CITY OF UNALASKA
UNALASKA, ALASKA

RESOLUTION 2017-63

A RESOLUTION OF THE UNALASKA CITY COUNCIL AUTHORIZING THE CITY MANAGER TO ENTER INTO AN AGREEMENT WITH V3 ENERGY, LLC, TO PERFORM THE WIND POWER DEVELOPMENT & INTEGRATION ASSESSMENT PHASE II PROJECT IN THE AMOUNT OF $45,481.

WHEREAS, the City of Unalaska has determined that it is in the best interests of the residents of the City of Unalaska to investigate alternative power sources; and

WHEREAS, the Wind Power Development and Integration Assessment Project is a part of the Fiscal Year 2018 CMMP; and

WHEREAS, the City of Unalaska has provided funding for such project; and

WHEREAS, the City issued a Request for Qualifications to perform the work and provided thirty days' response time, received four proposals which were analyzed and scored, and V3 Energy, LLC, was found to be the number one scored Respondent.

NOW THEREFORE BE IT RESOLVED that the Unalaska City Council authorizes the City Manager to enter into an agreement with V3 Energy, LLC to perform the Wind Power Development and Integration Assessment Project – Phase II in the amount of $45,481.

PASSED AND ADOPTED BY A DULY CONSTITUTED QUORUM OF THE UNALASKA CITY COUNCIL THIS 24th DAY OF OCTOBER, 2017.

MAYOR

ATTEST:

CITY CLERK

CITY OF UNALASKA CORPORATE SEAL STATE OF ALASKA

MEMORANDUM TO COUNCIL

TO: MAYOR AND CITY COUNCIL MEMBERS

FROM: DAN WINTERS, DIRECTOR OF PUBLIC UTILITIES

THRU: NANCY PETERSON, INTERIM CITY MANAGER

DATE: OCTOBER 24, 2017

RE: RESOLUTION 2017-63 – A RESOLUTION OF THE UNALASKA CITY COUNCIL AUTHORIZING THE CITY MANAGER TO ENTER INTO AN AGREEMENT WITH V3 ENERGY, LLC, TO PERFORM THE WIND POWER DEVELOPMENT & INTEGRATION ASSESSMENT PHASE II PROJECT IN THE AMOUNT OF $45,481.

SUMMARY: From 2003 to 2005, a Phase 1 analysis of the feasibility for wind energy in Unalaska was conducted by Northern Power Systems. Phase II of that project was never realized due to the inability of windmills of that era to withstand Unalaska's wind speeds. Due to recent interest by the Unalaska City Council in renewable energy, coupled with the availability of new technology, the City of Unalaska Department of Public Utilities let a Request for Qualifications (RFQ) for Phase II of the Wind Power Development and Integration Assessment Project. Resolution No. 2017-63 will award the Phase II work to V3 Energy, LLC for $45,481

PREVIOUS COUNCIL ACTION: In 2003, Unalaska City Council approved the Wind Integration Assessment Project through Ordinance 2003-11.

In FY2018 Council funded the Wind Power Development and Integration Assessment Project through Capital Budget Ordinance 2017-07 by providing $200,000 from the General Fund.

BACKGROUND: In 1999, a Wind Energy Feasibility Study of Unalaska was conducted for the State of Alaska's Division of Energy. In 2000, the US Department of Energy conducted an Energy Assessment for Unalaska as potential sites for future wind turbine development, in which Unalaska was ruled out due to the potential of excessively high wind speeds. In 2005, the City provided funding to complete its own Phase I Analysis report. The Phase I report was not finalized and Phase II was not initiated at that time due to tower site location issues and the inability of the technology to withstand Unalaska's wind speeds. These reports were included for Proposers' use with the Request for Qualifications.

Recently, Council has directed Staff to look into harnessing wind power to supplement our 20 MW generating capacity. To that end, a Request for Qualifications to find an engineering firm to develop a full assessment of the potential for wind power generation including detailed costs for development and integration was let on August 9, 2017. The Technical Proposals were due on September 20, 2017, and Price Proposals on October 4, 2017.

DISCUSSION: To re-boot the discussion on wind power in Unalaska, the Request for Qualifications' Scope of Services asked for respondents to develop a data collection plan addressing the following items:

- Current electric system power analysis to analyze feasibility for sizing and penetration into the remote micro-grid system, taking into account current and future electric production demands.
- Gather all available data, including the draft 2005 Phase I Study.
- Review and analyze available data, conduct site visit, to evaluate potential sites and needed equipment. An analysis of 5 sites is expected.
- Recommend and specify meteorological tower (MET) site location(s) and MET tower configuration based on anticipated height under boom (HUB) height for approximately 500-KW turbines under local wind and icing loads. The City anticipates a low penetration system.
- Identify environmental concerns.
- Identify needed permits and obtain them for up to 5 MET sites. The City of Unalaska will provide property access if needed.
- The City of Unalaska will help identify land use requirements, provide ARC-GIS maps and AUTOCAD single line of the utility, topographic maps, provide high resolution power production load data, and provide customer metering information.
- Identify MET site power needs, data storage retention, remote monitoring requirements, and associated costs.
- Determine MET tower equipment for the recommended site(s) and costs associated with acquiring a site(s), equipment installation, and data collection and monitoring. See Phase III.
- Summarize information in a written report. City of Unalaska review should be expected at the 65% and 95% levels.

Staff received Technical Proposals from V3 Energy, Coffman Engineers, Northern Power Systems, and WH Pacific. A team of employees of the Departments of Public Utilities, Public Works and Planning scored them. The results of that scoring deemed V3 Energy, LLC and Coffman Engineers, Inc. the top two proposers. Those entities were then interviewed and price proposals opened. After combining the Technical and Price Proposal Scoring, V3 Energy was deemed the best organization to perform the Phase II work. V3's team includes subcontractors with a strong history and knowledge of Unalaska including Mike Hubbard of The Financial Engineering Company.

ALTERNATIVES: Council could elect to re-advertise the Request for Qualifications.

FINANCIAL IMPLICATIONS: The project is funded through the General Fund in the amount of $200,000 and fully able to support the award of this work.

LEGAL: The City Manager will determine whether a legal opinion is required.

STAFF RECOMMENDATION: Staff recommends awarding the work to V3 Energy, LLC, for $45,481.

PROPOSED MOTION: I move to approve Ordinance 2017-63.

CITY MANAGER'S COMMENTS: The City Manager recommends approval of Resolution 2017-63. V3's proposal and project team demonstrate a solid understanding of the work and the experience to complete this project on behalf of the City.

Attachments:

- A- RFQ
- B- V3 Technical Proposal
- C- Coffman Technical Proposal
- D- V3 Cost Proposal
- E- Scoring Summary and Schedule of Fees
- F- Form of Agreement

Attachment "A"

Request for Proposals

Analysis of the
City of Unalaska
Wind Power Development
and
Integration Assessment Project
Phases II to IV

DPU Project No. 41-250

Prepared by:

City of Unalaska
Department of Public Utilities

PO Box 610
Unalaska, Alaska 99685

August 9, 2017

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LIST OF ATTACHMENTS

LIST OF ACRONYMS

DOE	Department of Energy
DPU	Department of Public Utilities
EA	Environmental Assessment
MET	Meteorology Tower
MW	Megawatt
ORC	Organic Rankin Cycle
PDF	Portable Document Format
RFP	Request for Proposals
ROM	Rough Order of Magnitude
UCO	Unalaska Code of Ordinances

1.0 INTRODUCTION

This is a RFP by the City of Unalaska Department of Public Utilities for an Analysis of the **City of Unalaska Wind Power Development and Integration Assessment Project – Phases II to IV**. All questions about this RFP must be directed to the Deputy Director of Public Utilities only.

City of Unalaska - Department of Public Utilities
JR Pearson, Deputy Director of Public Utilities
jrpearson@ci.unalaska.ak.us
P.O. Box 610
Unalaska, AK 99685
Phone 907-581-1260 x8108

Interpretations or clarifications considered necessary by the City of Unalaska in response to such questions will be issued by Addenda. Addenda will be emailed to all registered potential Respondents and also posted on the City of Unalaska website:

http://www.ci.unalaska.ak.us/rfps.

1.1 BACKGROUND

This description is provided for general informational purposes only and is not a substitute for site inspection and completion of other necessary due diligence by interested Respondents. Respondents must make their own independent assessment of the conditions and may not rely on any representation, description, or diagram provided by the City of Unalaska in preparing their Proposal. Various references are provided for informational purposes only at the below hyperlink as **Attachment A**:

References

The City of Unalaska has approximately 4,500 permanent residents and supports the largest volume seafood industry in the U.S. During various seafood processing seasons, the total population may swell to more than 9,000 due to the influx of transient employees hired to work for the seafood processors. Most of the seafood industry had been providing their own power, but with increasingly stringent permitting requirements and less efficient generating capacity, they have expressed interest in purchasing City of Unalaska power.

The Electric Utility provides power to approximately 730 Residential, 225 Commercial and 20 Industrial customers. Service usage is related directly to the industries that the community supports. Individual service usage can range from a few KWH/month to an excess of MWH/month. System "demand" also follows this broad trend with daily power productions varying in the magnitude of MW's of power produced. Annual peak/min demands historically trend between 4.5 MW to a recent historical high of 11.1 MW. One large seafood processor switched fully to City of Unalaska power in 2016, resulting in the recent historical high demands. Later this summer, the City of Unalaska expects up to 15 MW peak loads with a second large seafood processor abandoning self-generation and utilizing only City of Unalaska power.

The Electric Utility is comprised of the *Power Production Division* and the *Electric Distribution Division*, collectively hereinafter referred to as the "Electric Utility".

The *Power Production Division* consists of two Powerhouses, one "new" and one "old". The new facility contains (2) Wartsila W32V12 Engines paired with ABB 5.2MVA generators and (2) Caterpillar C280 engines paired with KATO 4.4MVA generators. The old facility contains two functional but unpermitted 1.2 MW Caterpillar engines used historically for load trimming, which are awaiting reinstatement through the next Title V permit renewal. In addition, the old facility houses three ElectraTherm Organic Rankine Cycle 50KW heat recovery units that operate to convert district loop heat to electricity. Power production operations are manned at the new facility with 24/7, three shift staffing. With the growth of both the City of Unalaska Powerhouse and demand loads, future plans are to develop waste heat recovery using stack robbers.

The *Electric Distribution Division* consist of a main Substation, Town Substation, approximately 10 miles of 34.5 KV Underground Primary Distribution line, 1,200 feet of submersible 34.5 KV Distribution line, 21 miles of 12.4KV underground Primary Distribution line, 200 pad-mount 1-ph and 3-ph Distribution Transformers, 5 Substation Transformers, 6 Reclosers, 20 Field Switches, and numerous Sectionalizers. The Electric Distribution Division consists of one Journeyman Lineman and two apprentice linemen at this time. In accordance with UCO 10.20.030, all service lines are required to be placed underground in the City of Unalaska.

With average sustained wind speeds as high as 17 mph, the City of Unalaska and Unalaska Island has been considered an optimal location for wind energy, with a few published studies and analyses. However, the construction environment in the City of Unalaska is challenging. Hurricane force winds and gust effects are common, strong seismic forces, heavy snow loads, wind driven precipitation and ice, corrosive marine conditions, and geographical remoteness necessitate careful planning, design, and construction.

In 1999, a Wind Energy Feasibility Study of Naknek and Unalaska was conducted for the State of Alaska's Division of Energy. In 2000, the US DOE conducted an EA for both Nome and Unalaska as potential sites for future wind turbine development, in which Unalaska was ruled out due to the potential of excessively high wind speeds. A draft Phase I analyses report was prepared in 2005 for the City of Unalaska, with plans to continue to Phase II. However, the Phase I report was not finalized and Phase II was not initiated at that time. See **Attachment A** for these documents.

To date, there has not been a full assessment of the potential for wind power generation including detailed costs for development and integration.

2.0 SELECTION PROCESS

Final Proposals will consist of two separate documents: a Technical Proposal and a Price Proposal. Only one Proposal from any individual, firm, partnership, or corporation, under the same or different names, will be considered. Should it appear to the City of Unalaska that any Respondent has interest in more than one Final Proposal for work contemplated, then all Final Proposals in which such Respondent has interest will be rejected.

2.1 EVALUATION AND AWARD PROCESS

The Deputy Director of Public Utilities will appoint the Evaluation Team from among City of Unalaska staff. The entire scoring procedure, including Evaluation Team meetings and scoring materials, will be held strictly confidential until after negotiations are concluded.

All Evaluation Team members will be required to certify that they have no conflicts of interest and that they will strictly adhere to the procedures herein described.

The sequence of events is as follows:

- The City of Unalaska receives the Technical Proposals.
- Evaluation Team evaluates Technical Proposals according to established criteria, assigns scores for evaluation factors, and sums an overall technical score for each Respondent.
- The Evaluation Team will schedule and conduct a brief one hour phone interview with each of the three highest scored Respondents.
- Price Proposals from the three selected firms are received.
- The Evaluation Team re-evaluates the three highest scored Proposals according to the established criteria.
- Technical and Price Proposal scores are combined according to the established weighting factors.
- Deputy Director of Public Utilities reviews final scores and forwards evaluation results to the Director of Public Utilities.
- The initial scope of services will only include Phase II.

- Negotiation with the Respondent with the highest scored Final Proposal or if necessary, the next lower scored responsive Respondent and so on. The Contract will be the Consulting Services Agreement (the Agreement), **Attachment B**. The City of Unalaska will be inflexible with regards to the Contract language. The Scope of Services, Schedule, and Fee for Services are negotiable.

- Director of Public Utilities forwards evaluation results and to the City Manager.

- City Manager makes their recommendation to the City Council for award.

- The City of Unalaska and the successful Respondent execute the Agreement and a purchase order is issued. The purchase order serves as notice to proceed.

2.2 CONDITIONS

The City of Unalaska reserves the right to reject any and all Final Proposals and/or to waive any informality in procedures.

This RFP does not commit the City of Unalaska to award a Contract, or procure or contract for any services of any kind whatsoever.

The selection of a successful Respondent shall be at the sole discretion of the City of Unalaska. No agreement between the City of Unalaska and any Respondent is effective until approved by the City Council of the City of Unalaska, signed by the City Manager, and a Purchase Order issued.

The City of Unalaska is not liable for any costs incurred by Respondents in preparing or submitting Final Proposals.

In submitting a Final Proposal, each Respondent acknowledges that the City of Unalaska is not liable to any entity for any costs incurred therewith or in connection with costs incurred by any Respondent in anticipation of City of Unalaska City Council action approving or disapproving any Agreement without limitation.

Any perception of a conflict of interest is grounds for rejection of any Final Proposal. In submitting a Final Proposal, each Respondent certifies that they have not and will not create and/or be party to conflicts of interest with any City of Unalaska official or employee. Including but not limited to any direct or indirect financial gain and/or gratuity or kickback <u>or through unauthorized communication with City of Unalaska employees or officials not listed in this RFP before the selection process is complete</u>

Nothing in this RFP or in subsequent negotiations creates any vested rights in any person.

2.3 TRANSMITTAL REQUIREMENTS

Technical and Price Proposals will be accepted before and on the published date and until the time specified. Each electronic file must be clearly named to identify the contents as the Technical Proposal or the Price Proposal.

Technical Proposals must be submitted in a single email no larger than 5 megabytes and the email header must clearly identify the Project and the Respondent e.g.

Name of Firm – Technical Proposal for Unalaska Wind Power Phase II-IV

Technical Proposals must be delivered to the email addresses below by **2:00 p.m., local time, on September 20, 2017** from a valid email account.

chazen@ci.unalaska.ak.us; purchase@ci.unalaska.ak.us

If a Respondent is contacted for an interview then the Price Proposal must be delivered to the email addresses below by **2:00 p.m., local time, on October 4, 2017** from a valid email account as a “reply-all” to the original submission email.

chazen@ci.unalaska.ak.us; purchase@ci.unalaska.ak.us

2.4 DOCUMENT REQUIREMENTS

One (1) copy of the Technical Proposal must be submitted in an electronic PDF file less than 5 megabytes in size, organized with bookmarks, and printable to standard 8.5” x 11” paper.

The recommended size of the Technical Proposal is about 5-30 pages not including resumes.

3.0 EVALUATION FACTORS

The purpose of the Technical Proposal is to evaluate each Respondent's capabilities for execution of the Project Phases II through IV. Evaluation criteria and weight are as follows:

Major Factor	Weight
1. Professional Qualifications	[40]
2. Experience and References	[30]
3. Narrative	[30]
Total	**[100]**

The Evaluation Team will rank each Respondent using a successive integer ranking system for each major factor. An Evaluator Score for each respondent will be calculated.

$100 – ((\text{Ranking}_1 \text{ x \% Weight}_1 + \text{Ranking}_2 \text{ x \% Weight}_2 + \text{Ranking}_3 \text{ x \% Weight}_3)\text{-1}) \text{ x } 5$

The Total Score for each Respondent is an average of all of the Evaluator Scores.

Price Proposal scores are then combined with Technical Proposal scores with the weighting shown below:

Technical Proposal = 100%

Price Proposal = 0%

Following the interviews Price Proposals which are limited to hourly rates will be considered under Narrative scoring.

The *Evaluation Score Sheet* will be used by the Evaluation Team to score each Proposal; **Attachment C**.

3.1 PROFESSIONAL QUALIFICATIONS

The Professional Qualifications section should include:

- A brief description of the number, qualifications, and types of key personnel who would serve on this Project including employees and subcontractors.

- Identify and furnish resumes of personnel and subcontractors who will serve in key positions for this project. Include specific experience for each person on similar or related projects.

- The location of the home office and the scope of services offered there.

- Any additional information reflecting on the Respondents ability to perform on this Project.

3.2 EXPERIENCE AND REFERENCES

The satisfactory completion of similar projects of equal size and complexity will be an important element in the evaluation.

- Provide information for (4) projects for which the Respondent has provided services most related to these Projects including remote diesel powered micro-grids.

- Provide a list of at least (2) references from each of the above projects that can comment on the firm's professional capabilities and experience. Names, email addresses, and phone numbers of individuals to contact must be included.

3.3 NARRATIVE WORK PLAN

Describe the methodology the Respondent will use to complete this Project for the City of Unalaska. The Narrative Work Plan will become the *Scope of Services* referenced within the *Agreement Exhibit "A"*, **Attachment B**. The Narrative Work Plan must not conflict with or supersede the *Agreement;* however, the Respondent should note any potential conflicts they would prefer to negotiate.

Provide information about the Respondents availability to complete Phases II-V by mid-2020.

3.4 PRICE PROPOSAL

Following interviews the Price Proposal for this RFP will be limited to a table of labor rates and % anticipated level of effort Phases II-IV. The Price Proposal will be considered under the post interview re-scoring under Narrative.

Following selection and negotiations with the selected Respondent the fully developed negotiated Price Proposal will become a T&M Not to Exceed fee for Phase II only but not Phases III-IV. It will also become the *Fee Proposal* referenced in the *Agreement Exhibit "C"*, see **Attachment B**.

The Price Proposal must include a line item fee schedule that includes:

- Table of labor rates and anticipated % level of effort Phases II-IV.

4.0 SCOPE OF SERVICES

The requested services are as outlined below. The City of Unalaska intends to Award Phase II to begin with. Phases III and IV would be awarded later separately. If there is any point in the work above where the Project does not appear to be feasible or practical, the City of Unalaska will be given the option of whether or not to continue the Project. If the Project is discontinued for this reason, the Consultant should provide a report or memorandum describing the reasons why the Project is not feasible.

The analysis will be conducted in accordance with industry standards and the Project is expected to be complete before December 31, 2020.

PHASE II – DEVELOP A DATA COLLECTION PLAN

- Current electric system power analysis to analyze feasibility for sizing and penetration into the remote micro-grid system, taking into account current and future electric production demands.
- Gather all available data, including the draft 2005 Phase I Study.
- Review and analyze available data, conduct site visit, to evaluate potential sites and needed equipment. An analysis of 5 sites is expected.
- Recommend and specify MET tower site location(s) and MET tower configuration based on anticipated HUB height for approx 500-KW turbines under local wind and icing loads. The City anticipates a low penetration system.
- Identify environmental concerns.
- Identify needed permits and obtain them for up to 5 MET sites. The City of Unalaska will provide property access if needed.
- The City of Unalaska will help identify land use requirements, provide ARC-GIS maps and AUTOCAD single line of the utility, topographic maps, provide high resolution power production load data, and provide customer metering information.
- Identify MET site power needs, data storage retention, remote monitoring requirements, and associated costs.

- Determine MET tower equipment for the recommended site(s) and costs associated with acquiring a site(s), equipment installation, and data collection and monitoring. See Phase III.

- Summarize information in a written report. City of Unalaska review should be expected at the 65% and 95% levels.

PHASE III – IMPLEMENT DATA COLLECTION PLAN - NEGOTIATED WITH PHASE I CONSULTANT OR REBID

- Install MET tower(s) and equipment including mobilization and eventual demobilization and site restoration.

- Collect and manage data for up to 24 months, with no less than 18 months of valid data.

- Quarterly progress reports of MET data and quality, and status of project. Provide raw data to the City in electronic form and summary form.

- Provide a wind data report with power production data, feasibility, recommendations, and economic analysis with years to payback and impacts to customer utility rates.

PHASE IV – PRE-DEVELOPMENT PLAN - NEGOTIATED WITH PHASE III CONSULTANT OR REBID

- Analyze potential effects on Powerhouse generation efficiencies as they may be related to wind power production.

- Analyze the final data and identify feasible development paths or alternatives that will provide minimal adverse impact to the existing power production and distribution system.

- For each alternative, provide a ROM design and construction cost estimate on wind power development and integration costs.

- For each alternative, provide an economic analysis to include at least the following:

    - Impact on current utility operations, including potential decreased engine efficiencies due to adverse load conditions
    - Land acquisition, if required
    - Permitting
    - Energy output

- Life cycle costs
- Operation and maintenance costs
- Displaced fuel costs
- Simple payback period and impact to utility rates

➢ Complete draft Phase IV report and submit to the City for comments.

➢ Complete the final Phase IV report.

➢ Present the final Phase IV report to City Council.

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5.0 DELIVERABLES

Provide a PDF copy of draft documents; four hardcopies of the final document; one PDF copy provided on CD or flash drive; and all drawing files must also be provided in AutoCAD or ARC-GIS and PDF format.

ATTACHMENT A

References

DOE/EA-1280

Nome, Alaska, Wind Turbine Demonstration Project

Final Environmental Assessment and Finding of No Significant Impact

November 2000

Prepared for:
U.S. Department of Energy
Golden Field Office
1617 Cole Blvd.
Golden, CO 80401

Prepared by:
Battelle Memorial Institute
505 King Avenue
Columbus, OH 43201

Finding of No Significant Impact

FINDING OF NO SIGNIFICANT IMPACT

SUMMARY

The U.S. Department of Energy (DOE) has prepared this Environmental Assessment (EA) to provide DOE and other public agency decision makers with the environmental documentation required to take informed discretionary action on the proposed Nome, Alaska, Wind Turbine Demonstration Project (DOE/EA-1280). The EA assesses the potential environmental impacts and cumulative impacts that would result from the installation and operation of wind turbines in Nome, Alaska. DOE's role in the proposed action would be limited to providing funding assistance for a portion of the construction and demonstration of wind energy technology in the challenging arctic environment. Although DOE would review project activities, DOE would have no responsibilities for construction supervision or facility operations. Further, DOE would have no responsibilities for the day-to-day management of the facility once it becomes operational. The Nome Joint Utility System would have sole responsibility for construction and operations.

FINDING

Based on the information in the EA, which analyzes the relevant environmental issues, DOE finds that no significant impact would result from implementing the proposed action to build and operate up to two wind turbines on Anvil Mountain, Nome, Alaska. The proposed action does not constitute a major Federal action significantly affecting the quality of the human or physical environment within the meaning of the National Environmental Policy Act, therefore, implementation of the proposed action does not require the preparation of an environmental impact statement.

Issued in Golden, Colorado, this 8th day of November, 2000.

Frank M. Stewart

Frank M. Stewart, Manager
U.S. Department of Energy, Golden Field Office

Final Environmental Assessment

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LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

CEQ	Council on Environmental Quality
dB	decibel
DEW	Distant Early Warning
DOE	U.S. Department of Energy
EA	environmental assessment
FAA	Federal Aviation Administration
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
IEA	International Energy Agency
kW	kilowatt
MOU	Memorandum of Understanding
mph	miles per hour
NEPA	National Environmental Policy Act of 1969
NWI	National Wetlands Inventory
PCB	polychlorinated biphenyl
SHPO	State Historic Preservation Officer
WACS	White Alice Communication System

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) and the State of Alaska are proposing to jointly fund a project that is intended to demonstrate and evaluate the feasibility of wind turbine-generated power in the challenging Alaskan environment. Several sites in Naknek, Unalaska, and Nome, Alaska, underwent an initial evaluation to determine their potential suitability for the proposed wind turbine project. Through an iterative screening process involving Federal, State, and local agency input, one potentially acceptable site in the Nome area was selected for more detailed evaluation in this final environmental assessment (EA). The site being considered is located atop Anvil Mountain (Figure 1). The proposed site is approximately 6 to 8 kilometers (4 to 5 miles) north of the town of Nome, adjacent to a decommissioned U.S. Air Force radar station that was an element of the Alaska Communications System ("White Alice Communication System" [WACS]) and the Distant Early Warning (DEW) line.

The power generation levels of the proposed project are tied directly to site suitability and the availability of Federal, State, local, and nongovernmental funding. To evaluate the potential environmental impacts that could occur from the installation and operation of wind turbines at the site, a range of representative operating levels is evaluated in this final EA. It is currently estimated that the State or other non-Federal entities would provide sufficient cost share funding for 225 to 750 kilowatts (kW) of wind turbine-generated electrical power at the proposed site. Therefore, to ensure that the full range of foreseeable technical alternatives is assessed, one or two utility-scale turbines, with a generation capacity of 225 kW to 750 kW, are considered in this final EA.

This final EA has been prepared under DOE's regulations and guidelines for compliance with the National Environmental Policy Act (NEPA) of 1969. It is being distributed to interested members of the public, Federal, State, and local agencies, and potentially affected Tribal organizations for review and comment prior to any final decisions by DOE and the State on the proposed project.

1.1 National Environmental Policy Act and Related Procedures

The NEPA as amended (42 U.S.C. § 4321, *et seq*), the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (40 CFR 1500-1508), and DOE's implementing procedures for compliance with NEPA (10 CFR 1021) require that DOE, as a Federal agency:

- Assess the environmental impacts of its proposed actions
- Identify any adverse environmental effects that cannot be avoided should the proposed action be implemented
- Evaluate alternatives to the proposed action, including a no action alternative
- Describe the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity
- Characterize any irreversible and irretrievable commitments of resources that would be involved should the proposed action be implemented

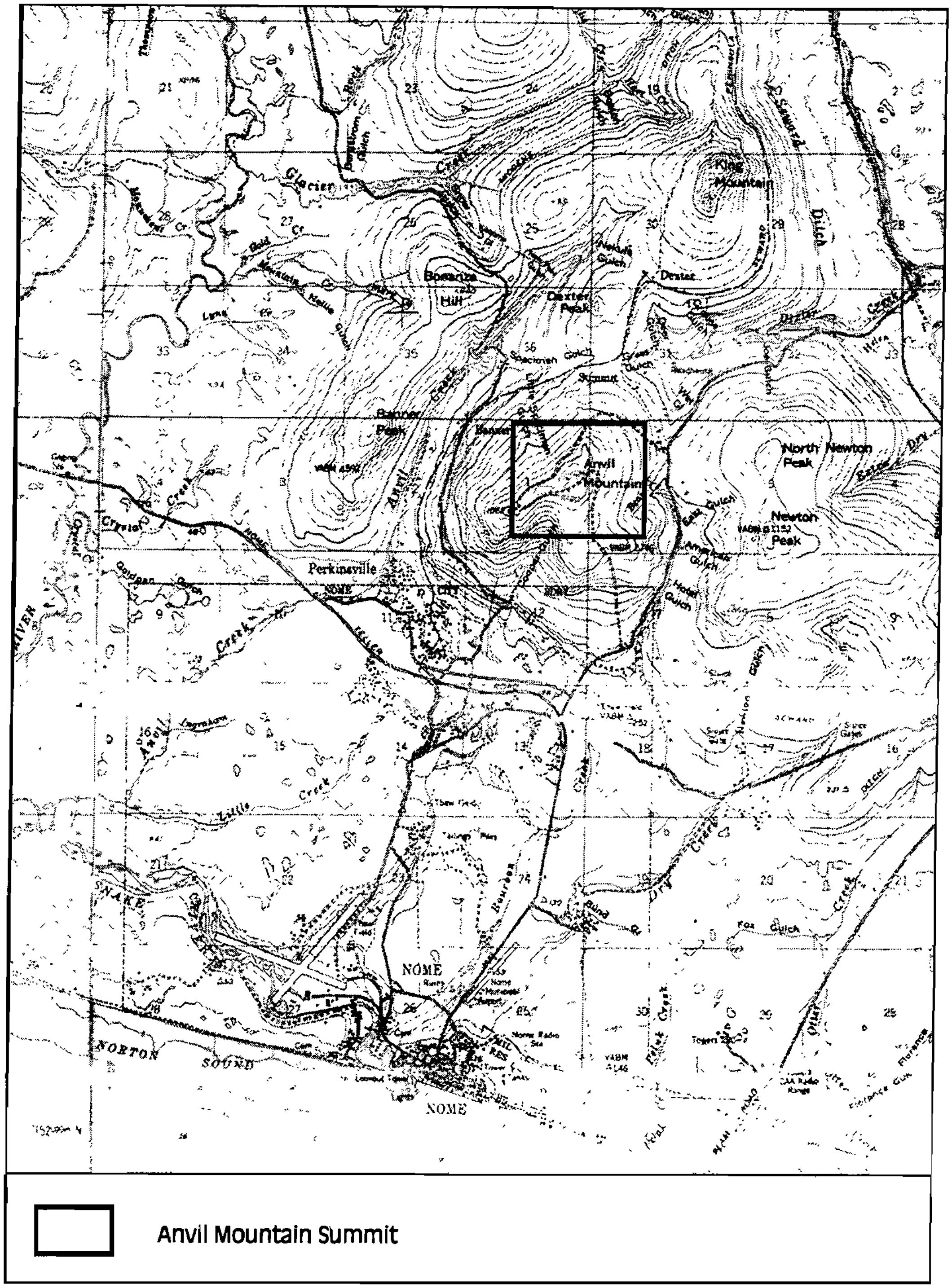

Figure 1. Proposed Anvil Mountain Site

These provisions must be addressed before a final decision is made to proceed with any proposed Federal action that could cause impacts to the human environment. This EA evaluated the potential individual and cumulative effects of the Proposed Action and the No Action Alternative on the physical, human, and natural environment. The EA is intended to (1) meet DOE's regulatory requirements under NEPA, and (2) provide DOE, the State of Alaska, and other agency decision-makers with the information they need to make informed decisions in connection with the proposed project.

1.2 Background

In fiscal year (FY) 1999, the DOE budget included funding for the demonstration of up to 100 kW of wind turbine power in Alaska. DOE and the State of Alaska began working together to identify viable sites for the Proposed Action. Critical to the initial site selection was an expectation that suitable wind resources would exist at a site. Optimum wind turbine performance is achieved between 28 and 30 miles per hour (mph). Regionally available data identified the west coast of Alaska and the Aleutian Islands as potentially viable from a wind resource perspective (DOE, 1986). Within these areas, several utilities were contacted to determine their capability to operate and maintain wind turbines and integrate wind turbine power into their existing generation system. Through interactions with these utilities, it became apparent that 100 kW of wind-generating capacity would be insufficient to generate the revenues needed to operate and maintain the wind turbine equipment. As a result of these interactions, the State of Alaska is identifying additional funding sources to develop commercial-scale wind turbine capacity between 225 kW and 750 kW.

Geographic considerations such as, but not limited to, topography, distance to the existing transmission grid, road access, and land availability were also considered because they would affect not only the potential environmental impacts of the Proposed Action but also the relative costs involved in its construction and operation. The combination of wind resources, utility capability, and geographic constraints led to the identification of multiple sites in Unalaska and Naknek. In the spring of 1999, these potential sites underwent additional site-specific characterization (Dames & Moore, 1999). Due to the potential for wind turbines to impact avian species, the U.S. Fish and Wildlife Service (FWS) also was contacted for its expertise regarding the potential occurrence of protected avian species at these sites.

As the layers of wind resource viability, utility capability, geographic constraints, and avian protection were compiled, many initially identified sites had to be dropped from further consideration because they were deemed no longer viable based on one or more siting criteria. In this initial screening, all sites in Naknek, and all but two sites in Unalaska, were deemed unacceptable either because available information suggested potentially significant environmental concerns, or because the available funding could not support the cost, in time and dollars, required for evaluating a site in more detail.

As a result of the initial elimination of sites, a potential site in Nome was added to the preliminary site-screening task. Site visits were made in October 1999 to view the proposed sites and to meet with local, Federal, and State agencies in Nome and Unalaska and with regional agency offices in Anchorage. Subsequent to the site visits, the formal scoping process prescribed under NEPA was initiated.

1.3 Scoping

Federal, State, and local agencies and Tribal organizations were sent scoping letters concerning the Proposed Action to assist DOE and the State in identifying potential issues that should be evaluated in this EA. Scoping notices also were sent to Nome and Unalaska libraries, newspapers, and television and radio stations to inform the public of the Proposed Action and solicit their input to the process. Appendix A contains the text of the scoping letter, the list of recipients, and the written comments received.

During the scoping period, DOE and the State spent several months working closely with various State and Federal agencies and local utilities to assess the sites for their technical, environmental, and economic viability. Extensive discussions with the FWS and its avian experts with site-specific knowledge led to a determination that the coastal Unalaska site would be unacceptable for wind turbine development at this time due to the potential for unacceptable impacts to numerous Federal and State protected avian species. An upland Unalaska site might have proven acceptable from an avian perspective; however, numerous physical limitations for the site were discovered during scoping. Snow depths over the site's access road exceeded 7.6 meters (25 feet) during the winter of 1999 – 2000. Estimated costs to extend the existing transmission lines to the site exceeded $1 million. Finally, wind speed records at the Unalaska airport have recorded gusts greater than 190 mph, which would well exceed the design basis for most commercial wind turbines.

As a result of these site-specific limitations, both sites at Unalaska were eliminated from detailed evaluation in this EA, leaving only the Nome site on Anvil Mountain for detailed assessment and comparison to the No Action Alternative.

1.4 Purpose and Need

It is a mission of DOE to assist in advancing the development and commercialization of energy efficiency and renewable energy technologies such as wind-generated power (see the Energy Policy Act of 1992, § 2.1.1.1). To demonstrate a cost-effective and clean source of electricity that reduces diesel fuel dependence and air emissions, DOE and the State of Alaska propose to fund the implementation of commercial-scale wind turbine-produced electricity at Nome. Information gained through this demonstration would be used as a basis for gauging the benefits of replacing or supplementing diesel-generated power with wind power. Upon a determination of the acceptability of this project, DOE would provide its share of the total project costs to the Alaska Energy Authority, which in turn would secure the balance of necessary funding and subsequently contract with the Nome Joint Utility System for project construction and operations.

DOE and the State began a wind turbine program in Alaska by erecting three 50-kW wind turbines in Kotzebue in 1997. The purposes of this program were to (1) demonstrate the viability of wind turbine-generated power and the capabilities of commercially available wind turbines in extreme arctic conditions, and (2) evaluate turbine performance and reliability under a wide range of temperatures, precipitation events, and strong arctic winds. The proposed wind turbine project for Nome, if implemented, would provide similar information for larger 250-kW to 750-kW wind turbines, which are of greater commercial interest to existing utilities.

If successful, this project could lead to greater application of wind turbine-generated power to meet the electrical needs of rural Alaska.

1.5 Organization of this EA

The EA is structured in accordance with the standards set forth in DOE's NEPA implementing regulations and guidelines. Section 2.0 describes the Proposed Action and alternatives in sufficient detail to allow the reader an understanding of the actions that would take place during construction, operation, and decommissioning of the proposed wind turbine(s). It also identifies the specific location proposed for the wind turbine installation. Section 3.0 characterizes the existing environment at the proposed site from a biological, physical, cultural, and social perspective. Section 4.0 assesses the impacts that could occur should the Proposed Action be implemented. Section 5.0 describes the cumulative impacts that might occur from the Proposed Action when combined with other related activities. Section 6.0 addresses short-term uses of the environment and the effect on long-term productivity, and the irreversible and irretrievable commitment of resources should the Proposed Action be implemented.

2.0 PROPOSED ACTION AND ALTERNATIVES

This section describes the Proposed Action and the No Action Alternative. It characterizes the site location and describes both general and site-specific activities that would be required for the construction, operation, and decommissioning of up to two wind turbines under the Proposed Action. It also characterizes the No Action Alternative, as required under NEPA. Other alternatives considered but eliminated from further evaluation are discussed in Section 1.2, Background, and Section 1.3, Scoping.

2.1 Proposed Action

DOE and the State of Alaska are considering providing financial assistance for the acquisition, installation, and operation of one or two commercially available wind turbines at one site in Alaska, generating between 225 kW and 750 kW of power. The proposed project would reduce future consumption of petroleum-based fuels by harnessing wind energy as an additional source of power production. Because the proposed project would represent less than 10 percent of existing demand, existing diesel generators would continue to operate.

Because final funding allocations have not been determined at this time, a range in turbine size and capacity is evaluated in this EA. This allows the decision-makers a full understanding of the differences among the commercially available turbines that could meet the project's needs. The range of turbine capacities evaluated in this EA is as follows:

- One 225-kW turbine
- Two 225-kW turbines
- One 550-kW turbine
- One 225-kW turbine and one 550-kW turbine
- One 750-kW turbine

The physical dimensions of a representative range of turbine options are summarized in Table 1.

For the purposes of this action, the Nome site has been determined, through a screening process summarized in Section 1.2, to be potentially viable for wind turbine-generated power. The proposed wind turbine site lies atop Anvil Mountain, approximately 7.2 kilometers (4.5 miles) north of Nome (Figure 1). The site is between 300 and 335 meters (1,000 and 1,100 feet) above mean sea level. It is adjacent to four rectangular, concave antenna arrays that were part of a decommissioned U.S. Air Force radar station. The station was part of the Alaska Communications System (WACS) and the DEW line. A gravel road leads to the proposed site; gravel and a concrete pad lie between the antennas. The concrete pad is all that remains of the buildings that housed the supporting equipment for the WACS/DEW line system. The proposed

Table 1. Nome, Alaska, Wind Turbine
Potential Options for 225 kW to 750 kW of Generating Capacity

Specifications	**Representative Turbines [a]**		
Unit Capacity	225 kW	550 kW	750 kW
Number of Blades	3	3	3
Tower Type	Tubular	Tubular	Tubular
Hub Height	107 ft [b]	134 ft	164 ft
Rotor Diameter	95 ft	131 ft	164 ft
Total Height (tower and rotor)	154 ft	199 ft	246 ft
Per Unit Rotor Area Swept	7,115 ft^2	13,526 ft^2	21,135 ft^2
Number of Units for 225 kW	1	0	0
Rotor Area Swept	7,115 ft^2		
Approximate Linear Footprint [c]	95 ft		
Number of Units for 500 kW	**2**	**1**	**0**
Rotor Area Swept	14230 ft^2	13,526 ft^2	
Approximate Linear Footprint	665 ft	131 ft	
Number of Units for 750 kW	**1 225-kW and 1 550-kW**		**1**
Rotor Area Swept	20,641 ft^2		21,135 ft^2
Approximate Linear Footprint	882 ft		150 ft

a. Turbine dimensions are representative of commercially available wind turbines.
b. Metric conversions: 1 foot = 0.3048 meter; 1 square foot = 0.0929 square meter.
c. Rotor width × number of units + five rotor widths between each unit.

wind turbine site would be adjacent to the DEW line site on ground that is partially disturbed from previous activity. The ground is mostly exposed rock with some native tundra vegetation. The Sitnasuak Native Corporation currently owns the land.

2.2 Construction and Installation

Assuming a decision to proceed is reached, the State would initiate site preparation and begin turbine procurement during the summer of 2001, hoping to complete installation before the winter of 2001 – 2002. Site preparations would require less than 4,000 square meters (less than 1 acre), regardless of turbine option, and would entail a limited amount of grading to establish a level site for foundation installation and provide a working surface for crane installation of the turbine(s). Due to the surface exposure of bedrock at the site, a concrete pad or ring requiring 150 to 230 cubic meters (200 to 300 cubic yards) of concrete would be the most likely foundation structure. Site preparation would require one bulldozer and one loader. Installation of the turbine(s) could require one or two 165- to 225-ton cranes. The 225-kW and 550-kW turbines would require the smaller cranes, which are available locally; however, the 750-kW turbine models would likely require the larger crane, which is not currently available in Nome and would have to be brought in specifically for this project. Estimated construction and installation time would be 6 weeks and would require three to six workers. With the exception of a job foreman experienced in wind turbine construction, the workers would be hired from the local work force.

The existing road between Nome and the Anvil Mountain site is gravel. Approximately 2 kilometers (1 to 1.5 miles) of the roadbed ascending Anvil Mountain may require some minor grading to support the movement of large cranes to the sites. The Nome Joint Utility System may be extending the existing transmission system further north through Hotel Gulch even if the proposed wind turbine project is not implemented (Figure 2). Even without the extension, the transmission systems would be accessible via transmission poles that currently come within 3 kilometers (2 miles) of the Anvil Mountain site. New transmission lines would cover the 3 kilometers (2 miles) between the proposed turbine site and existing transmission lines. The new lines would be constructed on 12-meter (38-foot) poles drilled into the ground at 76-meter (250-foot) intervals. Based on this spacing, it is estimated that 75 to 90 new poles would be required. A small amount of power would be supplied to the site for facility lighting, if needed, and to power de-icing features of the turbine(s).

The Anvil Mountain site is located approximately 7.2 kilometers (4.5 miles) from the Nome airport. Therefore, consultations were held with the Federal Aviation Administration (FAA) regarding the need for lighting on any of the turbines. In January 2000, the Nome Joint Utility System submitted a Notice of Proposed Construction (FAA Form 7460-1) to the FAA in accordance with the agency's regulations (14 CFR Part 77), and conservatively estimated that the maximum height of any wind turbine(s) placed on Anvil Mountain for the purpose and need of this project would not exceed 122 meters (400 feet). In February 2000, the FAA determined that at 122 meters (400 feet) above ground level and 468 meters (1,534 feet) above mean sea level, the proposed turbine(s) would

> *"...exceed obstruction standards but would not be a hazard to air navigation provided the following condition(s), if any, is (are) met: As a condition to this determination, the structure should be marked and/or lighted in accordance with FAA Advisory Circular 70/7460-1J, Obstruction Marking and Lighting, Chapters 4, 5 (Red)."* (Appendix B)

Should a decision be reached to proceed with the Proposed Action at the Anvil Mountain site, the turbine(s) would be marked and lighted in accordance with the FAA requirements of Circular 70/7460-1K, which took effect March 1, 2000.

2.3 Operations

Wind turbines are designed to convert rotational energy, resulting from wind energy on the rotor blades, into electricity through the use of a generator. Typical design features of today's commercially available wind turbines include wood-epoxy or fiberglass blades, redundant braking systems, the ability to rotate with the prevailing wind direction, and a design life of at least 20 years. All alternatives considered for this project would have a closed tubular tower to support the turbine and rotor.

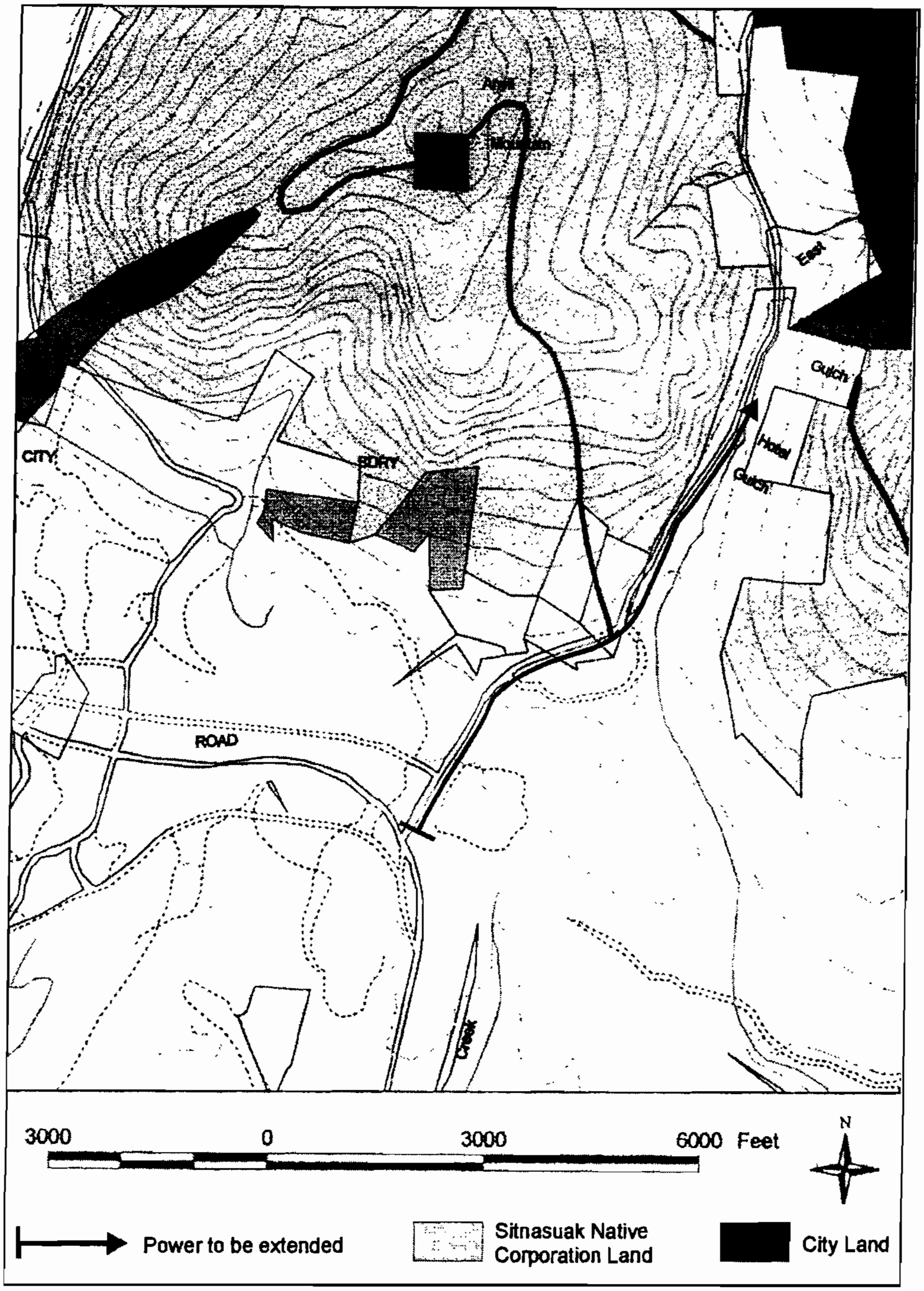

Figure 2. Anvil Mountain Access

Operationally, the wind turbine(s) would be computer-controlled for optimum performance as well as for safety shutdown when wind speeds exceeded design operations. Typically, turbines start spinning (called the "cut-in speed") at approximately 16 kilometers per hour (km/hr) (10 mph), while the speed at which they shut down (the "cut-out speed") is between 81 and 113 km/hr (50 and 70 mph). Most turbine systems are designed to withstand hurricane-force winds.

Existing utility company technical staff would integrate wind turbine power with the power grid. Other than an annual gearbox inspection and oil filter replacement, wind turbines require little routine maintenance. Gearbox oil requires replacement only every 7 to 10 years. Depending on the turbine model, each oil change would require between 150 and 190 liters (40 and 50 gallons). Currently, Nome has a waste oil burner that could dispose of the waste oil.

Operational safety considerations include turbine destruction from excess winds and damage to the turbine or nearby facilities from icing conditions. Ongoing testing programs confirm the ability of turbine components, especially rotors, to meet or exceed manufacturer specifications. Any selected turbine would have design specifications that exceed the maximum anticipated wind speed for a selected site. Icing would not be a concern to either turbine operations or nearby facilities because all turbine models under consideration have anti-icing design features.

2.4 Decommissioning

The expected operating life for commercially available wind turbines is currently estimated to be 20 years. At the end of the useful operating life, the turbine(s) would be removed and recycled. All lubricating fluids would be nonhazardous wastes that could be disposed of in a waste oil burner. Concrete pads could be recycled or disposed of at a solid waste landfill.

2.5 No Action Alternative

Under the No Action Alternative, no Federal funding would be made available, and therefore, wind turbine capacity would not be added to the proposed Anvil Mountain site. No road upgrades would be required, and no new transmission lines would be added to the proposed site. Under the No Action Alternative, diesel power generation and related air emissions would continue at current rates. Potential reductions in diesel fuel consumption and air emissions would not occur.

3.0 AFFECTED ENVIRONMENT

The Maleiut, Kauweramiut, and Unalikmiut Eskimos originally inhabited Nome. Gold discoveries are recorded as far back as 1865, but it was a gold strike on Anvil Creek in 1898 that started a gold rush that expanded Nome's population to more than 20,000. Since the first strike, the gold fields have yielded more than $136 million. Today, a few commercial operations and several individuals are actively seeking gold in the inland streambeds and the coastal beaches. As of 1999, Nome's population was 3,615. As the center of the Bering Strait/Seward Peninsula region, government services provide the majority of employment in Nome (DCED, 2000).

Consistent with CEQ and DOE NEPA guidance, this section characterizes only those elements of the environment at the site that are relevant to the assessment of impacts potentially occurring from the installation and operation of up to two wind turbines. For example, because the proposed wind turbine(s) would have no air releases or surface water discharges, this section does not attempt to characterize the current air quality in the area or existing stream flow, aquatic biology, or water quality. As stated in Section 1.4, Purpose and Need, information gained through this demonstration would be used as a basis for gauging the benefits of replacing or supplementing diesel-generated power with wind power. Those elements of the environment that could be affected by the Proposed Action are biota; noise; visual and aesthetic character; cultural, historic, and archaeological resources; and land use.

The proposed wind turbine site on top of Anvil Mountain is adjacent to the WACS, which was deactivated by the Air Force in 1979. Structures have been demolished and removed, and contaminated soils have been removed. However, four black concave antennas measuring approximately 18 meters (60 feet) wide and 24 meters (80 feet) tall, and 15 meters (50 feet) deep remain. The antennas serve as both a historic remnant of the Cold War and a navigational aid to local people who fish and hunt at sea (Air Force, 1996).

The mountaintop is generally disturbed ground from the White Alice site remediation with one large concrete pad remaining, which may be removed. Scattered around the mountaintop are various concrete footers and pipes; these served as anchor points or footers for structures that have been removed. Undisturbed areas are characterized by alpine tundra and exposed rock.

3.1 Biological Resources

The proposed site has a very thin mantle of soil covering bare rock. In undisturbed areas, grasses, sedges, forbs, lichens, mosses, and some low shrubs exist. Farther downslope from the proposed site is moist tundra consisting of low shrubs—mostly dwarf birch, willows, labrador tea, bog cranberry, lingonberry and bog blueberry, and cotton grass tussocks and sedges (Air Force, 1996). This lower-elevation habitat would be traversed by powerline poles placed every 50 to 60 meters (150 to 200 feet) to connect the site to the existing transmission grid located approximately 3 kilometers (2 miles) from the top of Anvil Mountain. No threatened or endangered plant species or critical habitats are known to exist in the area.

Using high-altitude aerial photography, the National Wetlands Inventory (NWI) has identified an area of wetlands on the south side of Anvil Mountain, approximately 2.4 kilometers

(1.5 miles) from the proposed wind turbines site (FWS, 1991). The existing access road passes through the approximate center of the wetland (Figure 3). Based on the aerial photographic interpretation, the wetland has been classified as a Palustrine System, which includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens. The wetland is further classified by the NWI by two subsystems, Persistent Emergent and Broad-leaved Scrub-Shrub, and is characterized by a saturated water regime.

Nome lies on the southern edge of an area known as the Seward Peninsula. This area extends westward from the Alaskan mainland. The Seward Peninsula is bounded on the south by Norton Sound, on the north by Kotezbue Sound, and on the west by the Bering Sea. A diverse mammalian community exists on the Seward Peninsula, including grizzly and polar bears, gray wolf, caribou, domestic reindeer, musk ox, moose, red fox, arctic fox, muskrat, arctic ground squirrel, weasels, shrews, mice, voles, lemmings, arctic hare, river otter, beaver, wolverine, lynx, and porcupine (Interior, 1999). Three ecosystems exist on the Seward Peninsula: marine/estuarine, tundra, and boreal forest. This complexity supports a great diversity of avian species in the region. More than 170 avian species have been recorded in the region, with more than 100 species identified in the Nome area. Many species sighted during the brief spring and summer seasons in the Nome area are shorebirds or pelagic species (living in the open ocean); however, a variety of passerines (perching and song birds such as sparrows, swallows, robins, and warblers), grouse, ptarmigan, and raptors such as rough-legged hawks, golden eagles, short-eared owls, gyrfalcons, peregrine falcons, and snowy owls are known to occur in the inland tundra habitats (Interior, 1996). Appendix C provides a partial list of species identified by the Department of the Interior as occurring in the Bering Land Bridge National Preserve located north of Nome. Because the proposed site at Anvil Mountain is located approximately 7 kilometers (4.5 miles) inland, shorebirds, pelagic species, ducks, and other waterfowl have been excluded from Appendix C because they are unlikely to occur at the proposed project site.

Two avian species, the spectacled eider (*Somateria fischeri*) and Stellar's eider (*Polysticta stelleri*), are listed as threatened under the Endangered Species Act and are anticipated to occur in the Nome region. However, the FWS has determined that wind turbine operations at the Anvil Mountain site would not likely adversely affect these listed species (Appendix C). One additional avian species, the bristle-thighed curlew (*Numenius tahitiensis*), is a candidate species for listing under the Endangered Species Act and is known to occur in the Nome area. However, according to the FWS, this species is likely to be found farther inland than Anvil Mountain, and local observations of its movements have noted that the species uses valleys as opposed to mountaintops when moving inland (Wheeler, 1999).

3.2 Land Use

The proposed site is located on lands owned by the Sitnasuak Native Corporation (see Figure 2). Other than the remnants of the White Alice Station, there are no other facilities atop Anvil Mountain. The City of Nome's water supply is drawn from a shallow groundwater source at Moonlight Springs, located at the base of Anvil Mountain approximately 1.6 kilometers (1 mile) from the proposed site. The proximity of this water source was a principal factor in the Air Force's decision to remediate asbestos and polychlorinated biphenyl (PCB) contamination from the White Alice site (Air Force, 1996).

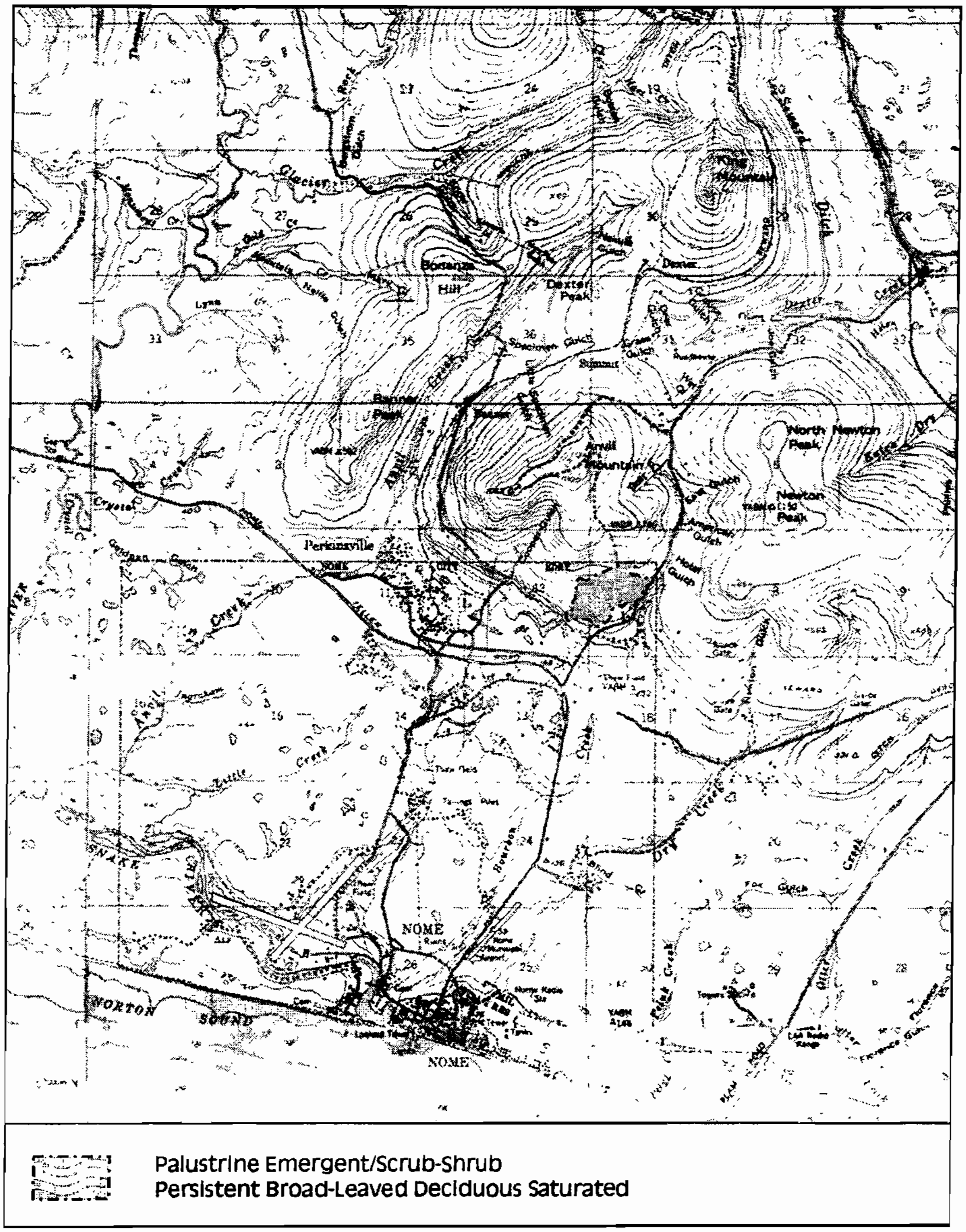

Figure 3. Anvil Mountain Wetlands

Below Anvil Mountain, 2 to 3 kilometers (1 to 2 miles) to the west, is a small placer gold mine working in the streambed. Farther to the north, a few scattered residences are found along the existing roadways. There are no residences or commercial facilities within a mile of the proposed Anvil Mountain site. In the area between the base of Anvil Mountain and Nome, there is little development other than numerous gravel quarries and the remnants of past gold dredging operations.

3.3 Meteorology

As recorded at the airport in the last 30 to 50 years of observation, Nome temperatures range from a high of 30°C (86°F) in July to a low of –47°C (–54°F) in January; temperatures average –3.2°C (26.2°F). Winds averaged 16.9 km/hr (10.5 mph) with a maximum sustained speed of 89 km/hr (55 mph) and a peak gust of 106 km/hr (66 mph). Total precipitation averages 38 centimeters (15 inches) per year, with the average annual snowfall around 140 centimeters (55 inches) (DOC, 1997).

The Wind Energy Resource Atlas of the United States rates areas around Nome as Wind Power Class of 3 to 7, depending upon location (DOE, 1986). Wind power classes are an analytical tool that combines wind speed and air density to measure the power of the prevailing winds for a given area. The higher the wind power class, the higher the wind power density and, therefore, the potential for wind turbine-generated power. Coastal areas immediately north of Nome are mapped as Wind Power Class 7, while adjacent inland areas are mapped as Wind Power Class 3. Areas farther inland are rated as Wind Power Class 2. The State of Alaska and the Nome Joint Utility System are currently operating a wind-monitoring system to determine the precise winds at the proposed Anvil Mountain site. This site-specific information will be available to decision-makers prior to any decisions to proceed at this site.

3.4 Cultural Resources

The Seward Peninsula was not covered during the Wisconsin glaciation; therefore, the prehistoric record of human activity in the region is considerable. Chipped stone implements such as microblades and harpoons have been found that date between 2,000 and 5,000 years ago. The historic record marks the existence of Inupiaq groups living on the Peninsula at the time of European exploration in the region. More recent records noted the surge of gold miners during 1898, which saw Nome's population swell to more than 20,000 in 1900. The Sitnasuak Native Corporation identified a cultural use of Anvil Mountain as a lookout for Native people to determine the location of ice during hunting activities in Norton Sound, but it noted that there was no known religious value for the site (Air Force, 1996).

A military presence in the area began during the gold rush years. The U.S. Air Force used Nome as a base during World War II and introduced the WACS in the 1950s. There are several historic structures in Nome and the surrounding area. The White Alice site atop Anvil Mountain has been reviewed and found to be eligible for the National Register of Historic Places. As a result of a Memorandum of Understanding (MOU) among the Alaskan Air Command, the Alaska State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation, the four antennas will remain on the site. The Air Force reviewed State and local records for other cultural resources that could be affected by their proposed demolition and found no cultural resources listed in the project area (Air Force, 1996).

3.5 Noise

Noise measurements were not available for the area; however, the area would be characterized as having a natural background level. There are no sensitive noise receptors such as residences, schools, and hospitals, or noise sources within a mile of the site.

3.6 Visual/Aesthetic Value

The view from atop Anvil Mountain provides a 360-degree perspective of ocean, coastal plain, alpine tundra, rolling foothills, and interior mountains for many miles. When viewed from Nome, the black concave billboard-like antennas are notable and are generally silhouetted against the skyline (Figures 4 and 5). This feature distinguishes Anvil Mountain from all other ridges immediately inland from Nome; some view the antennas as an asset to offshore navigation by local fishermen and sea mammal hunters (Air Force, 1996). The area around Anvil Mountain is characterized by gravel roads traversing most valley bottoms, scattered remnants of past gold-mining activities, gravel quarries, transmission lines, and widely spaced residential homes. Although most of the region is covered with native vegetation, the coastal plain between Anvil Mountain and Nome shows the effects of significant surface disturbance from past gold-mining operations in ponded quarries and mounded spoil piles.

3.7 Infrastructure

Well-maintained gravel roads exist to the base of Anvil Mountain and carry year-round traffic. From the well-maintained road, a narrow gravel road that is maintained in the winter extends up and over Anvil Mountain (see Figure 2). Approximately 2 to 3 kilometers (1 to 2 miles) of this road may require some minor widening and grading to accommodate the oversized cranes that could be needed to install the wind turbine(s). Transmission lines currently extend to within approximately 3 kilometers (2 miles) of the Anvil Mountain site and may be extended higher if current utility expansion plans are implemented. Assuming spacing of 76 meters (250 feet) between poles, it is conservatively estimated that 75 to 90 new poles would be required to extend power to the proposed Anvil Mountain site. No water, sewer, or gas lines extend to the top of Anvil Mountain, and none would be needed for the Proposed Action. The Nome Joint Utility System provides city water and sewer services to Nome residents and also supplies a peak demand of approximately 4,900 kW of diesel-generated electrical power.

