s) of the community or communities that will benefit from your project.

False Pass is located on the eastern shore of Unimak Island on a strait connecting the Pacific Gulf of Alaska to the Bering Sea. It is 646 air miles southwest of Anchorage.

2.3 PROJECT TYPE

*Put **X** in boxes as appropriate*

2.3.1 Renewable Resource Type			
X	Wind		Biomass or Biofuels
	Hydro, including run of river		Transmission of Renewable Energy
	Geothermal, including Heat Pumps		Small Natural Gas
	Heat Recovery from existing sources		Hydrokinetic
	Solar		Storage of Renewable
	Other (Describe)		

2.3.2 Proposed Grant Funded Phase(s) for this Request *(Check all that apply)*			
X	Reconnaissance		Design and Permitting
X	Feasibility		Construction and Commissioning
	Conceptual Design		

2.4 PROJECT DESCRIPTION

Provide a brief one paragraph description of your proposed project.

False Pass currently produces all their electricity from diesel generators and heating from burning fossil fuels. Data from a met tower set up several years ago was compromised and has data gaps when bears damaged the equipment, but the data still may be useful if analyzed using appropriate assumptions and software. The wind resource may prove to be good, but we won't know until the data is analyzed and a wind resource report is completed. In addition, an avian study will determine if birds will be of concern and/or if mitigation measures are necessary.

This project seeks funding for analyzing the raw wind data and preparing a wind assessment report for False Pass. Based on wind assessment results/report a subsequent proposal may be submitted for conceptual design. In addition, an avian study will determine if migrating or nesting birds present concerns to a wind project and determine mitigation measures. The principal goals of baseline bird studies are to quantitatively describe the temporal and spatial use by birds of the study area and provide baseline information on avian species and their habitat sufficient to use in evaluating the probable impact of installation of a wind turbine. The specific goals are to provide avian monitoring protocol training to local agent(s), collect avian data to determine bird activity at the delineated areas around the turbine site, record any dead or downed (injured) birds at the site that may be the result of collisions with the meteorological tower, and prepare avian monitoring reports including back-up information and complete avian data.

2.5 PROJECT BENEFIT

Briefly discuss the financial and public benefits that will result from this project, (such as reduced fuel costs, lower energy costs, etc.)

This project will reduce fuel and the overall energy costs to the False Pass community. False Pass currently produces all their electricity from diesel generators and heating from burning fossil fuels. Little biomass is currently available to offset home heating and hydro in the local streams and solar energy do not seem practical in False Pass, but the wind resource may prove to be good. Based on surveys of local community members False Pass has good wind and the report may support these survey results.

The estimated annual electricity savings, based on the use of a couple 10KW turbines will be 27,120kWh. This will translate into a financial savings of $7,594 per year (estimated at $0.28/kWh). Larger wind turbines will provide more power and more savings, but improvements to the electrical utility would be necessary; this will be investigated if this project is funded.

Other project benefits will include:

- Reduced dependence on diesel fuel and the expense involved in its transportation and storage.
- Save on current operation and maintenance costs by less time from using diesel generators
- Contribute to the reduction of air pollution and affects on climate change.

2.6 PROJECT BUDGET OVERVIEW

Briefly discuss the amount of funds needed, the anticipated sources of funds, and the nature and source of other contributions to the project.

The estimated Phase I Reconnaissance cost of this project is $74,075, Phase II Feasibility is $64,550. The project cost total is $138,625. Aleutians East Borough staff time will contribute in-kind to this project for project administration and management ($10,000). The total requested is $128,875.

2.7 COST AND BENEFIT SUMARY

Include a summary of grant request and your project's total costs and benefits below.

