Harnessing the Wind in Nome Alaska

A joint effort between

Bering Straits Native Corporation

and

Sitnasuak Native Corporation

2008

1. Executive Summary

Title of Project: Harnessing the Wind in Nome Alaska.

a. Contacts:

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b. Size of Project: $5,400,000

c. Description of Project:

This project provides for the installation of eighteen Entegrity EW-15 wind generators in Nome, Alaska. This is the first commercial wind farm to be installed in the city of Nome which currently gets 100% of its power from diesel generation. Nome is a rural community with approximately 3500 residents and is a hub community which supports many villages in the region.

The installation of this wind power project will provide a rated 900 kW of power with a maximum output of 1,170 kW to the Nome Joint Utility electric grid over a 20 year extendable project timeframe. Instead of selling the energy at the avoided cost rate allowed by law, the owners of the project have committed to selling the energy at a fixed or floating price below the avoided cost calculation. The revenues from the wind farm will be shared equally between Sitnasuak Native Corporation (SNC) and Bering Straits Native Corporation (BSNC). BSNC has further agreed to dedicate 50% of its profits from this project to development of renewable energy projects in the villages around Nome. Selling the energy at a rate below avoided costs will provide savings to the utility to help to lower the energy costs in the Nome area and provide some energy produced locally that is not dependent on imported oil. If oil prices continue to rise dramatically as they have been, that savings could be significantly higher than currently projected. Providing for renewable energy projects in villages should help reduce the dependency on oil in those locations where oil must be flown or barged in and ultimately help reduce energy rates in those locations. The profits from the project which are ultimately distributed to the shareholders of BSNC and SNC will help provide income to an area where many have very limited incomes.

Overall, this project provides a cash and tax credit based revenue stream of over $15 Million, provides jobs and keeps money working in the community while increasing overall power generation reliability by producing it locally. This is an excellent demonstration of a commercial opportunity that needs to be eagerly developed.

d. Supports State Rural Development Initiatives

This project ties in directly and supports several key issues with the State Goals. Furthermore, the project is very timely in that it lines up with the new Administrative Order 238 signed by Governor Palin in Alaska on September 14, 2007. Besides expanding renewable energy resource programs, the order intends to "promote aggressive development of renewable energy sources such as geothermal, wind, hydroelectric, tidal, and in-stream energy." Furthermore, the governor "is signing a letter that adds Alaska as an observer to the Western Climate Initiative." Alaska can demonstrate that wind power generation helps achieve the objectives of the initiative.

Alaska Energy Authority Mission: Reduce the cost of energy in Alaska. Alaska Energy Authority (AEA) projects and programs support its mission by 1) providing for the operation and maintenance of existing Authority-owned projects with maximum utility control, 2) assisting in the development of safe, reliable, and efficient energy systems throughout Alaska, which are sustainable and environmentally sound, 3) reducing the cost of electricity for residential customers and community facilities in rural Alaska, and 4) responding quickly and effectively to electrical emergencies.

This wind farm will sell energy below the actual avoided cost and clearly in its own way reduce energy costs and provide for further development while keeping energy dollars in the community by utilizing a local renewable wind resource.

e. Project Timeframe

Individuals responsible for overseeing the management of the project are primarily Jerald Brown (BSNC), Neal Foster (SNC) and Brian D. Jackson, P.E. (WCE). Resume information for all individuals is included in the feasibility study and appropriate sections. A more detailed project task list is included later.

Timeline	Goals & Tasks	
MAY 2008	Formalize Equipment Orders	BSNC / SNC
JUNE 2008	Secure Anchors and Foundations	
	Electrical and Site Work	WCE
AUGUST 2008	Wind Turbine Installation	WCE
SEPTEMBER 2008	Final Commissioning	WCE / Entegrity

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3. About the Owners

Bering Straits Native Corporation (BSNC) and Sitnasuak Native Corporation SNC are for-profit Alaska Native Corporations established by Congress in 1971 as part of the Alaska Native Claims Settlement Act.

BSNC and SNC together represent over 6,000 shareholders (and also serve over 10,000 descendants of shareholders), all of which are Alaska Natives. BSNC feels a responsibility for its shareholders and their descendants as is evidenced by the mission statement "***To improve the quality of life of our people through economic development while protecting our land and preserving our cultural heritage***". SNC's Statement of Purpose reads "***To earn profits on operations, while protecting our land and culture and benefiting shareholders***".

Board Resolutions

This project has been authorized and is fully supported by the corporations.

4. Community:

Nome: Target City

Nome is a 1st class City located on the south shore of Alaska's highly mineralized Seward Peninsula, 500 miles west of Fairbanks and approximately 510 miles northwest of Anchorage. Nome lies at approximately 64.25 North Latitude and 165.30 West Longitude, 102 miles south of the Arctic Circle and 161 miles east of Russia. Nome, as the center or "hub" of the Bering Straits/Seward Peninsula region, provides retail, transportation, medical and government services to the surrounding villages as well as city residents. As a "hub" community, all trans-shipment of goods to the region either arrive via air-freight or seasonal main-line barge service from Anchorage and Seattle, WA. There is no road access to Nome or the villages in the Census area.

Nome's population is 3,505 (2000 census), while the regional village based population is estimated at 11,300.

Income

USDA's Economic Research Service lists the Nome Census Area's unemployment rate at 12.1% with a median household income (2004) of $40,010 at 76.7% of the State Median Household Income. However, these numbers are misleading as the State of Alaska's Department of Labor reported "of the 5,765 reported residents age 16 and up, 63.7% percent were employed in 2003. However, of that number, 3,255 or 75.5% earned less than average annual wage of $36,700 and 2,058 or 47.7% earned less than full time minimum wage of $14,872". (State of Alaska, Department of Labor and Workforce Development, Research and Analysis Section publication "Alaska Economic Trends, June 2005", "Employment and Earnings Measures of Economic Distress"). Then in a more recent "Alaska Economic Trends – July 2006" noted the "Cost of Food at Home for a Week in Eight Alaska Cities", cited the 2005 food cost for a family of four with children ages 6 to 11 was $199.08 per week and 164% of Anchorage. These same groceries can be purchased in Portland, Oregon for $94.00. Cost of

food as well as all other consumer products are driven by the high cost of energy, affecting transportation, heating, lighting, cooling etc. Freight companies also add a substantial fuel surcharge to their base rates.

Energy Costs

The high cost of energy continues to have a negative impact on homes and businesses. Nome is dependent on fuel oil for both home heating and electrical generation. Nome Joint Utility Systems, Nome's electrical provider, supplies electricity to 2,160 consumers. Their base per kilowatt rate for residential customers is $.1775/kwh for usage between 200 and 700 kWh per month; however, there is also a fuel surcharge to adjust for the annual fuel cost increases. These fuel surcharges began in 2004 with a surcharge of $.0283, $.0752 in '05 and $.1354 in '06. With the surcharge of $.1354 added to the $.1775 base rate, 2006 per kilowatt rates were $.3129 plus a $5.00 base service charge and the 5% city of Nome Sales Tax.

Nome's two retail fuel suppliers, Bonanza Fuel and Crowley Services report current home heating fuel costs at $3.89/ gallon and $3.99/gallon respectively during the winter of 2007/2008. The average annual fuel oil expense per household in 2006 was $3,209.00. These high home heating fuel costs are felt monthly as essentially every day is a "heating degree day". Nome has 9,987 "heating degree days", with a high of 1,398 in January and a low of 146 in July (NASA Surface Meteorology and Solar Energy – Available Tables).

The University of Alaska – Anchorage Institute of Economic and Social Research (ISER) December 2005 Research Summary states "Diesel is the main energy source in remote communities, and in 2004 diesel outside the rail belt cost about five times as much per unit of energy as natural gas. Community facilities such as electrical plants, water and sewer services and health clinics use diesel fuel." From 1996 to 2006, annual average wholesale and retail prices for heating oil has increased by 187% and 139% respectively, after adjusting for inflation (U.S. Department of Energy, Energy Information Administration, 2007). The State of Alaska, Division of Community Advocacy, Research and Analysis Section, Department of Commerce, Community, and Economic Development just completed a report "Current Community Conditions: Fuel Prices Across Alaska, June 2007 Update" which noted on page 2 that "On July 30, 2007, the price of a barrel of Alaska crude oil reached near record highs of $78.58, a remarkable 152% increase over the 1997-2006 average price of $31.15". "Of noteworthy importance, as the State's oil revenues climb, Alaskans continue paying record high energy prices, especially in rural communities". September 20th set a new high for Alaska crude at $82.82 per barrel. The study also noted that western Alaska reported the highest average heating fuel retail price at $4.73 per gallon. In the reports Conclusion, it was noted that "Significantly increased fuel and energy costs combined with high unemployment rates, limited local economies, and local governments struggling to provide basic local services continue to present rural Alaska communities and households with challenging circumstances with no long-term solution in sight".

In 2006, the Nome Chamber of Commerce in concert with the City of Nome began researching options to replace diesel as our primary energy source. An Energy Summit was held that looked at the options including natural gas, geothermal, wind, solar, hydrogen and nuclear energy. Nome's Mayor Denise Michels noted at the same Energy Summit that "the City of Nome has made it a priority to deal with local and regional energy issues".

In January of 2005, the U.S. Department of the Interior completed a paper called the "Engineering and Economic Analysis of Natural Gas Production in the Norton Basin" (http://mms.gov/alaskareNatural_gasNorton.pfd). This study noted that although there is an estimated 18.20 BCF (billion cubic feet) of natural gas located within 30 miles of Nome, it would cost an estimated $100 million to develop it. The Pilgrim Hot Springs geothermal resource was estimated to cost $40 million for a 20 MW binary plant. It was estimated that it would cost an additional $20 million to tie the plant into the Nome grid. The abundance and quality of wind (Nome's Class 4 wind resource) became Nome's most cost effective way to address our energy needs.

5. Coordination with State Rural Development Initiatives

This project ties in directly and supports several key issues with the State Goals. Furthermore, the project is very timely in that it lines up with the new Administrative Order 238 signed by Governor Palin in Alaska on September 14, 2007. Besides expanding renewable energy resource programs, the order intends to "promote aggressive development of renewable energy sources such as geothermal, wind, hydroelectric, tidal, and in-stream energy." Furthermore, the governor "is signing a letter that adds Alaska as an observer to the Western Climate Initiative." Generating clean renewable energy from local wind instead of using imported fuels helps the economy and the environment. The irony is though Alaska exports oil, it must import fuel from refineries in the south.

On February 23, 2006 the Bering Straits Native Corporation's Board of Directors passed a Resolution that asked the Department of Energy and the Congress of the United States provide funding for the Tribal Energy Program, more specifically for Native-owned lands in Alaska, on a basis that it reflects the geographic area and energy potential of said lands. The exploration and development of these alternative and renewable resources would benefit not only the rural residents of Alaska, but would assist in securing domestic non-renewable and renewable energy for the greater good of the people of the United States.

Alaska Energy Authority Mission: Reduce the cost of energy in Alaska

Alaska Energy Authority (AEA) projects and programs support its mission by 1) providing for the operation and maintenance of existing Authority-owned projects with maximum utility control, 2) assisting in the development of safe, reliable, and efficient energy systems throughout Alaska, which are sustainable and environmentally sound, 3) reducing the cost of electricity for residential customers and community facilities in rural Alaska, and 4) responding quickly and effectively to electrical emergencies.

This wind farm will sell energy below the actual avoided cost and clearly in its own way reduce energy costs and provide for further development while keeping energy dollars in the community by utilizing a local renewable wind resource.

6. Project Overview

This project is completely ready to move forward from a design, technical, and feasibility perspective. With a timely notice to proceed, these turbines will be on one of the early barge shipments to Nome in the spring of 2008. The goal of the project team is to move ahead with excitement and enthusiasm to build this project in the most efficient manner.

6a. Project Design

This project is a very simple, easy to install design. The turbines are available and the equipment for installation is already available in Nome. The entire project can be installed and on-line by mid summer 2008. The attached engineering evaluation and summary shows the expected results and performance of the project. Extra expense and time is involved with arctic construction. The good news for this project is it is not inventing a new solution, but implementing a tried and proved method and system.

PROJECT ENGINEERING FEASIBILITY STUDY BY RENAISSANCE ENGINEERING & DESIGN

The following key sections 6a1, 6a2, 6a3, and 6a4 are part of an overall evaluation by Brian D. Jackson (credentials included in Section 6b Management. He states that "This project is completely feasible from a technical and a financial standpoint as a true generation project to contribute meaningful, reliable, renewable, electric energy to the Nome Joint Utility Distribution Grid."

The most important thing to note on the design is that nothing here is "revolutionary" or "experimental". The system is benefiting from the past ten years of experimenting that has gone on in Kotzebue, Alaska.

The Nome Project is benefiting from all of the lessons learned in previous projects and is drawing on the expertise of individuals that were involved with wind projects like this one and even specific to the Entegrity model proposed.

Note the exhibits under Tab 6c Regulatory apply specifically to this design section in addition. They show the utility requirements as well as some aspects of the Kotzebue installation where over a 1,000 kW of wind is operational.

6a1. Financial Performance Analysis

The attached business model spreadsheet is fairly complex but in a single page represents the operation of this commercial wind business venture over the next 20 years.

Over the 20 year life of the project on this sheet, the turbines produce $18M of energy assuming only a 3% inflation rate on the current avoided cost calculation of 23 cents per kWh. (Note that the turbines come with a 5 year warranty and Entegrity specifically states in the specifications that the turbine has a 30 year design life.) The fourth sheet shows the avoided cost calculations and the effect of the up to five cents per kWh discount that Bering Straits has been discussing with Nome Joint Utility. The budget which drives the capital cost of this project is included here for reference but discussed in greater detail in Section 7.

Note that the discount provided to the utility results in a $2.9 million savings over 20 years to Nome Joint Utility which can be transferred on the customers. Also this shows about $10 million being divided among Sitnasuak and Bering Straits and then distributed to the villages and/or shareholders as appropriate. Of particular note in addition in the energy capacity analysis chart the substantial boost in wind energy comes at a time when winter is setting in, particularly October, November, and December which also coincides with extra need for heating oil.

WESTERN Community Energy - PROJECT BUDGET Revised May 5, 2008	TOTAL 18 TURBINE PROJECT
Entegrity E15 100' Towers	**1170**
	PROJECT KW
Capital $/KW:	$4,681
Installed Capital $/Turbine:	$304,289
Project Capital Costs Budget	
ENTEGRITY WIND TURBINES AND TOWERS	$ 2,970,000
Transport Shipping and Offloading to Site	$ 333,000
Spare Parts, Specialty Tools	$ 60,000
Foundation / Tower	
Geotechnical Analysis	$ 45,000
Foundation Design	$ 25,000
Foundations	$ 540,000
Access Roads	$ 50,000
Local Tower Install Crew	$ 36,000
Crane	$ 45,000
Electrical Interconnection	
Electrical Contractor Labor	$ 72,000
480V - 25kV Transformer (One per 3-Pack)	$ 60,000
125A Disconnect: (One per 3-Pack)	$ 18,000
Wire: Low Voltage, High Voltage, Ethernet	$ 144,000
Power Quality / Capacitor Systems	$ 45,000
Conduit	$ 5,400
Trenching and/or Overhead Poles	$ 54,000
Electrical Permit	$ 1,000
Electrical Engineer One-Line	$ 4,000
Utility Metering, Interconnection Switch, Plant Upgrades	$ 110,000
SGIA Fees	$ 5,000
Legal Costs	
Project LLC Operating Agreement	$ 5,000
Permitting	
Environmental Permitting	$ 50,000
WCE's Fixed Program Management Fee (6% of Project Budget)	$ 328,632
Contingency (~21% of Non-Fixed Project Expenses)	$ 471,172
TOTAL PROJECT CAPITAL COST	**$ 5,477,204**

Entegrity E15 WIND TURBINES

6a2. Data Analysis Summary

Energy projections were performed on actual patched wind data from the Nome area. Much of the Anvil Mountain data had significant icing in it, and was collected and patched by others using airport and other wind data. When comparing actual data to a Rayleigh distribution with the same annual average wind speed, the energy production estimates are very close as seen in the analysis summaries. Using this finding, two more production estimates were performed with Rayleigh distributions and annual average wind speeds closer to the wind classes shown on the Alaska wind maps for the Nome area. The wind classes shown in the area are Class 4 and 5, and therefore additional energy projections were performed using 15.0 and 16.0 mph annual average wind speeds at 30 meters above ground level.

What this means in a summary form is that the financial projections based on a 30% capacity factor are EXTREMELY conservative. At the same time we have included a 95% availability indicating that we expect the turbines to be off-line about 5% of the time due to maintenance or other problems.

We know that Tin City which is located at the western point above Kotzebue on the attached wind map exhibits is a CLASS 7 wind resource. Modeling of turbines at that site results in over 50% capacity factor with any turbine at any height tower.

Capacity Factor Calculation with Patched Data from Alaska Energy Authority

Project Anemometer Locations

Nome Data Report

Alaska Wind Resource Maps

Wind Analysis Summary Report

Site Number

7310

Site Information

Project:	Nome, AK, Anvil Mtn.
Location:	Nome, AK, Anvil Mtn.
Site Elevation:	900 ft
Averaging Time:	60 min
Date Range:	1/1/06 0:00-12/31/06 23:00

Sensor Information

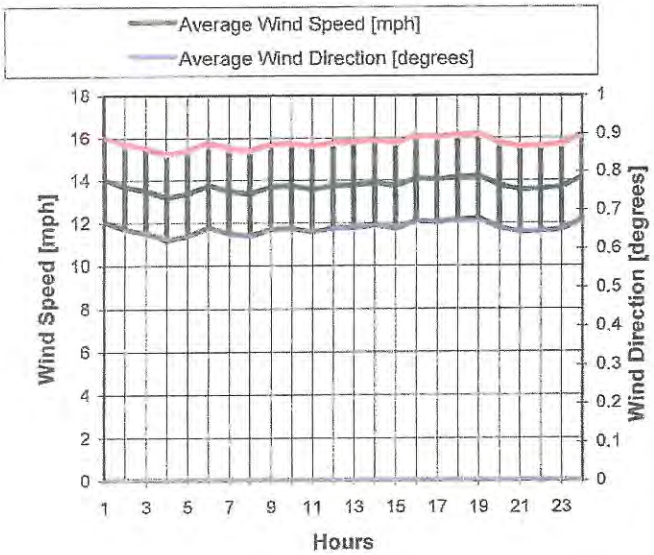
Sensor/Tower Height:	98 ft
Scaled Height:	98 ft
Windvane Offset:	0 degrees

Wind Rose Graph

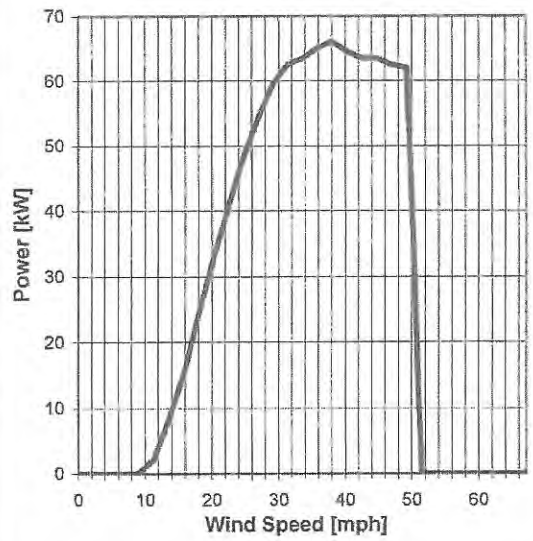
Drag wind rose picture here and size for best viewing.

Percent of Total Wind Energy — Inner Circle = 0%
Percent of Total Time — Outer Circle = 70%

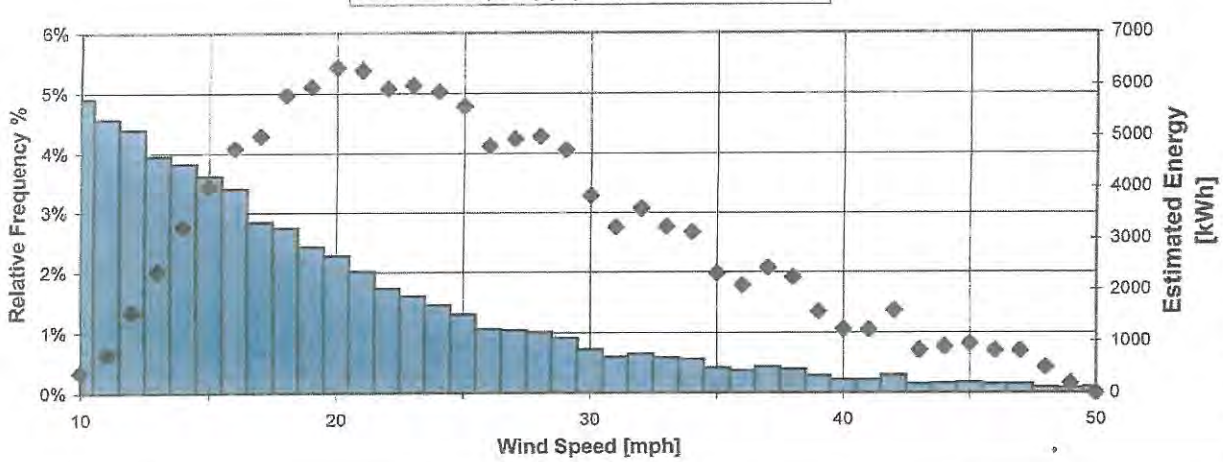
Diurnal Wind Speed Pattern



AOC 15/50, 15m rotor



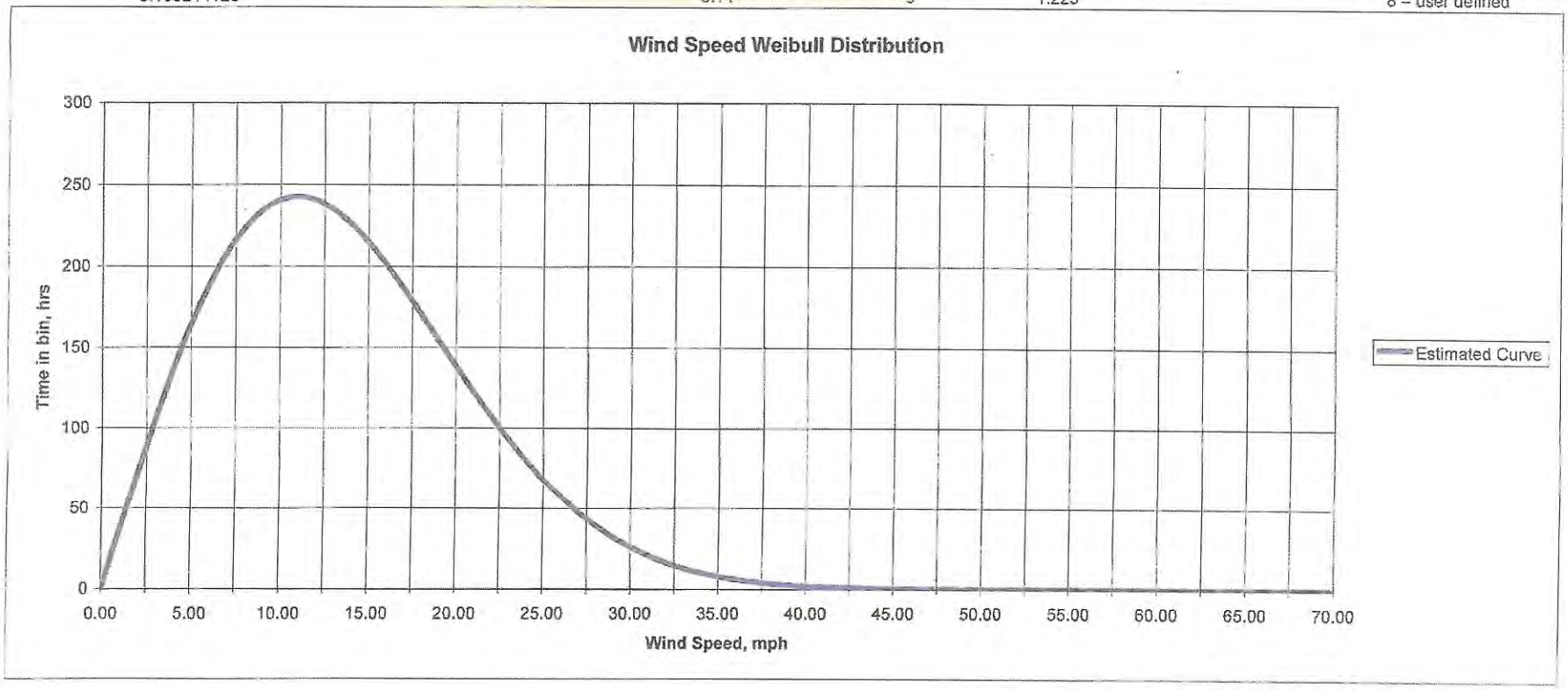
Frequency Distribution Graph



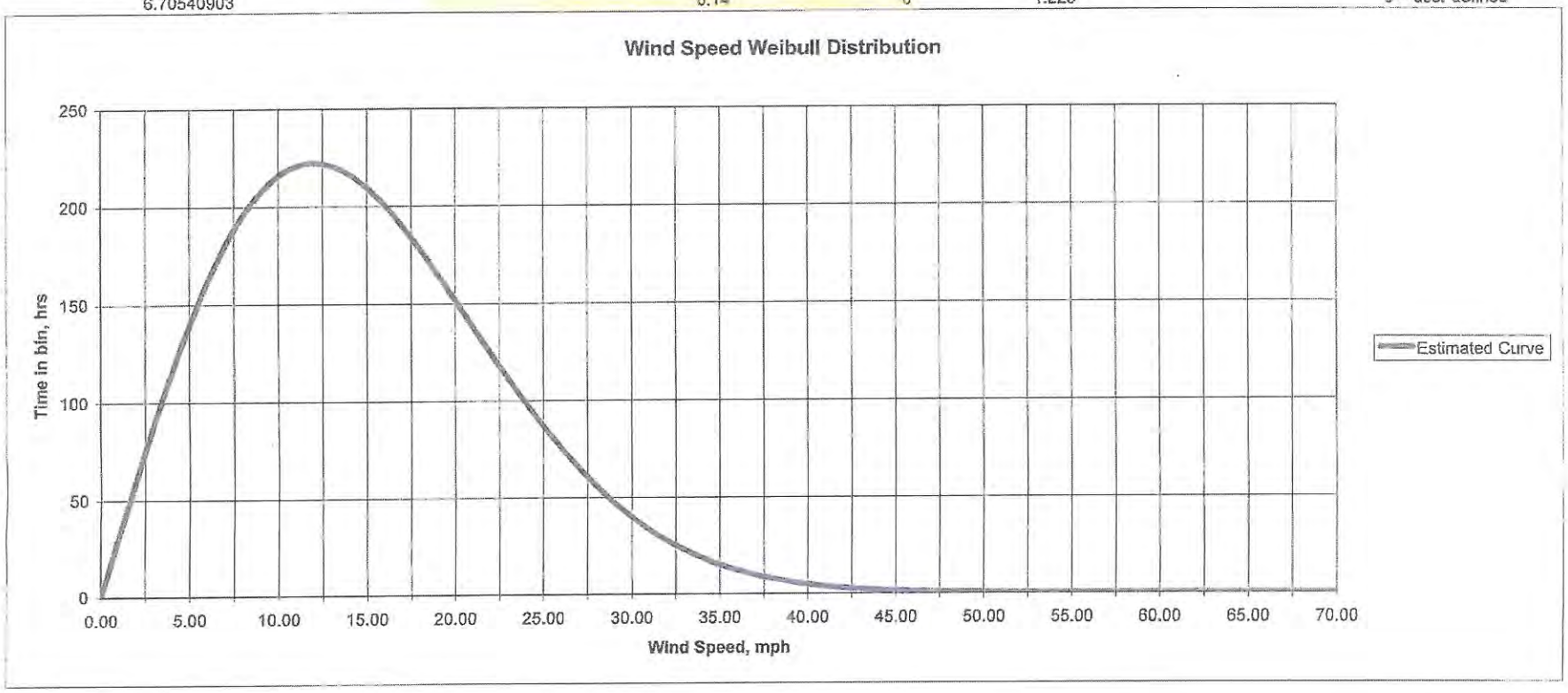
Statistics

Days Used in Calculation:	365.00
Hours Used in Calculation:	8760.00
Gust Speed:	133.63838 mph
Gust Time:	2/4/2006 15:00
Estimated Energy Output:	125937 kWh
Calculated Air Density:	1.191 kg/m^3
Average Wind Speed:	13.72 mph
Average Wind Direction:	0 degrees
Capacity Factor:	0.29
Turbine Manufacturer:	AOC/Entegrity
Turbine Model:	AOC 15/50, 15m rotor
Turbine Rating:	50 kW
Estimated Annual Production:	125937 kWh/Year
Scaled Est. Annual Producion:	126661 kWh/Year
Scaled Air Density:	1.188 kg/m^3
Scaled Capacity Factor:	0.29