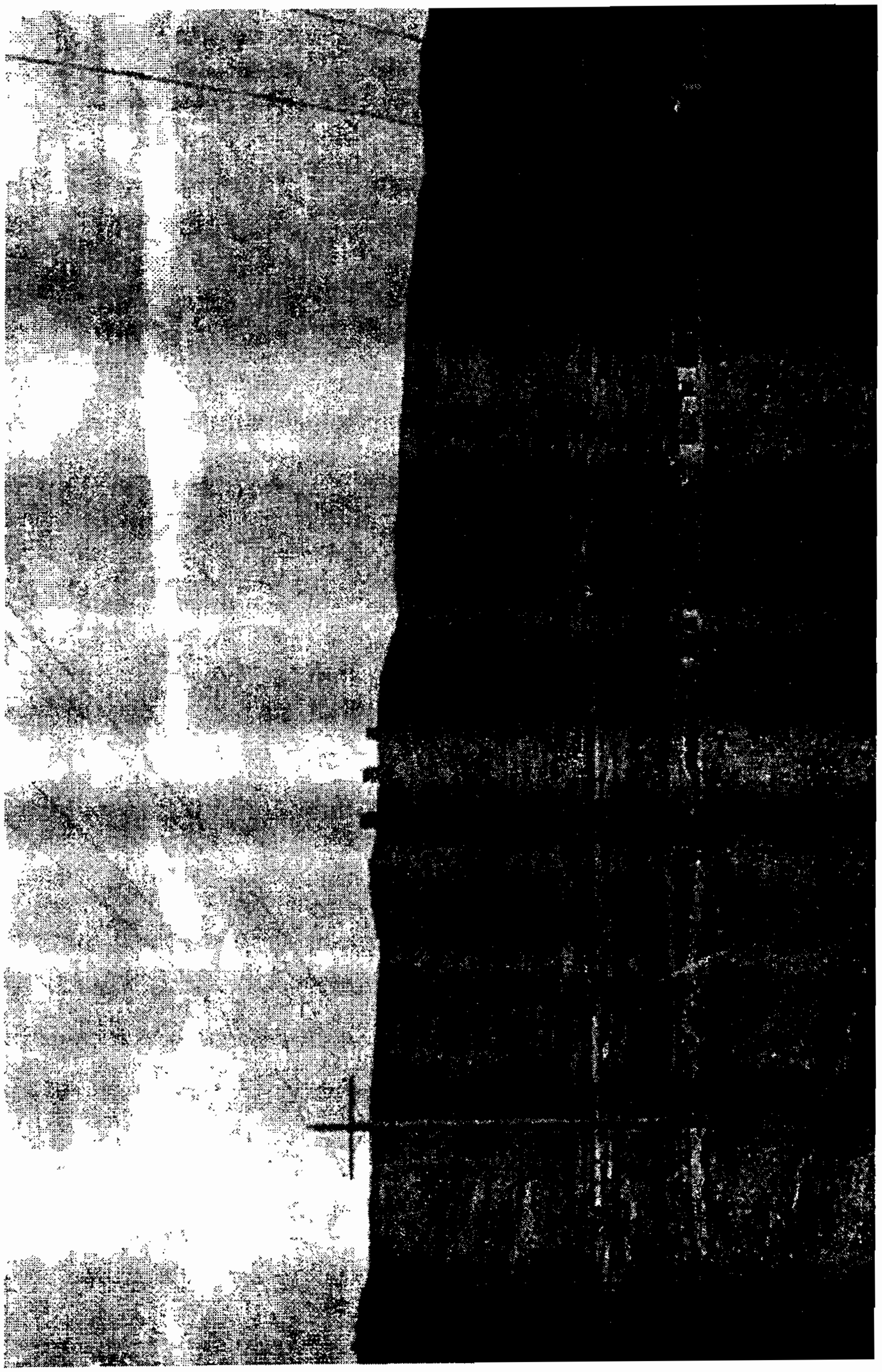

Figure 4. White Alice Antenna Arrays Atop Anvil Mountain

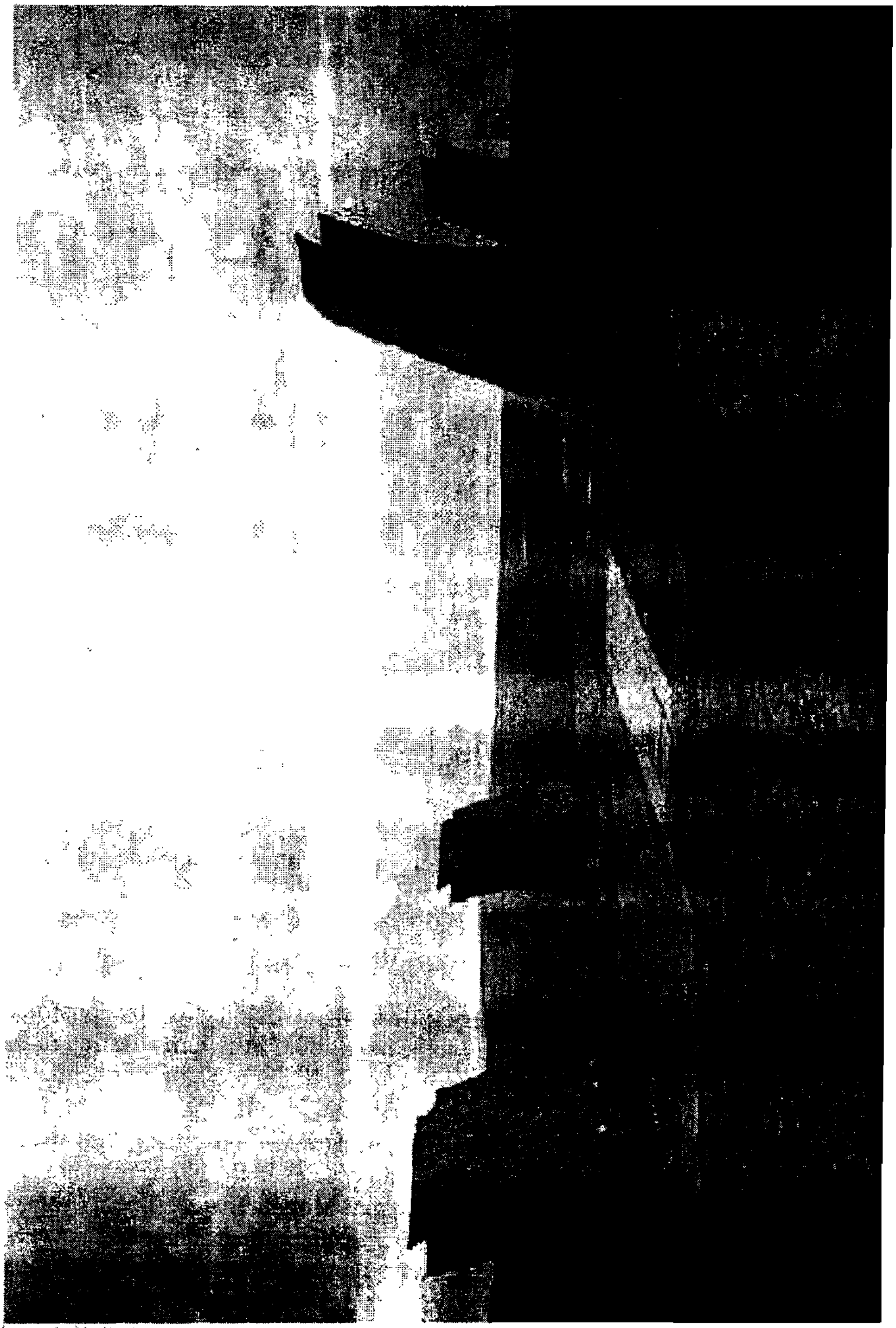

Figure 5. White Alice Antenna Arrays

4.0 ENVIRONMENTAL IMPACTS

Impacts from the Proposed Action are described in Section 4.1; impacts under the No Action Alternative are described in Section 4.2. Section 4.3 compares the impacts for the range of turbine power alternatives identified in Section 2.1.

4.1 Proposed Action

The impacts to the affected environment from the construction and operation of the wind turbine(s) atop Anvil Mountain are described in this section.

4.1.1 Biological Resources

The installation of the wind turbine(s) would use the existing road system for access to Anvil Mountain. Minor widening or grading of the road bed may be needed to facilitate oversized crane access. This action would disturb a few feet along the shoulders of the existing road, resulting in little or no loss of native vegetation. The installation of the turbine(s) atop Anvil Mountain could temporarily disturb up to 4,000 square meters (1 acre) of native vegetation and rock; however, the area of impact could be much smaller if construction can be accomplished within the area already disturbed by the operation and cleanup of the White Alice Station. The habitat that would be impacted is moist tundra dominated by mosses and lichen. This habitat type is not rare or unique in the area and is not critical habitat for any listed threatened or endangered species.

Transmission lines to the site would be installed, requiring approximately 3 kilometers (2 miles) installed on 75 to 90 new poles. Poles would be located immediately off the existing roadway; installation would disturb only the area required for each pole. Approximately six poles would be installed in the wetland area identified on the south side of Anvil Mountain. The local utility would apply for a permit to construct in a wetland from the Army Corps of Engineers, should a decision be reached to proceed with the Proposed Action. Based on construction authorization in 1999 from the Corps for extending transmission lines through the valley below Anvil Mountain (Appendix D), it is anticipated that Corps authorization would be granted for an extension to the proposed site.

Wind turbine operations would have the potential for avian impacts through habitat loss and collision with the turbine blades. Because very little habitat would be lost by construction of the proposed wind turbine, this impact is expected to be negligible. Any birds nesting in the area would likely be displaced by the proposed activities but would likely use adjacent habitats. Bird collisions have been documented at various wind turbine locations throughout the world but because of the location of the Anvil Mountain site, avian impacts are expected to be infrequent. As described in Section 3.1, the large populations of avian species in the Nome area are shorebirds and pelagic species that do not frequent the Anvil Mountain area. Local observation of the Bristle-thighed Curlew, a candidate species for listing under the Endangered Species Act, suggests movement patterns through valleys and not over mountaintops; therefore, no impacts to this species are anticipated (Wheeler, 1999). Raptors such as rough-legged hawks, golden eagles, short-eared owls, gyrfalcons, peregrine falcons, and snowy owls are known to occur in the inland tundra habitats of the Seward Peninsula and may be impacted through collisions with the wind turbine(s). However, as noted in Appendix C, raptors are relatively uncommon to rare in the Seward Peninsula, and collisions with the wind turbine blades are anticipated to be unlikely.

Impacts to mammalian species would be minor due to the small habitat losses from construction activities required for the Proposed Action. Wind turbine operations would have little to no effect on mammalian species.

4.1.2 Land Use

The Proposed Action would convert less than 4,000 square meters (1 acre) of disturbed tundra habitat to use for the wind turbine(s). Extension of the existing transmission lines would not alter any existing land uses. Site access has been negotiated through a Land Use Permit from the Sitnasuak Native Corporation (Appendix E). Two wind monitoring towers have been installed on Anvil Mountain under a temporary permit granted to the Nome Joint Utility System by the Sitnasuak Native Corporation.

4.1.3 Air Quality

The Proposed Action would have no air emissions; therefore, there would be no direct negative impacts to air quality. Because the proposed power produced by the wind turbine(s) would replace existing diesel-generated power, there likely would be a direct reduction in diesel emissions. If the wind turbine power demonstration were successful, the Proposed Action could reduce or eliminate the air emissions from the generation of 250 to 750 kW of diesel power.

4.1.4 Cultural Resources

There are no known cultural or archaeological resources on the Anvil Mountain proposed site or along the route proposed for the transmission line extension. Based on the Air Force's experience when it remediated the Anvil Mountain site, it is not anticipated that construction for the Proposed Action would uncover any such resources. The proposed construction and operation of the wind turbine(s) would have no impact on the WACS antennas that remain on the site. These structures were found to be eligible for the National Register of Historic Places in an MOU among the Alaskan Air Command, the Alaska SHPO, and the Advisory Council on Historic Preservation (Air Force, 1996).

4.1.5 Noise

The remoteness of the Anvil Mountain site from any noise receptors virtually eliminates any potential impacts from noise generated during construction or operations. The nearest receptors are approximately 1.6 kilometers (1 mile) west of Anvil Mountain. Construction noise would be limited to noise generated from heavy equipment needed to prepare the site and install the turbine(s). Construction activity would be of short duration and would occur only during normal daytime working hours. The limited duration and equipment utilized for construction, combined with the distances to the nearest receptor, would preclude impacts from construction noise.

Operationally, wind turbines do generate aerodynamic noise from the movement of the rotor blades and the mechanical noise from the movement of the turbine. Noise is measured by a decibels (dB) scale that spans the range from the threshold of hearing, 0 dB(A), to the threshold of pain, 140 dB(A). To account for the way humans perceive sound, the (A) scale in decibels, dB(A) is used. The (A) scale ignores those frequencies humans can't hear and emphasizes those that are most discernible. The dB(A) scale is logarithmic and not linear. For this project, the logarithmic scale means that installing two turbines instead of one would only increase the noise level by 3 dB over that noise generated by a single turbine. A 3-dB change is the smallest change most people can detect. In the 1970s, wind turbines of the size proposed for this project generated noise in the range of 95 to 115 dB(A) at the turbine (Gipe,1995). Although improved rotor designs and slower operating speeds have resulted in lower noise levels from today's wind turbines, this range will be used to be conservative. Using a common noise propagation model developed by the International Energy Agency (IEA), 95 to 115 dB(A) from a turbine would be reduced to 45 dB(A) within 100 to 250 meters (330 to 820 feet) from the turbine site (Gipe, 1995). To put 45 dB(A) into perspective, the average home has a sound pressure level of 50 dB(A) and a light wind through a forest has a level of 55 dB(A). Since the nearest receptors would be more than 1.6 kilometers (1 mile) away, noise from the proposed wind turbine(s) would not be discernible above ambient background noise, regardless of whether one or two turbines were operated atop Anvil Mountain. Coincidentally, although much smaller in capacity than those proposed for this project, personal wind turbines are operated by several of the nearest residences to the Anvil Mountain site.

4.1.6 Visual/Aesthetic Impacts

The additional wind turbine(s) would be visible from Nome. In part, their visibility would depend upon the final color choice: the commercial standard of off-white or, to aid in preventing ice formation, black. The existing four White Alice antennas are painted black and are significantly more massive than the proposed wind turbine(s), which would be narrow linear structures. Therefore, the wind turbine(s) would not appreciably change the view of Anvil Mountain from other locations in the area. The addition of lights to the wind turbine(s) required by the FAA (red at night and perhaps white during daylight hours) would introduce a new visual effect to Anvil Mountain. Such lighting is not uncommon in the Nome area; numerous radio antennas are also sufficiently high to warrant FAA-required lighting. Some may view the addition of the wind turbine(s) as a negative visual impact, but others who have requested that the Air Force leave the White Alice antennas intact may view the wind turbines and the FAA-required lighting as aids to navigation for those who fish and hunt at sea (Air Force, 1996).

4.1.7 Infrastructure

The proposed wind turbine project would require no water, sewer, or natural gas. The project would require a minimal amount of power to maintain FAA lighting and perhaps to operate heating systems to prevent ice buildup. Construction and operation of the wind turbine(s) would be performed by local residents; therefore, no new services would be required for employees. If successful, the project could reduce the potential need to expand the existing power system and add more diesel generators.

4.2 No Action Alternative

Under the No Action Alternative, the wind turbine project would not occur at Nome. The minor loss of natural habitat under the Proposed Action would not occur. There would be no increased potential for avian or visual/aesthetic impacts. A reduction in air emissions that could be a direct effect of the Proposed Action would not be realized under the No Action Alternative.

4.3 Comparative Assessment

To support agency decision-making regarding the project size, Table 2 compares anticipated impacts among the turbine options defined in Section 2.1. Table 2 shows that the only discernible differences among the power options identified for the Proposed Action are driven by the number of turbines. Two wind turbines would require a larger footprint than a single unit, whether two 250-kW turbines, or one 250- and one 500-kW turbine. As a result, there would be a slightly increased impact to biological resources and land use for the two-turbine options. Although avian impacts are anticipated to be small, intuitively there could be more impacts from either two turbines or from taller turbines. The state of scientific knowledge on avian impacts with wind turbines does not provide a more definitive conclusion regarding this potential impact area at this time.

Under no combination of turbine powers would there be direct negative impacts to air quality; however, if wind turbine operations were effective in this area, there likely would be a reduction in air emissions from diesel-generated power. Logically, the higher the turbine power choice for this Proposed Action, the higher the potential reduction in future emissions. This impact reduction would be relative to the power level and would not depend on the number of turbines.

Because cultural and archaeological resources are not known to occur on the proposed site, there is no potential for impacts under a one- or two-turbine operating scenario. Similarly, there would be no potential impact to the historic nature of the White Alice System atop Anvil Mountain.

There would be no noise impacts under any combination of turbine power and numbers. Visual or aesthetic impacts, whether regarded as negative or positive, would be slightly increased for power options involving two turbines. The existing infrastructure would be unaffected by any turbine power combinations. However, as was noted for air emissions, successful demonstration of wind turbine-generated power could reduce diesel demand and, therefore, alter the make-up of Nome's future power supply system.

Table 2. Comparative Impacts of Wind Turbine Power Alternatives

Impact Area	Wind Turbine Power Alternatives: One 250-kW turbine	Two 250-kW turbines	One 500-kW turbine	One 250-kW and One 500-kW turbine	One 750-kW turbine	No Action Alternative
Biological Resources	Less than 1 acre of habitat loss; slight potential for avian collisions	Less than 2 acres of habitat loss; slight potential for avian collisions	Less than 1 acre of habitat loss; slight potential for avian collisions	Less than 2 acres of habitat loss; slight potential for avian collisions	Less than 1 acre of habitat loss; slight potential for avian collisions	No habitat loss; the slight potential for avian collisions would not occur
Land Use	Less than 1 acre of natural habitat converted for wind turbine use	Less than 2 acres of natural habitat converted for wind turbine use	Less than 1 acre of natural habitat converted for wind turbine use	Less than 2 acres of natural habitat converted for wind turbine use	Less than 1 acre of natural habitat converted for wind turbine use	No change in land use
Air Quality	Likely reduction of diesel emissions	Likely reduction of diesel emissions	Likely reduction of diesel emissions	Likely reduction of diesel emissions	Likely reduction of diesel emissions	Maintains current diesel emissions
Cultural Resources	No direct effects	No direct effects	No direct effects	No direct effects	No direct effects	No impacts
Noise	No direct effects	No direct effects	No direct effects	No direct effects	No direct effects	No impacts
Visual/Aesthetic	Minor effect	Minor effect	Minor effect	Minor effect	Minor effect	No impacts
Infrastructure	No direct effect	No direct effect	No direct effect	No direct effect	No direct effect	Potential increase in diesel-generated power

5.0 CUMULATIVE IMPACTS

The proposed addition of one or two wind turbines to Anvil Mountain, as described in Section 2.1, would have a cumulative effect on visual/aesthetic impacts when viewed with the existing White Alice antenna arrays. For some viewers, the wind turbine(s) might be seen as an expanded negative impact on the existing ridgeline. For other viewers, the addition of wind turbines and associated lighting may be a positive supplement to the antenna arrays in aiding offshore navigation for winter hunting and summer fishing (Air Force, 1996). The additional transmission poles required to extend the current line to the top of Anvil Mountain would contribute additional cumulative visual impacts to the area when combined with the line extensions planned by the local utility. There are no other actions in the Anvil Mountain area that, when combined with the Proposed Action, would result in cumulative effects.

Should a decision be made to proceed with this demonstration project, and should wind-turbine generated power be successfully demonstrated in Nome, increased wind turbine use may be reasonably foreseeable in the future. However, such an event is beyond the scope of the action being proposed here; therefore, the cumulative consequences of additional turbines are not the responsibility of this EA but could be the subject of future NEPA documentation under Federal regulations or other permitting requirements under State regulations.

6.0 SHORT-TERM USES AND COMMITMENT OF RESOURCES

As identified in Section 1.1, NEPA requires Federal agencies to (1) describe the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, and (2) characterize any irreversible and irretrievable commitments of resources that would be involved should the Proposed Action be implemented. The Proposed Action would commit less than 4,000 square meters (1 acre) of previously disturbed tundra atop Anvil Mountain to the production of 250 kW to 750 kW of wind-generated electrical power. As a result of this action, Nome's dependency on diesel power could be reduced, leading to a reduction in air emissions. Such a reduction, although not significant on a national or global scale, would contribute to the reduction in greenhouse gases and thus contribute to the enhancement of long-term productivity.

The Proposed Action could result in the irreversible commitment of small quantities of steel, fiberglass, and concrete upon decommissioning of the turbine(s). Due to Nome's remoteness, recycling of these materials would be unlikely; therefore, landfill disposal is likely, making the commitment irreversible.

7.0 REFERENCES

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APPENDIX A – SCOPING

Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, Colorado 80401-3393

December 17, 1999

DISTRIBUTION LIST

SUBJECT: NOTICE OF SCOPING - ENVIRONMENTAL ASSESSMENT FOR PROPOSED WIND TURBINE PROJECT, NOME AND UNALASKA, ALASKA

The U.S. Department of Energy (DOE) and the State of Alaska are examining sites for the construction and operation of a proposed wind turbine project. The proposed project would generate between 225 and 750 kilowatts (kW) of electrical power. Nominal operating life of the turbine(s) would be approximately 20 years after which time they would be removed. Sites are currently being examined near the Alaskan communities of Unalaska and Nome. It is DOE's policy to integrate community and public concerns into its decision making process. Accordingly, prior to undertaking any action on the proposed project, DOE is soliciting public and agency inputs to aid in the identification of issues warranting more detailed evaluation in an Environmental Assessment (EA) prepared under the National Environmental Policy Act (NEPA).

During October of this year, representatives of DOE conducted site visits and met with representatives of Federal, State, and local agencies. Through the input of the U.S. Fish & Wildlife Service, the U.S. Corps of Engineers, and that of the local utilities, combined with the wind characteristics at each site, our list of potential sites for detailed characterization has been narrowed to:

- Unalaska - The sites under consideration are located south of town, off Captains Bay, in Pyramid Valley. Two sites are currently being considered in this area, one at the mouth of Pyramid Valley on the coastline, and the other within the valley 1/4 to 3/4 mile from the coast. Figure 1.

- Nome - One site is being considered in the Nome area. The proposed site is located atop Anvil Mountain, approximately four to five miles inland from Nome adjacent to a decommissioned U.S. Air Force radar station that was an element of the Alaska Communications System ("White Alice System") and the Distant Early Warning (DEW) line. Figure 2.

Construction at any of the proposed sites would involve installation of concrete footers placed on bedrock to support the wind turbine tower(s), and would disturb less than an acre. At the proposed Nome site approximately two miles of above ground transmission line would be required to connect with the existing electrical grid. At the Unalaska sites existing underground conduits would be utilized to connect to the electrical grid. The proposed sites are not within jurisdictional wetlands; therefore, the compliance requirements of 10 CFR Part 1022 pertaining to floodplains and wetlands are not implicated.

The size of the proposed action, with regard to kW capacity to be built, has yet to be finalized. Because the capacity decision will be based on available Federal, State and local funding, utility needs, and environmental impact considerations, a range in capacity will be evaluated in the EA to support decision-making. To assure an assessment of the full range of foreseeable technical alternatives, one or two utility scale turbines, with a generation of capacity of 225kW to 750kW, will be considered in the EA. The specifications for each turbine alternative at three operating levels are summarized on Table 1. Please note that the turbines dimensions identified are representative of commercially available turbines. Final turbine manufacturer selection would involve a formal competitive bidding process if a site is selected and a final decision to proceed is reached.

Please direct any comments, questions, or concerns you may have regarding this proposal to:

> Ms. Joyce Beck, NEPA Document Manager, U.S. Department of Energy, Golden Field Office, 1617 Cole Boulevard, Golden Colorado 80401-3393; telephone number 1-800-644-6735; or to electronic mail address joyce_beck@nrel.gov.

The draft EA document will be provided to interested parties for review and comment upon its completion. Comments, questions, or concerns received by January 21, 2000 will be considered prior to DOE reaching a final decision regarding funding of the proposed project.

Sincerely,

Timothy S. Howell
Acting NEPA Compliance Officer
Golden Field Office

Enclosure
As Stated
cc:
D. Hooker, GO
J. Beck, GO
T. Howell, GO
T. Anderson, BMI

2

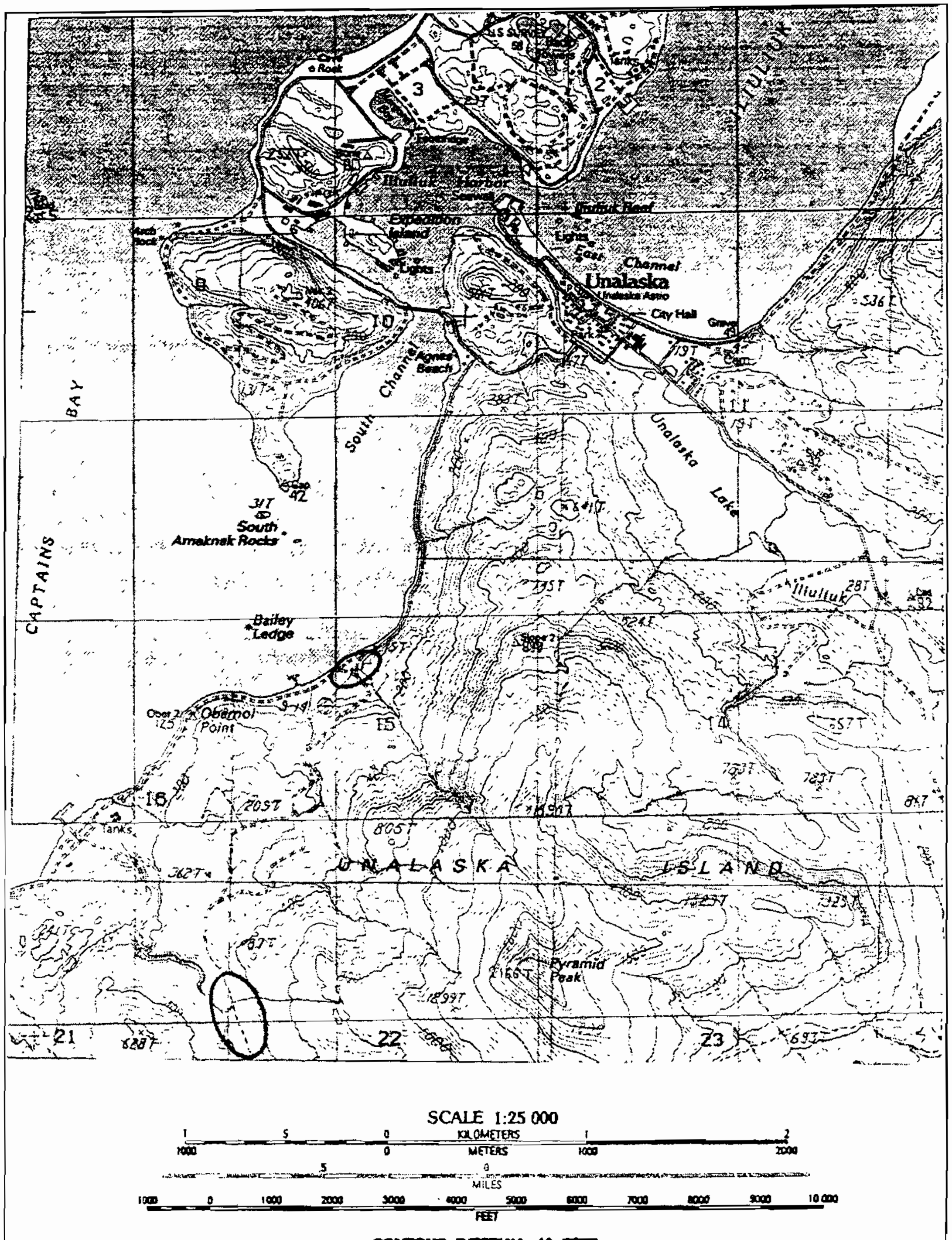

FIGURE 1 - Unalaska Sites

3

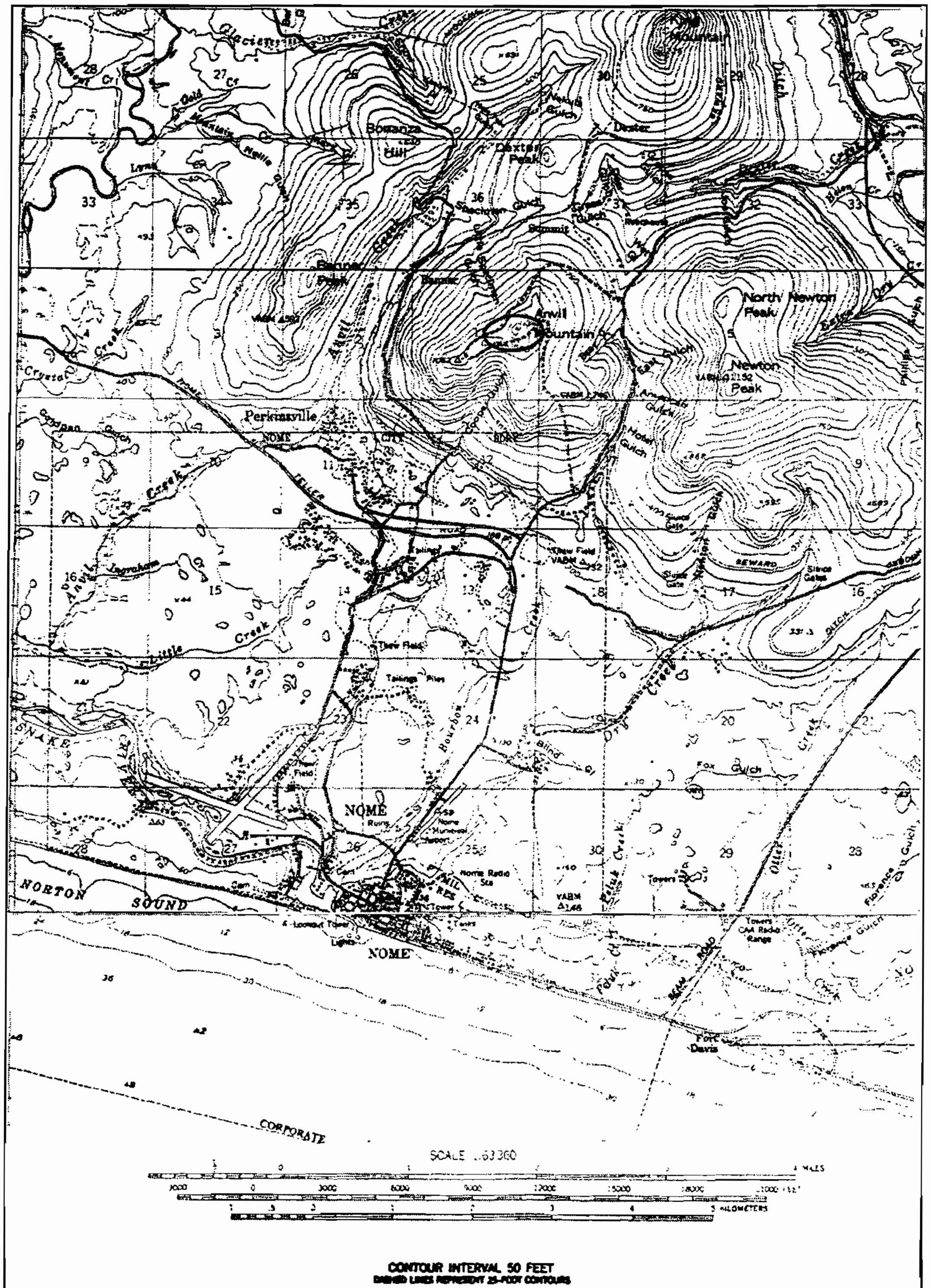

FIGURE 2 - Nome Site

4

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Nome Public Radio
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NJSB

U.S. FISH & WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services Anchorage
605 West 4th Avenue, Room 62
Anchorage, Alaska 99501-2249

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WAES

Ms Joyce Beck
NEPA Document Manager
U.S. Department of Energy
Golden Field Office
Golden, Colorado 80401

Dear Ms. Beck:

Thank you for your request for scoping information regarding the possible installation of wind turbines at Unalaska and Nome. We have provided previous comments on the potential for this project to affect threatened and endangered species. The purpose of this letter is to make you aware of relatively large concentrations of bald eagles at and near the Westward Seafood processing facility. This facility is on Captain's Bay in close proximity to Pyramid Creek.

Wintering bald eagles historically concentrated at the Unalaska landfill prior to its recent conversion to a baling operation. Since that time, the eagles still return to Unalaska during the winter, but have dispersed to less concentrated food sources. During a site visit to Captain's Bay January 10-14, 2000, between 50 and 75 bald eagles were consistently observed at Westward Seafoods.

We are concerned that a wind turbine located on the Captain's Bay coastline near Pyramid Creek would result in blade-strikes to wintering bald eagles and other birds. Bird use is substantially greater along the coast compared to inland sites, especially during the winter. For this reason we recommend that the turbine be located at the inland location where the risk of injury to birds is smaller than the coastal site. We would have serious concerns about locating the turbine on the coastline of Captain's Bay near Pyramid Creek.

Please telephone Mark Schroeder, Fish and Wildlife Biologist, at (907) 271-2797 if you have any questions.

Sincerely,

Ann G. Rappoport
Field Supervisor

cc: ADFG: W. Dolezal

TONY KNOWLES, GOVERNOR

DEPARTMENT OF FISH AND GAME

HABITAT AND RESTORATION DIVISION

P.O. BOX 25526
JUNEAU ALASKA 99802-5526
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January 27, 2000

Mr. Timothy S. Howell
Acting NEPA Compliance Officer
Golden Field Office
U.S. Department of Energy
1617 Cole Boulevard
Golden, CO 80401-3393

Dear Mr. Howell:

The Alaska Department of Fish and Game (ADF&G) has briefly reviewed the U.S. Department of Energy's proposal to generate electrical power using wind turbines near Unalaska and Nome, Alaska. We did not identify any significant fish and wildlife issues related near Nome. Comments on the Unalaska site follows.

Two sites are identified as being under consideration near Unalaska. Figure 1 of the December 17, 1999 correspondence shows one site is located near the ocean about 0.5 miles east-northeast of Obernoi Point in the SE¼NW¼ Sec 15, T 73 S, R 118 W, Seward Meridian. This location is very near Westward Seafood's processing plant and associated housing complex. However, per a telephone conversation with Mr. Mike Golat, Director of Public Utilities for the City of Unalaska, the site is not found at this location. It is his understanding that the site under consideration is supposed to be about 0.5 miles southwest of Obernoi Point on the south side of the lower reach of Pyramid Creek in the SW¼SE¼ Sec 16, T 73 S, R 118 W, S.M. This site is very near the Crowley Maritime industrial complex. The second site is found at about the 250 foot elevation in the SE¼NE¼ Sec 21 and the SW¼NW¼ Sec 22, T 73 S, R 118 W, S.M. where the East Fork Pyramid Creek and Icy Creek merge to form the mainstem of Pyramid Creek. This site is very near the City of Unalaska water storage reservoir and water treatment facility.

Several species of fish and wildlife are found in the vicinity. Along the coast, avian species of particular concern include the spectacled eider (*Somateria fischeri*) and Steller's eider (*Polysticta stelleri*) both listed as threatened species on the endangered species list. In addition, other species of concern include emperor geese (*Chen cangica*) and bald eagles (*Haliaeetus eucocephalus*) that congregate in the area during the winter.

The lower reach (approximately 1,600 feet) of Pyramid Creek supports pink salmon (*Oncorhynchus gorbuscha*) and coho salmon (*Oncorhynchus kisutch*), as well as Dolly Varden (*Salvelinus malma*). Pink salmon are known to spawn in the stream and coho salmon rear in it.

Mr. Timothy Howell 2 January 27, 2000

Resident Dolly Varden are found above a barrier waterfall on the mainstem of Pyramid Creek. They are also found in both Icy Creek and the East Fork Pyramid Creek.

Any proposal for wind turbines along the coast and close to sea level raises concern for bird strike mortality. The site near Crowley Maritime complex is such a location. To prevent potential injury to threatened species and wintering waterfowl and bald eagles this site should be eliminated from consideration. The proposal for a site away from the coastline and at higher elevations raises fewer concerns for bird strike. However, development of upland sites including access and facilities construction must be accomplished in a manner that prevents short and long-term soil erosion and that maintains water quality in Icy Creek, East Fork Pyramid Creek, and Pyramid Creek.

We appreciate the opportunity to comment. Should you have any questions please contact Mr. Wayne Dolezal of my Anchorage staff, at (907) 267-2333.

Sincerely,

Ken Taylor
Director

cc: R. Morrison, ADF&G
M. Golat, City of Unalaska
G. Wheeler, USFWS
W. Dolezal, ADF&G
M. McLean, ADF&G

APPENDIX B – FAA CORRESPONDENCE

Federal Aviation Administration
Alaskan Region, AAL-530
222 West 7th Avenue, #14
Anchorage, AK 99513-7987

AERONAUTICAL STUDY
No: 00-AAL-0023-OE

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ISSUED DATE: 02/24/00

JOHN HANDELAND
NOME JOINT UTILITY SYSTEM
70 POWERPLANT DRIVE, P.O. BOX 70
NOME, ALASKA 99762

** DETERMINATION OF NO HAZARD TO AIR NAVIGATION **

The Federal Aviation Administration has completed 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:

Description: WIND TURBINE(S)

Location: NOME AK
Latitude: 64-33-49.24 NAD 83
Longitude: 165-22-27.37
Heights: 400 feet above ground level (AGL)
1534 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does exceed obstruction standards but would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

-As a condition to this determination, the structure should be marked and/or lighted in accordance with FAA Advisory Circular 70/7460-1J, Obstruction Marking and Lighting, Chapters 4, 5(Red),

-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 construction reaches its greatest height (7460-2, Part II)

-It is required that the FAA be notified at least 48 business hours prior to the temporary structure being erected and again when the structure is removed from the site. Notification should be made to this office during our core business hours (Monday through Friday, 9:00 am to 3:00 pm) via telephone at 907-271-5903. Notification is necessary so that aeronautical procedures can be temporarily modified to accommodate the structure.

This determination expires on 08/24/01 unless:

(a) extended, revised or terminated by the issuing office or
(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 on the date the FCC denies the application.

Orig: David K
CC: Mary

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.

-As a result of this structure being critical to flight safety, it is required that the FAA be kept apprised as to the status of this project. Failure to respond to periodic FAA inquiries could invalidate this determination.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, frequency(ies) or use of greater power will void this determination. Any future construction or alteration, including increase in 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.

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 our office at 907-271-5903. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 00-AAL-0023-OE.

John J. Schommer (EBO)
Specialist, Operations Branch

7460-2 Attached

APPENDIX C – BERING LAND BRIDGE NATIONAL PRESERVE BIRD CHECKLIST AND FWS CORRESPONDENCE

Bering Land Bridge National Preserve Bird Checklist

Common Name	June	July	August
Golden Eagle	U	U	U
Northern Harrier	U	U	U
Rough-legged Hawk	C	C	C
Osprey	R	R	R
American Kestrel	R	R	R
Merlin	R	R	R
Peregrine Falcon	U	U	U
Gyrfalcon	U	U	U
Spruce Grouse	R	R	R
Rock Ptarmigan	U	U	U
Willow Ptarmigan	C	U	U
Short-eared Owl	C	U	C
Great Horned Owl	R	R	R
Snowy Owl	R	R	U
Northern Hawk Owl	R	R	U
Horned Lark	U	U	U
Tree Swallow	A	A	A
Violet Green Swallow	R	R	R
Bank Swallow	C	C	C
Cliff Swallow	C	C	C
Gray Jay	R	R	R
Common Raven	A	A	A
Arctic Warbler	U	U	U
Ruby-crowned Kinglet	U	U	U
Black-capped Chickadee	C	U	C
Gray-cheeked Thrush	A	A	A
Varied Thrush	U	U	U
American Robin	A	A	A
Northern Wheatear	U	U	U
Bluethroat	U	U	U
Siberian Rubythroat	1	*	*
Northern Shrike	U	U	U
Northern Pipit	C	C	C
Red-throated Pipit	R	R	R
White Wagtail	R	R	R
Yellow Wagtail	A	A	A
American Dipper	R	R	R
Orange Crowned Warbler	U	U	U
Yellow Warbler	C	C	C
Yellow-rumped Warbler	U	U	U
Wilson's Warbler	C	C	C
Northern Waterthrush	C	C	C
Savannah Sparrow	C	C	C

Common Name	June	July	August
American Tree Sparrow	C	C	C
Dark-eyed Junco	R	R	R
White-crowned Sparrow	A	A	A
Golden-crowned Sparrow	C	C	C
Lincoln's Sparrow	R	R	R
Fox Sparrow	A	A	A
Lapland Longspur	A	A	A
Snow Bunting	R	*	R
McKay's Bunting	R	*	R
Rusty Blackbird	U	R	R
Common Redpoll	A	A	A
Hoary Redpoll	A	A	A

A –Abundant, normally present in numbers, and several should be seen most days.
C – Common, normally present, and should be seen most days with a little work.
U – Uncommon, normally present, but hard to find.
R – Rare, present most years, but hard to find.
1 – Species is an infrequent visitor to the Seward Peninsula, but can be found 3 to 6 years out of 10.
***** – Insufficient information available from the road system to estimate the chances of seeing this species.

Source: Interior, 1996.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services Anchorage
605 West 4th Avenue, Room 62
Anchorage, Alaska 99501-2249

1849•1999

WAES

Timothy S. Howell
Office of Chief Counsel
Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, Colorado 80401-3393

SEP 6 1999

Dear Mr. Howell:

We received your letter requesting information on the potential presence of Federal threatened or endangered species, as well as migratory birds, at several potential project sites. The letter was received by us on August 12, 1999. As stated in your letter, the proposed project involves the construction and operation of an experimental fuel cell/wind turbine. The potential sites identified in your letter are Naknek, Unalaska, and Nome. We appreciated the early coordination on the part of the Department of Energy and its consultant with regards to this projects potential effects on natural resources. The following information is provided for use in planning the project. It should be considered as preliminary based upon our current knowledge, but without the benefit of having visited the sites or consulted with all species authorities.

Based on review of our information, the spectacled eider (*Somateria fischeri*) and Steller's eider (*Polysticta stelleri*), are the only two listed species anticipated to occur in the vicinity of the project sites. However, due to its location, the potential for construction and operation of the wind turbine to harm these species appears to be highest at Naknek - Site 1. The potential sites at Unalaska - Site 9 and Nome (Anvil Mountain) are located such that, upon initial review, operation of a wind turbine would not likely adversely affect these listed species.

As for other avian species, all of the sites pose some risk. The operation of the wind turbine at Naknek, especially during adverse climatic conditions (e.g., fog) could also impact several other species of ducks and geese. In addition, bald eagles, other raptors, and other migratory birds may also be harmed through its operation. Consequently, of the three sites evaluated, the potential for impacts to migratory birds appears to be greatest at this site.

The operation of the wind turbine at Unalaska - Site 9, because of its location, would appear least likely to impact ducks and geese, but still may harm raptors and passerines using the valley and associated ridge. The operation of a wind turbine at Nome, Anvil Mountain, poses risks to raptors, bristle-thighed curlew (*Numenius tahitiensis*), and other migratory birds. The potential impacts to bristle-thighed curlew are significant given this species' apparent decline.

Therefore, based on review of preliminary information, Unalaska - Site 9 would appear to constitute the least risk to migratory birds.

In regards to evaluating the potential differences in total area swept by the rotors and its ultimate affect on avian impacts, we recommend a completion of a thorough literature search. Based on a preliminary review of literature, Howell (1997), didn't detect a difference in bird strikes due to differences in the size of areas swept by a rotor, and that the number of units rather than the area swept by each unit appeared to be the more important factor affecting the number of bird strikes. It is important to note that he did record mortality of hawks, falcons, owls, ducks (mallard), herons (black-crowned night heron), dove, and various passerines during their study. In contrast, Winkleman (1985), didn't record any mortality due to the operation of medium-sized wind turbines in the Netherlands. Based on our review of these two papers, we think that a number of different species would ultimately be impacted.

We have enclosed the two referenced papers for your review and we look forward to further coordination on this issue. If you have any questions regarding this letter, please contact Art Davenport at (907) 271-2781(Endangered Species) or Gary Wheeler at (907) 271-2780 (Habitat Conservation).

Sincerely,

Ann G. Rappoport
Field Supervisor

Enclosure

cc: David Lockard - DCRA Div. of Energy
ADFG- Wayne Dolezal
- Al Ott
Tom Anderson - Battelle Memorial Institute

APPENDIX D – WETLAND CONSULTATIONS

NOME JOINT UTILITY SYSTEM

P.O. Box 70 • Nome, Alaska 99762 • (907) 443-NJUS • Fax (907) 443-6336

August 26, 1999

Don Rice, Unit Coordinator
North Section – Regulatory Branch
U.S. ARMY CORPS OF ENGINEERS
P.O. Box 898
Anchorage, AK 99506

Dear Mr. Rice:

We are planning extension of our electrical grid in three different directions as indicated on the attached copy of the Nome area USGS quad map. All extensions are continuations of existing overhead electrical service lines mounted on poles.

Option one is a three and one-half mile extension of an existing line located at the intersection of the Center Creek Road with the Nome-Teller Highway near the Nome-Beltz High School complex within the Alaska DOT/PF right-of-way to the Snake River to serve the Snake River and Sunrise Subdivision community. The route begins in Township 11 South, Ranger 34 West, Kateel River Meridian, Section 11 and continues westward through Sections 10, 3, 4 and 5. This route is across permafrostial soils which are most likely wetlands.

Option two is a one and one-half mile extension of an existing line located near the intersection of the Dexter Road with the Nome-Teller Highway to Hotel Gulch on the west flank of Newton Peak for the purpose of serving the Panorama Bench, Morning Star and Dry Creek Subdivision community. The route beings in T 11 S, R 34 W, KRM, Sec. 13, continues north across Sec. 12 and into Sec. 7 of T 11 S, R 33 W, KRM. This route is across tailings and naturally thawed soils which are probably not wetlands.

Option three is an eleven mile extension of an existing line located at the Nome Municipal Landfill along the Beam Road and continuing within the AK DOT/PF right-of-way northward to the Nome River Bridge for the purpose of serving the Triple Creek, Osborn, Dexter and Banner Creek communities. The route begins in T 11 S, R 33 W, KRM, Sec. 21 and continues northward through Sec. 16, 15, 10, 9, 2, 3 and 4, and through T 10 S, R 33 W, KRM, Sec. 33, 28, 21, 20, 17, 8, 9 and 4. This route is over mostly naturally thawed soils with occasional discontinuous areas of permafrost. This route may cross intermittent wetlands.

Would you please determine whether you have jurisdiction over any excavation or filling we may do during placement of power poles along these three proposed routes. Would you also determine if our filling or excavation would be covered under

U.S. Army Corps of Engineers/Don Rice
August 26, 1999
Page 2

any existing nationwide permits or if we need to make individual applications for any of these lines.

The three proposed line extensions are for primary distribution and do not include secondary distribution systems to individual residents within any of the existing communities. We will address those situations in the future on an as-needed basis. It is anticipated that a wetlands permit may be needed in the Snake River and Sunrise Subdivisions at the end of proposed route number one. However, if electrical utility extensions there are also covered under a nationwide permit, we would like to be so informed.

All communications regarding wetlands jurisdictional determinations, permits and public notifications should be addressed to me as the contact person for the Utility. I can be reached directly at (907) 443-6302, should you require additional information or clarification.

Sincerely,

John K. Handeland, General Manager
NOME JOINT UTILITY SYSTEM

Enclosure: USGS quad map

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 898
ANCHORAGE, ALASKA 99506-0898

REPLY TO
ATTENTION OF:

SEPTEMBER 10 1999

Regulatory Branch
North Section
9-991067

RECEIVED
SEP 14 1999
NJUS MTM

Mr. John K. Handeland
General Manager
Nome Joint Utility System
Post Office Box 70
Nome, Alaska 99762-0070

Dear Mr. Handeland:

Your request of August 26, 1999, for a Department of the Army (DA) jurisdictional determination to see if your project for the three proposed utility line extensions could fall under Nationwide Permit authorization near Nome, Alaska has been received. It has been assigned 9-991067, Snake River, which should be referred to in all future correspondence with this office.

We have determined that more information is essential before we can respond to your request. Please provide the following information:

a. Provide a typical plan view and cross section of your proposed line work; Nationwide Permit 12 does not cover foundation work-just utility line trenching, temporary stockpiling of material, and re-filling the trench with revegetation. Depending on how you plan doing any foundation work, another nationwide permit may authorize that work. If not, an individual permit may be required.

I also checked to see if your project might fall under General Permit 90-1M for the City of Nome. According to the map we received, none of the project would be in boundaries set up for the General Permit.

b. Was the original utility line work permitted?

c. From the name of your company, I am assuming that it is jointly owned Jointly owned by whom?

I am returning a copy of your map that will show where the wetland areas are located. All three routes go through wetland areas. Please keep in mind, also, that any discharge of fill material below the ordinary high water mark of a waterbody will need authorization too.

The terms and conditions of NWP 12, which may authorize your proposed work, requires a notification to resource agencies within the State of Alaska. Upon receipt of the requested information, we will begin the notification process.

-2-

Enclosed is a copy of our Regulatory Program Applicant Information Pamphlet, including a permit application. This pamphlet is designed to assist you in applying for a DA permit and provides general information and guidance on how to complete the permit application.

Your prompt attention to this matter will expedite processing your request. If you have not provided the required information within 30 days of the date of this letter, we will close your file. Closure of your file at such time will not preclude you from re-opening the file at a later date should you wish to do so.

We appreciate your cooperation with the Corps of Engineers' Regulatory Program. Please refer to file number 9-991067, Snake River, in future correspondence or if you have any questions concerning this letter. If you have any questions, please contact me at the letterhead address, by telephone at (907) 753-2716, or toll free in Alaska at (800) 478-2712.

Sincerely,

Faye E. Heitz

Faye E. Heitz
Regulatory Specialist

Enclosure

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 898
ANCHORAGE, ALASKA 99506-0898

REPLY TO
ATTENTION OF:

NOVEMBER 1 0 1999

Copy to Bruce M. Randy R. Bongo Pozo Jrisa

RECEIVED
NOV 17 1999
NJUS MTM

Regulatory Branch
North Section
D-991067

Mr. John K. Handeland
General Manager
Nome Joint Utility System
Post Office Box 70
Nome, Alaska 99762-0070

Dear Mr. Handeland:

This is in response to your letter of September 22, 1999, concerning your proposal to discharge approximately 440 cubic yards of native and imported fill material into approximately 0.03 acres of wetlands to construct three power lines in sections 11, 10, 3, 4, 5, 12, 13, T. 11 S., R. 34 W.; sections 21, 16, 15, 10, 9, 2, 3, 4, T. 11 S., R. 33 W.; and sections 33, 28, 21, 20, 17, 8, 9, and 4, T. 10 S., R. 33 W., Seward Meridian, in and near Nome, Alaska. We have determined that your project can be authorized under Nationwide Permit #12.

A Department of the Army nationwide permit (NWP) has been issued pursuant to the December 13, 1996, Federal Register, Final Notice of Issuance, Reissuance, and Modification of Nationwide Permits (61 FR 65874), which authorizes:

"12. Utility Line Discharges. Discharges of dredged or fill material associated with excavation, backfill or bedding for utility lines, including outfall and intake structures, provided there is no change in preconstruction contours. A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquefiable, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone and telegraph messages, and radio and television communication. The term "utility line" does not include activities which drain a water of the United States, such as drainage tile; however, it does apply to pipes conveying drainage from another area. This NWP authorizes mechanized landclearing necessary for the installation of utility lines, including overhead utility lines, provided the cleared area is kept to the minimum necessary and preconstruction contours are maintained. However, access roads, temporary or permanent, or foundations associated with overhead utility lines are not authorized by this NWP. Material resulting from trench excavation may be temporarily sidecast (up to three months) into waters of the United States, provided that the material is not placed in such a manner that it is dispersed by currents or other forces. The DE may extend the period of temporary side casting not to exceed a total of 180 days, where appropriate. The area of waters of the United States that is disturbed must be limited to the minimum necessary to construct the utility line. In wetlands, the top 6" to 12" of the trench should generally be backfilled with

-2-

topsoil from the trench. Excess material must be removed to upland areas immediately upon completion of construction. Any exposed slopes and stream banks must be stabilized immediately upon completion of the utility line. (See 33 CFR Part 322)."

Notification: The permittee must notify the district engineer in accordance with the "Notification" general condition, if any of the following criteria are met:
a) Mechanized landclearing in a forested wetland;
b) A Section 10 permit is required for the utility line;
c) The utility line in waters of the United States exceeds 500 feet; or,
d) The utility line is placed within a jurisdictional area (i.e., a water of the United States), and it runs parallel to a streambed that is within that jurisdictional area. (Sections 10 and 404)

We consider the notification of the district engineer for this proposal satisfied by the submission of your original letter dated September 22, 1999, and letter containing additional information dated October 26, 1999. Please note that the Corps of Engineers has completed General Condition 13, Notification, on your behalf.

The proposed work may be done under the authority of the above NWP provided it conforms to the general conditions shown on Enclosure 1 and to the regional condition(s), which have been established for various NWPs in Alaska, listed below.

Regional Conditions C, E and G apply to NWP #12.

Regional Condition C: A plan employing the techniques listed below shall be implemented to avoid or minimize disturbance to wetland vegetation and to re-establish such vegetation when disturbance cannot be avoided. Areas disturbed during project construction must be revegetated as soon as possible, preferably in the same growing season as the disturbance. Erosion protection shall be provided and remain in place until the soil is permanently stabilized.

Avoidance and minimization techniques may vary with site conditions and include, but are not limited to, the following:

- Planning construction access and scheduling work to avoid or minimize damage to wetland vegetation.

  Operating equipment in bog or emergent wetlands on frozen ground to minimize destruction of the natural vegetative mat.

  Using crane matting or suitable geotextile material to protect vegetation from damage by heavy equipment.

-3-

Revegetation techniques may vary with site conditions and include, but are not limited to the following:

- Seeding, planting, replacement of reserved ground cover, and/or fertilizing of re-contoured ground to promote re-establishment of natural plant communities. Species to be used for seeding and planting should follow this order of preference: 1) species native to the site; 2) species native to the area; 3) species native to the state; and 4) non-native species. Note: non-native species should be used only when the use of native species is not available.

  In peat wetlands, systematically removing the natural vegetative mat (with root masses intact) prior to construction, storing it in a manner to retain viability (usually frozen or hydrated), then replacing it after re-contouring the ground following construction, with final contours within one foot of adjacent undisturbed vegetative cover after one growing season and one freeze/thaw cycle. For minor utility projects where no imported bedding or backfill material is used (e.g., "plowed in" cables or small utility lines installed with ditch-witches), simple restoration to pre-work contours and appropriate revegetation (see above) shall suffice.

Regional Condition E: Project limits of authorized sites shall be clearly identified in the field prior to clearing and construction to ensure that impacts to waters of the U.S. are avoided beyond project footprints (e.g., staking, flagging, silt fencing, use of buoys, existing footprint for maintenance activities, etc.).

Regional Condition G: For utility lines in peat soils, specific measures must be included in the project description to ensure that excavation will not disrupt the integrity of the subject wetland hydrology. Such measures might include horizontal ditch/trench blocks or vertical backfill blocks to address and minimize out migration of groundwater, either as subsurface drainage from adjacent wetlands or to prevent utility line bedding from acting as a conduit channel for groundwater.

Attached with the general conditions on Enclosure 1 is a list of other required State, Federal, and local authorizations the State of Alaska would like to emphasize.

Please note General Condition 14 in Enclosure 1, which reads: "Every permittee who has received a nationwide permit verification from the Corps will submit a signed certification regarding the completed work and any required mitigation." Enclosure 2 is the form you need to send us once your project is complete.

This NWP verification will be valid for two years from the date of this letter, unless the NWP authorization is modified, reissued, or revoked.

If catalogued anadromous fish streams are crossed with an all-track vehicle, an Alaska Department of Fish and Game Title 16 Permit needs to be applied for.

In an effort to determine the level of customer satisfaction with the services provided to you, the Regulatory Branch asks that you take a few moments to provide us with any constructive comments you feel are appropriate by filling out the enclosed questionnaire. Our interest is to see how we can continue to improve our service to you, our customer, and how best to achieve these improvements. Additional comments may be provided through the use of an oral exit interview, which is available to you upon request. Your efforts and interest in evaluating the regulatory program are much appreciated.

Nothing in this letter shall be construed as excusing you from compliance with other Federal, State, or local statutes, ordinances, or regulations that may affect this work.

Please contact me at the letterhead address, at (907) 753-2716, toll-free from within Alaska at (800) 478-2712, or by FAX at (907) 753-5567, if you have additional questions.

Sincerely,

Faye E. Heitz

Faye E. Heitz
Regulatory Specialist

Enclosures

Enclosure 1

NATIONWIDE PERMIT GENERAL CONDITIONS

The following general conditions must be followed in order for any authorization by a NWP to be valid:

1. Navigation. No activity may cause more than a minimal adverse effect on navigation.

2. Proper maintenance. Any structure or fill authorized shall be properly maintained, including maintenance to ensure public safety.

3. Erosion and siltation controls. Appropriate erosion and siltation controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date.

4. Aquatic life movements. No activity may substantially disrupt the movement of those species of aquatic life indigenous to the waterbody, including those species which normally migrate through the area, unless the activity's primary purpose is to impound water.

5. Equipment. Heavy equipment working in wetlands must be placed on mats, or other measures must be taken to minimize soil disturbance.

6. Regional and case by case conditions. The activity must comply with any regional conditions which may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state or tribe in its section 401 water quality certification.

7. Wild and Scenic Rivers. No activity may occur in a component of the National Wild and Scenic River System; or in a river officially designated by Congress as a "study river" for possible inclusion in the system, while the river is in an official study status; unless the appropriate Federal agency, with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely effect the Wild and Scenic River designation, or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service.)

8. Tribal rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

9. Water quality certification. In certain states, an individual Section 401 water quality certification must be obtained or waived (see 33 CFR 330.4(c)).

10. Coastal zone management. In certain states, an individual state coastal zone management consistency concurrence must be obtained or waived (see Section 330.4(d)).

11. Endangered Species.
(a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act, or which is likely to destroy or adversely modify the critical habitat of such species. Non federal permittees shall notify the District

Engineer if any listed species or critical habitat might be affected or is in the vicinity of the project, and shall not begin work on the activity until notified by the District Engineer that the requirements of the Endangered Species Act have been satisfied and that the activity is authorized.
(b) Authorization of an activity by a nationwide permit does not authorize the "take" of a threatened or endangered species as defined under the Federal Endangered Species Act. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, both lethal and non-lethal "takes" of protected species are in violation of the Endangered Species Act. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. Fish and Wildlife Service and National Marine Fisheries Service or their world wide web pages at http://www.fws.gov/~r9endspp/endspp.html and http://kingfish.spp.nmfs.gov/tmcintyr/prot_res.html#ES and Recovery, respectively.

12. Historic properties. No activity which may affect historic properties listed, or eligible for listing, in the National Register of Historic Places is authorized, until the DE has complied with the provisions of 33 CFR Part 325, Appendix C. The prospective permittee must notify the District Engineer if the authorized activity may affect any historic properties listed, determined to be eligible, or which the prospective permittee has reason to believe may be eligible for listing on the National Register of Historic Places, and shall not begin the activity until notified by the District Engineer that the requirements of the National Historic Preservation Act have been satisfied and that the activity is authorized. Information on the location and existence of historic resources can be obtained from the State Historic Preservation Office and the National Register of Historic Places (see 33 CFR 330.4(g)).

13. Notification. This general condition pertains to notification requirements for certain NWPs which, if needed for this verification, has already been completed and satisfied.

14. Compliance certification. Every permittee who has received a Nationwide permit verification from the Corps will submit a signed certification regarding the completed work and any required mitigation. The certification will be forwarded by the Corps with the authorization letter and will include: a. A statement that the authorized work was done in accordance with the Corps authorization, including any general or specific conditions; b. A statement that any required mitigation was completed in accordance with the permit conditions; c. The signature of the permittee certifying the completion of the work and mitigation.

15. Multiple use of Nationwide permits. In any case where any NWP number 12 through 40 is combined with any other NWP number 12 through 40, as part of a single and complete project, the permittee must notify the District Engineer in accordance with paragraphs a, b, and c on the "Notification" General Condition number 13. Any NWP number 1 through 11 may be combined with any other NWP without notification to the Corps, unless notification is otherwise required by the terms of the NWPs. As provided at 33 CFR 330.6(c) two or more different NWPs can be combined to authorize a single and complete project. However, the same NWP cannot be used more than once for a single and complete project.

SECTION 404 ONLY CONDITIONS:

In addition to the General Conditions, the following conditions apply only to activities that involve the discharge of dredged or fill material into waters of the U.S., and must be followed in order for authorization by the NWPs to be valid:

1. Water supply intakes. No discharge of dredged or fill material may occur in the proximity of a public water supply intake except where the discharge is for repair of the public water supply intake structures or adjacent bank stabilization.

2. Shellfish production. No discharge of dredged or fill material may occur in areas of concentrated shellfish production, unless the discharge is directly related to a shellfish harvesting activity authorized by NWP 4.

3. Suitable material. No discharge of dredged or fill material may consist of unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.,) and material discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

4. Mitigation. Discharges of dredged or fill material into waters of the United States must be minimized or avoided to the maximum extent practicable at the project site (i.e., on-site), unless the District Engineer approves a compensation plan that the District Engineer determines is more beneficial to the environment than on-site minimization or avoidance measures.

5. Spawning areas. Discharges in spawning areas during spawning seasons must be avoided to the maximum extent practicable.

6. Obstruction of high flows. To the maximum extent practicable, discharges must not permanently restrict or impede the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters).

7. Adverse effects from impoundments. If the discharge creates an impoundment of water, adverse effects on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow shall be minimized to the maximum extent practicable.

8. Waterfowl breeding areas. Discharges into breeding areas for migratory waterfowl must be avoided to the maximum extent practicable.

9. Removal of temporary fills. Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.

3

OTHER REQUIRED STATE, FEDERAL, AND LOCAL AUTHORIZATIONS

As stated at 33 CFR 330.4(a): "It is important to remember that the nationwide permits (NWPs) only authorize activities from the perspective of the Corps of Engineers regulatory authorities and that other Federal, State, or local permits, approvals, or authorizations may also be required." Accordingly, 33 CFR 330(b)(2) specifies: "NWPs do not obviate the need to obtain other Federal, State, or local authorizations required by law." Although any and/or all of the NWPs may require other authorizations, the State of Alaska would like to emphasize the following potential requirements:

NWPs 1-23, 25-33, and 35-38: Work in a designated anadromous fish stream or other fish-bearing waters is subject to authorization from the Alaska Department of Fish and Game. Placement of cross-channel structure, drainage structures, or diversions in streams that contain either anadromous or resident fish is subject to authorization from the Alaska Department of Fish and Game.

NWP 6: Survey activities are subject to surface management regulations of the Alaska Department of Natural Resources and/or the Minerals Management Service and those mitigating measures pertaining to State and Federal oil and gas lease sales.

NWPs 1, 3, 6, 7, 11-15, 18-20, 25, 30, 31, 33, 35, and 36-38: Work in legislatively-designated State refuges, sanctuaries, or critical habitat areas is subject to authorization from the Alaska Department of Fish and Game.

NWP 7: The applicant must obtain a "Non-domestic Wastewater Discharge Plan Approval," or waiver of approval, from the Alaska Department of Environmental Conservation prior to construction of a stormwater outfall.

NWP 11: A small, seasonal dock may require a fish habitat permit from the Alaska Department of Fish and Game and/or a lease agreement from the Alaska Department of Natural Resources.

NWP 12: Timing, siting, road access, design, and construction methods of utility lines are subject to authorizations of Federal and State agencies with regulatory responsibility for such projects.

NWPs 13, 18, and 26: Placement of fill on State-owned land is subject to authorization from the State.

NWPs 3, 18, 19, 29, and 31: Many areas of the state are covered by Federal Emergency Management Agency (FEMA)-approved floodplain regulations, local land-use plans and regulations, and other ordinances and regulations related to development. These restrictions must be adhered to in the development of a residence on a fill permitted by a NWP.

All NWPs within the Kenai Peninsula Borough Coastal District: Dredging or filling within areas defined as floodplains by the Federal Emergency Management Agency (FEMA), and within the 50-foot setback from the Kenai River is subject to local regulations.

All NWPs involving the Kenai River and tributaries within the Kenai Peninsula Borough Coastal Districts: Kenai Peninsula Borough permits/approvals, as well as a fish habitat permit from the Alaska Department of Fish and Game and a park use permit from the Department of Natural Resources, may be necessary for your activity. Please contact the Kenai River Center at 260-4882.

4

All NWPs within the Matanuska-Susitna Coastal District: Within the 75-foot shoreline setback, all areas not occupied by allowed development must minimize disturbance of natural vegetation.

STATE POLICY REGARDING EROSION AND SILTATION CONTROLS

In addition to authorization requirements, activities authorized by Nationwide Permits must meet State water quality Standards. Nationwide Permit General Condition #3 provides for Erosion and Siltation Controls. In regard to these issues, the State of Alaska presents the following advisory information:

NWPs 3-7, 12-23, 25-27, 29-34, and 36-38: The Alaska Water Quality Standards, 18 AAC 70, establish strict limits on the amount of sediment and turbidity that may be introduced into fresh and marine waters, including wetlands. Because activities authorized by Section 404 Nationwide Permits usually involve excavation and/or placement of fill, there is considerable potential for the generation of sediment and turbidity. In concert with the requirements of Nationwide Permit General Condition 3, Erosion and Siltation Controls, the Alaska Department of Environmental Conservation policy is as follows.

Silt and sediment from excavation and fill activities should not enter wetlands or waterbodies outside the project footprint. Where practicable, fill material should be free from fine material that is subject to erosion and suspension. Excavation and fill activities should be conducted to prevent, minimize, and contain the erosion and suspension of fine material that could be carried off-site by surface runoff. If suspended material is evident outside the project footprint, appropriate control measures should be applied. These measures may include slope stabilization; filter fabric fences, straw bales, or other barriers; fiber matting; settling ponds; drainage control; trenches and water bars; waterproof covers over material piles and exposed soils; avoiding activity during heavy precipitation; revegetation; and other measures.

February 28, 1997

5

Enclosure 2

US Army Corps of Engineers
Alaska District

Permit Number: D-991067, Snake River

Name of Permittee: Nome Joint Utility System

Date of Issuance: NOVEMBER 1 0 1999

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

U.S. Army Corps of Engineers
Alaska District
Regulatory Branch
Post Office Box 898
Anchorage, Alaska 99506-0898

Please note that your permitted activity is subject to a compliance inspection by an U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above-referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Signature of Permittee ____________________ Date ____________________

APPENDIX E – COMMENTS ON DRAFT EA

Sitnasuak Native Corporation

Post Office Box 905 • Nome, Alaska 99762
(907) 443-2632 • Fax: (907) 443-3063

September 28, 2000

RECEIVED
OCT - 3 2000
DOE/GO

Steve Blazek,
Department of Energy
NEPA Compliance Officer
Golden Field Office
1617 Cole Blvd.
Golden, Colorado 80401

Dear Mr. Blazek:

The Sitnasuak Native Corporation's Land Committee reviewed the *Draft Nome, Alaska Wind Turbine Demonstration Project Environmental Assessment* (DOE/EA 1280). The document provided valuable information, primarily on land owned by this Corporation.

We support the wind turbine project as a alternate source of the diesel-generated power used locally. Our diesel is barged up the coast from California as we are located too far west to be able to access fuel from the Transalaska Pipeline. The Nome Joint Utility System has obtained a Land Use Permit from Sitnasuak for this pilot project.

Of interest to us, was the first paragraph in **Section 3.0, Affected Environment**. This is the first document that we have seen that said: "*The Maleiut, Kauweramiut, and Unalikmiut Eskimos originally inhabited Nome.*" Thank your for your recognition of our first people.

Respectfully,

Homer E. Hoogendorn
Chairman

Wind Integration Assessment

Phase 1 Report

Prepared for:

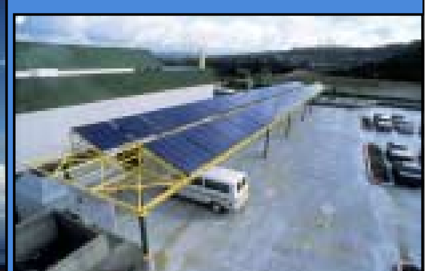
Chris Hladick
Manager

Dick Park
Director of Public Utilities

City of Unalaska
Unalaska, AK 99685
DRAFT

February 17,2005



Lawrence Mott
802-496-2955, ext. 239
lmott@northernpower.com

Northern Power Systems
182 Mad River Park
Waitsfield, VT 05673

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Executive Summary

Northern Power Systems (Northern) is pleased to provide The City of Unalaska (Unalaska) with this Wind Integration Assessment regarding the proposed wind project in the City of Unalaska and Dutch Harbor.

This report completes Phase 1, where Northern along with the City and with support from Ounalashka Corporation (OC) carried out a site investigation in order to provide a “go/no-go” determination of the basic feasibility of pursuing a wind project. Northern has investigated the areas involved in integrating wind energy into the diesel-powered grid of Unalaska. The outcome is an overview of the feasibility of locating wind generation in Unalaska.

Based on our review of available data the proposed integration of wind power in Unalaska meets or exceeds industry standards.

In order to properly assess the feasibility of a wind–diesel project several key technological and economic parameters need to be evaluated. These include the following:

Wind resource
Site conditions and constraints
Impact on powerhouse operations
Economics
Permitting

The available data to determine the feasibility is limited; no specific wind resource data has been collected, the electric load is growing, available generation equipment and infrastructure is in flux as the City is in the midst of expanding the diesel plant, and considering the use of processor generation capacity. The other significant factor is the availability and suitability of sites for wind turbines. These are the prime factors effecting the installation of a wind hybrid system. This report considers these factors and provides an assessment of whether wind power makes sense for Unalaska.

Prime wind farm sites identified are: Pyramid Valley, Strawberry Hill, and South Road. These areas possess a wind resource with an estimated annual average wind speed of at least 7 m/s (15 mph), the basic infrastructure, access, land use, integration, and permitting potential, along with qualities the City wishes to meet. These three sites were chosen for further investigation from seven sites investigated.