Grant Costs *(Summary of funds requested)*	
2.7.1 Grant Funds Requested in this application.	**$128,625**
2.7.2 Other Funds to be provided (Project match)	**$10,000**
2.7.3 Total Grant Costs (sum of 2.7.1 and 2.7.2)	**$138,625**

Project Costs & Benefits

(*Summary of total project costs including work to date and future cost estimates to get to a fully operational project)*	
2.7.4 Total Project Cost (Summary from Cost Worksheet including estimates through construction)	**$ not available**
2.7.5 Estimated Direct Financial Benefit (Savings)	**$ not available**
2.7.6 Other Public Benefit (If you can calculate the benefit in terms of dollars please provide that number here and explain how you calculated that number in your application (Section 5.)	**$ not available**

Alternative Energy Resources

Wind Diesel Hybrid

Installed KW	**200**
kW-hr/year	**406290**
Met Tower?	**no**
Homer Data?	**yes**
Wind Class	**7**
Avg wind speed	**8.50** m/s

		per kW-hr	Heat Cost $/MMBtu :
Capital cost	**$1,760,485**		
Annual Capital	**$118,332**	$0.29	$85.34
Annual OM	**$19,062**	$0.05	$13.75
Fuel cost:	**$0**	$0.00	
Total Annual Cost	**$137,394**	$0.34	**$99.08**

Non-Fuel Costs	$0.07
Alternative COE:	**$0.40**
% Community energy	180%
New Community COE (includes non-fuel and diesel costs)	**$0.68**

Savings
($58,999)

Diesel Engine Heat Recovery

Heat Recovery System Installed? **Y**
Is it working now? **Y**
BLDGs connected and working:
Powerhouse Only

			Value
Water Jacket	**2,068**	gal	**$11,615**
Stack Heat	**0**	gal	**$0**

Capital cost	**$72,009**
Annual ID	**$6,032**
Annual OM	**$1,440**
Total Annual costs	**$7,472**
Heat cost	**$32.70** $/MMBtu

Savings
$4,143

SECTION 3 – PROJECT MANAGEMENT PLAN

Describe who will be responsible for managing the project and provide a plan for successfully completing the project within the scope, schedule and budget proposed in the application.

3.1 Project Manager

Tell us who will be managing the project for the Grantee and include contact information, a resume and references for the manager(s). If the applicant does not have a project manager indicate how you intend to solicit project management support. If the applicant expects project management assistance from AEA or another government entity, state that in this section.

The Aleutians East Borough uses a team approach in project management and development. AEB staff maintains routine communications with False Pass City staff in all aspects of community development and projects. This close contact and coordination will continue in the False Pass Wind Power Project. The False Pass City Council has authorized the AEB to provide overall project administration and management of this project. Upon project funding, the AEB will select and work with Marsh Creek as the design and construction management consultants to initiate, oversee, and complete the project.

Aleutian East Borough Project Management staff includes:

- Sharon Boyette, Administrator
  907-274-7555, sboyette@aeboro.org

- Ted Meyer, Community Development Coordinator
  907-274-7555, tmeyer@aeboro.org

- Roxann Newman, Finance Director.
  907-497-2588, rnewman@aeboro.org

Attached are their resumes.

3.2 Project Schedule

Include a schedule for the proposed work that will be funded by this grant. (You may include a chart or table attachment with a summary of dates below.)

See Project Milestones table below for Project Schedule.

3.3 Project Milestones

Define key tasks and decision points in your project and a schedule for achieving them. The Milestones must also be included on your budget worksheet to demonstrate how you propose to manage the project cash flow. (See Section 2 of the RFA or the Budget Form.)

Project Milestones	Reimbursable Tasks	Timeline
Phase I. Reconnaissance		
• Project Scoping and **Community** Solicitation	• Project Management • Establish avian monitoring needs for area as suggested by USFWS • MC Team will travel to community for site assessment and to visit the school to introduce the project to Staff/Students/Community and solicit participation i.e. Introduce Wind for Schools, provide information about training opportunities for wind-diesel system operations, and solicit volunteers for avian monitoring (this task will be completed concurrently with the Preliminary Site Visit funded in the next milestone – no additional funding added for this milestone in budget)	8/1/11 to 10/31/11
• Resource Identification and Analysis	• Project Management • Preliminary site visit • Contract for wind data analysis • FAA Approval for met tower on selected site(s) • Determine point of contact and train local	9/1/11 to 10/31/12