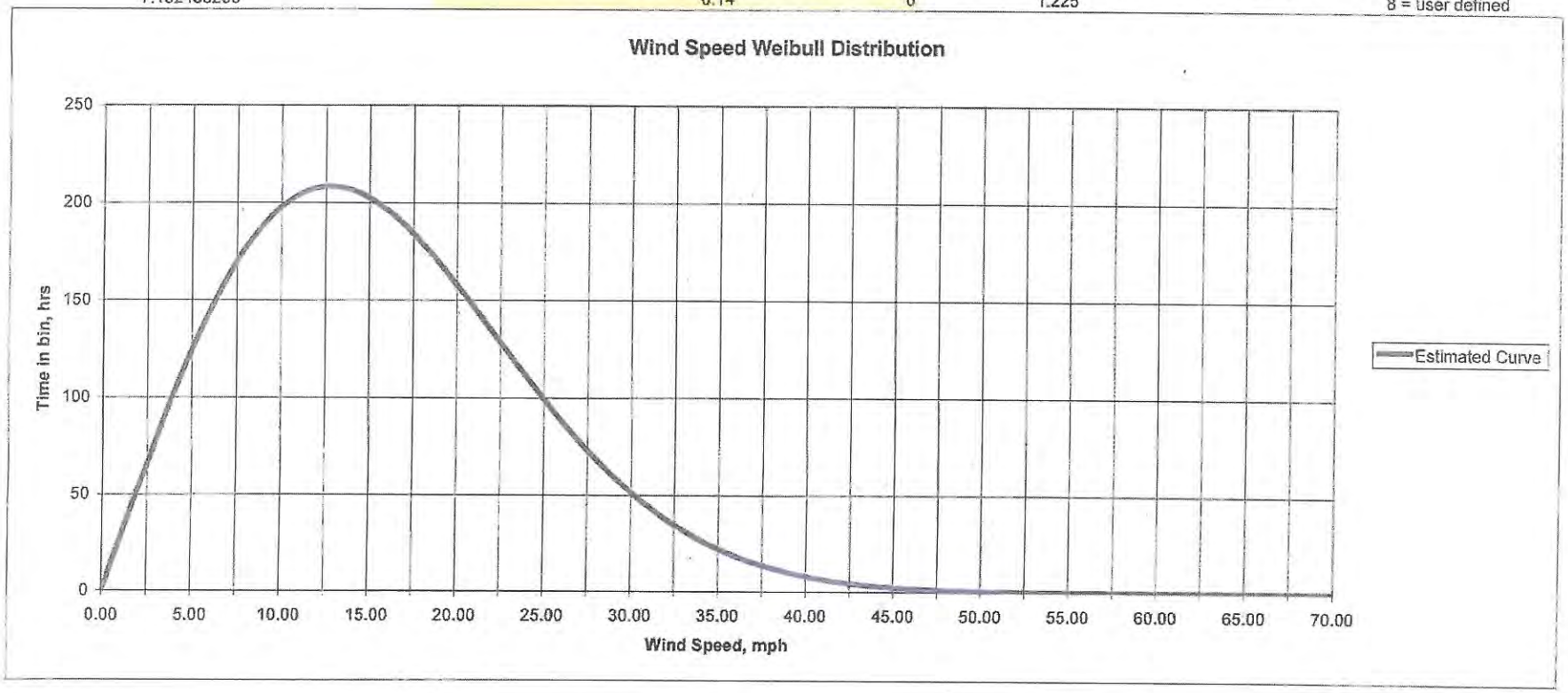
shape alpha =	2	hours	scale beta (metric) =		Enter number to choose power curve:	1 = GE 1.5MW, 70.5m rotor, 1.225kg/m3
scale beta =	15.48136217	8760.00	6.920591048		7	2 = GE 1.5MW, 70.5m rotor, 1.12kg/m3
Enter Mean, in mph	Anemometer height, m					3 = GE 1.5MW, 70.5m rotor, 1.02kg/m3
13.72	30	Total Gross Energy Production	Capacity factor			4 = GE 1.5MW, 77m rotor, 1.225kg/m3
Scaled Mean, in mph	Scaled hub height, m	129078.8513	29.4701%			5 = GE 1.5MW, 77m rotor, 1.12kg/m3
13.72	30					6 = GE 1.5MW, 77m rotor, 1.02kg/m3
Scaled Mean, in m/s		Estimated Wind Shear	Site Elevation (in feet)	Calculated Air Density average [kg/m^3], based on elevation		7 = Entegrity 50 KW, 15m rot., 1.225kg/m3
6.133214126		0.14	0	1.225		8 = user defined



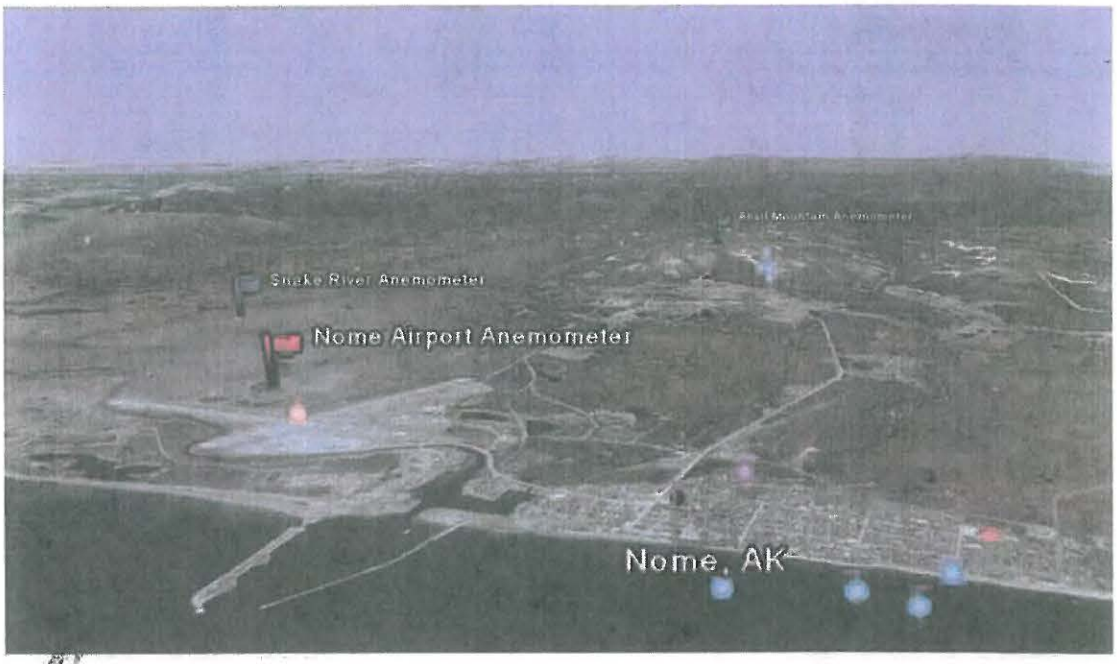
shape alpha =	2	hours	scale beta (metric) =	Enter number to choose power curve:	1 = GE 1.5MW, 70.5m rotor, 1.225kg/m3
scale beta =	16.92568751	8760.00	7.566243857	7	2 = GE 1.5MW, 70.5m rotor, 1.12kg/m3
Enter Mean, in mph	Anemometer height, m				3 = GE 1.5MW, 70.5m rotor, 1.02kg/m3
15.00	30	Total Gross Energy Production	Capacity factor		4 = GE 1.5MW, 77m rotor, 1.225kg/m3
Scaled Mean, in mph	Scaled hub height, m	157261.0921	35.9044%		5 = GE 1.5MW, 77m rotor, 1.12kg/m3
15	30				6 = GE 1.5MW, 77m rotor, 1.02kg/m3
Scaled Mean, in m/s		Estimated Wind Shear	Site Elevation (in feet)	Calculated Air Density average [kg/m^3], based on elevation	7 = Entegrity 50 KW, 15m rot., 1.225kg/m3
6.70540903		0.14	0	1.225	8 = user defined



shape alpha =	2	hours	scale beta (metric) =	Enter number to choose power curve:	1 = GE 1.5MW, 70.5m rotor, 1.225kg/m3
scale beta =	18.05406667	8760.00	8.070660114	7	2 = GE 1.5MW, 70.5m rotor, 1.12kg/m3
Enter Mean, in mph	Anemometer height, m				3 = GE 1.5MW, 70.5m rotor, 1.02kg/m3
16.00	30	Total Gross Energy Production	Capacity factor		4 = GE 1.5MW, 77m rotor, 1.225kg/m3
Scaled Mean, in mph	Scaled hub height, m	178818.8187	40.8262%		5 = GE 1.5MW, 77m rotor, 1.12kg/m3
16	30				6 = GE 1.5MW, 77m rotor, 1.02kg/m3
Scaled Mean, in m/s		Estimated Wind Shear	Site Elevation (in feet)	Calculated Air Density average [kg/m^3], based on elevation	7 = Entegrity 50 KW, 15m rot., 1.225kg/m3
7.152436299		0.14	0	1.225	8 = user defined



Nome Anemometer Locations. Note the Snake River Site in the open plains. Anvil Mountain site is on the exposed ridgetop.



ALASKA ENERGY AUTHORITY

Weather Station Wind Resource Summary for

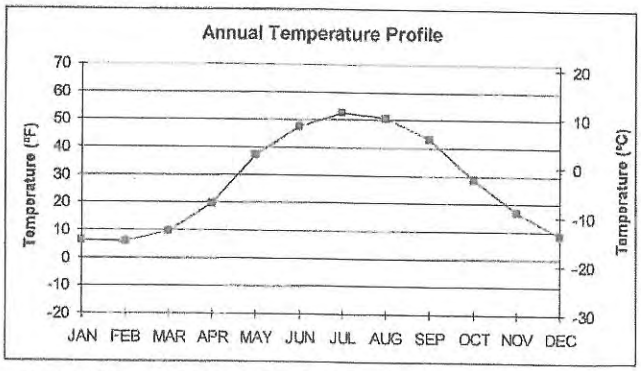
NOME, AK

ICAO Station Identifier: PAOM
Date Prepared: 8/3/2005

Site Description

State map courtesy of MSN MapPoint
Local map courtesy of AirNav, LLC

Latitude	64.517
Longitude	-165.45
Elevation	11.3 m
Tower Type	ASOS
Tower Height	8 m
Monitor Start	01/1973 01/1984
Monitor End	12/1981 05/2005
NCDC Data Set	702000



Site picture courtesy of Ed Doerr of NOAA

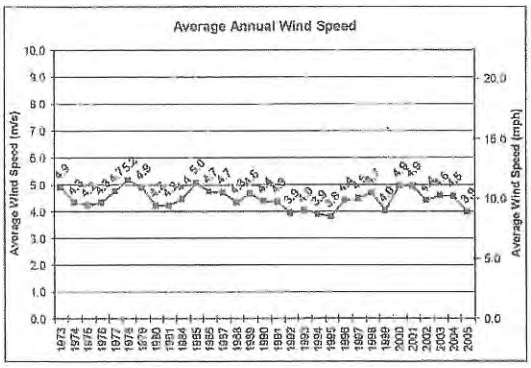
813 West Northern Lights Boulevard • Anchorage, Alaska 99503
907 / 269-3000 • FAX 907 / 269-3044 • Toll Free (ALASKA ONLY) 888 / 300-8534 • www.akenergyauthority.org

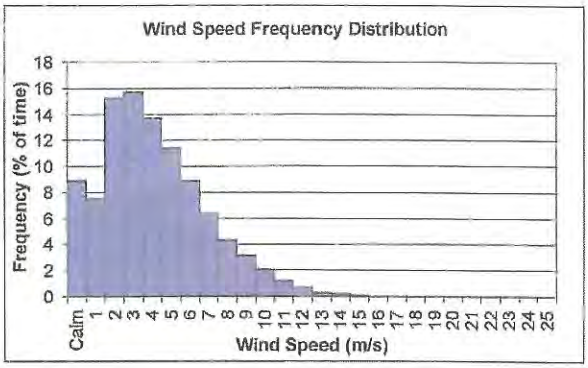
ALASKA ENERGY AUTHORITY

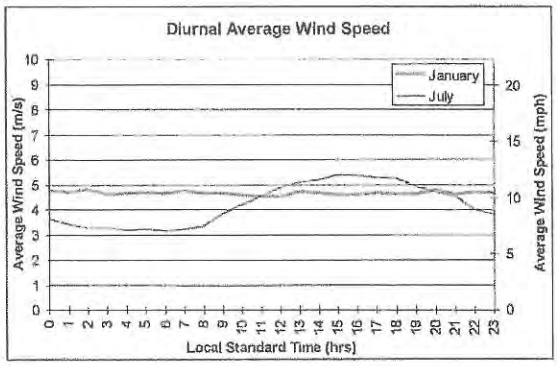
NOME

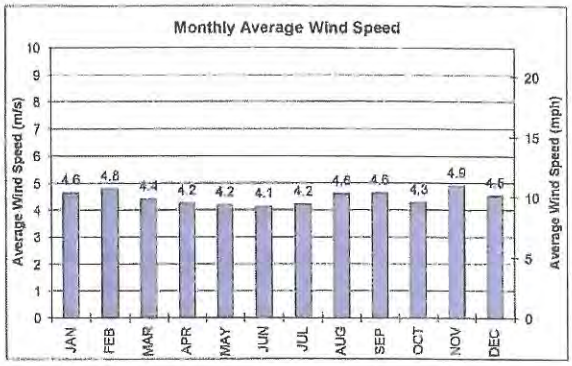
Wind Power Information

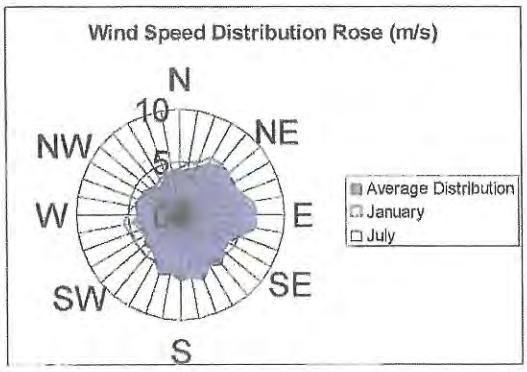
Average Power Density	141
Wind Power Class	2
Power Rating	Marginal

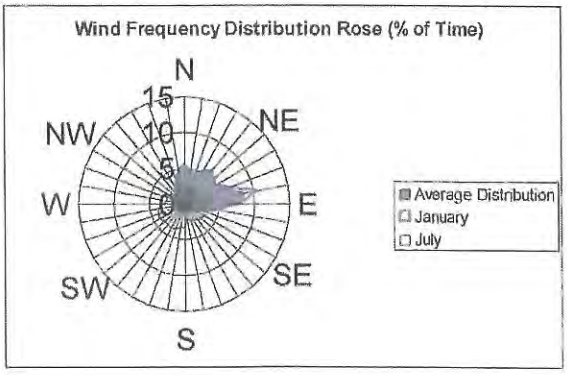












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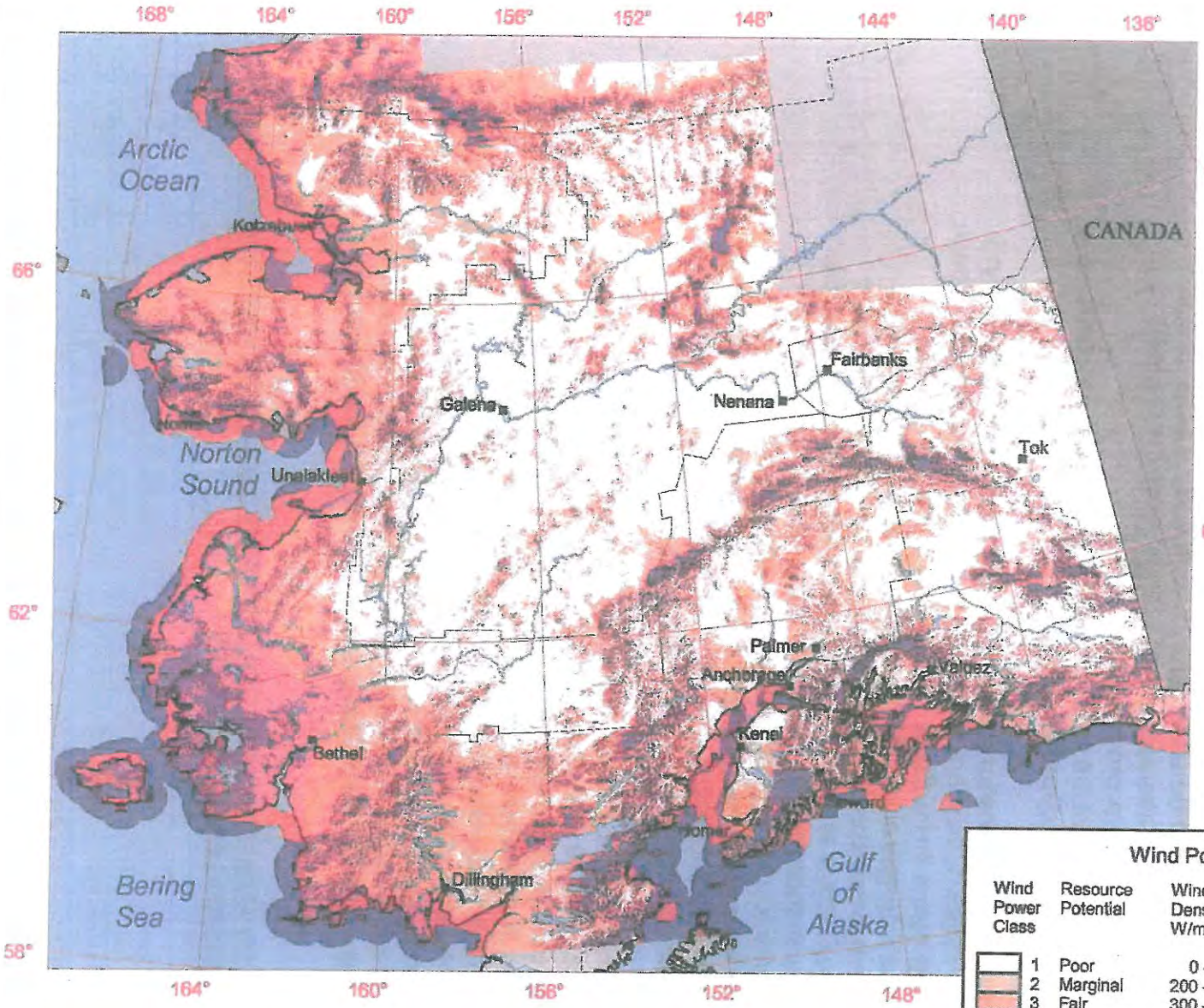
Alaska Mainland Regions 50 m Wind Power



The annual wind power estimates for this map were produced by AWS Truewind using their Mesomap system and historical weather data. It has been validated with available surface data by NREL and wind energy meteorological consultants.

Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed[a] at 50 m m/s	Wind Speed[a] at 50 m mph
1	Poor	0 - 200	0.0 - 5.3	0.0 - 11.9
2	Marginal	200 - 300	5.3 - 6.1	11.9 - 13.7
3	Fair	300 - 400	6.1 - 6.7	13.7 - 15.0
4	Good	400 - 500	6.7 - 7.3	15.0 - 16.4
5	Excellent	500 - 600	7.3 - 7.7	16.4 - 17.2
6	Outstanding	600 - 800	7.7 - 8.5	17.2 - 19.0
7	Superb	> 800	> 8.5	> 19.0

[a] Wind speeds are based on a Weibull k of 1.8. Weibull k values in Alaska vary from 1.4 to 2.0.

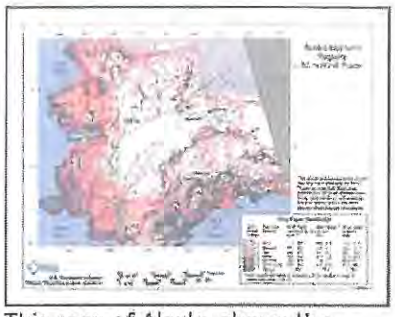
100 0 100 200 300 400 Kilometers

50 0 50 100 150 200 250 Miles

U.S. Department of Energy
National Renewable Energy Laboratory

16-JAN-2009 4.1.1

Alaska Wind Resource Map



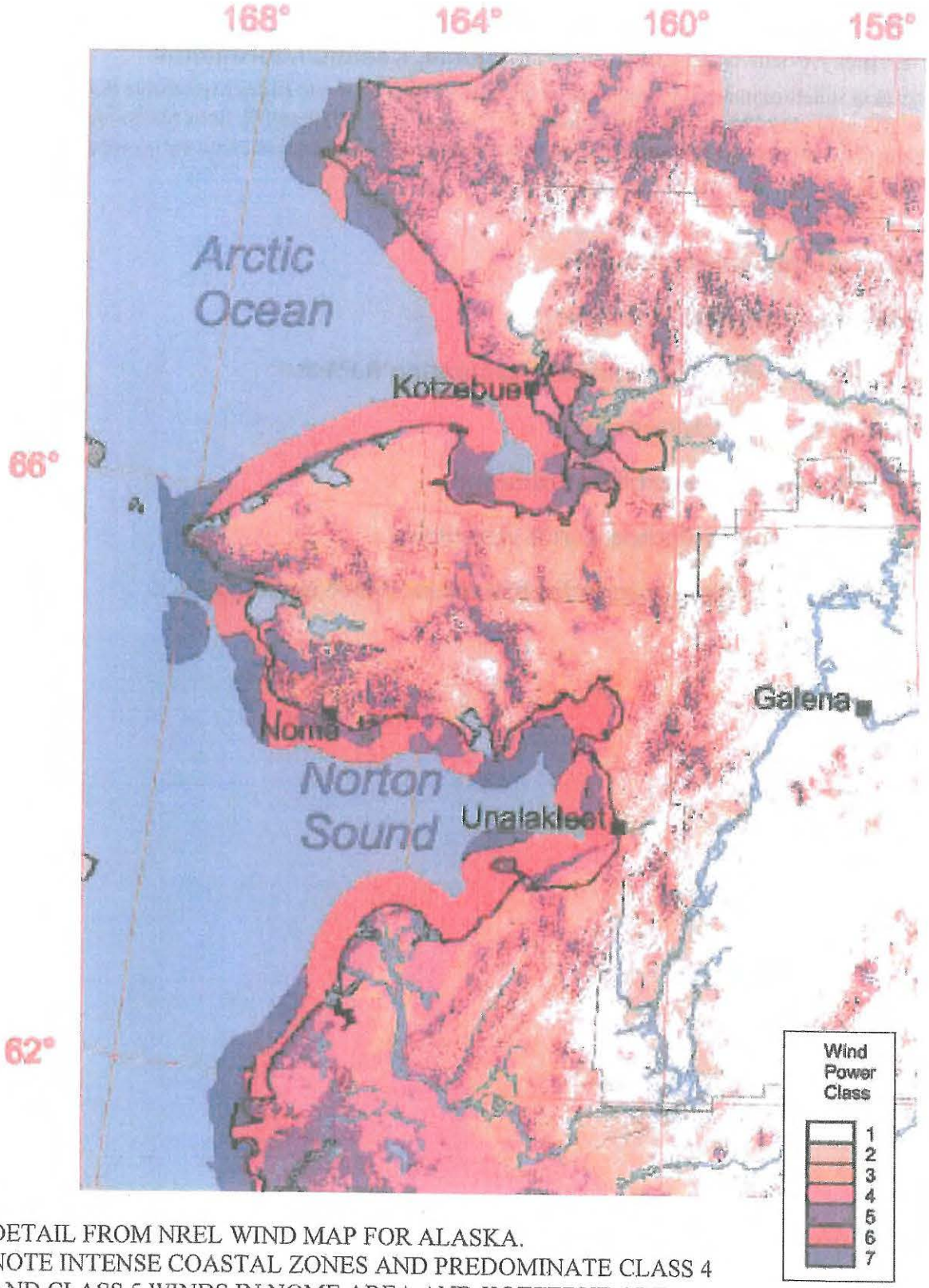
This map of Alaska shows the wind resource at 50 meters.