Investigation shows that the project can be installed using standard construction and erection methods and although installations at the potential sites are more complex and expensive than typical wind farms sites, they can be achieved using local practices. Interconnection with the local distribution/transmission may be accomplished, and is a cost issue rather than physical barrier. Integration with the current powerhouse, along with the planned powerhouse changes may also be accomplished with excellent benefit while ensuring power quality and reliability. Integration of wind power into the existing diesel grid will take detailed design, but the methods are now mature, and proven in Alaskan applications.

The project would be a strong fit with Unalaska's environmental, economic, and risk reduction goals and could be designed to meet the payback/life cycle cost threshold. Depending on the ownership structure the project may also be able to take advantage of green energy incentives and tax benefits, which may provide additional contribution to the project economics.

The main challenges to wind power in Unalaska are twofold:

- Permitting process: Historic site review (approval by SHIPO) and the Fish & Wildlife Dept.'s determination of avian concerns regarding the eider and eagles.
- High wind gusts and cold weather issues (storm winds, turbulence, complex terrain, icing events, and turbine wear/operating costs from these events). These operational concerns present added challenges for wind project performance, however, there are turbines available that would perform in these conditions.

Providing better definition to these issues may be accomplished by the installation of a meteorology (Met) tower(s) on the potential site(s). These installations will allow "a wind energy-based" quantification of the turbulence, and potential for storm damage and wear. A met tower can also provide further information on avian interaction (with the use of monitoring equipment), and enable visualization through the use of actual wind turbine size "flags" to be flown for demonstration purposes.

As the project meets or exceeds all of the technical and economic thresholds at this preliminary feasibility stage, Northern recommends that Unalaska move forward with Phase II of the feasibility analysis.

Phase II would include:

- Institute a formal site resource investigation
- Delve into the required technical, cost issues
- Map out permit and environmental site issues, and process
- Provide the information needed for a variety of contract/operational solutions to be explored, especially integration/control needs for the new diesel plant

Background

The City of Unalaska is following through with a DOE-funded process to ascertain the viability of integrating wind energy into the existing diesel engine powered grid serving Dutch Harbor and the City of Unalaska. The area is the largest port in Western Alaska and handles significant freight, both for general delivery to the smaller communities, and for support/transshipment to the fisheries and seafood processing facilities located in Unalaska.

Electric supply is a crucial part of Unalaska's infrastructure. With an electrical demand of over 8MW, electricity generation is a large issue with the need to consider fuel price volatility, air emissions, and fuel storage.

The City is considering the ability of wind power to reduce costs, improve air emissions, reduce fuel storage needs, and provide other benefits to the Community. Although these benefits are clear they must be weighed along with the high capital cost of wind power, the sensitive wildlife issues presented by a large amount of local bird activity, aesthetic concerns, and potential for storm winds that may limit the viability of commercial wind turbines.

The Unalaska area has a viable wind resource, and several potential wind sites. Various entities in the surrounding area have implemented wind power (TDX Corp. on St. Paul Island) or have explored its use – Sand Point, Cold Bay, St. George Island and of course Unalaska. AVEC, the largest cooperative utility in Alaska has been a leader in wind power integration starting with the Village of Wales, then Selawik, and now Toksook Bay, and Akula Heights (Kasigluk).

A previous wind energy study was made in 1999 by Dames & Moore, which looked at potential sites, available wind speed data, and wind turbine brochures. The study did not present any conclusions, nor provide direct integration data other than name possible wind turbine sites to be explored. These sites were: City Landfill, Haystack Hill, The Spit, the Wastewater treatment site, and Pyramid Valley.

The goal for this Phase I study was a review of all factors effecting the utilization of wind power, focusing on wind resource, and integration with the diesel generation assets, and site specifics. This focus has allowed sites to be specified for the installation of Met tower(s), and to offer further understanding of wind integration, and potential wind capacity as the new diesel plant is being designed and phased in.

Northern Power Systems is a leader in the field of wind-diesel system design, controls, and implementation. Integration with a diesel plant can be a complex endeavor, and this report has addressed the basic constraints, and costs of this effort, to ensure the City is armed with all cost data, and balance of system information associated with a project of this nature. The City has an ideal opportunity as it upgrades its generation facilities, to integrate controls and possible power quality components for the smooth integration of wind power. Wind power can help the City meet its goals of reducing fuel use, narrowing exposure to fuel price volatility, addressing air emissions, limiting future fuel storage needs, keeping more money in the community, and providing more employment.

The study included a three-day site visit, examining potential wind sites, learning about the planned development of the powerhouse and considering the overall generation plan of including the fish processor capacity. Interviews were performed to determine City needs and barriers to development of either distributed wind turbines or a small wind farm. The missing link is wind resource data measured at typical wind turbine hub height.

The conclusions drawn from this Phase I report will allow the City and its residents to discuss the application of wind power, review potential sites for ownership and implementation, all with a better understanding of its benefits and limitations.

Available Data and Assumptions

The intent of this Phase 1 report is to provide adequate information to enable Unalaska to make an informed decision on whether to go forward to the next phase of the feasibility study. Existing data, previous studies, interviews, and similar data from nearby locations have been used to compile this report.

Sources

The report is based on the following information:

- Existing wind resource data, site topography provided by Unalaska, and various State of Alaska and Federal Agencies.
- Site review by Northern staff on December 9 - 11, 2003
- Meeting with Chris Hladick, City Manager, Robin Hall City Planner, Wendy Svarny-Hawthorne (CEO – OC), and various City staff, Powerhouse Manager, and informal discussions with the Mayor, and City Council. Follow-up discussions with City Staff have been held as we gathered data and evaluated site constraints.
- Discussions with other utility operators in the Aleutian's and Alaska
- Discussion with City of Unalaska's powerhouse consultant (Dave Hubbard)
- Conversations with local staff, residents, officials. (refer to "Trip Report" in Appendix E)
- Evaluation of standard engineering and installation costs
- Review of available and appropriate wind turbine technology
- Consideration of the impact of weather and turbulence on wind turbine operation and maintenance

Assumptions

The following assumptions concerning the character of the data available to Northern should be noted:

- The wind resource assessment data gathered from the agencies is not site specific
- The estimates for foundation engineering and construction are based on a standard ballast foundation and assumption that sites would be suitable for this type (Northern did not receive site-specific geotechnical data).
- Electricity transmission/distribution one-line diagrams for the area have been reviewed in general for suitability at this stage, upgrades may be required depending on the site. Further details would be investigated, and described in Phase II.
- Electrical data, demand, generation, are based on a conversation and the report prepared by Dave Hubbard, in Maine from 2002/2003

- The avian review was carried out by ABR Inc., based in Fairbanks, who has done several studies on the Aleutians, please refer to the review in Appendix C for specific assumptions.

This Wind Project Evaluation Report, by itself, is not enough to adequately address a definitive description of installation cost, wind resource data and site constraints. Before Unalaska invests in this project we recommend several additional steps outlined in the Recommendations section of this report. These steps would constitute a normal process of completing project engineering and contracting estimates before committing to wind power as a significant generation asset and before procuring equipment and installation services.

Wind Resource

Wind resource is the most crucial aspect of wind power. As wind energy is a cubic function of wind speed, small increases in wind speed provide significant additional energy.

The wind resource in Unalaska is good, and more energetic than sites that already have implemented wind projects. Northern estimates an annual average of at least 7 m/s (15.4 MPH). Northern believes this number may be conservative, and expect more resource if correct siting is made. Surrounding areas, such as St. Paul Island, have annual averages of 8.5 m/s; Unalaska's resource is more limited by the topography than the available winds blowing through. A resource of 7 m/s can deliver economic wind power. The resource is seasonal (lower in the summer), but predictable due to the weather patterns of this region of the Bering Sea. The Japan Current, and temperature conditions often produce sweeps of weather – lasting for several days. These bring strong winds offering a stable source of energy. The weather events also induce significant storm winds, some over 100 MPH. These conditions are over the typical 60 MPH shut down speed of wind turbines, and can cause accelerated wear and potential damage to wind turbines.

Unalaska, and Dutch Harbor also have complex terrain, sharp hills and narrow valleys - conditions that cause turbulent winds. These winds can have gust factors, and angular components that induce uneven loads on wind turbines. Wind turbine siting is an important task, although a wind turbine site may be ideal regarding visual exposure (i.e. hidden behind a slope) this location may reduce output, and cause extreme wear.

The available data for Wind Resource is summarized in Table 1. The data is has limited value, as it was not collected at a potential wind site, was not collected at the correct height, and some of it was not "collected" at all, rather, they are estimates based on models. For the purposes of this report, we have defined an expected minimum of 7 m/s wind speed. A detailed review of the data is beyond the scope of the Phase 1 effort, and is not worth the effort fro the reasons listed above.

Table 1—Review of available data

SOURCE	AVG WIND SPEED			
	m/s	MPH	Location	Equip
Alaska Electric Power Statistics 1960-1995	8.00	17.84	Unalaska	
Western Region Climatic Center 1996-2002	5.02	11.20	Unalaska Airport	
Dames&Moore Report May 1999	5.20	11.60	PyramidValley	20ft tower
Dames&Moore Report May 1999	5.70	12.80	RockyPoint	30ft tower
Various city web sites	7.62	17.00		
www.city-data.com	7.65	16.83		
CH2MHill; Jul-Aug93; Hog Island & Spit	4.76	10.47	Hog Island	
CH2MHill; Jul-Aug93; Hog Island & Spit	4.43	9.76	Spit	
CH2MHill; Aug-Dec93; Hog Island	4.52	9.95	Hog Island	
CH2MHill; Jan-Feb94; Hog Island	5.54	12.20	Hog Island	

Note: Data sets are not complete, and minimal equipment, site specifications are available

Resource Conclusions:

- The data portrays a wind resource of at least 7 m/s annual average should be available at the various sites. The winter average winds will be higher, and offer a high Capacity Factor.
- High gust values are present, as would be expected in the Aleutians, and must be considered when evaluating wind turbine mechanical and lifetime performance.
- Turbulence will occur. This is of concern as are gusty winds, and should be addressed in the site evaluation, micrositing tasks
- The combination of the average speed and gust values put the site into a wind turbine design class: WTGS Class 2 or 3. The International Electro-technical Commission, an international body governing wind power standards, administers this standard designation. Although this class may not have high-energy value, the extreme gust must be considered and used to factor the design class. This means the wind turbines to be used should be designed, built and certified to withstand the challenges presented by this wind resource classification.
- Further information and analysis of the high wind speeds is required, in order to predict the lost energy when the wind speed is too high (wind turbines shut down).
- On site data collected at wind turbine hub height must be collected. Multiple levels of anemometry will allow many of the unknowns to be quantified.

Site Constraints

Unalaska presents challenges in the siting of wind turbines, although not necessarily anymore than other locations. Whether the turbines are sited in a concentrated wind farm setting, or distributed around the City and harbor, a variety of issues will have to be addressed. These issues are primarily related to environmental impact, visual impact, noise generation, and safety.

Issues related more specifically to Unalaska would be particular avian concerns, logistics, handling and site access. Wind turbines require heavy equipment, roads, crane pads, access to compatible distribution lines, and land that is available and economical.

A summary of infrastructure and permitting issues to be addressed follows.

Infrastructure

- Preliminary investigation shows reasonable soil conditions for foundations, collection and distribution system installation.
- Existing electrical distribution is available, and compatible with the wind power configurations considered.
- Distribution, collection systems can be installed per the standard City utility practice, using both above ground and buried conductors.
- Typical construction techniques (excavation/concrete/material handling/contracting) may be used for the wind project, and would work well in conjunction with other planned construction projects, especially for mixing large amounts of concrete.

  Cranes will need to be brought on island to meet the specification required. The existing cranes available are suitable as assist cranes only. The large MW size wind turbines considered require a 200-ton crane minimum, with long booms. (i.e. Manitowoc 2250 Series 3) The availability/practicality of crane size will drive the choice of turbine.
- The existing single-track roads to most sites can be upgraded to provide the necessary access for both construction and ongoing O & M without significant modification, added drainage, or impact to the natural area. Roads can be narrowed after construction.
- Security fencing will not be required for a project as equipment is located internal to the tubular towers
- The existing operations group of the City Utility/and its Lines Dept. is well suited to take on the normal operations and maintenance of the wind turbines. Factory technicians can support local personnel via remote monitoring packages, and would be called upon for recommended “majors”.

Permitting

Northern did not conduct a formal permit review. A review of requirements was carried out with the City, and via phone with several agencies. The following permitting information was gathered:

- The Forest Service has been operating under the guidelines set forth by the Bureau of Land Management related to wind and energy project construction. Their exists a wind power project review process through the BLM, The regional Forest Service office will be responsible to determine the review for Unalaska.
- Initial public scoping, and informational meetings for wind have been undertaken and the primary concerns raised related to:
    - visual impact
    - noise
    - avian issues
- A Fish and Wildlife scientist will need to complete a bird survey in Spring 2005
    - Review is required for the Met tower, for consideration of possible equipment to be added to protect against birds flying into the guy wires.
    - Avian activity may also be monitored during the Met study
    - Recent work from other Fish & Wildlife offices outside of Alaska can be considered during the Unalaska study, along with private work from ABR.

- An Environmental Assessment could be complete by Summer 2005
    - The Forest Service may be able to provide funding for the Environmental Assessment, which according to the Forest Service may cost $5,000 - $8,000
- SHIPO review for WWII artifacts will need to be considered, as Unalaska is required to contact SHIPO for review. No formal response was received from SIPO related to wind power, although once sites are determined, review may get underway

Permitting issues will focus on Avian concerns. The available data to determine the impact wind turbines may have on avian populations has increased significantly in recent years. The wind power industry has been proactive in supporting research, and wildlife biologists have spent more time in the field studying existing installations. Alaska has several wind projects moving ahead, therefore local understanding has improved. Certain Eider species are of concern, and will be the focus, along with the Eagle population. The Avian Review in Appendix C offers a detailed discussion on current understanding, Unalaska avian populations, and wind power interaction.

Impact on Utility Operations

Experience has shown that Wind power plants can be maintained and operated by a rural electric utility. The main concerns may be the required skills for operating wind turbines, impacts to grid stability, overall power quality and safety.

Wind turbines require similar skills to a diesel plant for operations and maintenance, and training can create a ready and able workforce for routine work. Manufacturers provide full warranties, and service contracts, ensuring sustainable operation of the equipment.

Power Quality is one of the typical issues mentioned when considering the integration of wind power into isolated grids reliant on diesel generators. Much work has been done over the past twenty years on system configuration, controls, and balance of systems. Wind turbines have also become more sophisticated, and able to be more forgiving as they partner with diesel generators in supplying quality power.

As envisioned, a medium to high penetration wind power configuration in Unalaska will provide the most economic benefit, as it will curtail diesel engine run time. As long as correct balance of system components are included (capacitor banks, secondary load, potentially a synchronous condenser or electronic equivalent). the grid system will remain balanced, without flicker, voltage concerns, nor undo reactive power consumption. A Wind –Diesel System technology Primer has been included in Appendix G

Safety concerns may stem from ice being thrown from the blades if the machine starts up after an icing event while a person is within a specific ice throw area. Current studies for application of wind power in much more dense areas (such as Europe) have shown this to be of little concern after normal precautions.

Isolated grid communities similar to Unalaska have undertaken wind –diesel and been successful. The country of Chile, has a ~2MW system, Canary Islands, several islands in Greece, and Northern Europe. A mature group of manufacturers in the USA, Australia, and Europe offer know-how, design, and equipment, providing the utility with alternatives to build and support a system.

On the whole, Utility operations will receive lower fuel costs, reduced pressure from emissions regulations, longer life of the diesel plant and if designed correctly – improved power quality.

Project Economics

The following Project Economics section provides an overview of the economic picture of integrating wind power; its installed costs, electrical output, life cycle costs, and potential alternative financial benefits. Wind power looks favorable.

Wind Turbines

Northern has selected three different wind turbine options, providing a look at small (250 kW), medium (660 kW), and large (1500 kW) wind turbine offerings. The expected annual output (MWH) is listed in Table 2. based on the 7 m/s annual average. Raw output is shown based on a Rayleigh Distribution for the predicted annual average wind speed. Colder average temperatures have a positive impact on air density. This was considered by using a power curve adjusted for air density, therefore increasing output in Unalaska.

Net Production

As with all wind projects, net annual production will be reduced by a variety of factors, including: icing, turbulence, electrical losses, and wake/array losses. The number of turbines, and the spacing of those machines will drive array losses. All turbines will experience downtime due to regular maintenance or for repairs – we have applied the industry standard for Availability (i.e. 2% of the time they will not able to generate power) across all of the turbines.

Raw output reduction summary:

1. Availability of 98%
2. Electrical losses of 6% (collection wiring, transformers, distribution)
3. Shut Down of 7% (local weather related: icing and high winds)

Giving total losses of 15%

Table 2—Energy Production Estimates (MWH)

Per Unit Production	GE 1.5	Vestas V47	Fuhrlander 250
Raw Production (MWH)	4,273	1,911	602
Net Production Less 15% Losses	**3,632**	**1,624**	**512**

Wind Power Configurations

Three configurations using three different turbines of 6MW, 6.6MW and 2.5MW have been modeled for potential installation. These are large quantities, but offer a look at the potential for a major part of the utilities demand The 6MW, 6.6MW configuration represents a wind "penetration" of roughly 50% of the current demand on an overall energy basis. This is considered medium to high penetration, as the nameplate capacity of the wind turbines are over the City demand at certain periods. This configuration takes advantage of economies of scale, makes wind power a significant contributor, and provides the ability to shut down engines, offering an opportunity for wind power to provide real benefit to the power plant economics. The 2.5MW configuration was included as an example of smaller wind turbines. The smaller size is not economic with the current price of small wind turbines, and without real savings on construction costs. The City should continue to consider configurations over 4MW to enable significant diesel plant impact, and realize the benefits of wind power.

Performance and Cost

The following table presents an analysis of three potential project scenarios using wind turbines appropriate for Unalaska. It is intended as a comparative tool in evaluating potential configurations relative to project cost. It does not include other turbine and project considerations such as size, visual impact, cold weather reliability, serviceability, and warranty or control systems performance.

For the purposes of this first stage feasibility evaluation we have provided a simple payback analysis. It does not take into account the time value of money, or specific tax benefits applicable to Unalaska.

Table 3—Project Economic Comparison

	GE1.5	Vestas V47	Fuhrlander
Unit Size (kW)	1500	660	250
# of Turbines	4	10	10
Installed Capacity (kW)	6000	6600	2500
Wind Systems complete fob, Unalaska	$7,495,200	$6,674,400	$3,745,000
Permit/Legal/PM/Engineering	$670,106	$636,600	$426,000
Installation & Commissioning *(includes Foundation Construction and Electrical Collection System)*	$904,976	$1,155,106	$739,041
Total Project Costs	$12,693,939	$12,576,128	$7,366,849
Installed Cost ($/kW)	$2,116	$1,905	$2,946
Total Project Cost after Federal Tax Credit and MACRS Depreciation Estimate*	$7,425,954	$7,357,035	$4,309,607
Annual Maintenance	$170,926	$162,456	$103,942
Annual Energy Output (MWH)	14,528	16,246	6,929
Lifetime COE $/kW (20 yr lifetime)	$0.077	$0.070	$0.124
Avoided cost of power (diesel offset)	$0.12	$0.12	$0.12
Production Tax Credit (10 yrs)	$2,353,657	$2,631,789	$1,122,574
Green Tag Value (10 yrs)	$1,307,587	$1,462,105	$623,652
Simple Payback (yrs)	5.5	4.8	10.6

Assumptions

The following assumptions were used in preparing the simple economic analysis in Table 3 above. (A more complete list of assumptions that were made in preparing this analysis is provided in Appendix D):

- Installation cost estimates were made with remote Alaskan construction in mind; bad weather allowances, unexpected soil conditions, equipment downtime.
- The average avoided cost of power over the 20-year lifetime is based on a portion of avoided fuel cost only as not all wind power will replace diesel. Conservative fuel cost: $ 0.12/kWh (even though the utility currently considers 0.14/kWh the fuel cost)
- The Federal Tax Credit and MACRS Depreciation Estimate includes a 10% Federal Tax Credit and an additional 35% savings due to tax benefits associated with depreciation.
- The Federal Production Tax Credit of $0.018 per kWh generated as in current law
- Regarding Green Tags:
    - The value of the Green Tags (the green power attributes associated with wind power) is $0.01 per kWh

- A discount factor and the time value of money has not been incorporated

Based on the above, the following conclusions can be drawn:

- The installed costs are in the range of large wind diesel systems
- The large configurations meet the payback requirements outlined by Unalaska,
- The lifetime cost of energy (COE) is competitive with utility supplied power.

The GE machines may offer the attraction of only four machines, but are more expensive in this particular review. In addition, the GE machine may be too large, the manufacturer may not warrant the turbine for this application/site conditions and/or a large crane may not be available or cost effective. For your information, the wind turbine on St. Paul Island is a Vestas V27 (225 kW).

Diesel Generation Offset

Low cost wind power can offset significant diesel generated megawatt hours (MWHs). The preliminary run for 10 Vestas V47's predict 11,372 MWH (70% of 16,246 –see explanation below). These wind generated MWHs save considerable fuel consumption. Wind power can be referred to as a negative load, thereby reducing demand on the diesels, allowing the diesel controls to throttle back and save fuel. There are limitations on fuel savings in this regard, as engines prefer to run well loaded, fuel consumption curves are not conducive to low load operations, and the engines will still wear, therefore O & M costs are reduced only marginally. New diesel engines are better able to respond to this situation, but the real goal is to shut engines off in order to save fuel and reduce O & M, emissions and fuel storage. Multiple diesel plants can be configured and controlled to allow engines of varying sizes to be run when needed. This allows concise load matching, and is similar to what a normal diesel plant does. While wind-diesel controls and systems are now prevalent and mature, there are still limits on how much savings can be attained by the integration of wind into a diesel grid.

More details of wind-diesel system technology, types, power quality issues, and modes of operation are discussed in Appendix G.

The for diesel plant impacts, the performance figures in Table 3, consider the following limitations:

1. Only 70% of the wind power can be used in the grid. Wind power may not be needed at the time it is generated, or if used at certain times, might result in unstable and/or unsuitable diesel plant operation. The remaining 30% can be used for a Secondary Load, i.e. productive uses such as heating buildings, through the use of a hydronic system with electric boilers.

2. At certain times a wind turbine may be curtailed (shut down) to maintain power quality, and diesel loading in high winds, low load conditions. This would occur when the Secondary load cannot absorb power at that moment.

While these requirements hurt the economics of wind-diesel, through careful system sizing and design major benefit can still be found, as wind has a much lower life cycle cost. The preliminary numbers show wind power costs of 6 – 7 cents/kWh, well under the current 14-cent/kWh diesel fuel cost of generation. Additional savings in reduced O & M, and fuel storage requirements (industry figure of +$7/gallon for new fuel storage facilities) show very promising results. The performance numbers listed, did not value the 30% of wind energy going to the Secondary load. Depending on its use the value will vary, but the utility Hydro – Quebec estimated that this energy had a value of 5 cents/kWh ten years ago.

The next phase in the feasibility study can model specific scenarios with real power plant configurations to determine the final value of wind –diesel generation for Unalaska.

Recommendations

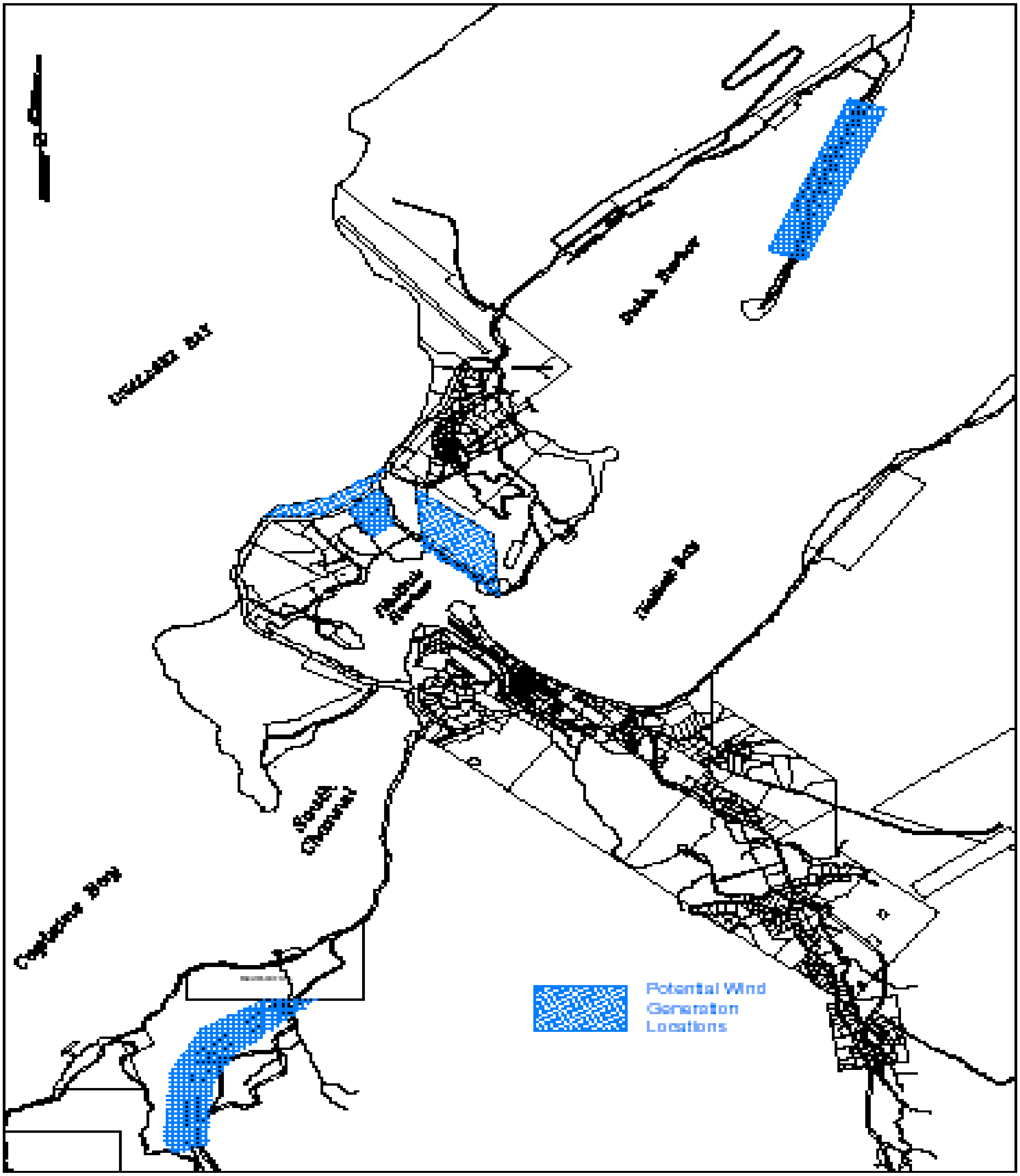
Based on this first stage feasibility evaluation of the existing wind resource, site logistics and available turbine equipment, a wind project in Unalaska is technically and economically viable and is worth pursuing. The City should continue on a path to gather additional site data necessary for project construction internally review the financial costs and benefits of the project and obtain permits for the met towers.

As part of this process in order to more fully develop the project before committing financial resources, Northern recommends a number of specific steps be taken.

- Initiate collection of wind resource data including addition of a temperature sensor at the Pyramid Valley Site.
- Engage the Fish & Wildlife Service and SHIPO in discussions and permitting activities for the Pyramid Site and one of the other potential sites determined during the Cities review of Phase 1.
- Move forward with Phase II of the feasibility: Preliminary Project Design

Phase II will build on the gathered data of Phase I, and
Institute a formal site resource investigation
Delve into the required technical, cost issues
Map out permit and environmental site issues, and process
Provide the information needed for a variety of contract/operational solutions to be explored
These tasks will provide documented project information that the City may use to plan, fund, contract, and implement the project. This information will be required in order to have contractors and/or developers formally respond to the City.

Appendix A – Map of Potential Sites



Unalaska - Dutch Harbor Alaska Trip Report

Dec 8-11,2003

Sat Dec 8 – Sun Dec 9:
Burlington,VT to Dutch Harbor,AK

Sun Dec 9
Arrive at Dutch Harbor airport. Met by City of Unalaska Manager, Chris Hladick.
Chris gave us a tour of Amaknak and Unalaska Islands including the Spit, UniSea, APL, LSA (Little South America), Western Seafoods, Bunker Hill, Pyramid Valley, small boat harbor, Snow Bowl. Lunched @ local church fundraiser with Chris. Later Lawrence and I returned to Pyramid Valley, small boat harbor, and Snow bowl.

Mon Dec 10
9am meeting with City Planner, Robin Hall, discussed potential wind turbine sites. These included

- Pyramid Valley,
- The Spit,
- Strawberry Hill,
- Front of Eagle Store/Grand Aleutian,
- west of UniSea (between UniSea & Bay).

It was determined that a letter from city manager Chris Hladick be sent to State Historic Preservation Office (SHPO) and the Fish & Wildlife Service describing our desires to look at these particular sites and determine if they had any preliminary objections.

Most sites were property of Ounalashka Corporation (OC). We scheduled an afternoon meeting with OC. Met with Wendy Svarny-Hawthorne (CEO), along with Dave, and Denise of Ounalashka Corporation to discuss potential sites. They're initial impressions appeared to be receptive to utilizing the sites for wind energy. Wendy indicated she would present the ideas to the OC.

Lunched with Aimee Kniaziowski(?-AsstCityMgr), ChrisHladick, Glen Fitch (PowerPlant Supv), Dave Kemp (Public Works) and Mayor Pam Fitch at the Grand Aleutian at the offer of Chris.

Received a tour of the city power plant by Glen Fitch. His phone numbers 581-1831 office and 391 3552 cell.

7pm at the invitation of Chris Hladick, Lawrence presented a 20min presentation on wind energy to the monthly city council meeting. Attendees included Mayor Pam Fitch, Bill Bradshaw (ex-PublicWorks) and Don Graves (UniSea). Bill Bradshaw indicated that the town had wind data available from previous studies.

Tue Dec 11:
Met in the morning with Chris Hladick. Took Lawrence to airport. Met with US Coast Guard regarding the collection of wind data. Office has been located on Unalaska for 5 years. Coast Guard office is located on Amaknak Island approx half mile from airport heading towards Unalaska Island. I was told the measuring devices were not working and they have no historical wind data.

Drove to end of paved spit (land area of spit continues for approx another half mile of which a dirt road exists for a portion) and photographed anemometer.

Returned to City Hall. Chris and I called Bill Bradshaw (Ex-Public Works) to ask about his knowledge of previous wind data. Bill referred us to Public Works. We called Dave Kemp. Dave brought several documents for me to review and copy.

Checked with Robin Hall concerning any preexisting soils data. She indicated to check with Public Works. I spoke again to Dave Kemp about the availability of any soils data in his possession. He brought over additional documents.

All documents from Public Works and the City that were copied and in our possession have been listed in the spreadsheet UnalaskaDocuments.xls

Met with APL (large container crane) Mary (office admin) & Perry (crane operator/supv?) concerning any wind measuring devices and data that they may collect. Perry took me to the control room on the crane. Wind measurements are kept in 15 min intervals. No electronic recording is done. Once a week hand recordings are done. Perry indicated that he was willing to do more recordings for us and /or allow us to install monitoring equipment. He thought there was an additional anemometer in their shop that he was offering us the use of.

Was provided the name of Reggie X(?) at the airport as a contact for owner of weather data. Photographed anemometer at the end of the airport runway. The airport lost their AWS weather station during the high wind (+160mph) event the previous week. There is an additional anemometer located at midfield of the airport. Reggie regularly records wind and weather data by hand daily and sends to the NWS in Anchorage 907-271-5122.

Spoke to Dale Rodda @ NWS Anchorage. He indicated that the NWS in Anchorage does a QC check of the data sent to them by Reggie. It is then sent to National Climatic Data Center, 828-271-4800, www.ncdc.noaa.gov and to Western Region Climatic Center, 775-674-7010, www.wrcc.dri.edu. Spoke to Jim Ashby @ WRCC. He indicated that monthly averages taken from data spanning the years 1996-2002 are available on their web site. They also have available daily data for each of those years for a price of $25/year with a maximum charge of $100 for 4 or more years.

Wed Dec 12:
Lunch w/Chris Hladick & Wendy Hladick @ Grand Aleutian.

Met again with Perry from APL to ask about availability of crane size/capabilities. He indicated drawings could be made available. Perry is working there until Feb on a temporary assignment out of Seattle. He also indicated that the local longshoremen were limited in their abilities at handling anything other than a standard container.

Met again with Reggie at airport to retrieve any data he had concerning FAA limits on obstructions. Reggie referred me to (?) in the airport maintenance shop. That person provided me with several FAA documents relating to construction of objects in proximity to airport.

The site visit was successful in obtaining:

- a number of wind sites to pursue,
- in meeting with decision makers, informing these decision makers and certain entities, such as F & W.
- We have land maps, one line details,
- An understanding of power plant operations, and typical load scenario's
- A large number of photographs, and understanding of the topography, and site conditions
- A knowledge of available infrastructure: including, docks, cranes, heavy equipment, concrete, distribution, contractors, and skilled labor.
- Preliminary wind data is available for the town/harbor

Next Steps:

- Obtain more wind data from NOAA, or Airport, possibly private source
- Confer with Chris Hladick on response from SHOLP and F & W
- Follow up with OC, and openness to siting wind facilities on OC land
- Discuss rates with OC
- Conduct another level of power planning review: such as Air quality issues, processor generation, future load scenario's, other issues related to an effective design for power generation in Unalsaka/Dutch harbor
- Obtain migratory bird report

PRELIMINARY ASSESSMENT OF BIRD ISSUES AT A PROPOSED WINDFARM NEAR DUTCH HARBOR, ALASKA

Robert H. Day and Robert J. Ritchie

ABR, Inc.—Environmental Research & Services, P.O. Box 80410, Fairbanks, AK 99708-0410
4 February 2004

Dutch Harbor–Unalaska is a moderately-sized, busy fishing community in inner Dutch Harbor itself. This is the largest fishing port in the US, in terms of amount and/or value of commercial landings. It also has a substantial amount of fisheries processing. Because of both the very active fishing and processing activities and the protected nature of the bay, it is a magnet for birds throughout the year.

There are three main bird taxa in this area that may interact with any windpower development: waterfowl, Bald Eagles, and gulls (several species). These taxa are important because of their abundance, their legal status and protection, and/or their movements or areas of concentration.

Waterfowl includes a large group of species, all of which are protected under the Migratory Bird Treaty Act (16 USC 703). Three main species are of note: Steller's Eiders, Emperor Geese, and Harlequin Ducks. Steller's Eiders also are protected under the Endangered Species Act (16 USC 1531). Only the Alaska breeding population is protected (the Russian birds, which form a majority of the entire wintering population in Alaska, are doing well), but, because the two populations mix in Alaska during the winter, the entire wintering area is of concern. Several hundred Steller's Eiders winter in the bay, foraging near the coastlines and over small shoals (Table 1, map). Emperor Geese have declined in numbers on their breeding grounds and winter along shorelines throughout this region (Table 1). Harlequin Ducks, which are considered a Species of Concern by the U.S. Fish and Wildlife Service, occur here all year but winter in large numbers (Table 1).

Bald Eagles are protected under the Bald and Golden Eagle Protection Act (16 USC 668). They breed throughout the area, although not in particularly large numbers, and occur throughout the area throughout the year (M. Jacobson, USFWS, Juneau, AK, in litt.). In winter, they concentrate in the bay in large numbers (Table 1), probably coming in from other islands. They probably concentrate here because of access to food at the landfill and because of the easy availability of food from fish-processing and fishing activities.

Gulls (a combination of various numbers of primarily Glaucous-winged Gulls, Mew Gulls, and Black-legged Kittiwakes) are protected under the Migratory Bird Treaty Act. They occur in the bay in various numbers throughout the year. Glaucous-winged Gulls and kittiwakes nest in the area, although not in large numbers. They especially concentrate in the bay around outfalls of fish-processing plants and near fishing boats in general, especially in winter (Table 1).

Table 1. Counts of bird species of interest on the annual Christmas Bird Count (one day in late December each year) for Unalaska–Dutch Harbor.

	YEAR		
SPECIES	2000	2001	2002
Emperor Goose	1031	1418	1272
Steller's Eider	703	546	696
Harlequin Duck	1016	629	969
Bald Eagle	622	681	878
Gulls	1026	186	782

We evaluated all five potential site locations with Daniel D. Gibson (University of Alaska Museum, pers. comm.), who has conducted several recent bird surveys in the bay. Site numbers are marked on a map that we have faxed, ranging from 1 for the northeastern site to 5 for the southwestern site.

Site 1: There is a submarine effluent outflow from canneries near this spit, so many birds concentrate in this area. Gibson has counted at least 700 gulls (primarily Mew Gulls + some Glaucous-winged Gulls and Black-legged Kittiwakes) foraging and concentrating in this area when fish-processing is occurring. He has not seen Steller's Eiders in this area.

Site 2: Many ducks, including scaup, goldeneyes, mergansers, and Harlequin Ducks, overwinter nearby in Iliuliuk Harbor; probably only a few Steller's Eiders do so, however. Nearby Strawberry Hill has the only grove of spruce trees in this area, so many passerines and small raptors are attracted to this site.

Site 3: This is a low, flat, and grassy area in town. Because this area is so low, some birds pass through it when they are crossing over Amaknak Island. In addition, this grassy area concentrates some migratory birds such as golden-plovers.

Site 4: There are large numbers of overwintering Emperor Geese, Steller's Eiders, gulls, and shorebirds such as Black Oystercatchers along this coastline. Eagles also forage here commonly.

Site 5: The number of birds seen drops off quickly as one heads inland, so this site might have the fewest birds. In summer, one may see terrestrial birds such as pipits or Rock Ptarmigan, but little else; in winter, numbers of birds probably are very low. However, some individual eagles and gulls occasionally fly over the area in a seemingly random fashion, as they do over most areas on the island.

Landfill: It is northeast of town and is sandwiched between the coastline and a steep hillside. Up to 300 eagles are counted here alone during the Christmas Bird Count (M. Jacobson, in litt.). Although this is not being considered as a probable windfarm site, we caution that the potential for interactions between birds and a windfarm might be high anywhere near here.This preliminary assessment suggests that the potential for bird interactions might be moderate or high at Sites 1–4 and near the landfill. It also suggests that the potential for bird interactions might be lower at Site 5.

Appendix D – Assumptions for Economics

Wind power costs;

These costs were estimated using available quotes, industry data and practical experience. Formal quotes were not obtained. Allowances were made in wind turbine and tower costs for the large increase in raw steel prices if the quotes were over 12 months old. Wind turbines w/standard tower currently cost ~$900/MW, for large machines, while smaller machines are more than double this. Shipping large components, with fragile parts such as blades is expensive. Cranes capable of the high, heavy lifts

Shipping

Based on past quotations and standard US shipping rates from the following factory locations:

shipped to Dutch Harbor:

GE: various location in lower 48, delivered to Port of Seattle

Vestas: via ocean from Denmark

Fuhrlander: Port of Seattle, after importation from Germany

Engineering/Project Management

The estimates were derived from past jobs conducted by NPS in Alaska and using industry standard assumptions for the required tasks.

Foundation

All foundations were assumed to be standard ballast style. P & H style foundations were not considered as they require deep excavation. The sites were assumed to contain rock, and may need blasting, drilling. Concrete will be required, even if rock anchoring is incorporated

Electrical & Collection System

Normal conductors, and trenching estimates were considered. Allowance of between 3000' and 4000' of conductor per turbine were assumed. Allowance for transformers, vaults, and substation were included.

Installation & Commissioning

Commercial rates for contractors, assumptions for crane rentals starting at a Seattle facility. costs also included lodging.

Annual Maintenance

Estimated maintenance includes scheduled and unscheduled needs. This includes Items such as:

- site inspections
- oil changes
- warranty specific requirements (factory service)

These are industry estimates, and have been adjusted to meet the configuration and type of turbine technology for each scenario. It was also assumed that Unalaska equipment maintenance staff can and would be trained to provide regular service.

Appendix E – Available Data

Data Collected from the City of Unalaska

RECVD	FORMAT	DATE	AUTHOR	TITLE	LONG TITLE
CITY	HARD COPY	May-99	DAMES&MOORE	FINAL REPORT - WIND ENERGY FEASABILITY STUDY	FINAL REPORT - WIND ENERGY FEASIBILITY STUDY - NAKNEK AND UNALASKA, AK - FOR THE STATE OF ALASKA - DEPARTMENT OF COMMUNITY AND REGIONAL AFFAIRS - DIVISION OF ENERGY
CITY	HARD COPY	Dec-93	CH2MHILL	WIND DATA - SUMMER DEPLOYMENT JUL-AUG 1993	CIRCULATION STUDY OF UNALASKA BAY AND CONTIGUOUS INSHORE MARINE WATERS - SUBMITTED TO HARBOR CIRCULATION STUDY WORKING COMMITTEE - FIELD DATA: SUMMER DEPLOYMENT (JULY-AUGUST 1993) WIND DATA
CITY	HARD COPY	May-94	CH2MHILL	WIND DATA - LONG TERM DEPLOYMENT AUG-DEC 1993	CIRCULATION STUDY OF UNALASKA BAY AND CONTIGUOUS INSHORE MARINE WATERS - SUBMITTED TO HARBOR CIRCULATION STUDY WORKING COMMITTEE - FIELD DATA: LONG TERM DEPLOYMENT AUGUST - DECEMBER 1993 - WIND DATA
CITY	HARD COPY	May-94	CH2MHILL	WIND DATA - WINTER DEPLOYMENT JAN - FEB 1994	CIRCULATION STUDY OF UNALASKA BAY AND CONTIGUOUS INSHORE MARINE WATERS - SUBMITTED TO HARBOR CIRCULATION STUDY WORKING COMMITTEE - FIELD DATA: WINTER DEPLOYMENT JANUARY - FEBRUARY 1994 - WIND DATA
PUBLIC WORKS	HARD COPY	Oct-95	STEIGERS CORP & RTP ENVIR ASSOC	REVISED PERMIT APPLICATION FOR PSD - FOR DUTCH HARBOR POWER PLANT	REVISED PERMIT APPLICATION FOR AIR QUALITY PROGRAM - PREVENTION OF SIGNIFICANT DETERIORATION (PSD) AND AIR QUALITY CONTROL - PERMIT TO OPERATE - FOR THE DUTCH HARBOR POWER PLANT - DUTCH HARBOR, ALASKA - STATE OF ALASKA - DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CITY	CD	Dec-03	CITY	UNALASKA TOPO	CD#1: UNALASKA TOPO
CITY	CD	VARIOUS	VARIOUS	AERIAL PHOTOS - CROWLEY & UNALASKA CAD DWGS - CITY PROPERTY & CITY ZONING	CD#2: CROWLEY OSI 1.JPG; UNALORTH10.JPG; CAD-MAPZONING03.DXF; CITYPROPERTY.DXF
PUBLIC WORKS	HARD COPY	Mar-94	ENVIROMETRICS	RESPONSES TO ADEC COMMENTS ON PSD APPLICATION	RESPONSES TO ADEC COMMENTS ON PSD APPLICATION - DUTCH HARBOR POWER PLANT
PUBLIC WORKS	HARD COPY	Jun-98	RTP ENVIRONMENTA L ASSOC	FOURTH QUARTER MONITORING REPORT - FEB THROUGH APRIL 1998	FOURTH QUARTER MONITORING REPORT - FEB THROUGH APRIL 1998 - DUTCH HARBOR POST CONSTRUCTION MONITORING PROJECT - UNALASKA, AK - PREPARED FOR ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION AIR QUALITY MAINTENANCE SECTION
PUBLIC WORKS	HARD COPY	Jun-96	RTP ENVIRONMENTA L ASSOC	FIRST QUARTER MONITORING REPORT - JUN 16 THROUGH SEPT 30, 1995	FIRST QUARTER MONITORING REPORT - JUN 16 THROUGH SEPT 30,1995 - DUTCH HARBOR OZONE MONITORING PROJECT - UNALASKA, AK - PREPARED FOR ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION AIR QUALITY MAINTENANCE SECTION
PUBLIC WORKS	HARD COPY	Sep-92	ENVIROMETRICS	DUTCH HARBOR POWER PLANT - PSD APPLICATION	DUTCH HARBOR POWER PLANT - PREVENTION OF SIGNIFICANT DETERIORATION APPLICATION
AIRPORT MAINTEN ANCE	HARD COPY	Mar-00	USDOT - FAA	PROROSED CONSTRUCTION OR ALTERATION OF OBJECTS THAT MAY AFFECT THE NAVIGABLE AIRSPACE	ADVISORY CIRCULAR - AC 70/7460-2K PROROSED CONSTRUCTION OR ALTERATION OF OBJECTS THAT MAY AFFECT THE NAVIGABLE AIRSPACE
AIRPORT MAINTEN ANCE	HARD COPY	Dec-03	CODE OF FEDERAL REGULATIONS	77.23 STANDARDS FOR DETERMINING OBSTRUCTIONS	14 CFR - CHAPTER 1 - PART 77 77.23 STANDARDS FOR DETERMINING OBSTRUCTIONS
AIRPORT MAINTEN ANCE	HARD COPY	Dec-03	CODE OF FEDERAL REGULATIONS	77.25 CIVIL AIRPORT IMAGINARY SURFACES	14 CFR - CHAPTER 1 - PART 77 77.25 CIVIL AIRPORT IMAGINARY SURFACES

AIRPORT MAINTENANCE	HARD COPY	Dec-03	USDOT - FAA	FORM - NOTICE OF ACTUAL CONSTRUCTION OR ALTERATION	FAA FORM 7460-2 FOR ADVANCE NOTICE OF CONSTRUCTION OR ALTERATION NOTICE OF ACTUAL CONSTRUCTION OR ALTERATION
AIRPORT MAINTENANCE	HARD COPY	Dec-03	USDOT - FAA	FORM - NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION	FAA FORM 7460-1 NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION
PUBLIC WORKS	HARD COPY	Feb-01	GOLDER ASSOC	SET OF 8 DRAWINGS PLAN & PROFILES - EAST POINT & BALLYHOO ROAD TESTHOLES	FIGURE A01,A06,A11,A16,A22,A26,A31,A36
PUBLIC WORKS	HARD COPY	Apr-01	GOLDER ASSOC	SET OF 3 DRAWINGS TEST PIT LOCATIONS	FIGURE 2 - TEST PIT LOCATIONS EAST POINT ROAD FIGURE 4 - TEST PIT LOCATIONS BALLYHOO RD & ALASKA SHIP SUPPLY AREA FIGURE 3 - TEST PIT LOCATIONS BALLYHOO RD & CITY DOCK AREA
ELECTRIC UTILITY	HARD COPY		ELECTRIC UTILITY	UNALASKA ONE LINE DIAGRAM	UNALASKA ONE LINE DIAGRAM

Appendix F – Turbine Operation in Cold Climes

This section has been included as an informative discussion of wind turbine operation in cold and energetic sites. Northern has years of experience in these more difficult climates, and has carried out formal studies considering the issues of cold weather and involving the comparison of the particular turbines mentioned.

NOTE: The following discussion was prepared for a previous exercise, and covers wind turbines smaller than what The City is considering, it has been included as an appendix to offer further insight and better perspective for the City of Unalaska, and is not intended to specifically cover Unalaska.

In addition to high winds and speeds, prolonged cold temperatures represent a challenge for wind turbines. Significant wind energy occurs during these low temperatures. If a machine cannot harvest this low temperature resource, the value of the project is considerably reduced. For the machine, increased fatigue stress on components, over power due to exceptionally dense air, and difficulties with turbine lubricants all contribute to turbine operational problems. Moreover, subzero conditions make servicing and maintenance of some turbine models all but impossible, resulting in reduced turbine availability during cold periods and potential safety issues for operators trying to service the machines.

Although most manufacturers provide minimum operating temperature specifications in their technical documents, some companies only provide this information upon request. Even when minimum operating and/or survival temperature information is provided, very few turbine manufacturers back this information up with empirical data collected from tests in cold chambers, or actual experience. Consequently, a given turbine's proven experience in cold regions becomes the best gauge of machine performance. Both the AOC15/50 and NW100 turbines have significant cold weather performance track records in Alaska and above Arctic Circle, while the Fuhrlander and Norwin turbines have none that we are aware of beyond intermittent cold soaks in Northern Europe.

Of the turbines considered for this evaluation, the Atlantic Orient turbine has the longest track record with regard to operation in arctic climates, with multiple machines in operation in both Wales and Kotzebue, Alaska and additional machines installed in Russia and Canada. Northern Power Systems has had one NW100 operating successfully for three winters in Northern Vermont (with temperatures as low as -25° C) and one NW100 operating in Kotzebue, above the Artic Circle since spring 2002, which has experienced -50° C along with the AOC machines installed at Kotzebue.

Air density also plays a major role. Coastal high density, cold air is more dense, and contains more energy, therefore increasing performance Seasonal cold temperatures may allow the machines to run much higher on the power curve.

Mechanical Drive Train

A significant problem with wind turbines in cold regions relates to fluids in the mechanical drive train, most specifically in the turbine gearbox. With the exception of the NW100, all of the turbines considered for this evaluation utilize asynchronous induction generators with oil-filled gearboxes. *(Note the Vestas V47, GE 1.5 are also gearbox machines)*

The high rotational speeds encountered in turbines with asynchronous induction generators require constant lubrication in gearboxes. As temperatures fall below -20° C (-4°F), difficulties with gearbox oil can become a major concern if not addressed. Even in less severe climates many gearbox failures in the industry have been attributed to this problem. As a result, heaters are typically fitted to gearboxes, providing correct operating temperatures, and an additional level of complexity, or potential failure.

The limitations of gearboxes in arctic or cold climates were a key reason for NREL's move to support the development of the direct drive technology in the NW100. In addition to several power quality advantages discussed below, the use of a variable speed direct-drive generator eliminates a gearbox in a turbine's drive train, which theoretically increases a turbine's reliability and decreases a turbine's long-term operation and maintenance requirements.

Rotors

A rotor is the unit made up of the individual blades and hub. All of the machines have three bladed rotors and are stall regulated. Stall regulation is the simplest type, whereby the blades are at a fixed pitch, and do not actively move as the conditions change. Active pitch is often used on larger machines, although the added cost, complexity is not desired for small machines that do not gain enough extra energy to account for it. *(Note: Vestas V47, and GE 1.5 are active Pitch)*

The machines are often offered with an optional rotor diameter for either low or high wind speed sites. An energetic site could cause damage to machines with large rotors (which have a greater swept area) that would be subject to extreme forces. Manufacturers will not warranty equipment if they believe it will not be able to withstand site conditions. As such, due to the high wind speeds and challenging conditions at the site, the Norwin 225, FL100 and FL250 machines were compared using smaller rotors, i.e. we have assumed smaller 27m, 19m and 27m rotors for each machine respectively as would be mandated by the manufacturers instead of the standard 29m, 21m and 29.5m rotors.

Braking Systems

In addition to gearbox issues, brake type may also impact the turbine reliability, and must be evaluated. The turbines being considered have several different types of braking systems: electro-dynamic, blade airfoil pitch, shaft mounted disc, gearbox mounted disc, and blade tip brakes. Ideally brakes should be simple, protected (rather than exposed to the environment such as ice), and operate smoothly to limit stresses on the turbine machinery. The NW100 has two independent braking systems, a proprietary electrical dynamic braking system and an internally mounted disk brake system on the main shaft. The NW100 breaking strategy is an important difference, in that the exposed mechanisms existent in the other break types, which are difficult to service, subject to the weather, and can, reduce turbine reliability. Atlantic Orient has had difficulties with their electro-magnetic tip brakes and rotary transformer. Although improvements have recently been made, the Fuhrlander and Norwin machines, which use blade brakes (where the very end of each blade can be pivoted to increase drag), may encounter problems in the challenging mountain environment.

Towers

Tubular towers have the distinct advantage of aesthetic appeal, reduction of avian interaction (tubular towers do not provide a bird roosting place while lattice towers do), and sheltered ascent for service. These advantages are at the expense of overall weight, and therefore cost. The NW100, FL100 and FL250, and the Norwin 225 currently specify tubular towers. The drive trains of these turbines are also completely enclosed within a nacelle, allowing protected access to the turbine at any time. Atlantic Orient uses steel lattice towers. These tower options are lighter in weight, less expensive and require a smaller crane to install than tubular towers. However, maintenance and repairs are made at the top of the tower while unprotected and exposed to the elements. This may mean that repairs are unable to be made in a safe and timely manner, increasing the mean time to repair (MTTR), and thus decreasing the availability of the turbines.

It is important that Unalaska consider the advantages of tubular towers. For several reasons; Aesthetics, (the potential for a specific tubular tower permit requirement made in regard to: avian issues), visual impact, and safety issues (such as preventing unauthorized climbing of lattice structures) along with the basics of ease of service and maintenance gained with a fully enclosed nacelle and tubular tower.

VAR, Frequency and Voltage Support

The turbines considered are of two electrical architectures: fixed speed with induction based generation, and variable speed synchronous generation. Both types have advantages, and disadvantages, but certain site conditions may impact the choice. Wind turbines using induction generators absorb some reactive power but generate real power. The resulting positive real power (kW) and negative reactive power (kVAR) contribution to the grid skews the ratio of real to reactive power and causes a reduction of the total power output and power factor. If not corrected with the use of additional capacitance, and/or switched capacitance banks, this can cause the local distribution system to run below rated power factor during periods of high wind and low load. With the exception of the NW100, which employs a variable speed synchronous generator connected to the grid through an inverter which can produce real power and offers power factor control, all of the turbines considered in this evaluation utilize induction generators. *(Note: Vestas V47 is a basic induction machine, while the GE 1.5 does have an inverter link, providing power quality advantages, though not as clean as direct drive technology)*

The smooth starting characteristics (avoiding high inrush current), and ability to possibly bolster this part of the grid through reactive power output, may give the variable speed–synchronous topology of the NW100 an advantage.

Turbine Orientation (Upwind/Downwind)

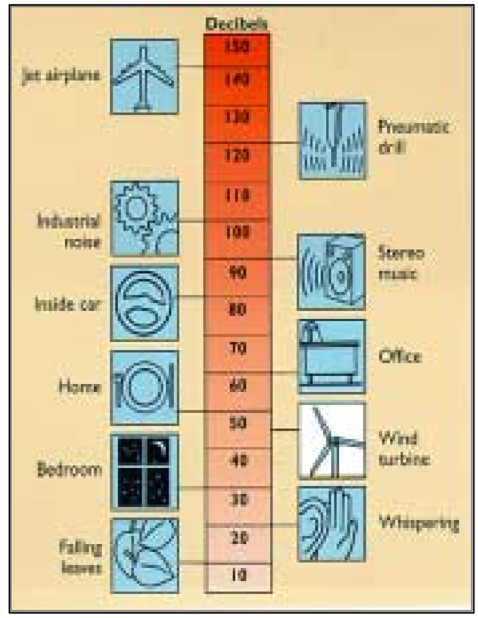
Of the five turbines reviewed all are upwind except the Atlantic Orient AOC 15/50. Upwind wind turbine blades catch the wind ahead of the actual turbine (like a propeller facing into the wind). In the case of the AOC turbine, it uses passive free-yaw downwind technology (the blades are downwind of the actual turbine and tower). The Norwin, NW100, and both Fuhrlander machines all operate in the upwind orientation and require a yaw motor to position the turbine into the wind. This adds an area of potential malfunction, but having demonstrated high reliability over years of operation it is now present on the vast majority of wind turbines of medium and large sizes. The AOC machine's passive free yaw downwind technology although perceived as a simple alternative to upwind active yawing, has several disadvantages:

- Turbulent winds can cause high yawing rates, and the machine can also become stuck in an upwind position only to be yanked violently into downwind position – both can potentially cause catastrophic bending moments in the rotor blades, bearings, shaft and even the tower.
- The droop cables on the turbine must be manually unwound, requiring additional scheduled maintenance.
- Fatigue due to a phenomenon known as "tower shadow", which occurs because the airflow around the tower is altered before it meets the swept area of the turbine. This fatigue is evidenced by a characteristic noise when the rotor's blades sweep past the tower.

In summary, we believe that active yaw technology using motorized yaw drives is a superior design. Fuhrlander, Norwin and the NW100 incorporate this design, and this approach is used exclusively on all larger machines. *(Note: The Vestas and GE machines are upwind, active yaw)*

Noise

Public opinion on noise output from a wind turbine is often quite subjective. However, noise test standards determining relative levels of noise emissions from a particular machine do exist and are regularly evaluated in the industry.



Turbine Decibel Level Comparison to Common Sounds

The basic contributors to noise are: 1) blade-tip –"whistle", 2) generator - "hum", and 3) rotor –"whoosh". All three of these can vary from machine to machine. In the case of the four machines evaluated, the AOC will be the "loudest" as it has tip brakes that can whistle, an exposed generator that will emit a hum in windy conditions, and as a downwind machine, will emit a tower induced pulse noise as the blades sweep by. The Fuhrlander and Norwin machines, which are of similar design to each other, will emit some blade tip noise as they have blade brakes, although different than the AOC tip brakes. Norwin and Fuhrlander will also emit some generator and gearbox noise although muffled as they have nacelles covering these components. The NW100 will be the quietest, as it has no blade or tip brakes to whistle, and its low speed generator is almost silent.

Warranty

Norwin and Northern Power Systems offer a two-year standard warranty. AOC and Fuhrlander offer only one-year coverage as standard. This is a significant difference, because a turbine manufacturer's ability to deliver, warranty, and support their product is a critical consideration in the current climate in the wind industry. Changes in the market, as well as fluctuations in incentive programs have put the financial viability of some manufacturers in question, and the small number of manufacturers offering medium size machines continues to put pressure on these smaller firms to be careful with warranty and service offerings. In addition, the liability and logistical difficulties that are necessary for supporting small numbers of machines in remote or distant areas can be difficult. With that said, the four manufacturers considered are standing solidly behind there product, and tend to be realistic about warranty costs and service requirements.

The Unalaska site is rough: it has high wind gusts, a very high annual average wind speed, icing conditions, is cold and has turbulent winds from the complex terrain. These site conditions will cause any turbine manufacturer to be concerned. Unalaska will want to ensure the warranty provisions are clear, and do not allow loopholes because of these conditions. Conversely, Unalaska should provide all available data to the manufacturers to assure that the manufacturer has prepared the turbine to withstand this site.

Service

While not researched in detail, a short section on service is included. As already discussed, there are few turbines of this size range to support a formal service entity in close proximity to the site. The large wind farms just now sprouting up in Oregon have a service staff, but typically are not trained on smaller machines. Norwin and Fuhrlander currently rely on factory personnel in Europe for major service, and/or training. AOC staff is based in Prince Edward Island, Canada. While Northern Power has service staff based at the NWTC in Boulder, Colorado and in Vermont, and will have trained technicians via an Alaskan utility.

All of the machines will require a factory trained service at least once a year, typically twice per year while under warranty. Training will typically be conducted during these periods, allowing the Unalaska Staff to become proficient and therefore able to perform regular checks, lubrication, and basic service.

Appendix G – Wind-Diesel Integration

Wind-Diesel Hybrid System Fundamentals

Introduction

Wind power can be a beneficial energy source for many communities. Remote villages and island communities that are isolated from a large electrical grid, typically depend solely on diesel generators for their electrical needs. These communities often pay a high price for power due to the cost of transporting fuel and maintaining small isolated power stations. The successful addition of wind power can reduce fuel and maintenance costs at these power stations, resulting in lower energy costs. In addition, wind-diesel hybrid systems produce a significant amount of excess energy, herein defined as a secondary load, which is typically converted into heat for productive use in the community. Finally, although wind-diesel hybrid systems are disconnected from a large electrical grid, these power systems are designed to maintain utility grade reliability and quality.

Successful wind-diesel hybrid system performance is related to several factors including:

- Site specific wind characteristics, including daily and seasonal variations
- Site wind speed turbulence intensity
- Electrical demand and its correlation with high wind speed
- The minimum operating power levels of the diesel generators

When designing a wind-diesel hybrid power system, a variety of options and system architectures are evaluated based on the factors outlined above and the operating features desired by the community. The size of the load, the practical size and number of wind turbines, the possible uses of the secondary load energy for heating or air conditioning purposes, and the amount of time that a system is desired to operate in a wind-only mode (with all diesels turned off), together define the hybrid system design. Below we present several different wind-diesel hybrid system architectures and explain some of their key components.

System Overview

The primary components of a wind-diesel hybrid power system include:

- Diesel generators
- One or more wind turbines
- A synchronous condenser or rotary converter and battery bank
- Secondary loads

- Engine and wind system controllers

We define wind-diesel systems as being either low penetration or high penetration based on the amount of installed wind capacity as compared to the average load from the community.

Modern wind turbines are available in a variety of sizes between 50 kW and 1500 kW for a wind-diesel system.

Low Penetration Hybrid Systems

In a conventional diesel power system the generator power level follows the demanded load. If more than one generator is on line, the load is shared in proportion to the rated power of each generator. The engine speed governor controls fuel to the engine to regulate it to its rated speed, and consequently the generator's frequency to 60 Hz. A balance of mechanical and electrical power occurs at the generator; as load demand and generator electrical load increases, the shaft mechanical torque increases, which tends to reduce shaft speed and generator frequency. The governor responds by increasing fuel to the engine to maintain speed and frequency, increasing mechanical power at the generator shaft to follow the demand of the electrical load. The engine, governor, actuator, and fuel distributor represent a stable closed loop control system to regulate frequency. Field experience has proven the stability of this control loop.

When a small amount of wind power is added to a system, the engine governors adjust to the reduced load; tolerating the small contribution provided by the fluctuating wind power. This mode of operation is acceptable until the installed turbine capacity exceeds 15% to 30% of the load demand. This operating scenario is defined as a low-penetration hybrid system.

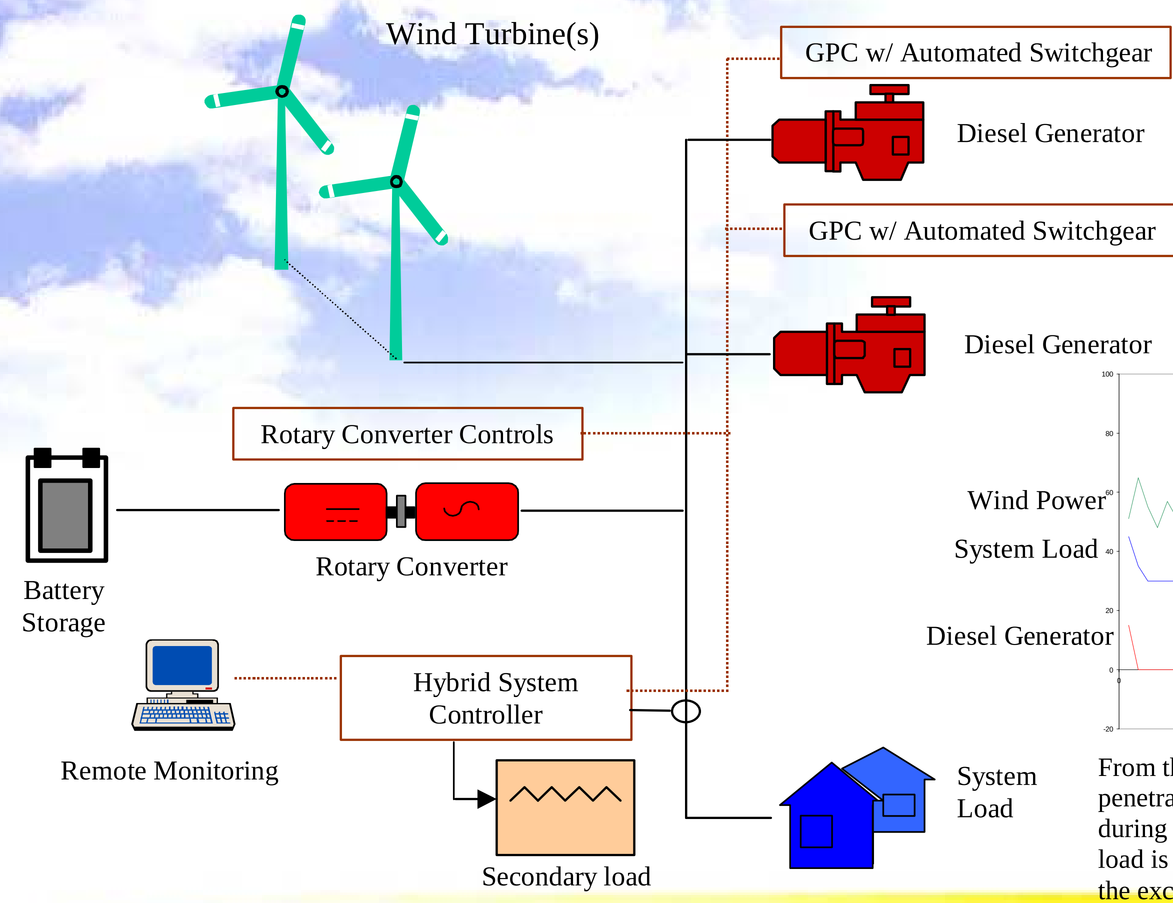
High-Penetration Hybrid Systems

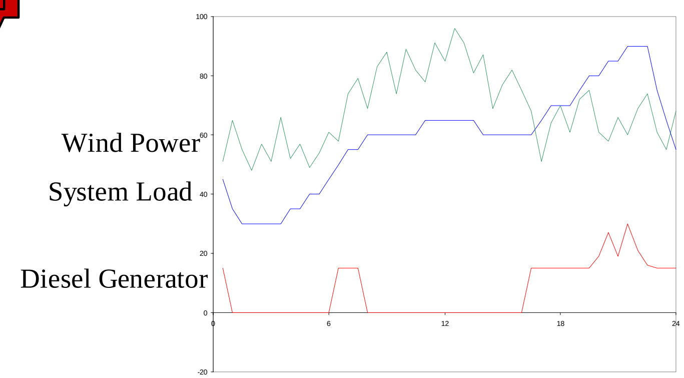
When the installed wind capacity exceeds 20% - 30% of the load demand, the uncontrolled wind power begins to play havoc with the engine governors and dispatch control. As installed wind capacity is increased, peak wind power could potentially exceed the load demand on occasion, causing the engines to be back-driven and the system to become unstable. This occurs because induction generator wind turbines contribute power according to the wind passing the rotors, irrespective of load demand. In addition, the variability of the wind often creates large power fluctuations over short time periods. Consequently, a wind-diesel system must increase or reduce diesel-generated power quickly to accommodate the wind power and keep frequency constant. Since the diesel can't absorb excess wind turbine power, frequency control requires the addition of an active load element, herein defined as a secondary load. This additional wind power influence, the active load element and a closed-loop control circuit complicate the system and provide opportunity for control loop interactions and unstable operation.

In a remote island power system, stability is power quality as defined by the constancy of voltage and frequency of the electric power produced. High penetration wind-diesel systems are inherently unstable and require active control to make them work at constant frequency. The challenge is the large uncontrolled power source presented by the induction wind turbine. To meet this challenge a synchronous condenser or rotary converter must be included in the hybrid configuration to provide reactive power (VAR) support for the induction (asynchronous) wind turbine generators. A sample 1-line pictogram of a high-penetration wind-diesel hybrid configuration is presented below.