	agents to conduct avian observations • Gather avian observations	
• Land use, permitting, and environmental analysis	• Project Management • Determine site ownership issues, if any • Contact agencies for preliminary approval: SHPO, DOD, ACMP • Document, if any, community concerns with sight and sound at chosen location	9/1/11 to 10/31/11
• Preliminary design analysis and cost	• Project Management • Utilize Wind Resource Report to identify optimal wind turbines and configuration – 4 types are currently under consideration: Remanufactured Vestas V-27 North Wind 100 Nordtank 300kW Wind Micon M530-250W	10/1/12 to 11/30/12
• Cost of energy and market analysis	• Project Management • Assess cost of energy for current and predicted usage	10/1/12 to 11/30/12
• Simple economic analysis	• Project Management • Compare current vs. predicted price of energy	10/1/12 to 11/30/12
• Final report and recommendation s	• Project Management • Prepare Wind Resource Report and Present to School /Community along with options for development. Solicit input from community and interest in training for wind-diesel O&M	11/1/12 to 12/31/12
Phase II. Feasibility		
• Project scoping and community solicitation	• Project Management • Assess interest for advanced training in wind-diesel O&M • Provide School information about vocational training opportunities in wind-diesel O&M	8/1/11 to 9/30/11
• Detailed energy resource analysis	• Project Management • Evaluate existing diesel power plant, electrical distribution system, and geotechnical data • Evaluate condition and acceptability of existing controls and switchgear for compatibility with a wind system	8/1/12 to 12/31/12
• Identification of land and regulatory issues	• Project Management • Address site ownership and regulatory issues, if any	9/1/11 to 10/31/11
• Permitting and	• Project Management	9/1/11 to 12/31/12

environmental analysis	• Contact USFWS, FAA, DOD, ACMP, and SHPO for approval of conceptual design • Assess and document any issues with wetlands or telecommunications, including mitigation efforts planned if necessary • Document community sentiment regarding visual or sound issues	
• Detailed analysis of existing and future energy costs and markets	• Project Management • Review historical power plant and electrical consumption data • Identify building candidates for heat recovery • Identify planned or proposed future growth load for community	11/1/12 to 12/31/12
• Assessment of Alternatives	• Project Management • Compare productivity of different wind turbines and configurations for local wind regime. Consider penetration level benefits vs complexity. • Compare and contrast complicity of equipment and wind penetration systems with capacity and interest of community to operate and maintain • Provide community with clear picture of options available to them for wind-diesel power production – solicit input into decision	11/1/12 to 12/31/12
• Conceptual design analysis and cost estimate	• Project Management • Include design of heat recovery system utilizing engine jacket heat combined with excess electricity from wind energy in wind-diesel power plant design	11/1/12 to 12/31/12
• Detailed economic and financial analysis	• Project Management • Calculate rate for electricity that displaces diesel through the heat recovery system	11/1/12 to 12/31/12
• Conceptual business and operations plans	• Project Management • Business and Operations Plan developed for wind-diesel power plant w/heat recovery system with participation from community. Meet with utility board to discuss and formalize.	11/1/12 to 12/31/12
• Final report and recommendations	• Project Management • Community Meeting to Present Plan and Announce Training Opportunities • Final Grant Report to AEA	11/1/12 to 3/30/13

3.4 Project Resources

Describe the personnel, contractors, equipment, and services you will use to accomplish the project. Include any partnerships or commitments with other entities you have or anticipate will be needed to complete your project. Describe any existing contracts and the selection process you may use for major equipment purchases or contracts. Include brief resumes and references for known, key personnel, contractors, and suppliers as an attachment to your application.

The Aleutians East Borough staff will be responsible for implementation and successful completion of the project. The AEB will confer routinely with the False Pass City staff while simultaneously working with qualified consultants (Marsh Creek LLC and V3 Energy) to develop and complete the project.

The AEB will follow its procurement and bid policies as far as selecting firms and purchasing equipment, supplies, and materials. Selection of consultant and contractors will be based on the type and amount of past wind project experience of the firm as well as individual work experience, experience and familiarity in the AEB region, and project cost.