The Department of Energy's Wind Program and the National Renewable Energy Laboratory (NREL) published a new wind resource map for the state of Alaska. This resource map shows wind speed estimates at 50 meters above the ground and depicts the resource that could be used for utility-scale wind development. Future plans are to provide wind speed estimates at 30 meters, which are useful for identifying small wind turbine opportunities.

As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). In general, at 50 meters, wind power Class 4 or higher can be useful for generating wind power with large turbines. Class 4 and above are considered good resources. Particular locations in the Class 3 areas could have higher wind power class values at 80 meters than shown on the 50 meter map because of possible high wind shear. Given the advances in technology, a number of locations in the Class 3 areas may suitable for utility-scale wind development.

This map indicates that mainland Alaska has wind resources consistent with utility-scale production. The largest contiguous low elevation area of good-to-excellent resource is located in the western part of the state between Bethel and the Yukon River Delta. Coastal locations along the Bering Sea and the Arctic Ocean are likely to have good-to-excellent resource. Excellent wind resources are located on higher ridge crests crest locations throughout mainland Alaska including the Brooks and Alaska Ranges and the Chugach Mountains.

http://www.eere.energy.gov/windandhydro/windpoweringamerica/maps_template.asp?stateab=ak



DETAIL FROM NREL WIND MAP FOR ALASKA.
NOTE INTENSE COASTAL ZONES AND PREDOMINATE CLASS 4 AND CLASS 5 WINDS IN NOME AREA AND KOTZEBUE AREA

6a3. Entegrity Wind Systems Quote, Manuals, Design, Information

This section is self explanatory; however, it is significant to note the Entegrity turbine is the result of almost 10 years of collaborative research and development at the National Renewable Energy Laboratory. The covers of a few select test reports are included after Larry Flowers' support letter in Section 6a5.

Quote for Turbines from Entegrity

Specifications and 5 year Warranty

Customer Information, Technical and Operation Packet

Operation and Service Manual

Maintenance and Inspection Instructions

Special TILT-UP Tower Photos and Instructions

Special Pier Foundation Designs for Kotzebue and Nome Region

ntegrity
Wind Systems

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Boulder Colorado 80302
USA
info@entegritywind.com
www.entegritywind.com

Renaissance Engineering and Design
Mr. Brian Jackson
2792 Desert Wind Road
Oasis, Idaho 83647-5020

September 28, 2007

RE: List Price and Ten (10) Turbine

Mr. Jackson,

This letter is to acknowledge that Entergity Wind Systems Inc. (EWSI) intends to work with Renaissance Engineering and Design (Renaissance) in good faith to help Remnaissance develop its proposal to sell ten (10) EW15 50kW wind turbines for installation in Nome, Alaska.

Current list price on the EW15 50kW turbine including turbine, 100' lattice tower and SCADA controller is $165,000 US for units sold outside the lower 48 (XWorks EWSI). The price includes a five-year warranty and five-year O&M agreement. The price does not include shipping (estimated at $13,000/unit).

Please continue to work with Mark Boumansour directly to coordinate all support, including sales and engineering, from EWSI. We look forward to working with you on this exciting project. Please let us know if you need any additional information to prepare your proposal.

Regards,

John M Brown
Managing Director
303.440.8799

cc: Mark Boumansour, Derek Burns, Charles Newcomb, Malcolm Lodge, EWSI

Printed on recycled paper

EW15 60HZ Specifications

SYSTEM

Type	3 ϕ Grid Connected
Configuration	Horizontal Axis
Rotor Diameter	15 m (49.2 ft)
Centerline Hub Height	25 m (82 ft)

PERFORMANCE PARAMETERS

Rated Electrical Power	50 kW @11.3 m/s (25.3 mph)
Maximum Power Rating	66 kW
Wind Speed Ratings	
Cut-In	4.6 m/s (10.2 mph)
Shut-Down (high wind)	22.4 m/s (50 mph)
Design Speed	59.5 m/s (133 mph)
Calculated Net Annual Output	5.4 m/s (12 mph) 87,000 kWh
@ 100 % availability	6.7 m/s (15 mph) 153,000kWh
	8.0 m/s (18 mph).215,000 kWh

ROTOR

Type of Hub	Fixed Pitch
Rotor Diameter	15 m (49.2 ft)
Swept Area	177 m² (1902 ft²)
Number of Blades	3
Rotor Solidity	0.077
Rotor Speed @ rated wind speed	65 rpm
Location Relative to Tower	Downwind
Cone Angle	6°
Tilt Angle	0°
Rotor Tip Speed	51 m/s (114 mph) @ 60 Hz
Design Tip Speed	6.1

BLADE

Length	7.2 m (23.7 ft)
Material	Epoxy /glass fibre
Blade Weight	150 kg (330 lbs) approximate

GENERATOR

Type	3 phase/4 pole asynchronous
Frequency	60 Hz
Voltage	3 phase @ 60 Hz, 400-600 VAC
kW @ Rated Wind Speed	50 kW
kW @ Peak Continuous	66 kW
Insulation	Class F
Enclosure	Totally Enclosed Air Over
Options	Arctic low temp shafting -40°c

TRANSMISSION

Type	Planetary
Housing	Ductile iron
Ratio (rotor to gen. speed)	1 to 28.25 (60 Hz)
Rating, output horse power	88
Lubrication	Synthetic gear oil/non toxic
Heater (option)	Arctic version, electric

YAW SYSTEM

Normal	Free, passive
Optional	Yaw damp
Electrical	Twist Cable

TOWER

Type	Free standing galvanized bolted lattice
Tower Height	24.4 m (80 ft)
Options	30.5 m (100 ft), Tilt down

FOUNDATION

Type	Concrete pads, piers or special

CONTROL SYSTEM

Type	Microprocessor based
Communications	Ethernet/Internet module for energy monitoring and maintenance dispatch
Enclosures	NEMA 1, NEMA 4 (optional)
Soft Start	Optional

ROTOR SPEED CONTROL

Running	Passive stall regulation
Start up	Aerodynamic
Shut-down	Aerodynamic tip brake. Parking brake for servicing.

BRAKE SYSTEM CONTROL

Fail-safe aerodynamic, electrodynamic, and parking brakes.

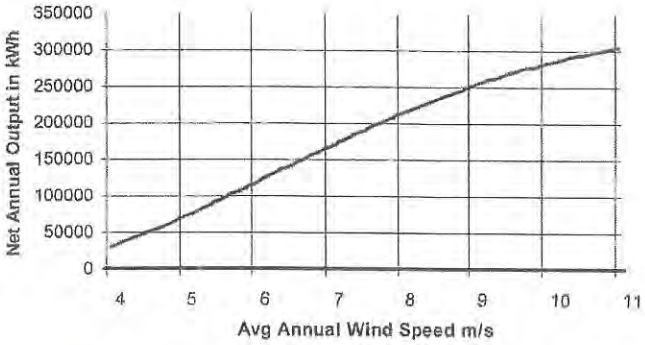
APPROXIMATE SYSTEM DESIGN WEIGHTS

Tower	3,210 kg (7,080 lb)
Rotor & Drive train	2,420 kg (5,340 lb)
Weight on Foundation	5,630 kg (12,420 lb)

DESIGN LIFE: 30 Years
DESIGN STANDARDS: Applicable Standards, AWEA, and IEC
DOCUMENTATION: Installation Guide and Operation & Maintenance Manual
SCHEDULED MAINTENANCE: Semi-annual or after severe events.

FOR MORE INFORMATION ON THE EW15 WIND TURBINE PLEASE VISIT OUR WEBSITE AT ***www.entegritywind.com*** OR CALL US AT 902-368-7171

EW15 Estimated Annual Energy Output
60 Hz

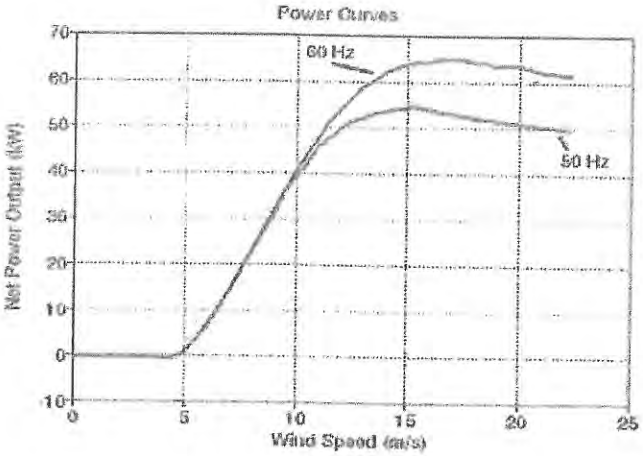


ntegrity Wind Systems Inc.

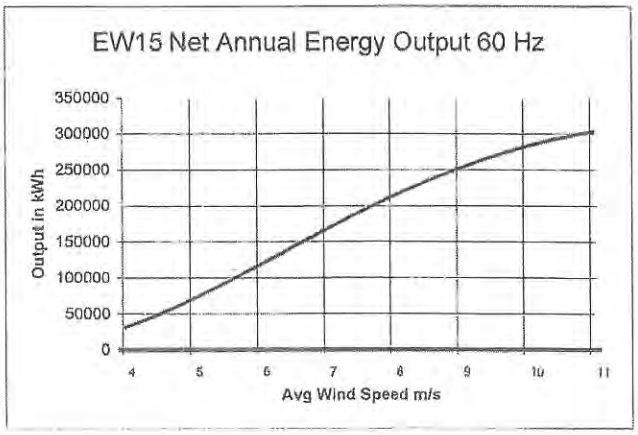
EW15 (formerly AOC 15/50) Power Curve 60hz

Compiled from data from Bushland Texas, San Gorgonio California, and Burlington Vermont USA
Adjusted for sea level

ind Speed (mph)	Wind Speed (m/s)	Power (kW)
0.0	0.0	-0.062
1.1	0.5	-0.062
2.2	1.0	-0.061
3.4	1.5	-0.061
4.5	2.0	-0.057
5.6	2.5	-0.056
6.7	3.0	-0.052
7.8	3.5	-0.060
8.9	4.0	-0.326
10.1	4.5	-0.150
11.2	5.0	1.180
12.3	5.5	3.841
13.4	6.0	7.145
14.5	6.5	10.698
15.7	7.0	14.514
16.8	7.5	18.754
17.9	8.0	23.231
19.0	8.5	27.662
20.1	9.0	31.741
21.3	9.5	36.222
22.4	10.0	40.238
23.5	10.5	44.156
24.6	11.0	47.535
25.7	11.5	51.355
26.8	12.0	53.899
28.0	12.5	56.399
29.1	13.0	58.835
30.2	13.5	60.217
31.3	14.0	61.944
32.4	14.5	62.905
33.6	15.0	63.803
34.7	15.5	64.196
35.8	16.0	64.452
36.9	16.5	64.879
38.0	17.0	64.869
39.1	17.5	64.838
40.3	18.0	64.337
41.4	18.5	64.140
42.5	19.0	63.362
43.6	19.5	63.552
44.7	20.0	63.563



Average Wind Speed		Weibull distribution k = 2.0
m/s	MPH	Annual Energy Output(kWh)
4	8.9	31171
4.1	9.2	34530
4.2	9.4	38038
4.3	9.6	41686
4.4	9.8	45468
4.5	10.1	49377
4.6	10.3	53404
4.7	10.5	57542
4.8	10.7	61784
4.9	11.0	66121
5	11.2	70546
5.1	11.4	75052
5.2	11.6	79631
5.3	11.9	84275
5.4	12.1	88979
5.5	12.3	93734
5.6	12.5	98535
5.7	12.8	103374
5.8	13.0	108246
5.9	13.2	113143
6	13.4	118060
6.1	13.6	122992
6.2	13.9	127932
6.3	14.1	132875
6.4	14.3	137817
6.5	14.5	142751
6.6	14.8	147673
6.7	15.0	152578
6.8	15.2	157462
6.9	15.4	162320
7	15.7	167148
7.1	15.9	171942
7.2	16.1	176697
7.3	16.3	181410
7.4	16.6	186077
7.5	16.8	190694
7.6	17.0	195258
7.7	17.2	199766
7.8	17.4	204214
7.9	17.7	208600
8	17.9	212919
8.1	18.1	217170
8.2	18.3	221350
8.3	18.6	225457
8.4	18.8	229487
8.5	19.0	233439
8.6	19.2	237311
8.7	19.5	241100
8.8	19.7	244806
8.9	19.9	248426
9	20.1	251959
9.1	20.4	255404
9.2	20.6	258760
9.3	20.8	262025
9.4	21.0	265198
9.5	21.3	268280
9.6	21.5	271269
9.7	21.7	274165
9.8	21.9	276968
9.9	22.1	279678
10	22.4	282294
10.1	22.6	284817
10.2	22.8	287246
10.3	23.0	289583
10.4	23.3	291828
10.5	23.5	293980
10.6	23.7	296041
10.7	23.9	298012
10.8	24.2	299893
10.9	24.4	301685
11	24.6	303389



ENTEGRITY WIND SYSTEMS INC.
FIVE YEAR WARRANTY ON EW15 WIND TURBINE GENERATOR

PART I: WARRANTY

The EW15 Wind Turbine Generator and components supplied by Entegrity Wind Systems Inc. (EWSI) are warranted to the original purchaser to be free from defects in material and workmanship to the extent and for the period and subject to the conditions specified hereunder.

If a defect in material or workmanship becomes evident during the EWSI warranty period, EWSI will repair, or at its option, replace the component within a reasonable time, and without charge for parts and EWSI direct factory labor. EWSI reserves the right at its sole discretion to replace defective parts with either new or factory re-built parts, and/or to replace complete assemblies instead of individual components thereof. Component parts replaced under this warranty shall carry only the remaining portion of the original warranty.

This warranty shall be for a five year period, commencing on the date the turbine is mounted on the tower or on the 91st day after the date of shipment from the place of manufacture, whichever occurs first. For projects requiring multiple EW15 Wind Turbine Generators and requiring a staggered delivery schedule, the warranty commencement date may be negotiable prior to completion of the sales agreement or purchase order.

PART II: DISCLAIMER

This warranty is the sole warranty that applies to the EW15 Wind Turbine Generator. EWSI MAKES NO OTHER WARRANTIES EITHER EXPRESSED OR IMPLIED OTHER THAN THOSE SET FORTH HEREIN. EWSI MAKES NO WARRANTIES OF SUITABILITY OF PERFORMANCE FOR A PARTICULAR PURPOSE AND/OR SITE.

PART III: LIMITATIONS OF DAMAGES

EWSI shall not be liable for consequential damages or any incidental expenses resulting from any equipment or component failure except that EWSI will cover consequential damages to the EWSI wind turbine system in which the improperly functioning component or part is installed.

EWSI's sole responsibility hereunder shall be to replace or repair any defective or non-conforming part as set forth in Part I.

PART IV: EXCLUSIONS

This warranty shall not include: (a) repair of damage caused by misuse, abuse, or failure to maintain or operate the equipment in accordance with the manufacturer's written instructions; (b) repair of damage caused by nuclear incident, war, invasion, hostilities, acts of foreign enemies, civil war, rebellion, insurrection, military or usurped power or martial law or confiscation by order of any government or public authority, terrorism, winds over 120 MPH (54 m/s), vandalism, fire, floods and other Acts of God, such as earthquakes, lightning, tornadoes, cyclones, hurricanes or, by equipment and/or services provided by any party other than EWSI; (c) repair of damage to equipment other than the wind system components furnished by EWSI; (d) upgrading of the wind system in terms of output or reliability; and (e) cosmetic refinishing which EWSI does not consider essential to the proper functioning of the system.

The direct labor component of this warranty covers in factory time by authorised EWSI service personnel. This warranty does not cover travel or other costs associated with transporting personnel, equipment, tools, or on site labor by EWSI personnel or others. Costs for such items will be billed by EWSI to the Owner at cost.

PART V: WARRANTY CLAIM PROCEDURE

Owners of EW15 Wind Turbine Generators that qualify under this warranty shall notify EWSI of the equipment serial and identification numbers and the date and nature of the suspected failure or defect. When it is determined that parts or components are to be replaced, Owner shall return the defective parts or components prepaid to EWSI. EWSI will ship repaired or replacement parts or components by most economic means to commercial depot nearest to Owner.

PART V1: OTHER RIGHTS AND REMEDIES

EWSI reserves the right the make changes and improvements in its products without incurring any obligation to make these changes and improvements to products previously supplied. EWSI reserves the right to change the terms of this warranty in the future without incurring any obligation to make the revised terms applicable to products previously sold or supplied.

Effective date from: May 15, 2006

NOTICE: All content subject to notice and disclaimers specified on page [illegible] of this manual.
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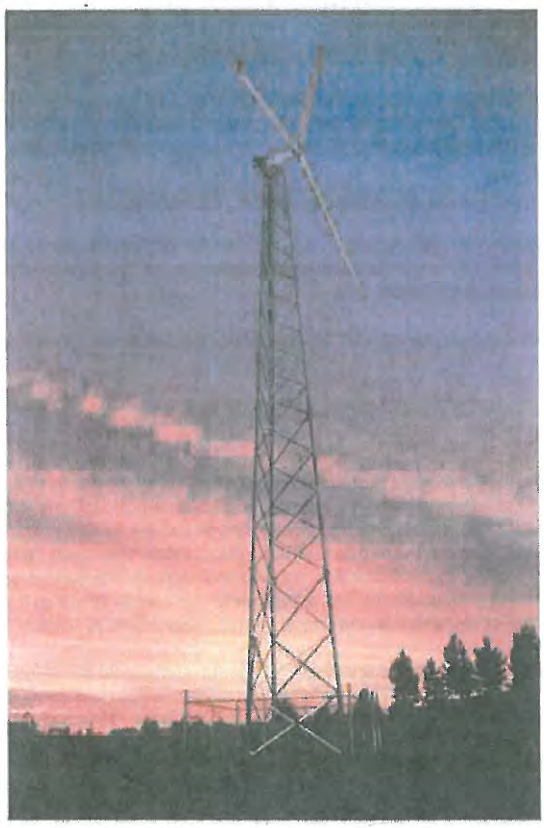
entegrity
Wind Systems Inc.

EW15

WIND TURBINE GENERATOR

Formerly the AOC 15/50



Customer Information Packet

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Fax - 1·902·368·7139
Email- info@entegritywind.com
www.entegritywind.com

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Disclaimer

Welcome to the EW15 Wind Turbine Information Package. As used in these Terms and Conditions, the term "**EW15**" refers to the Wind Turbine manufactured by Entegrity Wind Systems Inc. (**EWSI**) as represented at ***www.entegritywind.com*** as well as that contained in any publication or advertisements that include, but are not limited to, handouts from trade shows, magazine articles, third party websites, print advertisements, and other emailed information. Entegrity Wind Systems Inc. does not control, and is not responsible for, any third-party site on which the EW15 wind turbine is featured or our website is linked to from. Likewise, the term "**Information Package**" refers to printed information that is meant to inform the reader about the specific features of the EW15 Wind Turbine.

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for a particular purpose and/or site. EWSI shall not be responsible for any direct or consequential damages or any incidental expense, including economic loss resulting from the use of this document or our website. Their use is intended to provide product evaluation information only.

Power curves, as represented in the Information Package and shown on the website are representative of typical power available at the controller based on measured and calculated data. Annual energy is calculated using power curves and a Rayleigh wind speed distribution. Energy production may be greater or lesser dependent upon actual wind resources and site conditions, and will vary with wind turbine maintenance, altitude, temperature, topography and the proximity to other structures.

For the EWSI website, EWSI periodically schedules system downtime for maintenance and other purposes. Unplanned outages also may occur. EWSI shall have no liability for the resulting unavailability of the website or for any loss information caused by planned or unplanned system outages, or any outages of web host providers or the Internet infrastructure and network external to the website.

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Charlottetown, PE, C1A 7L9
Attention: Carmen MacIntyre
Telephone: (902) 368-7171
E-mail: info@entegritywind.com

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1.0 Background & Technical Specifications

Together with the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory's (NREL) Advanced Wind Turbine Program, Entegrity Wind Systems Inc. (EWSI) (then known as Atlantic Orient Corporation or AOC) developed an advanced 50 kW wind turbine which produces energy at competitive rates for distributed generation; village electrification, diesel-based utilities and purchased power displacement for agriculture, industry and municipalities.

AOC based its design on the Enertech E44 series wind turbines, of which approximately 750 were built between 1982 and 1986. They were installed in wind power stations throughout the United States, as well as in several other countries. Most are still in operation today. AOC evaluated the historic performance of a significant number of E44 series wind turbines, identifying problem areas and ranking them according to their impact on turbine downtime. Specific downtime related issues were then targeted and solutions proposed. The impact of the various solutions was then evaluated on an economic and risk basis to further define the benefits of each improvement.

Resulting from this analysis, AOC developed a preliminary design for a 50 kW wind turbine: the AOC 15/50. The results obtained were so encouraging that the final design and prototyping of the AOC 15/50 were initiated under separate NREL contracts. The Dutch National Laboratory for Renewable Energy (ECN) performed an independent reliability analysis concluding that the AOC 15/50's design was sound.

After an extensive review and analysis of the operating histories of existing wind turbines, AOC's design team incorporated many design features in the AOC 15/50 to enhance its energy production. These features included:

- Advanced modified NREL thick airfoils
- Electromagnet controlled tip brakes
- Single piece hub casting
- Innovative slip ring to transfer power to the tip brakes
- Integrated gearbox with improved internal components
- Totally-enclosed generator
- Single piece cast tower top with larger yaw bearings
- Uniformly tapered galvanized lattice tower
- Advanced controls based upon a microprocessor controller
- Ethernet communication module for remote monitoring

In September 2004, Entegrity Wind Systems Inc. (EWSI) assumed the assets of Atlantic Orient Corporation and officially changed the machine name to the EW15 from the AOC 15/50. The remainder of this information package will refer to the company as EWSI and will be updated soon to reflect the change of name of the machine in the foundation and tower load drawings. All information on the wind turbine is current.