A rotary converter combines the function of a synchronous condenser and a power converter, allowing power to be transferred to and from a DC and battery bank. The main advantage of incorporating a rotary converter in a hybrid system is that the margin required to operate in a wind-only mode is reduced. Without the battery storage provided by a rotary converter, the variability of wind and the consequent variability of power supplied by the wind turbine(s) will prevent the diesel generators from shutting down, often even during periods of high wind.

Sample High-Penetration Wind-Diesel Hybrid Architecture





From this graph we see that with a stable high-penetration architecture, the diesels can turn off during intervals with high wind. The Secondary load is called upon during those periods to "dump" the excess energy generated by the wind turbine.

Secondary and Optional Loads

As discussed above, high-penetration hybrid systems require some form of load element to accommodate the excess energy in the system during periods when wind generated electricity exceeds the load. The secondary load or “dump” load must always be on-line in the system to absorb any energy that is in excess of the system load at any time. For example, the dump load may heat water that can be used for space heating. Another way to accommodate excess energy in the system is with the addition of optional load air conditioners. Optional load heaters are different from the secondary or “dump” load in that they are located within the local grid, are thermostatically controlled, and consequently can be overridden when heating is not needed. Optional load heaters are only available for use when there is excess energy available in the system.

An optional load heater placed in a school or other public building can serve to reduce fuel costs during winter months during periods when wind energy exceeds the local load. If the wind power exceeded the load during such a period, the secondary water heater would be called upon to make up the difference between the load demand and the wind power output. Secondary load heaters in general must be placed near the power plant. The economics of wind-diesel hybrid power systems are often very favorable when a value is placed on this secondary load heat.

Modes of Operation

Most wind-diesel hybrid power systems have the ability to operate in three distinct modes:

- Diesel-only mode
- Wind-diesel mode
- Wind-only mode

Diesel-Only Mode

In the diesel-only mode of operation, the power system will function as a typical diesel generator providing the electrical load with the diesel generator controls providing the frequency and voltage regulation. The optional load unit heaters are recommended in order to maintain minimum operating levels (25 % of rated diesel power). At most locations appropriate for incorporating wind, operation in the diesel-only mode is infrequent.

Wind-Diesel Mode

In the wind-diesel mode, the wind turbine and the diesel operate in parallel. The electrical power from the wind turbine and the diesel generator are combined to provide power to the grid. Voltage and frequency regulation are provided by the diesel generator controls assisted by the system secondary load controller.

In this mode it is anticipated that there will be an abundance of heat energy provided to the optional heat load and secondary load. The amount of optional and/or secondary load will be equivalent to the instantaneous energy produced minus the electrical demand by the village. Essentially the secondary load provides the energy balance to maintain system frequency stability without unloading (or negatively loading) the diesel engine.

Wind-Only Mode

When there is sufficient wind energy for the wind turbine to carry the entire electrical load and provide an adequate margin to account for the variation in the wind speed and anticipated variations in village load, the diesel engine can be shut down. When the diesel is shut off, the synchronous condenser (or rotary converter) provides reactive power to the grid to maintain voltage stability. The secondary load controller communicates with the secondary heaters so that the system frequency does not deviate.

The amount of time that a system can operate in each mode will fluctuate and is based on:

- The average wind speed.
- The wind speed variation, measured as turbulence intensity and causing the turbines power output to vary.
- The average electrical load and the variation of that load.
- The allowable margin, defined as the amount of wind energy in excess of the load power required. An average - positive margin is required in a system to insure frequency stability. The average wind power must exceed the utility demand (during Wind Turbine Only mode) or the spinning components will slow down and the frequency of the system will drop.

One of the obvious goals of a wind-diesel hybrid system is to minimize the run-time of the diesel generators. This can occur when a sufficiently steady wind can allow the wind turbines to carry the primary loads. However, the reality of a wind-diesel hybrid power system is that often times there is sufficient wind to carry a system load, but the variability in the wind is such that the diesels are not allowed to completely turn off. During the design phase of a wind-diesel project, Northern conducts modeling activities whereby we specify a minimum diesel run-time to avoid scenarios where diesels are required to turn on and off in short time intervals. As a result, it is typical to conduct modeling scenarios where a system is sized so that wind provides over 90% of the energy demand, yet the variability in the wind keeps the diesel facility operating over 90% of the time as well. The uncontrolled nature of wind power simply does not allow for wind-only mode except during the rare wind events.

As a rule of thumb, the installed wind capacity needs to be over twice the average load if significant wind-only periods are desired. The incorporation of a rotary converter and battery bank will compensate for this variability and result in significant wind-only time.

Powerhouse Requirements and Layout

The addition of wind power into an existing diesel facility would require the integration of several hardware components and control cabinets inside a community's powerhouse. Space would be required for a synchronous condenser or rotary converter and their controllers, a battery bank, a wind-hybrid system controller, and the secondary load controller. The control cabinets will need to be located in an enclosed area preferably in close proximity to the engines, and synchronous condenser or rotary converter. In addition, the secondary load heater should be located as close to the powerhouse as possible to ensure a quick response between the chiller/heater and the secondary load controller. If there is no existing facility, then considerations will need to be made for a new powerhouse, switchgear and a diesel genset.

Overview of Costs

In general, wind-diesel hybrid power systems cost between US$1,600 - US$2,800 per installed kilowatt of wind capacity. Wind turbines in the 50kW - 250kW size range cost between US$1,800 - US$3000 per kilowatt. The engine(s), engine controls, secondary load heaters and the system integration make up the balance.

Appendix H – About Northern

As a technology-neutral Engineering, Procurement and Construction (EPC) contractor providing high reliability electric power systems for commercial and industrial customers, we are confident of being able to offer you the highest quality and value for this project.

Founded in 1974, Northern Power Systems has installed more than 800 systems in 45 countries on all seven continents. We have long-term experience in project management, from preliminary site assessment and economic modeling, through design and fabrication, to system installation, commissioning and personnel training. Northern has a long history of getting the job done on budget, on time, and within specifications. We have been a pioneer in matching appropriate turbine technology to specific project site conditions, and we regularly partner with the leading turbine manufacturers in the world including NEG Micon, Vestas, Fuhrlander and GE Wind among others. Our unparalleled track record in the renewable energy industry was underscored when former U.S. Assistant Secretary of Energy for Energy Efficiency and Renewable Energy, Dan Reicher, joined Northern Power Systems as Executive Vice President in 2001.

Northern's customers have included Bechtel, Cargill Dow, Chevron, Flour Daniel, PG&E, Hydro-Québec, the Woods Hole Research Center, AT&T, Newfoundland and Labrador Hydro, Johnson & Johnson, PEMEX, SC Johnson, SNC Lavalin, Suncor, Yukon Electric Corporation, various branches of the US Armed Forces, the National Renewable Energy Laboratory, and the National Science Foundation, as well as state and local governments.

Over the past 28 years, Northern has installed wind turbines throughout the world. The outstanding reliability of our wind projects is perhaps best highlighted by our turbines powering satellite communications at the South Pole, which have successfully operated for more than 15 years in winds up to 88.5 m/s (198 mph) and temperatures as low as -80º C. The range of our experience in the wind industry includes modeling and feasibility reports small and large wind farm projects, wind resource assessment and pre-development for commercial wind farms, wind turbine design and installation, including the HR3 (3.2kW), NW100 (100kW) and NW1.5 (1.5MW), the commercial integration of wind generators in remote hybrid isolated electric grids, and the development of power electronics for megawatt-scale variable speed, direct drive wind turbines.

Recent wind projects include:

- Feasibility Study for an 80 megawatt wind farm in Nebraska for Cargill Dow
- Installation of a Vestas V29 for the Tanadgusix Electric Corporation in St. Paul, Alaska
- Wind resource monitoring and predevelopment services for 60 MW wind farm in Vermont
- Installation of a NW 100 for the Kotzebue Electric Authority in Kotzebue, Alaska
- Feasibility study for a 250 kW expansion of a wind-diesel hybrid system for the US Navy on San Clemente Island, California
- Installation, long-term testing and analysis of two 600 kW wind turbines as part of the Advanced Research Turbine Program at the National Renewable Energy Lab in Boulder, Colorado
- Feasibility study of wind and other renewable energy sources for US Immigration and Naturalization Service border stations
- Assessment for installation of a 100kW wind turbine at the Woods Hole Research Center in Falmouth, Massachusetts
- Feasibility/Integration Study for American Electric Power (AEP)/e7 regarding a wind-diesel hybrid system in the Galapagos Islands
- Assessment for six 100kW wind turbines for the Alaska Village Electric Cooperative
- Wind resource assessment for Middlebury College for wind power at its Snow Bowl ski area

Northern's wide-ranging power industry experience beyond the wind energy sector also demonstrates relevant project management and technical capabilities. For example, in 2001, Northern completed an $18 million project for turnkey delivery of 113 power systems along a 1,000-mile oil pipeline running from the Caspian Sea to the Black Sea through Russia and Kazakhstan. For this project Northern met very stringent power reliability and quality assurance requirements of the prime contractor, Fluor Daniel, and the end customer, Chevron. This year, we commissioned a 1 MW combined heat and power system for an industrial customer in California, and we are completing installation of a 3.2 MW landfill gas-powered cogeneration project for SC Johnson in Wisconsin.

Northern adheres to a strict Quality Assurance process throughout all phases of each turnkey project. We have been reviewed and approved by multiple government and private sector clients and are widely recognized throughout the industry for the quality of the systems that we install and support. Northern's quality procedures conform to ISO-9001 guidelines.

FINAL REPORT
WIND ENERGY FEASIBILITY STUDY
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FOR THE
STATE OF ALASKA
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May 24, 1999
D&M Job No. 37203-013-218

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1.0 INTRODUCTION

Dames & Moore was retained by the State of Alaska, Department of Community and Regional Affairs, Division of Energy (DOE) to complete an evaluation of the feasibility of incorporating wind energy with the existing diesel power generation systems in Naknek and Unalaska, Alaska. The work completed as part of this project included collecting existing available data for these two communities regarding wind resources, climate, environmental factors, land use, and other issues which were considered pertinent in each community. Site visits were conducted to each community to gather information, consult with local utilities, and visit potential sites which were considered feasible for installation of a wind turbine generator (WTG) from a wind resource perspective and which would likely be acceptable to community members.

Upon completion of the data collection efforts and the site visits, this report was prepared to document the data collected, discuss the various sites considered in each community, and to evaluate the feasibility of installation of the turbines based on engineering constraints, wind resources, capital cost, and operational cost.

2.0 SITE VISIT RESULTS

Deborah Allen of Dames & Moore and Tom Zambrano of AeroVironment Inc., conducted the site visits to Naknek and Unalaska during the week of March 22, 1999. David Lockard of the DOE also attended the Unalaska site visit. The following paragraphs provide a summary description of each community, pertinent information regarding the local electric utility, and descriptions of each individual site considered for installation of a WTG.

2.1 NAKNEK SITE VISIT

The Naknek site visit was conducted on March 22 and 23, 1999. The work completed included meeting with Naknek Electric Association (NEA) personnel, including Donna Vukich, the NEA General Manager. Other key contacts include Arne Erickson of the Bristol Bay Borough, Susan Savage and Steve Hill of the US Fish and Wildlife Service (USFWS), and the National Weather Service (NWS) in King Salmon.

<u>Community Background Information</u>

Naknek is located on the north bank of the Naknek River near the northeastern end of Bristol Bay as shown on Figure 1. The economy of the community is based primarily on commercial and sport fishing and processing. The community is connected to nearby King Salmon by an approximately 12 mile long road. Naknek is accessible only by air and sea. Most larger commercial airlines operate out of the King Salmon airport, while local residents and small charter operations utilize the Naknek airstrip. Electrical service to King Salmon, Naknek, and South Naknek, which is located on the south side of the river near its mouth, is provided by Naknek Electric Association (NEA). All distribution lines are aerial.

History of Wind Energy in Naknek

The information presented in this paragraph was compiled based on discussions with NEA personnel and local residents and agency representatives. Several wind projects both private and public have been attempted in Naknek over the years with varying amounts of success. Many of the smaller, privately-owned and maintained installations are still in operation. All operating turbines are connected to the NEA distribution system, and excess energy not used by the generator is compensated with energy credits. One such unit is a 10 kW turbine which has been operating since the mid-1980s. The unit is located in the main residential area of town and is maintained by the homeowner (Einar Bakkar).

Two public wind projects were reported. One included the installation of two WTGs installed as part of the sewage lagoon project in the mid-1980s. There were problems with poor initial installation as well as operation and maintenance, and the project was generally considered a failure by most residents. One turbine was also installed approximately 10 years ago by the Borough. The turbine never worked properly, and the project was soon abandoned. The Borough turbine is still standing.

Electrical Utility

NEA is a member owned electrical cooperative which serves the Naknek, King Salmon, and South Naknek areas. The power plant is located near the community school and contains 9 diesel powered generators with a total generating capacity of 7,185 kilowatts (kW). One additional generator is scheduled to be on line this June, increasing the total capacity to 8,507 kW. The current total operating efficiency (1998 year) is 15.06 kilowatt-hours (kWh) per gallon of diesel fuel. The utility uses approximately 1.35 million gallons of fuel annually, with recent fuel prices of $0.66 per gallon in 1998 and $0.74 per gallon in 1997. The existing switchgear in the oldest section of the plant is being replaced to maximize capacity of the generating equipment.

Peak loads of 3.1 MW are experienced during the winter, with 5.2 MW peaks during the summer months. Average loads are in the range of 2.5 to 3 MW. The utility deregulated from the Alaska Public Utilities Commission (APUC) in 1982 and only holds a certificate of public convenience from the commission for their territory. The utility hopes to expand its facility to provide the ability to serve several of the canneries which operate during the summer red salmon commercial fishing season. Most of the canneries currently self-generate.

The rate structure per the current NEA tariff is as follows.

<u>Residential</u>	
Facility Charge	$15.00
First 1000 kWh	0.18
Over 1000 kWh	0.165
<u>Commercial – Single Phase</u>	
Facility Charge	$30.00
First 1000 kWh	0.18
Over 1000 kWh	0.165
<u>Commercial – Three Phase</u>	
Facility Charge	$60.00
First 1000 kWh	0.18
Over 1000 kWh	0.165
<u>Large Power – Year Round</u>	
Facility Charge	$100.00
All kWh	0.15
Demand per kWh	10.00
<u>Large Power – Seasonal</u>	
Facility Charge	$200.00
All kWh	0.135
Demand per kWh	12.00
<u>Wholesale</u>	
All kWh	$0.1363
Minimum bill	$15,000.00

New services along the Pike Lake and Rapids Camp extensions are required to pay a $3,000 non-refundable fee for connection.

The utility lost 1.5 MW in demand in 1995 with the deactivation of the US Air Force Sir Station at King Salmon. Since that time, they have increased the demand up to 1995 levels by adding new users and completing line extensions.

Long-term construction plans include:

Line extensions to Lake Camp

Line extension to Pederson Point

Possible future customers include canneries, the military, new fishing lodges located a reasonable distance from the existing distribution system, and new residential customers.

Land Status

The primary landowners in the Naknek area include the Bristol Bay Borough and the Pauq-vik Native Corporation. Although sites owned by both parties were considered during the site visit, the emphasis was placed on Borough lands to minimize capital and operation and maintenance costs for the project.

Sites Considered

The following paragraphs provide brief descriptions of each of the sites considered for installation of a wind turbine within the project area. The approximate location of each site is shown on Figures 2 and 3.

Site 1 – Sewage Lagoon Site: This site is located in Naknek on the bluff near the sewage lagoons at the western end of town. The land is owned by the Borough and the parcel is 112 acres in size. There are two large mounds which resulted from stockpiling of excavated materials during construction of the sewage lagoons approximately 15 years ago. These mounds are approximately 10 to 15 feet higher than the surrounding area and are generally vegetated with grass. The area surrounding the mounds is relatively flat, except for the steep bluff on the western edge of the site which extends to the beach at sea level below. Significant erosion of the bluff has occurred over the years. The soils in the project area are reported to consist of silt and silty sands, and it is believed that an isolated mass of permafrost is present at the site. Vegetation consists of typical tundra plants, with no brush or trees in the immediate vicinity. The wind is reported to blow fairly constantly at the site, and it is likely that some shearing effect is caused by the proximity of the site to the bluff and Bristol Bay waters. Single phase power distribution lines are located nearby and extend past the site for at least one mile, and 3-phase power is available approximately less than one mile from the site.

Site 2 – Pederson Point: This site is located approximately 3 miles north of Site 1 and is not accessible by road. The land at Pederson Point is owned by the Pederson Point cannery, whose land is surrounded by Pauq-vik land. A small private airstrip is located at the cannery site. Although we were unable to visit the site, the topography, vegetation, and soil conditions are reported to be similar to those at the lagoon site, except that the bluff is lower in elevation. Power distribution lines are located several miles from Pederson Point; however, extension of a road and power to the site are expected within five to ten years. The cannery at Pederson Point currently self-generates. Because of the site's inaccessibility and distance from the distribution system, this site is not considered feasible for installation of a WTG. However, the site may be suitable for a hybrid wind/fuel cell project.

Site 3 – KAKN Radio Station: Site 3 consists of the area surrounding the KAKN Radio station which is located approximately 2 miles from Naknek along the Naknek/King Salmon Highway. The land is owned by the Lutheran Mission. There are two large towers in the immediate area, one owned by the radio station and the other owned by Alaska Rural Communication System (ARCS). The ARCS tower is not currently in use and is scheduled for demolition sometime in the near future. The ARCS tower is estimated to be approximately 100 feet tall. The topography of the site is relatively flat with gently sloping hills in the surrounding area. This area has the highest elevation in the Naknek area. Soils conditions at the project site are unknown, but likely consist of silty sands and gravels similar to the soils observed in the cut banks of the Naknek River. The presence of permafrost is unlikely but may be found in isolated areas. Vegetation consists of typical tundra plants, with clusters of alders and willows. The distribution line between Naknek and King Salmon follows the highway, therefore, the site is very close to the distribution lines. However, installation of a WTG within close proximity to the radio tower would likely cause signal interference and other problems, and site is not considered feasible for further evaluation. The radio station collects and records daily maximum wind speed, and has been doing so since October.

Site 4 – King Salmon Area/Pike Lake: Site 4 consists of the entire King Salmon area. Several individual sites were visited, including the Pike Lake area. Reportedly, wind resources in the King Salmon area are usually approximately 10 to 20% less than in Naknek. Therefore, no site in the King Salmon area is considered feasible due to the inadequacy of the wind resource.

Site 5 – South Naknek: This site consists of the South Naknek area, which is located across the Naknek River from Naknek. Most of the land in the area is owned by the Pauq-vik native corporation. Several locations within this site were visited, including the area near the airport, a hill south of the airport, and other locations along the road and close to the power distribution system. There is a relatively high hill on which a shop is located which would be considered the best location for a WTG on the south side of the river. The topography of the South Naknek area is characterized by gently rolling hills with some lower, flatter areas. Soils conditions at the project site are unknown, but likely consist of silty sands and gravels similar to the soils in other areas. The presence of permafrost is unlikely but may be present in some isolated locations.

Vegetation consists of typical tundra plants, with clusters of alders and willows, and some small spruce, mostly near the river. The distribution line between Naknek and South Naknek follows the road in most of the areas visited, therefore, the site is very close to the distribution lines. Three phase power has not been extended beyond the main housing area in South Naknek, although single phase aerial lines extend a significant distance along the river to the southwest to serve sparse residential areas and some summer-only cabins. The South Naknek area is accessible only by plane or boat during the summer and by driving on the river ice during the winter. Conducting routine maintenance of a WTG in the South Naknek area would be more costly than for the other side of the river due to these access difficulties. Therefore, installation of a WTG in this area is not considered feasible.

Site 6 – Borough Landfill: This site is located at approximately Mile 3 of the Naknek/King Salmon Highway. The land on which the landfill is situated is owned by the Borough, and most surrounding lands are owned by the Pauq-vik corporation. The topography of the area is relatively flat with some low gently rolling hills in the surrounding area. The landfill site itself is a local high point. Based on observations of exposed soils in the surrounding area, the soil conditions at the project site likely consist of silty sands and gravels. Permafrost is unlikely. Vegetation consists of typical tundra plants, with sparse clusters of alders and willows. The distribution line between Naknek and King Salmon follows the highway, and the site is very close to the distribution lines. This site is considered feasible for installation of a WTG, however, the sustainable wind resources are reported to be lower than in other areas by local residents.

Site 7 – King Salmon Flats: This site consists of the low area along the Naknek/King Salmon Highway between approximately Mile 8 and 12. Most of the land in the area is owned by the Pauq-vik corporation with some land near the road owned by the Borough. The topography of the area is flat and consists of generally low-lying tundra. Soil conditions at the project site are unknown, but likely consist of soils similar to those found in the rest of the area. Based on the vegetation and topography, there is likely a relatively thick organic layer and permafrost may be present. Vegetation consists of typical tundra plants, with no brush or trees. The distribution line between Naknek and King Salmon follows the highway, and the site is very close to the distribution lines. The area is reportedly subject to significant snow drifting during the winter months. Because the area is generally low, available wind resources are probably lower than at some of the other sites considered.

Site 8 – Existing 10 kW Turbine Site: This site is located in a residential area in the main part of town. An existing 10 kW Jacobs turbine is installed on a tower and has been successfully operating for over 10 years. The turbine is maintained by the owner, Einar Bakkar. Although this site is not suitable for installation of a large turbine because the area is primarily residential, it may be cost effective to install a larger, more efficient turbine such as the AOC 15/50 kW on the existing tower to increase output. Nearby residents are accustomed to the turbine as well as to any noise produced.

2.2 UNALASKA SITE VISIT

The Unalaska site visit was conducted on March 24 - 26, 1999. The work completed included meeting with Unalaska Electric Utility (UEU) personnel, including Mike Golat, the UEU General Manager. Other key contacts include Karen Blue of UEU and Scott Diener, the Planning Director for the City of Unalaska. There are no USFWS or NWS offices in Unalaska.

Community Background Information

Unalaska is located on the southern portion of Iliuliuk Bay on Unalaska Island in the eastern Aleutian Islands as shown on Figure 1. The Dutch Harbor area is located on the eastern side of Amaknak Island. The two areas are connected by a bridge. The economy of the community is based primarily on commercial fishing and processing in addition to providing support for the Bering Sea and North Pacific fishing fleets. Unalaska is accessible only by air and sea. Several commercial airlines provide daily flights to Unalaska. Electrical service to the entire area is provided by UEU. All distribution lines are buried.

History of Wind Energy in Unalaska

According to local sources, two WTGs have been installed in the past in the Unalaska area. Both installations were located on exposed peaks, and high gusts damaged the tower or turbine at each location in a short time. There are currently no operating or non-operating turbines in the Unalaska area.

Electrical Utility

UEU is a member owned electrical cooperative which serves the Unalaska/Dutch Harbor area. The utility owns 9 diesel powered generators with a total generating capacity of 7,500 kW. Eight of the units are located in the power plant on Amaknak Island, and the ninth is located in a mobile van in Unalaska Valley on Unalaska Island. The Pyramid Valley Hydroelectric Project is scheduled to begin design this year, and should be operational in two years. The Pyramid Valley Project will increase the utility's capacity by 600 kW. The current total operating efficiency (1998 year) is 14.5 kWh per gallon of diesel fuel. The utility uses approximately 2 million gallons of fuel annually, with recent fuel prices of $0.67 per gallon in 1998 and $0.87 per gallon in 1997.

Peak loads of 5.5 to 6.0 MW are experienced routinely. With a current total capacity of 7.5 MW, there is not adequate capacity to add any large customers to the system. Average loads are in the range of 3.5 to 4.0 MW. The utility deregulated from the APUC in 1982 and holds a certificate of public convenience from the commission for their territory. The utility hopes to expand its facility to provide the ability to serve several of the canneries and other industrial users which operate during commercial fishing activities. All of the canneries and many industrial users currently self-generate.

The rate structure per the current UEU tariff is as follows.

Residential

Customer Charge	$7.50 per meter per month
Energy Charge	0.20 per kWh

Small General Services (non-residential with 20 kW demand or less, does not require demand metering.

Customer Charge	$10.00 per meter per month
Energy Charge	0.21 per kWh

Large General Services (all services with demands from 20 to 100 kW for a minimum of 6 months per City fiscal year.)

Customer Charge	$50.00 per meter per month
Demand Charge	6.70 per kW
Energy Charge	0.175 per kWh

Industrial Service (demands exceeding 100 kW for a minimum of 6 months per City fiscal year.)

Customer Charge	$100.00 per meter per month
Demand Charge	7.70 per kW
Energy Charge	0.1275 per kWh

Long-term construction plans include:

Pyramid Creek Hydroelectric Project

Possible future customers include canneries, current industrial users not on City power, and new residential customers.

Land Status

The primary landowners in the Unalaska area include the City of Unalaska and the Ounalashka Corporation. Although sites owned by both parties were considered during the site visit, the emphasis was placed on City lands to minimize capital and operation and maintenance costs for the project and avoid land lease costs.

Sites Considered

The following paragraphs provide brief descriptions of each of the sites within the project area which were considered for installation of a WTG. The approximate location of each site is shown on Figures 4 and 5. Due to heavy snow pack at the time of the site visit, the types of vegetation present at any of the sites could not be determined.

Site 1 – City Landfill: This site is located on the eastern side of Iliuliuk Bay at the City landfill. The site is located on a flat area at the base of a steep mountainside. The landfill cells are located on the east side of the access road. The landfill is currently in the process of being expanded. A baler facility was constructed at the southern end of the site several years ago. The land is leased from the Ounalashka Corporation. Although site specific geotechnical data was not obtained, it is expected that the soils in the project area likely consist of gravel and sand with bedrock at a relatively shallow depth. The wind is reported to blow fairly constantly at the site. Three phase power distribution lines extend to the bailer facility. Hundreds of bald eagles and ravens were observed scavenging at the landfill during the site visit. The baler facility was recently constructed to reduce the bird population at the landfill site.

Site 2 – Haystack Hill: This site is located on a low hill with a maximum elevation of approximately 375 feet msl. Several communications towers and a small building are also located on the hilltop. An access road leads to the site, and three phase power is also available. Several residences are also located on the hill. Most of the land on Haystack Hill is owned by the Ounalashka Corporation; however, two lots on the southwest side of the hill are owned by the City. Site specific soils information was not located, but it is likely that bedrock is located at a relatively shallow depth. Because of the elevation and exposure at the site, the wind is reported to blow constantly at the site, with extreme high gusts. The proximity of the site to residences and the presence of the communications towers may present a problem. This site is considered feasible for installation of a WTG; however, relocation of the communications towers would be required.

Site 3 – Mount Ballyhoo Above Airport: This site is located on the side of Mount Ballyhoo above the Unalaska airport. No access road leads to the site, and three phase power is not available nearby. Most of the land on Mt. Ballyhoo is owned by the Ounalashka Corporation. Because of the proximity of the site to the airport and the distance from power lines, the site is not considered feasible for installation of a WTG.

Site 4 – Top of Mount Ballyhoo: This site is located on the top of Mount Ballyhoo. No access road leads to the site, and three phase power is not available nearby. Most of the land on Mt. Ballyhoo is owned by the Ounalashka Corporation. This site is not considered feasible for installation of a WTG for similar reasons to Site 3.

Site 5 – Strawberry Hill – Old Water Tower Site: This site is located on a low hill on the west site of Iliuliuk Bay with a maximum elevation of approximately 120 feet msl. An access road is present on the hill; however, it is not maintained during the winter months. Three phase power is not available nearby. Most of the land on Strawberry Hill is owned by the Ounalashka Corporation. Site specific soils information was not identified, but it is likely that bedrock is located at a relatively shallow depth. This site is not considered feasible due to the distance from existing infrastructure.

Site 6 – Bunker Hill: This site is located on Bunker Hill which is located on the southern side of Airport Beach Road and the western side of Captains Bay. An access road leads up the hillside, but is not maintained during the winter months, and three phase power is not available nearby. Most of the land on Bunker Hill is owned by the Ounalashka Corporation. This site is not considered feasible for installation of a WTG for similar reasons to Site 3.

Site 7 – Spit: This site is located on the low spit which extends from the northern end of Amaknak Island to the southwest approximately two miles. The spit separates Dutch Harbor on the west from Iliuliuk Bay on the east. Power and an access road are available to the end of the spit where the U.S. Coast Guard is reportedly installing navigational aids. The land on the spit is owned by the Ounalashka Corporation. Although site specific soil data was not obtained, the soils likely consists of typical sand and gravel beach deposits. It has also been reported that a midden is located on the spit approximately midway along its length.

Site 8 – Wastewater Treatment Plant: This site is located at the site of the existing City wastewater treatment plant. The plant is located along Airport Beach Road north of Bunker Hill. The plant site is relatively flat; however a sheer 30-40 foot cliff is located behind the building. Installation of WTGs at the top of the cliff may be feasible; however, an access road would need to be constructed. Three phase power is available at the plant. The plant site itself and some of the land above the cliff behind the plant is owned by the City, and all surrounding lands are owned by the Ounalashka Corporation. Site specific soil information was not identified, but it is likely that bedrock is located at a relatively shallow depth based on observations at the site.

Site 9 – Pyramid Valley: This site is located at Pyramid Valley near the proposed location of the new hydroelectric plant. Due to the heavy snowfall at the time of the site visit, the road to the area had not been plowed and the field team was unable to visit the site. Wind monitoring was completed for one year during the initial studies for the design of the hydro-plant resulting in a mean annual wind speed of 5.2 m/s (11.6 mph) with a 20-foot tower height. All land in the area is owned by the Ounalashka Corporation except for a 200 foot corridor along Icy Creek (for the water treatment plant) and two privately owned lots within Pyramid Valley and extending to Captain's Bay.

2.3 PREFERRED SITES

Based on the results of the data collection and site visit tasks, the following sites in each community were selected for further consideration and feasibility analysis.

Naknek

In Naknek, Site 1 – Sewage Lagoon (Figure 6) is considered the best location for consideration of installation of a WTG. The site already has an industrial use and is owned by the Borough. Based on previous wind monitoring data in the Naknek area, the wind resources are considered feasible for installation of a WTG, although site specific wind monitoring data will be required. The sewage lagoon site is reported to be one of the windiest areas in the community and likely has the best chance of having adequate wind resources to make wind energy feasible in Naknek.

Unalaska

Several sites are considered feasible for installation of a WTG in the Unalaska area. The preferred site in Unalaska, based solely on land use and ownership and available wind resources, is Site 1 – City Landfill (Figure 7). As with Naknek, the site has industrial use and is leased by the City. The lease is fairly specific as to use as a landfill, and coordination with the Ounalashka Corporation will be required to allow installation of a WTG. The wind resources in Unalaska are greater than that in Naknek, therefore, this factor is not as key to preferred site selection. Actually, some sites in Unalaska may be excluded due to turbulence and high wind gusts. For this reason, sites closest to the water would be preferable over inland or upland sites. The landfill site has open water in the predominant wind direction and is not expected to experience excessive turbulence.

Alternative sites that are acceptable from a wind resource perspective include Haystack Hill (Site 2), the spit (Site 7), the wastewater treatment plant (Site 8), and Pyramid Valley (Site 9). However, Haystack Hill would require relocating the existing communications towers, resulting in significantly higher capital costs. The Ounalashka Corporation was contacted regarding the spit site. It is generally believed that the potential cultural value of the midden site and the visual impact of a wind turbine in this exposed area eliminates the spit from consideration.

3.0 WIND RESOURCES

3.1 GENERAL INFORMATION

The general background wind feasibility information presented in this section was primarily gathered from the Danish Wind Turbine Manufacturers Association web site (www.windpower.dk) which contains general information and typical calculations for determining the feasibility of wind energy, and the National Renewable Energy Laboratory web site (rredc.nrel.gov) which contains wind resource data for areas throughout the country. According to the data available, wind power density in the Naknek Area is Class 4 and in the Unalaska area is Class 7. According to the NREL site, Class 3 areas or greater are generally suitable for most WTG applications. A summary of the estimated wind power density and wind speed for the various wind power classes is presented on Table 1.

TABLE 1[1]

CLASSES OF WIND POWER DENSITY AT 10m AND 50m[2]

Wind Power Class[4]	10 m (33 ft)		50 m (164 ft)	
	Wind Power Density (W/m^2)	Speed[3] m/s (mph)	Wind Power Density (W/m^2)	Speed[3] m/s (mph)
1	0	0	0	0
2	100	4.4 (9.8)	200	5.6 (12.5)
3	150	5.1 (11.5)	300	6.4 (14.3)
4	200	5.6 (12.5)	400	7.0 (15.7)
5	250	6.0 (13.4)	500	7.5 (16.8)
6	300	6.4 (14.3)	600	8.0 (17.9)
	400	7.0 (15.7)	800	8.8 (19.7)
7	1000	9.4 (21.1)	2000	11.9 (26.6)

Notes:
1. Table from rredc.nrel.gov web site. Product of Pacific Northwest National Laboratory, operated for the US Department of Energy by Battelle Memorial Institute.
2. Vertical extrapolation of wind speed based on the 1/7 power law.
3. Mean wind speed is based on Rayleigh speed distribution of equivalent mean wind power density. Wind speed is for standard sea level conditions. To maintain the same power density, speed decreases 3% per 1000 m (5% per 1000 feet) elevation.

4. Each power wind class should span two power densities. For example, Wind Power Class 3 represents the Wind Power Density range between 150 W/m^2 and 200 W/m^2. The offset cells in the first column attempt to illustrate this concept.

General

The feasibility of installing a WTG at any given location is primarily dependent upon the available wind resources at the site. The potential energy content of the wind varies as the cube of the wind speed, meaning that if the wind speed is twice as high in one location as another it contains eight times as much energy. Therefore, it is important to identify the site within each community which has the highest potential wind resources. There are several factors which affect available wind resources and which should be considered in site selection:

Roughness: Roughness of the wind is governed by the topography of the surrounding area as well as obstructions to the wind such as buildings or other structures. Since water is very smooth, selection of a site nearest the water will minimize roughness.

Wind Shear: The wind is usually at a lower speed at the ground surface than above the ground. The wind speed may be significantly lower on the turbine rotor in the bottom position than in the top position.

Wind Speed Variability: Wind is generally higher during the daytime because temperature differences between land and sea are greater during the day. Since power usage is generally higher during the day, wind power can effectively be used to assist utilities in meeting peak loads.

Turbulence: Areas with high roughness are often subject to turbulence, which includes irregular wind flows. High turbulence increases operation and maintenance costs and causes excess wear on the turbine and rotor. Towers should be high enough to minimize the effect of turbulence. Obstacles near the turbine often cause localized turbulence.

Wind Obstacles: Obstacles such as trees and buildings decrease the downwind speed and can also cause turbulence in the surrounding area. Obstacles within approximately 1 kilometer of the turbine in the primary wind direction should be taken into account when calculating available wind power.

Wake Effect: With any WTG, there will be a wake of very turbulent air behind the turbine for some distance. This is particularly important to consider if more than one turbine is being installed, because operation of upstream turbines can affect the production of the downstream turbines.

Tunnel Effect: This effect happens when the wind speed is increased due to compression into a smaller area such as a canyon or steep valley. Depending upon the configuration of the "tunnel", wind speed can easily be increased by as much as 30 to 50% due to the tunnel effect. Taking advantage of the tunnel effect may also result in an increase in turbulence.

Hill Effect: This effect is similar to the tunnel effect except that the wind becomes compressed on the windward side of the hill rather than in a canyon.

During selection and evaluation of the various sites in each community, the factors above were considered. Sites were selected to minimize obstructions in the project area and to take advantage of the various effects listed above. For example, there are two small hills at the sewage lagoon site in Naknek. Placing a turbine on one of these hills will take advantage of the hill effect. Additionally, roughness and turbulence should be low since the site is adjacent to the Bristol Bay.

3.2 SITE SPECIFIC WIND DATA

Various agencies were contacted regarding the availability of wind monitoring data in each community. The following paragraphs provide a summary of the data collected and reviewed and copies of pertinent information are included in Appendix A. Please note that none of this data was collected at the proposed sites under consideration in this study. Site specific monitoring data for the preferred sites should be collected prior to proceeding with the design and construction of a WTG.

Naknek: Several sources of wind monitoring data were identified in the Naknek and King Salmon area. The NWS has been collecting wind data at the King Salmon airport for many years at an anemometer height of 11.6 m. During the site visit, data for monthly average wind speeds at the airport were collected for the past year. Based on this data, the average annual wind speed at the King Salmon airport is 10.7 mph (4.8 m/s). It is estimated that the average wind speed in King Salmon is approximately 20 % less than in Naknek, resulting in an average wind speed of approximately 13 mph (5.8 m/s) for Naknek. The KAKN radio station in Naknek has been recording maximum daily wind speed since October 1998. The anemometer is located approximately 1 m above the roof of the building, for a total anemometer height of approximately 5 m. The radio station indicates an average maximum daily wind speed of approximately 23.7 mph (10.6 m/s) over a six-month monitoring period. Over the identical six-month period, King Salmon W.S.O. also monitored for maximum wind speed. Results indicate that the average maximum daily wind speed in King Salmon is 17.6 mph (7.9 m/s) which is 26 % less than Naknek.

AeroVironment, Inc. conducted a wind monitoring program in Naknek in 1981 and 1982 under contract to the US Department of Energy and the Alaska Power Administration. Monitoring was completed at three sites including 1) an area referred to as "Naknek Hill" which is located on a hill south of the airport, 2) south of the sewage lagoon site near the west end of town, and 3) near the cemetery which is located several miles east of town along the Naknek-King Salmon Highway. Monitoring at Naknek Hill was completed for over one year, and monitoring at the west end of town was completed for nearly one year. Monitoring at the cemetery site was discontinued after a few months because of generally low wind speed readings. Anemometer height in all cases was 10 m. The results of the monitoring indicated that the average annual windspeed in the Naknek area is 13.7 mph. Since this monitoring data was obtained at a height of 10m, it can be reasonably assumed that the wind speed at greater heights will be somewhat higher.

Considering these available sources of wind information, it is reasonable to assume that the average annual wind speed for the Naknek area is approximately 14.0 mph (6.25 m/s). Potential power output calculations were prepared based on this value.

Unalaska: Very little data was available regarding average annual wind speed in the Unalaska area. The Steiger's Corporation collected data as part of the permitting effort for the Pyramid Valley Hydroelectric Project from July 1995 through June 1996. The anemometer was located at an elevation of 517 feet (158 m) with a tower height of 20 feet (6.1 m). As part of this same effort, data was collected near Rocky Point at an elevation of 100 feet (30m) with a tower height of 30 feet (9 m). The two monitoring efforts resulted in an average annual wind speed of 11.6 mph (5.2 m/s) at Pyramid valley and 12.8 mph (5.7 m/s) at Rocky Point. Considering that the Unalaska area is located within an area reported to have Class 7 wind power density, these results are lower than expected and likely represent data from a somewhat sheltered area. The State of Alaska community profile for Unalaska indicates the mean annual wind speed is 17 mph (7.6 m/s), however, this data was reported by DCRA to possibly be an incorrect conversion from nautical to statute miles. According to the Wind Energy Resource Atlas of the United States, the average annual wind speed for Cold Bay, which is along the Aleutians approximately 180 miles northeast of Unalaska, is 7.5 m/s. Because of the lack of reliable wind monitoring data in Unalaska, the power output calculations for the various turbines presented in the remainder of this section have been prepared for a range of wind speeds. Actual output and optimum turbine selection should be based on monitoring obtained at the preferred site.

3.3 ESTIMATED POWER OUTPUT

Factors Considered

There are several factors which must be considered when estimating the available power at a site. A discussion of some of the key considerations in estimating power output is presented below.

Wind Variability: One of the most important factors is the variability of the wind speed. Wind variation along the Aleutian Islands typically follows a Weibull Distribution (NREL) represented by a graph with wind speed on the x-axis and frequency on the y-axis. The shape of this distribution provides a more accurate estimate of the power available from a particular turbine than simply estimating available power using the mean annual wind speed. The shape of the curve is characterized by a “shape parameter”. If the shape parameter is exactly 2, it is referred to as a Rayleigh distribution which is used by many turbine manufacturer’s to provide standard performance values for their WTGs. Figure 8 presents the annual wind distribution for Naknek, and was prepared using average daily wind speeds resulting from the 1981/1982 wind monitoring data performed by AeroVironment, Inc. This distribution generally corresponds to a shape parameter of 2, which indicates the wind speed is more commonly close to the mean than at significantly higher or lower values. Due to the lack of availability of daily or hourly wind data in Unalaska, and the variation in mean annual wind speed as determined from the various sources, we were unable to obtain a realistic wind distribution for the community. For purposes of estimating theoretical power output for the various turbines, output for a range of wind speeds was calculated using a shape parameter of 1.5. This factor was selected because it is anticipated that wind speeds are more commonly above the mean in Unalaska than in Naknek.

Power Density: Since the power of the wind varies with the cube of the wind speed, a significantly higher amount of power is generated during the times the wind speed is higher than the mean. The distribution of energy at different wind speeds is referred to as the power density. It is not possible to accurately estimate the potential wind power available based solely on the average annual wind speed. Site specific monitoring data is required to complete an accurate analysis.

Temperature and Pressure: Since the air is denser at lower temperatures, more power is generated by turbines in cold climates than in warm climates. Correcting the density from 58 ^{o}F to 0 ^{o}F can result in up to a 13% increase in power. Most standard WTG power curves are prepared for standard temperature and pressure (20 ^{o}C and 1 atm) and therefore must be corrected for the actual site temperature.

Loss Factors: There are several factors which are generally accepted to reduce the actual power production from the theoretical value. Several of these factors include the following.

1. **Availability:** It is important to consider availability of the wind power to the grid. In general, in can be assumed that the turbine is 97% efficient, which represents only a 3% loss of power.

2. **Transmission System Losses:** These losses are generally several percent of the total and consist of the transmission line losses. These losses increase with the distance of the turbine from the distribution point.

3. **Soiling of Blades:** Soiling of blades includes dirt, insects, and other deposits on the blades such as ice. This is generally a loss of a few percent, but can be much higher depending upon specific site conditions.

4. **Control System Losses:** These losses are generally 1 to 3% of the total and include losses related to the reaction time of the turbine during cut in/cut out, reacting to a change in wind direction, or controlled power output reduction due to cold weather.

5. **Turbulence Losses:** These losses vary greatly depending upon the site and turbulence experienced. Standard turbine power curves are based on areas with low turbulence density.

6. **Interference Losses:** Interference losses are generally a few percent and are the result of interference from a variety of sources including the wake effect, roughness, and obstacles.

Considering all of these potential losses which reduce the theoretical output of a turbine, a 25% reduction has been used in this study.

Turbines Analyzed

Wind turbine generators can be described according to the following controls used to optimize wind energy production.

- variable speed,
- variable pitch,
- stall-regulated, or
- various combinations of the previous.

To provide a representative range of turbine sizes for inclusion in this study, power output for six turbines ranging from 50 kW to 750 kW was estimated. The turbines selected for evaluation were chosen based upon the following criteria.

- Manufactured in the United States,
- Ability to perform in cold regions, and
- Size.

Turbines from several manufacturers with varying output and characteristics were selected for further evaluation based on the criteria above. Brief descriptions of each turbine considered are presented below. Selected manufacturer's data for the various turbines is included in Appendix B, and power curves for each turbine used for power output analysis are presented on Figure 9.

Zond Z-50 750 kW: Zond Energy Systems (Zond), subsidiary of Enron Wind Development Corporation (EWDC) developed the Z-50 based on the previously successful Z-40 550 kW (See next section) and on experience gained through the installation and operation of over 2500 wind turbines installed in the USA since 1981. The Z-50 has obtained necessary field verification and is currently available on the market.

The Z-50 is a variable speed, variable pitch wind turbine and can be equipped with a cold weather package that allows operation down to -40º C (-40º F). The cold weather package includes a gearbox heater, generator winding heater, heated anemometer, heated yaw vane, cold weather software, and lower temperature rated parts such as lubricants, steel tower, cables and hydrophobic coating on fiberglass rotor blades [fluorourethane-silicone gel (StaClean®)]. The Z-50 controller software reduces power output to 225 kW (speed variation) when the ambient air temperature drops to -20º C (-4 º F) and shuts down at -40º C (-40º F). The three Z-50 blades result in a rotor diameter of 50 m and a hub height of 53.5-m (175-ft). The rotor is equipped with redundant safety features, an air brake and a fail-safe mechanical brake system.

Zond Z-40 550 kW: The Z-40, predecessor to the Z-50, is a constant speed, variable pitch WTG with the same cold weather package and safety features. The Z-40 has three blades that result in a rotor diameter of 40 m and are mounted on a 40-m high (130 ft) tubular tower. One difference between the Z-40 and the Z-50 is in the weight, 132 and 217 kips, respectively. This could be a cost advantage during shipping and installation. Although a Z-40 has recently been installed in the Yukon Territory, the Z-40 is currently off production. Zond indicates that production could be re-initiated if the market exists.

NEG Micon M750 400/100kW and M700 225/40 kW: NEG Micon is a Danish company that recently expanded to the USA and Canada. NEG Micon is expected to be established as a USA manufacturer for turbines ranging from 600 to 900 kW by the summer of 1999. Currently, both the M750 and the M700 series are considered Danish products and are planned to be taken out of production in 2000. The purpose of including the 400 kW and 225 kW WTGs is to provide a full range of turbine sizes for evaluation. No USA manufactured turbines of this size class are available and those manufactured elsewhere are being discontinued. For this reason, the only relevant equipment information results from the power curves provided in Figure 9 and the rotor diameter and the hub height. The M700 has a rotor diameter of 29.8-m (97.8 ft) at a height of 36 m (97.8 ft), whereas the M750 is 31 m (101.7 ft) in diameter and 36 m high. The dual ratings (400/100kW and 225/40kW) are provided since the units reduce output in extreme cold weather.

NPS Northwind 100: Northern Power Systems (NPS), formerly Northwind Power Company, has been operating in the USA since 1974. NPS has considerable experience with cold region WTG installations. Building upon experience gained during development of a WTG for the harsh climate at the South Pole, NPS designed the Northwind 100 for subarctic and arctic climates and for incorporation in primarily diesel power generation systems. As part of the Wind Turbine Verification Program, Northwind controllers and cold weather package along with a Vestas 225 kW turbine are being incorporated into a high penetration diesel hybrid system for the Tanadgusix Corporation in St. Paul, Alaska. A Northwind 100 is scheduled for installation and testing in Kotzebue, Alaska in 1999, with the first commercial installation scheduled for the year 2000.

The NPS Northwind is a variable speed WTG with a direct drive that does not have a gearbox. The hub height is 24 m and the 16.6 m diameter rotor consists of three blades. The unit does not have blade pitch control, tip brakes, or tip flaps. The brakes are mechanical and electrical. The WTG is rated to -45º C (-50º F) and the simple blade design is intended to minimize problems associated with icing. The Northwind 100 was designed simply and durably specifically for cold regions, small villages, and diesel hybrid applications.

AOC 15/50 kW: The Atlantic Orient Corporation (AOC) 15/50 kW WTG has been extensively tested in numerous cold region locations such as central Russian Siberia, Northwest Territory and Northern Ontario in Canada, Vermont, New Hampshire, Maine, and Kotzebue, Alaska. The Kotzebue site, managed by Brad Reeve of Kotzebue Electric Association, is being used to evaluate for the Wind Turbine Verification Program. Mr. Reeve provided cost information from Kotzebue for 1998 that provided a check on the costing methods and assumptions used in this analysis. A summary of the verification test at the Kotzebue site will be published later this year. Although the AOC 15/50 is included in this feasibility study, details will be limited and the reader is encouraged to review the Kotzebue report when it becomes available.

Power Output Calculations

The power output for the various turbines was estimated using the "Wind Turbine Power Calculator" provided at the Danish Wind Turbine Manufacturers Association web site (www.windpower.dk). A model based on the 1981/1982 wind data for Naknek was prepared by AOC and was used as a check for the validity of the rough calculations obtained from the web site. More accurate calculations should be completed once site specific wind monitoring data is obtained.

Table 2 presents a summary of the estimated annual power output for Naknek and Unalaska. Appendix C includes more detailed tables for each community with the input parameters which were used to calculate the theoretical output at each site. For estimating purposes, mean annual wind speeds of 14 mph (6.25 m/s) and 15 mph (6.7 m/s) were used to generate the data presented in Table 2. Since the actual wind speed in Unalaska may be higher or lower than the assumed 15 mph at a given site, power output was calculated for a range of speeds. Figure 10 presents the power output for the six turbines considered at wind speeds ranging from 6 to 12 m/s.

TABLE 2

ESTIMATED POWER OUTPUT

NAKNEK					
Turbine	Rated capacity (kW)	Theoretical Maximum Output (kWh/yr)(1)	Gross Energy Output (kWh/yr)(2)	Net Energy Output (kWh/yr)(3)	Net Capacity Factor (%)
Z50	750	6,574,500	2,908,828	2,181,621	33.2%
Z40	550	4,821,300	1,779,556	1,334,667	27.7%
NEG M750	400	3,506,400	1,177,700	883,275	25.2%
NEG M700	225	1,972,350	776,475	582,356	29.5%
NPS 100	100	876,600	288,015	216,011	24.6%
AOC 15/50	50	438,300	206,028	154,521(4)	35.3%
UNALASKA					
Turbine	Rated capacity (kW)	Theoretical Maximum Output (kWh/yr)(1)	Gross Energy Output (kWh/yr)(2)	Net Energy Output (kWh/yr)(3)	Net Capacity Factor (%)
Z50	750	6,574,500	2,943,252	2,207,439	33.6%
Z40	550	4,821,300	1,905,713	1,429,284	29.6%
NEG M750	400	3,506,400	1,263,712	947,784	27.0%
NEG M700	225	1,972,350	794,817	596,112	30.2%
NPS 100	100	876,600	326,417	244,812	27.9%
AOC 15/50	50	438,300	212,224	159,168	36.3%

Notes: (1) Assumes turbine operates at rated capacity for an entire year.
(2) Output calculated based on mean wind speed and site characteristics.
(3) Includes 25% loss factor.
(4) Estimated power output from the AOC model based on hourly data is 163,506 kWh/yr

4.0 ENGINEERING CONSIDERATIONS

This section provides a summary of engineering considerations such as foundations, cold weather operations of wind turbines, and potential impacts to the power grid.

Foundations

Geotechnical conditions at the sewage lagoon site in Naknek consist of silts and silty sands based on observations of the exposed bluff which extends to the beach at the mouth of the Naknek River. Area residents report that permafrost has been encountered in the area at a relatively shallow depth. The two spoil piles which were placed at the site during construction of the lagoons likely consist of uncompacted silts and silty sands and will not provide adequate strength for a concrete foundation. Because of these soil conditions, the most likely suitable foundation for this site consists of a pile system. The most cost effective system will probably consist of a minimum of three piles installed to a suitable depth based on soil conditions (60 to 80 feet). The actual pile foundation design will depend upon the soil properties encountered during a geotechnical investigation. NEA reports drill rigs are available in Naknek for completion of drilling at the proposed site.

Soil conditions in Unalaska most likely consist of a layer of organic and mineral soils underlain by bedrock at a relatively shallow depth. Depending upon the conditions present at the precise site selected for installation of a turbine, these soil conditions are suitable for a concrete foundation anchored to the bedrock.

Cold Weather Considerations

All of the turbines selected for analysis in this study included cold weather designs and have been installed at other cold region locations. The Zond turbines have an optional cold weather package available which has been included in the estimated capital costs in this study. These cold weather packages include construction materials rated to lower temperatures than those for standard installations, and the addition of heaters to control equipment, gearbox, and hydraulic systems. Software specifically designed for cold weather operations is also included. Special coatings are used on the rotor blades to limit or eliminate ice build-up. For example, the Zond units incorporate a hydrophobic flourourethane/silicone substance marketed as “StaClean”. Cold weather rotor blades are specified as black to facilitate shedding of ice when the blades are exposed to sunlight. Under severe icing conditions, it may be necessary to manually shut down the turbine.

The NPS 100 uses durable and simple mechanical systems with cold weather material specifications to counter harsh climatic conditions. The NPS 100 employs a direct, variable speed drive and has no gearbox. Lubrication specifications are important because there are no heaters. Integration into the electrical grid requires an electronic conversion package. The AOC 15/50 is also appropriate for cold region installations. These components include a transmission and enclosure heater, low temperature lubrication, and stearns brake heater. More specifics may be obtained by reading the verification report to be published by KEA.

Impacts to the Existing Grid and Generation System

There are several factors which can affect the existing grid and generation system when a wind turbine is installed. Usually, power quality is of most importance to electrical utilities and their customers. Power quality refers to the stability of the voltage and frequency and the absence of flicker and other anomalies which may cause brown-outs or damage the grid. Brown-outs and other items which affect power quality can be caused if the WTG is immediately connected or disconnected from the grid. Modern turbines are "soft-starting" which allows the current to enter the grid gradually, similar to the effect a dimmer switch has on an incandescent light fixture. This prevents large power surges and resulting power quality degradation.

Based on the size of turbines considered in this analysis, and on the average daily loading of both NEA and UEU, the wind turbine installation would be considered "low penetration" which is generally defined as less than 15 to 20% of the total load. Controls on modern wind turbines are designed to control power quality by monitoring the performance of the wind turbine, and by monitoring the voltage and frequency of the grid. The control systems can disconnect the turbine from the grid when conditions are not ideal.

Higher penetration systems (>20%) require much more sophisticated and costly control systems to monitor and control power quality.

Construction Considerations

Preliminary research indicates that adequate construction equipment is available for installation of all turbines in each community, except for the Zond Z-40 and Z-50 which will require mobilization of one and two large cranes, respectively. Existing cranes in Naknek and Unalaska are capable of driving the piles, and would only require mobilization of a pile driver if none is available at the time of construction. In both communities, adequate heavy equipment is available to construct the anticipated foundation as described above, and mobilization of the larger cranes will be required only for the erection of the turbine itself. Concrete batch plants and fill materials are available in both communities.

5.0 ENVIRONMENTAL CONSIDERATIONS

This section provides a description of the potential environmental and biological issues which were investigated as part of this study and may affect site selection. The data presented in this section is based upon research of previously prepared reports in the project areas, and on initial contacts with agencies who may have an interest in the project. No field work or extensive studies were completed in regard to the environment. The primary purpose of this effort was to identify environmental issues which may require significant consideration and may cause delays or increase the capital cost as the project progresses toward construction. It is anticipated that these environmental and biological issues will be addressed more fully in the Environmental Assessment (EA).

5.1 NAKNEK

Very little specific environmental data was identified for the Naknek area specifically. Several reports related to biology and the environment were identified for the King Salmon area. This data is generally assumed to be relevant to Naknek based on the proximity of the two communities. It is assumed that a more in depth analysis of these issues specific to the Naknek area will be conducted during completion of the EA.

Climate

The climate in the Naknek area is mainly maritime, and is characterized by cool, humid, and windy weather with relatively little seasonal temperature variation. Average summer temperatures range from 42 to 63 ^{o}F, with average winter temperatures between 10 and 30 ^{o}F. Extremes from –40 to 88 ^{o}F have been recorded. Total precipitation is 20 inches annually, including 44 inches of snowfall. Fog is common during the summer months.

The wind in the King Salmon area is characterized by southeasterly and easterly winds during winter (October through March) that are associated with high pressure over northern Alaska and low pressure over the southern Bering Sea or Gulf of Alaska. Summer winds (June through September) are primarily from the south and southeast and usually result from a blocking ridge of high pressure that extends into Alaska from the southeast and cyclonic storm activity over interior Alaska. Late winter and early spring winds are primarily from the north and northeast.

According to the AeroVironment wind monitoring report, the wind in Naknek is more northerly in the fall and winter and more southerly in the spring and summer.

Vegetation and Wetlands

Tundra and hills characterize the Bristol Bay lowland region, including the Naknek area. Major plant communities in the region are characterized as dry or moist tundra communities and Subarctic or boreal forest. Vegetation in boreal forest community in this region is characterized by scattered white spruce, paper birch, balsam poplar, and several species of willows. Tundra communities primarily consist of low ericaceous shrubs, such as Labrador tea, blueberry, and crowberry, plus dwarf and shrub birch, and several species of grasses, sedges, and mosses.

The Naknek area supports a wide diversity of wetland communities including palustrine, lacustrine, riverine, and estuarine systems. Wet meadows, shrub bogs, and freshwater marshes occur at poorly-drained sites throughout the area. Riverine wetlands occur in areas adjacent to many of the streams and rivers in the area. In general, wetlands have not been delineated in the Naknek area.

The vegetation surrounding the sewage lagoon area (Site 1), which is considered the primary and preferred site in Naknek consist mostly of tundra. Although the site was frozen and lightly covered with snow at the time of the site visit, the flat topography and local knowledge indicates that the site may be classified as wetlands. No ponds were observed in the area immediately surrounding the site. The Army Corps of Engineers (COE) was contacted for a preliminary determination as to wetlands in the area. A fill permit (404) will be required for construction of and access road to the project site.

Fish

Bristol Bay is the site of the largest sockeye salmon harvest in the world. Sockeye, chinook, coho, chum, and pink salmon are all present in the Naknek River and local streams. Chinook, chum, and coho salmon spawn in the Naknek River from approximately the lower lagoon near King Salmon to Naknek Lake. Resident fish species found in the Naknek River drainage include rainbow trout, Arctic char, Arctic grayling, lake trout, burbot, and northern pike.

Birds

Naknek's marsh and aquatic habitats provide rich food sources and staging areas for numerous resident and migratory birds. Waterfowl, cranes, shorebirds, terns, gulls, and jaegers migrate through this area and breed on the wet tundra and at ponds. Common migrant raptor species include osprey, rough-legged hawks, and short-eared owls. Resident raptor species include bald eagles, gyrfalcons, and great-horned owls. The area is also a major migration route for tundra swans. Passerines such as the Lapland longspur, snow bunting, Savanna sparrow, American dipper, and several species of swallows are commonly observed. The varied habitat in the area supports an abundance of bird life. Bird counts have been conducted for a number of years by the US Fish and Wildlife Service (USFWS) during the spring migratory season and around Christmas.

Threatened and Endangered Species

The USFWS was contacted regarding the potential presence of threatened or endangered species in the project area. According to Mr. Greg Balough of USFWS, the following three endangered or threatened species are potentially present in the project area.

The entire Alaskan breeding population of Stellar's eider is listed as threatened. The Naknek and King Salmon area are near the northern edge of the molting and wintering range. These birds are diving ducks that spend most of the year in shallow, near-shore marine waters. Molting and wintering flocks congregate in protected lagoons and bays, and along rocky headlands and islets. In summer, they nest on coastal tundra adjacent to small ponds or within drained lake basins. Stellar's eiders have been observed in the Naknek/King Salmon area in recent years according to bird count data provided by the USFWS.

The spectacled eider is threatened throughout its range. Spectacled eiders are diving ducks that spend most of the year in marine waters where they probably feed on bottom-dwelling mollusks and crustaceans. Around spring break-up, breeding pairs move to nesting areas on wet coastal tundra. Spectacled eider's have not been observed in the area in recent years according to bird count data provided by the USFWS.

Three subspecies of peregrine falcon occur in Alaska. The American peregrine falcon is endangered throughout its range, but may be delisted within the next year. The arctic peregrine falcon was removed from the endangered species list in 1994, and the Peale's peregrine falcon has never been listed as threatened or endangered. The Naknek area is located on the southern border of the birds breeding range and on the northern border of the migration range.

Based on our initial contacts with the USFWS, consideration of these threatened and endangered species will be required for this project. These issues should be addressed in more detail in the EA.

Cultural Resources/ Archaeology

The state historic preservation office was contacted regarding the potential presence of historic/archaeological sites in the Naknek area. A summary of the historic sites present near the sites considered for installation of a WTG in Naknek area is presented below.

Site 1 – Sewage Lagoon: Near Site Nak-002

Site 2 – Pederson Point: No known sites but contains areas with high potential to contain undiscovered sites, archeological survey may be required.

Site 3 – KAKN Radio Station Area: No known sites, relatively low potential to contain unreported sites.

Site 4 – King Salmon Area: No known sites but contains areas with high potential to contain undiscovered sites, archeological survey may be required.

Site 5 – South Naknek: Contains three known sites, NAK-012, NAK-013, and NAK-022.

Site 6 and 7 – Borough Landfill and Flats: No known sites, relatively low potential to contain unreported sites.

Site 8 – Existing 10kW Turbine Site: Near site NAK-023

Since Site 1 is the primary site considered feasible in this study, a more in depth discussion of the archaeology of the immediate area is provided. NAK-002 is considered one of the first archaeological discoveries in the area. The site was first investigated by Ales Hrdlicka in 1931. During the investigation, human skeletons were excavated near the mouth of the Naknek River on the bluff on the north side of the river. The site was identified as "Pavik", and was determined to be primarily prehistoric in age. The site was further investigated by Helge Larson in 1948 during which time enough trade beads were found to determine that the site had been occupied during the nineteenth century. Further investigations in subsequent years identified housing depressions and artifacts throughout the site. Potential archaeological impacts should be considered in more detail during completion of the EA.

5.2 UNALASKA

The information presented in this section was obtained from prior environmental and engineering reports prepared for other projects in the Unalaska area. It is assumed that a more in depth analysis of these issues specific to the Unalaska area will be conducted during completion of the EA.

Climate

The climate in the Unalaska area is mainly maritime, and is characterized by cool, humid, and windy weather with relatively little seasonal temperature variation. January temperatures range from 25 to 35 ^{o}F; summers range from 43 to 53 ^{o}F. Extremes from 12 to 80 ^{o}F have been recorded. Total precipitation is 64 inches annually, including 21 inches of snowfall.

The wind in the Unalaska area is characterized by southeasterly winds. The Amaknak /Unalaska area is usually characterized by wind, rain, fog, and overcast skies. Moderate to strong winds are recorded throughout the year, with wind velocities of more than 100 knots recorded during strong winter storms. Local topography significantly affects localized wind speed and direction. Icing during cold and windy periods is reported to occur frequently.

Vegetation and Wetlands

The topography of the area is relatively steep, and most of the land on Amaknak and Unalaska Islands is considered uplands. Because of the topography, wetlands are generally localized and confined to areas near streams and lakes. It is likely that none of the sites considered in this study would be considered wetlands unless the site is adjacent to a water body.

Vegetation in the upland areas generally consists of grasses, willows, alders, and heath-type plants. The vegetation at all of the previously undeveloped sites considered in this study is assumed to be similar to that described above. A thick snow pack and poor weather conditions during the time of the site visit made it impossible to identify the types of vegetation present at each individual site.

The COE was contacted for a preliminary determination as to wetlands in the area and to determine whether a fill permit (404) will be required for construction of a turbine and access road. According to the COE, no wetlands have been delineated in the Unalaska area. It is unlikely that a wetlands permit will be required since the sites considered in this study are generally upland sites or are located at areas previously developed, but the COE should be contacted during the permitting process.

Fish

The Unalaska/Dutch Harbor port ranks number one in the United States for seafood volume and value. The local economy consists of commercial fishing and support services, as well as for cargo transport to Pacific Rim nations. The waters surrounding the area are abundant with various species of salmon, crab, cod, herring, halibut, pollock, etc. Several streams on the islands support spawning salmon and resident Dolly Varden. Herring feed throughout Unalaska Bay and are generally present in all inner bays in the area. Red king and tanner crab are reportedly distributed throughout Unalaska Bay and contiguous bays.

Birds

Emperor geese feed and rest along the entire shoreline of Unalaska Bay and Captains Bay. Migratory waterfowl are present throughout the area, and mallards, green-winged teal, scaup, red-breasted and common merganser, and harlequin duck are reported to nest along streams, lakes, and wetlands. Seabirds also nest in some areas along rocky cliffs. Birds using upland habitats include Savannah and song sparrow, Lapland longspur, snow bunting, gray-crowned rosy finch, winter wren, raven, and bald eagle. Most of these birds use willow-shrub land and grassy areas for feeding and nesting habitat.

At the time of the site visit, upwards of two hundred bald eagles were observed at the community landfill (Site 1). Although not endangered or threatened in Alaska, bald eagles are protected under the Bald Eagle Protection Act. Further environmental study should be conducted during the EA to determine potential effects on bald eagles at the landfill site.

Threatened and Endangered Species

The USFWS was contacted regarding the potential presence of threatened or endangered species in the project area. According to Mr. Greg Balough of USFWS, as with Naknek, the Steller's eider, spectacled eider, and peregrine falcon are all potentially present within the Unalaska area. Unalaska is within the molting and wintering range of the Steller's eider, and within the migratory range of the both the spectacled eider and the peregrine falcon.

Based on our initial contacts with the USFWS, consideration of these threatened and endangered species will be required for this project. These endangered species as well as the bald eagle population of the area should be addressed in more detail in the EA.

Cultural Resources/ Archaeology

The state historic preservation office was contacted regarding the potential presence of historic/archaeological sites in the Unalaska area. A summary of the historic sites present near the sites considered for installation of a WTG in Unalaska area is presented below.

Site 1 – City Landfill and Site 2 – Haystack Hill: No known sites, relatively low potential to contain unreported sites.

Sites 3 through 8: All within the Dutch Harbor Naval Operating Base National Historic Landmark (UNL-120).

Site 5 – Strawberry Hill and Site 8 – Wastewater Treatment Plant: No known sites but contains areas with high potential to contain undiscovered sites, an archaeological survey may be necessary.

Site 7 – Spit: Although not identified by the State Historic Preservation Office, local sources reported the possible presence of a midden approximately half way down the spit from the main portion of Amaknak Island.

Sites 1, 2, 7, 8, and 9 are all considered feasible from an engineering and land ownership perspective. If site 7 or 8 are selected, a more detailed evaluation of archaeological and cultural resources may be required during completion of the EA.

6.0 ECONOMIC ANALYSIS

The cost analysis was completed for the various turbines and sites based on manufacturer provided data, historical cost information provided by the utilities, and typical transportation charges for Alaska. Sites which are considered feasible will generally require construction of minimal site infrastructure, since the feasible sites were selected due to their proximity to existing infrastructure.

Cost spreadsheets and a detailed listing of the assumptions used when preparing the estimates is presented in Appendix D. Table 3 presents a summary of the capital cost estimates prepared for the sewage lagoon site in Naknek, and the landfill, Pyramid Valley, and wastewater treatment plant sites in Unalaska.

TABLE 3

CAPITAL COST ESTIMATE SUMMARY

Analysis Results	Turbine					
	AOC 15/50 kW	NPS Northwind 100 kW	NEG M700 225/40 kW	NEG M750 400/100 kW	Zond Z-40 550 kW	Zond Z-50 750 kW
Naknek Sewage Lagoon Site						
Turbine Costs	$133,442	$251,883	$403,766	$674,519	$924,347	$1,199,689
Site Development	$41,569	$42,215	$47,480	$47,988	$53,301	$56,597
Contingency (10 %)	$17,501	$29,410	$45,125	$72,251	$97,765	$125,629
Site Total	**$192,511**	**$323,507**	**$496,371**	**$794,758**	**$1,075,413**	**$1,381,914**

TABLE 3 Cont.