3.5 Project Communications

Discuss how you plan to monitor the project and keep the Authority informed of the status.

The AEB Community Development Coordinator will be the project liaison and contact person among all parties (City of False Pass staff, Marsh Creek LLC, general contractors, vendors, and the AEA). The position will help coordinate all project team communications, meetings, and disseminate information on a routine basis. The coordinator will be responsible for all periodic progress reports and other information requests to the AEA. AEB will work closely with the selected contractors and keep the AEA informed of progress by regular e-mail updates as components of the project are completed. The contractor’s interim and final reports will be submitted promptly when completed. Close liaison will be maintained with the contractors throughout the project. Issues to be tracked include scope clarifications, progress relative to budget, schedule, data recovery, and health and safety. These will include the project matching funds.

3.6 Project Risk

Discuss potential problems and how you would address them.

There are potential problems in project logistics and construction in remote areas such as Aleutians East Borough communities. Adverse weather conditions can also cause project delays.

Aleutians East Borough staff has much experience in setting up and managing community development projects in AEB communities. Similarly, local labor has much experience, savvy, and know-how to get the job done in adverse conditions such as poor weather. Good team planning and reliance on local knowledge about community conditions help reduce the risk in development projects in remote areas.

The U.S. Fish and Wildlife Service was consulted about avian and environmental concerns.

Endangered waterfowl use the area so avian studies will be necessary. Transmission lines may pose a threat to birds, and the avian study will consider that and make recommendations if the cables should be buried or not.

SECTION 4 – PROJECT DESCRIPTION AND TASKS

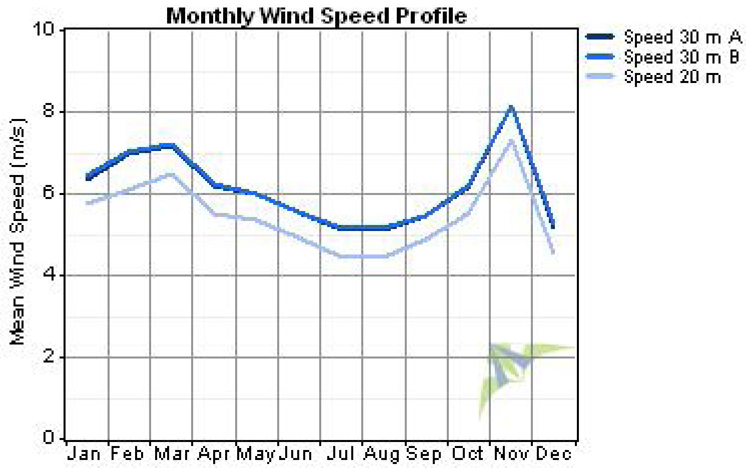
- *Tell us what the project is and how you will meet the requirements outlined in Section 2 of the RFA.*
- ***The level of information will vary according to phase(s) of the project you propose to undertake with grant funds.***
- ***If you are applying for grant funding for more than one phase of a project provide a plan and grant budget form for completion of each phase.***
- *If some work has already been completed on your project and you are requesting funding for an advanced phase, submit information sufficient to demonstrate that the preceding phases are satisfied and funding for an advanced phase is warranted.*

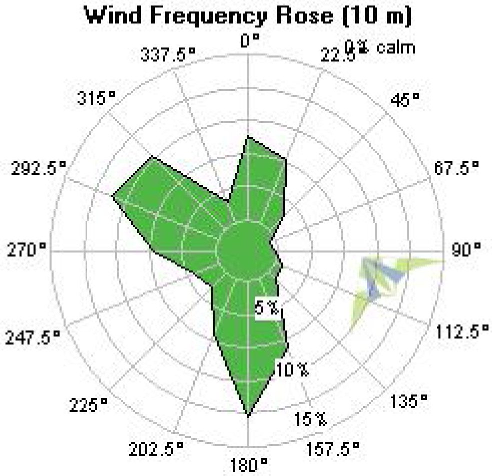
4.1 Proposed Energy Resource

Describe the potential extent/amount of the energy resource that is available.
Discuss the pros and cons of your proposed energy resource vs. other alternatives that may be available for the market to be served by your project.