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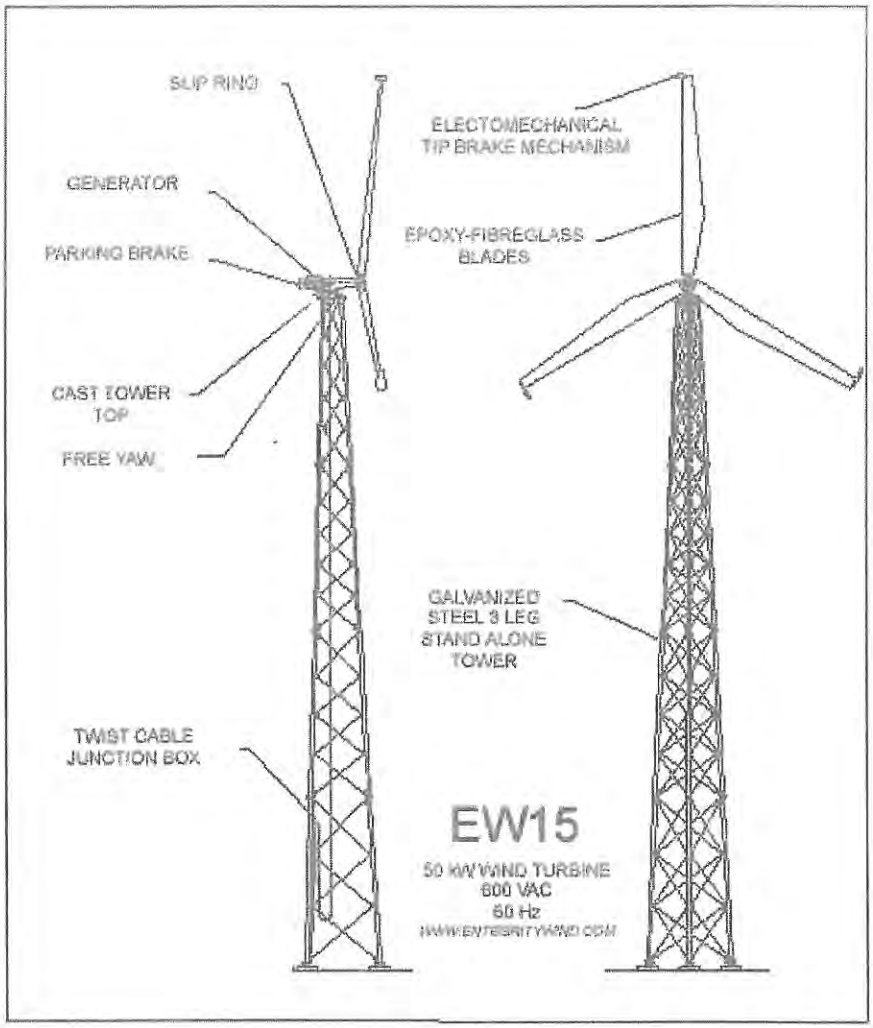

Figure 1-1 EW15 WTG

Figure 1-1 illustrates a typical EW15 Wind Turbine Generator (WTG). The designation 15 refers to the turbine's 15 m diameter rotor and its rated output of 50 kW. The rated output is reached at wind speeds of 12 m/s (26.8 mph) for the 50 Hz WTG and 11.3 m/s (25.3 mph) for 60 Hz WTG. As shown in the power curve in Figure 1-2, the wind turbine is designed to cut in at 4.6 m/s (10.2 mph). The turbine is stall regulated and at about 15 m/s reaches its peak output of 55 kW for the 50 Hz WTG and 66 kW for the 60 Hz WTG. Assuming 100% availability and average wind speed of 6.7 m/s (15mph), it is calculated to produce 145,000 kWh/year for the 50 Hz WTG and 153,000 kWh/year for the 60 Hz WTG. Figure 1-3 illustrates the projected net annual energy production as a function of average annual wind speed. Full specification for both the 50 Hz and 60 Hz configurations are given in the appendix.

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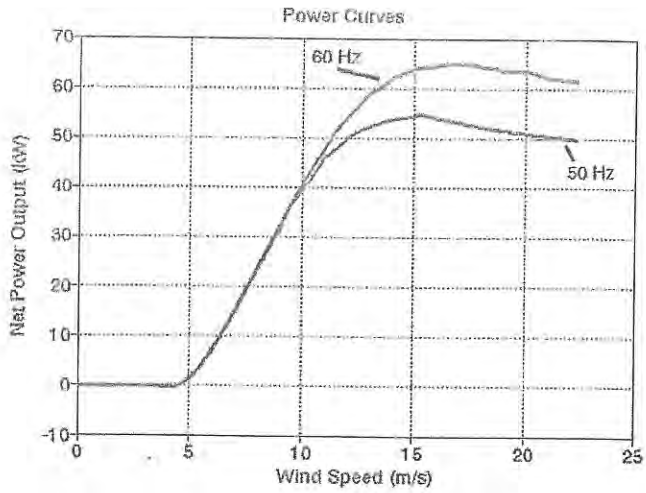

Figure 1-2 EW15 Power Curve

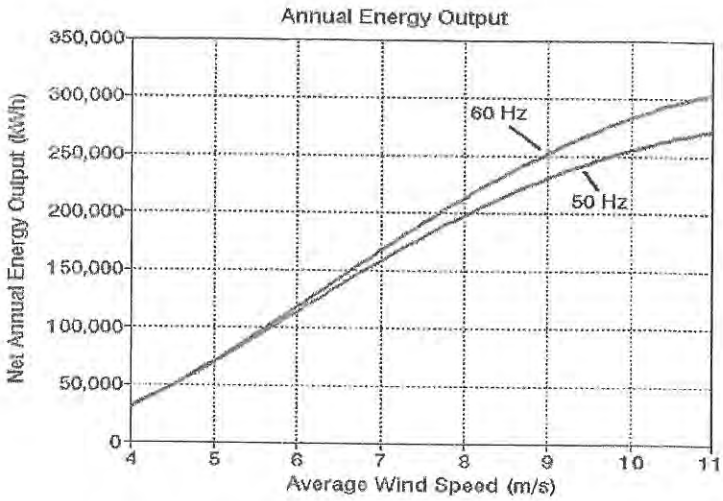

Figure 1-3 EW15 Projected Net Annual Energy Production

NOTE: The power curves show the typical power available at the controller based on a combination of measured and calculated data. Annual energy is calculated using power curves and a Rayleigh wind speed distribution. Energy production may be greater or less depending on the actual wind resources and site conditions and will vary with wind turbine maintenance, altitude, temperature, topography and the proximity to other structures including other wind turbines.

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The EW15 has been designed as a robust, economical, low-maintenance wind turbine to be utilized in extreme environments. The tower top casting provides a rigid, low cost interface between the gearbox and the tower. The low speed shaft has a sufficiently large diameter and the necessary material strength to accommodate the structural and fatigue loads encountered during operation. The hub consists of a single piece casting for design simplicity. See Figure 1-4

Figure 1-4 EW15 Drive Train Assembly

A more detailed view of the turbine assembly is provided in Figure 1-5. The design team aimed for design simplicity. The heart of the design is the integrated gearbox consisting of a single piece, cast housing. The generator is flange-mounted to the planetary gearbox with the enclosed parking brake directly coupled to the totally enclosed generator. There is no nacelle.

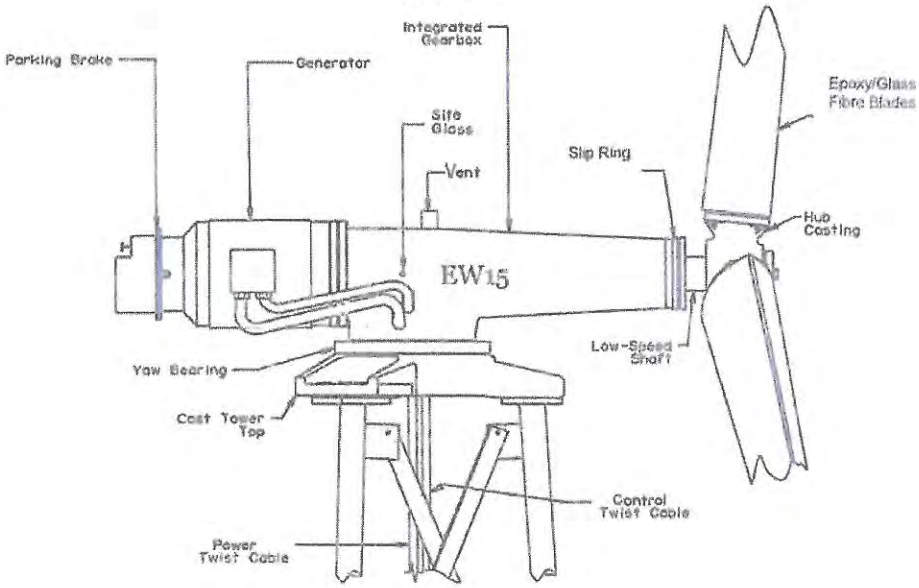

Figure 1-5 EW15 Drive Train Assembly

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The EW15 aerodynamic tip brakes are latched or released by electromagnet when triggered by the control system. A spring return device assembly is incorporated to return the tip brake to closed position. All components are designed for fail-safe operation. See Figure 1-6 below.

Figure 1-6

EW15 Wind Turbine with Tip Brakes Deployed

The EW15 uses an induction generator and can be easily interconnected to an electric utility network (3 Phase, 400 to 600 VAC) or a diesel grid. The details of your installation will be based on the requirements of the interfacing network and/or the local utility. A Single Phase turbine is in development and expected to be field ready in 2007-2008

2.0 Research, Development & Field Testing

The EW15 represents the latest technology in highly reliable, affordable turbines. Our design effort is fully supported by design tools, which include FLAP, PROP, YAWDYN, ADAMS and Algor for finite element analysis.

EWSI maintains a test facility for continuous testing of key system components. Drive train components, generators, control systems and braking systems have been thoroughly evaluated under a range of loading conditions. Furthermore, long term testing and research continues to provide EWSI with data to refine modeling and analysis techniques, as well as to verify the performance and reliability of its products.

Over the past twelve years, EWSI has been involved with a series of test wind turbines in various climates. Some of these wind turbines have been instrument-equipped for structural load evaluation. Locations of these turbines included Palm Springs CA, Rocky Flats CO, Bozeman MT, Bushland TX, South Burlington VT, Scotland, and the Atlantic Wind Test Site

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on Prince Edward Island, Canada. EWSI, in cooperation with the United States Department of Energy and Kotzebue Electric Association Alaska, has developed a small wind farm during the past six years with twelve EW15s. See Figure 2-1. The project is located in Kotzebue, north of the Arctic Circle, and was monitored and evaluated for performance by the DOE and EPRI Wind Turbine Verification Program.[1]

Figure 2-1 Wind Farm at Kotzebue, Alaska

To date, commercial wind turbines have been located in Canada's Northwest Territory, Northern and Southern Ontario, Saskatchewan, Prince Edward Island, Alaska, Central Russian Siberia, Argentina, Maine, New Hampshire, Texas, North Dakota, Vermont, New York, United Kingdom and Morocco. Currently EWSI is focusing on the North American Market Area only for the EW15 wind turbine. Other areas will be added when production levels increase in 2007-2008 and when marketing and after sales support for these areas are developed.

[1] For more information on the Kotzebue project please visit www.kea.coop

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3.0 Project Planning

The appendix includes a project-planning outline, which includes timelines and basic details on site factors, permits, utility interface, and installation. These sections are intended as checklists to assist our customers in addressing the relevant details of an installation in a logical sequence. Although most items apply to both large and small projects, not every item will apply to every project. To insure thorough planning, it is very important that customer understand why a particular detail is or is not appropriate to the installation.

By reviewing the entire list at various stages of the project, the customer should be able to ensure that no details necessary to complete a project have been overlooked.

4.0 Delivery Schedule

The EW15 has a delivery time of typically two to six (2-6) months after receipt of deposit. Delivery schedules largely depend on independent project and site-specific characteristics.

5.0 Warranty

EWSI will provide its normal five-year warranty on the EW15, which becomes effective at the time of turbine installation and successful commissioning or ninety (90) days after the shipping date, which ever occurs first. See Warranty in the appendix.

6.0 Installation, Commissioning & Maintenance

Unless otherwise requested and agreed upon, the installation, commissioning and maintenance of the EW15 turbine is the responsibility of the customer. It is highly recommended however that the customer solicit the services of EWSI trained personnel to provide site supervision and commissioning of the wind turbine. A per diem and travel and accommodation expenses apply to any EWSI personnel sent to the customer site.

6.1 Typically Required Installation Tasks (Manual Available)

1. Design and install foundation.
   Specifications are found in the appendices.
2. Provide weatherized shelter for turbine control boxes. Provide cabling and conduit between the turbines, controllers and utility interface.
   EWSI can provide controllers mounted in an ISO container or other suitable shelter. NEMA 4 enclosures are also available at extra cost.
3. Provide utility interface.
4. Wind Turbine Installation.
5. Wind Turbine commissioning.
6. Service and maintenance training.
   The EW15 requires minimal O&M. See the Following.

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7.0 Operation & Maintenance

Typically, the system requires 2 man-days of annual inspection and adjustment and 3hrs/month or less in routine inspection. A remote monitoring system is also available which will allow remote diagnosis and performance monitoring. At the time of commissioning EWSI will conduct operations and maintenance training for personnel if requested.

Monthly Inspection • Visually inspect turbine/site for obvious problems • Record meter & run time readings • Inspect for loose fasteners	
Semi-annual Inspection (every 6 months) • Check torque of tower bolts • Check torque of blade and turbine bolts • Inspect yaw bearing/lock • Inspect & test tip brakes • Inspect generator–connections	• Inspect gearbox for leaks • Inspect main shaft for leaks • Inspect slip rings or rotary transformers • Re-grease yaw bearing and yaw lock (be sure not to over grease)

8.0 Spare Parts

Depending on site-specific conditions EWSI will recommend certain spare parts be purchased in order to lessen the likelihood of potential down time. Factors taken into consideration will include site-specific climate conditions, availability of local suppliers in the vicinity of the site, numbers of machines installed, and overall accessibility to the site. Remote or other difficult to reach sites may require more on hand stock due to long delivery times or un-availability of common items such as mechanical hardware or electrical components.

9.0 Wind Turbine Generator Cost

The final cost of the EW15 will depend on selected options for specific site conditions. The standard EW15 includes the EW15 drive train assembly, basic controller for grid interconnection, blades, and 100 ft (30 m) SSV tower. [2] 80ft (24.4m) and specialty towers available at additional or lesser charge. The foundation is site specific and its design and construction is normally the customer's responsibility. EWSI may have a local install company or may be able to suggest a local contractor for your area. Other available options include arctic and marine weather protection packages, specialized controllers for remote communication and wind-hybrid system integration, and aeronautical obstruction warning equipment.

Typical payment terms are as follows:

- 25% deposit upon placement of order
- Balance upon shipment

[2] EWSI reserves the right to alter price at any time. Pricing may also vary depending on quantities ordered. Contact us at info@entegritywind.com or (902) 368-7171 for current pricing.

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10.0 Appendix

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Item A

EW15 *50 Hz* WTG Design Specifications

SYSTEM

Type	3 ϕ Grid Connected
Configuration	Horizontal Axis
Rotor Diameter	15 m (49.2 ft)
Centerline Hub Height	25 m (82 ft)

PERFORMANCE PARAMETERS

Rated Electrical Power	50 kW @11.3 m/s (25.3 mph)
Wind Speed Ratings	
cut-in	4.6 m/s (10.2 mph)
shut-down (high wind)	22.4 m/s (50 mph)
design speed	59.5 m/s (133 mph)
Calculated Net Annual Output @ 100 % availability	5.4 m/s (12 mph) 85,000 kWh 6.7 m/s (15 mph) 145,000 kWh 8.0 m/s (18 mph) 199,000 kWh

ROTOR

Type of Hub	Fixed Pitch
Rotor Diameter	15 m (49.2 ft)
Swept Area	177 m² (1902 ft²)
Number of Blades	3
Rotor Solidity	0.077
Rotor Speed @ rated wind speed	62 rpm
Location Relative to Tower	Downwind
Cone Angle	6°
Tilt Angle	0°
Rotor Tip Speed	48.6 m/s (109 mph) @ 50 Hz
Design Tip Speed	6.1

BLADE

Length	7.2 m (23.7 ft)
Material	Epoxy /glass fibre
Blade Weight	150 kg (330 lbs) approximate

GENERATOR

Type	3 phase/4 pole asynchronous
Frequency	50 Hz
Voltage	3 phase @ 50 Hz, 400-600 V
kW @ Rated Wind Speed	50 kW
kW @ Peak Continuous	55 kW
Insulation	Class F
Enclosure	Totally Enclosed Air Over
Options	Arctic low temp. shafting (-40°c)

TRANSMISSION

Type	Planetary
Housing	Ductile Iron
Ratio (rotor to gen. speed)	1 to 24.57 (50 Hz)
Rating, output horse power	88
Lubrication	Synthetic gear oil/non toxic
Heater (option)	Arctic version, electric

YAW SYSTEM

Normal	Free, passive
Optional	Yaw damp
Electrical	Twist Cable

TOWER

Type	Free standing galvanized bolted lattice
Tower Height	30 m (100 ft)
Options	24.4 m (80 ft) Monopole 30 m (100 ft) Tilt down

FOUNDATION

Type	Concrete pads, piers or special

CONTROL SYSTEM

Type	Micro Processor Based
Communications	Ethernet Module or Serial link to central computer for energy monitor and maintenance dispatch
Enclosures	NEMA 1, NEMA 4 (optional)
Soft Start	Optional

ROTOR SPEED CONTROL

Running	Passive stall regulation
Start up	Aerodynamic
Shut-down	Aerodynamic tip brake. Parking brake for servicing.

BRAKE SYSTEM CONTROL

Fail-safe aerodynamic and parking brakes.

APPROXIMATE SYSTEM DESIGN WEIGHTS

Tower	3,210 kg (7,080 lb)
Rotor & Drive train	2,420 kg (5,340 lb)
Weight on Foundation	5,630 kg (12,420 lb)

DESIGN LIFE: 30 Years
DESIGN STANDARDS: Applicable Standards, AWEA and EIA
DOCUMENTATION: Installation Guide and Operation & Maintenance Manual
SCHEDULED MAINTENANCE: Semi-annual or after severe events.

NOTE 1: Entegrity Wind Systems Inc. is constantly working to improve their products; therefore, product specifications are subject to change without notice.

NOTE 2: Power curves show typical power available at the controller based on a combination of measured and calculated data. Annual energy is calculated using power curves and a Rayleigh wind speed distribution. Energy production may be greater or lesser dependent upon actual wind resources and site conditions, and will vary with wind turbine maintenance, altitude, temperature, topography and the proximity to other structures including wind turbines.

NOTE 3: For design options to accommodate severe climates or unusual circumstances, please contact the technical and sales office in Prince Edward Island, CANADA.

NOTE 4: For integration into high penetration wind-diesel and village electrification schemes contact the technical & sales office in Prince Edward Island, CANADA for technical support and systems design.

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Item B

EW15 *60 Hz* WTG Design Specifications

SYSTEM

Type	Grid Connected
Configuration	Horizontal Axis
Rotor Diameter	15 m (49.2 ft)
Centerline Hub Height	25 m (82 ft)

PERFORMANCE PARAMETERS

Rated Electrical Power	50 kW @11.3 m/s (25.3 mph)
Wind Speed Ratings	
cut-in	4.6 m/s (10.2 mph)
shut-down (high wind)	22.4 m/s (50 mph)
design speed	59.5 m/s (133 mph)
Calculated Net Annual Output @ 100 % availability	5.4 m/s (12 mph) 87,000 kWh 6.7 m/s (15 mph) 153,000 kWh 8.0 m/s (18 mph) 215,000 kWh

ROTOR

Type of Hub	Fixed Pitch
Rotor Diameter	15 m (49.2 ft)
Swept Area	177 m^2 (1902 ft^2)
Number of Blades	3
Rotor Solidity	0.077
Rotor Speed @ rated wind speed	65 rpm
Location Relative to Tower	Downwind
Cone Angle	6°
Tilt Angle	0°
Rotor Tip Speed	51 m/s (114 mph) @ 60 Hz
Design Tip Speed	6.1

BLADE

Length	7.2 m (23.7 ft)
Material	Epoxy /glass fibre
Blade Weight	150 kg (330 lbs) approximate

GENERATOR

Type	3 phase/4 pole asynchronous
Frequency	(Hz) 60 Hz
Voltage	3 phase @ 60 Hz, 400-600 V
kW @ Rated Wind Speed	50 kW
kW @ Peak Continuous	66 kW
Insulation	Class F
Enclosure	Totally Enclosed Air Over
Options	Arctic low temp. shafting (-40°c)

TRANSMISSION

Type	Planetary
Housing	Ductile iron
Ratio (rotor to gen. speed)	1 to 28.25 (60 Hz)
Rating, output horse power	88
Lubrication	Synthetic gear oil/non toxic
Heater (option)	Arctic version, electric

YAW SYSTEM

Normal	Free, passive
Optional	Yaw damp
Electrical	Twist Cable

TOWER

Type	Free standing galvanized bolted lattice
Tower Height	30.5 m (100 ft)
Options	24.4 m (80 ft) Monopole 30 m (100 ft) Tilt down

FOUNDATION

Type	Concrete pad, pier or special

CONTROL SYSTEM

Type	Micro Processor Based
Communications	Ethernet Module or Serial link to central computer for energy monitor and maintenance dispatch
Enclosures	NEMA 1, NEMA 4 (optional)
Soft Start	Optional

ROTOR SPEED CONTROL

Running	Passive stall regulation
Start up	Aerodynamic
Shut-down	Aerodynamic tip brake. Parking brake for servicing.

BRAKE SYSTEM CONTROL

Fail-safe aerodynamic and parking brakes.

APPROXIMATE SYSTEM DESIGN WEIGHTS

Tower	3,210 kg (7,080 lb)
Rotor & Drive train	2,420 kg (5,340 lb)
Weight on Foundation	5,630 kg (12,420 lb)

DESIGN LIFE: 30 Years

DESIGN STANDARDS: Applicable Standards, AWEA, EIA and IEC

DOCUMENTATION: Installation Guide and Operation & Maintenance Manual

SCHEDULED MAINTENANCE: Semi-annual or after severe events.

NOTE 1: Entegrity Wind Systems Inc. is constantly working to improve their products; therefore, product specifications are subject to change without notice.

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REV. November 2006

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Item C

Entegrity Wind Systems Inc.: Client Project Questionnaire

Site Characteristics

1. *Installation Location(s):*_____
2. *Average Annual Wind Speed ____m/s (1 mph = .447 m/s)*
3. *Peak Wind Speed ____ m/s*
4. *Direction of Prevailing Wind _____*
5. *Distance from utility service point / diesel generators to turbine site. _____m*
6. *Obstructions (trees, hills, buildings, restrictions) O Yes O No*
7. *Please describe the geographic area of the site (include area size in m², accessibility and local restrictions relative to height, proximity to boundaries, etc.) and attach to this questionnaire. Include photo(s) or map(s) if possible.*

Cost Information

1. *Net Price of Electricity _____ $ / kWhr*
2. *Utility Buy-back Rate _____ $ / kWhr*

Grid Parallel Application

1. *Load to be displaced _____*
2. *Peak Load _____*

Utility Grid Information

1. *Primary Voltage O 13.8kV O 12.5kV O 4160V O 2400V OOther_____*
2. *Secondary Voltage O 400V O 415V O 480V O 600V OOther_____*
3. *Frequency O 50Hz O 60Hz*

Transformer Data

1. *Taps Number Plus_____ Number Minus_____ Step %_____*
2. *Mounting Type OPole OPad OOther*
3. *Rated kVa _____*
4. *Winding Configuration Primary O Wye O Delta O Other_____*
5. *Winding Configuration Secondary O Wye O Delta O Other_____*
6. *Impedance_____ Per Unit*
7. *Surge / Lightning Protection _____*

Contact Information

Name: _____
Address: _____
_____
Expected Purchase Order Date:
_____
Phone: _____
Fax: _____
E-mail: _____
Expected Commissioning Date:
_____

Additional information will be required for all wind-hybrid applications.

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Items D & E

EW15 WTG Tower Loads Specifications

Foundation Loads Three Leg SSV Lattice Tower

FOUNDATION INFORMATION						
	Tower Base Loads (lbsf)			Single Leg Loads (lbsf)		
	Vertical Loads (weight)	Horizontal Loads (thrust)	Overturning Moment (ft-lbs)	Horizontal	Vertical	
					Tension	Compression
80 ft. SSV	12,400	21,200	1,360,000	12,700	141,000	150,000
100 ft. SSV	15,300	24,400	1,810,000	14,600	158,000	168,000

Loads calculated by spreadsheet at survival wind speed of 59.5 m/s (133 mph).

Loads at the maximum operating wind speed of 22.4m/s (50 mph) are much lower.

The included figures illustrate the typical anchor bolt orientations for the Rohn SSV tower. A typical pad type foundation is also illustrated. Please note that the loads, soil conditions and tower design for the specific site will dictate the foundation design. This information is intended as a guide for planning purposes only. Monopole tower is a specialty item. Drawings available to purchasers upon request.

EW15 WTG Shipping Configurations and Weights [3]

Description	Qty (pallets)	Crated Dimensions (inches L x W x H)	Weights (lbs)	Packing
Turbine Drive train	1	120" x 45" x 50"	5300	Crate
Blade Set	1	300" x 48" x 50"	1300	Crate
Controller Boxes	1	36" x 36" x 36"	350	Crate
80' (24.4m) Tower	1	240" x 96" x 42"	9000	Bundle
100' (30m) Tower	1	240" x 96" x 56"	11,000	Bundle
100' (30') Monopole	1	2 pieces 600" x 36"	15,000	Tubes

EWSI offers their turbines **EXW** at the individual points of manufacture. EWSI can arrange the shipping of EW15 wind turbines to points within North America (Canada, USA, Mexico) on the customer's behalf. EWSI will bill all freight, taxes and duties incurred at cost to the customer. For international customers, EWSI can arrange to have your turbine consolidated to the Canadian or US port of your choice and packaged into a 40' container. International customers must arrange their own ocean transportation and domestic shipping within their own country. All importation taxes and duties due at the destination country are the customer's responsibility. EWSI will provide customs paperwork (Commercial Invoices, NAFTA, etc) at the request of the customer. EWSI can arrange customs clearance for North American Customers.

[3] NOTE: All dimensions and weights are approximate for estimation purposes only.

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Item F

Project Planning Outline

i. Site Factors

Site selection may have a significant effect on annual energy production. It is worth the additional time and effort to locate the proper site to maximize energy production. The following site factors should be considered:

- Wind resource characteristics
- Average wind speed
- Frequency and duration of power producing winds
- Prevailing wind direction
- Turbulence
- Peak wind speed
- Height and location of obstructions
- Distance from utility service
- Local height restrictions, proximity to boundaries, etc.
- Tower height
- Proximity of wind turbines to each other
- Site accessibility and its effect on construction and maintenance costs.
- Safety zone of the site regarding proximity of public access.