CAPITAL COST ESTIMATE SUMMARY

Analysis Results	Turbine					
	AOC 15/50 kW	NPS Northwind 100 kW	NEG M700 225/40 kW	NEG M750 400/100 kW	Zond Z-40 550 kW	Zond Z-50 750 kW
Unalaska Landfill Site						
Turbine Costs	$124,570	$237,243	$382,761	$649,314	$879,371	$1,125,666
Site Development	$16,102	$16,769	$22,486	$23,061	$29,277	$33,297
Contingency (10 %)	$14,067	$25,401	$40,525	$67,237	$90,865	$115,896
Site Total	**$154,738**	**$279,413**	**$445,772**	**$739,612**	**$999,513**	**$1,274,859**
Unalaska Pyramid Valley Site						
Turbine Costs	$124,570	$237,243	$382,761	$649,314	$879,371	$1,125,666
Site Development	$23,826	$24,493	$30,210	$30,785	$37,001	$41,021
Contingency (10 %)	$14,840	$26,174	$41,297	$68,010	$91,637	$116,669
Site Total	**$163,235**	**$287,909**	**$454,269**	**$748,108**	**$1,008,009**	**$1,283,356**
Unalaska Wastewater Treatment Plant Site						
Turbine Costs	$124,570	$237,243	$382,761	$649,314	$879,371	$1,125,666
Site Development	$38,546	$39,213	$44,930	$45,505	$51,721	$55,741
Contingency (10 %)	$16,312	$27,646	$42,769	$69,482	$93,109	$118,141
Site Total	**$179,427**	**$304,101**	**$470,461**	**$764,300**	**$1,024,201**	**$1,299,548**

Operations and maintenance costs for the various turbines were obtained from the turbine manufacturer's and from Kotzebue Electric Associations AOC installation. Table 4 provides a summary of the range of estimated annual operation and maintenance costs for the six turbines included in this study. In general, the midpoint of the ranges provided in the table corresponds to double the cost provided by the manufacturer to account for the higher costs in Alaska.

Turbine	Annual O&M Cost
Zond Z-50 750 kW	$17,000-23,000
Zond Z-40550 kW	$15,000-20,000
NEG M750 400/100 kW	$12,000-18,000
NEG M700 225/40 kW	$10,000-15,000
NPS Northwind 100 kW	$7,000-10,000
AOC 15/50 kW	$4,000-7,000

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information and analysis presented in this document, it appears that wind energy may be feasible in both Naknek or Unalaska, assuming that environmental issues can be addressed in a timely and cost-effective manner. However, there may be economic risks associated with installing larger, heavier wind turbines on poor soils and in severe climatic conditions. Unfortunately, the discontinuation of many of the WTGs in the 100 kW and 500 kW range prevents the selection of moderately priced turbines which may be the best choice. We recommend installation of the largest possible turbine for which capital funding can be obtained and economic risk minimized. Because of the high cost of mobilization of cranes to either community, the best alternative includes installing the largest turbine possible that can be installed using locally available equipment.

In regard to feasible sites in each community, Site 1 – Sewage Lagoon is considered the best site in Naknek based on all factors considered in this analysis. Since the wind resources in Naknek are expected to be marginally feasible, it will be important to monitor the wind for an eighteen month period to verify that the wind resources used in this analysis are representative of conditions at the project site.

In Unalaska, Sites 1, 8, and 9 are considered feasible for installation of a turbine. Some sites may be too turbulent for turbine installations. As with Naknek, site specific monitoring data should be obtained prior to design and installation of the turbine. The actual site selected for turbine installation will be dependent upon the results of the EA and UEU preference. Table 5 provides an overall summary of the issues discussed in this report for each site considered.

TABLE 5
PREFERRED SITE SUMMARY

Parameter	Naknek	Unalaska		
	Site 1 – Sewage Lagoon	Site 1 – Borough Landfill	Site 8 – WWTP	Site 9 – Pyramid Valley
Land Ownership	BBB	OC–City lease	City & OC	Varies
Wetlands Present?	Possible	No	Possible	Possible
Impacts to Fisheries?	No	No	No	No
Impacts to Birds?	Moderate	High	Moderate	Moderate
Endangered Species Considerations?	Yes	Yes	Yes	Yes

Cultural Resources?	Yes	No	Possible	Possible
Noise Impacts to Residences?	No	No	Possible	No
Visual Impacts?	No	No	Yes	No
Site Ranking per community	1	1	4	5

Notes: BBB = Bristol Bay Borough
OC = Ounalashka Corporation

The difficulty in incorporating wind power with a diesel generation system lies in the fact that diesel turbines generally have a narrow operating range at peak efficiency. Operating the generators at other than peak efficiency also results in higher operation and maintenance costs and generator wear. Unless the WTG can generate enough power to allow the utility shut down a diesel generator, savings resulting from diesel displacement will generally be low. The best option is to install the largest turbine possible so that adequate power is generated to displace a turbine. The displacement can be raised by carefully managing the operation of both the WTG and diesel generators. More feasibly, wind power can be used to increase the capacity of the generating system rather than to displace fuel consumption.

Based on the information presented in this report, it is recommended that a wind monitoring station be set up at the Sewage Lagoon site in Naknek in order to verify the assumptions used in this analysis and to gather adequate data to conduct a more in depth analysis of the estimated power to be generated by a WTG at this site. It is also recommended that monitoring stations be set up at a minimum of two of the most feasible sites in Unalaska. Two anemometers should be placed on each tower. Anemometer height should be at the standard 33 feet (10m) and at the hub height of the proposed turbine.

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USFWS. Undated. Threatened and Endangered Species Fact Sheet, Spectacled Eider.

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Waythomas, C.F. 1994. Overview of Environmental and Hydrogeologic Conditions at King Salmon, Alaska. U.S. Geological Survey Open File Report 94-323.

ATTACHMENT B

Draft Consulting Services Agreement

CITY OF UNALASKA

Consultant Agreement

Analysis of the City of Unalaska Wind Power Development And Integration Assessment Project Phase II

FILE NO. 41-250

Prepared By:

City of Unalaska
P.O. Box 610
Unalaska, Alaska 99685
907.581.1260

\\file-server\city docs\DPU\Admin\Wind Power Assessment RFP\RFP and Attachments\Consulting Services Contract Agreement and Scope of Services.doc

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AGREEMENT FOR CONSULTING
AND RELATED SERVICES

THIS AGREEMENT is entered into this ______ day of **__________________________, 2017** by and between **____,** (hereinafter called "Consultant"), and the **CITY OF UNALASKA** (hereinafter called "City").

WITNESSETH THAT:

WHEREAS City desires to engage Consultant to render consulting and related services for the performance of an **Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II,** and

WHEREAS Consultant represents that it has the experience and ability to perform such services; and

WHEREAS the parties hereto desire to enter into a basic agreement setting forth the terms under which Consultant will, as requested, perform such work;

NOW THEREFORE the parties hereto do mutually agree as follows:

1. <u>Employment of Consultant</u>

Consultant agrees to provide professional services in accordance with the provisions of this Agreement. A written description of the work to be performed, schedule and compensation is set out in **Exhibits A-C** of this Agreement.

2. <u>Performance</u>

Consultant agrees to perform the work described in **Exhibit A- Scope of Services**; however, the Consultant is not authorized to perform any work or incur any expense which would cause the amount for which he is entitled to be paid under this Agreement to exceed the amount set forth in **Exhibit C – Fee Proposal** without the prior written approval of the City. All services shall be rendered in accordance with the schedule set forth in **Exhibit B – Contract Schedule**.

The work shall include but not be limited to the following: furnishing all equipment, transportation, per diem, travel, and supplies to perform all scopes of work that are authorized under the State of Alaska's Professional Engineering License, in connection with the **Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II.**

3. Fee

After receipt of a periodic billing for said services, the City agrees to pay Consultant as compensation for the services under this Agreement such sums of money as set forth in **Exhibit C** of this Agreement. The amount payable to the Consultant shall not exceed the amount specified in **Exhibit C**.

4. Payments

City agrees to make monthly payments to Consultant as services are performed and costs are incurred, provided Consultant submits a proper invoice for each payment, in such form accompanied by such evidence in support thereof as may be reasonably required by the City. City may, at its option, withhold ten percent (10%) from each monthly payment pending satisfactory completion of the work by Consultant. All invoices are otherwise due and payable within thirty (30) days of receipt by City. City shall pay Consultant for the services identified in **Exhibit A** the **Not to Exceed Total Fee of $_____________**. The Not to Exceed Total Fee is based on the distribution of the Not to Exceed Total Fee between tasks set forth in **Exhibit A.** The portion of the Not to Exceed Total Fee billed and paid for Consultant's services shall be equal to the proportion of services actually completed for each task set forth in **Exhibit A** during the billing period to the fee total specified for that task.

5. Personnel

Consultant agrees to furnish all personnel necessary for expeditious and satisfactory performance of this Agreement, each to be competent, experienced, and well qualified for the work assigned. No person objected to by the City shall be employed by Consultant for work hereunder.

6. Independent Contractor Status

In performing under this Agreement, Consultant acts as an independent contractor and shall have responsibility for and control over the details and means for performing the consulting services required hereunder.

7. Indemnification

Consultant shall defend and save harmless City or any employee, officer, insurer, or elected official thereof from and against losses, damages, liabilities, expenses, claims, and demands but only to the extent arising out of any negligent act or negligent omission of Consultant while performing under the terms of this contract.

8. Assignment

Consultant shall not assign this Agreement or any of the monies due or to become due hereunder without the prior written consent of City.

9. Subcontracting

Consultant may not subcontract its performance under this Agreement without prior written consent of City. Any subcontractor must agree to be bound by terms of this Agreement.

10. Designation of Representatives

The Parties agree, for the purposes of this Agreement, the City shall be represented by and may act only through the Deputy Director of Public Utilities or such other person as he may designate in writing. Consultant shall advise City in writing of the name of its representative in charge of the administration of this Agreement, who shall have authority to act for and bind Consultant in connection with this Agreement.

11. Termination

Either party shall have the right to terminate this Agreement in whole or in part at any time and for reasonable cause, by delivery of thirty (30) days written notice, specifying the extent and effective date thereof. After receipt of such notice, Consultant shall stop work hereunder to the extent and on the date specified in such notice, terminate all subcontracts and other commitments to the extent they relate to the work terminated, and deliver to City all designs, computations, drawings, specifications and other material and information prepared or developed hereunder in connection with the work terminated.

In the event of any termination pursuant to this clause, Consultant shall be entitled to be paid as provided herein for direct labor hours expended and reimbursable costs incurred prior to the termination pursuant to Section 3 hereof, and for such direct labor hours and reimbursable costs as may be expended or incurred thereafter with City's approval in concluding the work terminated, it being understood that Consultant shall not be entitled to any anticipated profit on services not performed. Except as provided in this clause, any such termination shall not alter or affect the rights or obligations of the parties under this Agreement.

12. Ownership and Use of Documents

Consultant agrees that all original design reproducible drawings, all pertinent calculations, specifications, reports, data and other documents prepared for the City hereunder are the property of the City and the City shall have the right, without payment of additional compensation, to disclose, reproduce and use such documents for this project

13. Insurance

A. During the term of the contract, the Contractor shall obtain and maintain in force the insurance coverage specified in these requirements. Such coverage shall be with an insurance company rated “Excellent” or “Superior” by A. M. Best Company, or a company specifically approved by the City.

B. The contractor shall carry and maintain throughout the life of this contract, at its own expense, insurance not less than the amounts and coverage herein specified, and the City of Unalaska, its employees and agents shall be named as additional insured under the insurance coverage so specified and where allowed, with respect to the performance of the work. There shall be no right of subrogation against the City or its agents performing work in connection with the work, and this waiver of subrogation shall be endorsed upon the policies. Insurance shall be placed with companies acceptable to the City of Unalaska; and these policies providing coverage thereunder shall contain provisions that no cancellation or material changes in the policy relative to this project shall become effective except upon *30* days prior *written* notice thereof to the City of Unalaska.

C. Prior to commencement of the work, the contractor shall furnish certificates to the City of Unalaska, in duplicate, evidencing that the Insurance policy provisions required hereunder are in force. Acceptance by the City of Unalaska of deficient evidence does not constitute a waiver of contract requirements.

D. The contractor shall furnish the City of Unalaska with certified copies of policies upon request. The minimum coverages and limits required are as follows:

1. Workers' Compensation insurance in accordance with the statutory coverages required by the State of Alaska and Employers Liability insurance with limits not less than $1,000,000 and, where applicable, insurance in compliance with any other statutory obligations, whether State or Federal, pertaining to the compensation of injured employees assigned to the work, including but not limited to Voluntary Compensation, Federal Longshoremen and Harbor Workers Act, Maritime and the Outer Continental Shelf's Land Act.

2. Commercial General Liability with limits not less than $1,000,000 per Occurrence and $2,000,000 Aggregate for Bodily Injury and Property Damage, including coverage for Premises and Operations Liability, Products and Completed Operations Liability, Contractual Liability, Broad Form Property Damage Liability and Personal Injury Liability.

3. Commercial Automobile Liability on all owned, non-owned, hired and rented vehicles with limits of liability of not less than $1,000,000 Combined Single Limit for Bodily Injury and Property Damage per each accident or loss.

4. Umbrella/Excess Liability insurance coverage of not less than $1,000,000 per occurrence and annual aggregate providing coverage in excess of General Liability, Auto Liability, and Employers Liability.

5. If work involves use of aircraft, Aircraft Liability insurance covering all owned and non-owned aircraft with a per occurrence limit of not less that $1,000,000.

6. If work involves use of watercraft, Protection and Indemnity insurance with limits not less than $1,000,000 per occurrence.

7. Professional Liability insurance with limits of not less than $1,000,000 per claim and $1,000,000 aggregate, subject to a maximum deductible $10,000 per claim. The City of Unalaska has the right to negotiate increase of deductibles subject to acceptable financial information of the policyholder.

E. Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the City, its officers, officials, employees and volunteers; or the contractor shall provide a financial guarantee satisfactory to the City guaranteeing payment of losses and related investigations, claim administration and defense expense.

F. All insurance policies as described above are required to be written on an "occurrence" basis. In the event occurrence coverage is not available, the contractor agrees to maintain "claims made" coverage for a minimum of two years after project completion.

G. If the contractor employs subcontractors to perform any work hereunder, the contractor agrees to require such subcontractors to obtain, carry, maintain, and keep in force during the time in which they are engaged in performing any work hereunder, policies of insurance which comply with the requirements as set forth in this section and to furnish copies thereof to the City of Unalaska. This requirement is applicable to subcontractors of any tier.

14. <u>Claims Recovery</u>

Claims by City resulting from Consultant's failure to comply with the terms of and specifications of this contract and/or default hereunder may be recovered by City by withholding the amount of such claims from compensation otherwise due Consultant for work performed or to be performed. City shall notify Consultant of any such failure, default or damage therefrom as soon as practicable and no later than 10 days after discovery of such event by written notice. Nothing provided herein shall be deemed as constituting an exclusive remedy on behalf of City, nor a waiver of any other rights hereunder at law or in equity. Design changes required as a result of failure to comply with the applicable standard of care shall be performed by the Consultant without additional compensation.

15. Performance Standard

Services performed under this Agreement will be performed with reasonable care or the ordinary skill of the profession practicing in the same or similar location and under similar circumstances and shall comply with all applicable codes and standards.

16. Compliance with Applicable Laws

Consultant shall in the performance of this Agreement comply with all applicable federal, state, and local laws, ordinances, orders, rules, and regulations applicable to its performance hereunder, including without limitation, all such legal provisions pertaining to social security, income tax withholding, medical aid, industrial insurance, workers' compensation, and other employee benefit laws. Consultant also agrees to comply with all contract provisions pertaining to grant or other funding assistance which City may choose to utilize to perform work under this Agreement. The Consultant and all subcontractors must comply with state laws related to local hire and prevailing wages.

17. Records and Audit

Consultant agrees to maintain sufficient and accurate records and books of account, including detailed time records, showing all direct labor hours expended and all reimbursable costs incurred and the same shall be subject to inspection and audit by City at all reasonable times. All such records and books of account pertaining to any work performed hereunder shall be retained for a period of not less than six (6) years from the date of completion of the improvements to which the consulting services of this Agreement relate.

18. Reporting of Progress and Inspection

Consultant agrees to keep City informed as to progress of the work under this Agreement by providing monthly written progress reports, and shall permit City to have reasonable access to the work performed or being performed, for the purpose of any inspection City may desire to undertake.

19. Form of City Approval

Except as otherwise provided in this Agreement, City's requests and approvals, and Consultant’s cost estimates and descriptions of work to be performed, may be made orally where necessary, provided that the oral communication is confirmed immediately thereafter in writing.

20. Duration of Agreement

This agreement is effective for a period of three (3) years from the date first shown above. The agreement may be extended by the mutual written agreement of City and Consultant.

21. Inspections by City

The City has the right, but not the duty, to inspect, in the manner and at reasonable times it considers appropriate during the period of this Agreement, all facilities and activities of the Consultant as may be engaged in the performance of this Agreement.

22. Endorsements on Documents

Endorsements and professional seals, if applicable, must be included on all final plans, specifications, estimates, and reports prepared by the Consultant. Preliminary copies of such documents submitted for review must have seals affixed without endorsement (signature).

23. Notices

Any official notice that either party hereto desires to give the other shall be delivered through the United States mail by certified mail, return receipt requested, with postage thereon fully prepaid and addressed as follows:

To City:	To Consultant:
JR Pearson, Deputy DPU Direcctor	______________________
City of Unalaska	______________________
Box 610	______________________
Unalaska, Alaska 99685	______________________

The addresses hereinabove specified may be changed by either party by giving written notice thereof to the other party pursuant to this paragraph.

24. Venue/Applicable Law

The venue of any legal action between the parties arising as a result of this Agreement shall be laid in the Third Judicial District of the Superior Court of the State of Alaska and this contract shall be interpreted in accordance with the laws of the State of Alaska.

25. Attorney's Fees

In the event either party institutes any suit or action to enforce its right hereunder, the prevailing party shall be entitled to recover from the other party its reasonable attorney's fees and costs in such suit or action and on any appeal therefrom.

26. Waiver

No failure on the part of City to enforce any covenant or provisions herein contained, nor any waiver of any right hereunder by City, unless in writing and signed by the parties sought to be bound, shall discharge or invalidate such covenants or provisions or affect the right of City to enforce the same or any other provision in the event of any subsequent breach or default.

27. Binding Effect

The terms, conditions and covenants contained in this Agreement shall apply to, inure to the benefit of, and bind the parties and their respective successors.

28. Entire Agreement/Modification

This agreement, including Exhibits A-C, and the Consultant's proposal dated _________________ constitutes the entire Agreement between the parties with respect to the subject matter hereof, and all prior negotiations and understandings are superseded and replaced by this Agreement and shall be of no further force and effect. No modification of this Agreement shall be of any force or effect unless reduced to writing, signed by both parties and expressly made a part of this Agreement.

In witness whereof, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement in duplicate on the respective date indicated below.

CONTRACTOR

By:___________________________________
________________, Its ____________

State of Alaska)
) ss.
Third Judicial District)

The foregoing instrument was acknowledged before me on the ____ day of ____________, 2017, by _____________________________, the ________________________________ of __________________, a __________ Corporation, on behalf of the corporation.

____
Notary Public, State of Alaska
My Commission Expires ________________

CITY OF UNALASKA, ALASKA

By:__________________________________
David A. Martinson, City Manager

State of Alaska)
) ss.
Third Judicial District)

The foregoing instrument was acknowledged before me on the ____ day of ____________, 2017, by David A. Martinson, City Manager for the City of Unalaska, a First Class Alaska Municipal Corporation, on behalf of the City of Unalaska.

____
Notary Public, State of Alaska
My Commission Expires _______________

CITY OF UNALASKA

EXHIBIT "A"
SCOPE OF SERVICES

The Consultant will work with the City to complete **Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II.**

Each of the deliverables outlined below will be provided electronically as an Adobe Acrobat (PDF) file.

The Scope of Services for this Contract includes the following general tasks:

Task 1: ________________

The deliverable for Task 1 will be a technical _____________________________.

Task 2: ___________________________________

The deliverable for Task 2 will be a __________________________________.

Task 3: ________________________________

The deliverable for Task 3 will be a _________________________________.

Task 4: Review by the City

In task 4, ____.

Task 5: ____

The deliverable for this task will be a ____.

Task 6: __________________________________ Plan

CITY OF UNALASKA

Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II

EXHIBIT "B"

CONTRACT SCHEDULE

		COMPLETION DATE
	Site Visit	____________________
Task 1:	___________________________________	____________________
Task 2:	___________________________________	____________________
Task 3:	___________________________________	____________________
Task 4:	___________________________________	____________________
Task 5:	___________________________________	____________________
Task 6:	___________________________________	____________________
Task 7:	___________________________________	____________________

CITY OF UNALASKA

EXHIBIT “C”
FEE PROPOSAL

EXHIBIT C - CONSULTANT FEE PROPOSAL DETAIL

CITY OF UNALASKA
DEPARTMENT OF PUBLIC WORKS
P.O. BOX 610
UNALASKA, AK 99685

PROJECT NAME: Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II
FILE NO.: 41-250
CONSULTANT:

INVOICE DATE: ____________________
PAY ESTIMATE NO.: _____
PERIOD: FROM_________TO__________

TASK	DESCRIPTION	QTY	U/M	UNIT PRICE	FEE TOTAL	QTY			% COMPL	$ VALUE TO DATE	$ REMAINING
						PREVIOUS	CURRENT	TO DATE			
1		1	L/S		$ -				0%	$ -	$ -
2		1	L/S		$ -				0%	$ -	$ -
3		1	L/S		$ -				0%	$ -	$ -
4		1	L/S		$ -				0%	$ -	$ -
5		1	L/S		$ -				0%	$ -	$ -
					$ -					$ -	$ -

ATTACHMENT C

Evaluation Score Sheet

Proposal Evaluation
Wind Power Assessment - Phases II to IV

Technical Attributes	***Weight***	***%***	**Firm A**	**Firm B**	**FIRM C**			
Professional Qualifications	*40*	*40.0%*	95.0	90.0	100.0			
Experiences and References	*30*	*30.0%*	90.0	100.0	95.0			
Narrative	*30*	*30.0%*	90.0	95.0	100.0			
Technical Proposal Raw Score	*100*	--	92.0	94.5	98.5			
Technical Proposal Adjusted Score	--	*100%*	92.0%	94.5%	98.5%			

Enter the Price Proposal (if any) in USD

Cost Attributes	***Weight***	***%***	**Firm A**	**Firm B**	**FIRM C**			
Cost USD	*0*	--						
Price Proposal Score	--	*0%*	0.0%	0.0%	0.0%			

Total Score	**92.0%**	**94.5%**	**98.5%**		
Ranking	**3**	**2**	**1**		

Proposal Evaluation
Wind Power Assessment - Phases II to IV

For each Technical Attribute rank each Respondent starting with 1,2,3,4,5 and 6 and so forth. 1 is best, 2 is next best, 3 is third best, etc.. Do not skip or repeat numbers.

Attributes	***Weight***	***%***	**Firm A**	**Firm B**	**FIRM C**			
Professional Qualifications	*40*	*40.0%*	2	3	1			
Experiences and References	*30*	*30.0%*	3	1	2			
Narrative	*30*	*30.0%*	3	2	1			

Do not edit. The below calculates the rankings you entered above as a percentage. Each successive rank is a difference of 5%.

Attributes	***Weight***	***%***	**Firm A**	**Firm B**	**FIRM C**			
Professional Qualifications	*40*	*40.0%*	95.0	90.0	100.0			
Experiences and References	*30*	*30.0%*	90.0	100.0	95.0			
Narrative	*30*	*30.0%*	90.0	95.0	100.0			
Total Weight	*100*	*100.0%*	92.0	94.5	98.5			
Ranking			3	2	1			

I certify that I have no conflicts of interest and that I have strictly adhered to the procedures described in the Request for Qualifications.

Evaluator Signature:

Date:

Technical Proposal to City of Unalaska
Department of Public Utilities
for

Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project, Phases II to IV

DPU project no. 41-250

September 19, 2017

Submitted by:

Douglas Vaught, P.E.
V3 Energy, LLC
Eagle River, Alaska
dvaught@v3energy.com
www.v3energy.com
907.350.5047

V3 Energy, LLC of Eagle River, Alaska, along with Electric Power Systems, Inc. of Anchorage, Alaska and other partners, is pleased to submit this proposal to the City of Unalaska for Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project, Phases II to IV.

Contents

Professional Qualifications

The project team is comprised of highly experienced people with a long track record of successful projects in Alaska, including substantial experience in Unalaska and elsewhere in the Aleutian Islands and the Alaska Peninsula. Note that not all are needed for each project phase, as noted

Project Team

The project team consists of the following companies:

- V3 Energy, LLC (**V3 Energy**), based in Eagle River, Alaska
- Electric Power Systems, Inc. (**EPS**), based in Anchorage, Alaska
- Bering Straits Development Co. (**BSDC**), based in Nome, Alaska
- Solstice Alaska Consulting, Inc. (**SolsticeAK**), based in Anchorage, Alaska
- John E. Wade Wind Consultant, LLC (**John Wade**), based in Portland, Oregon
- Financial Engineering Co. (**FEC**), based in Rockport, Maine
- Cultural Resource Consultants, LLC (**CRC**), based in Anchorage, Alaska

V3 Energy, LLC

V3 Energy is a wind energy consulting engineering firm based in Eagle River, Alaska – in business since 2003 – that focuses on renewable wind energy systems, with emphasis on Alaska village power systems. Core strenghts includes wind power project development, wind turbine performance and layout optimization modeling, power system static modeling, wind turbine site selection, meteorological test tower installation, wind resource data analysis including IEC 61400-1 criteria, solar resource analysis, project economic analysis, feasibility studies, power integration, and project management. Emphasis is on the holistic integration of renewable energy to supply electric, thermal and transportation power needs. Current and past clients include North Slope Borough, Yukon Energy Corp. (YT, Canada), Alaska Village Electric Cooperative, Northwest Arctic Borough, Bristol Bay Native Corporation, CH2M Hill, Inc., TDX Power, Alaska Energy Authority, Kodiak Electric Association, WHPacific, Inc. and Alaska Native villages and corporations, among others. For detailed information including reports and other information for download, please visit www.v3energy.com.

Douglas Vaught, P.E., is the owner and principal engineer of V3 Energy. He has installed scores of 10-to-60 meters height met towers in Alaska, including for Alaska Village Electric Cooperative, Barrick Gold (the Donlin Creek gold mine prospect near Aniak), Northwest Arctic Borough, Lake and Peninsula Borough, Red Dog Mine, North Slope Borough, Bristol Bay Native Corp., Aleutian Pribilof Island Community Development Association, enXco Development Corp. (Fire Island near Anchorage and elsewhere in Alaska), the Alaska Energy Authority and others.

V3 Energy's Alaska Business License no.: 433180, Alaska Certificate of Authorization (Professional Engineering) No. 1489.

Electric Power Systems, Inc.

Electric Power Systems, Inc. (EPS) is a full-service multidisciplinary consulting engineering firm that has specialized in all aspect of electric power systems in Alaska since our 1996 founding in Anchorage. Our staff includes electrical, mechanical, civil, and structural engineers; technicians, and tradesmen; and specialized support staff focused on delivering comprehensive services to electric power system owners.

Our work includes everything from feasibility studies, to primary power generation, to transmission and distribution systems, to ongoing maintenance and upgrades of existing systems. EPS' work in Alaska can be found from North Slope to the tip of the Panhandle, throughout the Interior, and into the Aleutians. We believe that no other firm has delivered more successful electrical infrastructure projects in Alaska. This experience includes multiple projects involving integration of renewal resources into the local islanded electrical grids.

EPS has relevant experience in Unalaska, Kodiak, Kotzebue, Buckland, Cordova and Akutan along with other islanded grids throughout Alaska and the Pacific Northwest. EPS has provided engineering and construction services for the recent additional and integration of the ORC units at the City of Unalaska's powerhouse. EPS is also providing engineering and construction services for the upgrade and expansion of the City of Unalaska's distribution system, allowing for additional energy sales to local processors.

David Buss, PE will be the lead electrical engineer on the project. Mr. Buss has over 20 years of experience in power system design and construction management. This includes: generation plant design and integration; switchgear design for generators and substations; and protective relay settings and evaluation. He provides generation, distribution and transmission support, as well as project management services, to clients throughout the State. Mr. Buss will work closely with the project team to provide the electrical expertise required to evaluate and provide recommendations for this project.

Electric Power Systems, Inc. Alaska Business License no.: 226409, Alaska Certificate of Authorization (Professional Engineering) No. 738.

Bering Straits Development Corp.

Bering Straits Development Company is in Nome, Alaska, sharing the same roof as the parent corporation, Bering Straits Native Corporation. The 110 Front Street location is home to the regional construction office and its many departments. Servicing the Nome area, villages within the region and communities throughout Alaska, it is the commitment for success through quality and assurance that the construction division and specialty trade departments will continue to grow and prosper.

Bering Straits Development Company created a department to direct a strong focus on the cost of living in rural communities. The Energy Efficiency and Renewable Energy Management Department have been working on energy efficiency and renewable energy projects throughout rural Alaska. The department is tasked locally with finding ways the Native Corporation can cut operating costs of their facilities and collect the data for providing low cost savings development. Each project from concept to execution is internally designed, implemented and installed by BSDC employees.

BSDC has collaborated with V3 Energy for met tower installations in several locations, including Bethel, Noorvik, Selawik and Elim. For the Phase III met tower installations, as per previous met tower installation work collaborating with V3 Energy, BSDC will be tasked with mobilizing tools and equipment to Unalaska, hiring local labor support and installing the met towers proper while V3 Energy will focus on sensors, datalogging and communications. This team approach has proven to be highly efficient by segregating the primary met tower tasks into each company's primary area of strength.

BSDC General Contractor License no.: 21829

Solstice Alaska Consulting, Inc.

SolsticeAK is an Anchorage- based, woman-owned small business, that will be responsible for assessing potential environmental impacts and determining environmental and permitting needs for project alternatives. SolsticeAK has been in business over nine years and has six employees, providing services related to environmental planning, including National Environmental Policy Act (NEPA) documentation and associated assessments, plus community and public involvement. SolsticeAK has experience managing large and small NEPA documentation projects, which require alternatives development, impact analyses, public and agency involvement, and field survey and reporting. In addition, SolsticeAK helps clients comply with federal and state environmental laws including the Clean Water Act, National Historic Preservation Act and the Endangered Species Act. For the past nine years, SolsticeAK has been Alaska Village Electric Cooperative's (AVEC) on call contractor providing permitting and NEPA documentation support for energy projects throughout Alaska and has worked closely with V3 Energy on many occasions with renewable energy project proposal development for AVEC.

SolsticeAK has relevant experience in Unalaska and the Aleutians; e.g., a recently-permitted dock expansion project in Captains Bay. As mitigation for the dock project, SolsticeAK worked with the City of Unalaska on restoration requirements for the Lower Iliuliuk River. Also, SolsticeAK completed the environmental analysis for the Adak Hydroelectric Reconnaissance Study which involved research of environmental conditions and working with project engineers to determine potential impacts to environmental resources and required environmental permits and authorizations.

SosticeAK's Alaska Business License no.: 937940 (Alaska Disadvantaged Business Enterprise #9900647)

John E. Wade Wind Consultant, LLC

John Wade worked for nearly 40 years as a university researcher and consultant meteorologist whose principal area of expertise was wind energy site selection and evaluation. He has been involved in the development of close to 100 wind farms and thousands of megawatts of wind power development in the United States, Canada, Australia, Spain, Central America, and India. This experience involved siting turbines from almost all the major turbine manufacturers and working for many wind farm developers. In addition, John was involved in village applications of wind energy in Alaska, and a wide variety of applied meteorological investigations from the use of vegetation as an indicator of wind energy potential to investigations of climate trends in the western United States. He was the principal author of two wind prospecting manuals: *Biological Wind Prospecting* and *Remote Sensing for Wind Power Potential: A Prospectors Handbook*. In 2005, John was awarded a Lifetime Achievement Award by the American Wind Energy Association for work in the field of meteorology and wind resource assessment.

John Wade and Douglas Vaught of V3 Energy have been colleagues for many years and traveled together to several rural Alaska communities in 2004 for wind prospecting work on behest of the Alaska Energy Authority (AEA) and John traveled separately during that time to Unalaska with AEA. John Wade and Douglas Vaught worked together in 2006 on the Kodiak wind site data analysis in Kodiak that led to development of Kodiak Electric's highly successful six-turbine wind farm on Pillar Mountain. In the time since, John has assisted V3 Energy with particularly difficult wind analysis problems, such as assessment of extreme wind probability in unusual situations and modeling of wind flow in complex terrain.

John brings a very high level of understanding of wind flow and wind power development in highly complex terrain. Although John Wade is now retired, he has agreed to participate in the City of Unalaska wind power development project out of professional interest. Although John will not travel for this project, he will collaborate with V3 Energy with site selection and data analysis and interpretation on an as-needed basis.

Cultural Resource Consultants, LLC

CRC will provide technical support related to cultural and historical resources. CRC has 35 years of Alaskan historic preservation experience ranging from literature reviews and quick field surveys of small project areas to multi-year projects involving complex National Historic Preservation Act (NHPA) Section 106 analyses. Michael Yarborough, CRC's Principal Archeologist, has 35 years of archeological experience in Alaska and has worked in the Aleutian Islands region since 1971. In 1977, he surveyed the portion of Amaknak Island known as "Little South America" for the U.S. Fish and Wildlife Service where he surveyed a proposed runway and access road in 1984, and a port and expansion of the Unisea facility in 1989. He worked with the U.S. Army Corps of Engineers from 1998 to 2001 on environmental restoration of Unalaska and Dutch Harbor under the formerly used defense sites (FUDS) program. He completed a Section 106 evaluation of safety improvements at the Unalaska Airport in 2001 and an archeological review and consultations for the East Point/Ballyhoo Roads Rehabilitation project in 2001 and 2002. He was the archeologist on the M/V Selendang Ayu grounding on Unalaska Island in 2005, and directed six and a half months of archeological salvage recovery at the Amaknak Bridge Site in 2006 and 2007. In 2007, he co-directed archeological testing at the Quarry Site on Amaknak Island and surveyed the proposed site of a new courthouse in downtown Unalaska. He also evaluated cultural and historic resources for the Unalaska Airport Environmental Impact Statement, a project that lasted from 2006 to 2010. Most recently, in 2014, he surveyed FUDS project areas on Amaknak Island for the U.S. Army Corps of Engineers, and the site of a new house in Unalaska for the Aleutian Housing Authority.

CRC's Alaska Business License no.: 723799

Financial Engineering

FEC was formed as a sole proprietorship in 1995 to assist clients in developing and analyzing the data required for long-term decisions. These decisions can relate to lending of capital funds, strategic plans, implementation of capital projects, fuel supply, and other issues. Although most clients are within the electric utility industry, projects in other industries have included ethanol production, commercial fishing, mining, natural gas, petroleum, and transportation.

Long-term projections have inherent imprecision, and even if a long-term forecast is relatively accurate, short-term fluctuations can significantly affect operating results. Consequently, investigations include thorough reviews of alternative assumptions – both short- and long-term.

Many clients have Boards of Directors with backgrounds outside of the industry. Consequently, reports present the findings in a clear, concise manner that can be fully understood by audiences with diverse backgrounds.

Projects typically lend themselves to the development of computer software developed specifically for each project. While large programs developed for specific industries are used at times, the "one-size-fits-all" lacks a degree of precision that is important for an analysis. The Financial Engineering Company can quickly develop the required programs, usually with less time being required for the entire project than if a "canned" program was used.

Originally located in Anchorage, Alaska, the company was moved to Rockport, Maine, in 2002.

Contractual Relationships for this Project

V3 Energy will be the prime contractor for Phases II and III of this project. In Phase II, V3 Energy will contract SolsticeAK, CRC, John Wade and possibly EPS for advice and support with development of the data collection plan. In Phase III, V3 Energy will contract BSDC for installation of the met towers, with John Wade for data review, and possibly with FEC for economic analysis.

Both V3 Energy and EPS prefer that EPS be the prime contractor for Phase IV of this project. In Phase IV, EPS will contract FEC and V3 Energy for completion of the wind power pre-development plan.

Project References

V3 Energy and EPS project references are detailed below.

V3 Energy, LLC

V3 Energy has completed many met tower, wind analysis and feasibility projects, including for two long-term clients, Alaska Village Electric Cooperative (AVEC) and Northwest Arctic Borough (NWAB). See www.v3nergy.com for information and downloadable reports of all V3 Energy projects.

Project 1 – AVEC villages

V3 Energy has served as AVEC's wind power consultant since 2003 and in that capacity has installed met towers, analyzed wind data, modeled wind flow, and written feasibility studies and conceptual design reports for many of AVEC's 54 villages. Projects include St. Mary's where a 900 kW EWT52-900 is presently being installed, Shaktoolik where two 100 kW NPS100 turbines are operational, Chevak where four NPS100 turbines are operational, Gambell and Savoonga where two NPS100 turbines are operational in each, Emmonak where four NPS100 turbines are operational, Toksook Bay where four NPS100 turbines are operational, Mekoryuk where two NPS100 turbines are operational, and Bethel where an EWT52-900 will soon be installed. Additionally, V3 Energy has installed met towers and completed wind power development work for AVEC communities (e.g., Elim, Eek, Marshall, New Stuyahok, Selawik, Mountain Village and others) where wind turbines have not yet been installed or where wind power was deemed infeasible for technical and/or economic reasons. See www.v3energy.com for further information. Please navigate to the community of interest via the Project Map for downloadable reports and other information.

A notable AVEC project that encompassed a broad, holistic view of wind power and power distribution intertie options was the *Intertie Options for Selected AVEC Villages* report submitted to the Denali Commission in 2014. This project examined intertie options and attendant site location and turbine capacity possibilities for larger-scale wind power development for eleven village-pair possibilities, with placement of redundant powerplants into standby mode. The analysis included both technical and economic factors to demonstrate long-term cost savings for the utility. Douglas Vaught of V3 Energy was principal author of this report and his analysis was built on an economic modeling spreadsheet originally developed for AVEC by Michael Hubbard of FEC. A copy of this report is available on request.

References:

Forest Button Key Accounts Manager Alaska Village Electric Cooperative, Inc. Phone: 907-646-5961	Brent Petrie Former Key Accounts Manager (retired from) Alaska Village Electric Cooperative Phone: 907-351-4756

Email: fbutton@avec.org	Email: bnpetrie@gmail.com

Project 2 – Northwest Arctic Borough villages

Northwest Arctic Borough has tasked V3 Energy with several high priority wind site selection, met tower installation, wind analysis and modeling projects in the region, including for the communities of Deering, Buckland, Kivalina and Noorvik. Deering and Buckland have been subsequently been developed with one NPS100 wind turbine in Deering and two NPS100 wind turbines in Buckland. The Buckland project was complicated by the wind resource, energy production and development cost trade-off between two sites, one near the village itself and the other at higher elevation on a hill five miles distant. V3 Energy's analysis work demonstrated the superior potential of the more distant site, which was subsequently developed.

In Kivalina, V3 Energy has assisted NWAB with wind energy planning, including wind resource analysis and wind flow modeling for development of Kisimigiuktuk Hill (commonly referred to as K-Hill), on the slopes of which a new school is planned and where the community will re-locate to escape the risk and danger of Kivalina's present location on an exposed barrier spit. Other Kivalina-related analysis work included a study of intertie options to connect the village to the nearby Port of Red Dog Mine, and possible wind power options if accomplished. See https://www.v3energy.com/kivalina/ for downloadable reports and further information.

V3 Energy has assisted NWAB with extensive wind power analysis and planning work in Noorvik, including installation of met towers at four separate sites, and extensive wind analysis and modeling work. A notable product of V3 Energy's Noorvik work is a Noorvik-Kiana Intertie Options Report which examined technical and economic considerations of electrically connecting Noorvik to the upstream (of the Kobuk River) village of Kiana. This analysis included an analysis of wind turbine and wind power capacity options possible for the intertied communities and focused on the most developable of the four met tower sites studied. See https://www.v3energy.com/noorvik/ for downloadable reports and further information.

References:

Ingemar Mathiasson Energy Manager Northwest Arctic Borough Phone: 269-816-2992 Email: IMathiasson@nwabor.org	Sonny Adams Director of Alternative Energy NANA Regional Corporation Phone: 907-265-4185 Email: sonny.adams@nana.com

List of V3 Energy's met tower/wind resource analysis projects

Including and in addition to the AVEC and NWAB projects described above, a mostly complete list of rural Alaska communities and locations in Alaska where V3 Energy has installed met towers and/or analyzed the wind resource from met tower data include:

Bristol Bay	Y-K Delta	NW Arctic, Bering Straits	North Slope	Aleutians, Penin., Kodiak	Southcentral, Interior
Dillingham (3 sites)	Donlin Creek (6 sites)	Noorvik (4 sites)	Point Hope	Kodiak (2 sites)	Fire Island, Anch. (5 sites)
Naknek (2 sites)	Bethel (3 sites)	Kivalina (2 sites)	Point Lay	Cold Bay	JBER, Anch.

Bristol Bay	Y-K Delta	NW Arctic, Bering Straits	North Slope	Aleutians, Penin., Kodiak	Southcentral, Interior
Egegik	St. Mary's (2 sites)	Red Dog Mine (3 sites)	Wainwright	False Pass	Tok (2 sites)
New Stuyahok (2 sites)	Napakiak	Selawik	Atqasuk	Atka	Delta Junction (2 sites)
Togiak	Mekoryuk	Buckland (2 sites)	Kaktovik	Perryville	Minto
Kokhanok	Marshall	Gambell	Anaktuvuk Pass	Old Harbor	Healy (2 sites)
Levelock	Mtn. Village	Savoonga		St. George	Caribou Hills
Manokotak	Chefornak	Stebbins		King Cove	Eva Creek
Koliganek	Chevak	Shaktoolik		Nelson Lagoon	Hatchers Pass
Clark's Point	Quinhagak	St. Michael		Shemya	Kasilof

Additional V3 Energy Project – Yukon Energy

A recent notable V3 Energy outside Alaska was a 2016 survey of wind power site options in Yukon Territory, Canada. CBER Consulting Services of Revelstoke, British Columbia, V3 Energy, LLC and Envint Consulting of Laval, Quebec completed a study of wind energy potential for Yukon Energy Corporation (YEC). The study addressed utility-scale wind power as a potential source of electrical generation for the territory. The study included an inventory of candidate wind project sites (accomplished by review of AWS Truepower Windnavigator maps, plus site visits by aircraft), development of project designs at the conceptual level, economic modeling and additional review of project constraints.

For the study, 26 candidate sites were selected based on wind speed, distance to transmission lines, road access and land ownership, then narrowed to seven selected sites for further analysis. For these sites, preliminary wind farm designs were developed for 20, 10 and 6 MW capacities, and suitable wind turbines were suggested based on individual site characteristics. Capital cost and energy estimates were prepared for the project sites and levelized cost of energy was determined to provide a comparison with other energy resources.

The project was completed in 2016. Please visit http://resourceplan.yukonenergy.ca/options/wind/ for a summary and a link to download the report. A client contact reference is Marc-Andre Lavigne of Yukon Energy Co. in Whitehorse, Yukon, Canada. Phone 867-393-5413, email Marc-Andre.Lavigne@yec.yk.ca.

Electric Power Systems, Inc.

EPS has extensive experience in energy projects throughout Alaska and the Pacific Northwest. EPS has provided services that include in-depth technical studies to evaluate interconnection requirements, dynamic stability and overall impacts of energy projects for Hawaii, Guam, and Alaska. EPS has also provided engineering and construction services for implementation of energy projects, coordinating a practical and feasible implementation of the projects. See below for two representative EPS projects.

Project 1 – Kotzebue Electric Switchgear and SCADA System Upgrades

EPS engineers and technicians completed the design and installation of switchgear, SCADA, and mechanical/ electrical systems for the Kotzebue Electric Association in Alaska.

Kotzebue is a remote hub community, electrically isolated from any other system. The community predominantly runs on diesel, and on the power produced by 14 wind turbines. Following acceptance of our designs by the owner, EPS worked with other members of the ESG companies to install and modify equipment in a phased manner prevented loss of power to the community. Our work included adding SCADA system automation that monitors remote equipment, provides automatic control of generation loads, and enhances system optimization and troubleshooting. This system uses Canary Trending and Wonderware InTouch software to provide historical alarming, and help optimize the economics of wind/diesel integration. EPS utilized a radio backhaul to connect a remote wind turbine system to the main power plant as well as point-to-multipoint radio system for gathering SCADA telemetry from distribution switches through the town.

Our services provided include electrical engineering design and commissioning, PLC/IO/HMI programming, instrument calibration/ testing/troubleshooting, Ethernet network, control panel layout and wiring diagrams, VFD configuration/troubleshooting/ support, equipment/instrument maintenance, radio system support, and on-call support.

References:

Matt Bergan, Project Engineer, Kotzebue Electric Association, 245 4th Street, Kotzebue, AK 99752, 907-442-3491

Martin Shroyer, General Manager, Kotzebue Electric Association, 245 4th Street, Kotzebue, AK 99752, 907-442-3491

Project 2 – Nome Wind Integration

Since 1998, EPS has supported Nome Joint Utility System in their utility system upgrades, maintenance, and system modifications. This support includes study, design, and installation efforts to implement their wind integration efforts. EPS has performed a boiler study for waste heat and frequency regulation, system modeling, load flow analysis, coordination and protection studies, and initial line extension studies. EPS has installed a GE Fanuc-based Supervisory Control and Data Acquisition system for wind integration, monitoring and operation of a two-unit, 12 MW capacity diesel generator power plant, two-unit 6 MW capacity diesel generator backup power plant, two 1 MW wind turbines, and eighteen 50 kW wind turbines. Together, they operate to allow more efficient management of the diesel generators to optimize the economics of wind integration.

Reference:

John Handeland, Utility Manager, Nome Joint Utility System, (907) 443-6587, johnh@njus.org

Additional EPS Project – Unalaska Powerplant Design and Construction

Unalaska (Dutch Harbor) is an electrically isolated island community at the heart of the North Pacific/Bering Sea. The Unalaska Power Plant was completed in several phases. EPS was an integral partner with the city from the conceptual design stage to the end of the project, and continues to deliver support and upgrades to the City of Unalaska on a regular basis

Phase I included feasibility studies, site selection, conceptual design, final design, construction, construction management and final acceptance testing of the 22-megawatt (MW) diesel power plant. Our work on this project included designing the installation of two generators, site design, building design, all utility interconnections, Supervisory Control and Data Acquisition (SCADA)/automation design, protective relaying design, switchgear design, coordination studies and fuel tank and fuel delivery systems design. Mechanical designs included the HVAC system for the combustion and cooling air; seawater and air cooling, jacket water heat transfers from the engines, and assistance during construction. EPS also completed system coordination studies, arc-flash studies, breaker and switchgear commissioning, grounding study and overall plant acceptance testing. This phase was completed in 2011.

Due to EPS' performance, the Owner selected us to design and construct the next phase of the project. Phase II of the Unalaska Power Plant included the installation of a 4.4-MW CAT C-280 engine. This was the first C-280 installed in Alaska, and one of the few worldwide operating in the harsh subarctic marine environment.

EPS designed the C-280 installation, and controls modifications to the existing plant. EPS also designed, and EPC/MBI installed, the cooling and switchgear integration, the loadshare and unit start/stop controls, modifications to the station switchgear, instrumentation, starting air, waste heat, exhaust, fuel, structural support and plant electrical systems. Additionally, the unit installation included new exhaust stack, silencers, controls, and commissioning for the unit and switchgear. As an addition to the project, new protective relaying at Town Substation, and installed SCADA controls was also included in the project.

Due to the success of the Phase II effort, the Owner again selected EPS to design and construct Phase III of the project, consisting of a second C-280 4.4 MW engine. Coupled with the installation of the new engine, Organic Rankin Cycle (ORC) heat recovery systems were installed to increase the efficiency of the plant. EPS completed the design of the new engine, installed a new SCADA system and completed the design of the ORC units. EPS completed construction QA/QC services, project management and commissioning for the ORCs and new engine while EPC and MBI completed the construction.

Reference:
Dan Winters, 907-581-1260, dwinters@ci.unalaska.ak.us
Matthew Scott, Electrical Engineering Technician, 907-581-1831, mscott@ci.unalaska.ak.us

Additional EPS Project – Interconnection Requirement Studies, Hawaii

EPS has performed many Interconnection Requirement Studies (IRS) for the Hawaiian Electric Company (HECO) and Hawaii Electric Light Company (HELCO) utilities. These studies consist of using power flow and dynamic simulations to determine the steady state and transient impact of new generation on the system. A detailed protection analysis is done to determine if the protection schemes and communications equipment near the point of interconnection is sufficient or requires modification. The results of the studies are then used to determine if other transmission system improvements are required. Performance requirements for the proposed interconnection are developed for steady state conditions (voltage, dispatch, etc.), dynamic conditions (voltage and frequency ride-through, tripping schemes), and for fault conditions (clearing times, trip schemes, remedial action, etc.). EPS has performed IRS's for the following proposed generation additions:

- Tradewinds – 5.5 MW Biomass - HELCO System
- North Shore Wind Power – 30 MW Wind - HECO system
- PGV Expansion – 16 MW Geothermal - HELCO System
- Hu Honua Biomass – 21.5 MW biomass - HELCO System

• IC Sunshine – 5 MW Photovoltaic - HECO system
• H-Power Expansion – 30 MW Steam-fired trash burner - HECO system
• Kalaeloa Renewable Energy Park – 5 MW Photovoltaic - HECO System

References:
Lisa Dangelmaier, Manager of Production, Operations and Systems Planning, HELCO, 808-969-0273, lisa.dangelmaier@hawaiielectriclight.com
Dean Arakawa, Director Transmission Planning, HECO, 808-547-7311, dean.arakawa@hawaiianelectric.com

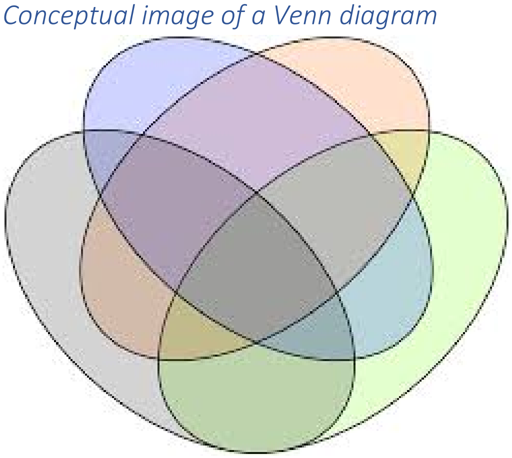
Narrative Work Plan

The entire Aleutian Island chain is marked by a very strong wind resource which, at first glance, indicates strong and obvious potential for wind power in Unalaska. But, true of most Aleutian Islands and certainly of Unalaska, dramatic and significant topographic relief can result in extraordinarily high winds in exposed areas and sometimes very low winds in highly sheltered locations such as bays and coves. The topographic complexity of Unalaska, combined with exposure to powerful North Pacific and Bering Sea storms, makes for a challenging wind power environment. The objective of this project is not finding strong wind – that is straightforward enough in Unalaska – but rather identifying locations of *developable* wind for wind power for the community.

Project Team's Philosophy of Approach

There are many criteria to consider with wind prospecting in Unalaska, well beyond the wind resource itself. Consider a Venn diagram where each site selection criterion is a circle of the diagram.

Conceptual image of a Venn diagram



A *developable* location for wind power in Unalaska is one where all circles, or criteria, overlap. These criteria include at a minimum:

- Wind resource; high (but too high) mean wind speed, normal or near normal Weibull distribution, low turbulence and acceptable extreme wind behavior (the latter two will be especially critical in Unalaska)
- Power distribution infrastructure; proximity to existing (or planned), and sufficient amperage capacity of to accept input from of wind farm
- Roads/access; proximity to existing, or reasonable cost to develop or improve access

- Site size; large enough to host a turbine array that meets project goals
- Land use; available for development (ownership, easement restrictions, lease rates, etc.)
- Airspace; FAA restrictions for airport flight operations (this is a key consideration!)
- Terrestrial wildlife and avian species; no unacceptable impacts to habitats, flyways, etc.
- Wetlands, parks and other high-value environments; no insurmountable restrictions
- Noise, shadow flicker (turbine blades passing between the sun and an observer) and aesthetics; minimal impact to residents
- Rime icing environment and/or ice throw risk; minimal risk and/or acceptable mitigating measures possible

Phase II Work Plan

City of Unalaska defines Phase II as development of a data collection plan to support subsequent wind resource data collection efforts.

System Configuration Review

Wind power site analysis, measurement and selection depends on project goals. The Request for Proposals (RFP) refers to a low penetration configuration goal (pg. 4-10), which per Alaska Energy Authority (AEA) means that wind power supplies 8 to 20% of the annual electric load demand. To achieve this, instantaneous wind power input could possibly be as high as 120%. Low penetration wind-diesel systems sometimes are tied to secondary loads to shunt excess energy, but overall, the control system philosophy is relatively simple, or not much more complicated anyway than necessary for diesel power alone.

Interestingly though, per AEA, medium wind penetration is not too different than low penetration, except for higher average and instantaneous wind power input and somewhat more complex control system requirements. But, for both low and medium penetration, the diesel engines always remain on and sufficiently loaded to control system voltage and frequency. An initial discussion between City of Unalaska and the project team regarding the pros and cons of low vs. medium penetration and Unalaska's wind penetration goals is very important as it has direct bearing on wind turbine options, number of wind turbines required and consequently bears on site selection criteria.

With reasonable assumptions of present and future electric and thermal load demand and wind resource assumptions from existing information and/or meso-scale modeling, the project team will create an Unalaska electric system wind-diesel model using HOMER software[1] to explore the boundaries of low and medium wind penetration. The result of this effort will be a summary of wind power capacities and suitable turbine options to meet a range of goals that can be discussed.

Team members required: V3 Energy and EPS

Gather and Review Existing Reports/Data and Wind Models

The project team will review existing wind power-related reports as referenced in the RFP and will analyze other pertinent sources of information such as Dutch Harbor Airport wind records. For this project, most valuable information is wind data itself (summary information or actual/raw) and a review

[1] HOMER is the global standard software for microgrid optimization; see http://www.homerenergy.com/index.html

of all previous wind site options, the rationale for choosing them, and subsequent opinions regarding their development potential.

In reviewing the 1999 Wind Energy Feasibility Study, Naknek and Unalaska report and the 2005 Wind Integration Assessment Phase 1 report, several sites are qualitatively identified and discussed, including City Landfill, Mount Ballyhoo, Pyramid Valley, the Spit, Strawberry Hill, wastewater treatment plant, west of UniSea. Unfortunately, neither report includes a good reference map, which would have been helpful, but both reports are consistent with note of sparse availability of high quality wind data, upon which a wind power project for Unalaska absolutely depends.

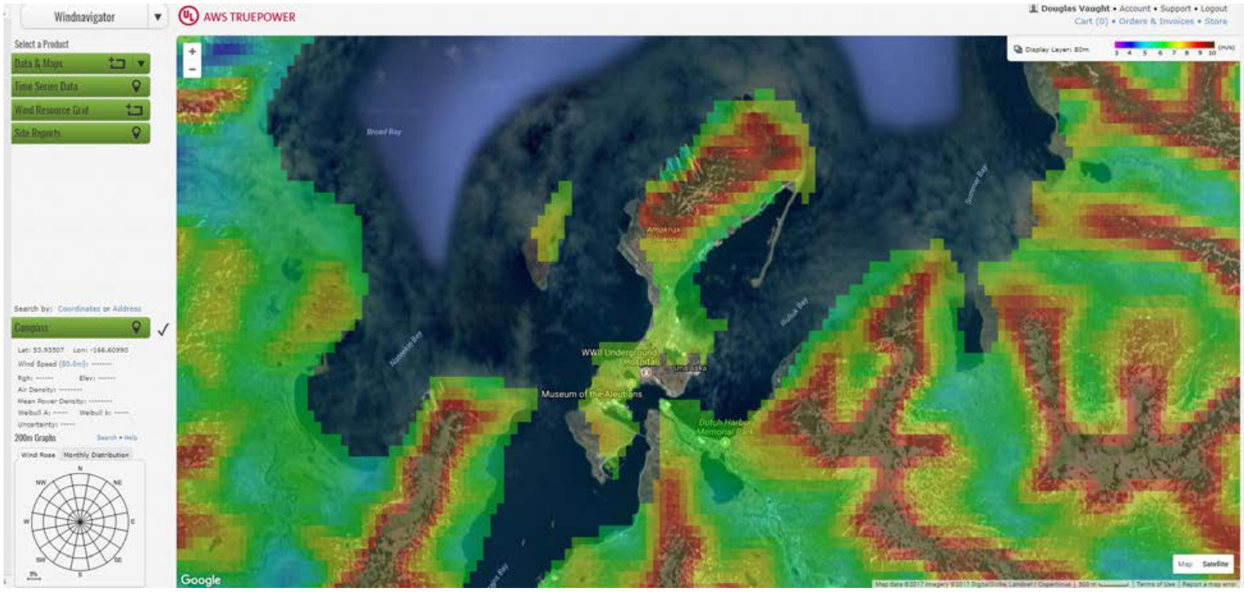
To supplement the review of existing information and before considering site options, the project team, with $150/day online access, will use AWS Truepower's Windnavigator wind mapping software[2]. Windnavigator employs an impressive and visually intricate 200-meter resolution of predicted wind speed. This is much higher than free wind data resources such as the International Renewable Energy Agency (IRENA) database which uses lower-resolution DTU (Danish Technical University) modeling. AWS Truepower offers point-by-point wind characteristic statistical information, such as wind rose, Weibull parameters, air density, etc., for most land areas world-wide. This will provide a "big picture" understanding of the Unalaska-area wind resource and will allow the project team to quickly identify sites of highest interest. As a cross-check though, the IRENA wind database will be checked for consistency with AWS Truepower, and vice versa.

The following image from the AWS website is a wind speed image of Unalaska at 80 meters elevation above ground level. With paid access, one can obtain the additional wind resource information of interest, as noted above, that are blanked out in this view, plus with paid access one can adjust the wind speed layer to heights other than 80 meters. For example, if one is interested in a 40 meter hub height, such as for the Vestas V39 wind turbine, Windnavigator can be set to display wind information at that elevation.

From reading previous Unalaska wind reports and reviews of AWS Truepower and IRENA databases, a list of candidate met tower site options will be chosen and weighed against mitigating criteria such as environmental considerations, airspace, land ownership, and others. The objective is to identify several possible sites for met tower installation that can be vetted with an on-the-ground perspective during the site visit.

[2] Windnavigator is designed for prospecting green-field sites, identifying locations for a wind monitoring campaign or assessing completed projects; see: https://www.awstruepower.com/software/windnavigator/.

AWS Truepower wind map of Unalaska, 80 meters elevation above ground level



Team members required: V3 Energy and John Wade

Site Visit, plus Environmental and Cultural Concerns

Following initial system modeling, discussions with City of Unalaska regarding penetration and wind power capacity options, review of existing reports/data and a review of Windnavigator and IRENA wind modeling information, a site visit can be scheduled. An on-the-ground perspective is critically important before investing too much time and effort in specifying met tower locations and obtaining permits.

Referencing the Venn diagram of site selection criteria presented earlier, one element, besides the wind resource, that benefits from an on-the-ground perspective is the environmental overview of site options. For this reason, it is suggested that Robin Reich of SolsticeAK accompany Doug Vaught of V3 Energy on the site visit.

Based on a preliminary search, the table below highlights potential environmental and/or historical/cultural constraints associated with the wind sites studied in the 2005 Phase I Report. This review would be expanded and revised of course with deletion of sites or inclusion of new met tower sites of interest.

Environmental and cultural review of Unalaska 2005 Phase I wind report

Site	Contaminated Sites nearby	Migratory Birds Potential	Mapped Bald Eagle Nests	Wetlands Potential	Anadromous Streams	Known Cultural/ Historic Sites	Other constraints
The Spit	1 active site	Moderate to high	0.60 miles away	Unmapped, but low	No	Near Dutch Harbor Naval Operating Base and Ft. Mears NRHP	
Strawberry Hill	5 active sites	Moderate to high	0.6 and 0.9 miles away	Unmapped, but medium	No	Within Dutch Harbor Naval Operating Base and Ft. Mears NRHP	

Site	Contaminated Sites nearby	Migratory Birds Potential	Mapped Bald Eagle Nests	Wetlands Potential	Anadromous Streams	Known Cultural/ Historic Sites	Other constraints
Eagle Store/Grand Aleutian	1 active site	Moderate to high	2 nests 0.35 miles away	Unmapped, but medium	No	Within Dutch Harbor Naval Operating Base and Ft. Mears NRHP	GCI tower
Between Unisea and Bay	2 active sites	Moderate to high	2 nests 0.1 mile away	Unmapped, but low to medium	No	Within Dutch Harbor Naval Operating Base and Ft. Mears NRHP	
Pyramid Creek	2 active sites	Low	None documented	Unmapped, but high	Yes	Potential	

(NRHP: National Register of Historic Places)

Team members required: V3 Energy, SolsticeAK and CRC

Met Tower Site Selection and Permitting

With site selection criteria in mind, the project team will consider wind turbine models suitable for Unalaska's load and a low (to possibly medium) penetration configuration approach. The RFP mentions approximately 500 kW models, but it should be noted that there are no new-manufacture 500 kW wind turbines on the market. The 500 kW Vestas V39, of which there are two presently operational in Alaska (in Sandpoint), meets this criterion, but the project team would like City of Unalaska to be aware that this turbine is no longer manufactured and cannot be obtained as new. It is, however, obtainable as a remanufactured unit from Halus Power Systems in San Leandro, California, but availability is subject to supply from wind farm re-development projects in Denmark or elsewhere in northern Europe where most of these models were installed.

If considering only new manufacture wind turbines, models of approximately 1,000 to perhaps as high as 2,000 kW capacity could suitable for Unalaska. Turbines in this range are available from well-known and highly regarded manufacturers who provide excellent warranties and support. These are large machines though, with blade tip heights from 75 to 120 meters (250 to 395 ft.) above ground level, which must be kept in mind during met tower site selection.

Upon narrowing met tower location options to approximately five candidate sites, any necessary permits will be obtained. This can be a tricky exercise, depending on one's objectives, as obtaining permits for a temporary met tower are less troublesome than for permanent wind turbines. This is especially crucial with respect to FAA's airspace obstruction evaluation. Wind turbines are much higher than met towers and FAA may approve a met tower at a site, but then later deny permits for (higher) wind turbines. Ideally one confirms before monitoring a site that wind turbines at the desired hub height are acceptable at that location, or at least likely so, but unfortunately that's not always fully possible, at least not without an expensive and time-consuming process of FAA applications and public reviews.

One hundred percent certainty of FAA approval for all wind turbines of possible interest at all contemplated met tower site locations is excessive and not recommended. Although airspace restrictions are likely to be problematic in Unalaska – this is a common problem for nearly all rural Alaska wind power projects – this project should be viewed as an iterative process where information is developed and refined as the project proceeds. Without such an approach, installing met towers may prove impossible as criteria, if one seeks full upfront certainty, can checkmate each other. For airspace considerations, the project team will use the Notice Criteria Tool found on FAA's obstruction evaluation website[3] for a first-pass evaluation of prospective wind turbines at prospective met tower sites to understand possible permitting objections. The same will be true for wetland and other environmental considerations. Obvious problems, such as ILS glide slope interference and possibly also RNAV missed approach minimums, would most likely disqualify a site for met tower installation, but barring highly obvious problems, often it's best to carry on, measure the site for the wind resource and if promising, further investigate permitting requirements for wind turbines.

Team members required: V3 Energy, John Wade, Solstice and CRC

Met Tower Equipment

V3 Energy, LLC has long and extensive experience with NRG Systems, Inc. [4] wind resource monitoring products and based on that familiarity, would develop recommendations and specifications using their equipment, including met towers, sensors, dataloggers and modem communication devices including their UK-based service provider, Wireless Innovations.

The use of meteorological test (met) towers to collect wind resource data typically dictates installation of hub height or near-hub height models (60 meters is a standard height, although 34, 50 and 80 meter height models are available too) to gather data most representative of that to be encountered by wind turbines. This is especially important in complex terrain where unusual wind shear, turbulence and/or wind gust behavior may be present. High met towers though are expensive, time-consuming and difficult to install, and not always necessary to vet a site for wind power suitability. Often, the latter can be accomplished with a much smaller and simpler 10-meter met tower, which is also available from NRG Systems, Inc. Although a 10-meter tower is much too low to adequately determine the wind resource at turbine hub height, it is high enough in most locations to measure highly undesirable (for wind turbine operations) wind behavior such as high turbulence, rapidly shifting wind direction and extreme wind gusts, all of which are often quickly detectable, especially during autumn and winter, and which are not modeled by AWS Truepower's Windnavigator and IRENA software.

With this, and depending on the site options selected, it may be preferable to install a combination of 10-meter and higher met towers, install only 10-meter met towers, or install fewer met towers initially with an intent to move them periodically to other candidate wind sites. This type of approach is iterative in nature though and implies perhaps a modified scenario of events than delineated in Phase III of the RFP. Unalaska is a very challenging wind power environment and an iterative approach recognizes the primary limitation for wind power development in the community at present, namely a lack of data. The intent of an iterative approach is to quickly and inexpensively screen sites for wind turbine suitability by closely examining the data for evidence of turbulence, rapidly shifting wind direction (indicating unstable wind flow), and excessively high wind gusts. Should a site clearly exhibit

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[3] See https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showNoNoticeRequiredToolForm for information

[4] See https://www.nrgsystems.com/ for company information.

these undesirable behaviors, which often can be discerned within a few months' time, there may be little value in collecting a full 18 to 24 months of data from it and hence best to move the met tower to another candidate location as soon as possible.

Ten-meter height met towers, besides using them to screen out undesirable wind sites, are also a relatively inexpensive method to identify highly desirable sites. Should data from a 10-meter tower appear highly promising over a reasonable time, the site could be re-configured with a large, hub height or near-hub height met tower to collect data needed to fully characterize the site for wind turbines.

To reiterate the main point, the pivotal issue with wind power in Unalaska at present is a lack of high quality met tower data and lack of confidence in commercially-available wind data and flow models to make an informed siting decision. More data is necessary, as the City of Unalaska recognizes, but a good monitoring plan will collect data with these questions in mind:

- What data is necessary?
- What questions must one answer with that data?
- How much data is necessary to answer the questions?
- What's the next step once questions are answered?

Once a monitoring plan is agreed upon, an equipment list can be developed and installation costs estimated. Remote monitoring and data communications are not difficult and can be readily handled with cellular and/or satellite-based modems. Cellular modems are preferred as they are less expensive to purchase and operate than Iridium satellite models, but the latter of course can communicate from any location on the planet. The met tower dataloggers can also operate in a non-communication mode where manual data download is periodically required, but that is not ideal. V3 Energy, LLC has seen this method go wrong too many times to recommend it. Lost data is very expensive to re-acquire.