False Pass may have class 5 wind (see preliminary report table and figures below), and the wind resource could exceed the community's electrical energy needs when the wind is blowing. Additional analysis of these data is necessary for determining the quality of wind in False Pass.

Report Created: 8/12/2010 14:22 using Windographer 2.0.4
Filter Settings: <Unflagged data>
Variable Value
Latitude N 54° 52' 0.000"
Longitude W 163° 25' 0.000"
Elevation 17 m
Start date 12/1/2005 00:00
End date 9/4/2007 12:00
Duration 21 months
Length of time step 10 minutes
Calm threshold 0 m/s
Mean temperature 5.55 °C
Mean pressure 101.1 kPa
Mean air density 1.264 kg/m³
Power density at 50m 531 W/m²
Wind power class 5 (Excellent)
Power law exponent 0.303
Surface roughness 0.904 m
Roughness class 3.83
Roughness description Suburban





4.2 Existing Energy System

4.2.1 Basic configuration of Existing Energy System

Briefly discuss the basic configuration of the existing energy system. Include information about the number, size, age, efficiency, and type of generation.

The City of False Pass owns and operates the False Pass Electrical Utility. The electric utility serves 21 residential, 11 commercial, one state facility, and nine community facilities customers.

There are three John Deere diesel generators used for power generation. Generator #1 has a rated capacity of 90 kW, generator #2 has a capacity of 125kW, and Generator #3 has a capacity 150 kW. The peak load is 75 kW with an average load of 49kW. The community has used an average of 47,000 gallons per year of diesel #2 for electrical generation for the last two years. The utility's power distribution system is all underground 3-phase wire operating at 12,470 volts grounded Y.

4.2.2 Existing Energy Resources Used

Briefly discuss your understanding of the existing energy resources. Include a brief discussion of any impact the project may have on existing energy infrastructure and resources.

The False Pass Power Plant produces electrical energy by burning diesel fuel in engine-driven generators. This satisfies a community power consumption of approximately 384,699 kWh per year. This consumption does not include power that is used to operate the power plant, or power lost in distribution. By integrating wind power into the existing system, our goal is to generate the same amount of energy output, using substantially less fuel than is currently being used.

4.2.3 Existing Energy Market

Discuss existing energy use and its market. Discuss impacts your project may have on energy customers.

False Pass is located on the eastern shore of Unimak Island on a strait connecting the Pacific Gulf of Alaska to the Bering Sea. It is 646 air miles southwest of Anchorage and accessible only by air and barge transportation. The community experiences long and cold winter nights, and severe winter storms can be continuous.

Existing power consumption is approximately 384,699 kWh per year. Reliable power service is essential for airport lights (especially in winter), the health clinic, school, government, tribal, and corporation buildings and facilities, harbor utilities, the Bering Pacific Seafood Plant, commercial enterprises, and residences.

Wind power will ultimately help stabilize or even lower monthly electricity costs which keep increasing due to the reliance of fuel for power generation.

4.3 Proposed System

Include information necessary to describe the system you are intending to develop and address potential system design, land ownership, permits, and environmental issues.

4.3.1 System Design

Provide the following information for the proposed renewable energy system:

- A description of renewable energy technology specific to project location
- Optimum installed capacity
- Anticipated capacity factor
- Anticipated annual generation
- Anticipated barriers
- Basic integration concept
- Delivery methods

A design of a wind-generator hybrid system will depend upon the wind assessment report findings. Vertical axis turbine(s) may be more appropriate for this site.

4.3.2 Land Ownership

Identify potential land ownership issues, including whether site owners have agreed to the project or how you intend to approach land ownership and access issues.

There are a couple of potential wind turbine sites located at the city shop and the city power building. The City is agreeable to a potential wind turbine project being sited on their land.