EWSI is committed to responsible siting of its turbines. EWSI will only sell EW15 wind turbines to customers who have locations where there is sufficient wind and where there is responsible personnel either employed by EWSI or from local companies specializing in renewable energy equipment and retained by the customer that can provide long term routine maintenance and emergency repair for the turbine.

ii. Utility Factors

The EW15 uses an induction generator, which requires the interfacing electrical system to provide generator excitation. Each turbine includes power factor correction capacitors. The turbine installation must consider specific factors regarding the interfacing utility network to provide for a safe and efficient installation. A "Customer Project Questionnaire" is located in the Appendix and should be completed and returned to EWSI. The following utility related factors should be considered:

- Interconnection Requirements and Standards
- Buy back rates, contract options, green pricing, net billing, etc.
- Available line capacity (kVA)
- Available fault current
- Voltage and phase configuration of the local utility line
- Distance to connection point
- Size and winding configuration of the step down transformer if required
- To assist EWSI in designing your interface, please complete and return the attached questionnaire.

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iii. Permits & Approvals

Many wind turbine locations will require permits and approvals. It is normally the customer's responsibility to determine which permits / approvals apply to your particular site.

Often these permits & approvals are available from:

- Municipalities or local councils
- Counties
- States or Provinces
- Federal (FAA, FCC, etc.)
- Commissions (energy, heritage, etc.)
- Utilities

Permits may be required in relation to the following factors:

- Construction
- Foundation Engineering
- Electrical
- Interconnection
- Zoning, land use
- Communication Interference
- Aviation Interference
- Environmental Impact
- Inspections required for above
- Safety

iv. Plans & Drawings

Suggested items to have on hand or to prepare for efficient and proper site development: and for the submittal, if necessary, for various approvals:

- Plot plan
- Site layout
- Tower foundation drawing
- Tower assembly drawing
- Site wiring diagram
- Control building interior wiring (if applicable) diagram
- Control building physical layout (if applicable)
- Utility interface – single line drawing
- Utility interface – three line drawing
- Wind turbine wiring schematic
- Your local wiring inspector should review the design of the electrical installation prior to commencing work at the site.

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v. Construction Planning Considerations

To minimize time and cost, the following items should be considered in the planning process:

- Subcontractor roles and responsibilities
- Cable trenches (type, length and depth)
- Control enclosure design
- Site specific weather extremes
- Tower foundation type
- Foundation forming details
- Site accessibility and road conditions
- Crane availability and cost
- Concrete availability and cost
- Backhoe availability and cost
- Labor skills and related costs
- Soil Characteristics
- Depth to significant frost
- Allowable bearing capacities.
- Blasting
- Availability of hand tools
- Concrete working tools
- Fencing materials and security

vi. Installation Personnel Considerations

The installation of a wind turbine generator requires specialized skills, equipment and experience. EWSI assumes that installation personnel will have the required skills, experience, and equipment to install and/or maintain the wind turbine. Only trained and qualified technicians should attempt to climb the wind turbine tower using IEC/OSHA/ANSI approved practice and equipment. It is very highly recommended that a trained EWSI representative be present for the erection, assembly and commissioning of the wind turbine. The turbine warranty is only valid on EWSI commissioned turbines or those turbines commissioned by EWSI approved and trained installers. In addition the following should also be present at specific times during the installation:

- 1 to 2 qualified technicians trained in climbing safety to erect and install turbine
- Qualified crane operator to operate the crane during turbine lifting
- Certified electrician and/or utility personnel to install cables and wire controllers
- Additional labor for tasks such as tower assembly

vii. Foundation Installation

Foundation types and installation are specific to each site. The foundation must be designed for the load conditions expected at that particular site. Refer to IEC standards for Wind Turbines for additional information. Each leg of the tower should be electrically grounded per electrical standards for the region.

See the Items "G", "H" & "I" for information on foundation design loads and foundation layout. The standard foundation for the EW15 can be dug or drilled in locations with cohesive and deep soil conditions. The civil engineer, responsible for the foundation design, should consider site-specific conditions. It may be suitable to excavate for power and control cables at this time. For wire and cable information, see the installation manual to be provided with shipment or contact your EWSI project manager. Please note that the drawings in this section are still being updated to reflect the name change of the machine and company.

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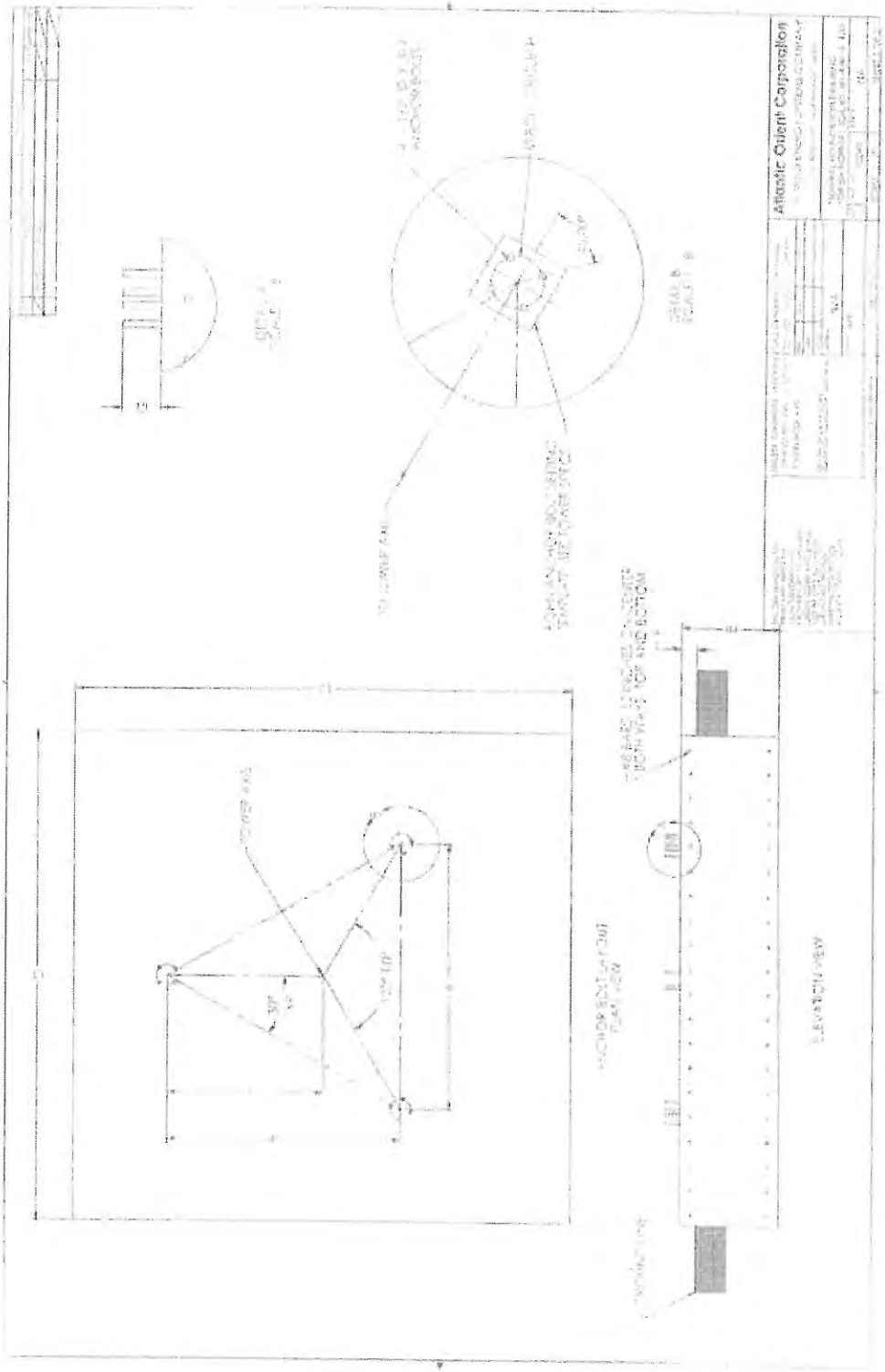
Item G

EW15 WTG Foundation Specifications
Standard Tower, Normal Soil



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TOWER	DIMENSION							
	A	B	C	D	E	F	G	H
80 FT	10' - 9 1/8"	9' - 3 13/16"	6'-2 9/16"	19' - 3"	4' - 0"	0' - 6"	7 1/2"	10 1/4"
100 FT	12' 10"	11' - 1 5/16"	7'-4 7/8"	21' - 0"	6' - 0"	0' - 8"	7 1/2"	10 1/4"

NOTES

1. ALL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF [illegible] PSI AT 28 DAYS
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS MEETING THE REQUIREMENTS OF ASTM A615 GRADE 60
3. MINIMUM CONCRETE COVER ON REINFORCEMENT SHALL BE [illegible] INCHES
4. FOR ANCHOR BOLT LOCATIONS AND INSTALLATION INSTRUCTIONS, SEE SPECIFICATIONS FOR TOWER BEING USED
5. FOR FOUNDATIONS AND ANCHOR BOLT TOLERANCES AND FOUNDATION NOTES, SEE SPECIFICATIONS FOR TOWER BEING USED
6. SPLICES IN REINFORCEMENT SHALL NOT BE ALLOWED. WELDING OF REINFORCING STEEL OR ANCHOR BOLTS IS NOT ALLOWED
7. ALL CONSTRUCTION SHALL CONFORM TO LOCAL CODES AND TO THE LATEST VERSION OF ACI 318 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE
8. THE BASE OF THE FOUNDATION SHALL BE PLACED ON NATURAL UNDISTURBED SOIL
9. IN THE PLAN VIEW THE AXIS OF THE TOWER SHALL BE LOCATED AT THE CENTER OF THE FOUNDATION
10. THE CONTRACTOR SHALL CONFIRM THAT THE SOIL CONDITIONS AT THE SITE ARE AT LEAST THE EQUIVALENT OF ETA NORMAL SOIL (4000 PSF ALLOWABLE BEARING PRESSURE) AND THAT THE DEPTH OF THE FOUNDATION IS ADEQUATE FOR MAXIMUM FROST DEPTHS AT THE SITE.
11. CONTACT ACO BEFORE FOUNDATION CONSTRUCTION FOR LATEST REV DRAWINGS AND SPECIFICATIONS

Atlantic Orient Corporation

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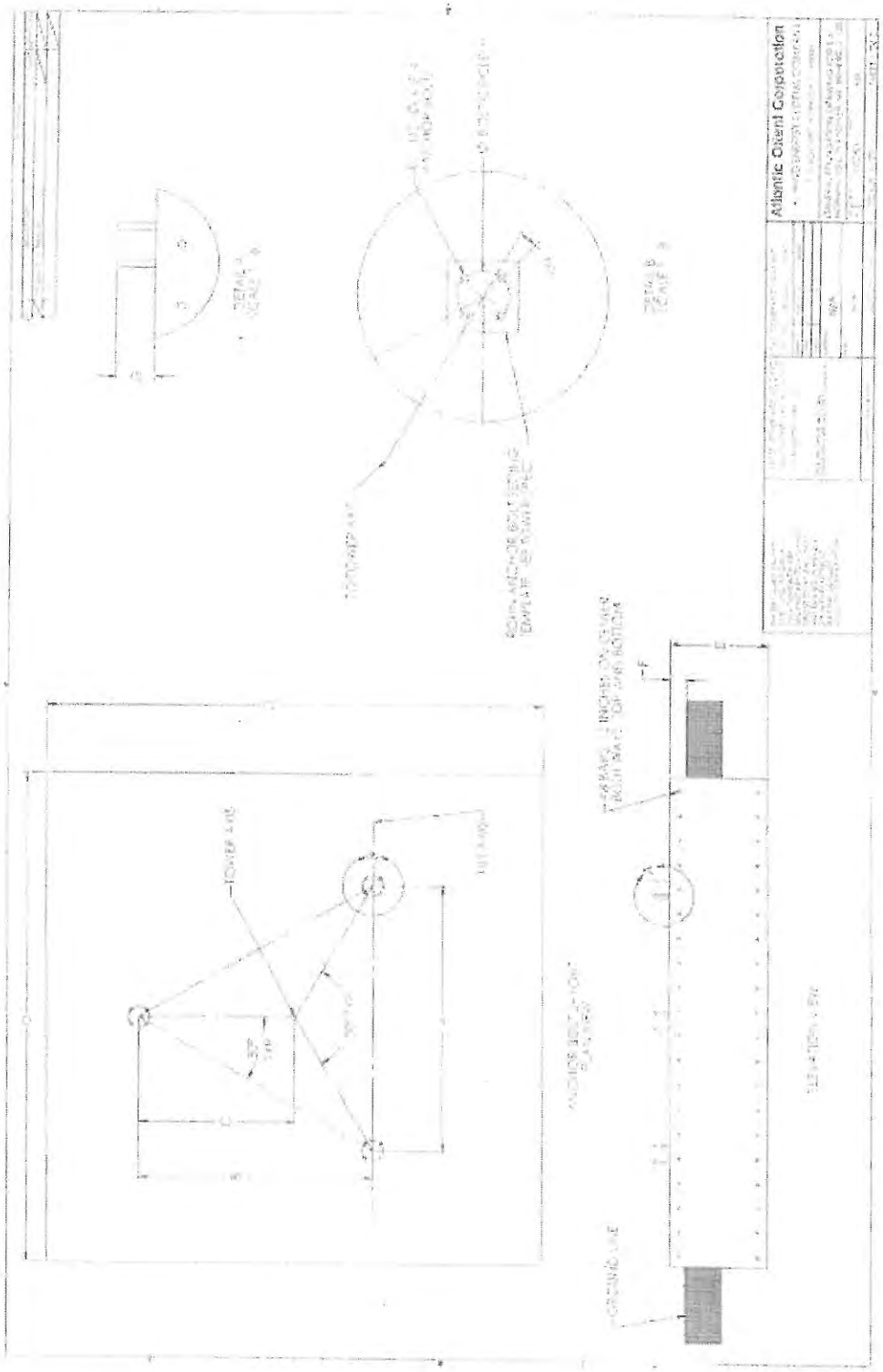
EW15 WTG Foundation Specifications
Tilt Tower, Normal Soil



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TOWER	DIMENSION							
	A	B	C	D	E	F	G	H
80 FT	10' - 9 1/8"	9' - 3 13/16"	6'-2 9/16"	19' - 3"	4' - 0"	0' - 6"	7 1/2"	10 1/4"
100 FT	12' 10"	11' - 1 5/16"	7'-4 7/8"	21' - 0"	6' - 0"	0' - 8"	7 1/2"	10 1/4"

NOTES

1. ALL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF [illegible] PSI AT 28 DAYS
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS MEETING THE REQUIREMENTS OF ASTM A615, GRADE 40
3. MINIMUM CONCRETE COVER ON REINFORCEMENT SHALL BE 3 INCHES
4. FOR ANCHOR BOLT LOCATIONS AND INSTALLATION INSTRUCTIONS, SEE SPECIFICATIONS FOR TOWER BEING USED
5. FOR FOUNDATION AND ANCHOR BOLT TOLERANCES AND FOUNDATION NOTES, SEE SPECIFICATIONS FOR TOWER BEING USED
6. SPLICING REINFORCEMENT SHALL NOT BE ALLOWED. FAILURE OF REINFORCING STEEL OR ANCHOR BOLTS IS NOT ALLOWED
7. ALL CONSTRUCTION SHALL CONFORM TO LOCAL CODES AND TO THE LATEST VERSION OF ACI 318 "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE"
8. THE BASE OF THE FOUNDATION SHALL BE PLACED ON NATIVE UNDISTURBED SOIL
9. IN THE PLAN VIEW THE AXIS OF THE TOWER SHALL BE LOCATED AT THE CENTER OF THE FOUNDATION.
10. THE CONTRACTOR SHALL CONFIRM THAT THE SOIL CONDITIONS AT THE SITE ARE AT LEAST THE EQUIVALENT OF ETA NORMAL SOIL 1500 PSF ALLOWABLE BEARING PRESSURE AND THAT THE DEPTH OF THE FOUNDATION IS ADEQUATE FOR MAXIMUM FROST DEPTH AT THE SITE
11. CONTACT ADC DEPORE'S FOUNDATION CONSTRUCTION FOR LATEST ECN DRAWINGS AND SPECIFICATIONS

Atlantic Orient Corporation

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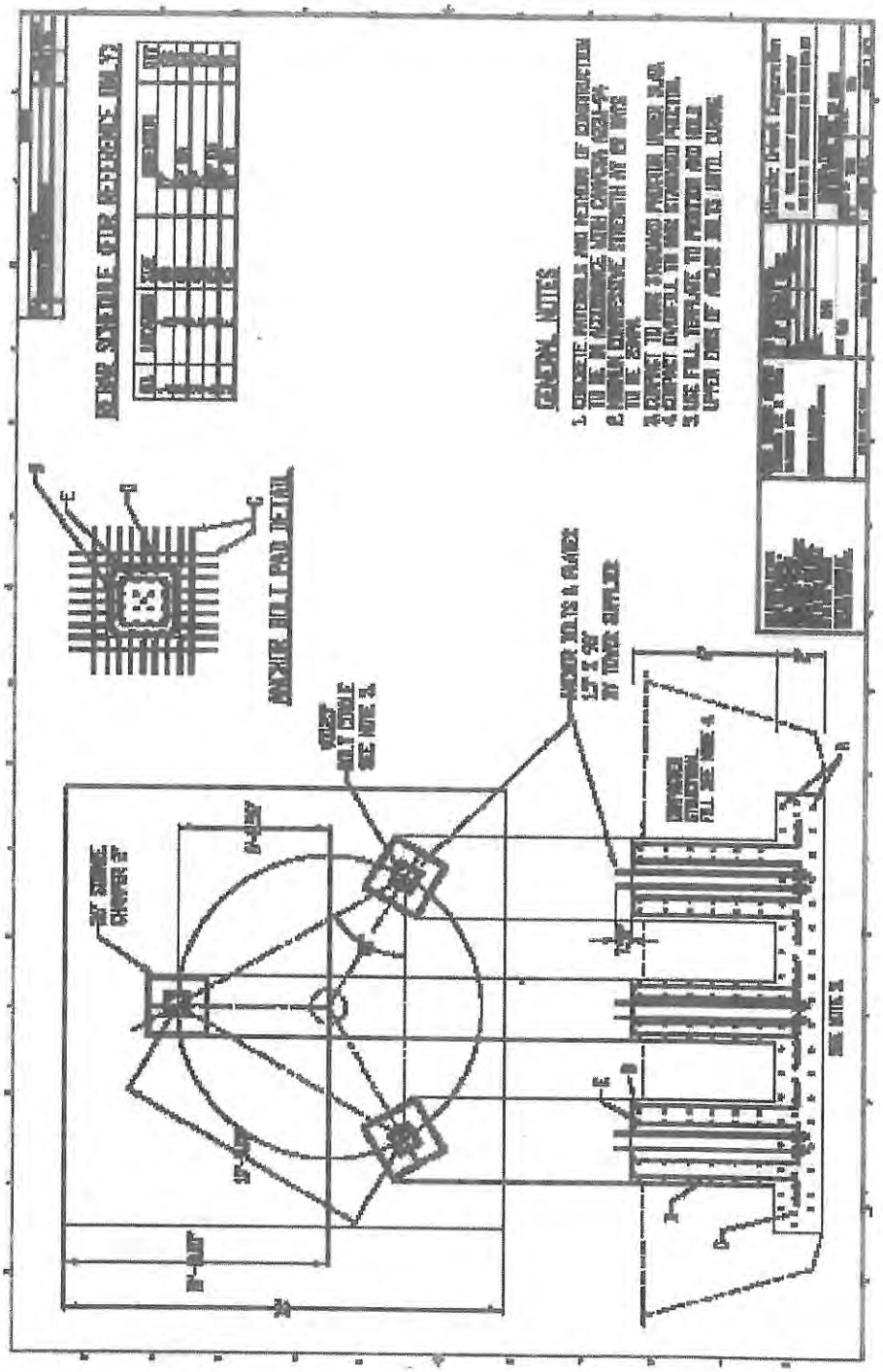
Item I

EW15 WTG Foundation Specifications

Pedestal Style, Standard Tower, Normal Soil

80 ft (24.4 m)



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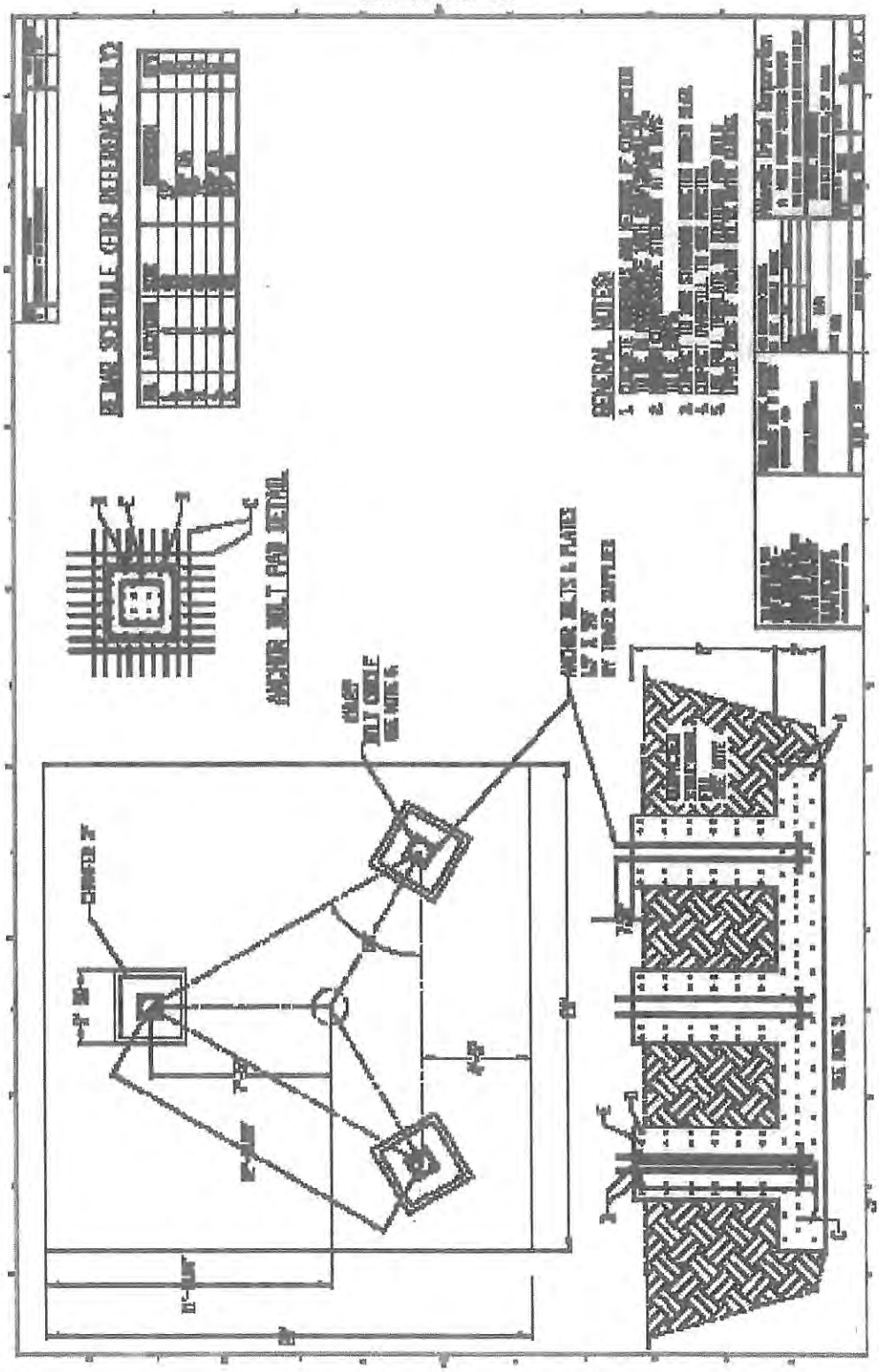
EW15 WTG Foundation Specifications

Pedestal Style, Standard Tower, Normal Soil

100 ft (30 m)