Team members required: V3 Energy, LLC and John Wade

Met Tower Alternative

A possible alternative to an initial deployment of met towers, whether 10-meter height or higher, is deployment of a Lidar (light detection and ranging) unit. These units are ground-based devices that illuminate a target with pulsed laser light to detect motion. For wind power, the (low power) laser points straight up and detects the movement of dust and particulates carried by the air. A Lidar unit for wind prospecting measure wind speed, direction, turbulence intensity and wind shear at several or more user-selected heights up to nearly 300 meters above ground level. This is well beyond the capabilities of even the highest and most robust met towers and can be accomplished with no permitting required for airspace intrusion.

Besides the measurement of winds at very high heights, Lidar directly measures wind vector, which can be resolved mathematically into its horizontal and vertical components. With met towers, vertical flow must be measured with separate instrumentation and the flow vector calculated. Vertical wind flow is insignificant at flat, coastal sites where the wind flow is laminar across the ground surface, but in complex, high topographic-relief terrain it can be an issue as wind manufacturers limit allowable up-flow to prevent excessive mechanical loading of the rotor drive bearings.

Lidar technology is very capable, but there are downsides of course. Lidar units are relatively expensive to purchase or lease and they require a continuous and reliable external power supply, the later which presents a considerable obstacle at remote sites. By contrast, met tower sensors are self or battery-powered and modems are powered by small PV panels, hence met towers need very little maintenance.

Like a 10-meter intended for short-term prospecting purposes and easily moved, the Lidar unit could be managed similarly. It's too expensive to purchase or lease more than one unit and hence one must use them judiciously and strategically to obtain as much useful information as possible in the shortest time frame, referencing the four questions posed in the previous section of this proposal.

It is premature of course to make an argument for Lidar, but possible use of this technology could be considered, especially for site options where data is strongly desired, but installation of high met towers may be highly problematic due to airspace obstruction permitting issues. A possible candidate site is Hog Island in Unalaska Bay. A Lidar unit could fully characterize the wind resource on Hog Island without need to involve the FAA.

Team members required: V3 Energy, LLC and John Wade

Phase III Work Plan

City of Unalaska defines Phase III as implementation of the data collection plan developed in Phase II.

Met Tower Installation

Upon City of Unalaska approval of the data collection plan and obtainment of required permits and permissions, the met towers can be installed. Given the high cost of travel to Unalaska, preferably this will be accomplished in one trip, but it's undesirable to allow problems at one site to delay others, so the project team will be flexible and will work closely with City of Unalaska to minimize expenses, yet ensure timely progress of the project.

V3 Energy, LLC will contract BSDC to assist with the met tower installations. Although V3 Energy has installed met towers on its own, it is more efficient and faster to split the workload between tower-related tasks and sensor, datalogger and communications-related tasks. For this, BSDC will be responsible for the former and V3 Energy the latter. V3 Energy and BSDC have worked together in this manner over the past few years on met tower projects in Elim, Noorvik, Selawik and Bethel.

Installing a met tower, especially a large one, requires a labor crew to assist with transporting equipment, anchoring, assembly and crew support during the tower lift. Although BSDC will be under contract to V3 Energy for the met tower installations, BSDC will have responsibility to hire local labor support and direct their efforts. In addition, BSDC will provide all necessary installation tools and equipment such as met tower-specific lift winches, power and hand tools. Larger equipment such as vehicles and all-terrain vehicles, if needed, will be rented in Unalaska.

Both V3 Energy and BSDC are strong adherents of workplace safety and strictly abide by met tower installation safety protocols described in the NRG Systems, Inc. installation manuals. The long and considerable met tower experience of V3 Energy and BSDC will ensure that the met towers are installed correctly, safely and quickly.

Team members required: V3 Energy, LLC and BSDC

Data Analysis and Reporting

Met tower modems typically are programmed to communicate once per day. This enables one to keep a close eye on the health of the met tower and to closely monitor unusual weather conditions, should they be of interest or concern. NRG's new style datalogger has a further capacity to allow one to call the logger – instead of waiting for it to call you – to enable real-time monitoring of weather conditions. This may not be necessary at all five sites, but may be desired at one or more sites of highest interest and potential.

V3 Energy uses Windographer software for wind data analysis. Referencing online information, *Windographer is the market-leading software for analyzing, visualizing, and validating wind resource data from meteorological towers and remote sensing systems – the critical data required to model wind power projects.*

Data validation will be accomplished with Windographer's data validation tools, which offer several methods – manual, scatterplot, and via definable rules – to flag data as potentially compromised. Compromising events include icing, tower shadow (when one anemometer of a paired set is behind the tower when the wind is from a defined sector), broken or poorly functioning sensors, etc. Icing is of particular interest in Unalaska as higher elevation sites may pose the risk of rime icing. Rime is a destructive form of ice which forms when supercooled water vapor in wind-drive fog or clouds freezes on contact and can rapidly form elaborate structures. Although often quite beautiful, rime ice is sticky, heavy and tenacious and can lead to met tower collapse from weighted guy wires.

Standard wind project met tower sensors are not designed to directly detect icing, but with use of Windographer software, icing is detectable indirectly via examination of temperature, relative humidity, average and standard deviation of the sensor(s), length of time of the event, and comparison to the other met towers and possibly the airport weather station. Data flagged as icing, whether via a set of definable rules or manually, can be removed from the dataset to avoid a negative bias of wind speed.

If icing at a site is exceptionally problematic, but otherwise the site exhibits good characteristics of wind behavior and development potential, heated anemometers and wind vanes can be installed, but these require a power source, which typically and expensive to arrange. Hence, generally it is best to begin a data collection campaign with standard sensors and refit later with heated sensors if necessary. This can be considered another example of the iterative nature of wind resource assessment.

The transference of raw data can be accomplished several ways, including a City of Unalaska email address programmed into the modems, periodically by WinZip compression, or via text files after upload to Windographer software. Raw data, though, precedes any data filtering, so the City of Unalaska may also be interested in filtered/validated data, which can be emailed as text files.

For this project, after validating the data, Windographer's auto-generated reports with additional information, as needed, likely will be sufficient for quarterly reporting. A final custom wind resource assessment (WRA) report (for each site separately or combined, as requested) that includes met tower installation documentation, photographs, extended analysis, explanations, modeling, etc. will be prepared. An example report can be downloaded at https://www.v3energy.com/joint-base-elmendorf-richardson/.

Inclusion of power production data, feasibility and economic analysis goes beyond the confines of a typical WRA report and most typically is written as a feasibility study report, but of course a WRA and feasibility study can be combined if desired. The economic analysis can be accomplished most simply with use of the Alaska Energy Authority's Renewable Energy Fund (REF) scoring model Excel spreadsheet which, although not as sophisticated as the economic analysis requested in Phase IV of this project, is quicker and provides a rough indication of economic feasibility of a project. Note that although the REF process has been inactive for that past two years due to State of Alaska budget constraints and hence the scoring spreadsheet has not been updated since 2015, it is still very useful as contains built-in assumptions of project capital cost, yearly-escalated fuel prices per community, operations and maintenance costs, discount rate, etc. But, FEC may propose or recommend a relatively simple alternative to the REF scoring spreadsheet that is indicative of potential but less robust than the broader economic analysis planned in Phase IV.

Team members required: V3 Energy, John Wade and (possibly) FEC

Phase IV Work Plan

City of Unalaska defines Phase IV as the technical analysis of wind system integration and the economic analysis of wind power development.

EPS has been working with the City of Unalaska's electric department in both expanding their distribution system and increasing their generation capabilities since 1998. EPS will utilize this prior experience and extensive knowledge of the City's power system to determine the impacts potential wind will have on the system.

The system limitations due to the expected system changes will be identified and described. Where appropriate, recommendations for mitigation measures including system improvements will be proposed. As part of this study, EPS will communicate our preliminary findings to the City of Unalaska and will coordinate a discussion of our combined thoughts for system improvements, as we work through the results. This will ensure that the resulting report contains the most effective and practical recommendations.

Working with V3 Energy and FEC, EPS will proceed with the following steps to evaluate the system impact of potential wind energy as identified in the previous phases of this project.

Step 1: Data Collection, Assumptions, Improvements – Collect the most current system models, including load estimates for both the present and future conditions, for use in the system evaluation. EPS will use existing models if there are no updated versions.

Step 2: Existing System – Conduct power flows for the existing system with present day and future load estimates including potential wind energy. Evaluate the impact on the generation facilities and potential changes in unit efficiencies based on projected loading.

Step 3: Improvement Options - Evaluate possible new line options and / or generation options impacted by the addition of wind energy. Compare the benefits of each option identified. Evaluation will include the following parameters

- Operational impacts including unit efficiencies
- Land acquisition, if required

- Permitting
- Energy output
- Life cycle costs including operational and maintenance costs
- Displaced fuel costs (savings)
- Simple payback period and impact to utility rates

Step 4: Report – Provide a draft technical report addressing the impacts to the City of Unalaska's system.

V3 Energy, LLC Résumé

V3 ENERGY LLC
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Eagle River, AK 99577, USA
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Consulting Services

- Wind resource analysis, IEC standards assessment, wind flow modeling and turbine energy production
- Wind-diesel power plant (isolated grid) modeling, design and economic evaluation
- Cold climate/atmospheric icing analysis of wind turbine operational impact
- Meteorological (met) test tower installation in remote environments
- Wind turbine siting, permitting, flicker shadow and noise analyses
- Project development and management

Recent Clients

- Yukon Energy Corporation (Canada)
- North Slope Borough
- Alaska Village Electric Cooperative
- Lake and Peninsula Borough
- Northwest Arctic Borough
- Pacific Northwest National Laboratory
- Aleutian Pribilof Is. Community Develop. Assoc.
- Alaska Power and Telephone Co.

Representative Projects

- Identified *developable* (near road system and power infrastructure) wind power site options in Yukon Territory, Canada using meso and micro-scale wind modeling tools. Narrowed selection to seven sites and created prospective turbine array layouts and energy production estimates for 5, 10 and 20 MW wind power capacity configurations. Project included a flight survey of the site options plus cost/benefit analyses. Teamed with CBER of Revelstoke, B.C. and Envint of Lavel, QC. Client: Yukon Energy Corp.
- Wind project development of Chukchi and Arctic Coast villages, including conceptual design, modeling, permitting, siting analysis, turbine evaluation, wind resource analysis and community discussions. Have teamed with other engineering firms for parts of this extended project effort. Client: North Slope Borough.
- Authored electrical intertie study of all possible distribution interconnections among the 58 communities served by Alaska Village Electric Cooperative (AVEC). The study considered possible routes, wind power options for combined communities and long-term economic benefit of connection. Client: AVEC.
- Authored numerous wind power conceptual design and feasibility study reports for isolated grid, wind-diesel systems in rural Alaska. Reports included wind resource evaluation, wind flow modeling, power system configuration modeling, turbine energy production analysis and economic benefit. Clients: AVEC, Northwest Arctic Borough, Lake and Peninsula Borough and others.
- Wind power study of Site Summit area of Joint Base Elmendorf Richardson in Anchorage, Alaska. Project included installation of met tower, wind flow modeling, weather station data analysis and prospective wind turbine layout options. Client: Pacific Northwest National Laboratory, for the USAF.
- Installed many scores of 10 to 60-meter height met towers throughout rural and urban Alaska. Projects typically include site selection, permitting, local work force training/support, auxiliary systems power design and installation (for obstruction lights and communications), and system communications. Clients: many.
- Please visit www.v3energy.com for further information and to download project reports.

Douglas Vaught, P.E.
Wind Power Engineer
Anchorage, Alaska, USA
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dvaught@v3energy.com

Specialized Knowledge and Experience

- Project management
- Wind resource assessment and analysis
- Wind turbine performance and layout optimization (WAsP software)
- Wind-diesel power system configuration modeling
- Project feasibility and economic modeling
- Meteorological test tower installation
- Cold climate considerations of wind turbine operations and testing

Education

- B.S, Aerospace Engineering, 1984, Tau Beta Pi, Navy ROTC, University of Kansas, Lawrence, Kansas
- Graduate, 1986, U.S. Navy Nuclear Power Training Officer Program (M.S. engineering equivalent), Orlando, Florida and Idaho Falls, Idaho
- Master Environmental Studies, 1995, The Evergreen State College,

Professional Qualifications

V3 Energy LLC, Anchorage, Alaska, 2003 – present. Owner and principal engineer of Anchorage, Alaska area-based consulting engineering firm focused on renewable wind energy systems, with emphasis on Alaska village power systems. Project work includes wind power project development, wind turbine performance and layout optimization modeling, power system static modeling, wind turbine site selection, meteorological test tower installation, wind resource data analysis including IEC 61400-1 criteria, solar resource analysis, project economic analysis, feasibility studies, power integration, and project management. Emphasis on the holistic integration of renewable energy to supply electric, thermal and transportation power needs. Current and past clients include North Slope Borough, Yukon Energy Corp. (YT, Canada), Alaska Village Electric Cooperative, Northwest Arctic Borough, Bristol Bay Native Corporation, CH2M Hill, Inc., TDX Power, Alaska Energy Authority, Kodiak Electric Association, WHPacific, Inc. and Alaska Native villages and corporations, among others. For detailed information including reports and other information for download, please visit www.v3energy.com.

Bristol Environmental and Engineering Services Corp., Anchorage, Alaska, Senior Engineer, 1998 – 2003. Project manager and engineer on a variety of engineering, risk management, and environmental remediation projects in rural Alaska and other locales. Work included petroleum, PCB, asbestos cleanup/removal and building demolition in the Aleutians Islands, Native villages, and federal facilities. A notable project was risk assessment analysis of unexploded ordnance on Kaho'olawe Island (near Maui) for the State of Hawaii's Kaho'olawe Island Reserve Commission.

Spacemark Inc., Anchorage, Alaska, Environmental Manager, 1997 – 1998. Environmental Manager of the former Adak Island Naval Base under an operations and maintenance contract. Led a staff of environmental technicians for hazardous waste/material management, water and air compliance monitoring, and other base-wide environmental issues.

CH2M Hill, Richland, Washington, Senior Engineer, 1994 – 1997. Engineer for US Dept. of Energy environmental restoration projects at abandoned nuclear reactor sites along the Columbia

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Wind Power Engineer
Anchorage, Alaska, USA
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Olympia, Washington, Thesis title: *Risk Assessment and Cleanup Policy at the Hanford Nuclear Reservation: A Case Study*

Registration

- Professional Engineer, Alaska (CE10034)
- Professional Engineer, Washington State (32367)

Affiliations

- American Society of Mechanical Engineers
- Renewable Energy Alaska Project, Board Member

River, Washington. Team leader of a technology demonstration project (with Pacific Northwest National Laboratory) to test innovative technologies for treatment of radioactively-contaminated groundwater.

National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington, Environmental Engineer, 1993 – 1994. Project Manager for hazardous waste and petroleum cleanup of the Pribilof Islands (St. Paul and St. George Islands), Alaska.

Puget Sound Naval Shipyard, Bremerton, Washington, Mechanical and Environmental Engineer, 1989 – 1993. Responsible for guiding environmental and hazardous waste cleanup activities at the facility as the remediation program manager. Earlier served as a staff engineer for submarine hydraulic system repair projects.

U.S. Navy Officer, 1984 – 1989. Nuclear powerplant engineering officer and gunnery officer on USS Arkansas (CGN-41), a nuclear-powered guided-missile cruiser. Operated shipboard nuclear reactors and related systems. Directed complex reactor and steam powerplant acceptance and startup test evolutions during complex overhaul at Puget Sound Naval Shipyard, Washington. Stood engineering, bridge, and combat control center watches at sea. Deployed to western Pacific, Mediterranean Sea, North Pacific (USSR coast), and overhaul at Puget Sound Naval Shipyard, Bremerton, Washington. Awarded Expeditionary Medal for Libyan conflict, 1986.

Training/Presentations/Publications

Development of Isolated Grid, Wind-Diesel Power Systems in Alaska, Winterwind 2014, Sundsvall, Sweden, February 2014

Renewable Energy Systems and *Renewable Energy Project Development* courses, Adjunct Faculty, Mat-Su College (Univ. of Alaska branch campus), Palmer, Alaska, 2011

Wind Power Icing Challenges in Alaska: a Case Study of the Native Village of Saint Mary's, Winterwind 2008, Norrköping, Sweden, December 2008

Wind resource reports, wind-diesel feasibility studies, and conceptual design reports as deliverables; please visit www.v3energy.com.

Electric Power Systems, Inc. Résumés

Electric Power Systems inc.
Consulting Engineers

William J. (Bill) Brimstein
Professional Electrical and Control Systems Engineer

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Professional Registrations

Electrical Engineer – PE, Alaska EE 10195, Idaho EE 11215
Controls System Engineer - Alaska No. 14121

Bill is involved in generation planning studies, generation control and monitoring projects for electric utilities, switchgear upgrades and commissioning for industrial customers and governmental agencies. Project manager and design for diesel & hydro generation, and industrial installation and protection upgrades. Performs studies, design, installation and project management for projects relating to monitoring, coordination, arc flash protection/mitigation, control, and diesel & hydro generation installation. Has installed and commissioned various improvements to hydroelectric and diesel generation systems. Has performed incident energy analysis for utility and industrial to determine the various arc flash boundaries as well as determining what personal protective equipment (PPE) must be used in approaching each boundary.

Relevant Experience

Unalaska Power Plant
City of Unalaska, Unalaska, Alaska

Performed feasibility studies, site selection, conceptual design, final design, construction, construction management and testing services and final acceptance testing for two 5 MW Wartsila diesel power plant. The project consists of the design and installation of a new power plant to serve the city and processors located in Unalaska, Alaska. The project includes site design, building design, utility interconnections, SCADA/automation design, protective relaying design, switchgear design, coordination studies, fuel tank and fuel delivery systems design and project commissioning, testing and startup.

Subsequent projects included the design, install, commissioning and startup of two additional 4MW CAT C175 deisel gensets into new power plant. Project included HMI upgrades and seamless control of combination CAT/Wartsila operating systems.

Snake River Power Plant
Nome Joint Utility Systems, Nome, Alaska

Performed electrical design, overall project management, and specialty construction for the design and construction of a 20 MW diesel power plant for the community of Nome. Scope included engine selection, site development, environmental remediation, permitting, geotechnical, civil, architectural, structural, SCADA/automation design, and system electrical improvements to accommodate the new plant. Scope also included space layout, electrical facilities, and heating for support of water and wastewater facilities located in the plant, including water system heating, pumping, and dosing.

Fort Raymond Backup Power Plant
City of Seward, Seward, Alaska

Performed feasibility studies, site selection, conceptual design, final design, construction, construction management and testing services and final acceptance testing for two 2 MW EMD diesel power plant. The project consists of the design and installation of a new power plant to serve as emergency backup power for the city of Seward, Alaska. The project includes site design, building design, utility interconnections, SCADA/automation design, protective relaying design, switchgear and controls design, coordination studies, fuel tank and fuel delivery systems design and project commissioning, testing and startup.

Subsequent projects included the design, install, commissioning and startup of two additional 2MW EMD diesel gensets into the power plant. Project included HMI upgrades, new switchgear, and implementation of isochronous load sharing control system on all four of the plant diesel gensets.

Deering Hybrid Wind System
Northwest Arctic Borough, Deering, Alaska

Provided engineering design, installation, and commissioning for the village of Deering's wind-diesel power system with new generator controllers and station PLC to interface with the SCADA system and handle system functions. An initial site visit was performed to evaluate the existing control and power system to identify any existing problems, check accuracy of existing drawings and determine installation and commissioning sequence. A complete design package was provided prior to construction. The power plant is comprised of four diesel generators ranging in size from 100-170kW, and existing generator controls were removed and Woodward Easygen controllers were installed while keeping the plant online during construction and commissioning. A GE RX3i PACS PLC was installed to replace the outdated PLC hardware, and handle the interface between the new SCADA system, generator controllers, power meters, Energy Recovery Heater (ERH), wind turbine, and handle ancillary I/O. PLC programming was provided to maximize the wind generation, minimize fuel consumption and send any excess power from the wind turbine to the ERH. A SCADA server was installed to provide a centralized control station, and VPN connection was added for secure remote access. The SCADA server includes one second sampling rate historian to record critical data with real time viewing of the data on the HMI's. Training was provided to plant personnel for operating and maintenance and a secured remote access system to provide support when requested. EPS continues to provide remote support to assist with troubleshooting.

Kotzebue EMD Unit Integration
Kotzebue Electrtic Association, Kotzebue, Alaska

EPS acted as the design firm for the removal of two 1.1MW units and the replacement of these units with one EMD 710/900RPM 1400 kW unit. The project includes the controls modification design and integration to existing SCADA control system, electrical installation of genset and ancillary equipment, commissioning and startup which includes setup and testing of the Basler Voltage regulator, Woodward 2301D governor and Digital Synchronizing and Loading Controls.

Education

B.S., Electrical Engineering, with emphasis on Power Systems Engineering, University of Nevada, Reno, 1994

David Buss

Professional Engineer

Contact Information

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Email: dbuss@epsinc.com

Professional Registrations

Electrical Engineer	Alaska Registration No. 10466
Control Systems Engineer	Alaska Registration No. 14123

Summary of Qualifications

Mr. Buss has extensive experience providing electrical and control systems engineering solutions to the electric power systems industry. His expertise includes: system coordination; relay settings; power generation controls; switchgear controls; motor controls; system start-ups; and troubleshooting, maintenance, and design engineering. Mr. Buss has the proven ability to work independently on projects where an orchestrated sequence of events is needed to prevent electrical system outages. His experience includes managing a range of multidiscipline projects involving multiple engineers and technicians.

Relevant Experience

Professional Electrical Engineer — ***2001 –Present***
Electric Power Systems, Inc. — *Juneau, AK*

As a professional electrical engineer working for Electric Power Systems, Inc. (EPS), Mr. Buss has successfully delivered professional services to utility, industrial, and government clients throughout Alaska. Some of Mr. Buss's project experience in this position includes:

- **Inside Passage Electric Cooperative –** Provide engineering and technical support to the cooperative in support of Kake, Angoon, Hoonah and Chilkat Valley utilities. Support includes all aspects of the electric utility from power generation, distribution, metering and controls.
- **City and Borough of Juneau Waste Water Department –** Provide engineering and technical support for the CBJ in maintenance and operation of the Juneau Douglas, Auke Bay and Mendenhall Waste Water Treatment Facilities. Provide on-site troubleshooting for the continuing operation of the belt press, SCADA, MCCs, controls and other systems.
- **City and Borough of Juneau Water Department –** Support troubleshooting at Last Chance Basin. Principal engineer for the design and construction management of upgrades to the plant MCC, controls and backup generation.
- **City of Sitka Electric Department**. Acted as the staff engineer for City of Sitka. Duties included troubleshooting outages and system performance issues, control problems, and protective relaying settings. Also provided day-to-day engineering support to electrical department staff.

- **City of Sitka Electric Department Engineering Support.** Provided engineer support for the design, installation and startup of the new Solar diesel fired turbine. Duties included review of manufacturer drawings, supervision of in-house design functions, on-site City representative for inspection, programming and startup of equipment.
- **City and Borough of Juneau Waste Water Department Headworks Upgrade –** Provide engineering support for the technical evaluation of the City and Borough of Juneau's waste water facility headworks. Identify deficiencies in the existing control systems and make recommendations for future upgrade of the headworks.
- **National Radio Astronomy Observatory ALMA Power System Review**. Provided on-site technical expertise in review of the ALMA Observatory in San Pedro de Atacama, Chile. Review of the installed power system including generation and distribution to determine deficiencies and areas of correction. Provide report making recommendations for improving system reliability and safety.
- **Wrangell Substation Relay Upgrade**. Responsible engineer for the design, material procurement, testing, and setting of five SEL-351 protective relay upgrades in an energized substation. Senior engineer on updated coordination study for new relay settings. Supervised and directed installation and customer switching to prevent outages within the City of Wrangell's utility customer base.
- **Petersburg Substation Relay Upgrade**. Responsible engineer for the design, material procurement, testing, and settings of SEL-351 protective relay upgrades in an energized substation. Senior engineer on updated coordination study for new relay settings. Supervised and directed installation and customer switching to prevent outages within the City of Petersburg's utility customer base.
- **Homer Electric Association Bradley Lake Hydro Exciter Replacement.** Responsible engineer for the design, equipment specification, installation support and startup for the replacement of static exciters on two 60 MW hydro generators. Senior engineer for performing updated exciter and associated relay settings and provided oversight for updated stability settings to be applied in new Power System Stabilizer (PSS). Supervised installation and provided startup and testing for new exciters.
- **Homer Electric Association Bradley Lake Hydro Relay Replacement.** Provided senior engineering review of relay replacement at the Bradley Lake Hydro Project. Included replacement of generator, transformer, distribution and transmission relays with updated relay coordination study. Provided on-site installation supervision, startup and commissioning.
- **Kotzebue Electric Association Wind Generation Integration**. Design engineer for upgrading of switchgear and engine controls. Designs included replacement of existing plant switchgear, as well as design and installation of new switchgear and diesel controls. These allow full integration of wind power with diesel generation. Acted as the Owner's representative for factory testing of new equipment. Responsible for developing protective relay coordination study and relay settings. Responsible for implementation and start-up of all relay and control settings.
- **Alyeska Pipeline Services Feeder Relay Protection Upgrade**. Responsible engineer for this project. Completed design for dual microprocessor based feeder relay protection upgrade; delivered coordination study and provided relay settings; and

provided installation supervision, checkout, relay testing, training, start-up, and as-built drawings.

- **Alyeska Pipeline Services Generator Controls Upgrade.** Responsible engineer for design, programming, and field startup of new generator controls for the Alyeska Pipeline Valdez terminal steam turbines. Provided IFC drawing packages, specifications, and engineering support for completion of the project.
- **Alyeska Pipeline Services Generator Protection Upgrade**. Completed design review for dual microprocessor based generator protective scheme. Design included construction drawings for demolition of existing electromechanical relays, installation of new microprocessor based relays, and controls, and upgrades to the protective scheme. Provided installation supervision, checkout, relay testing, training, start-up, and as-built drawings.
- **Alyeska Pipeline Services Black Start Generator Installation.** Responsible engineer for field installation and startup of new Caterpillar C175 3 MW generators that replaced the existing back up generators for the pipeline terminal. Responsible for on-site field modifications, programming of controls, and start-up of controls.
- **Doyon Utilities Fort Wainwright Powerhouse Upgrade and Automation.** Project Engineer for steam turbine upgrade that consisted of upgrading the governors, exciters, turbine controls, SCADA controls, steam supply system, and ancillary electrical equipment and switchgear for four 5 MW steam turbines located within the Fort Wainwright Power Plant. The project included the design for mechanical and electrical systems, and field engineering, as well as testing and commissioning for the project.
- **Doyon Utilities Fort Greely Powerhouse Upgrade**. Responsible engineer for design, installation and startup of three Caterpillar C175 3 MW generators that replaced the existing back up generation at Fort Greely. Responsible for the design of all switchgear, controls, engine interface, and protection. On-site engineer for installation supervision and startup.
- **Doyon Utilities Black Rapids Powerhouse Upgrade and Automation**. Responsible engineer for upgrade of the Black Rapids Powerhouse that took the powerhouse from being manned, to being unmanned. Provided review of existing generator operations and controls, and cost efficient recommendations to meet the requirements of the project. Implemented recommendations in the electrical design, procured required equipment, and supervised and directed installation of the upgrades. Responsible engineer for start-up and commissioning of the control system.
- **Metlakatla Power and Light Five Year Study.** Responsible engineer for the evaluation and report outlining electric utility five year plan. Perform system evaluation, collect equipment data and provide report outlining a five year plan for the utility. Plan included all aspects of utility operations; distribution, generation, relaying, controls, SCADA and metering.
- **City of Wrangell Municipal Light and Power SCADA.** Responsible engineer for the installation of a WonderWare-based SCADA system for monitoring local power plant data. Design, installation, and programming of required communication, network, and software components. Worked with local craft labor and city employees to

coordinate completion of the project.

- **City of Wrangell Municipal Light and Power Generator Troubleshooting.** Provided engineering expertise for troubleshooting of generator control problems. Tuned generator controls, corrected wiring errors, and tested and commissioned modified controls.
- **Green Creek Arc Flash Study.** Responsible engineer for providing an arc flash analysis for the Greens Creek Mine's electrical system. Supervised as-building of existing electrical equipment, modeling of system and arc flash analysis.
- **Kensington Mine Start-Up Assistance**. On short notice, provided engineering review of relay settings and installation. Responsible for check-outs during start-up of generator controls and switchgear. Directed modifications as needed.
- **Thomas Bay Power Authority.** Responsible engineer for the testing of protective relays and meters. This required self guided work, and expertise working on and around energized equipment. Directed and coordinated switching schemes in a manner to minimize outage time.

Electrical Engineer ***1994-2001***

Alaska Electric Light and Power *Juneau, Alaska*

Assistant generation engineer for AEL&P. Facilities owned and operated by AEL&P include three hydro projects constructed in the early 1900's, one hydro project constructed in the 1970's, and back-up diesel power generation. Duties included evaluating and troubleshooting operational and control/relaying problems associated with generation and switchgear design, operation, and maintenance. Produced designs for system improvements related to generation and protective relaying. Acted as the on-call engineer responding to system outages and emergencies. Specific projects and duties included:

- **Staff engineer for generation department.** Responsible for working with craftsmen to operate, maintain, and upgrade the backup diesel generation plants. Work included annual maintenance of diesel turbines, diesel reciprocating engines, hydro generators, and SCADA system. Provided engineered designs for upgrade of existing equipment and relay programming.
- **Upgrade of original hydro voltage regulators and exciters**. Responsible for developing an RFP for replacement of voltage regulators and static exciters on two 36 MVA hydro generators. Performed proposal evaluation, participated in selection of winning bidder, reviewed and approved construction drawings, supervised installation and assisted in start-up and commissioning.
- **Field engineer representing AEL&P during due diligence inspections of the Snettisham hydro project.** Required thorough knowledge of all aspects of the hydro plant. Participated in the inspection of switchgear, substation, tunnels, penstocks, lake facilities (gate shaft, level monitoring, etc.), valves, wicked gates, runners, and efficiency tests.
- **Upgrade of original automatic synchronizer at Snettisham Hydro Project.** Responsible for design of replacement automatic synchronizer. Design included correction of design flaw in original installation. Supervised installation and directed

start-up and commissioning.

- **Management and Operations**. Supervised work performed by skilled employees (IBEW). Responsible for generation department training programs and safety meetings. Trained new operators and crew. Directed work as required.
- **Field engineer for inspection of 138 kV submarine power cables**. Responsible for supervision of the inspection of four 138 kV submarine cables linking the Snettisham power plant to Juneau. Duties included locating and selecting appropriate contractors, documenting the condition of the existing cables, and supervising all work associated with the cable inspection. Provided reports as to the status of the project and condition of the cables to the board of directors.
- **Design and supervise installation of new 138 kV submarine cables.** Responsible for on-site supervision of all aspects of the installation of four new submarine cables. Performed design, installation supervision, and start-up of interface of new submarine cables with the existing 138 kV transmission line. Reviewed design drawings, made field modifications when required, documented installation and testing, and assisted in training of pumping stations.

Education

B.S. Electrical Engineering ***1992-1996***

Washington State University, Pullman Washington

Bering Straits Development Company Résumé

BERING STRAITS DEVELOPMENT CO.

A Subsidiary of the Bering Straits Native Corporation
1010 Front Street, Nome, AK 99762
(907) 443-5254

GENERAL CONTRACTOR COMPANY
INCORPORATED ON JUNE 23RD 1975

BERING STRAITS DEVELOPMENT CO.
A Subsidiary of the Bering Straits Native Corporation
1010 Front Street, Nome, AK 99762
(907) 443-5254

Statement of Corporate Mission

Bering Straits Development Company is located in Nome Alaska sharing the same roof as the parent corporation Bering Straits Native Corporation. The 110 Front Street location is home to the regional construction office and its many departments. Servicing the Nome area, villages within the region and communities throughout Alaska it is the commitment for success through quality and assurance that the construction division and specialty trade departments will continue to grow and prosper.

Our company provides its ongoing devoted services as property managers for the Native Corporation owned facilities. Local, regional and statewide businesses are provided our professional services through maintenance contracts held in position for continuous years. Local and abroad services are well structured with logistics, staff and equipment on hand. Providing professional services to the remote areas in and outside the region has proven effective with the hub location in Nome. A fast reliable service supported by continuous aviation transportation minimizes the logistical challenges and higher rates of out of region contractors.

The services provided by Bering Straits Development Company strongly support the local community with jobs and education. Trade employees benefit greatly from a well structured apprenticeship program instructed by nationally certified instructors. The support continues by using local resources; business's, supply companies and subcontractors benefit from our locally operated general contracting services. It's these services and commitment to quality and professionalism we strive to continue providing locally, regionally and statewide.

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QUALIFICATIONS

Bering Straits Development Company maintains its strong workforce throughout the region based on their ability to take a project from the planning stage and carry it all the way to completion. Projects of all sizes and magnitude set the mold for this company. As the company continues to grow at its abilities the resources and equipment acquired have put BSDC among all strong large business competitors. However remaining a small disadvantage company the ability to team up with large sub contractors and employing local tradesman keeps the project scopes broad.

Bering Straits Development Company has a very skilled internal department along with the ability to pull in resources from any of its sister companies.

- **SOUND QUARRY**
- **GOLDEN GLAICER**
- **STAMPEDE VENTURES**
- **INUIT SERVICES**
- **EAGLE EYE ELECTRIC**
- **AYAK**
- **GREEN ENERGY SOLUTIONS**
- **BS AEROSPACE**
- **BS LOGISTICS**
- **GLOBAL SUPORT SERVICES**
- **IKIGAK SERVICES**
- **IYABAK CONSTRUCTION LLC**

These sister companies support each other to offer a full service contracting firm. Accommodations, car truck and equipment rentals, mineral exploration, utility installations, government contracting, logistics, security systems, fire alarms, large trucking and hauling, mechanical and electrical installations, support and administration are a few of the abilities BSDC can provide.

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NEW DEVELOPMENT PERFORMANCE

Bering Straits Development Company is a full service General Contracting entity holding residential endorsement, full time on staff mechanical and electrical administrators providing services in the region and throughout the state.

Bering Straits Development Company created a department to direct a strong focus on the cost of living in the rural communities. The Energy Efficiency and Renewable Energy Management Department have been working on energy efficiency projects and renewable energy projects throughout the rural areas of the state. The department is tasked locally with finding ways the Native Corporation can cut operating costs of their facilities and collect the data for providing low cost savings development. Each project from concept to execution was internally designed implemented and installed by BSDC employees.

Upgrading heating plants to improve efficiency, upgrading lighting systems to more efficient products, installing LED lighting to cut operating cost up to 80%, replacing and better sealing of windows and doors, replacing motors with higher efficiency type, and installing renewable energy systems where applicable are a few ways BSDC is pioneering ways to a more sustainable lifestyle. All the methods and equipment used to create these energy saving measures have been incorporated into a BSDC owned retail store called Green Energy Solutions. Locally operated the store offers sales of LED and CFL light bulbs, LED fixtures, engine block heater timers, whole home energy monitoring meters, composting units, renewable energy systems and is a place for informative knowledge that displays collected data and images of completed projects.

Bering Straits Development Company continues to procure contracts for new construction and remodel work. BSDC has provided training for the construction department on the techniques of cold climate building and applicable codes. BSDC has residential, commercial and industrial energy auditing services available and has found with providing these certified professional services it has become a key element to determining best case savings for customers.

Construction Manager / Electrical Administrator / Energy Efficiency Specialist	
Name: Robert Bensin	**Location: Nome, Alaska**
Professional Summary	
Mr. Bensin has held a Journeyman's Electrical License in the State of Alaska since 2002 and obtained his Electrical Administrators License in 2009. With over 25 years of electrical experience, Mr. Bensin has developed a broad background in electrical and construction with a strong passion for energy efficiency and renewable energy. Mr. Bensin has brought his expertise to rural Alaska and built a lasting relationships within the communities as an energy specialist. Contracted by the State of Alaska, Mr. Bensin is currently the Point Contact for the Development of the Bering Strait Regional Energy Plan.	
Education and Certifications	

Education

Bayport Bluepoint High School of N.Y. GED

Brookhaven Occupational Construction Education School, New York. Two-year technical school covering the science and formulas of electricity, as well as the design and execution of supply and circuitry wiring.

Certifications

- **State of Alaska Residential Endorsement #100616**
- **Electrical Administrator, State of Alaska #1701**
- **Electrical Journeyman, State of Alaska #20030123**
- **Certified Energy Rater, AHFC #101**
- **Building Performance Institute (BPI) Certified #5016340**
- **Certified Electrical and Specialty Trade Instructor, Solar Photovoltaic and Introduction to Wind #6071731(National Center for Construction Education and Research NCCER)**
- **Certified Instructor for Wind Turbine Safety and Rescue**

Affiliations

- **Member of the International Association of Electrical Inspectors (IAEI)**
- **National Fire Protection Association (NFPA)**
- **U.S Green Building Council (U.S.G.B.C)**
- **National Center for Construction Education and Research (NCCER)**
- **Board Member Seat: Alaska Association of Energy Professionals (AAEP)**
- **Board Member Seat: Renewable Energy Alaska Project(REAP)**
- **Member Home Performance with Energy Star**

Skills

- **Construction Management**
- **Bidding and Proposals**
- **Business Development**
-
- **Residential, Commercial and Industrial Electrical**
- **Controls for Lighting, Automation and HVAC Systems**
- **Cold Climate Construction**
- **Whole Building Diagnostics, Thermal Imaging**
- **Energy Efficiency and Renewable Energy Concepts, Design and Implementation**
- **Certified Energy Rater Specializing in Residential, Commercial and Institutional Energy Audits**

Relevant Employment History

- **Bering Straits Development Company, Construction Manager, Electrical Administrator, Energy Efficiency and Renewable Energy Division Manager, Nome, Alaska 2008-Current:** Perform daily administration for a full service general contracting division, plan review, material takeoffs, bidding, logistics, acquisitions, scheduling, safety training, and field installations.
- **Eagle Electric LLC, Electrical Supervisor, Nome Alaska, 2004-2009:** Journeyman Electrician in charge of all electrical operations in Nome, office, bidding, material purchasing, logistics, scheduling safety training, and field installations.

Solstice Alaska Consulting, Inc. Résumé

ROBIN REICH, PRESIDENT, SOLSTICE ALASKA CONSULTING, INC.

EDUCATION

M.S. studies, University of Alaska, Biology
B.S., Humboldt State University, Biology and Zoology, 1992

PROFESSIONAL AFFILIATIONS

Alaska Association of Environmental Professionals

EXPERIENCE

Robin, who founded Solstice Alaska Consulting, Inc., has more than 20 years of experience planning and preparing environmental documents and permitting for energy projects in Alaska. Robin has prepared numerous Categorical Exclusions and Environmental Assessments in accordance with the National Environmental Policy Act and U.S. Department of Energy, U.S. Department of Agriculture Rural Utilities Service, Denali Commission, Bureau of Indian Affairs, U.S. Environmental Protection Agency, U.S. Fish & Wildlife Service, and other agencies' guidance. She is skilled at obtaining authorizations and permits for energy projects under the Clean Water Act, Endangered Species Act, Migratory Bird Treaty Act, National Historic Preservation Act, and other federal and state regulations. Robin has completed numerous projects in Unalaska and understands the Aleutians' natural environment.

PROJECTS

On Call Environmental Services, Alaska Village Electric Cooperative (AVEC). Currently, Robin is the project manager for an on-call contract to assist AVEC with planning, environmental documents, permitting, public involvement, and grant writing for energy projects throughout Alaska. Under this contract, Robin led permitting activities for wind projects in Bethel, Toksook, Shaktoolik, and Emmonak. She has been responsible for reviewing existing wind farms to ensure that environmental mitigation measures (including bird strike studies and tower diversions) were implemented in Savoonga, Gambell, and Quinhagak. She obtained environmental approvals for interties between Emmonak and Alakanuk, Brevig Mission and Teller, and New Stuyahok and Elim. Also under this contract, Robin has helped secure over $30 million in grants for wind and other energy projects.

Captains Bay (Unalaska) Dock Expansion Project, Offshore Systems. Robin led a team to prepare an U.S. Army Corps of Engineers' wetlands permit application that included a detailed project description, statement of purpose and need, and alternative analysis. Robin successfully consulted with the NOAA Fisheries to comply with the ESA, the MMPA, and the Magnuson-Stevens Act for potential impacts on listed birds and marine mammals and Essential Fish Habitat. Robin then developed wetlands mitigation plan which involved close coordination with the City of Unalaska on the Lower Iliuliuk River Restoration Project.

Adak Hydroelectric Reconnaissance Study, TDX. Robin led a team to research regulatory and FERC jurisdictional requirements for two proposed hydroelectric projects at Adak. Robin researched environmental conditions and worked with project engineers to determine potential impacts to environmental resources including anadromous fish streams, wetlands, cultural resources, and endangered species. Required environmental permits and authorizations were summarized in a memorandum.

Nushagak Electric Feasibility Study, Coffman Engineers. Robin completed environmental field analysis, agency scoping, permitting analysis, and an environmental overview and feasibility report for potential wind, hydroelectric, and heat recovery projects in the Dillingham area. Environmental impacts of future possible wind power generation and hydroelectric sites were evaluated, including extension of electric lines, civil engineering constraints, and vehicular and equipment access.

Mekoryuk Wind Farm Project Environmental Document and Permitting, Coffman Engineers. Robin drafted the environmental document for the installation of two wind turbines in Mekoryuk. She consulted with USFWS and obtained approval for placement of the turbines under the MBTA and the ESA. She consulted with the State Historic Preservation Officer and obtained concurrence that the project would not impact cultural or historic properties. Robin managed a subcontractor responsible for wetlands delineation and employed the data to obtain a USACE wetlands permit. Also, Robin obtained FAA Determinations of No Hazard to Air Navigation.

Deering Wind Project, Coffman Engineers. Robin led a team in preparing applications for a USACE wetlands permit and a Northwest Arctic Borough Land Use Permit for a new turbine in Deering. Work involved consulting with USFWS regarding potential impacts to ESA-listed Spectacled and Steller's Eider, other migratory birds, and polar bears; working with the State Historic Preservation Officer regarding potential impacts to cultural sites; and working with the Borough on local hire expectations.

Akutan Airport EA, DOT&PF. Robin led a team to plan and complete an EA and obtain permits for a new airport on Akun Island. Robin led a large team of scientists and planners who surveyed and prepared reports on the natural environment (wetlands, fish streams, the marine environment, birds, sea otters, and geotechnical conditions). She led public and agency coordination. This project was constructed.

Land Use Permitting Program Development, Aleutian East Borough. Robin helped with the development of permitting database tool to assist with processing permit applications. Robin worked closely with borough staff, the consultant developing the permit program, and the database designers to develop an online computer database that met the needs of the AEB and the requirements of the permitting program. This database is currently in use.

Environmental Planner, Unalaska Airport Safety Improvements EA, Tryck Nyman Hayes, Inc. Robin assisted with public involvement and other project scoping, and a marine habitat characterization for runway rehabilitation and other safety improvements for the Unalaska Airport. The project included performing a marine habitat assessment and drafting an environmental document which was approved by the FAA. The document focused on impacts to the marine environment, historical sites, contamination, and storm water quality.

John E. Wade Wind Consultant, LLC Résumé

RESUME

JOHN E. WADE
Wind Consultant LLC
2575 NE 32nd Ave
Portland OR 97212 (503) 287 4329 bus. phone; Skype: *jwadewind1*; (503) 309 8954 mobile
wade.j@comcast.net e-mail address

SUMMARY

My principal area of expertise is wind energy site selection and evaluation. I have been a principal investigator in wide variety of applied meteorological investigations including estimation of extreme wind speeds; use of vegetation as an indicator of wind energy potential; climate trends in the western United States; utility integration of wind energy; icing effects of on transmission lines and wind turbine generators; corrosion impacts on wind turbines; and remote sensing applications to wind resource assessment. I am the principal author of two US Department of Energy reports: *Biological Wind Prospecting* and *Remote Sensing for Wind Power Potential: A Prospectors Hand book.*

EDUCATION

BS Atmospheric Sciences with minor in Business, Oregon State University, 1974
MS Civil Engineering, University of Washington, 1976

PROFESSIONAL POSITIONS

John Wade Wind Consultant LLC, Portland, OR, Aug 2003 – present
Meteorologist, Terranova Power, San Diego, CA/Portland, OR, Aug 2001 – July 2003
Meteorólogo, Terranova/Eurovento, Santiago de Compostela España, Junio 1999- Julio 2003
Program Technician, Oregon Department of Energy, Salem OR, March 1998- June 1999.
Senior Meteorologist, AeroVironment. Monrovia California and Corvallis OR. July 1996- November 1998.
Research Assistant, Oregon State University, Wind Research Cooperative, Corvallis OR. February, 1998 – June 1999 (part time).
Senior Meteorologist, Kenetech Windpower Inc., San Francisco, CA May 1994- May 1996.
Environmental Project Manager, Oregon Department of Transportation, Salem, OR, and September 1991 - May 1994.
Manager, Ambient Air Projects, Keystone/NEA Environmental Resources, Tigard, Oregon, September, 1990 to September, 1991
Senior Meteorologist, AeroVironment, Monmouth, OR, office, 1988-1989
Vice President/Treasure, Pacific Wind Energy, Corvallis, OR, 1980-1989
Senior Research Meteorologist, Mechanical Engineering, Corvallis, OR, 1987-1989
Senior Research Assistant, Atmospheric Sciences, Corvallis, OR 1977-87
Air Pollution Meteorologist, Food Chemical Research Laboratory, Seattle, WA, 1974-1975
Air Pollution Meteorologist, Mathematical Sciences Northwest, Bellevue, WA, 1975

FIELDS OF SPECIALIZATION

Wind Energy Resource Assessment
Environmental Project Management and Site Screening
Engineering Meteorology
Air Pollution Meteorology
Meteorological Measurements
Applied Climatology

FOREIGN LANGUAGES

Spanish

MILITARY EXPERIENCE

Weather Observer, U.S. Air Force, 1966-1970, Viet Nam Era Veteran, Honorable Discharge.

PATENTS

US Patent Publication (Source: USPTO), Publication No. US 6975925 B1 published on 13-Dec-2005

Application No. US 10/393703 filed on 19-Mar-2003, Abstract (English)

Methods and apparatus for forecasting energy output of a wind farm. A method for forecasting an energy output of a wind farm includes maintaining a data base of wind patterns, each wind pattern being associated with an energy output that the wind farm produces. The method includes receiving a current wind pattern. The method includes searching the data base for a wind pattern that matches the current wind pattern. The method includes calculating a forecast energy output that the wind farm will produce in response to the current wind pattern, the calculation being based, when there is a matching wind pattern in the knowledge base, on the energy output associated with the matching wind pattern.

Inventors/Applicants: Barnes, David L., Juarez, Ruben, Wade, John
Assignees: Windlynx Systems, B.V. San Diego, CA, US
Classifications: International: H02J 1/14, National: 700/286; 700/287, Field of Search: 700/286; 700/287; 700/290; [+4]

CONSULTANT WORK EXPERIENCE

C.F. White Fluoride Plant Environ. Assess. **Valentine, Fisher and Tomlinson**, 1975.
Air Quality Analysis for BC Hydro, **Environmental Research and Technology**, 1976.
Determination of Dispersion Coefficients from Wind Data, **Alsid and Snowden**, 1976
Wind Power Resource Assessment in the State of California and Development of a Resource Assesment Methodology, **California Energy Commission**, 1978.
Wind Power Potential in the Pacheco Pass Region in Central California, commissioned by the **California Department of Water Resources**, 1978.
Wind Flow in Eagle Lake area in Northern California, **Global Weather Associates**, 1978.
Wind Field Assessment in the Tehachapi Mountains, **Aerovironment, Inc**., 1979.

Wind Field Assessment in the Altamont Pass Area, **Pacific Gas and Electric**, 1979.
Wind Field Assessment in New Hampshire, **Arthur D. Little, Inc**.,
Wind Field Assessment in the Pacific Power and Light Service Area, **Pacific Power and Light** (***Pacific Corps***), 1979.
Wind Flow Analysis Around the Peebles Test Facility, **General Electric Company**, 1979.
Wind Assessment at Whisky Run, **Pacific Power and Light Company**, 1980.
Wind Prospectus California and Nevada, **Wind Farms Ltd**., 1981.
Wind Resource Reliability Assessment, Solano Pass and San Gorgonio Pass Areas, **Arthur D. Little Inc.,** 1982-1983.
Wind Resource Studies at Agate Beach Wind Turbine Site, **Alcoa Allied Products**, 1982.
Wind Resource Assessment at Whisky Run, **PP&L**, 1983-1987.
Wind Resource Assessment in the Owens Valley, **Southern California Edison**, 1984-1985.
An Assessment of Interannual Wind Variation in Southern California, **Zond, Inc**., 1985.
Wind Flow Studies for Micrositing**, Solar Energy Research Institute**, 1985-1988.
Precipitation Effects of Wind Turbine Performance, **Solar Energy Research Institute**, 1985-1987.
Evaluation of Massachusetts & New Hampshire, Wind Energy**, AeroVironment, Inc.,** 1985.
Performance Evaluation of California Windfarms, **Internal Revenue Service**, 1986-1987.
Wind Resource Evaluation of Methodology, **R. Lynette & Assoc**., 1987-1988.
Wind Turbine Performance Evaluation, **Crosby, Heafey, Roach and May**, 1987.
Wind Turbine Performance Evaluation, **Denenberg, Tuffley, Bocan and others**, 1988.
Galloping Conductor Study, **Bonneville Power Administration**, 1988.
Pesticide Drift in the Horse Heaven Hills, **Stuart Turner Company**, 1989.
Pacific Northwest Wind Power Prospecting, **Zond Wind Energy Systems**, 1991 - 1993.
Wind Energy Prospecting Pacific Northwest, **Carter Wind Turbines**, 1992 - 1993.
Wind Energy Assessment - Royal Slope Area, **Myrick and Sons**, 1993.
Juniper Point Wind Energy Study, **Columbia Aluminum**, 1993.
Ice Effects on Wind Turbine Performance**, W.A. Vachon and Associates**, 1994.
Due Diligence for Various Wind Energy Projects, **W.A. Vachon and Associates**, 1996-98.
Wind Resource Analysis, **Chugach Electric**, Anchorage AK, May 1998- present.
Wind Resource Analysis, Energy Northwest, Richland WA August 2001 to present.
General Consulting, PPM Energy, Portland OR, November 2001- present.
Wind Map Verification, National Renewable Energy Laboratory, Boulder CO, Sep. 2001- present
PPM Energy, a subsidiary of Scottish Power, Portland OR, 2001-present.
Energy Northwest, 2001 Richland WA 2001 –present
Chugach Electric, Anchorage AK, 2001-present.
CH2M-Hill, Seattle WA, 2002-present.
Many other clients that disclosure agreement does not permit listing.

<u>PROFESSIONAL ACTIVITIES</u>
<u>Professional Societies</u>
American Meteorological Society
American Wind Energy Association
<u>Committees, Commissions and Boards</u>

Technical Advisor for the Yaquina Head Advisory Committee, Yaquina, OR, 1978.
Member, Oregon State Solar Energy Advisory Board, 1978.
Governor Solar Energy Advisory Group, 1978-1979
State of Oregon Global Warming Advisory Committee 1988-1989

PUBLICATIONS

Technical Journals

"Trees as a Local Climate Wind Indicator," **J. Appl. Meteor.**, 18, 1182-1187, 1979.

"Reply to comment of J.P. Hennessey on *'Trees as a Local Climatic Wind Indicator',"* **J. Appl. Meteor.,** 19, 1024-1026, 1980.

"Wind Power Prospecting Using Aerial Reconnaissance," **Wind Enginr.,** 4, 108-114, 1981.

"*Annual and seasonal variations in mean wind speed and wind turbine energy production,"* **Solar Energy,** 45, 285-289, 1990.

"*Wind Energy Prospecting and Site Evaluation Methodology,*" (with R.W. Baker), **Wind Power Digest**, January 1979.

Books

"A Handbook on the Use of Trees as an Indicator of Wind Power Potential," DOE Report RLO-2227-79-3, 1979.

"A Guide to Biological Wind Prospecting," (with E.W. Hewson), DOE Report RLO-2227-80-2, 1980.

"Remote Sensing for Wind Power Potential - A Prospectors Handbook," (with P.A. Maule, C.L. Rosenfeld, S.G. Woodley, G. Bodvarsson, and M.R. McClenahan), DOE Report ET-20316-81-1, 1981.

CONTRACT RESPONSIBILITY

"Vegetation as an Indicator of High Wind Velocity," U.S. Department of Energy, E.W. Hewson, Principal Investigator, J.E. Wade, Co-Principal Investigator, $288,000, 1977-1981.

"State Anemometer Loan Program," Oregon Department of Energy, J.E. Wade, Principal Investigator, R.W. Baker, Co-Principal Investigator, $13,182, 1978-1979.

"Investigation of Wind Power Potential on Bureau of Reclamation Land in the Pacific Northwest," Bureau of Reclamation, R.W. Baker and J.E. Wade, Co-Principal Investigators, $8,780, 1979-1980.

"Investigation of the Wind Regime at Boardman, Oregon," Battelle Pacific Northwest Laboratories, J.E. Wade, Principal Investigator, $7,500, 1980.

"Wind Power Potential at 4 Oregon State Parks," Oregon Department of Energy, J.E. Wade, Principal Investigator, R.W. Baker, Co-Principal Investigator, $11,707, 1983-1984.

"Regional Wind Energy Assessment in the Bonneville Power Service Territory," Bonneville Power Administration, R.W. Baker, Principal Investigator, J.E. Wade, Co-Principal Investigator, $1,414,971, 1980-1986.

"Wind Energy Research at the Whisky Run Windfarm, Soar Energy Research Institute, J.E. Wade Principal Investigator, $52,000, 1987-1988.

"Wind Energy Assessment in the Goodnoe Hills and Cape Blanco Areas," Bonneville Power Administration, R.W. Baker,Principal Investigator, J.E. Wade, Co-Principal Investigator, $908,000, 1980-1986.

"Long-Term Trend Tracking and Climatological Analysis of the Pacific Northwest Wind Data Base," Bonneville Power Administration, J.E. Wade, Principal Investigator, $206,011, 1986-1987.

"Wind Energy Data Base Management and Forecasting," Bonneville Power Administration, S.N. Walker, Principal Investigator, J.E. Wade, Co-Principal Investigator, $181,315, 1987-1989.

"Extreme Winds at FAA Repeater Sites," Federal Aviation Administration, J.E. Wade, Principal Investigator, $1,500, 1988.

"Investigation of the Impact of Changing Climate on Climate Variability and Extremes," Pacific Gas and Electric Company, J.E. Wade, Principal Investigator, $30,000, 1989-90.

"Climate Trend Investigation in the Western United States," Southern California Edison Company, J.E. Wade, Principal Investigator, $25,000, 1990.

"Tacoma Slag Study," sub to SAIC prime for Environmental Protection Agency, J.E. Wade, Principal Investigator, $35,000, 1990-1991.

"Alkali Lake Hazardous Waste Site Characterization of Meteorology and Volatile Organic Compound Emissions," sub to PTI prime for Oregon Department of Environmental Quality, J.E. Wade, Principal Investigator, $53,000, 1991-1992.

"Carbon Monoxide Investigation in the Vicinity of Geneva Steel, Geneva Steel, $75,000, 1991.

<u>SPECIAL TRAINING</u>

Hazardous Material Training (40 hours) May 1991, (8 Hour Refresher) May 1992.

Hazardous Material Training for supervisors (8 hour) May 1991.

Sampling Air Toxics (8 hours) EPA Training Course, Durham, NC April, 1991.

Transportation Planning Rule, (8 hours), Oregon Department of Transportation (ODOT) Technical Training Workshop, November, 1991

Working, 40 hours ODOT Personnel Training Course, February, 1992.

Value Engineering, (40 hours), ODOT Leadership Training Course, scheduled May 1993.

Environmental Impact Analysis Training, Federal Highway Administration, (32 hours), scheduled July, 1993.

Artemis Project Planning Training, ODOT Training program for project scheduling, resource allocation and budgeting.

ArcInfo, Geographic Information System ESRI, Salem February 1998.

ArcView, Geographic Information System ESRI, Salem May 1998.

WAsP, Numerical modeling to predict wind energy output, Riso National Laboratories Roskilde, Denmark.

<u>Conference Proceedings</u>

"Meteorological Factors Affecting Sulfate Molecular Form in the Midwest," (with R.J. Charlson), Proceedings of the Pacific Northwest International Section of the Air Pollution Control Association, Spokane, WA, 1977.

"Biological Wind Prospecting," (with E. W. Hewson), Third Biennial Conference and Workshop on Wind Energy Conversion Systems, Washington, DC, 1977.

"Trees as an Indicator of Wind Power Potential," (with E.W. Hewson), Proc. of the 1978 Annual Meeting of American Section of the International Solar Energy Society, Denver, CO, 754 pp., 1978.

"Trees as an Indicator of Wind Power Potential, (with E.W. Hewson), Proceedings of the Conference on Wind Characteristics and Wind Energy Siting, Portland, OR, June 1978.

"Field Measurements in the Wake of a Wind Turbine Generator," (with R.W. Baker), Proceedings of the American Wind Energy Association Meeting, Portland, OR, April 1981.

"Applications of Remote Sensing to Wind Power Facility Siting," (with P.A. Maule and C.L. Rosenfeld), International Geophysics and Remote Sensing Symposium Proceedings, Washington, DC., June 8-10, 1981.

"Biological Wind Prospecting," (with E.W. Hewson), 62nd Annual Meeting of American Association for the Advancement of Science (Pacific Division), Eugene, OR, June 15-17, 1981.

"Wind Characteristics at Selected Wind Power Data Stations in the Pacific Northwest," (with R.W. Baker), Fourth U.S. National Conference of Wind Engineering Research, Seattle, WA, July 26-29, 1981.

"Field Measurements in the Wake of a Wind Turbine Generator," (with R.W.Baker), in Proc. Am. Wind Energy Assoc., Portland, OR, April, 1981.

"Wind Power Assessments and Remote Sensing," (with P.A. Maule and C.L Rosenfeld), in Technical Papers of American Society of Photogrammetry, ACSM-ASD Convention, Denver, CO, 1982 .

"The Use of Dendrological Indicators of Blowdown and Mass Wasting," in the Proceedings of the Regional Meeting of the National Council of the Paper Industry for Air and Stream Improvement, Portland, OR, 1983.

"A Strategy for Taking Wake Measurements in Complex Terrain," (with R.W. Baker, O.P.G. Persson and S.N. Walker), Proceedings of the Sixth Biennial Wind Energy Conference, Minneapolis, MN, June 1983.

"Wind Resource Assessment at Oregon State University," presented at the American Wind Energy Association Meeting, San Francisco, CA, September 1983.

"Assessing Wind Climate in Complex Terrain Using Wind Deformed Trees," (with R.W. Baker and J.D.Geyer), presented at the Third Conference on Mountain Meteorology, October 16-19, Portland, OR, 1984.

"Ridgecrest Winds in Mountainous Terrain," (with R.W. Baker and O.P.G. Persson), Corvallis, OR, 1983. Also presented at the Third Conference on Mountain Meteorology, Portland, OR, October 16-19, 1984.

"The Meteorological Aspects of Wind Farm Feasibility Study Conducted at Cape Blanco, OR," (with R.W. Baker, N.G. Butler, and A. Duncan), presented at the 1986 American Society of Mechanical Engineers Meeting, New Orleans, LA, February 1986.

"Wind Energy Studies at Whisky Run Windfarm," (with S.N. Walker and R.W. Baker), presented at the 1987 American Society of Mechanical Engineers Meeting, Dallas, TX, 1987.

"Local Windflow Studies at the Whisky Run Wind Generation Facility," (with S.N. Walker and J. Lambert), presented at the 1987 ASME-JSME Solar Energy Conference, Honolulu, HI, 1987.

"Estimating Extreme Winds at Wind Energy Conversion Facilities," (with R.J. Wittrup and N.G. Butler), presented at the Annual American Wind Energy Conference, San Francisco, CA, 1987.

"Wind power prospecting in developing countries," (with S.N.Walker), presented at the Annual American Wind Energy Conference, Honolulu, HI, 1988.

"Climate change and its impact on utilities in western North America," (with N. Butler, R. Swanson and J. Young) presented at the 84th Annual Meeting of the Air Waste Management Assoc., Vancouver, BC, 1991.

"Chemical composition of a coal fired power plant plume," (with J.A. Cooper), presented at the 84th Annual Meeting of the Air Waste Management Association, Vancouver, BC, 1991.

Technical Reports

"The Addy Air Quality Monitoring Program: Current Data Accumulation and Potentially Usable Atmospheric Parameters," (with G.A. Erickson), Washington Department of Ecology Report, MSNW 75--236-2, 1975.

"Vegetation as an Indicator of High Wind Velocity," (with E.W. Hewson and R.W. Baker), ERDA Report RLO-2227-77-2, 1977.

"Wind Potential in Selected Areas of Oregon," (with E.W. Hewson and R.W. Baker), Report No. PUD 77-5, Oregon State University, 1977.

"Wind Energy Field Survey in Southern California," (with R.W. Baker), Energy Resources Conservation and Development Commission, Sacramento, CA, 1978.

"Wind Energy Study - Pacific Northwest Region," (with J.N. Peterson, E.W. Hewson, D.O. Everson, R.W. Baker, and D.W. Amos), Technical Report prepared for the Army Corps of Engineers, Walla Walla District, Walla Walla, WA, 1978.

"A Program for Assessing the Local Wind Field with Instrumentation," (with T. Zambrano), AVR-9550, AeroVironment, Inc., Pasadena, CA, 1979.

"Vegetation as an Indicator of High Wind Velocity," (with E.W. Hewson and R.W. Baker), DOE Report RLO-2227-79-1, 1979.

"Wind Energy in the Mountains of New Hampshire as a Potential Energy Source for the Portsmouth Naval Shipyard," (with W.A. Vachon, W.T. Downey, F. March, F.R. Madio and G.R. Schimke), prepared for Naval Material Command, Washington, DC, 1979.

"Pacific Power and Light Wind Resource Study," (with R.W. Baker), published by Pacific Power and Light Company, Portland, OR, 1980.

"Regional Wind Energy Assessment Program Progress Report," (with R.W. Baker, O.P.G. Persson, and B. Armstrong), BPA Report BPA 81-6, 1981.

"Wind Energy Assessment Studies in the Goodnoe Hills-Cape Blanco Areas," (with R.W. Baker, O.P.G. Persson, and R.W. Katz), BPA Report BPA 81-7, 1981.

"Wind Energy Assessment Studies in the Goodnoe Hills and Cape Blanco Areas," (with R.W. Baker and O.P.G.Persson), BPA Report 82-10, 1982.

"Regional Wind Energy Assessment," (with R.W. Baker and O.P.G. Persson), BPA Report 82-9, 1982.

"Regional Wind Energy Assessment," (with R.W.Baker), BPA Report 83-12, 1983.

"Wind Energy Assessment Studies in the Cape Blanco Area," (with R.W. Baker and P.C. Katen), BPA Report 83-14, 1984.

"A Wind Resource Assessment at 4 Oregon Coastal Parks." (with P.A. Maule), Technical Report prepared for the Oregon Department of Energy, 1984.

"Wind Energy Assessment Studies at the Cape Blanco Wind Farm Study Area," (with R.W. Baker), BPA Report 84-17, Oregon State University, Corvallis, OR, 1984.

"Regional Wind Energy Assessment Program, Progress Report, October 1983-September 1984," (with R.W. Baker and R.J. Wittrup), BPA Report 84-18, Oregon State University, Corvallis, OR, 1985.

"A Wind Energy Assessment in the Northeastern Southern California Edison Service Territory," (with R.W. Baker and S.N. Walker), Pacific Wind Energy Report 85-1, Corvallis, OR, 1985.

"Regional Wind Energy Assessment Program, Progress Report, October 1983-September 1984," (with R.W. Baker and R.J. Wittrup), BPA Report 84-18, Oregon State University,Corvallis, OR, 246 pp., 1985.

"A Wind Energy Assessment in the Northeastern Southern California Edison Service Territory," (with R.W. Baker and S.N. Walker), Pacific Wind Energy Report 85-1, Corvallis, OR, 326 pp., 1985.

"Pacific Northwest Wind Regional Assessment Program Volume I-II," (with R.W. Baker, R.J. Wittrup, J.A. Buckley, and W.E. Frick), BPA Report 85-19, Corvallis, OR, Vol. I. 152 pp., Vol. II 257 pp., 1985.

"Energy Estimates at the Whisky Run Wind Farm," (with R.W. Baker and S.N. Walker), Pacific Wind Energy Report 85-2, Corvallis, OR, 38 pp., 1985.

"The Relationship of Recent Wind Measurements in San Gorgonio and the Tehachapi's to the Long Term Wind Climatology of Southern California," (with R.W. Baker), Pacific Wind Energy Report 85-3, 34 pp., 1985.

"Wind Turbine Performance and Array Spacing," (with R.W. Baker and S.N. Walker), BPA Report 86-20, Portland, OR, 130 pp., 1986.

"Cape Blanco Wind Farm Feasibility Study," (with R.J. Wittrup), BPA Report 86-21, Portland, OR, 105 pp., 1986.

"Regional Wind Energy Assessment Program," (with R.W. Baker and K. Redmond), BPA Report 86-22, 275 pp., 1986.

"Verification of Wind REAP Data and an Investigation of an Approach for Filling in Missing Data," (with R.J. Wittrup, J.R. Buckley, and S. De Silva), BPA Report 87-23, 105 pp., 1987.

"Analysis of Characteristics of Extreme Winds at Wind Energy Survey Sites in the Pacific Northwest and Prediction of Design Wind Speeds," (with R.J. Wittrup), BPA Report 87-24, 116 pp., 1987.

"Climate Changes in the Pacific Northwest and Its Impact on Energy Planning; Preliminary Report of Findings," (with R.J. Wittrup and K.R. Redmond), BPA Report 87-26, 145 pp., 1988.

"Regional Wind Energy Assessment Program," (with S.Y. Kenagy), BPA Report 87-27, 58 pp., 1988.

"The Effects of Climate Change on Energy Planning and Operations in the Pacific Northwest Volumes I and II," (with K.E. Redmond and P.A. Klingeman), BPA Report 89-29, 1990.

"Regional Wind Energy Assessment Program," (with S.N. Walker), BPA Report 88-28, 52 pp., 1989.

"Wind Forecasting on Utility Operations," (with S.N. Walker and R.W.Baker) BPA Report 89-30, 1990.
"Seasonal Weather Forecast Verification," (with S.N. Walker and R.W.Baker) BPA Report 89-31, 1990.
"Integration of Wind Energy into the Electrical Utility System," (with S.N. Walker and R.W.Baker) BPA Report 89-32, 1990.
"Regional Wind Energy Assessment Program," (with S.N. Walker), BPA Report 89-33, 61 pp., 1990.