4.3.3 Permits
Provide the following information as it may relate to permitting and how you intend to address outstanding permit issues.
- List of applicable permits
- Anticipated permitting timeline
- Identify and discussion of potential barriers

Potential permits required of the project include:

Threatened Species (U.S. Fish & Wildlife)
The USFWS is concerned about bird kills caused by birds flying into wind turbines, towers and guy wires. They have not adopted a formal position against installing wind turbines. In fact, the USFWS is in the process of installing vertical axis wind turbines at their complex in the AEB community of Cold Bay. The USFWS staff in Cold Bay has expressed the position that at potential wind turbine sites the flight patterns of birds should be assessed before turbine installation so that bird kills can be minimized.

Aviation Considerations (FAA).
Because of the proximity of the False Pass Airport to potential wind turbine sites in town, there may be need to make a hazard determination of the turbine site in relation to the runway.

Telecommunication Impacts (National Communications Information Administration and the National Weather Service)
Wind turbines may interfere with communications signals by generating electromagnetic noise and/or creating physical obstructions that distort communications signals.

4.3.4 Environmental
Address whether the following environmental and land use issues apply, and if so how they will be addressed:
- Threatened or Endangered species
- Habitat issues
- Wetlands and other protected areas
- Archaeological and historical resources
- Land development constraints
- Telecommunications interference
- Aviation considerations
- Visual, aesthetics impacts
- Identify and discuss other potential barriers

- Land development constraints

As all identified land owners are agreeable to a potential wind turbine located on their property, the only potential land development constraints may arise from site location issues with:

- Threatened or Endangered species (U.S. Fish & Wildlife)
- Telecommunications interference (National Communications Information Administration and the National Weather Service)
- Aviation considerations (FAA)

Potential permit issues with the above will be addressed early in the project development process.

4.4 Proposed New System Costs and Projected Revenues
(Total Estimated Costs and Projected Revenues)
The level of cost information provided will vary according to the phase of funding requested and any previous work the applicant may have done on the project. Applicants must reference the source of their cost data. For example: Applicants Records or Analysis, Industry Standards, Consultant or Manufacturer's estimates.

4.4.1 Project Development Cost
Provide detailed project cost information based on your current knowledge and understanding of the project. Cost information should include the following:

- Total anticipated project cost, and cost for this phase
- Requested grant funding
- Applicant matching funds – loans, capital contributions, in-kind
- Identification of other funding sources
- Projected capital cost of proposed renewable energy system
- Projected development cost of proposed renewable energy system

From the Alaska Energy Authority reports (see excerpts below) a total project costs would be under $2M.

Alternative Energy Resources

Wind Diesel Hybrid

					per kW-hr	Heat Cost $/MMBtu :
Installed KW	200		Capital cost	$1,760,485		
kW-hr/year	406290		Annual Capital	$118,332	$0.29	$85.34
Met Tower?	no		Annual OM	$19,062	$0.05	$13.75
Homer Data?	yes		Fuel cost:	$0	$0.00	
Wind Class	7		Total Annual Cost	$137,394	$0.34	$99.08
Avg wind speed	8.50	m/s	Non-Fuel Costs		$0.07	
			Alternative COE:		$0.40	
			% Community energy		180%	
			New Community COE (includes non-fuel and diesel costs)		$0.68	

Savings
($58,999)

Diesel Engine Heat Recovery

Heat Recovery System Installed? Y
Is it working now? Y
BLDGs connected and working:
Powerhouse Only

			Value
Water Jacket	2,068	gal	$11,615
Stack Heat	0	gal	$0

Capital cost	$72,009
Annual ID	$6,032
Annual OM	$1,440
Total Annual costs	$7,472
Heat cost	$32.70 $/MMBtu

Savings
$4,143

This phase of the project (this proposal) total cost is $138,625 with $10,000 matching. We anticipate securing some funding from the federal government for this project which would require good avian study and environmental data and reporting. Based on the economic findings we will investigate the use of loans and capital contributions.

4.4.2 Project Operating and Maintenance Costs

Include anticipated O&M costs for new facilities constructed and how these would be funded by the applicant.

(Note: Operational costs are not eligible for grant funds however grantees are required to meet ongoing reporting requirements for the purpose of reporting impacts of projects on the communities they serve.)