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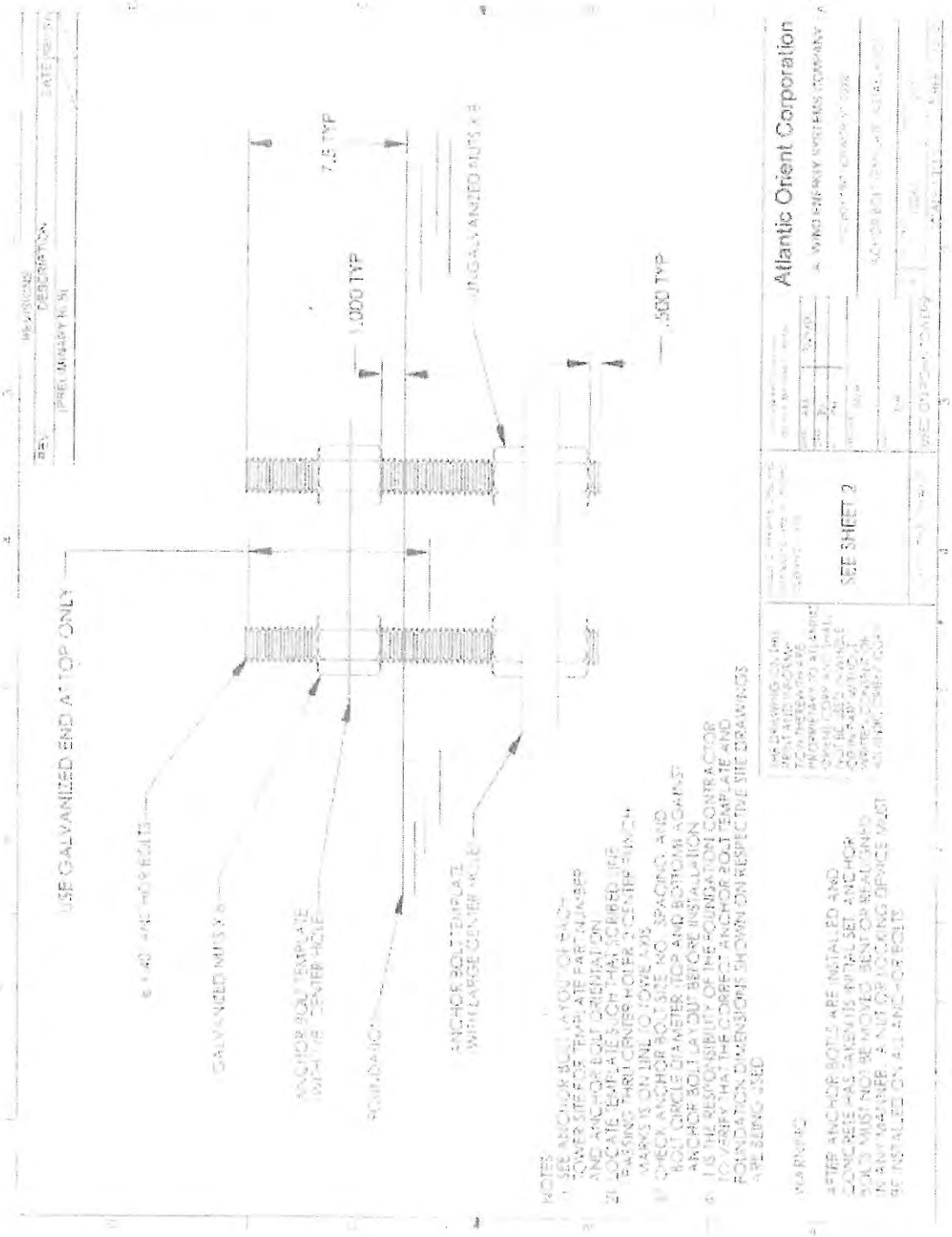
EW15 WTG Anchor Bolt Specifications
Standard Tower

Item J



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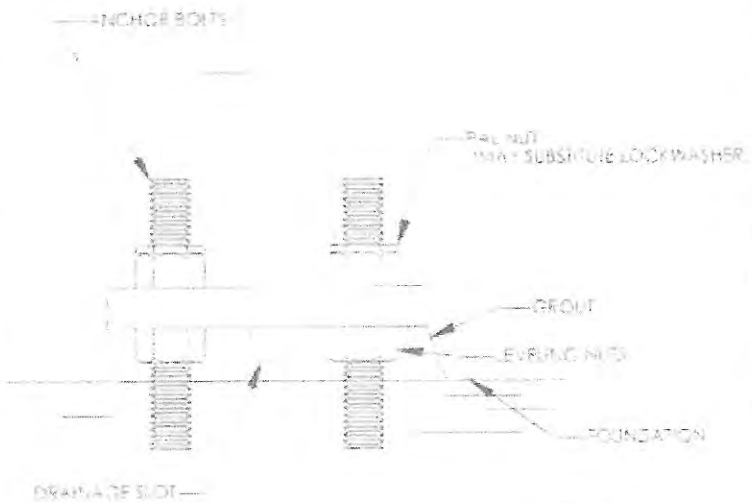
REVISIONS		
REV	DESCRIPTION	DATE APPR'D
	PRELIMINARY RLS	



TOWER FOUNDATION
GROUT DETAIL

FOUNDATION AND ANCHOR TOLERANCES

FOUNDATIONS

1)	CONCRETE DIMENSIONS	± 1"
2)	DEPTH OF FOUNDATION	+3 / -0
3)	DRILLED FOUNDATIONS OUT OF PLUM	1.0 DEG
4)	REINFORCING STEEL PLACEMENT	PER A.C. 301
5)	PROJECTION OF EMBEDMENT	± 1/8"
6)	VERTICAL EMBEDMENT OUT OF PLUM	1/2 DEG

ANCHOR BOLTS

7)	MAXIMUM DISTANCE FROM CENTERLINE OF ANCHOR BOLTS TO CENTERLINE OF FOUNDATION	1/24 OF PIER DIAMETER UP TO A MAX OF 2"
8)	ANCHOR BOLT SPACING	1/16"
9)	ANCHOR BOLT CIRCLE ORIENTATION	1/4 DEG
10)	ANCHOR BOLT CIRCLE DIAMETER	± 1/16"

SELF SUPPORTING TOWER

11)	FACE SPREAD DIMENSION CENTER TO CENTER OF ANCHOR BOLT CIRCLES	± 1/16" OR 1/16" PER 20 FT OF FACE SPREAD
12)	MAXIMUM DIFFERENCE BETWEEN ANY TWO FOUNDATION ELEVATIONS	1/2"

THE DESIGN, DATA, DRAWINGS AND INFORMATION CONTAINED HEREIN ARE PROPRIETARY TO ATLANTIC ORIENT CORP. AND SHALL NOT BE USED IN ANY WAY OR MANNER WITHOUT WRITTEN CONSENT OF ATLANTIC ORIENT CORP.

SEE SHEET 2

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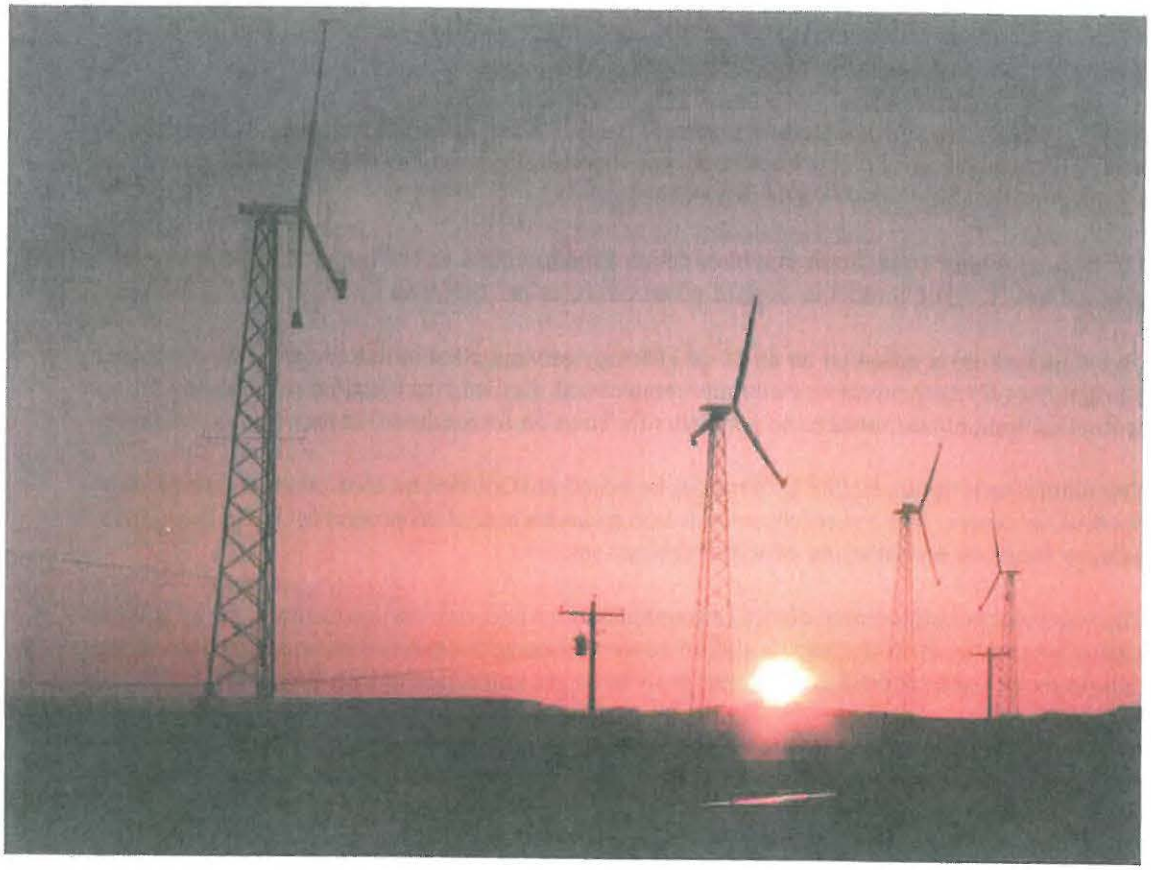
EW15 WIND TURBINE



OPERATION AND SERVICE MANUAL

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Wind Systems Inc

Revised March 2006

EW15 Wind Turbine

General Description

The EW15 is an intermediate scale wind turbine generator intended for the production of electric power when interconnected to conventional three phase electric power systems having industrial voltage ser vice at 400 – 600 VAC 50 or 60 Hz. The wind turbine is designed for rated output of 50 kW and can be operated at higher power levels under favourable conditions. The electrical generator has a rated capacity of 66kW/60 HZ (55 kW/50HZ).

The EW15 uses a three bladed stall regulated rotor that drives an induction generator through a two stage planetary gearbox. The generator is connected directly to an electric system into which it will supply electric power when driven by the wind.

The system is shut down by deployment of aerodynamic brakes on the tip of the blades and stopped by a parking brake that is applied when the rotor is slowed by the aerodynamic brakes.

The wind turbine is mounted on an 80 or 100 foot galvanized steel lattice tower. It is necessary to climb the tower for general service and maintenance. Skilled and certified persons having fall protection training are required to perform this function on a scheduled and occasional basis.

The wind turbine is controlled by a computer based control system located in an enclosure near the base of the tower. The control system also provides electrical protection to mutually prevent damage by faults on the utility or wind turbine system.

The wind turbine requires relatively little maintenance and service and is designed for a thirty year life expectance. The machine should however be regularly serviced and inspected to ensure that minor events and conditions do not grow to larger and more serious problems.

The information and instructions that follow in this document are intended to provide operators and service personnel with the information necessary to properly operate and maintain the wind turbine.

This version of the manual is provisional and has been composed to reflect many recent changes and revision. Please contact EWSI to report and comment on discrepancies and errors you may find so we may make improvements.

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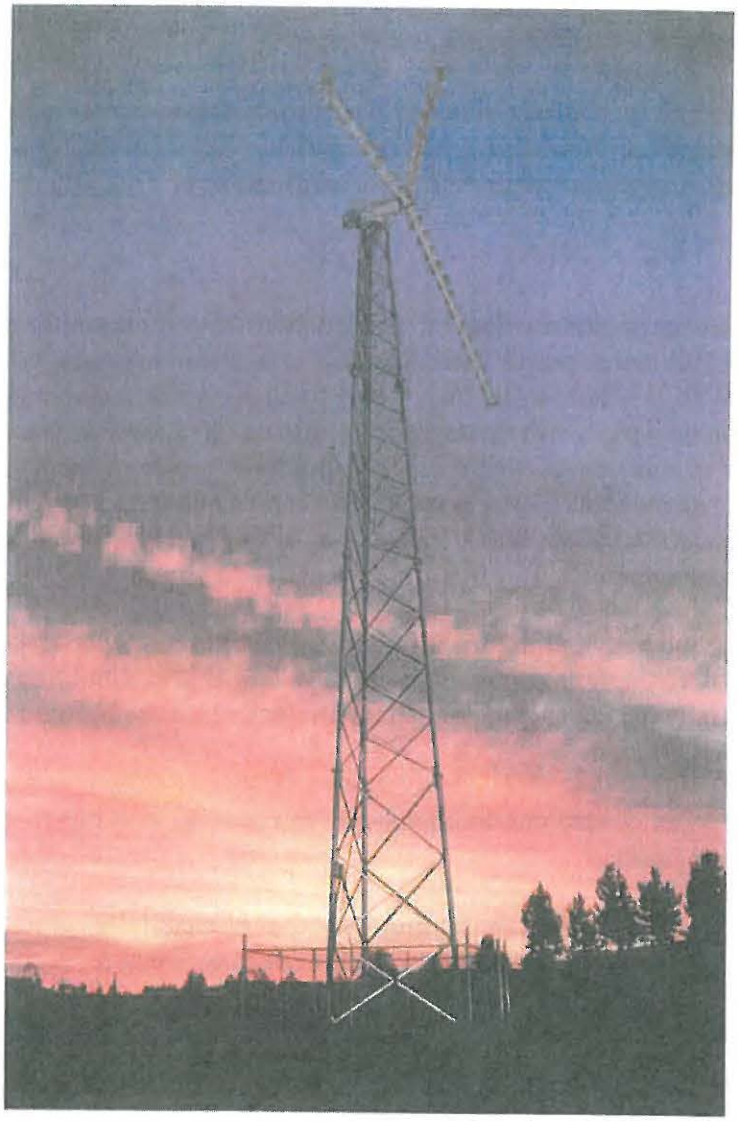
EW15 Wind Turbine



EW15 Operational Strategy

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Wind Systems Inc

Revised March 2006

OPERATIONAL STRATEGY:

The EW15 uses a relatively simple operational strategy to convert the kinetic power or energy of the wind to useful electrical power and energy.

A few basic principals and facts of physics and electrical theory must be understood by the reader to fully grasp the information being described in the following description of the method of operation and control of the EW15 wind Turbine.

General:

The Ew15 wind turbine uses the principal if induction or asynchronous generation to enable production of electrical power while connected to a three phase electrical source. By this method the EW15 is able to utilize what is basically a simple three phase squirrel cage induction motor which, when caused to rotate at a speed higher than the synchronous speed or frequency of the grid, will produce power proportional to the difference in speed between the EW15 generator and the generators that supply the grid. The difference in speed varies from about zero (0) to eighty (80) rpm above the fixed 1800 rpm of the grid generators.

The EW15 generator requires that three phase grid voltage at the proper level be supplied by the grid and will not generate power or voltage unless this condition is met. The EW15 control system is designed specifically for the voltage level being used at the site or location of the wind turbine.

The EW15 generator under certain conditions can be operated as a motor for testing or for special operational reasons.

The frequency, voltage and related harmonics of the electricity produced are all established by the electric grid to which the wind turbine is connected.

Principal Components:

The principal components of the EW15 are:

Tower: A simple galvanized steel lattice structure to support the wind turbine at a height of 80 ft. or 100 ft. above ground. The tower incorporates a climbing safety device and ladder pegs to enable access to the tower top

Tower Top: The lower part of the wind turbine which contains a cable tension hanging apparatus to support power and control cables which extend to ground level and a circular turntable bearing which supports the main turbine components and allows the wind turbine to align passively with the wind direction such that the wind turbine blades are down wind of the tower. A device for locking the yaw action is provided under the tower top.

Drive train: The drive train is the combination of a generator, a gearbox, a parking brake, a rotor hub and three rotor blades with aerodynamic brakes at the tips.

Control System: The control system consists of a PLC (programmable logic controller or computer microprocessor) which allows automatic operation and electrical and mechanical protection of the wind turbine. The controller provides for human control and adjustment of the wind turbine operating condition and operational parameters. It is intended for use by technically trained and knowledgeable persons. The wind turbine and control systems are designed fail safe to avoid possible damage to the wind turbine by accident, failure of a component or improper use.

Drive Train Components:

Rotor Blades: The rotor blades are specially designed and shaped fiberglass composite structures which efficiently capture the energy of the wind to drive the low speed shaft of the gearbox. The blades and drive train are designed to operate at nearly constant speed and to passively regulate the maximum power which may be produced over the 5m/s - 25 m/s rated wind speed range for the wind turbine. The blades are designed to stall aerodynamically at higher wind speeds to limit power and rotor speed.

The blades produce very little torque when not rotating at operational speed but do provide sufficient torque to cause initial rotation to begin operation from the stopped condition and to accelerate the wind turbine to operational speed.

The range of rotational speed of the blades is from 63 to 65 rpm.

Gearbox: The EW15 gearbox is a two stage planetary gearbox with a ratio of 28.5, which increases the rotation of the driven shaft to drive the generator. The generator speed ranges from 1800 to about 1875 rpm. At about 1850 rpm the generator will develop about 66kW of electrical power which is injected into the electric grid.

Generator: The generator is a three phase squirrel cage induction motor (generator) which is driven directly by the gearbox. The generator is connected by three wires that run down the tower to an electrical junction box at the bottom of the tower and then to the control system.

Braking system: The EW15 braking system consists of aerodynamic brakes at the tip of the blades and a disc brake on the rear end of the generator shaft.

Tip Brakes: The tip brakes are aerodynamic drag panels at the tip of each blade, which are controlled by the control system. When held closed by an electromagnet they are in operating position and present very little braking effort to rotation of the blades. When released by the control system to shut the machine down the tip brakes present a higher aerodynamic force than can be produced by the blades and will cause the rotor to slow. The generator is always disconnected from the grid before the tip brakes are released or deployed. The tip brakes are returned by a spring to the closed position when the rotor is parked. Low voltage electric power to energize the tip brake holding electro-magnets is supplied through slip rings located between the gearbox and rotor hub.

Parking Brake: The parking brake is a self adjusting disc brake used to hold the wind turbine in the parked or stopped condition. The brake is not applied while the wind turbine is at operating speed. The brake is electrically operated and held in the braked position by a strong spring. It is released for operation by an electrical control signal from the controller. The brake is applied to park the machine only after a time delay, which allows the rotor to slow to about 12 rpm. This reduces the wear and tear on the parking brake discs.

Wind Turbine Sensors

There are several sensors, which measure parameters and operation conditions to enable control and protection of the wind turbine while parked and while operating.

Anemometers: Two anemometers located on the tower just below the rotor blades are used to measure the operating wind speed. The wind speed values are used to provide a wind sped indication to the controller and to cause release of the parking brake and holding of the tip brake which will enable possible start up of the wind turbine. There are two anemometers. The highest measured value from the anemometers is chosen by the control system for control. This eliminates the effect of one anemometer being behind the tower and the circumstance where one anemometer may be out of service because of damage. The failure of one anemometer, or a higher than usual difference in indication will cause an alarm to be set but not a shut down or failure to operate.

Rotor Speed Sensors: Two RPM sensors are located on the generator shaft. One is calibrated to measure from zero (0) to 2000 RPM and the other from 1700 to 2000 RPM. The 0 – 2000 RPM is used for coarse speed indication and the 1700 – 2000 RPM is used for actual control of the wind turbine. The reason for two sensors is also to provide protection against failure of one sensor and possible erroneous speed indication. The speed sensors and RPM value is the most important variable and parameter for control of the wind turbine.

Failure of a speed sensor will prevent operation of the wind turbine.

Grid Monitor: A grid voltage and phase sensing relay is installed in the controller to sense improper grid conditions and prevent operation of the wind turbine if grid conditions are not proper.

Parking Brake Current Sensor: A current sensing device is installed in the controller that measures current to the parking brake. If the indication is that the current is not present the wind turbine will not operate.

Normal Operation: The normal operation sequence for the wind turbine is as follows:

This description assumes that the wind turbine is parked in low winds and no faults are present which will prevent the wind turbine from operating.

If faults are present they can be cleared by reset from the STATUS screen. If they cannot be cleared repairs are necessary by a trained and skilled service person.

1. When the wind speed increases above the CUT-IN setting the parking brake and tip brakes will be actuated to allow rotation of the wind turbine rotor under the influence of the wind. The wind turbine will begin to rotate and accelerate up to operating speed. The acceleration time will depend on actual wind speed and temperature. Cold temperatures slow acceleration. Very cold temperatures may prevent acceleration. In this condition there is a Forced Start option that will force start the wind turbine.
2. When the generator reaches 1800 RPM the wind turbine will connect to the grid and generate.
3. If the generator speed falls below the low generator speed set point because of low wind speed the wind turbine will shut down or coast depending on whether the COAST function has been selected.
4. If the wind turbine is in COAST mode and the wind speed falls below the low wind speed cut out the brakes will be applied and the wind turbine will shut down.
5. If the generator speed increases above the set points for over-power or over-speed, the wind turbine will shut down. The wind turbine will automatically restart after these faults.
6. If the generator speed increase above the emergency generator speed the wind turbine will shut down and not restart unless manually reset. This is to prevent possible serious conditions that might cause damage if operated. A trained and skilled person should investigate the cause of the over-speed.
7. If any fault of the grid, parking brake or speed sensors is detected the wind turbine will shut down.

Users of this manual will find that not all possible combinations of possible events, reactions and faults of the wind turbine when operating have been anticipated or described. Careful study of the Operators Instruction and Maintenance and Inspection Sections of this manual will help in diagnoses of problems.

EW15 Wind Turbine

Maintenance and Inspection Instructions

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Wind Systems Inc

Revised March 2006

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Waiver of Liability

Entegrity Wind Systems Inc. (EWSI) provides these instructions for use by trained and experienced workers to assist their efforts to ensure the proper operation, inspection and maintenance of the EW15 Wind Turbine. EWSI assumes no responsibility or liability for injury, damage or any loss that may occur as the result of or during the execution of this work by any others.

It is assumed that the persons using these instructions have been trained by EWSI in the operation of the wind turbine.

1. Inspection Instructions

Cautions

All personnel performing this work should be trained in the use, operation and maintenance of all technical equipment, tools, components and other systems associated with the operation and maintenance of the EW15 wind turbine.

a. Ensure that proper fall safety and tower climbing safety procedures, equipment and practice is used at all times.

b. Inspect all safety equipment before climbing.

c. Use a tool bucket and hoisting rope or cable for heavy tools.

e. All climbers must be certified and trained for elevated work and rescue.

f. Use radios for communications to ground and controls.

g. Ensure yaw lock is applied while working above yaw bearing or on the wind turbine blades.

h. Ensure mains power is OFF while working above the yaw bearing and when in proximity of rotor blades. Remove control wire from main contactor while inspecting and testing tip brakes and parking brake.

i. Contact the manufacturer, agent or other trained and experienced persons for advice if unsure of proper operational information, methods, test methods or trouble shooting of the equipment.

1.1 Semi Annual and Post Commissioning

Operate wind turbine in test mode and in normal operation to confirm proper operation per operators' instructions. Special attention is to be given to operation and return of tip and parking brakes.

Maintain log of findings, conditions and action taken. See Maintenance and Inspection Summary Log at the end of this section.

Instructions

a. Rotor

___ Remove slip ring cover.
___ Inspect slip rings and brushes for wear, contamination and proper operation.
___ Inspect low speed shaft seal for oil leaks.

See Bolt and Torque Specifications attached.

___ Check torque of inside ringfedder bolts to specification (90 ft-lbs) use 10mm key.
___ Mark shaft and hub with permanent marker to create index mark for future inspection.
___ Check blade bolt torques to specification (235 ft-lbs).

b. Generator

___ Ensure all power to the machine is OFF

___ Remove the generator junction box cover and inspect all wire terminations for proper tightness and signs of damage from heat or corrosion.

c. Gearbox

___ Inspect oil level to mid point of sight glass.
___ Draw a 1 oz. sample of oil and inspect for contamination and color.
___ Send sample to EWSI for analysis.
___ Inspect power and control cables for proper support and damage. Adjust and repair/replace as necessary.
___ Inspect accumulation of twists on power and control cables down tower and unwind as necessary. No more than twenty twists should be allowed.

d. Parking Brake

___ Pull manual release handle and ensure easy rotation of the rotor.
___ Push handle back in locked position.

1.2. 6 Months Post Commissioning and Every Two Years

Perform the following at 6 months after commissioning and then each two years or when the parking brake is suspected to be malfunctioning.
Remove brake cover and inspect for graphite dust from wear.
Inspect brake worn indication and record position

a. Tip Brakes

___ Place wind turbine in test mode and select tip brake test mode.
___ Test holding power of tip brakes to specification (65 lbs on trailing edge to force open.
___ Release from test and confirm smooth open and close action.
___ Inspect securing hardware for tightness and integrity.
___ Inspect plate for bending or other damage.
___ Inspect rubber bumper.
___ Inspect blade and leading edge tape for damage.
___ Confirm proper operation during normal shutdown and return to closed position.

b. Tower

___ Inspect tower braces and flange fasteners for tightness of pal nuts and torque as necessary (150 ft-lbs and 250 ft-lbs respectfully).
___ Inspect tower top bolts and torque as necessary (600 ft lbs)
___ Inspect the anemometer boom, wiring and anemometers for proper security and operation.
___ Inspect all fastenings for completeness and torques per specifications.
___ Open and inspect the tower junction box and ensure that all wiring, fittings and weather seal are proper.

c. Controller

___ Confirm proper operation of all control and monitoring functions.
___ Confirm wind speed indications from both anemometer
___ Confirm rotor speed indications from both speed sensors during test operation
___ Confirm kW indications during normal operation.

e. Display

___ Open each menu item and confirm proper indication
___ Enter parameter mode confirm all parameter setting to log book values.
___ Enter test mode and confirm action of tip brake and parking brake test functions
___ Enter full test (hand) mode and confirm operation of rotor jog.
___ Switch quickly from jog to On to confirm proper operation.

2. Log Book

You should record observations made during inspection and testing in a log book. The Summary Maintenance and Inspection Log Sheet following provides a means of recording observations and actions taken. Please FAX or E-mail a completed copy to EWSI if you wish us to maintain a record as well

3. Maintenance

This work should be performed only during periods and conditions where performance of the work can be executed safely. Avoid working in winds higher than 5.0 m/s or during very cold and wet weather.

a. Yaw Lock and Bearing

___ Apply general purpose heavy duty waterproof grease to the yaw lock device until grease is extruded from beneath. Remove excess grease. Engage and disengage the yaw lock several times to ensure smooth operation.
___ Apply general purpose heavy duty waterproof grease to the yaw bearing at lubrication points until grease is extruded from beneath. Remove excess grease. Manually rotate the yaw bearing several times through 360 degrees applying a little grease with each turn. Ensure free rotation and remove all signs of excess grease.

b. Drive Train

___ Add oil as specified if not visible on sight glass.

c. Brake

Follow brake manufacturers instruction to perform this work

___ Replace brake pads when wear indicator is below 20% indication.
___ Follow brake instruction to reset wear indicator and adjust spring.
___ Ensure proper operation of rotor speed sensors following reassembly.

e. Tip Brakes

A suitable platform is required to enable easy replacement or adjustment of tip brakes. Consult EWSI for advice and direction on alternatives for accessing tip brakes. Refer to drawings provided for removal and replacement of parts.