Others Prepared Reports

Numerous proprietary reports for developers including: Design Projected Output for Windplants, Quality Assurance Plans, Sampling and Analysis Plans, Standard Operating Procedures, Technical Reports, White Papers, and Research Proposals, Turbine Suitability and Plant Performance.

INVITED SEMINARS

"Wind Power," Eastern Oregon State College, LaGrande, OR, 1977.

"Wind Power Research, "Northwest Regional Construction Institute, Mt. Hood, OR, 1978.

"Biological Wind Prospecting," Dartmouth College, NH, 1979.

"Trees as an Indicator of Wind Power Potential," University of Virginia, VA, 1979.

"Trees as an Indicator of Wind Power Potential," University of Texas, Austin, TX, 1979.

"Wind Power Research Activities at OSU," "OSU Today" meeting, OSU Foundation, Oregon State University, Corvallis, OR, March, 1981.

"Wind Prospecting," Atmospheric Research Center, State University of New York, Albany, NY, June 1981.

"The Use of Dendrological Indicators of Blowdown and Mass Wasting," Regional Meeting of the National Council for Air and Stream Improvement, Portland, OR, May 1983.

"Local Wind Flow Variation Before and After Installation of a Wind Generation Facility," U.S. Department of Energy, Livermore, CA, January 1987.

Financial Engineering Co. Résumé

the Financial Engineering Company was formed as a sole proprietorship in 1995 to assist clients in developing and analyzing the data required for long-term decisions. These decisions can relate to lending of capital funds, strategic plans, implementation of capital projects, fuel supply, and other issues. Although the majority of clients are within the electric utility industry, projects in other industries have included ethanol production, commercial fishing, mining, natural gas, petroleum, and transportation.

Long-term projections have inherent imprecision, and even if a long-term forecast is relatively accurate, short-term fluctuations can significantly affect operating results. Consequently, investigations include thorough reviews of alternative assumptions – both short- and long-term.

Many clients have Boards of Directors with backgrounds outside of the industry. Consequently, reports present the findings in a clear, concise manner that can be fully understood by audiences with diverse backgrounds.

Projects typically lend themselves to the development of computer software developed specifically for each project. While large programs developed for specific industries are used at times, the “one-size-fits-all” lacks a degree of precision that is important for an analysis. The Financial Engineering Company can quickly develop the required programs, usually with less time being required for the entire project than if a “canned” program was used.

Originally located in Anchorage, Alaska, the company was moved to Rockport, Maine, in 2002.

For more information, contact:

Michael Hubbard, P.E.
the Financial Engineering Company
235 Rockland Street
Rockport, Maine 04856
(207) 593-9131 / (907) 522-3351
(207) 593-9053 / (907) 344-1843 (fax)
email: mhubbard@FinEngCo.com

OVERVIEW

Mr. Hubbard has over 35 years of experience in providing consulting services to a wide variety of clients in the electric power industry. Services include:

- Detailed power supply modeling and integration with long-term financial analyses
- Development of finance plans and equity management plans to implement specific capital additions or system financings
- Cost allocation analyses in support of rate development
- Strategic and risk assessments for implementing courses of action
- Computer modeling including the development of several client-specific hourly dispatch models and financial planning tools
- Valuation of utility systems

Consulting services are provided primarily to consumer-owned utilities, although other clients have included investor-owned utilities and private clients.

EDUCATION

Master of Business Administration (1980) - University of Washington, Seattle, Washington (Areas of Concentration: Operations and Systems Analysis, Finance)

B. S. in Civil and Environmental Engineering (1977) - Washington State University, Pullman, Washington

EMPLOYMENT HISTORY

1995 - Present
the Financial Engineering Company (Founder and Principal)

1990 - 1995; 1980 - 1984
R. W. Beck and Associates, Anchorage, Alaska; Sacramento, California (AK - Director, Alaska Operations; CA - Supervising Engineer)

1988 - 1990
Frank Moolin & Associates, Inc., Anchorage, Alaska (Manager of Consulting Engineering)

1984 - 1988
Alaska Energy Authority, Anchorage, Alaska (Finance Manager)

PRESENTATIONS/TESTIMONY

- Alaska Rural Energy Conference – Taking the Mystery Out of Rates
- International County/City Managers Annual Meeting – Utility Deregulation: A Case History
- Alaska Rural Energy Conference – Northwest Arctic Borough Regional Generation Plan

- Alaska Public Utilities Commission – Golden Valley Electric Association: Purchase of FMUS Electric System (Written Testimony / Oral Testimony)
- Regulatory Commission of Alaska – Golden Valley Electric Association: Revenue Requirements and Cost of Service Study (Written Testimony)
- Regulatory Commission of Alaska – TDX Sand Point Generating: Cost of Service Study
- Regulatory Commission of Alaska – TDX Sand Point Generating: Cost of Service Study
- Regulatory Commission of Alaska – Alaska Power Company: Cost of Service Study
- Alaska Public Utilities Commission – State of Alaska: Healy Clean Coal Plan of Finance
- Maine Public Utilities Commission – Houlton Water and Power Company: Rate Benefits of Alternative Transmission Service
- Maine Public Utilities Commission – Kennebunk Light & Power District: Revenue Requirements/Rate Filing
- Maine Public Utilities Commission – Fox Islands Electric Cooperative, Inc: Revenue Requirements/Cost of Service/Rate Filing (2006)
- Maine Public Utilities Commission – Fox Islands Electric Cooperative, Inc: Revenue Requirements/Rate Filing (2002, 2003, and 2005)
- Maine Public Utilities Commission – Town of Madison: Revenue Requirements/Rate Filing
- Maine Public Utilities Commission – Town of Madison: Inception Rate Filing
- Numerous presentations to Boards of Directors, Councils, and Consumers

PROFESSIONAL REGISTRATION / BOARDS

State of California - C 34827 (Civil Engineer). Passed Arctic Engineering course.

Past Board Member (Alternate) of the Northern Maine Independent System Administrator, Inc.

OTHER

Mr. Hubbard has extensive experience with Visual Basic for Applications (VBA) and has written numerous programs for client-specific applications. The integration of these VBA programs with Excel for Input and Output enhances the usefulness with client interaction and integration with other planning models. Programs include: 1) hourly economic dispatch models used for resource evaluation, long-term financial planning, avoided cost calculations, and estimates of integration costs; 2) reservoir modeling, and 3) financial forecasts.

Renewable Resource Studies

Mr. Hubbard has played a key role in evaluating renewable energy resources for various utilities. Projects include the following.

PV/BESS System, Kaua'i Island Utility Cooperative – Responsible for modeling the KIUC system dispatch with and without potential PV/BESS systems. Initial modeling included writing a VBA program to estimate hourly discharge from the BESS into the grid to minimize high-cost thermal resources. The hourly model used by KIUC at the time for overall system modeling was later updated to a different vendor, and Mr. Hubbard is now responsible for all system modeling using this new program. PV/BESS systems are now modeled as mini-hydro pump storage to optimize charges to and discharges from the BESS.

Wind Integration Analysis, Golden Valley Electric Association – A wind developer is attempting to sell power from a potential wind resource to GVEA under PURPA guidelines. Mr. Hubbard is responsible for modeling the GVEA system and determining the amount of regulation required to follow the wind resource, the impact that the additional regulation requirements has on other resources, the cost of the additional regulation, and the overall cost impact that the wind resource has on the ratepayers.

Floating Wind Platform Development, Monhegan Plantation Power District – A developer desires to install several small, floating wind turbines offshore from Monhegan Island in the State of Maine. As part of this development, the developer has offered economic incentives to MPPD, and Mr. Hubbard is responsible for evaluating these incentives and helping MPPD chart a path forward. Part of this analysis requires analyzing other renewable resource options and the risk associated with the developer's project.

Financial and Other System Modeling

Mr. Hubbard has modeled the financial operations of numerous clients. As such, he must be well-versed in accounting systems of utilities, financial structures, lending requirements, and regional energy markets.

Client Specific Models, *Various Clients.* Mr. Hubbard has developed numerous client-specific models that detail financial operations over a multi-year evaluation period. Modeling is used in support of debt financing, evaluating specific projects, and developing sustainable business plans. Models include both system and project-specific evaluations with specific projects including wind turbine installations, hydroelectric resources, gas-fired turbines/combined cycle projects, geothermal resources, an LNG system, and others. Models have included:

- Financial Forecast Model, City of Boulder. This model was developed for the client to use in projecting the feasibility of acquiring the IOU assets and setting up a municipal utility. Model development included both on-line documentation as well as a User's Guide, and the model was released to the public for use by those interested.
- Financial Forecast and Rate Model, Fishers Island Utility Company, Fishers Island, New York. Developing a financial forecast model to be used in support of rate adjustment filings submitted to the New York Public Service Commission.
- Management Financial Forecast Model, Kaua'i Island Utility Cooperative. A model is being developed by Mr. Hubbard for use by KIUC management in projecting various financial metrics based on relatively high-level input assumptions.
- Financial Forecast/Rate Development Model, Cordova Electric Company. Develop a 15-year financial forecast to be used by CEC staff in support of on-going operations as well as support in borrowing.
- Hourly Dispatch Model, various clients. Mr. Hubbard has modeled several electric utility systems that simulates dispatch on an hourly basis for multiple years. One model was developed specifically for the client to use while other models have been developed for on-going work by Mr. Hubbard.

US Rural Utilities Service Financial Forecast Model, *Various Clients.* Mr. Hubbard has extensive experience with the RUS Financial Forecast model and has modified the model to incorporate the various nuances of specific client systems, especially those with generation assets, and to make the model more user-friendly. Clients include: Golden Valley Electric Association, Naknek Electric Association, Kaua'i Island Utility Cooperative, Kotzebue Electric Association, and Fox Islands Electric Cooperative.

Ethanol Plant Restructuring. As part of a team managing the operations of two ethanol plants, Mr. Hubbard developed a 13-week cash flow model to project cash flow infusion requirements until the plants were sold. The model was continually updated to assist in evaluating potential hedging of corn and ethanol.

INTEGRATED RESOURCE PROGRAMS/POWER SUPPLY EVALUATIONS

Power Supply Modeling, Avoided Cost, Long-Range Planning, *Kaua'i Island Utility Cooperative (On-going).* Primary modeler of the KIUC system using the UPLAN modeling software and now setting up GenTrader to model the KIUC system. Responsible for inputting system and resource parameters into the model and running the model in support of fuel budget forecasts, rate filings, load forecast development, integrated resource planning, and other activities. Analysis includes projecting hourly avoided costs with these projections used in Schedule Q (purchase of behind-the-meter solar) rate filings with the Commission and evaluating several specific solar and solar/battery storage systems. Also responsible for running the RUS Financial Forecast model in support of loan applications and utility planning.

Resource Evaluation/Avoided Cost Support, *Golden Valley Electric Association (On-going).* Assist the utility in evaluating various resource and fuel options using the GenTrader dispatch software. Prior to the implementation of GenTrader, Mr. Hubbard wrote an economic dispatch model specific for GVEA that simulated utility operations on an hourly basis over a multi-year study period and was constructed using the VBA programming language and Excel for Input/Output.

Power Supply Study, *City of Unalaska.* Assist the City in several studies evaluating various power supply options in an effort to reduce the use of diesel generation. Responsibilities include meeting with potential power suppliers and developers, fuel suppliers, and others to assess the probability of success, develop paths forward, preparing financial assessments of various options, and reporting to City staff and Council. Three specific reports were prepared that evaluated various generating options and made recommendations for immediate generation additions and long-term courses of action. An hourly dispatch model was developed by Mr. Hubbard to properly account for resource usability and spinning requirements given the seasonality of loads and how loads can change by several megawatts in very short periods of time. Action plans were developed for implementing courses of action while taking into account the various risks. Generating technologies evaluated included geothermal, wind, solar, tidal, wave, hydroelectric, and LNG.

Alternative Power Supply, *Copper Valley Electric Association.* Evaluated various power supply alternatives for this remote utility as the utility attempts to lessen its dependence on fossil fuels. Generating technologies evaluated included biomass, wind, solar, geothermal, and specific hydro sites. Based on the findings of the study, CVEA is now pursuing the development of the Allison Lake hydroelectric project.

Confidential Client – Hydroelectric Purchase, *Cooperative.* Evaluated the potential risks and benefits for this client to purchase a hydroelectric facility that was then owned by another entity. An hourly resource/dispatch model was developed that included reservoir modeling to properly evaluate hydro production given inflows, mandatory releases, and generation outflows.

COST-OF-SERVICE / RATE STUDIES

Mr. Hubbard has been responsible performing revenue requirement, cost of service, and rate-design analyses in both the regulated and un-regulated arenas. Specific clients and projects include the following.

Kaua'i Island Utility Cooperative: Marginal Cost of Power

Monhegan and Matinicus Islands: Rate Setting Analysis

City of Seward: Cost-of-Service/Rate Study

Kennebunk Light and Power District: Rate Study,

City of Unalaska: Cost-of-Service/Rate Study

Cordova Electric Association: Cost of Service/Rate Design

Fox Islands Electric Cooperative: Cost-of-Service/Rate Study

Nome Joint Utilities System: Cost-of-Service/Rate Study

Cultural Resource Consultants, LLC Résumé

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C

CULTURAL RESOURCE CONSULTANTS LLC

3504 East 67th Avenue
Anchorage, Alaska 99507
(907) 349-3445

Michael Roy Yarborough

Education:

- University of Toronto, course work for Ph.D., 1973 to 1974.
- University of Toronto, Master of Arts Degree in Archeology, 1973.
- University of Arkansas, Bachelor of Arts Degree with high honors in Anthropology, 1972.

Employment:

- Principal Archeologist, Cultural Resource Consultants LLC, Anchorage, July 1981 to present.
- Archeologist, USDA Forest Service, Chugach National Forest, Anchorage, April to May 1990.
- Archeologist, U.S. Fish and Wildlife Service, Alaska Regional Office, Anchorage, June 1977 to July 1981.
- Supervisory Archeologist, Alyeska Pipeline Project, Institute of Arctic Biology, University of Alaska, Fairbanks, May 1974 to August 1976.

Selected Manuscripts and Publications

Yarborough, Michael R.
1984 *Archeological Survey of a Proposed Airport Site, Unalaska, Alaska*. Cultural Resource Consultants, Anchorage.

Yarborough, Michael R.
1989 *Archeological and Historical Survey of the UniSea Port Complex, Dutch Harbor, Alaska*. Cultural Resource Consultants, Anchorage.

Yarborough, Michael R.
1998 Archeological Testing of UNL-048, The Margaret Bay Site, Unalaska, Alaska. Cultural Resource Consultants, Anchorage.

Yarborough, Michael R.
2001 *2000 Archaeological and Historical Report on the Environmental Restoration of Amaknak and Unalaska Islands under the Formerly Used Defense Sites (FUDS) Program*. Prepared for the U.S. Army Corps of Engineers, Alaska District. Cultural Resource Consultants LLC, Anchorage.

Yarborough, Michael R.
2001 *Archeological and Historical Literature Review for the East Point/Ballyhoo/Airport Beach Road Rehabilitation Project, Amaknak and Unalaska Islands, Alaska*. Report prepared for HDR Alaska, Inc. Cultural Resource Consultants LLC, Anchorage.

Yarborough, Michael R.
2001 *Section 106 Evaluation for the Unalaska Airport Safety Improvement Project, Amaknak Island, Alaska*. Report prepared for HDR Alaska, Inc. Cultural Resource Consultants LLC, Anchorage.

Yarborough, Michael R.
2002 Determination of Eligibility for the Dutch Harbor Townsite (UNL-294). Prepared for the U. S. Army Corps of Engineers, Alaska District, Anchorage. Cultural Resource Consultants LLC, Anchorage.

Yarborough, Michael R.
2002 *2001 Archaeological and Historical Report on the Environmental Restoration of Fort Learnard and Dutch Harbor/Unalaska under the Formerly Used Defense Sites (FUDS) Program*. Report prepared for U.S. Army Corps of Engineers, Alaska District. Cultural Resource Consultants LLC, Anchorage.

Yarborough, Michael R.
2004 *Documentation for Determination of No Adverse Effects for the East Point/Ballyhoo/Airport Beach Roads Improvements Project, Unalaska and Amaknak Islands, Alaska.* Report prepared for the Alaska Department of Transportation and Public Facilities. Cultural Resource Consultants LLC, Anchorage.

Yarborough, Michael R.
2014 *Archaeological Survey of 2013 FUDS Project Area, Amaknak Island, Alaska.* Prepared for the U. S. Army Corps of Engineers, Alaska District, Anchorage. Cultural Resource Consultants LLC, Anchorage.

Yarborough, Michael R., Aubrey L. Morrison, and Sarah Meitl
2014 Archaeological and Historical Survey of a Portion of Tract C, U.S. Survey 853, Unalaska, Alaska. Prepared for the Aleutian Housing Authority, Anchorage. Cultural Resources Consultants LLC, Anchorage.

Yarborough, Michael R., Jason S. Rogers, Catherine L. Pendleton, Edward P. Arthur, Shawna M. Rider, and Erika E. Malo
2010 *Salvage Recovery at the Amaknak Bridge Site (UNL-050), Dutch Harbor, Alaska*. Report prepared for the Alaska Department of Transportation and Public Facilities. Cultural Resources Consultants LLC, Anchorage.

Rogers, Jason S., Michael R. Yarborough, and Catherine L. Pendleton
2008 *Archaeological Testing at UNL-469, Quarry Site, Amaknak Island, Alaska*. Cultural Resource Consultants LLC, Anchorage.\

Technical Proposal for Unalaska Wind Power Phase II - IV

DPU Project Number: 41-250

September 20, 2017

800 F Street | Anchorage, Alaska 99501

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September 20, 2017

JR Pearson, Deputy Director of Public Utilities
City of Unalaska
PO Box 610
Unalaska, Alaska 99685

Subject: DPU Project No: 41-250 Technical Proposal for Unalaska Wind Power Phase II- IV

Dear Mr. Pearson:

Coffman Engineers, Inc. (Coffman), along with our team of experienced subconsultants, is very excited to present the following information in response to your RFP to provide a data collection plan and a feasibility study for the integration of wind power into the micro-grid in Unalaska. Coffman's team is passionate about renewable energy and we are fully committed to the development of renewable energy resources, with a particular focus on isolated microgrids. That overall commitment, coupled with our experience developing practical, cost-effective power system designs throughout Alaska, will drive us to be deeply engaged in making an Unalaska renewable energy project successful.

Work on the project would include site visits, stakeholder meetings, analysis of the existing power system, a preliminary design basis, cost estimates, and economic analysis for development and integration. The analysis will also consider long term maintenance of a future wind system. With a proper system design and integration, and right-sizing generation assets, there are significant opportunities to offset fuel costs with wind power, resulting in more stable cost of energy over the long-term. There may also be significant opportunity for selling recovered heat. Our approach would include analysis of the impact that a wind project would have on heat sales opportunities.

Coffman is a multidiscipline engineering firm providing Mechanical, Electrical, Structural, Civil, Project Management, Landscape Architecture, Fire Protection Engineering, and Corrosion Control engineering, as well as Construction support. The information in this proposal highlights our understanding of the project scope as well as over a decade of our team's relevant Alaskan qualifications conducting wind energy work. The Coffman team has completed many wind turbine studies, designs, and provided support during construction and operations to ensure successful implementation. Projects have ranged from high level studies to complete design of new power plants and wind power systems as well as tank farms, recovered heat distribution systems, commissioning, and fuel dispensing systems. We believe that our experience supporting all aspects of planning, design, construction, and operations of wind and isolated power systems will help steer the Unalaska wind power development and integration assessment project towards a practical, cost-effective solution for the City of Unalaska.

Another significant component that Coffman will research is the efficiency of the existing power plant and distribution system (controls, correctly sized transformers, etc). The power you do not have to generate with new infrastructure is the cheapest power available. Coffman has worked on many energy audits and retro-commissioning projects for large facilities to find low hanging fruit that can significantly reduce energy consumption and energy costs.

Our Anchorage office and staff will manage this wind feasibility assessment study. Specialty consultants will support the partnership effort for wind resource analysis and MET tower siting, geotechnical engineering, permitting, detailed life cycle cost analysis, and environmental services.

We appreciate the opportunity to provide you this information for an renewable energy solution in Unalaska, and we look forward to working with you and your team. Please contact me if you have any questions.

Sincerely,

Tony SlatonBarker, PE
Principal, Energy and Sustainability
Coffman Engineers, Inc.
907.276.6664, slatonbarker@coffman.com

PROFESSIONAL QUALIFICATIONS

WIND TURBINE TOWER

COFFMAN ENGINEERS, INC. (Coffman), located at 800 F Street, Anchorage, Alaska, 99501, have created sustainable design solutions for engineering projects for over 37 years. We are a collaborative company engaging in diverse projects with experience that includes serving as prime and sub-consultant on a wide variety of projects. Since we began in 1979, we have grown from a seven person structural firm focusing on Alaska industrial clients to what we are today: a firm with a depth of 470 professionals across 14 offices in Anchorage, Alaska; Honolulu, Hawaii; Seattle and Spokane, Washington; Hood River, Oregon; San Diego, Oakland, and Los Angeles, California; Charleston, South Carolina, and Washington D.C. Metro. Coffman offers mechanical, electrical, structural, civil, instrumentation and controls, landscape architecture, fire protection engineering, process piping, and corrosion control engineering as well as commissioning, project management, and pipeline integrity management.

Coffman has provided design solutions utilizing alternative forms of energy for many clients in Alaska, Hawaii, Guam, and the Northwestern United States. Examples include Coffman's work with the Alaska Village Electric Cooperative (AVEC) and Northwest Arctic Borough on their wind turbine installations and recovered heat systems. The experience gained on these projects has given our team first hand insight into the importance of providing seamless integration of renewable energies that are well adapted to Alaska conditions. Our work with other utilities in Alaska (Kodiak and Chugach Electric) on flywheel, battery and solar projects has also provided us great insight into what works best for Utilities as well as system integration issues.

Alternative and renewable energy is not just a theory to the members of this team. All individuals assigned to this project have been involved with multiple alternative energy projects, including wind, hydro, solar, battery and flywheel projects, throughout remote Alaska. Our team understands the specific complexities associated with this type of work, and we enjoy the challenges of designing alternative energy projects for Alaska's harsh environment. We offer a continuity of services from concept to a completed project. The following information demonstrates the experience and capabilities of our key team members.

For this project, Coffman proposes a small team consisting of wind analysis experts and professional engineers experienced in renewable energy design.

Coffman will lead the design, Shannon & Wilson will provide Geotechnical Engineering, Solstice Alaska Consulting (SolsticeAK) (DBE #9900647), will provide environmental engineering, and our academic experts from Alaska Center for Energy and Power (ACEP), Northern Economics, and Cultural Resource Consultants will round out our team. Rich Stromberg of ACEP will provide wind analysis expertise. Rich was previously the Alaska Energy Authority's manager of Wind Development, and is now with the Alaska Center for Energy and Power (ACEP).

For over a decade, Coffman has been committed to supporting renewable energy for its clients, as well as in the community, the State and the US. Our first wind turbine project in Alaska was started in 2003. We have been members of REAP for over 5 years and regularly support committees and regular business. We participate in local, regional and US non profit groups supporting renewable energy.

Renewable energy is not just an engineering project for us, it is a passion. You will get more than dedication to the project if Coffman engineers is successful. As we are deeply committed to the concept as well as the project.

We have over 15 people in our Anchorage office that meet on a regular basis to discuss issues and concerns relating to renewable energy and how to promote it. We also have an office champion in each of our 10 main offices and we meet multiple times a year to discuss promoting renewable energy and energy resiliency.

We participate in the Alaska wind energy working group meetings as well as Islanded Grid Resource Center gatherings. We have attended RCA and governmental meetings associated with Renewable energy and Utility and microgrids issues in Alaska and California.

We participate in the Regular AWEDTG (Alaska Wood Energy Development Task Group) meetings.

We have a corporate budget specifically set up to support renewable energy. Tony SlatonBarker is the corporate manager of that budget and uses it to support many renewable efforts in Alaska and throughout the Northwestern US.

We designed the Begich Middle school wind turbine at no cost to the Owner. We also supported a Polaris wind turbine installation at no cost.

COFFMAN TEAM'S FULL PROJECT SUPPORT CAPACITY

Coffman's team has ideal skills for this overall project.

- Our team has worked together on multiple wind power feasibility studies.
- We have full design, permitting, and construction support teams so we can take this project from preliminary evaluations thru final design, construction, and commissioning.
- We have supported clients on grant applications for obtaining funding for renewable energy projects
- We have supported clients evaluating long term feasibility of renewable energy projects
- We have worked on wind projects of all sizes (Eva Creek wind farm 2 MW wind turbines to 10kW units)
- We have worked on wind diesel power systems throughout Alaska for over 10 years.

Tony SlatonBarker, PE, LEED AP
Principal, Energy and Sustainability
Alaska License #SE14334, #CE10259

Tony is so passionate about renewable wind energy that he toured the 30 MW Block Island wind farm during his vacation. It was the very first offshore wind farm in the United States. Tony has more than 25 years' experience in the Engineering and Construction Industry in Alaska. He has worked on renewable projects of all types and sizes from wind turbines (large-2 MW and small 10 KW) to solar and biomass projects. He is intimately involved with sustainable design renewable and alternative energy projects in Alaska, and he is currently the manager of Coffman's Corporate Renewable Energy efforts. Tony has worked on many energy projects that have required integration with conventional heating systems and power plants. Tony's project management experience includes wind resource analysis (Noorvik/Deering) design and construction of major power plant upgrades, school renovations, utility modifications, wind, solar, biomass projects, flywheel, battery, feasibility studies for alternative energy options and engineering peer reviews for all types of facilitates. Tony was the design and construction support engineer for the 350 kW Vergnet turbine installed in Guam. It is mounted on a 50 meter tower that can be tilted down and blades secured in 1 hour. This design was used due to likelihood of typhoons an 200 mph plus wind speeds. The foundation was also a combination of soil anchors and cement fill to save on concrete installation costs. A tilt down option with a unique foundation may be very applicable to the Unalaska area, and will be researched.

Martin Miller, PE
Project Manager, Mechanical Engineer
Alaska License #ME12030

Martin has 14 years of design and project management experience in Alaska and abroad including experience in all stages of project development, planning, energy auditing, design, installation, commissioning, and operations. He is responsible for design and construction administration for utility, commercial, and industrial projects throughout Alaska. Martin also provides project management and design of energy projects with a focus on integrating renewable energy generation into existing isolated electrical grids. Martin was project manager for the planning and design of the Northwest Arctic Borough's wind turbine project in rural Alaska and the recent Solar feasibility study work and project design for Chugach Electric. Martin also has the unique experience of working directly for a utility and integrating multiple new wind turbines into existing isolated diesel power systems in Sand Point, Alaska and Saint Paul, Alaska. Martin was also responsible for renewable energy feasibility studies in the Alaskan communities of Adak, Manley, and Tatitlek.

Lee Bolling
Mechanical Engineer
Alaska License #ME100010

Lee Bolling has performed energy audits and alternative energy feasibility studies, and has completed designs for energy conservation measures and alternative energy systems in Alaska. He has performed investment grade energy audits of over 1.5 million SF of large commercial and public buildings across the state of Alaska. Lee has completed many alternative energy feasibility studies, investigating the cost-effectiveness of wind, hydroelectric, biomass, solar thermal, solar PV and heat pump systems. His past work includes the design of an innovative sea water heat pump system for a large aquarium in Seward, Alaska and designing one of the first solar thermal systems in Anchorage, Alaska. Lee has also performed energy modeling for private clients, architects, and LEED Certified projects to predict energy savings of various designs and for LEED Energy and Atmosphere credits.

Aaron Busche-Vold, PE
Electrical Engineer
Alaska License #EE12949

Aaron has 13 years of multidiscipline experience in electrical and controls engineering. His experience is multifaceted in the fields of electrical engineering, instrumentation engineering, and automation. His prior project experience includes work for Deering wind, Noorvik feasibility, Nushagak electric wind hydro heat recovery, feasibility analysis, Bethel Power Plant heat recovery upgrades, Chugach Electric Flywheel project, multiple Tesoro Kenai Refinery instrumentation projects, and he is one of the programmers/designers on the AWWU SCADA term contract. Aaron also has instrumentation and automation experience for operations and maintenance in the oil and gas industry.

Will Veelman, SE, PE
Principal Structural Engineer
Alaska License #SE14016, CE7557

Will has over 33 years experience associated with general civil and structural projects. He is a principal with Coffman Engineers and is currently the manager of the civil/structural group. His experience in Alaska includes a variety of industrial, commercial, institutional, and military projects. His engineering experience includes permitting; designs for new facilities, renovations, and additions; analysis of existing structures; seismic studies; site grading and drainage; water transmission; sewer systems; access roads; and pipelines. Will is also experienced in construction management and inspection, and was the engineer of record for all the wind turbine foundation designs that Coffman has completed in Alaska.

Tom Looney, PE, LEED AP
Managing Principal, Electrical Engineer
Alaska License #EE9369

Tom has more than 28 years of electrical engineering and systems assessment, project management, commissioning, and construction experience. He manages Coffman's Anchorage office and provides QA/QC for our electrical engineering team, and provides overall guidance for all electrical designs. His project management experience includes budgeting, design team management, procurement, and construction management. Tom's design experience has included conceptual and project designs through functional checkout and commissioning, and he has worked on power plant projects all over Alaska.

SHANNON & WILSON INC.
Alaska Business License #38088

Shannon & Wilson is experienced in designs to mitigate frost heave, permafrost thaw settlement, and seismic issues on foundations and infrastructure in the Interior, as well as construction materials testing and cold-weather earthwork construction consulting. Over our 42 years of continuous Alaska office operations, our firm has provided geotechnical services for the U.S. Army Corps of Engineers, the Army, Navy, Air Force, and other Department of Defense (DoD) clients. These contracts included construction, renovations, or remediation assessments of a variety of structures such as hangars, residences, hospitals, utility buildings, community centers, bridges, as well as roads, runways, and other pavement structures.

Kyle Brennan, PE
Geotechnical Engineer
Alaska License #CE11122

Kyle has 14 years of experience performing geological and geotechnical engineering related work on projects throughout Alaska. He also serves as chair of the Municipality of Anchorage Geotechnical Advisory Commission. Kyle's responsibilities have included geotechnical engineering support and project management for projects including utilities, power generation/distribution, communications towers, road and rail infrastructure, airports, sea ports, and building development. He is well versed in providing practical geotechnical solutions for shallow and deep foundations, retaining walls, bulkhead structures, soil and rock slope stability, as well as cut/embankment development over a wide variety of soil and rock conditions. Kyle also has strong experience in finding and evaluating soil and rock construction materials resources. He has the ability to provide practical and innovative solutions to many of the geotechnical engineering design challenges that can be found in Alaska such as permafrost soils, seismicity, and remote locations with limited resources.

SOLSTICE ALASKA CONSULTING, INC. (SolsticeAK) Alaska Business License #937940

SolsticeAK will be responsible for assessing potential environmental impacts and determining environmental and permitting needs for project alternatives. SolsticeAK is a successful woman-owned small business headquartered in Anchorage. SolsticeAK has been in business over 9 years and has 6 employees. They provide services related to environmental planning, including National Environmental Policy Act (NEPA) documentation and associated assessments, and community and public involvement. Solstice has experience managing large and small NEPA documentation projects, which require alternatives development, impact analysis, public and agency involvement, and field survey and reporting. In addition, SolsticeAK also helps clients comply with various federal and state environmental laws including the Clean Water Act, National Historic Preservation Act, and Endangered Species Act. Related to this project, for the past nine years, SolsticeAK has been Alaska Village Electric Cooperative's (AVEC) on call contractor providing permitting and NEPA documentation support for energy projects throughout Alaska. SolsticeAK has relevant experience in Unalaska and the Aleutians; they recently permitted a dock expansion project in Captains Bay. As mitigation for the dock project, they worked with the City of Unalaska on restoration of the Lower Iliuliuk River. Further, SolsticeAK completed the environmental analysis for the Adak Hydroelectric Reconnaissance Study which involved research of environmental conditions and working with project engineers to determine potential impacts to environmental resources and required environmental permits and authorizations. Alaska Business License: #937940 (Alaska Disadvantaged Business Enterprise #9900647)

SolsticeAK subcontracted to Coffman on:

- Nushagak Electric Feasibility Study
- Mekoryuk Wind Farm Project
- Deering Wind Project
- Alakanuk School Wind Project

Under separate contracts to the same client, SolsticeAK and Coffman have work together on:

- Bethel Heat Recovery Project (for AVEC)
- New Stuyahok Power Plant Project (for AVEC)

Robin Reich, Environmental Planner

Robin Reich, President of Solstice, would assist with environmental permitting. Robin has more than 19 years of experience with environmental permitting, studies, and documentation on projects throughout Alaska, including the NSB and Barrow. Most recently, she assisted the NSB to initiate environmental consultation with the Bureau of Land Management and U.S. Fish and Wildlife Service regarding the design of an overhead powerline between Barrow and Atqasuk. She obtained wetlands and fish habitat permits for new hangar at the Will Rogers Memorial Airport. She obtained environmental permits for a new 12.2-acre equipment and materials staging area and cold storage building at the Deadhorse Airport. Also, for the NSB, she led community involvement activities to incorporate the community comment and Traditional Native Knowledge into the Nuiqsut boat launch location and design. Having grown up in rural Alaska (Bethel) and having spent her entire professional career helping public and private clients obtain regulatory approvals, Robin is well aware of the issues and challenges surrounding Alaskan projects.

ALASKA CENTER FOR ENERGY AND POWER (ACEP) ACEP is an applied energy analysis group based at the University of Alaska Fairbanks, providing leadership in analyzing and developing energy systems for islanded, non-integrated electric grids and their associated oil-based heating systems. Because many of the issues related to implementing innovative energy solutions are complex, their program addresses the technical integration of renewables with these small isolated diesel-based energy systems. They also consider integration from a broader perspective: integration of solutions into the social realities of a community, integration of the cultural fabric into sustainable energy solutions, integration of university researchers across disciplines and with community partners; and integration of their facilities and resources with those of our national partners.

Rich Stromberg, B.S., M.A. Candidate
Research Professor

Rich worked as Wind Program Manager for the Alaska Energy Authority (AEA) for many years. He was intimately involved in analyzing wind resources, installing MET towers throughout Alaska, retrieving and analyzing MET tower data, and determining appropriate options for harvesting wind energy in accordance with local constraints. Rich has worked cooperatively with Coffman from an Owner's granting agency oversight perspective on many projects over the years. Rich is currently pursuing a master's degree in environmental management. For this project, he will provide MET tower support and review, met tower siting, installation, data collection system, existing wind resource review and evaluation, and evaluating collected met tower data after receipt.

NORTHERN ECONOMICS
Alaska Business License #251276

Northern Economics, founded in Anchorage, Alaska in 1982, is recognized as a leading economic consulting firm in Alaska, serving a wide clientele in both private and public sectors. Northern Economics' staff includes experts in economics, financial feasibility analysis, land use planning, demographics and population studies, resource economics, market research, and socioeconomic impact assessment. Northern Economics specializes in developing practical, cost-effective solutions in economic planning and assessment for its clients. In its 35 years, Northern Economics has grown with the Alaskan economy, and served as consultant for many of Alaska's largest projects and most important decisions made in the state. No one knows Alaska economics better.

Mike Fisher, MSPM, MBA, PMP
Principal and Senior Consultant

Mike has 15 years of experience with a focus on financial, business, and market demand analysis. His expertise is in developing spreadsheet-based models and providing value-added data analysis. He holds an MBA, an M.S. in Project Management, and the Project Management Professional certification. He has experience working with several simulation programs, including @RISK, Crystal Ball, and DecisionTree. His experience includes evaluating the financial feasibility of wind and hydro facilities in the Dillingham region; business planning for water and sanitation utilities for several Alaskan communities under contract with ANTHC and Village Safe Water; and evaluation of alternative energy projects submitted in response to the Alaska Energy Authority's Alaska Alternative Energy Projects RFP. Under three contracts, Mike's work included calculating the proposed projects' life-cycle benefit-cost ratio based on the applicants' benefit and cost estimates, as well as an independent assessment of each project and a revised benefit-cost ratio.

CULTURAL RESOURCE CONSULTANTS, LLC
Alaska Business License #: 723799

(CRC) will provide technical support related to cultural and historical resources. CRC has 35 years of Alaskan historic preservation experience ranging from literature reviews and quick field surveys of small project areas to multi-year projects involving complex National Historic Preservation Act (NHPA) Section 106 analyses. Michael Yarborough, CRC's Principal Archeologist, has 35 years of archeological experience in Alaska and has worked in the Aleutian Islands region since 1971. He worked with the U.S. Army Corps of Engineers from 1998 to 2001 on environmental restoration of Unalaska and Dutch Harbor under the formerly used defense sites (FUDS) program. He completed a Section 106 evaluation of safety improvements at the Unalaska

Airport in 2001 and an archeological review and consultations for the East Point/Ballyhoo Roads Rehabilitation project in 2001 and 2002. He was the archeologist on the M/V Selendang Ayu grounding on Unalaska Island in 2005, and directed six and a half months of archeological salvage recovery at the Amaknak Bridge Site in 2006 and 2007. In 2007, he co-directed archeological testing at the Quarry Site on Amaknak Island and surveyed the proposed site of a new courthouse in downtown Unalaska. He also evaluated cultural and historic resources for the Unalaska Airport Environmental Impact Statement, a project that lasted from 2006 to 2010. Most recently, in 2014, he surveyed FUDS project areas on Amaknak Island for the U.S. Army Corps of Engineers, and the site of a new house in Unalaska for the Aleutian Housing Authority.

Michael Roy Yarborough, Ph.D.
Principal Archeologist

Mike has nearly 40 years of archaeological experience in Alaska and has worked in all areas of the state. He meets the Secretary of the Interior's professional qualifications in both prehistoric and historic archaeology, has an excellent working knowledge of the historical and archaeological literature available for Alaska, and has experience in working with state and federal agencies. He has completed over 100 cultural resource surveys throughout the state during his tenure at CRC, and has authored numerous cultural resource reports.

KOKHANOK WIND TURBINES

EXPERIENCE & REFERENCES

GAMBELL WIND FARM

EXPERIENCE AND REFERENCES

Coffman has a proud history of successful renewable energy project feasibility analysis and design. A few relevant project examples and references are listed below. Additional information and experience is available upon request.

Fairbanks Economic Development Corporation (FEDC) Biomass Feasibility Studies

Coffman has been successful bidder on these feasibility studies for 5 years in a row. These projects required on-site inspections of villages across the state from Dillingham to Southeast to Kiana and Kodiak and Fairbanks. Coffman Engineers inspected existing facilities which have potential for biomass heating systems to offset diesel fuel usage. An important feature of the process was to include and consult community members in an informal setting regarding biomass technology to determine community needs, desire for energy independence, and availability and price of local biomass options. Coffman gathered detailed information on existing heating systems so that conceptual design options could be thoroughly evaluated. Once all of the available information was reviewed, a proposed system was evaluated for future final study. This included site investigation report, preliminary design options, construction cost estimating, and economic and life cycle cost analysis.

References:

Samantha Reynolds: (907) 452-2185
sreynolds@investfairbanks.com
Fairbanks Economic Development Corporation
330 Wendell Avenue, Suite E
Fairbanks, AK 99701

Devany Plentovich: (907) 771-3068
dplentovich@aidea.org
Alaska Energy Authority
813 W. Northern Lights Blvd
Anchorage, AK 99503

Northwest Arctic Slope Borough (NWAB) Wind Diesel Deering and Noorvik

Coffman Engineers performed feasibility analysis and wind resource analysis for these projects. Including wind turbine siting, MET tower data analysis, and wind turbine siting. Once final details For Deering, once the final details were agreed to among applicable stakeholders, the civil, structural, mechanical, electrical, controls and geotechnical engineering for the design to integrate new wind turbines into the existing diesel generator power plant and power grid were completed. The design included site layout, access road design, foundation design, electrical design (transmission and power plant modifications) and mechanical design (Electric boilers and integration with existing heat recovery systems). The design allowed for excess power generation to be converted to heat and distributed to the community through a boiler grid interface, or utilize the existing power plant coolant system to dissipate excess thermal energy. This project is relevant because it demonstrates our work in rural areas across all disciplines. The Noorvik project was evaluated and coordinated with the resource, the airport the utility and the community and it was determined Wind was not the ideal renewable energy option. A subsequent project installed a solar system.

References:

Ingemar Mathiasson: (907) 445-2031 Ambler
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163 Lagoon Street
Kotzebue, AK 99752
Cell (269) 816-2992

Matt Bergan, PE: (907) 442-3491
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Project Engineer
Kotzebue Electric Association
PO Box 44
Kotzebue, AK 99752

Chugach Electric Association (CEA) Solar Photovoltaic (PV) 500kW Feasibility Study and Preliminary Design

The scope of this project was to develop a concept solar PV project to demonstrate commercial/utility scale photovoltaic (PV) in Anchorage up to 500kW DC, and to evaluate technologies and grid integration issues. Considerations included; siting options on the main CEA Campus; construction cost and risk; levelized cost of energy; review of incentives like tax and financing, and PV panel efficiency- standard vs. premium. Silicon-based PV panels were selected based upon their ready availability and modular aspects, and their scalability.

References:

Dustin Highers: (907) 762-4775
dustin_highers@chugachelectric.com
Chugach Electric Association
Director, Power Supply Technical Services
5601 Electron Dr.
Anchorage, AK 99518

Paul Risse: (907) 762-4532
risse_paul@chugachelectric.com
Chugach Electric Association
Sr. VP Power Supply
5601 Electron Dr.
Anchorage, AK 99518

Alaska Village Electric Cooperative (AVEC) Bethel Power Plant

Coffman provided a detailed engineering evaluation of the Bethel power plant heat recovery system to assist in developing an Alaska Energy Authority grant funded project. Services included heat energy modeling, pipeline integrity analysis, pumping, and controls. Evaluation of existing and potential new customer services network led to determination of capacity limitations and future expansion potential. Evaluation of exhaust gas heat recovery was also included. Coffman successfully worked with the client to incorporate findings into the grant application to obtain design funds. The project then proceeded to design of a new heat recovery module. Currently the module is being shipped to Bethel for integration into the Utility's system at the Bethel power plant. Coffman prepared the design and is supporting the construction of the new module and integration into the onsite mechanical, electrical and controls systems. The project is continuing with a feasibility study for upgrades to the existing heat recovery district heating system.

References:

Forest Button: (907) 646-5961
fbutton@avec.org
Alaska Village Electric Association
Manager, Project Development & Key Accounts
4831 Eagle St.
Anchorage, AK 99503

Lenny Welch: (907) 543-2949 (Bethel)
Alaska Village Electric Association
Operations Manager, Bethel
4831 Eagle St.
Anchorage, AK 99503

METHODOLOGY & NARRATIVE WORK PLAN

METHODOLOGY

Design Team

Coffman's team has extensive experience providing project scoping, feasibility and design services for wind generation projects in challenging environments throughout the Aleutians, Alaska, and the Pacific Rim.

Our dedicated team is accustomed to supporting projects through all stages of development, which helps ensure that concepts and constraints are carried through to the finished product and minimizes loss of information and momentum at transitions.

Our proposed design team includes subconsultants that have successfully worked with Coffman in the past on energy feasibility studies and design projects. Coffman will act as the lead consultant providing design team management, energy modeling, and engineering services including construction feasibility and, Rich Stromberg will support wind resource evaluation, MET tower siting and installation efforts, and MET tower data analysis, Shannon & Wilson will perform Geotechnical services, SolsticeAK will provide permitting and environmental engineering services, Northern Economics will provide financial feasibility and economic analysis, and Rich Stromberg of ACEP will provide MET tower support and data analysis.

Narrative Work Plan

Meeting the needs of the Unalaska Department of Public Utilities and specifically those of the Power Production and the Electric Distribution Divisions is the primary goal of the project team. To do so the team will focus on working with the key stakeholders (Utility, large power customers, local, state and federal agencies to identify priorities, project goals, and constraints.

The Phase II work effort (as Phase I has been completed by Owner) will have multiple parallel paths: Wind resource Analysis/MET tower siting, Energy Modeling for electrical and heat recovery systems, and Power System Integration Feasibility.

An initial task will be working with stakeholders to gather existing documentation and create new documentation as needed to initiate the project. Using existing high resolution data will help jump start this effort.

Wind Resource Analysis/MET Tower Siting

The existing wind resource data and other siting constraints will be evaluated to determine the most appropriate locations for new MET towers.

Wind turbine production in complex terrain is highly dependent on its location and hub height. Selecting appropriate MET tower locations is a critical step to ensure a smooth transition from data collection to design and implementation. For this reason, MET tower locations are considered most ideal when they are located on the same site as the proposed wind turbine. A complete and thorough evaluation of the MET tower locations in Phase II will help prevent unforeseen issues in Phases III and IV.

Existing anecdotal evidence indicates many sites (Haystack Hill) may have good wind resource but are subject to significant turbulence and extreme high wind events that could impact long term viability of wind turbine installation. Year-round access is critical for a successful project. These issues will be considered for all MET tower installation locations.

Our team has successfully implemented MET tower based feasibility studies in locations similar to Unalaska; extreme high winds (Adak), icing (Deering/Noorvik), difficult access (LRRS).

Power System Integration Analysis will be the work to determine how best to integrate wind turbines into the existing Unalaska power system.

Energy Modeling - Electricity and Heat

An hourly energy model will be created using a combination of software programs, including Homer Pro. A synthesized wind profile will be created from existing data. This wind profile will serve as input to the energy model, electrical and heat load preferred minimum diesel loading, diesel engine efficiency and recovered heat availability. Initial energy model outputs will inform the MET tower site selection and help identify any limitations on wind project installed capacity.

Energy modelling will begin with a review of prior reports and operations logs as well as the provided high resolution load data (as available). The customer metering information will be integrated into these datasets to create daily and seasonal load profiles. Future loads will be forecasted in order to better project forward looking load profiles. Including Port Cranes, Fish processor loads, and power produced from the existing ORC units.

Additional evaluation of possible heat supply loads (adjacent building heating or other process loads thru district heat loop) will be incorporated into the analysis. The heat loop could allow an increase in wind capacity as it would provide a place to send additional wind energy (via electric boiler) when the electrical grid cannot accept all the wind power produced.

The fish processors expected load will also need to be evaluated as they potentially have large hourly, daily, and seasonal fluctuations as well as possible start and stop loads. We will obtain existing load data from the Processors. The electric cranes at the port will also need to be integrated into the Modeling. This is similar to the Kodiak and Chugach electric projects we worked on where batteries and flywheels were installed to help the large swings in load when cranes kicked on or wind farms dropped offline.

The selection of the appropriate MET towers will take into account factors such as tower height, proposed turbine hub height, foundation guy anchors, gin pole tower raising, sensor types, remote monitoring options, implications of icing and turbulence as well as surface roughness. Heated anemometers and control enclosure power needs will be considered and will factor into the MET tower and instrument selection as well.

Proposed MET sites will be evaluated based on publicly available information as well as ARC-GIS data provided by the City of Unalaska. The team will use knowledge of Unalaska and the Aleutians and environmental regulations to identify natural, social, economic, and environmental concerns associated with each alternative. Existing databases and wind data will be evaluated, existing reports will be consulted, and experts and local stakeholders will be interviewed to determine constraints, including: aviation airspace, wetlands, contaminated sites, cultural and historic resources, endangered species, migratory birds, anadromous streams, and visual resources. In addition, the team will identify and apply for environmental permits and authorizations and land use requirements that would be needed for each alternative, including FAA airspace and U.S. Army Corps of Engineers approvals.

In addition, the team will conduct a review of existing geotechnical information (prior studies, geologic mapping, etc.) to provide an understanding of the likely soil and rock conditions at the sites to be developed. Our geotechnical consultant will also evaluate MET tower sites for future possible foundation requirements (a great wind site that will require very expensive foundations will not be economical). Literature research will be followed up with site surface reconnaissance and the development of foundation recommendations for the MET sites and preliminary foundation recommendations for potential tower site alternatives.
We anticipate that drilling explorations will not be required during Phase II and all site work will be conducted with hand-operated or locally available equipment. Foundation recommendations will

accommodate seismic conditions of the area and will address shallow rock, poor near-surface soils, and remote construction considerations.

MET tower siting analysis will also address property and land costs. The existing Property owned by the City in Pyramid Valley will be evaluated. The reduced costs of using city owned property could save significant initial project costs, long term land lease costs and reduce permitting requirements.

Environmental services will include review of existing data to evaluate the likely presence of known contamination within the various sites to be developed. If known contamination is expected at any of the considered sites for development, the team will describe the conditions and provide input on how the contamination may impact design of the facilities and estimate the impact to construction, schedule, and cost.

Finally, proximity to existing distribution systems and infrastructure will be considered along with any seasonal travel restrictions.

Power System Integration Analysis is an initial analysis in Phase II that is to be updated during Phase IV. This includes an analysis of existing electrical generation and distribution systems, taking inventory of both the Power Production Division assets as well as the Electric Distribution Division infrastructure. Analysis of generation assets will include prime mover, alternator, and controls systems including voltage regulators and governors, and engine controllers.

Asset dispatch controls will be evaluated for necessary upgrades or replacement in order to integrate current equipment with proposed wind turbine production. In addition, Power Production Division operational standards will be investigated to include spinning reserve requirements, minimum diesel engine loading practice and black start recovery procedures as well as load shedding. Remote indication and control options will also be vetted at this time. A thorough background will be developed to summarize operational goals and metrics for defining successful project implementation through Phases II to IV.

The existing distribution and transmission system will be evaluated for the quantity of single phase vs three phase systems components (transformers, power lines, etc) and recommend upgrades as required to integrate with new proposed systems.

Electric Distribution Division infrastructure will be evaluated for wind turbine, small hydro, and ORC integration. Transient analysis will be evaluated and performed as needed to address transformer inrush, feeder breaker settings, wind turbine trips and real and reactive power capacity for all generating configurations.

Opportunities for local demand control and response will also be evaluated to help maintain appropriate voltage and frequency related to the variable generation.

Throughout Phase II life cycle upgrades to both generation and distribution equipment will be considered and factored in where appropriate. Phase II findings will be summarized in a report format, with reviews at 65% and 95% levels of completion.

Phase II Scope of Work: Data collection plan

- Power analysis of current electrical system (Diesel generators, ORC)
- Research for available past system information and available wind data
- Review and analysis of available Load Data
- Site visit to determine potential MET sites
- Environmental and Geotechnical study
- Permitting for MET sites
- Land use requirement investigation
- Determine MET site details (power needs, data storage, remote monitoring, costs)
- Design MET sites (equipment, costs, etc.)
- Summarize all information in report format, with 65% and 95% reviews

Phase III Current Scope of Work: Implement Data Collection (Future - Not In Scope)

- Install MET sites. Includes mobilization, demobilization and site restoration efforts.
- Collect and manage data for 24 months. 18 months of useful data required.
- Prepare quarterly progress reports. Include data, data quality, project status. Raw data deliverable in electronic and summary form.
- Final wind data report with production data, feasibility, recommendations and economic analysis. Economic analysis to include years to payback and rate impacts.

Phase IV Scope of Work: Pre-Development Plan (Future - Not In Current Scope)

- Analyze powerhouse generation efficiencies
- Analyze final data
- Identify feasible developmental paths with alternatives that minimize adverse impact to existing power production and distribution system
- For each alternative, develop ROM design and construction cost estimate. Itemize for wind power development and integration costs.
- Economic analysis of each alternative including:
    - Impact to current utility operations, includes effects on engine efficiencies
    - Land acquisition
    - Permitting
    - Energy output
    - Life cycle costs
    - Operations and maintenance costs
    - Displaced fuel cost savings
    - Simply payback period
    - Impact to utility rates
- Complete draft report for city review and comment.
- Complete final report.
- Presentation of report to City Council.

Coffman Engineers is proud to say we have an excellent record for completing design projects on schedule for our clients. We have ample staffing to meet shifting demands and workload. We take our client's schedules seriously, and when we commit to a schedule, we will make every effort to meet or beat it. Project managers actually plan to finish earlier than the scheduled completion date so that there is time for the quality control process. We are certainly aware that unforeseen issues may crop up, but our employees are dedicated to meeting deadlines regardless of the challenges.

Coffman Engineers employs approximately 100 full time employees in our Anchorage office. We also have the ability to draw from our staff of more than 370 employees from our other 13 offices if needed.

KEY PERSONNEL RESUMES

HOOPER BAY WIND TURBINES

Years of Experience
With this Firm: 13
With Other Firms: 10

Education
M.S., Clarkson University, Civil/Structural Engineering, 1993
B.A., Major Physics, Minor Math/Political Science, Middlebury, 1989

License
Alaska Civil Engineer #CE10259, 2000

Alaska Structural Enginer #SE14334
LEED® Accredited Professional, 2003

MOA Post Disaster Damage Assessor, 1997

Alaska Structural Engineer #SE 14334, 2014

Professional/Community Activities
American Society of Civil Engineers (ASCE)

U.S. Green Building Council (USGBC)

American Institute of Steel Construction (AISC)

Renewable Energy Alaska Project (REAP)

TONY SLATONBARKER, PE, LEED® AP

Principal, Energy and Sustainability

Tony has more than 23 years experience in the Engineering and Construction Industry in Alaska. He has worked on projects of all types and sizes from wind turbines large and small to solar and biomass projects. He is intimately involved with sustainable design and alternative energy projects in Alaska, and he is currently the manager of Coffman's Alternative Energy and Sustainability Program. Tony has worked on many alternative energy projects that have required integration with conventional heating systems and power plants. Tony's project management experience includes design and construction of school renovations, additions, wind, solar, biomass projects, feasibility studies for alternative energy options and engineering peer reviews for all types of facilitates.

Project Experience:

Nushagak Electric Feasibility Study
Dillingham, AK

Project manager for performing a site visit and feasibility study for Nushagak Electric power supply. The project included a multi-person site visit and interviews with power company representatives, power plant operators, and local linemen. Data from multiple years of previous studies were reviewed and incorporated into the study as required. Future possible wind power generation sites were evaluated for extending utilities to site, civil issues for siting, vehicular and equipment access, and environmental impacts of a new facility. The impact of adding wind or hydro power to the grid was evaluated in regards to existing diesel fired power plants heat recovery system. Also evaluated was the feasibility of upgrading the existing single phase transmission lines to 3-phase transmission lines. Controls systems required to operate the grid (frequency and voltage) with multiple power sources (wind, hydro, and diesel) were also researched. An overall feasibility report and economic model of different power supply options was prepared and provided to the Owner for future planning purposes.

Fairbanks Economic Development Corporation Biomass Feasibility Studies throughout Alaska

Project Manager for over 20 facility evaluations throughout Alaska in order to evaluate them for biomass energy opportunities. Coffman determined community needs and desires for energy independence and provided the community with viable options for further studies using biomass heating systems in their community. Projects were completed on time and on budget.drives and controls. The sites existing fault current, coordination and arc flash study was updated to reflect the distribution system modifications.

TONY SLATONBARKER, PE, LEED® AP

Principal, Energy and Sustainability

NWAB Wind Diesel Deering Noorvik, Noovik, AK

Project manager for this project which included initial evaluation of wind turbine size, quantity, location, integration requirements with exiting power plant, construction cost estimate, and benefit cost ratio analysis of different options. Three separate town site visits were conducted to coordinate with the Town council and to make sure project was in line with city long term and existing plans. Coordination with water plant also occurred as they would benefit from the heat produced by excess wind energy. Extensive coordination with local utility was also undertaken to determine their requirements and future plans. Original scope included civil design (access road and pads), mechanical design (electric boiler for dump load and tie to existing diesel power plant heat recovery system), structural engineering for wind turbine foundations, new power plant electrical controls module, electrical equipment supports, electrical distribution (power line extension), electrical controls for tie in to existing power plant, wind turbine transformer and disconnect, energy modeling, and permitting studies. Coffman is teamed with Marsh Creek, a construction contractor, for constructability reviews. It is important to note that Coffman acts as prime consultant routinely and hires architects as subconsultants regularly such as for our projects at Tanacross, Delta Greely, and Thorne Bay, as well as for our industrial projects. For this project, we managed subconsultants for geotechnical reviews and surveying. Due to current power plant condition and system arrangement, wind power may not be an economically viable option at this time. Three other options: Solar, power plant heat recovery upgrades, and power plant replacement, are currently being evaluated.

LYSD Alakanuk Renewable Energy Systems, Alakanuk, AK

Tony was lead project engineer for feasibility studies for renewable energy, including Geothermal, biomass, wind, and solar. The final analysis included the installation and design of wind and solar(behind the meter). The school was outfitted with four rows of fixed, roof mounted solar panels, totaling 14kW of capacity that were grid intertied. A 10 kW Bergey wind turbine was also grid intertied. An alternative energy feasibility study was done for the possible installation of a biomass boiler or ground source heat pumps. The Wind turbine foundation was steel piles and steel base frame system due to permafrost geotechnical issues. Turbine was mounted on a 55 foot steel monopole tower.

Eva Creek Wind Farm Peer Review, Healy, AK

Tony was Lead Structural Engineer on the complete 3rd party peer review for the wind towers including concrete foundations, geotechnical issues, tower and WTG for the (12) twelve 2 MW Repower Wind turbines. Foundations are approximately 50 feet in diameter and 10 feet thick. Work included code review, Material reviews, structural loading evaluations, Preparing an independent 3D computer model (SAP) to evaluate soil loading, vibration, settlement, etc. Independent static analysis and final findings report was also prepared.

Anchorage School District Begich Middle School Wind Turbine, Anchorage, AK

Coffman Engineers assisted the Anchorage School Districts, Begich Middle School’s Technology Teacher (Scott McKim) with the installation of a Skystream Wind turbine on a 70 foot monopole tilt up tower. The School received a Wind For Schools Grant and the students worked much of the upfront permitting and planning issues. Coffman assisted in some of the permitting associated with the new MOA permit process for Wind turbines. This was the first wind turbine permitted under the new process. Coffman also assisted with project management and coordinated the Surveyor and geotechnical engineer. Coffman completed the structural design for the insulated concrete spread footing foundation and specified soil conditions for concrete placement. Coffman also completed the electrical tie in design for the Turbine. The turbine is grid tied and Coffman completed the tie in documentation required by Chugach Electric Association. Coffman also provided construction support during project completion.

Years of Experience:
With this Firm: 3
With Other Firms: 10

Education:
B.S. Mechanical Engineering; University of Virginia; 2002

License
Alaska; Licensed Mechanical Engineer; #ME12030; 2008

Professional/Community Activities:
American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

IEEE Power and Energy Society

Previous work at other Firms:
2009 to 2013, TDX Power Anchorage, AK

2003 to 2008, RSA Engineering, Anchorage, AK

MARTIN J. MILLER, PE

Project Manager

Martin has 13 years of design and project management experience in Alaska and abroad including experience in all stages of project development, planning, energy auditing, design, installation, commissioning, and operations. He is responsible for design and construction administration for utility, commercial, and industrial projects throughout Alaska. Martin also provides project management and design of energy projects with a focus on integrating renewable energy generation into existing isolated electrical grids.

Project Experience:

AVEC Bethel HX System
Anchorage, AK

Project manager for engineering evaluation of Alaska Village Electric Cooperative's Bethel power plant heat recovery system, which circulates engine jacket water heat from six (6) 2.2MW reciprocating diesel engines through approximately 2 miles of 10-inch pipe, serving a range of community customers. The evaluation lays the groundwork for future repairs and upgrades by identifying efficiency improvement opportunities, maintenance and operations improvements, and pipeline integrity issues. Developed hourly energy modeling to provide guidance on expansion opportunities, by providing in-depth look at customer heat loads, heat available from the engines, and piping system losses. Standard customer connection details, as-built piping diagrams, and technology review for BTU metering were also provided. Coffman also completed a pipeline integrity assessment, with the support of an industrial inspection contractor, due to suspected Corrosion Under Insulation (CUI). Coffman developed the inspection plan, obtained and vetted quotes from the inspection contractors, oversaw and directed the inspection process, compiled the results and developed recommendations.

NWAB Wind Diesel Deering Noorvik
Noovik, AK

Project manager for planning and design of a wind turbine project in rural Alaska. The project included an initial evaluation of wind turbine size, quantity, integration requirements with exiting power plant, construction cost estimate, and benefit cost ratio analysis of different options. Once final project scope was determined we performed civil design (access road and pads), mechanical design (electric boiler for dump load and tie to existing diesel power plant heat recovery system), structural engineering for wind turbine foundations, new storage module, and electrical equipment supports, electrical distribution (power line extension), electrical controls for tie in to existing power plant, wind turbine transformer and disconnect, energy modeling, and permitting studies. Coffman also supported the contractor solicitation phase and provided construction administration services to the owner.

MARTIN J. MILLER, PE
Project Manager

* Indicates Pre-CEI projects

2016 Alyeska G004 PS01 Black Start Generator
Anchorage, AK
Martin was project manager for an alternatives analysis and front end engineering and design (FEED) to support upgrades to the onsite power generation system. In this role, he led Coffman's efforts from a technical and administrative perspective. The analysis included a review of reliability for equipment and fuel supplies to an isolated industrial facility, powered primarily by two gas turbines in the 5-13MW capacity range. Reciprocating and turbine generators in the 1MW capacity range were considered to meet blackstart and contingency power needs. The scope of work included project management (project engineering), preliminary design, close coordination with Operations, and cost estimating to support the business case for recommended upgrades.

2016 Alyeska F889 Power Generation
Martin was project manager for an alternatives analysis and front end engineering and design (FEED) to support power system reliability upgrades at a remote industrial facility in Alaska's arctic. In this role, he led Coffman's efforts from a technical and administrative perspective. The analysis included a review of reliability for generating assets and fuel supplies through a range of operating scenarios, including blackstart and extended unmanned operation. Reciprocating and turbine generators in the 800-kW capacity range were considered. The scope of work included project management (project engineering), preliminary design, close coordination with Operations, and cost estimating to support the business case for recommended upgrades.

Saint Paul Wind-Diesel System*
Project manager for the integration of a 675 KW wind-diesel power plant into the isolated diesel-powered grid on St. Paul Island in Alaska. Project included design and construction.

United States Air Force (USAF) Wind-diesel Systems for Long Range Radar Sites*
Cape Lisburne, Cape Romanzof, and Cape Newenham, Alaska
Performed wind resource assessment and mechanical design of three 450KW wind-diesel systems for USAF Long Range Radar Sites in western Alaska at Cape Lisburne, Cape Romanzof, and Cape Newenham.

Remote Alaska Communities Feasibility Studies*
Adak, Tatitlek, and Manley, Alaska
Performed renewable energy feasibility studies for the remote Alaskan communities of Adak, Tatitlek, and Manley.

Remote Alaska Communities Feasibility Studies*
Adak, Tatitlek, and Manley, Alaska
Performed renewable energy feasibility studies for the remote Alaskan communities of Adak, Tatitlek, and Manley.

Years of Experience
With this Firm: 9
With Other Firms: 3

Education
B.S. Electrical Engineering; Michigan Technological University; 2005

License
Alaska; Licensed Electrical Engineer; EE#12949; 2011

Professional/Community Activities
LEED Accredited Professional

Association of Energy Engineers IEEE Member

AARON BUSCHE-VOLD, PE, LEED® AP

Engineer, Electrical Engineering

Aaron Busche-Vold's electrical engineering experience includes designs for industrial, commercial, and institutional facilities. He has particular experience with electrical distribution systems, lighting, PLC design, and alternative energy. Aaron has been involved with projects throughout Alaska for over 12 years, including work on several off shore oil platforms, Kenai Peninsula natural gas fields, and on the North Slope. He also has extensive worldwide experience.

Project Experience:

Goose Creek Correctional Center
Wasilla, AK

Electrical engineer for a design-build project to construct a 1536 bed, 435,000 sf, 90 acre, medium security correctional facility. The project included five buildings, fuel tank farm, and emergency generation plant. Aaron performed engineering services that included design of the electrical, UPS, fire alarm, lighting, and control systems for the Outside Administration Building and Bulk Fuel Storage Facility. The Outside Administration Building is approximately 24,500 sf and houses offices, IT & security equipment, conference spaces, visitor processing, and the command & control center. The Bulk Fuel Storage Facility is sized to provide fuel for electricity, cooking, and heating for the entire facility for one month. It has the capacity to hold 120,000 gallons of LP, 77,000 gallons of diesel fuel, and 1,000 gallons of gasoline. It includes motor fuel dispensing, an LP air blender and vaporizer system, SCADA system, and leak detection.

Kokhanok Wind Turbines
Kokhanok, AK

Electrical engineering for the design to integrate two refurbished 90kW Vestas V-17 wind turbines into the existing diesel generator power plant. The design allowed for excess power generation to be converted to heat and distributed to the community through a boiler grid interface, or to utilize the existing power plant coolant system to dissipate excess thermal energy. The electrical design was coordinated with site layout, foundation design, and the mechanical design.

LYSD Alakanuk Replacement School
Alakanuk, AK

Electrical engineer for the design of a 55,000 sf replacement school in Alakanuk, Alaska. Due to the arctic environment, there were some constraints to the design; however, many sustainable alternatives were able to be used. The school was outfitted with four rows of fixed, roof mounted solar panels, totaling 14kW of capacity that were grid intertied. A 10kw wind turbine connected to resistance heaters in the ventilation system is being used for internal and space heating. The lighting was designed to be efficient and conserve energy. An alternative energy feasibility study was done for the possible installation of a biomass boiler or ground source heat pumps. The school design was made to have a low environmental impact.

AARON BUSCHE-VOLD, PE, LEED® AP

Engineer, Electrical Engineering

Anchorage School District Begich Middle School Wind Turbine
Anchorage, AK

Electrical engineer for the design oversight and QA/QC for the installation of a wind turbine at the Anchorage School District's Begich Middle School. The turbine was a Skystream Wind turbine on a 70 foot monopole tilt up tower. The turbine was grid tied and Coffman completed the tie in documentation required by Chugach Electric Association. Coffman also provided construction support during project completion.

GPA Wind Turbine Pilot Project
Barrigada, Guam

Electrical engineer for the design and installation of a 275 kW Vergnet wind turbine. This was a design/build project with DCK Worldwide as the prime contractor. The engineering scope of this pilot project included design of roads and pads, foundations, electrical design and grid tie in, and limited SCADA support.

Design Wind Turbines and Integrate with Existing Power Plant
Noorvik, Alaska

Electrical engineer for this project which included initial evaluation of wind turbine size, quantity, location, integration requirements with exiting power plant, construction cost estimate, and benefit cost ratio analysis of different options. Three separate town site visits were conducted to coordinate with the Town council and to make sure project was in line with city long term and existing plans. Coordination with water plant also occurred as they would benefit from the heat produced by excess wind energy. Extensive coordination with local utility was also undertaken to determine their requirements and future plans. Original scope included civil design (access road and pads), mechanical design (electric boiler for dump load and tie to existing diesel power plant heat recovery system), structural engineering for wind turbine foundations, new power plant electrical controls module, electrical equipment supports, electrical distribution (power line extension), electrical controls for tie in to existing power plant, wind turbine transformer and disconnect, energy modeling, and permitting studies. Coffman is teamed with Marsh Creek, a construction contractor, for constructability reviews. It is important to note that Coffman acts as prime consultant routinely and hires architects as subconsultants regularly such as for our projects at Tanacross, Delta Greely, and Thorne Bay, as well as for our industrial projects. For this project, we managed subconsultants for geotechnical reviews and surveying. Due to current power plant condition and system arrangement, wind power may not be an economically viable option at this time. Three other options: Solar, power plant heat recovery upgrades, and power plant replacement, are currently being evaluated.