AEA estimated the O & M costs for a Wind—Diesel system in False Pass to be $19,062. Currently the O & M costs at the diesel plant are not recoverable. The city is unable to charge an energy rate that will cover the O & M costs because the customers can not afford energy at that cost. A more accurate estimate of Wind-Diesel O & M costs will be developed by the Wind Study. Combining wind into the diesel system will allow the Utility to keep energy pricing affordable to residents without losing money on its O & M costs.

Alternative Energy Resources

Wind Diesel Hybrid

Installed KW	200	
kW-hr/year	406290	
Met Tower?	no	
Homer Data?	yes	
Wind Class	7	
Avg wind speed	8.50	m/s

		per kW-hr	Heat Cost $/MMBtu :
Capital cost	$1,760,485		
Annual Capital	$118,332	$0.29	$85.34
Annual OM	$19,062	$0.05	$13.75
Fuel cost:	$0	$0.00	
Total Annual Cost	$137,394	$0.34	$99.08
Non-Fuel Costs		$0.07	
Alternative COE:		**$0.40**	
% Community energy		180%	
New Community COE (includes non-fuel and diesel costs)		$0.68	

Savings

($58,999)

4.4.3 Power Purchase/Sale

The power purchase/sale information should include the following:

- Identification of potential power buyer(s)/customer(s)
- Potential power purchase/sales price - at a minimum indicate a price range
- Proposed rate of return from grant-funded project

The Wind Study will identify power/purchase sale information accurately. AEA estimates that Wind-Diesel cost of energy as potentially $0.83 per kwH.

The AEP has provided the potential cost range of power from a wind-diesel system. The cost of displaced fuel will be used as a pricing method for False Pass.

Table 3-4. Wind System Cost Range – Rural Alaska Reconnaissance

	Capital Cost ($/kW)		Operating Cost ($/turbine/yr)		Total Cost ($/kWh)	
	Low	High	Low	High	Low	High
Low Wind Penetration	$2200		$2600		$0.10	
High Wind Penetration		$3600		$60,000		$0.28
DOE Small (< 40kW) Wind Turbine Verification Project Cost Targets[40]					$0.38	$0.60

Source: Section 2.1.6 Characterization of Existing Technology Deployed in Alaska

4.4.4 Project Cost Worksheet

Complete the cost worksheet form which provides summary information that will be considered in evaluating the project.

Download the form, complete it, and submit it as an attachment. Document any conditions or sources your numbers are based on here.

MarshCreek LLC provided the costs for the wind study and pricing for wind turbines. Sources sited for potential wind energy savings and costs came from the AEP document downloaded from the AEA site.

SECTION 5– PROJECT BENEFIT

Explain the economic and public benefits of your project. Include direct cost savings, and how the people of Alaska will benefit from the project.

The benefits information should include the following:

- Potential annual fuel displacement (gal and $) over the lifetime of the evaluated renewable energy project
- Anticipated annual revenue (based on i.e. a Proposed Power Purchase Agreement price, RCA tariff, or cost based rate)
- Potential additional annual incentives (i.e. tax credits)
- Potential additional annual revenue streams (i.e. green tag sales or other renewable energy subsidies or programs that might be available)
- Discuss the non-economic public benefits to Alaskans over the lifetime of the project

According to the AEP study, False Pass has the potential to save over $58,000 or over 10,000 gallons in displaced fuel annually. There have been no Proposed Power Purchase Agreement price, RCA tariff, or cost based rates for the proposed wind-diesel system developed at this time.

The people of False Pass would like to be less dependent on the variable price of diesel fuel, lessen the environmental risks of fuel transport and storage hazards by requiring less diesel fuel to power their community.

SECTION 6– SUSTAINABILITY

Discuss your plan for operating the completed project so that it will be sustainable.