___ Remove the tip brakes by removing the fastening nuts and disconnect. If tip brakes are to be removed, do so only one at a time to prevent difficulty in rotating rotor due to unbalanced gravity loads during reinstallation.

f. Controller

___ Inspect power connections for corrosion or heat damage and ensure all cable fittings are tight.

___ For controllers located outside inspect the controller enclosure for evidence of leakage or damage from the elements or other sources. Repair as necessary.

___ Visually inspect all components for signs of damage. Repair as necessary.

EW15 Wind Turbine: Summary Maintenance and Inspection Log Sheet

Location: _____ DATE: _____
dd/mm/yy

Reported By: _____

Phone No.: _____ FAX: _____

Please repot Action taken, Observations and Comments for each section. Attach additional sheets if necessary:

INSPECTION	ACTION	OBSERVATIONS COMMENTS
Rotor		
Generator		
Gearbox		
Parking Brake		
Tip Brakes		
Tower		
Controller		
Display		
MAINTENANCE		
Yaw Lock and Bearing		
Drive Train		
Parking Brake		
Tip Brakes		
Controller		
Other		

LIFTING INSTURCTIONS

COMBINED TURBINE-TOWER ASSEMBLY

The following is the recommended procedure for assembly of the tower and turbine prior to erection of the combined tower and turbine components.

The following tools are required:

1. Socket Wrenches, 3/8" 1/2" and 3/4" drive up to 2"
2. Torque Wrenches, 250 ft-lbs and 600 ft-lbs
3. 5/8 and 1" drift pin
4. 2 ton cable puller or chain fall
5. Various hand tools

Procedure:

1. Raise the tower onto secure blocking placed 16-20 feet from the tower top until the flanges of the tower top are about 9 feet above the ground. Ensure blocking is stable in all directions.
2. Carefully lift the wind turbine drive train using fabric slings. Once the drive-train is suspended, fully disengage the yaw locking pin allowing the tower top to be rotated. It is also necessary to orient the wind turbine horizontal with the generator junction box upwards. Use a cable puller or "come-along" attached to the centre gearbox lifting eye and lifting hook to adjust orientation to allow easy fit up to the tower top. Do not use the lifting eyes on the drive-train for main lifting. See diagram 1.

Diagram 1.COMBINED TURBINE-TOWER ASSEMBLY CONT'D

3. Route the blade cables through the tower to the base. See diagram 2.

Diagram 2.

4. Install the drive-train to the tower top. The nuts are to be downward. Leave loose until all are in place. The use of a lining bar may be required to enable bolt insertion.

Diagram 3.

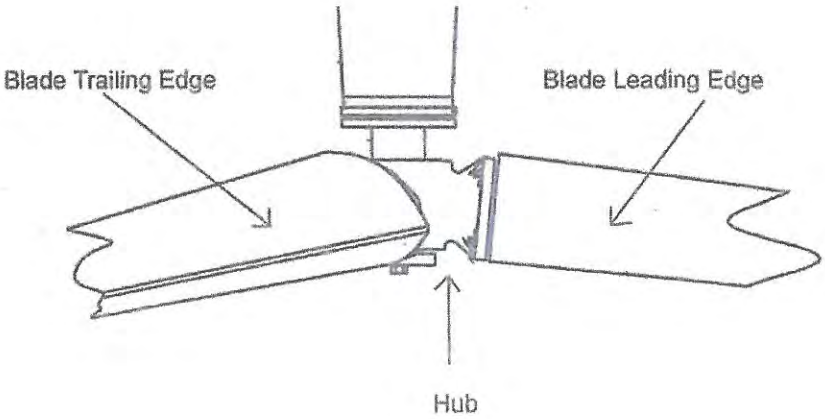
5. Torque the nuts to 600ft/lbs. it may be necessary to remove some brace bolts to allow fit of the torque wrench socket depending on the type.
6. Engage the yaw lock securely. Then release the come along and sling tension gradually and test security and stability of the complete tower/drive-train assembly on the blocking. Adjust as necessary.
7. Release the yaw lock and rotate the drive-train so that the hub is downward. Relock the yaw.
8. Complete the installation of anemometer see Diagram 4.

Diagram 4.

9. Remove the blades from the shipping crate and attach to the hub with the bolts and washers provided. Support the blade until the bolts are securely tightened. Ensure that the holes in the blade inserts are clean. Apply a 1"x 1/4" strip of Medium Strength thread locking compound to each bolt on insertion. Leave bolts loose but with oval washers fully seated in hub slots until blade pitching is complete. Ensure no bolts are cross threaded upon insertion. See Diagram 5.

Diagram 5.

10. Pitch (rotate) each blade clockwise, looking at the tip, about its long axis such that the washers are as fully rotated as possible to one end of the hub slots. In other words: Push with the bolts slightly loose so that the trailing edge of the blade is pushed down towards the ground until the pitching washers rest against the side of their slots Tighten the bolts fully snug with a ½ drive 15/16 socket. Install all three blades in this fashion before torquing the bolts.



11. Using a calibrated torque wrench tighten the bolts in sequence beginning with the uppermost bolt. Label this bolt #1. Then torque in sequence as shown below to 180ft/lbs and then to 240ft/lbs. See Diagram 6

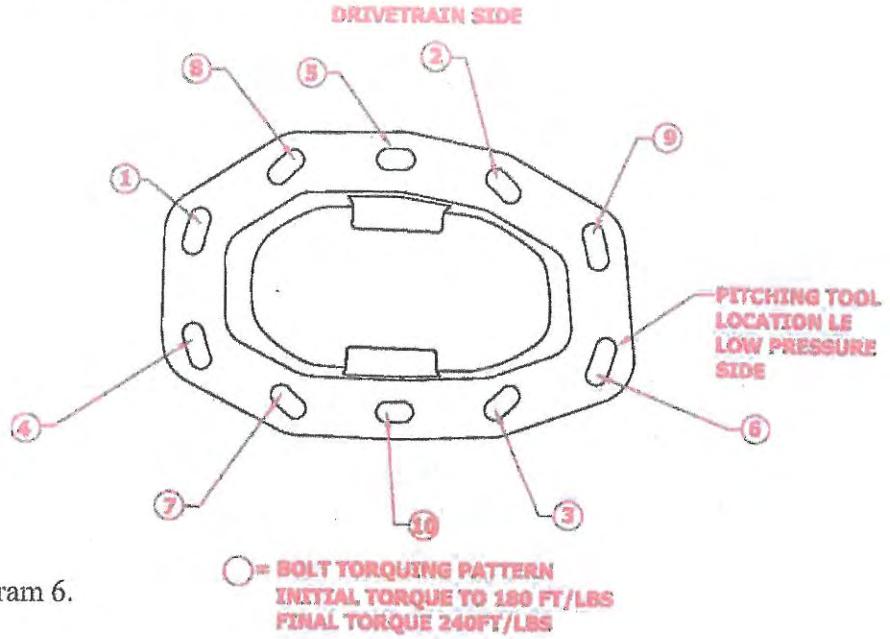


Diagram 6.

12. Install tip brake plates to each blade end. Connect the tip brake wires at the hub and place cable ties to eliminate any long loops in cable. See Diagram 7. for an example of a properly installed plate.

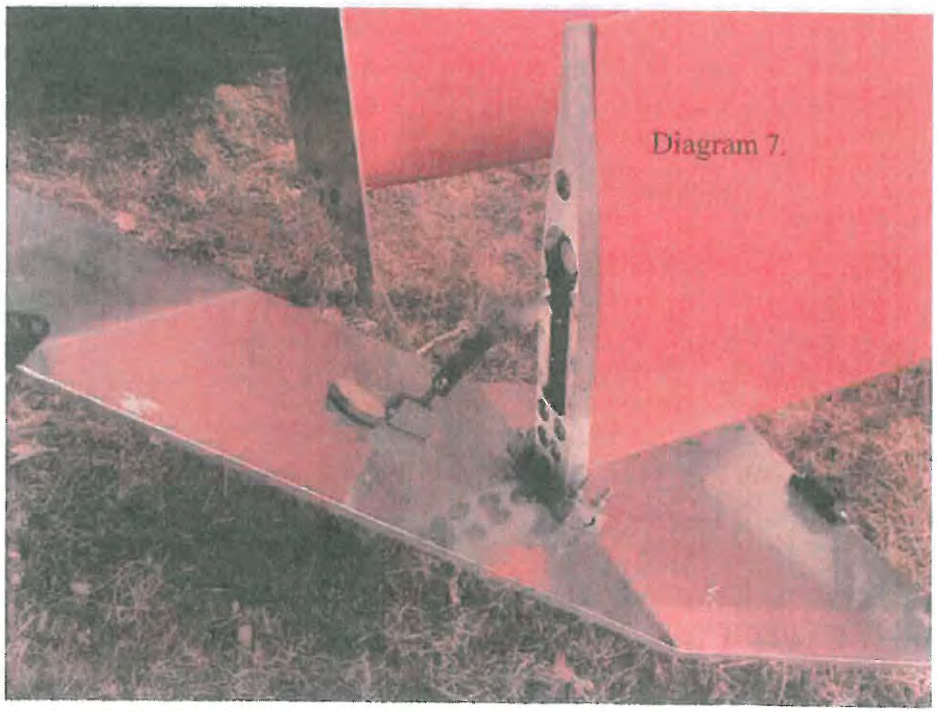


Diagram 7.

13. Consult with the crane operator to determine the best method of lifting the turbine using the crane onsite. Below is the most popular method used for lifting the complete tower and turbine assembly. It is also advisable to have a consultation with the crane company at the time of booking the service in order to prevent delays onsite on the day of lift. See Diagrams 8, 9 & 10.

Diagram 8.

RECOMMENDED SLING POSITIONS DURING LIFT. NOTE SMALL SLING IS USED AS A CHOKER TO BRING TWO MAIN SLINGS TOWARDS CENTER OF TOWER.

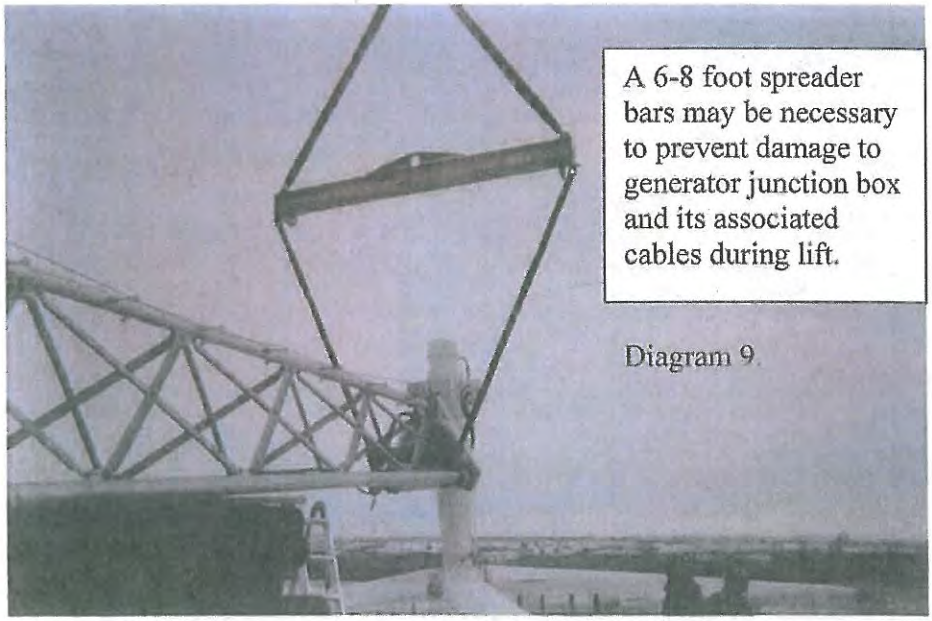


Diagram 9.

READY FOR LIFT

Diagram 10.

LIFT CONTINUING Diagram 11.

14. Place one install team member at each foundation anchor bolt location to guide the lifted tower onto the leveled anchor bolt bottom. Minor adjustments to tower leg or bolt orientation may be necessary o make holes in tower flanges fit over bolts. See Diagrams 12. & 13.

Diagram 12.

Diagram 13.

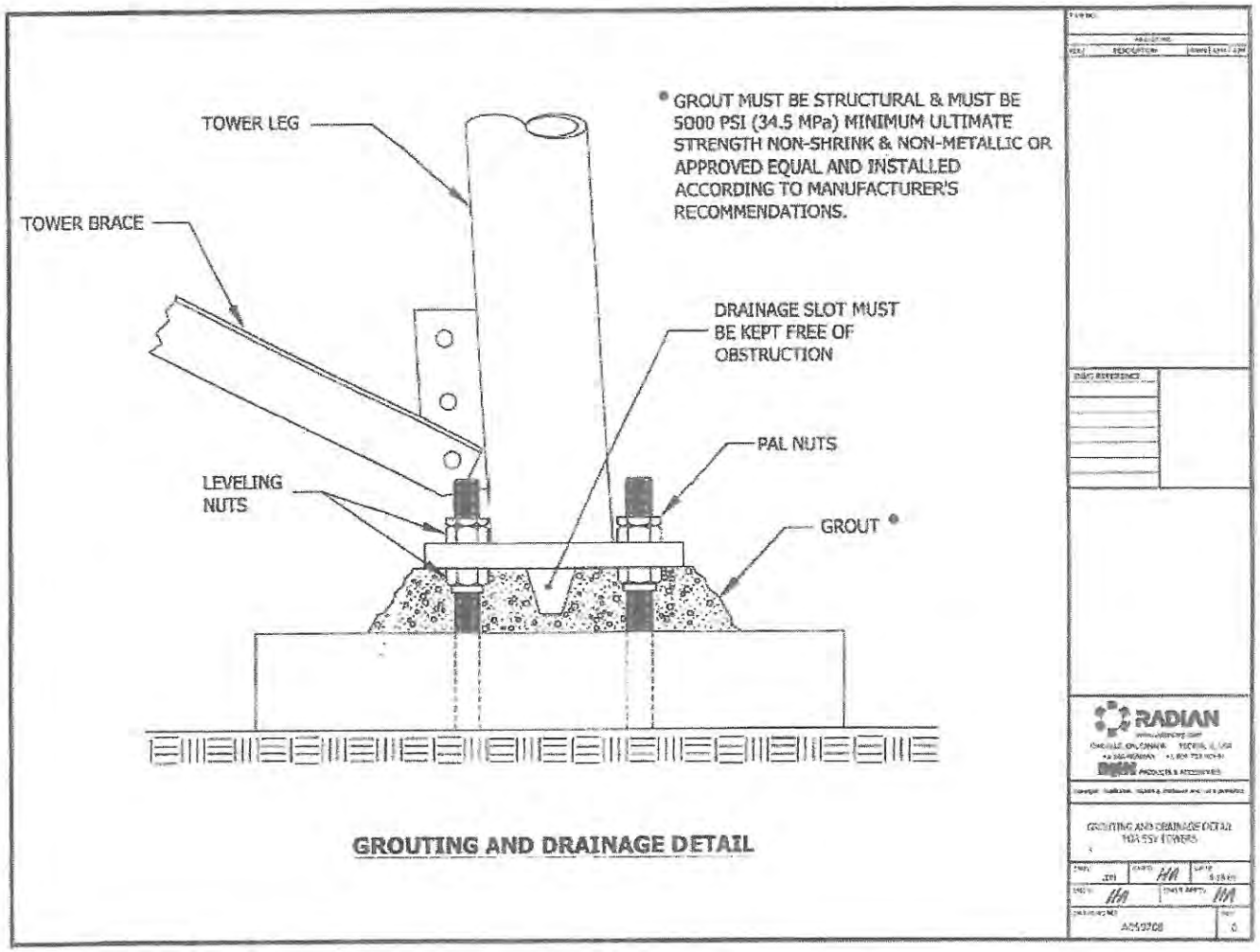
15. Once all tower legs oriented properly over anchor bolts and secured with nuts and washers provided. Tighten any bolts on legs and cross braces that were loosened in order to make tower fit anchor bolts properly. Climb tower to release crane sling from top of tower.

COMPLETED LIFT

Diagram 14.

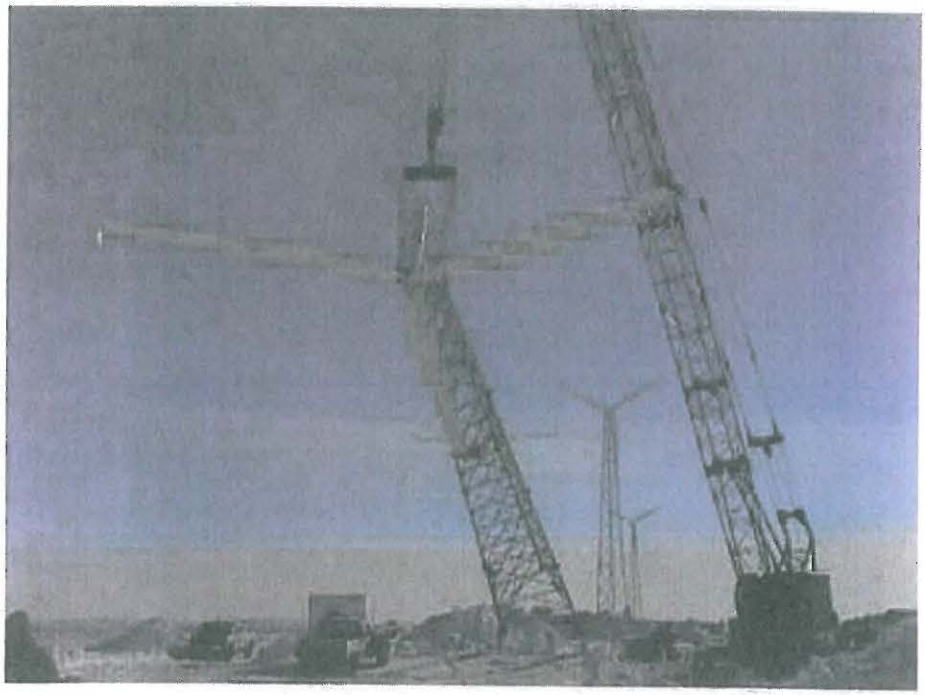
16. Grout the base of the tower legs using the grouting specifications and instructions on the drawing shown as Diagram 15. Failure to grout the tower as specified can lead to structural fatigue of tower components. See Diagram 16 for an example of a properly completed grouting of a tower base.

Diagram 15

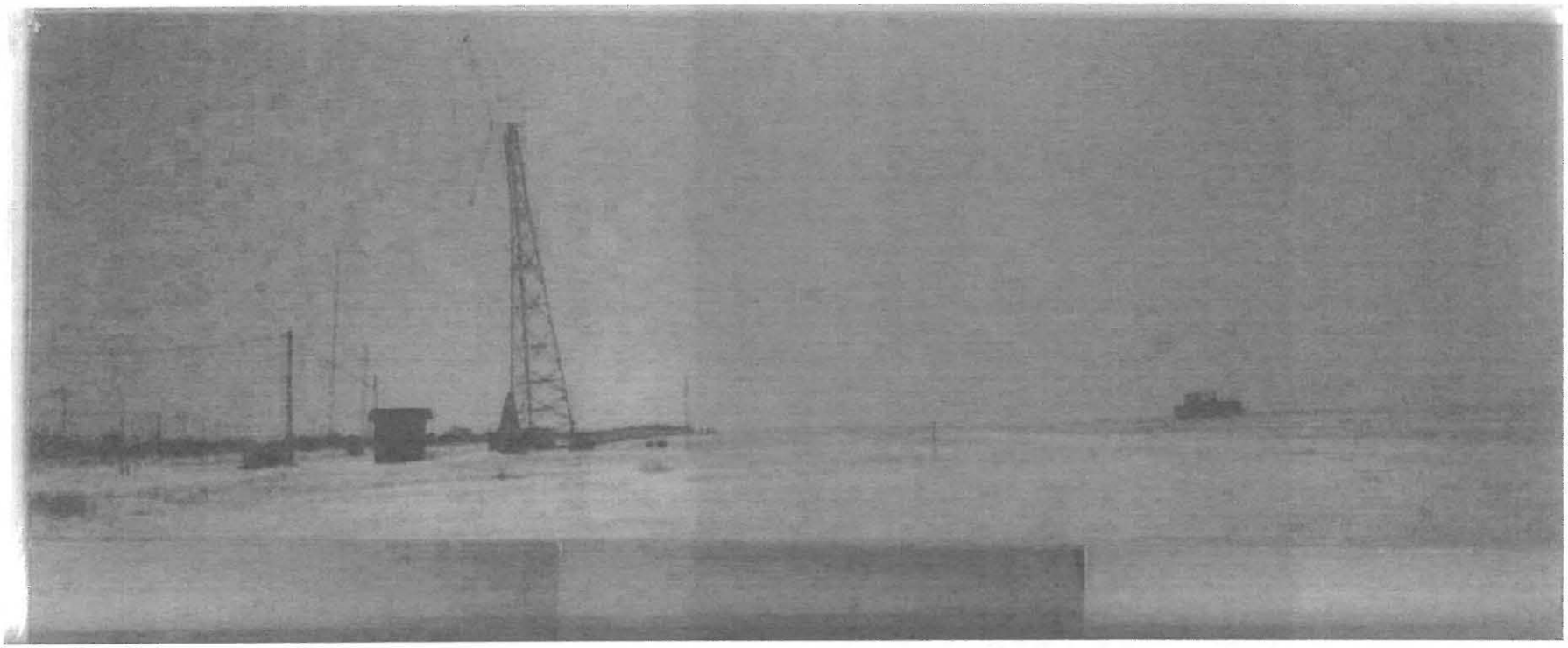


ENTEGRITY WIND TURBINE EW15

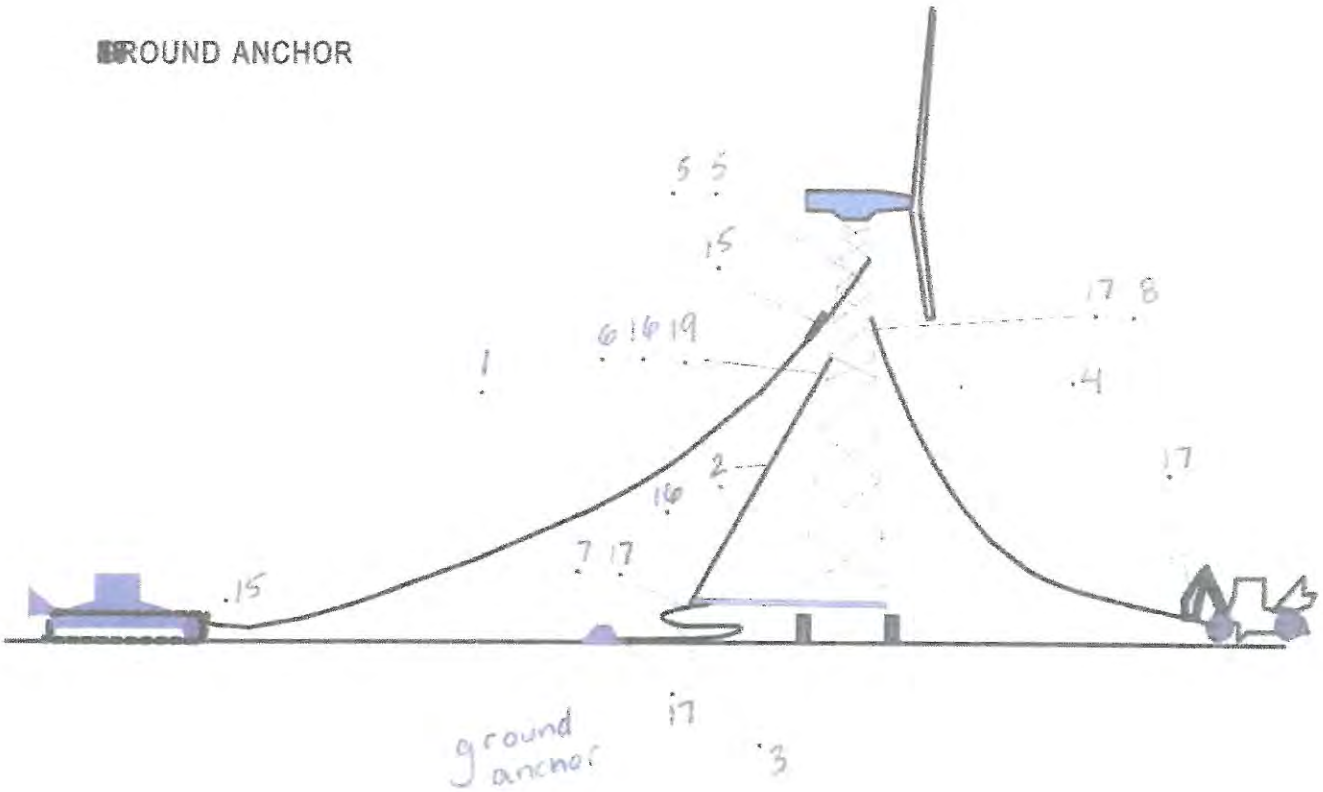
TILT-UP TOWER ADDITIONAL INFORMATION



Raising Kotzebue Wind Turbine



GROUND ANCHOR



Bob,

Following is the list of material and equipment necessary for lowerering and re-erection the machine. I think some of the equipment we used to erect the machine was obtained from the job tool box that the contractor provided so we may have to obtain some replacements.