DGSD Biomass Heating System
Delta Junction, AK

Electrical engineer for the construction of a 5 MMBTUH, wood-chip fueled, bio-mass boiler plant to provide heat a 77,000 sf school in sub-Arctic Alaska. The boiler plant also the school district to heat the school with locally sourced wood chips instead of fuel oil. It resulted in significant cost savings. The boiler plant is housed in 4200 sf building that houses boiler equipment, wood chip storage, and an area to park two 40' wood chip trailers. Aaron performed engineering services that included design of power distribution within the building, connections to the utilities in the existing school, interior and exterior lighting, fire alarm, and grounding and bonding.

LEE BOLLING, PE, CEA, CEM

Mechanical Engineering / Alternative Energy Specialist

Years of Experience
With this Firm: 5
With Other Firms: 5

Education
B.S. Civil Engineering; University of Alaska, Anchorage; 2009

Sustainable Design Program; Ecosa Institute, Arizona; 2007

License
Alaska; Licensed Mechanical Engineer (AK#ME100010)

AEE, Certified Energy Manager, #200008; 2013

AEE Certified Energy Auditor #1595; 2011

Professional/Community Activities
American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

Association of Energy Engineers (AEE)

Lee Bolling has helped clients throughout Alaska improve the cost effectiveness of their facilities through energy conservation and efficient facility operations. His passion is in the design of high performance, energy efficient buildings and development of cost-effective renewable energy systems. Lee is a Certified Energy Manager and Certified Energy Auditor, who has completed over 3.0 million square feet of energy audits on large commercial and public buildings and facilities throughout Alaska. Lee has also worked on numerous renewable energy feasibility studies and designs, in both rural Alaska and the Railbelt, including wind, solar, biomass and heat pump systems. His past work includes the design of an innovative sea water heat pump system for a large aquarium in Seward, Alaska and designing one of the first solar thermal systems in Anchorage, Alaska. Lee has also performed energy modeling for private clients, architects, and LEED Certified projects to predict energy savings of various designs and for LEED Energy and Atmosphere credits. Lee has been actively involved in the completion of FEDC Biomass Feasibility Studies for the last four years.

Project Experience:

FEDC Biomass Feasibility Studies (2013-2016)
Dillingham Area, AK
Mechanical engineer for inspections of four villages in the Dillingham Area (Iliamna, Clarks Point, Nondalton, and Stuyahok) and evaluated them for biomass energy opportunities. Once all was evaluated economically for future final evaluation. Coffman determined community needs and desires for energy independence. Provided community with viable options for further studies using biomass heating systems in their community.

AHFC Alaska REALS Energy Audits
Anchorage, AK
Certified Energy Auditor for energy engineering services performed to complete ASHRAE Level II investment grade energy audits (IGAs) on 31 Alaska school district buildings totaling 1.9 million SF. Administration, support, and school buildings, including K-12, elementary, middle, and high schools, were included. Under a program advanced by the Alaska Housing Finance Corporation (AHFC), our IGAs identified energy conservation measures and evaluated their cost-effectiveness with computer modeling and construction cost estimates. Coffman investigated plumbing, heating, cooling and ventilation systems, electrical lighting and power systems, building control systems, and the shell/envelope construction. Coffman's capabilities as a multi-discipline engineering firm brought mechanical, electrical, and structural engineering expertise to bear. The school districts included Anchorage, Mat-Su Borough, Kenai Peninsula Borough, and Southwest Region.

LEE BOLLING, PE, CEA, CEM

Mechanical Engineering / Alternative Energy Specialist

Southeast Island School District Thorne Bay Wood Fired Boiler
Thorne Bay, AK

Mechanical engineering and energy auditing support for the designing and integrating of the "Garn-in-a-Box" wood fired boiler into the Thorne Bay School. Work includes project management, mechanical, electrical, and civil/structural engineering services as well as construction administration. Feasibility study, design documents, fire marshal permitting, and construction administration.

CIRI HVAC Upgrades
Anchorage, AK

Certified Energy Auditor for this project. Coffman had already performed an Energy Audit at the building in 2009, and designed a new HVAC chiller and Variable Speed pump system for the building. Based on Coffman's performance during the first project, CIRI contacted Coffman again for a more involved project. Coffman retro-commissioned the facility, identified areas for improvement, designed the improvements to the HVAC system. Once construction of the improvements was complete, Coffman eturned to the facility and commissioned the new equipment, identifying issues with the construction, inspecting the new equipment performance and ensuring the Owner received the improvements they desired. Highlights included a retrocommissioning report, complete as-builting of the mechanical HVAC distribution system, design drawings for the complete replacement of VAV terminal units and heating piping, new control strategies for the VAV units, the AHUs, the boilers, and the terminal heating units. Coffman performed the construction administration on the project, reviewing equipment submittals, performing periodic site inspections and reviewing required testing submittals. Finally, Coffman commissioned all of the new work to demonstrate to the owner that their project was completed and met their requirements.

BBR Energy Audit
Anchorage, AK

Certified Energy Auditor for performing a Level II Investment Grade Energy Audit of Harold's Appliances building in Anchorage, Alaska. These audits complied with the Alaska Energy Authority 2012 Alaska Commercial Energy Audit Program requirements. This energy audit was conducted at Harold's Appliances for BBR Investments, LLC. The building is 4,060 square feet (sf) and includes two office suites and a large shop in the back of the building. The north office suite is occupied by Solstice Alaska Consulting. The south office suite and shop is occupied by Harold's Appliances. The entire building, including both office suites and shop, was audited. The location of the building is shown in the following regional and overhead images. The energy audit was conducted in order to evaluate areas and equipment where energy savings can be realized.

Hydaburg Biomass
Hydaburg, AK

Coffman is providing engineering services for the design and construction administration of a biomass heating system for the Hydaburg School, located in Hydaburg, Alaska. The plan includes a design to integrate the Garn wood-fired-boilers into the existing diesel-fired boiler system used to heat all of the school buildings, and included BTU meters required in the grant. The project design includes a building to house the Garn boiler system and firewood storage. Teacher housing and a commercial greenhouse may be added in the future.

WILL VEELMAN, SE, PE
Principal, Civil/Structural Engineering

Will has over 33 years experience associated with general civil and structural projects. He is a principal with Coffman Engineers and is currently the manager of the civil/structural group. His experience in Alaska includes a variety of industrial, commercial, institutional, and military projects. His engineering experience includes permitting; designs for new facilities, renovations, and additions; analysis of existing structures; seismic studies; site grading and drainage; water transmission; sewer systems; access roads; and pipelines. Will is also experienced in construction management and inspection.

Years of Experience
With this Firm: 33
With Other Firms: 0

Education
B.S.; Civil Engineering; Washington State University; 1981

License
Alaska; Licensed Civil Engineer; #7557; 1988

Alaska; Licensed Structural Engineer; #14016; 2013

Washington; Licensed Civil Engineer; #25521; 1988

Professional/Community Activities
Society of American Military Engineers (SAME)

Project Experience:

AVEC Wind Tower Structural Design
Kasigluk, Toksook Bay, Hooper Bay, and Chevak, AK
Principal civil/structural engineer for the design of wind turbine tower foundations in several locations throughout Alaska. The projects included the work associated with providing structural design services, including coordination with the project civil engineer, geotechnical engineer, and coordination with the wind turbine and tower vendor and the construction contractor for a three tower array of 100 kW turbines at each location. Dynamic modeling of the turbine, tower, and foundations was performed during the initial structural design phase to quantify the effects of the foundation stiffness on the overall stiffness of the system. The final design consisted of a pile foundation (due to warm permafrost conditions), with a composite structural steel and concrete base for Kasigluk.

Lake and Peninsula Borough Kokhanok Wind Turbines
Kokhanok, AK
Civil, structural, mechanical, electrical and geotechnical engineering for the design to integrate two refurbished 90kW Vestas V-17 wind turbines into the existing diesel generator power plant. The design included site layout, foundation design, electrical design and mechanical design. The design allowed for excess power generation to be converted to heat and distributed to the community through a boiler grid interface, or utilize the existing power plant coolant system to dissipate excess thermal energy.

NWABSD Kobuk K12 School Design
Kobuk, AK
Will served as principal structural engineer for the design of a renovation of 5,500 SF of existing school and 11,500 SF of new school to include new boiler and fire building modules. A total of six fuel oil boilers where supplied to allow for system turndown and reliability. The school spaces included classrooms, administrative areas, kitchen, and gymnasium. Two 8,000 gallondouble containment fuel oil tanks were provided along with 13,000 gallons of fire water storage for the facility. The school ventilation systems were split by building occupancy and the classroom spaces were served with variable air volume units with reheat for thermal comfort.

SHANNON & WILSON, INC.

Years of Experience
With this Firm: 17
With Other Firms: 0

Education
M.S. Geological Engineering, University of Alaska; Fairbanks; 2003

B.S. Geological Engineering; University of Alaska, Fairbanks; 1998

License
Alaska Professional Civil Engineer, #CE11122

KYLE BRENNAN, PE
Vice President, Geologist

Kyle Brennan has 17 years' experience performing geological and geotechnical engineering related work on projects throughout the State of Alaska. Since joining Shannon & Wilson in May 2000 as a staff-level geotechnical engineer, Kyle has advanced to his current position as manager of Shannon & Wilson's Anchorage Geotechnical Group. Kyle also serves as chair of the Municipality of Anchorage Geotechnical Advisory Commission. With Shannon & Wilson, Kyle has provided geotechnical engineering services for a wide variety of projects, both large and small. His responsibilities have included geotechnical engineering support and project management for projects including road and rail infrastructure, airports, sea ports, utilities, power generation/distribution, communications towers, and building development. Kyle has provided all of these services to both private and public clients in Alaska's population centers as well as its rural communities. Kyle is well versed in providing practical geotechnical solutions for shallow and deep foundations, retaining walls, bulkhead structures, soil and rock slope stability, as well as cut/embankment development over a wide variety of soil and rock conditions. His varied experience across the State of Alaska has also given him the ability to provide practical and innovative solutions to many of the geotechnical engineering design challenges that can be found in Alaska such as permafrost soils, seismicity, and remote locations with limited resources.

Project Experience:

Fire Island Wind Farm Reconnaissance, Fire Island, Alaska. Kyle performed as project manager for a project to conduct field reconnaissance at the Fire Island Wind Farm. The project is located on an uninhabited, undeveloped island roughly 3 miles west of Anchorage, Alaska and is accessible only by boat or plane. Kyle directed the reconnaissance effort to evaluate the likely foundation conditions at potential wind tower sites and the materials available on the island for construction of foundations and access roads to the wind tower sites. Kyle prepared a geotechnical report that included the results of site observations and laboratory testing, accompanied by tabulated field notes and photographs from the site visit.

Rescue 21 Towers, Southeast and Kodiak Island, Alaska. Kyle provided project management and engineering support for a project that included four new Rescue 21 (R21) towers spread between Kodiak and Southeast, Alaska.

KYLE BRENNAN, PE
Vice President, Geologist

SHANNON & WILSON, INC.

The towers were to be located on remote mountain tops and ridge lines at Cross Mountain, Deception Hills, Middle Cape, and Twin Peaks. Kyle developed an exploration plan that included a site visit and surface reconnaissance at each tower site. Kyle oversaw the preparation of a separate geotechnical report for each site that included the observations at each site, a narrative of expected soil and rock conditions, approximate rock strengths (based on observation and point load testing), and anchored concrete foundation design parameters.

Fawn Mountain Microwave Tower, Ketchikan, Alaska. Kyle provided geotechnical project management for a project to build a new microwave antenna on Fawn Mountain near Ketchikan, Alaska. The tower site was on remote mountain top north of Ketchikan. Kyle traveled to the site to conduct surface reconnaissance to estimate soil overburden and rock type and strength to be used for foundation design. Kyle provided a letter report that summarized his findings and recommendations for rock anchors to support the tower. The recommendations were contingent on pull testing that was to be conducted during construction.

Alaska Land Mobile Radar Tower, Haines, Alaska. Kyle provided geotechnical project management for a project to build a new radar tower on near Haines, Alaska. The tower site was on remote mountain side southwest of Haines. Kyle oversaw explorations that consisted of a geologist travelling to the site to conduct surface reconnaissance to estimate soil overburden and rock type and strength to be used for foundation design. The geologist also observed drilling of several pilot holes (with an air rig) at the tower site. Kyle provided a letter report that summarized his findings and recommendations for rock anchors to support the tower. The recommendations were contingent on pull testing that was to be conducted during construction. The pull tests were conducted and it was found that anchor strengths on one leg of the tower did not meet the design criteria. Kyle worked with the structural engineer to adjust the design of the foundation to include an extra anchor.

Ballyhoo Road Improvements, Unalaska, Alaska. Kyle provided senior oversight and engineering support for a project to pave approximately 1.5 miles of Ballyhoo Road in Unalaska, Alaska. The project included review of existing subsurface information and conducting additional test pit explorations to fill data gaps and support final roadway design. Kyle oversaw the development of an engineering report that provided geotechnical engineering recommendations for the project including developing a paved surface over variable subgrade conditions ranging from shallow bedrock to soft marine sediments.

Road Improvement Master Plan, Unalaska, Alaska. Kyle performed as project manager for a project to develop a road improvement master plan for the City of Unalaska. To assist with the work, Kyle assembled a team that included a civil design subcontractor and a pavement expert. The work was carried out in two phases, the first was to evaluate the existing road system in the City, observe existing roadway performance, and develop potential causes of observed distress in existing pavements. To accomplish this, Kyle traveled to Unalaska with the pavement expert to interview City personnel and local industrial users and to review existing road designs. Kyle and the pavement expert also developed an apparatus to measure asphalt pavement ruts at specific points over time to help determine growth rates of the observed rutting. The second phase consisted of working with the City and design team to develop a new road classification system based on predicted traffic demands and future development. Kyle and the design team developed standard road designs, maintenance criteria, and life cycle costs for each classification.

Years of Experience: 20

Education

M.S. studies, University of Alaska, Biology

B.S., Humboldt State University, Biology and Zoology, 1992

Professional/Community Activities

Alaska Association of Environmental Professionals

ROBIN RIECH

President

Robin, who founded Solstice Alaska Consulting, Inc., has more than 20 years of experience planning and preparing environmental documents and permitting for energy projects in Alaska. Robin has prepared numerous Categorical Exclusions and Environmental Assessments in accordance with the National Environmental Policy Act and U.S. Department of Energy, U.S. Department of Agriculture Rural Utilities Service, Denali Commission, Bureau of Indian Affairs, U.S. Environmental Protection Agency, U.S. Fish & Wildlife Service, and other agencies' guidance. She is skilled at obtaining authorizations and permits for energy projects under the Clean Water Act, Endangered Species Act, Migratory Bird Treaty Act, National Historic Preservation Act, and other federal and state regulations. Robin has completed numerous projects in Unalaska and understands the Aleutians' natural environment.

Project Experience:

On Call Environmental Services, (AVEC)

Currently, Robin is the project manager for an on-call contract to assist AVEC with planning, environmental documents, permitting, public involvement, and grant writing for energy projects throughout Alaska. Under this contract, Robin led permitting activities for wind projects in Bethel, Toksook, Shaktoolik, and Emmonak. She has been responsible for reviewing existing wind farms to ensure that environmental mitigation measures (including bird strike studies and tower diversions) were implemented in Savoonga, Gambell, and Quinhagak. She obtained environmental approvals for interties between Emmonak and Alakanuk, Brevig Mission and Teller, and New Stuyahok and Elim. Also under this contract, Robin has helped secure over $30 million in grants for wind and other energy projects.

Captains Bay (Unalaska) Dock Expansion Project, Offshore Systems

Robin led a team to prepare an U.S. Army Corps of Engineers' wetlands permit application that included a detailed project description, statement of purpose and need, and alternative analysis. Robin successfully consulted with the NOAA Fisheries to comply with the ESA, the MMPA, and the Magnuson-Stevens Act for potential impacts on listed birds and marine mammals and Essential Fish Habitat. Robin then developed wetlands mitigation plan which involved close coordination with the City of Unalaska on the Lower Iliuliuk River Restoration Project.

Adak Hydroelectric Reconnaissance Study, TDX

Robin led a team to research regulatory and FERC jurisdictional requirements for two proposed hydroelectric projects at Adak. Robin researched environmental conditions and worked with project engineers

ROBIN RIECH, PRESIDENT

Solstice Alaska Consulting, Inc.

to determine potential impacts to environmental resources including anadromous fish streams, wetlands, cultural resources, and endangered species. Required environmental permits and authorizations were summarized in a memorandum.

Nushagak Electric Feasibility Study, Coffman Engineers

Robin completed environmental field analysis, agency scoping, permitting analysis, and an environmental overview and feasibility report for potential wind, hydroelectric, and heat recovery projects in the Dillingham area. Environmental impacts of future possible wind power generation and hydroelectric sites were evaluated, including extension of electric lines, civil engineering constraints, and vehicular and equipment access.

Mekoryuk Wind Farm Project Environmental Document and Permitting, Coffman Engineers

Robin drafted the environmental document for the installation of two wind turbines in Mekoryuk. She consulted with USFWS and obtained approval for placement of the turbines under the MBTA and the ESA. She consulted with the State Historic Preservation Officer and obtained concurrence that the project would not impact cultural or historic properties. Robin managed a subcontractor responsible for wetlands delineation and employed the data to obtain a USACE wetlands permit. Also, Robin obtained FAA Determinations of No Hazard to Air Navigation.

Deering Wind Project, Coffman Engineers

Robin led a team in preparing applications for a USACE wetlands permit and a Northwest Arctic Borough Land Use Permit for a new turbine in Deering. Work involved consulting with USFWS regarding potential impacts to ESA-listed Spectacled and Steller's Eider, other migratory birds, and polar bears; working with the State Historic Preservation Officer regarding potential impacts to cultural sites; and working with the Borough on local hire expectations.

Akutan Airport EA, DOT&PF

Robin led a team to plan and complete an EA and obtain permits for a new airport on Akun Island. Robin led a large team of scientists and planners who surveyed and prepared reports on the natural environment (wetlands, fish streams, the marine environment, birds, sea otters, and geotechnical conditions). She led public and agency coordination. This project was constructed.

Land Use Permitting Program Development, Aleutian East Borough. Robin helped with the development of permitting database tool to assist with processing permit applications. Robin worked closely with borough staff, the consultant developing the permit program, and the database designers to develop an online computer database that met the needs of the AEB and the requirements of the permitting program. This database is currently in use.

Environmental Planner, Unalaska Airport Safety Improvements EA, Tryck Nyman Hayes, Inc.

Robin assisted with public involvement and other project scoping, and a marine habitat characterization for runway rehabilitation and other safety improvements for the Unalaska Airport. The project included performing a marine habitat assessment and drafting an environmental document which was approved by the FAA. The document focused on impacts to the marine environment, historical sites, contamination, and storm water quality.performing a marine habitat assessment and drafting an environmental document which was approved by the FAA. The document focused on impacts to the marine environment, historical sites, contamination, and storm water quality.

RICH STROMBERG
Research Professor

Years of Experience
With this Firm: 1
With Other Firms: 33

Education
Master candidate in Environmental Management; 2017

B.S. Mathematical Sciences, University of Texas at Dallas; 1983

Emergency Medical Technician-Basic Albuquerque Technical Vocational Institute/University of New Mexico; 1993.

Wilderness EMT certification; 1995

B.A. Journalism, University of Alaska Anchorage: 2008

Professional/Community Activities
Volunteer for Woodmen Valley Fire Department

Captain for La Veta Fire Department 2003-2009

Rescue volunteer for Albuquerque Mountain Rescue Council 1991-1999.

References:
Peter Crimp, former deputy director, Alaska Energy Authority, 907-843-2147
Bruce Cain, former executive director, Native Village of Eyak. 907-822-3476
Jorge Romero, manager, Intel Corporation. 505-893-7000
Kristi Welton-Kidder, manager, Intel Corporation (retired). 505-730-9358
Barry Pleshek, chief, Woodmen Valley Fire Protection District. 719-964-3492
Steve Patchett, former president, Albuquerque Mountain Rescue Council. 505-294-8236

Rich is a diverse candidate with 34 years of experience in science, engineering, management, journalism and public service in the areas of emergency medical services, wilderness search and rescue and urban/wildland firefighting. He is also currently pursuing his master's degree in environmental management.

Project Experience:

University of Alaska / Alaska Center for Energy and Power (May 2017-present) – Research faculty and team lead for renewable energy development initiative in Nunavut, Canada.

ACEP/Arctic Council: Arctic Remote Energy Networks Academy (Feb. 2017-present) – Mentor for energy initiatives in northern Canada that benefit Inuit and Gwich'in communities. Provide technical and program assistance to village energy projects currently in development.

Crested Butte Mountain Resort (Nov. 2016 – April 2017) – Grad student intern focusing on energy efficiency and sustainability initiatives at the ski resort. Use Dept. of Energy modeling tools and develop detailed models in Excel and Java to identify energy and cost savings for the resort.

Alaska Energy Authority/ State of Alaska (Sep. 2009 – Dec. 2015) – Wind/solar program manager responsible for 76 projects across the state with a total budget exceeding $100 million. Serve as the primary state technical resource for solar/wind energy, resource assessment, design review and performance analysis of the integration of clean power into existing village and Railbelt power systems across Alaska. Negotiate grant contracts and provide technical and business oversight of state-funded projects to ensure they are completed within budget and meet performance expectations. Provide outreach and public education on solar/wind energy topics. Extensive experience with modeling tools Windographer and HOMER plus working knowledge of ArcGIS, QGIS and terrain flow modeling. Developed custom modeling tools.

Years of Experience
With this Firm: 14
With Other Firms: 19

Education
M.S. Project Management, University of Alaska, Anchorage; 2006

MBA, Western Washington University; 2001

B.S. Physics, Western Washington University; 1999

Project Management Professional #278257, Project Management Institute; 2005

MICHAEL FISHER, MSPM, MBA, PMP
Principal and Senior Consultant

Northern Economics

Mike has worked on a wide variety of projects at Northern Economics, ranging from feasibility studies for Alaskan ports and harbors to statistical analyses to market studies and business plans. He has also given presentations at a number of conferences held by the Alaska Association of Harbormasters and Port Administrators and a session on business planning at the Alaska Sea Grant's Marine Advisory Program's Public Seafood Processing and Cold Storage Facility Workshop.

Project Experience:

Wind/Hydro Feasibility Study
Northern Economics evaluated the financial feasibility of wind and hydro facilities in the Dillingham region. For Coffman Engineers and Nushagak Electric elephone Cooperative, Inc., 2013.

Alternative Energy Project Evaluation. Rounds 3 through 6.
Northern Economics evaluated alternative energy projects submitted in response to the Alaska Energy Authority's Alaska Alternative Energy Projects RFP. The evaluations included calculating the proposed projects' life-cycle benefit-cost ratio based on the applicants' benefit and cost estimates, as well as an independent assessment of each project and a revised benefit-cost ratio. Mike's focus in Round 3 and 4 was on wood energy projects in which wood would be burned in high-efficiency stoves to store heat energy in water for interior heating, thus displacing the use of diesel and other non-renewable fuel sources. His focus in Round 5 was on geothermal and heat pump projects. His focus in Round 6 was on heat recovery projects. For the Alaska Energy Authority, 2009, 2010, 2011, 2012.

Cost Modeling and Simulation Analysis for Hilcorp Drift River Terminal.
Project Manager. Northern Economics provided modeling and simulation support for development of the Drift River Terminal's tariff component for decommissioning, removal, and remediation of facilities. The modeling effort used engineer estimates of line item costs developed in three scenarios, each with probabilities and timelines. The analysis estimated the probabilistic annual spending amounts and overall net present value. For Coffman Engineers and Hilcorp Alaska, 2017.

Little South America (LSA) Land Development Study. Project Manager. Northern Economics was contracted to provide economic analysis of suitable land development options for Ounalashka Corporation's land holdings on LSA in Unalaska, Alaska. The first phase of the analysis consisted of a study to determine the potential for LSA to support outer continental shelf oil and gas exploration and development

MICHAEL FISHER, MSPM, MBA, PMP

Principal and Senior Consultant

activities, and to conduct a highest and best use analysis of the lands for a range of other potential purposes. For Ounalashka Corporation, 2012-2013.

King Salmon Water Feasibility Study. Project Manager. Evaluate the financial feasibility of the Bristol Bay Borough to provide water service to additional households in King Salmon. The project would add additional wells and extend water lines to households not currently on the water system. The study looked at the necessary infrastructure improvements, the user fees necessary to support construction and operation of a utility to support the service, and the feasibility of the Borough providing this service. For Bristol Bay Borough, 2007-2008.

Water and Sewer Utility Life Cycle Cost Analysis. Project Manager. Northern Economics developed a life cycle cost model for a water and wastewater facility to support a prison under construction in the Matanuska-Susitna Borough. The model and its results were prepared to support a design-build-operate proposal for providing the water and wastewater service to the prison. For Valley Utilities, LLC, 2009.

Anchorage Water and Wastewater Utility Financial Modeling. Northern Economics was contracted by AWWU to redesign their financial forecast model. The existing model at the start of the project consisted of a large number of linked spreadsheets. Work involved mapping the existing model to understand how it works, flowcharting and planning the processes for a new model, and developing a new model to allow more accurate forecasting and the ability to evaluate the effect of policy decisions on AWWU's financial ability to pay dividends, maintain capital investment, and/or hold rates steady. A separate work effort was the development of a policy planning model with simplified inputs to consider general capital improvement portfolios and rate setting choices. For CH2M-Hill and Anchorage Water and Wastewater Utility, 2007-2008.

Life Cycle Cost Analysis for Eagle River 690 Pressure Zone Intertie Project. Project Manager. Northern Economics analyzed the life cycle cost analysis of six options for AWWU's Eagle River 690 Pressure Zone Intertie Project. We used construction cost estimates from another contractor as the basis for the analysis, along with utility operating costs and depreciation schedules from the utility. After reviewing the results of the analysis, AWWU asked Northern Economics to incorporate a cash flow analysis to show the financing implications of the project alternatives. The two sets of analyses were summarized and submitted to AWWU as an input into the decision, which included both financial and operational considerations. For R&M Consultants, Inc. and Anchorage Water and Wastewater Utility, 2013.

Port of Dutch Harbor Rate Structure Study. Project Manager. Northern Economics worked on a rate structure study for Port of Dutch Harbor facilities. The goal of the study was to make the rate structure consistent across all port and harbor facilities, while allowing for differences in use types, capabilities, and amenities. For the City of Unalaska, 2014-2016.

Arctic Deep Draft Port Comments. Project Manager. Northern Economics conducted interviews and collected information about historical and planned use of Unalaska and Port of Dutch Harbor facilities by vessels operating in the Arctic, including oil and gas exploration activities. This information was compiled for the City of Unalaska to prepare comments on an upcoming report by the U.S. Army Corps of Engineers. For the City of Unalaska, 2014-2015.

Carl E Moses Boat Harbor Rate Study. Project Manager. Northern Economics developed moorage and other rates for the new Carl E. Moses harbor in Unalaska. The new facility will open in fall 2011. For the City of Unalaska, 2011.

MICHAEL FISHER, MSPM, MBA, PMP

Principal and Senior Consultant

Northern Economics

Port and Harbor Ten-Year Development Plan Update. Update the Port and Harbor Ten-Year Development Plan. Work includes an analysis of factors affecting marine activities in Unalaska, including the review of historical facility use data and industries affecting the local economy. Review tariffs for Port of Dutch Harbor facilities and existing conditions and needs. Assess needed infrastructure maintenance and improvements over the next decade to meet demand for facilities and services. Provide rate recommendations for existing and planned facilities. For the City of Unalaska, 2008-2009.

Little South America Harbor Revenue Model. Develop a user-friendly spreadsheet model for planning the allocation of vessel slip sizes in the planning process for the proposed Little South America harbor. The model provides the user with estimates of the revenues generated and capital cost of various designs based on rough order of magnitude costs and estimates of the space required to accommodate vessels of various sizes. For the City of Unalaska, 2005-2006.

Ten-Year Port and Harbor Development Plan. Provide a 10-year development plan for the City of Unalaska/Port of Dutch Harbor to identify, evaluate, rank, and schedule projects for development and funding. Analyze current and future conditions, including the competitive environment, and provide recommendations about facilities and services to offer, capital project priorities, scheduling, and financing and funding strategies. The fleet analysis included a comprehensive look at the existing fleet by size and vessel type, followed by interviews with processors, vessel owners and operators, and policymakers to determine anticipated changes in the fleet composition over the next ten years. For the City of Unalaska, 2003-2004.

Benefits of Upgrading Position 1. Describe potential benefits of upgrading Position 1 at the Unalaska/Dutch Harbor Marine Center. Work includes identifying and describing potential benefits of the upgrade, providing qualitative and quantitative justifications for benefits, and report preparation. For the City of Unalaska, 2003.

Susitna-Watana Hydroelectric Project: Benefit-Cost and Economic Impact Analyses. Northern Economics conducted separate studies to evaluate the merits of the proposed Susitna-Watana Hydroelectric Project. Mike's work was focused on a benefit-cost analysis of the facility. For the Alaska Energy Authority, 2014-2015.

The Importance of Cook Inlet Oil and Gas to Southcentral Alaska. Project Manager. Northern Economics prepared a report discussing the importance of Cook Inlet oil and gas, with an emphasis on gas, to the Southcentral Alaska economy. The report reviewed historical and current production and consumption of gas and then evaluated the relative costs of alternative fuel options as a proxy for the importance of Cook Inlet gas. The report also discussed additional benefits from Cook Inlet oil and gas activity, including employment, wages, state revenues, and state royalty payments. For the Anchorage Chamber of Commerce. 2013-2014.

Sawmill Cove Feasibility Study. Project Manager. Northern Economics lead a team to evaluate the feasibility of development of the Sawmill Cove Industrial Park in Sitka, Alaska. Developments under consideration included a deep water dock, large vessel moorage, and a haul-out facility, along with supporting uplands development to support those activities. Phase 1 of the study consisted of scoping and a public meeting. Phase 2 of the study consisted of an evaluation of cargo demand for the deep water dock, a vessel owner survey, preliminary engineering design and cost estimating, and screening-level feasibility studies of each of the three developments. For the City and Borough of Sitka, 2013-2014.

MICHAEL ROY YARBOROUGH

Principal Archeologist

Mike has nearly 40 years of archaeological experience in Alaska and has worked in all areas of the state. He meets the Secretary of the Interior's professional qualifications in both prehistoric and historic archaeology, has an excellent working knowledge of the historical and archaeological literature available for Alaska, and has experience in working with state and federal agencies. He has completed over 100 cultural resource surveys throughout the state during his tenure at CRC, and has authored numerous cultural resource reports. Mike has extensive experience with WWII installations and history, Aleutian archaeology, and multi-participant consultation. He has experience surveying for and monitoring historic properties, devising mitigation for historic properties, and preparing Programmatic Agreements and Memoranda of Agreement. He has worked in the Interior, Southwest Alaska, Southeast Alaska, Western Alaska, Central Alaska, in the Aleutians, and on the North Slope.

Years of Experience: 43

Education

Ph.D. course work; University of Toronto; 1973- 1974

M.A. Archeology; University of Toronto; 1973

B.A. high honors in Anthropology; University of Arkansas; 1972.

Professional/Community Activities

Alaska Association of Environmental Professionals

Publications (5 of 13)

1984 Archeological Survey of a Proposed Airport Site, Unalaska, Alaska. Cultural Resource
Consultants, Anchorage

1989 Archeological and Historical Survey of the UniSea Port Complex, Dutch Harbor, Alaska.

1998 Archeological Testing of UNL-048, The Margaret Bay Site, Unalaska, Alaska

2001 2000 Archaeological and Historical Report on the Environmental Restoration of
Amaknak and Unalaska Islands under the Formerly Used Defense Sites (FUDS) Program. Prepared for the U.S. Army Corps of Engineers, Alaska District

2004 Documentation for Determination of No Adverse Effects for the East Point/Ballyhoo/Airport Beach Roads Improvements Project, Unalaska and Amaknak Islands,
Alaska. Report prepared for the Alaska Department of Transportation and Public Facilities

Experience:

Principal Archeologist, Cultural Resource Consultants LLC, Anchorage, July 1981 to present.

Archeologist, USDA Forest Service, Chugach National Forest, Anchorage, April to May 1990.

Archeologist, U.S. Fish and Wildlife Service, Alaska Regional Office, Anchorage, June 1977 to July 1981.

Supervisory Archeologist, Alyeska Pipeline Project, Institute of Arctic Biology, University of Alaska, Fairbanks, May 1974 to August 1976.

Project Team

Organization Chart

City of Unalaska

Coffman Engineers

Contract Manager and Principal-in-Charge

Tony SlatonBarker, PE LEED AP

Project Manager

Martin Miller, PE
Coffman Engineers

Met Tower Siting
Rich Stromberg
ACEP

Permitting
Robin Reich, President
Solstice Alaska Consulting DBE #9900647

Cultural Resources
Michael Roy Yarborough, PhD
Principal Archeologist

Wind Resource Analysis
Martin Miller, PE
Rich Stromberg

Fuel Offset
Lee Bolling, PE
Coffman

LCOE
Mike Fisher
MSPM, MBA, PMP
Northern Economics

Electrical Engineering
Aaron Busche-Vold
PE, LEED AP
Coffman

Civil/Structural Engineering
Will Veelman, SE, PE
Coffman

Geotechnical Engineering
Kyle Brennan, PE
Shannon & Wilson

Phase Element	Time Estimate	Category	Company	Participation (%)	Hours/ Units	Rate	Cost
System configuration review	16	Labor	V3 Energy	50	8	$ 185	$ 1,480
			EPS	50	8	$ 205	$ 1,640
		Expenses	Homer monthly		1	$ 185	$ 185
		Markup					$ 183
Review existing reports, data, models	24	Labor	V3 Energy	50	12	$ 185	$ 2,220
			John Wade	50	12	$ 135	$ 1,620
		Expenses	AWS day pass		2	$ 150	$ 300
		Markup					$ 192
Initial Site Visit	24	Labor	V3 Energy	100	24	$ 185	$ 4,440
		Expenses	Airfare		1	$ 1,200	$ 1,200
			Lodging		2	$ 155	$ 310
			M&I		3	$ 101	$ 303
			SUV rental, DUT		3	$ 115	$ 345
			ANC parking		3	$ 16	$ 48
		Markup					$ 221
Environmental and cultural review	20	Labor	V3 Energy	10	2	$ 185	$ 370
			SolsticeAK	45	9	$ 120	$ 1,080
			CRC	45	9	$ 123	$ 1,107
		Markup					$ 219
Second Site Visit	72	Labor	V3 Energy	33.3	24	$ 185	$ 4,440
			SolsticeAK	33.3	24	$ 120	$ 2,880
			CRC	33.3	24	$ 123	$ 2,952
		Expenses	Airfare		3	$ 1,200	$ 3,600
			Lodging		6	$ 155	$ 930
			M&I		9	$ 101	$ 909
			SUV rental, DUT		3	$ 115	$ 345
			ANC parking		9	$ 16	$ 144
		Markup					$ 1,176
Site selection and permitting	20	Labor	V3 Energy	40	8	$ 185	$ 1,480
			John Wade	30	6	$ 135	$ 810
			SolsticeAK	15	3	$ 120	$ 360
			CRC	15	3	$ 123	$ 369
		Markup					$ 154
Met tower equipment selection	16	Labor	V3 Energy	60	9.6	$ 185	$ 1,776
			John Wade	40	6.4	$ 135	$ 864
		Markup					$ 86
Phase II report	32	Labor	V3 Energy	40	12.8	$ 185	$ 2,368
			John Wade	10	3.2	$ 135	$ 432
			SolsticeAK	25	8	$ 120	$ 960
			CRC	25	8	$ 123	$ 984
		Markup					$ 238
						Total	$ 45,481

Attachment B

Proposal Evaluation
Wind Power Assessment - Phases II to IV
Post Interview Evaluation

Technical Attributes	***Weight***	***%***	**Coffman**	**V3 Energy**				
Professional Qualifications	*40*	*40.0%*	96.7	98.3				
Experiences and References	*30*	*30.0%*	97.5	97.5				
Narrative	*30*	*30.0%*	96.7	98.3				
Technical Proposal Raw Score	*100*	--	96.9	98.1				
Technical Proposal Adjusted Score	--	*100%*	96.9%	98.1%				

Enter the Price Proposal (if any) in USD

Cost Attributes	***Weight***	***%***	**Coffman**	**V3 Energy**				
Cost USD	*0*	--						
Price Proposal Score	--	*0%*	0.0%	0.0%				
Total Score			**96.9%**	**98.1%**				
Ranking			**2**	**1**				

Digitally signed by Robert Lund
DN: cn=Robert Lund,
o=Department of Public Works,
ou, email=rlund@ci.unalaska.ak.us,
c=US
Date: 2017.10.05 17:46:58 -08'00'

Proposal Evaluation
Wind Power Assessment - Phases II to IV

For each Technical Attribute rank each Respondent starting with 1,2,3,4,5 and 6 and so forth. 1 is best, 2 is next best, 3 is third best, etc.. Do not skip or repeat numbers.

Attributes	*Weight*	*%*	Coffman	V3 Energy				
Professional Qualifications	*40*	*40.0%*	2	1				
Experiences and References	*30*	*30.0%*	1	2				
Narrative	*30*	*30.0%*	2	1				

Do not edit. The below calculates the rankings you entered above as a percentage. Each successive rank is a difference of 5%.

Attributes	*Weight*	*%*	Coffman	V3 Energy				
Professional Qualifications	*40*	*40.0%*	95.0	100.0				
Experiences and References	*30*	*30.0%*	100.0	95.0				
Narrative	*30*	*30.0%*	95.0	100.0				
Total Weight	*100*	*100.0%*	96.5	98.5				
Ranking			2	1				

I certify that I have no conflicts of interest and that I have strictly adhered to the procedures described in the Request for Qualifications.

Evaluator Signature: [signature]

Date: 10/5/18

Proposal Evaluation
Wind Power Assessment - Phases II to IV

For each Technical Attribute rank each Respondent starting with 1,2,3,4,5 and 6 and so forth. 1 is best, 2 is next best, 3 is third best, etc.. Do not skip or repeat numbers.

Attributes	*Weight*	%	Coffman	V3 Energy				
Professional Qualifications	*40*	*40.0%*	1	2				
Experiences and References	*30*	*30.0%*	2	1				
Narrative	*30*	*30.0%*	2	1				

Do not edit. The below calculates the rankings you entered above as a percentage. Each successive rank is a difference of 5%.

Attributes	*Weight*	%	Coffman	V3 Energy				
Professional Qualifications	*40*	*40.0%*	100.0	95.0				
Experiences and References	*30*	*30.0%*	95.0	100.0				
Narrative	*30*	*30.0%*	95.0	100.0				
Total Weight	*100*	*100.0%*	97.0	98.0				
Ranking			2	1				

I certify that I have no conflicts of interest and that I have strictly adhered to the procedures described in the Request for Qualifications.

Evaluator Signature:

Date:

Proposal Evaluation
Wind Power Assessment - Phases II to IV

For each Technical Attribute rank each Respondent starting with 1,2,3,4,5 and 6 and so forth. 1 is best, 2 is next best, 3 is third best, etc.. Do not skip or repeat numbers.

Attributes	***Weight***	***%***	**Coffman**	**V3 Energy**				
Professional Qualifications	*40*	*40.0%*	2	1				
Experiences and References	*30*	*30.0%*	1	2				
Narrative	*30*	*30.0%*	2	1				

Do not edit. The below calculates the rankings you entered above as a percentage. Each successive rank is a difference of 5%.

Attributes	***Weight***	***%***	**Coffman**	**V3 Energy**				
Professional Qualifications	*40*	*40.0%*	95.0	100.0				
Experiences and References	*30*	*30.0%*	100.0	95.0				
Narrative	*30*	*30.0%*	95.0	100.0				
Total Weight	*100*	*100.0%*	96.5	98.5				
Ranking			2	1				

I certify that I have no conflicts of interest and that I have strictly adhered to the procedures described in the Request for Qualifications.

Evaluator Signature:

Date: 10/5/17

Proposal Evaluation
Wind Power Assessment - Phases II to IV

For each Technical Attribute rank each Respondent starting with 1,2,3,4,5 and 6 and so forth. 1 is best, 2 is next best, 3 is third best, etc.. Do not skip or repeat numbers.

Attributes	***Weight***	**%**	**Coffman**	**V3 Energy**				
Professional Qualifications	*40*	*40.0%*	1	2				
Experiences and References	*30*	*30.0%*	1	2				
Narrative	*30*	*30.0%*	1	2				

Do not edit. The below calculates the rankings you entered above as a percentage. Each successive rank is a difference of 5%.

Attributes	***Weight***	**%**	**Coffman**	**V3 Energy**				
Professional Qualifications	*40*	*40.0%*	100.0	95.0				
Experiences and References	*30*	*30.0%*	100.0	95.0				
Narrative	*30*	*30.0%*	100.0	95.0				
Total Weight	*100*	*100.0%*	100.0	95.0				
Ranking			1	2				

I certify that I have no conflicts of interest and that I have strictly adhered to the procedures described in the Request for Qualifications.

Evaluator Signature:

Date:

Tom Cohenour

Digitally signed by Tom Cohenour
DN: cn=Tom Cohenour, o=City of Unalaska, ou=Department of Public Works,
email=tcohenour@ci.unalaska.ak.us, c=US
Date: 2017.10.05 14:52:20 -08'00'

Proposal Evaluation
Wind Power Assessment - Phases II to IV

For each Technical Attribute rank each Respondent starting with 1,2,3,4,5 and 6 and so forth. 1 is best, 2 is next best, 3 is third best, etc., Do not skip or repeat numbers.

Attributes	*Weight*	*%*	Coffman	V3 Energy				
Professional Qualifications	*40*	*40.0%*	2	1				
Experiences and References	*30*	*30.0%*	2	1				
Narrative	*30*	*30.0%*	2	1				

Do not edit. The below calculates the rankings you entered above as a percentage. Each successive rank is a difference of 5%.

Attributes	*Weight*	*%*	Coffman	V3 Energy				
Professional Qualifications	*40*	*40.0%*	95.0	100.0				
Experiences and References	*30*	*30.0%*	95.0	100.0				
Narrative	*30*	*30.0%*	95.0	100.0				
Total Weight	*100*	*100.0%*	95.0	100.0				
Ranking			2	1				

I certify that I have no conflicts of interest and that I have strictly adhered to the procedures described in the Request for Qualifications.

Evaluator Signature: [signature]

Date: 5-Oct-2017

Proposal Evaluation
Wind Power Assessment - Phases II to IV

For each Technical Attribute rank each Respondent starting with 1,2,3,4,5 and 6 and so forth. 1 is best, 2 is next best, 3 is third best, etc.. Do not skip or repeat numbers.

Attributes	***Weight***	***%***	**Coffman**	**V3 Energy**				
Professional Qualifications	*40*	*40.0%*	2	1				
Experiences and References	*30*	*30.0%*	2	1				
Narrative	*30*	*30.0%*	2	2				

Do not edit. The below calculates the rankings you entered above as a percentage. Each successive rank is a difference of 5%.

Attributes	***Weight***	***%***	**Coffman**	**V3 Energy**				
Professional Qualifications	*40*	*40.0%*	95.0	100.0				
Experiences and References	*30*	*30.0%*	95.0	100.0				
Narrative	*30*	*30.0%*	95.0	95.0				
Total Weight	*100*	*100.0%*	95.0	98.5				
Ranking			2	1				

I certify that I have no conflicts of interest and that I have strictly adhered to the procedures described in the Request for Qualifications.

Evaluator Signature: Lori Gregory

Date: 10/5/17

CITY OF UNALASKA WIND POWER DEVELOPMENT AND INTEGRATION ASSESSMENT PROJECT – PHASES II TO IV - INTERVIEWS
OCTOBER 3rd, 2017

888-363-4734
1258939
2149

I. Introductions:

City of Unalaska::

a) Andy McCracken – DPU Powerhouse Supervisor
b) Matt Scott – DPU Powerhouse Electrical Engineering Technician
c) Robert Lund – DPW City Engineer
d) Mark Morrow – DPW Engineering Technician
e) Tom Cohenour – DPW Director
f) Dan Winters – DPU Director
g) JR Pearson – Deputy Director DPU
h) Bil Homka – Planning Director

Consultant::

II. Questions:

a) The SOQ presented a team of individuals outside the core consultant. How do you plan to control spending on this project?

b) Describe your experiences rallying support and presenting similar projects to elected government officials and/or other civic organizations such as Native Corporations.

c) What design considerations most concern you regarding specifying and certifying equipment to be sited in an Aleutian climate zone? Which if any manufacturers would you consider reasonable for consideration?

d) Can you be objective about the feasibility of wind power and describe a situation where you recommended stopping a project short because it was infeasible and why?

III. Open Discussion:

IV. Schedule:

a) The City will re-score the SOQs by Friday October 6th, 2017 and send the results to both respondents.

b) Develop the scope of work for Phase II and negotiate fees.

Robert Lund

Subject: Wind Study Final Evaluation
Location: Not a Meeting

Start: Thu 10/5/2017 3:00 PM
End: Thu 10/5/2017 3:00 PM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Robert Lund
Required Attendees: Bil Homka; Matthew Scott; Mark Morrow; JR Pearson; Dan Winters; Tom Cohenour; Lori Gregory; Andy McCracken

Not a Meeting

Attached are the rate sheets. Please consider them under Qualifications in addition to their actual qualifications.

At this time score sheets are due for Coffman Engineers versus V3 Energy. Please print sign and scan them to rlund@ci.unalaska.ak.us

Evaluation Score Sheet- Wind Po... | V3 Energy LLC, Price Proposal ... | Coffman 2017 City of Unalaska...

Price Proposal to City of Unalaska
Department of Public Utilities
for

Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project, Phases II to IV

DPU project no. 41-250

October 4, 2017

Submitted by:

Douglas Vaught, P.E.
V3 Energy, LLC
Eagle River, Alaska
dvaught@v3energy.com
www.v3energy.com
907.350.5047

Price Proposal for Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project, Phases II to IV, DPU Project No. 41-250

V3 Energy, LLC of Eagle River, Alaska, along with Electric Power Systems, Inc. of Anchorage, Alaska and other partners, is pleased to submit this price proposal to the City of Unalaska for Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project, Phases II to IV.

Contents

Price Proposal for Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project, Phases II to IV, DPU Project No. 41-250

Project Team

As noted in the Technical Proposal, dated September 19, 2017, the project team consists of the following companies:

- V3 Energy, LLC (**V3 Energy**), based in Eagle River, Alaska
- Electric Power Systems, Inc. (**EPS**), based in Anchorage, Alaska
- Bering Straits Development Co. (**BSDC**), based in Nome, Alaska
- Solstice Alaska Consulting, Inc. (**SolsticeAK**), based in Anchorage, Alaska
- John E. Wade Wind Consultant, LLC (**John Wade**), based in Portland, Oregon
- Financial Engineering Co. (**FEC**), based in Rockport, Maine
- Cultural Resource Consultants, LLC (**CRC**), based in Anchorage, Alaska

Fee Schedule

Fee schedules for project participants supplied to V3 Energy are for 2017 and in some cases subject to increase, as noted below.

Rates

Company	Person	Hourly Rate	Expenses	Notes
V3 Energy, LLC	Douglas Vaught, P.E.	$185	Actual + 10%	For duration of project
Electric Power Systems, Inc.	Bill Brimstein, P.E.	$205	Actual + 10%	Valid to 12/31/17
	David Buss, P.E.	$221		
Bering Straits Development Co.	Robert Bensin	$130	Actual + 25% (mat'ls, svcs) Actual + 15 (subs)	Effective 8/1/2017
	Unalaska-sourced laborers hired by BSDC	$70		
Solstice Alaska Consulting, Inc.	Robin Reich	$120	Actual +5%	Thru 12/2018 at least
John E. Wade Wind Consultant	John Wade	$135	None expected	For duration of project
Financial Engineering Co.	Michael Hubbard, P.E.	$195	No markup	2018 rate; noted as $205 in 2019 and $230 in 2020
Cultural Resources Consultants, LLC	Michael Yarborough	$123	Not noted	Noted as 2017 billing rates

Anticipated Participation

Based on understanding of the City of Unalaska Request for Proposal of this project, the Technical Proposal submitted on September 19 and the telephone interview yesterday, anticipated participation or level of effort of each company for the project is presented below. The estimation of participation level is subject to change as the project proceeds, new information is acquired, and data obtained, per the nature of an iterative or investigative process. Note that these estimates are not price loaded, hence only reflect anticipated time involvement.

Anticipated Participation Rates

Phase	Phase Element	Company	Participation (%)
II	System configuration review	V3 Energy	60
		EPS	40
	Review existing reports, data, models	V3 Energy	50
		John Wade	50
	Site visit, environmental and cultural review	V3 Energy	40
		SolsticeAK	30
		CRC	30
	Site selection and permitting	V3 Energy	40
		John Wade	30
		SolsticeAK	15
		CRC	15
	Met tower equipment selection	V3 Energy	70
		John Wade	30
	LIDAR alternative	V3 Energy	60
		John Wade	40
	Phase II report	V3 Energy	50
		John Wade	30
		SolsticeAK	10
		CRC	10
III	Met tower installation	V3 Energy	45
		BSDC	55
	Data analysis and reporting	V3 Energy	65
		John Wade	30
	Phase III report	V3 Energy	60
		John Wade	30
		FEC	10
IV	Powerhouse generation impact	EPS	90
		V3 Energy	10
	Feasibility analysis of development	EPS	75
		V3 Energy	25
	ROM design and cost estimate	EPS	65
		V3 Energy	15
		FEC	20
	Economic Analysis	EPS	20
		V3 Energy	20
		FEC	60
	Phase IV report	EPS	50
		V3 Energy	25
		FEC	25
	Presentation to city council	EPS	33
		V3 Energy	33
		FEC	33

2017 CITY OF UNALASKA RATE SCHEDULE
Effective October 2017

DESCRIPTION	HOURLY RATE	% ANTICIPATED LEVEL OF EFFORT
PRINICPAL III	216.00	0.5
PRINICPAL I	200.00	5
SENIOR CONSULTANT	216.00	0
SENIOR PROJECT ENGINEER	200.00	0
SENIOR PM	185.00	0
SENIOR ENG/PM	170.00	15
ENGINEER III/CP III/CIP III	150.00	10
ENGINEER II/CP II/CIP II	145.00	20
ENGINEER I/CP I/CIP I	125.00	20
PIPING DESIGN SPECIALIST	170.00	0
SENIOR DESIGNER	145.00	0
DESIGNER III/TECH III	135.00	0
DESIGNER II/TECHNICIAN II	125.00	0
DESIGNER I/TECHNICIAN I	105.00	0
DRAFTER II	95.00	0
DRAFTER I	85.00	1
SENIOR GEOTECHNICAL VP	215.00	1
SENIOR GEOTECHNICAL ENGINEER	115.00	5
ACEP WIND CONSULTANT	150.00	5
PRINCIPAL ENVIRONMENTAL PLANNER	120.00	10
PRINCIPAL ARCHAEOLOGIST	123.00	3
PRINCIPAL ECONOMIC CONSULTANT	170.00	3
CLERICAL	75.00	1.5

See next page for reimbursable expenses

REIMBURSABLE EXPENSES

AUTOMOBILE

Mileage, per mile $0.535 (current IRS allowed mileage-rate)

EQUIPMENT, SUPPLIES, AND OTHER SERVICES

The following equipment, supplies, and other services will be billed at 1.10 times actual cost:

- Postage, shipping and air freight delivery.
- Messenger and delivery service.
- Airfare, lodging and car rental.
- Permits, licenses, and fees required for performance of the work.
- Sub-consultant services and equipment.
- Unusual services, equipment, and facilities, not customarily furnished or incurred in our normal operations.

CITY OF UNALASKA

Consultant Agreement

Analysis of the City of Unalaska Wind Power Development
And
Integration Assessment Project
Phase II

FILE NO. 41-250

Prepared By:

City of Unalaska
P.O. Box 610
Unalaska, Alaska 99685
907.581.1260

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AGREEMENT FOR CONSULTING AND RELATED SERVICES

THIS AGREEMENT is entered into this ______ day of __________________________**, 2017** by and between **____,** (hereinafter called "Consultant"), and the **CITY OF UNALASKA** (hereinafter called "City").

WITNESSETH THAT:

WHEREAS City desires to engage Consultant to render consulting and related services for the performance of an **Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II,** and

WHEREAS Consultant represents that it has the experience and ability to perform such services; and

WHEREAS the parties hereto desire to enter into a basic agreement setting forth the terms under which Consultant will, as requested, perform such work;

NOW THEREFORE the parties hereto do mutually agree as follows:

1. Employment of Consultant

   Consultant agrees to provide professional services in accordance with the provisions of this Agreement. A written description of the work to be performed, schedule and compensation is set out in **Exhibits A-C** of this Agreement.

2. Performance

   Consultant agrees to perform the work described in **Exhibit A- Scope of Services**; however, the Consultant is not authorized to perform any work or incur any expense which would cause the amount for which he is entitled to be paid under this Agreement to exceed the amount set forth in **Exhibit C – Fee Proposal** without the prior written approval of the City. All services shall be rendered in accordance with the schedule set forth in **Exhibit B – Contract Schedule**.

   The work shall include but not be limited to the following: furnishing all equipment, transportation, per diem, travel, and supplies to perform all scopes of work that are authorized under the State of Alaska's Professional Engineering License, in connection with the **Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II.**

3. Fee

After receipt of a periodic billing for said services, the City agrees to pay Consultant as compensation for the services under this Agreement such sums of money as set forth in **Exhibit C** of this Agreement. The amount payable to the Consultant shall not exceed the amount specified in **Exhibit C**.

4. Payments

City agrees to make monthly payments to Consultant as services are performed and costs are incurred, provided Consultant submits a proper invoice for each payment, in such form accompanied by such evidence in support thereof as may be reasonably required by the City. City may, at its option, withhold ten percent (10%) from each monthly payment pending satisfactory completion of the work by Consultant. All invoices are otherwise due and payable within thirty (30) days of receipt by City. City shall pay Consultant for the services identified in **Exhibit A** the **Not to Exceed Total Fee of $_____________**. The Not to Exceed Total Fee is based on the distribution of the Not to Exceed Total Fee between tasks set forth in **Exhibit A.** The portion of the Not to Exceed Total Fee billed and paid for Consultant's services shall be equal to the proportion of services actually completed for each task set forth in **Exhibit A** during the billing period to the fee total specified for that task.

5. Personnel

Consultant agrees to furnish all personnel necessary for expeditious and satisfactory performance of this Agreement, each to be competent, experienced, and well qualified for the work assigned. No person objected to by the City shall be employed by Consultant for work hereunder.

6. Independent Contractor Status

In performing under this Agreement, Consultant acts as an independent contractor and shall have responsibility for and control over the details and means for performing the consulting services required hereunder.

7. Indemnification

Consultant shall defend and save harmless City or any employee, officer, insurer, or elected official thereof from and against losses, damages, liabilities, expenses, claims, and demands but only to the extent arising out of any negligent act or negligent omission of Consultant while performing under the terms of this contract.

8. Assignment

Consultant shall not assign this Agreement or any of the monies due or to become due hereunder without the prior written consent of City.

9. Subcontracting

Consultant may not subcontract its performance under this Agreement without prior written consent of City. Any subcontractor must agree to be bound by terms of this Agreement.

10. Designation of Representatives

The Parties agree, for the purposes of this Agreement, the City shall be represented by and may act only through the Deputy Director of Public Utilities or such other person as he may designate in writing. Consultant shall advise City in writing of the name of its representative in charge of the administration of this Agreement, who shall have authority to act for and bind Consultant in connection with this Agreement.

11. Termination

Either party shall have the right to terminate this Agreement in whole or in part at any time and for reasonable cause, by delivery of thirty (30) days written notice, specifying the extent and effective date thereof. After receipt of such notice, Consultant shall stop work hereunder to the extent and on the date specified in such notice, terminate all subcontracts and other commitments to the extent they relate to the work terminated, and deliver to City all designs, computations, drawings, specifications and other material and information prepared or developed hereunder in connection with the work terminated.

In the event of any termination pursuant to this clause, Consultant shall be entitled to be paid as provided herein for direct labor hours expended and reimbursable costs incurred prior to the termination pursuant to Section 3 hereof, and for such direct labor hours and reimbursable costs as may be expended or incurred thereafter with City's approval in concluding the work terminated, it being understood that Consultant shall not be entitled to any anticipated profit on services not performed. Except as provided in this clause, any such termination shall not alter or affect the rights or obligations of the parties under this Agreement.

12. Ownership and Use of Documents

Consultant agrees that all original design reproducible drawings, all pertinent calculations, specifications, reports, data and other documents prepared for the City hereunder are the property of the City and the City shall have the right, without payment of additional compensation, to disclose, reproduce and use such documents for this project

13. Insurance

A. During the term of the contract, the Contractor shall obtain and maintain in force the insurance coverage specified in these requirements. Such coverage shall be with an insurance company rated “Excellent” or “Superior” by A. M. Best Company, or a company specifically approved by the City.

B. The contractor shall carry and maintain throughout the life of this contract, at its own expense, insurance not less than the amounts and coverage herein specified, and the City of Unalaska, its employees and agents shall be named as additional insured under the insurance coverage so specified and where allowed, with respect to the performance of the work. There shall be no right of subrogation against the City or its agents performing work in connection with the work, and this waiver of subrogation shall be endorsed upon the policies. Insurance shall be placed with companies acceptable to the City of Unalaska; and these policies providing coverage thereunder shall contain provisions that no cancellation or material changes in the policy relative to this project shall become effective except upon *30* days prior *written* notice thereof to the City of Unalaska.

C. Prior to commencement of the work, the contractor shall furnish certificates to the City of Unalaska, in duplicate, evidencing that the Insurance policy provisions required hereunder are in force. Acceptance by the City of Unalaska of deficient evidence does not constitute a waiver of contract requirements.

D. The contractor shall furnish the City of Unalaska with certified copies of policies upon request. The minimum coverages and limits required are as follows:

1. Workers’ Compensation insurance in accordance with the statutory coverages required by the State of Alaska and Employers Liability insurance with limits not less than $1,000,000 and, where applicable, insurance in compliance with any other statutory obligations, whether State or Federal, pertaining to the compensation of injured employees assigned to the work, including but not limited to Voluntary Compensation, Federal Longshoremen and Harbor Workers Act, Maritime and the Outer Continental Shelf’s Land Act.

2. Commercial General Liability with limits not less than $1,000,000 per Occurrence and $2,000,000 Aggregate for Bodily Injury and Property Damage, including coverage for Premises and Operations Liability, Products and Completed Operations Liability, Contractual Liability, Broad Form Property Damage Liability and Personal Injury Liability.

3. Commercial Automobile Liability on all owned, non-owned, hired and rented vehicles with limits of liability of not less than $1,000,000 Combined Single Limit for Bodily Injury and Property Damage per each accident or loss.

4. Umbrella/Excess Liability insurance coverage of not less than $1,000,000 per occurrence and annual aggregate providing coverage in excess of General Liability, Auto Liability, and Employers Liability.

5. If work involves use of aircraft, Aircraft Liability insurance covering all owned and non-owned aircraft with a per occurrence limit of not less that $1,000,000.

6. If work involves use of watercraft, Protection and Indemnity insurance with limits not less than $1,000,000 per occurrence.

7. Professional Liability insurance with limits of not less than $1,000,000 per claim and $1,000,000 aggregate, subject to a maximum deductible $10,000 per claim. The City of Unalaska has the right to negotiate increase of deductibles subject to acceptable financial information of the policyholder.

E. Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the City, its officers, officials, employees and volunteers; or the contractor shall provide a financial guarantee satisfactory to the City guaranteeing payment of losses and related investigations, claim administration and defense expense.

F. All insurance policies as described above are required to be written on an "occurrence" basis. In the event occurrence coverage is not available, the contractor agrees to maintain "claims made" coverage for a minimum of two years after project completion.

G. If the contractor employs subcontractors to perform any work hereunder, the contractor agrees to require such subcontractors to obtain, carry, maintain, and keep in force during the time in which they are engaged in performing any work hereunder, policies of insurance which comply with the requirements as set forth in this section and to furnish copies thereof to the City of Unalaska. This requirement is applicable to subcontractors of any tier.

14. <u>Claims Recovery</u>

Claims by City resulting from Consultant's failure to comply with the terms of and specifications of this contract and/or default hereunder may be recovered by City by withholding the amount of such claims from compensation otherwise due Consultant for work performed or to be performed. City shall notify Consultant of any such failure, default or damage therefrom as soon as practicable and no later than 10 days after discovery of such event by written notice. Nothing provided herein shall be deemed as constituting an exclusive remedy on behalf of City, nor a waiver of any other rights hereunder at law or in equity. Design changes required as a result of failure to comply with the applicable standard of care shall be performed by the Consultant without additional compensation.

15. Performance Standard

Services performed under this Agreement will be performed with reasonable care or the ordinary skill of the profession practicing in the same or similar location and under similar circumstances and shall comply with all applicable codes and standards.

16. Compliance with Applicable Laws

Consultant shall in the performance of this Agreement comply with all applicable federal, state, and local laws, ordinances, orders, rules, and regulations applicable to its performance hereunder, including without limitation, all such legal provisions pertaining to social security, income tax withholding, medical aid, industrial insurance, workers' compensation, and other employee benefit laws. Consultant also agrees to comply with all contract provisions pertaining to grant or other funding assistance which City may choose to utilize to perform work under this Agreement. The Consultant and all subcontractors must comply with state laws related to local hire and prevailing wages.

17. Records and Audit

Consultant agrees to maintain sufficient and accurate records and books of account, including detailed time records, showing all direct labor hours expended and all reimbursable costs incurred and the same shall be subject to inspection and audit by City at all reasonable times. All such records and books of account pertaining to any work performed hereunder shall be retained for a period of not less than six (6) years from the date of completion of the improvements to which the consulting services of this Agreement relate.

18. Reporting of Progress and Inspection

Consultant agrees to keep City informed as to progress of the work under this Agreement by providing monthly written progress reports, and shall permit City to have reasonable access to the work performed or being performed, for the purpose of any inspection City may desire to undertake.

19. Form of City Approval

Except as otherwise provided in this Agreement, City's requests and approvals, and Consultant’s cost estimates and descriptions of work to be performed, may be made orally where necessary, provided that the oral communication is confirmed immediately thereafter in writing.

20. Duration of Agreement

This agreement is effective for a period of three (3) years from the date first shown above. The agreement may be extended by the mutual written agreement of City and Consultant.

21. Inspections by City

The City has the right, but not the duty, to inspect, in the manner and at reasonable times it considers appropriate during the period of this Agreement, all facilities and activities of the Consultant as may be engaged in the performance of this Agreement.

22. Endorsements on Documents

Endorsements and professional seals, if applicable, must be included on all final plans, specifications, estimates, and reports prepared by the Consultant. Preliminary copies of such documents submitted for review must have seals affixed without endorsement (signature).

23. Notices

Any official notice that either party hereto desires to give the other shall be delivered through the United States mail by certified mail, return receipt requested, with postage thereon fully prepaid and addressed as follows:

To City:	To Consultant:
JR Pearson, Deputy DPU Direcctor	______________________
City of Unalaska	______________________
Box 610	______________________
Unalaska, Alaska 99685	______________________

The addresses hereinabove specified may be changed by either party by giving written notice thereof to the other party pursuant to this paragraph.

24. Venue/Applicable Law

The venue of any legal action between the parties arising as a result of this Agreement shall be laid in the Third Judicial District of the Superior Court of the State of Alaska and this contract shall be interpreted in accordance with the laws of the State of Alaska.

25. Attorney's Fees

In the event either party institutes any suit or action to enforce its right hereunder, the prevailing party shall be entitled to recover from the other party its reasonable attorney's fees and costs in such suit or action and on any appeal therefrom.

26. Waiver

No failure on the part of City to enforce any covenant or provisions herein contained, nor any waiver of any right hereunder by City, unless in writing and signed by the parties sought to be bound, shall discharge or invalidate such covenants or provisions or affect the right of City to enforce the same or any other provision in the event of any subsequent breach or default.

27. Binding Effect

The terms, conditions and covenants contained in this Agreement shall apply to, inure to the benefit of, and bind the parties and their respective successors.

28. Entire Agreement/Modification

This agreement, including Exhibits A-C, and the Consultant's proposal dated _________________ constitutes the entire Agreement between the parties with respect to the subject matter hereof, and all prior negotiations and understandings are superseded and replaced by this Agreement and shall be of no further force and effect. No modification of this Agreement shall be of any force or effect unless reduced to writing, signed by both parties and expressly made a part of this Agreement.

In witness whereof, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement in duplicate on the respective date indicated below.

CONTRACTOR

By:___________________________________

_______________, Its ___________

State of Alaska)
) ss.
Third Judicial District)

The foregoing instrument was acknowledged before me on the ____ day of ___________, 2017, by ___________________________, the ______________________________ of _________________, a _________ Corporation, on behalf of the corporation.

____
Notary Public, State of Alaska
My Commission Expires _______________

CITY OF UNALASKA, ALASKA

By:_________________________________

David A. Martinson, City Manager

State of Alaska)
) ss.
Third Judicial District)

The foregoing instrument was acknowledged before me on the ____ day of ___________, 2017, by David A. Martinson, City Manager for the City of Unalaska, a First Class Alaska Municipal Corporation, on behalf of the City of Unalaska.

____
Notary Public, State of Alaska
My Commission Expires ______________

CITY OF UNALASKA

EXHIBIT "A"
SCOPE OF SERVICES

The Consultant will work with the City to complete **Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II.**

Each of the deliverables outlined below will be provided electronically as an Adobe Acrobat (PDF) file.

The Scope of Services for this Contract includes the following general tasks:

Task 1: __________________

The deliverable for Task 1 will be a technical _________________________________.

Task 2: ____

The deliverable for Task 2 will be a _______________________________________.

Task 3: _____________________________________

The deliverable for Task 3 will be a ______________________________________.

Task 4: Review by the City

In task 4, ____.

Task 5: ____

The deliverable for this task will be a ____.

Task 6: _______________________________________ Plan

CITY OF UNALASKA

Analysis of the City of Unalaska Wind Power Development and Integration Assessment Project – Phase II

EXHIBIT "B"

CONTRACT SCHEDULE

		COMPLETION DATE
	Site Visit	____________________
Task 1:	________________________________	____________________
Task 2:	________________________________	____________________
Task 3:	________________________________	____________________
Task 4:	________________________________	____________________
Task 5:	________________________________	____________________
Task 6:	________________________________	____________________
Task 7:	________________________________	____________________

CITY OF UNALASKA

EXHIBIT "C"
FEE PROPOSAL