Include at a minimum:

- Proposed business structure(s) and concepts that may be considered.
- How you propose to finance the maintenance and operations for the life of the project
- Identification of operational issues that could arise.
- A description of operational costs including on-going support for any back-up or existing systems that may be require to continue operation
- Commitment to reporting the savings and benefits

The City of False Pass Electric Utility currently operates the power plant and electrical distribution system in False Pass. The Utility will incorporate an O & M surcharge into its rate structure to recoup the costs of operating and maintaining the renewable energy infrastructure. Actual O & M costs will be determined once specifications are developed for the wind turbines to be installed as a result of this study.

There will be a learning curve in operating the proposed wind-diesel system. Adequate training and support will be budgeted during additional phases. Selection of the wind turbine system will take into account surrounding communities systems already in existence. This will positively contribute to the wind market penetration to support trained personnel.

SECTION 7 – READINESS & COMPLIANCE WITH OTHER GRANTS

Discuss what you have done to prepare for this award and how quickly you intend to proceed with work once your grant is approved.

Tell us what you may have already accomplished on the project to date and identify other grants that may have been previously awarded for this project and the degree you have been able to meet the requirements of previous grants.

The Aleutians East Borough was awarded a $25,000 grant from the Alaska Energy Authority on July 27, 2009 to perform a renewable energy resource feasibility study for the communities of Cold Bay, False Pass, and Nelson Lagoon (the AEB contributed $5,000 cash and $10,000 in-kind to the project). The study project was completed on May 18, 2010 and submitted to the AEA on June 2, 2010. The study contains an analysis of existing energy power systems, potential renewable energy resources, and recommendations for renewable energy projects in the three communities. The study provides the basis for much of the information contained in this grant.

The City of False Pass and the Aleutians East Borough are currently receiving assistance from the Aleutian Pribilof Island Association and Marsh Creek, Inc. to follow-up on the project recommendations contained in the completed Renewable Energy Feasibility Study. Specifically, we are refining the type of equipment specified in the plan as well as developing work plans for project implementation. This work also provides the basis for much of the information in this application. With this additional work – completion of the avian and the feasibility studies, the City of False Pass Electrical Utility will be ready to proceed immediately.

SECTION 8– LOCAL SUPPORT

Discuss what local support or possible opposition there may be regarding your project. Include letters of support from the community that would benefit from this project.

The False Pass City Council and the Aleutians East Borough Assembly both passed resolutions in public meetings in support of the False Pass Electric Utility's Renewable Energy Fund Round IV Grant, entitled, "False Pass Renewable Energy Wind Project". Please see the enclosed two resolutions.

SECTION 9 – GRANT BUDGET

Tell us how much you want in grant funds Include any investments to date and funding sources, how much is being requested in grant funds, and additional investments you will make as an applicant.

Include an estimate of budget costs by milestones using the form – GrantBudget3.doc

Provide a narrative summary regarding funding sources and your financial commitment to the project.

The expected cost of the feasibility study is $138,625. The Grant Budget Form is attached.

SECTION 9 – ADDITIONAL DOCUMENTATION AND CERTIFICATION

SUBMIT THE FOLLOWING DOCUMENTS WITH YOUR APPLICATION:

A. Contact information, resumes of Applicant's Project Manager, key staff, partners, consultants, and suppliers per application form Section 3.1 and 3.4.

B. Cost Worksheet per application form Section 4.4.4.

C. Grant Budget Form per application form Section 9.

D. Letters demonstrating local support per application form Section 8.

E. An electronic version of the entire application on CD per RFA Section 1.6.

F. Authorized Signers Form.

G. Governing Body Resolution or other formal action taken by the applicant's governing body or management per RFA Section 1.4 that:

- **Commits the organization to provide the matching resources for project at the match amounts indicated in the application.**
- **Authorizes the individual who signs the application has the authority to commit the organization to the obligations under the grant.**
- **Provides as point of contact to represent the applicant for purposes of this application.**
- **Certifies the applicant is in compliance with applicable federal, state, and local, laws including existing credit and federal tax obligations.**

H. CERTIFICATION

The undersigned certifies that this application for a renewable energy grant is truthful and correct, and that the applicant is in compliance with, and will continue to comply with, all federal and state laws including existing credit and federal tax obligations.

Print Name	
Signature	
Title	
Date	