Wire Cables(Purpose, diameter x length, load, location)
1. Main lifting fixed, 1" x 200', 20,000lb, from tower 70ft. level (lower legs) over gin pole to bulldozer
2. Gin pole support #1, 5/8" x 75ft, 10,000lb, from tower 60ft level (climbing leg) to gin pole end
3. Gin pole safety #2, 3/8" x 120ft, 2000lb, from gin pole end to ground anchor
4. Tower hold back, 3/8" x 200ft, 2000lb, from tower top to backhoe.

Wire or Nylon Slings with loops(purpose, diameter x length, load, quantity)
5. Main lifting, 5/8" x 20ft, 10,000lb, 2.
6 Gin pole support, 5/8" x 6ft, 5,000lb, 1.
7. Gin pole safety, 1/2" x 6ft, 2000lb, 1.
8. Tower hold back, 3/8"x 6ft, 2000lb, 1
9. Wind turbine assembly, 1/2" x 12ft, 6,000lb, 2.
10. Wind turbine assembly, 1/2" x 6ft 6,000lb, 2.

Cable clips(cable diameter, quantity)
11 1", 12.
12. 5/8", 15.
13. 3/8", 12.
14 1/2", 16, for miscellaneous use.

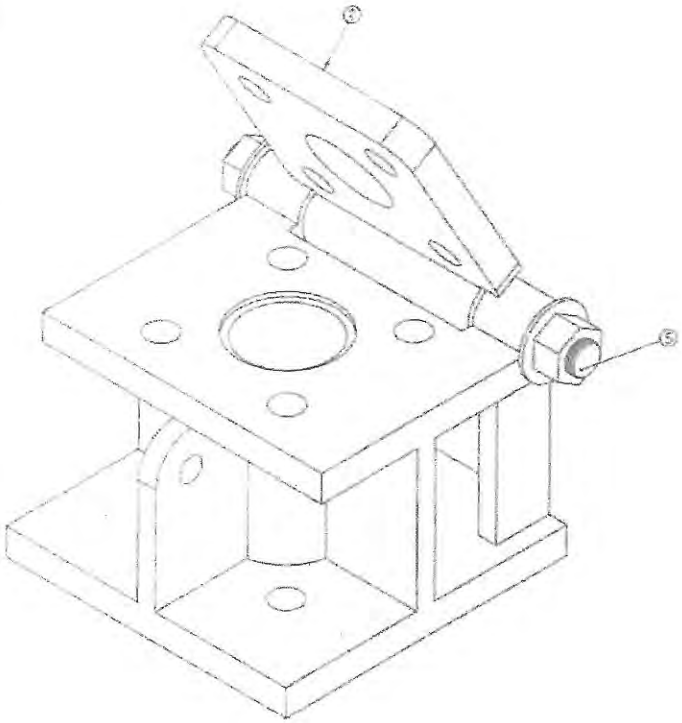
Shackles(type, pin diameter, location,quantity)
15. Screw pin, 1-3/4", main lifting cable and lower block anchor,2.
16. Screw pin, 3/4", gin pole support, 2.
17. Screw pin, 1/2", gin pole safety and tower hold back, 4.
18. Screw pin, 1/2", miscellaneous use, 4.

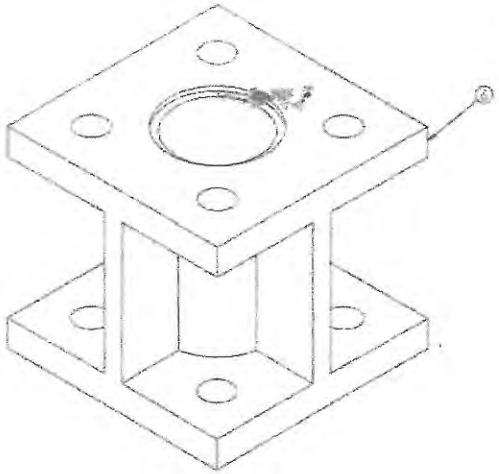
Turnbuckle(purpose, type, diameter x length, load, quantity)
19. Gin pole support, jaw & jaw, 3/4" x 24", 4,000lb, 1

Refer to the diagram next page for illustration of where the items are used.

Regards,

Kotzebue Foundation





BILL OF MATERIALS

NO.	QTY	P/N	DESCRIPTION
1	2	10604	TILT TOWER HINGED BASE
2	2	10603	TILT TOWER HINGED PLATE
3	4	10621	1 5/8 USS FLAT WASHER
4	4	10622	1 5/8-8UN HEX NUT, GRADE 2
5	2	10623	1 5/8-8UN THREADED ROD, GRADE B7
6	1	10605	TILT TOWER UNHINGED BASE

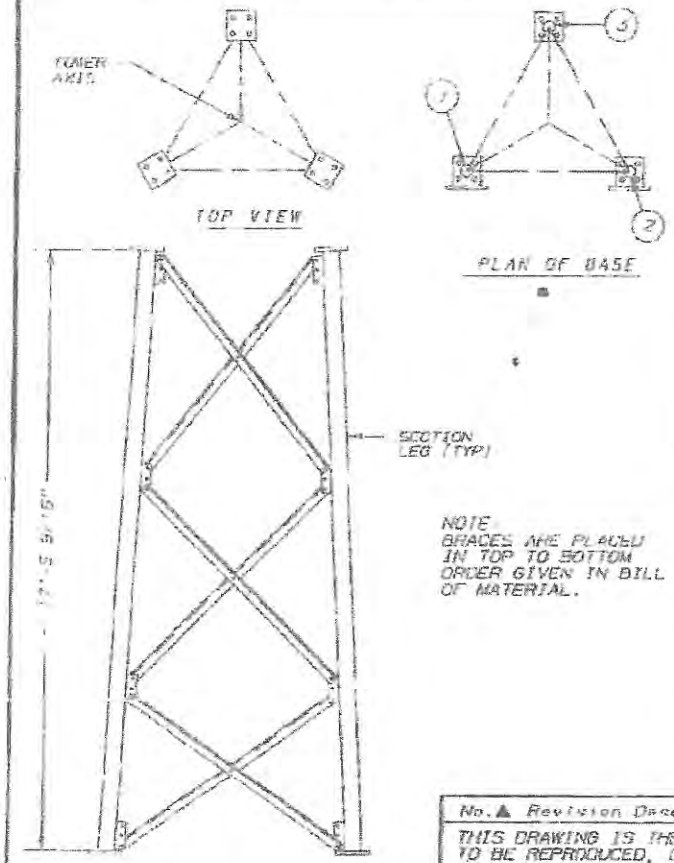
Atlantic Orient Corporation

SEE NOTES

10628-A

Rohn Tilt Bottom DWG

ATTN: MICHAEL MACINNIS FAX 902-368-7139



NOTE
BRACES ARE PLACED IN TOP TO BOTTOM ORDER GIVEN IN BILL OF MATERIAL.

BILL OF MATERIAL

ITEM	QUAN.	PART NO.	DESCRIPTION	DWG NO.
1	1	V6642	LEG 4EH PIPE	B991672
2	1	V6643	LEG 4EH PIPE	B991680
3	1	V65045	STEP LEG 4EH PIPE	B920687
4	6	X91	DIAG. BRACE (L2 X 2 .19)	SK720320
5	6	X97	DIAG. BRACE (L2 X 2 .19)	SK720320
6	6	X93	DIAG. BRACE (L2 X 2 .19)	SK720320
7	45	2100293A	BOLT ASSY (.63 X 1.50)	U770404
8	12	X40029	1" ANCO NUTS	N/A
9	16	S/BSTEP	STEP BOLTS	N/A

MISCELLANEOUS INFORMATION

FLANGE PLATE						SPREAD	
OFFSET	BEVEL	TOP SIZE	TOP P/N	BOTTOM SIZE	BOTTOM P/N	TOP	BOTTOM
N/A	3.3 STU	9.5X9.5 X1.25	95A	13.5X13.5 X1.25	*	9' 9 1/8"	10'-8 1/8"

* - P/N V6563A1L

GENERAL NOTES

1. LEG P/N IS STAMPED AT BOTTOM OF EACH LEG OF EACH SECTION
2. PAL NUTS ARE PROVIDED FOR ALL TOWER BOLTS.
3. STEP BOLTS ARE PROVIDED ON ONE LEG ONLY.
4. FLANGE BOLTS (*) GIVEN IN BILL OF MATERIAL ARE FOR FLANGE PLATES AT BOTTOM OF SECTION. IF THE SECTION IS USED AS A BASE SECTION SEE THE TOWER ASSEMBLY DRAWING OR ANCHOR BOLT LAYOUT FOR CORRECT SIZE AND QUANTITY OF ANCHOR BOLTS.
5. BEVEL FOR FLANGE PLATES IS FOR BOTTOM FLANGE PLATES ONLY UNLESS OTHERWISE NOTED.

No.	Revision Description	Date	Rev By	Ckd By	Appd By

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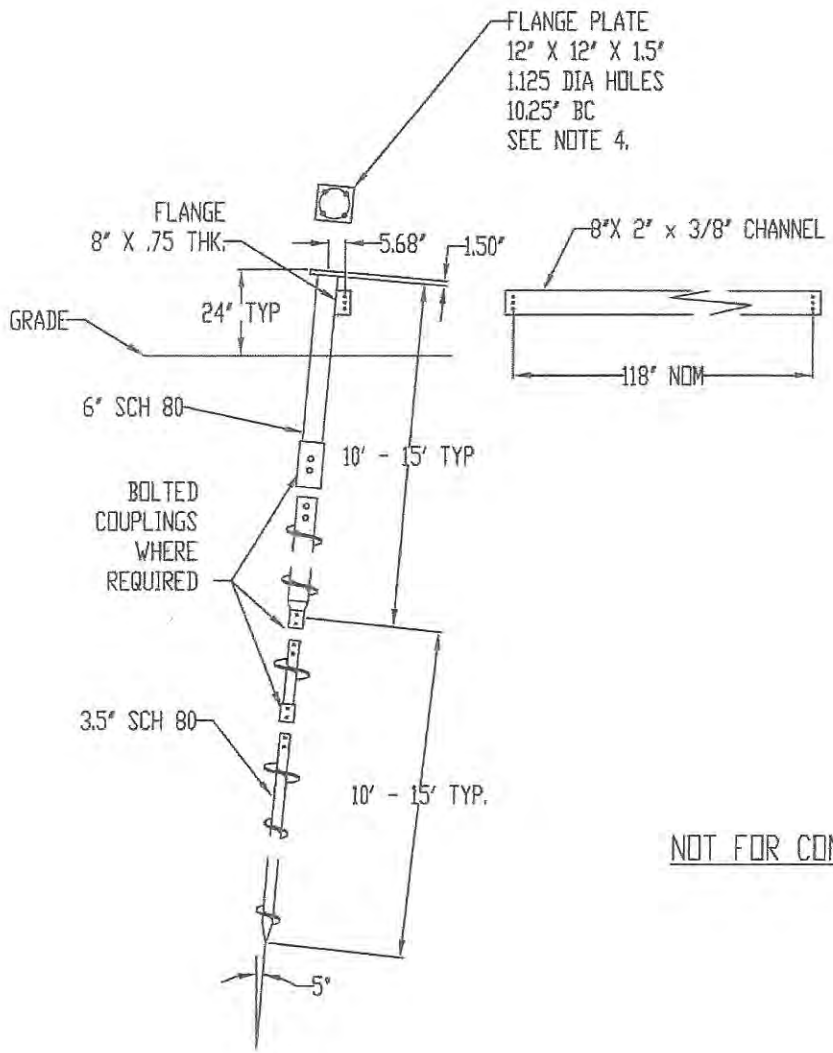
ROHN

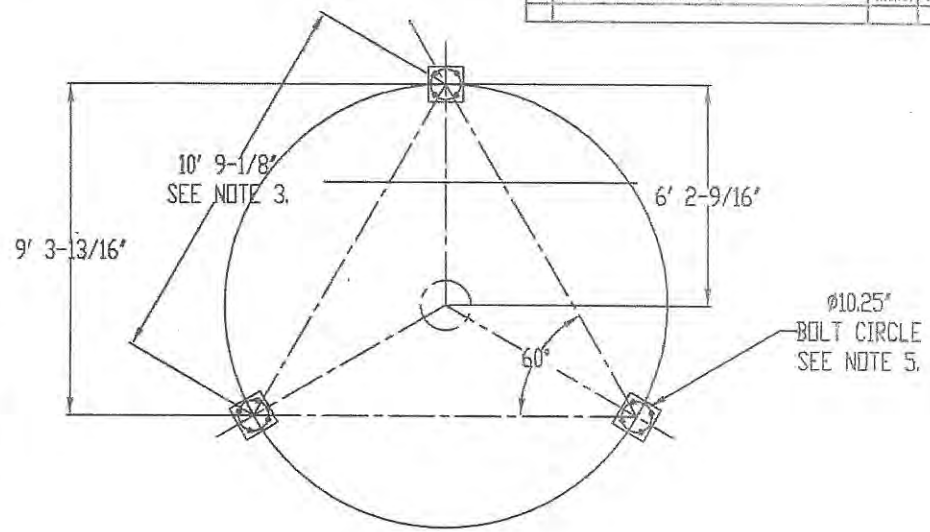
Scale: None	By	Date
Drawn:	LLK	4/28/98
Checked:	SAG	5/13/98
App. Eng.:	TB	5/15/98
App. Sales:		

Title: (SPECIAL) ASSEMBLY DETAILS FOR SSV SECTION 9N415 (BASE)

DRAWING NO.: A98131

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
0	SUBMERGED PERIMETAL FOUNDATION (AUG)	07/07/04	MAL





GENERAL NOTES

1. MATERIAL: HOT GALVANIZED WORK TO ANSI/TIA/EIA-222F
2. AUGER DIMENSIONS TO LOAD AND SOIL CONDITIONS
3. MAINTAIN TO =/- .5"
4. FLANGE WELDED AFTER PILE PLACEMENT.

NOT FOR CONSTRUCTION

THE DRAWING ON THIS PRINT AND INFORMATION THEREWITH ARE PROPRIETARY TO ENTEGRITY WIND SYSTEMS INC. AND SHALL NOT BE USED IN WHOLE OR IN PART WITHOUT WRITTEN CONSENT OF ENTEGRITY WIND SYSTEMS INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:

SEE WIND TWG & ANSI/EIA FOUNDATION AND ANCHOR TOLERANCES

DO NOT SCALE DRAWING

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

DWN MAL 03/05/05
CHKD
APVD
MATERIAL N/A
FINISH N/A

USED ON EW15

ENTEGRITY WIND SYSTEMS INC.
A WIND ENERGY SYSTEMS COMPANY
P.O. BOX 832 CHARLOTTETOWN PE CANADA C1A 7L9

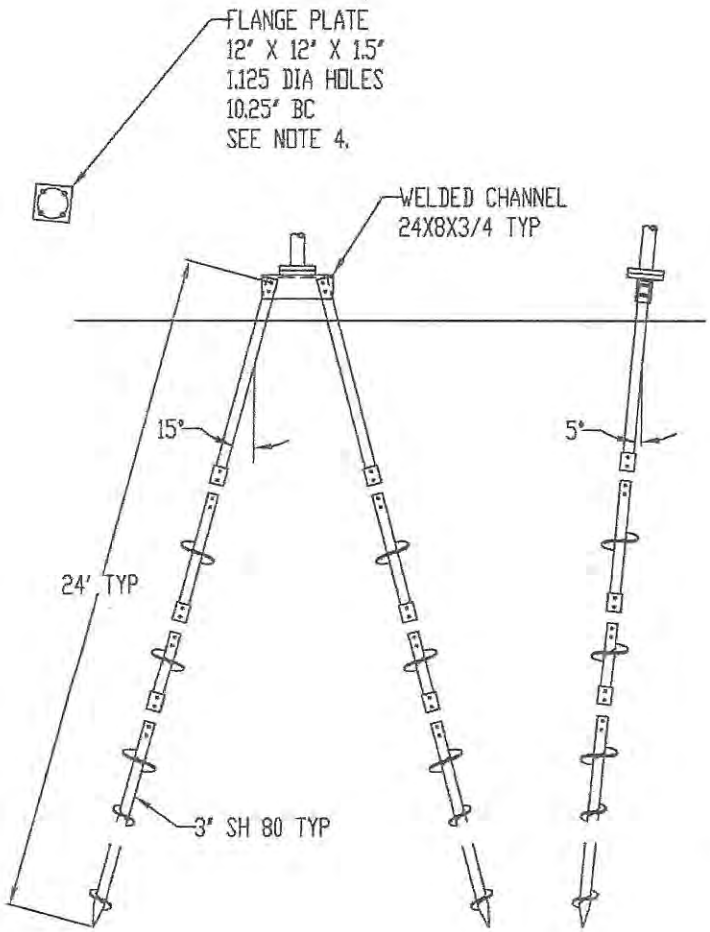
AUGER PILING FOR 60 FT TOWER
FOR HO[illegible]US SILT PERMAFROST SOIL

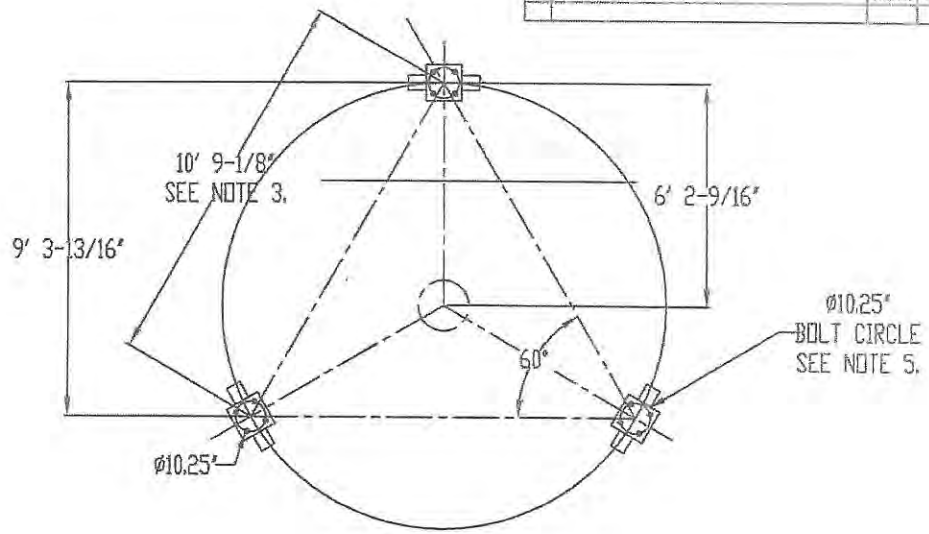
SIZE B | DWG NO. | REV NO. NA

SCALE: N.

SHEET 1 OF 1

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
0	SUBMERGED PERMAFROST FOUNDATION (SPF)	07/07/00	MAL





GENERAL NOTES

1. MATERIAL: HOT GALVANIZED WORK TO ANSI/TIA/EIA-222F
2. AUGER DIMENSIONS TO LOAD AND SOIL CONDITIONS
3. MAINTAIN TO =/- .5"
4. FLANGE WELDED AFTER PILE PLACEMENT.

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
SEE WIND DWG 0 [illegible] FOUNDATION AND ANCHOR TOLERANCES
DO NOT SCALE DRAWING

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE
DRAWN MAL 07/07/00
CHKD
APVD
MATERIAL N/A
FINISH N/A
USED ON EW15

ENTEGRITY WIND SYSTEMS INC.
A WIND ENERGY SYSTEMS COMPANY
P.O. BOX 832 CHARLOTTETOWN PE CANADA C1A 7L9

DUAL AUGER PILING FOR 80 FT TOWER FOR NON-[illegible]TUS SILT PERMAFROST SOIL

SIZE B | DWG NO. | REV NO. NA
SCALE n. | SHEET 1 OF 1

6a4. Utility Interconnection Preliminary Design

This sketch is a preliminary ONE-LINE Electrical Diagram which shows how simple the installation of 10 turbines can be on a distribution line. The layout is subject to final engineering calculations, but the plan is to copy the utility distribution line arrangement from the point of interconnection and simply run out to six separate transformers.

Each transformer is sized to accommodate three turbines and an enclosure will be provided for the turbine switches and controls.

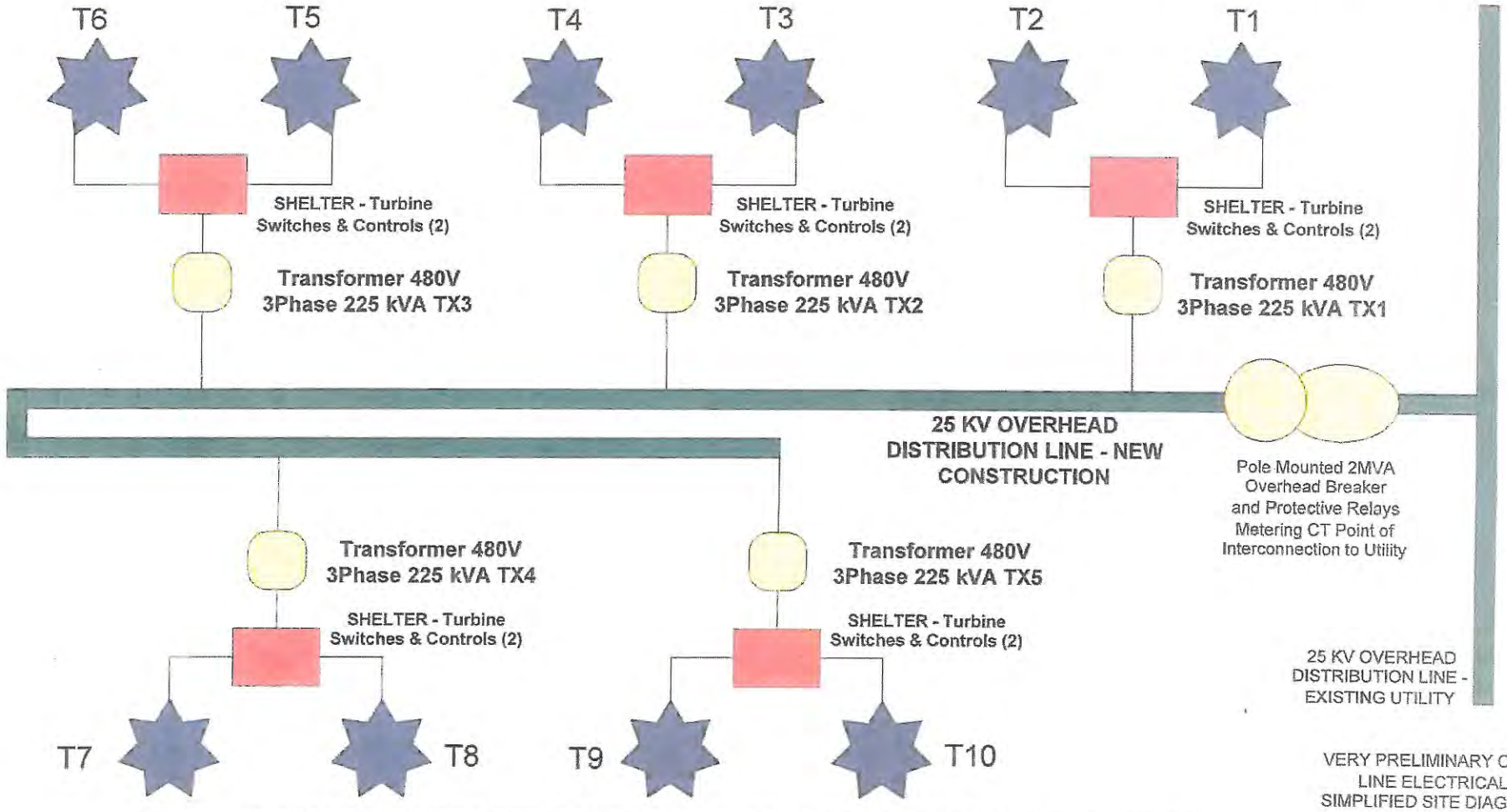
The turbines will be arranged in a line and in the future more turbines could be added to the end of the line for project expansion.

HARNESSING THE WIND IN NOME ALASKA

BERING STRAITS NATIVE CORP
TURBINE OWNER - PROJECT OWNER

10 ENTEGRITY WIND TURBINES 50/65 kW EACH
500 KW RATED PROJECT
650 KW MAXIMUM PROJECT OUTPUT

FIRST COMMERCIAL WIND FARM IN NOME



VERY PRELIMINARY ONE-LINE ELECTRICAL SIMPLIFIED SITE DIAGRAM

THIS DRAWING SHOWS THE EXPECTED LAYOUT FROM A WIRING STANDPOINT WITH ONE TRANSFORMER PER TWO TURBINES CONNECTED TO AN OVERHEAD 25KV DISTRIBUTION LINE WITH APPROPRIATE SWITCHGEAR TO UTILITY 25KV LINE

6a5. Project Design Support Letters

Idaho National Laboratory Letter

The Idaho National Lab has been analyzing projects around the Nation at DOE sites and others including particularly a project at Tin City around the corner and north of Nome and Kotzebue Alaska. They are very helpful in detailed data analysis and wind resource projections for project development and efforts to assist developers and industry.

National Renewable Energy Laboratory Letter

The National Renewable Energy Laboratory in Golden, Colorado helped perform testing and certification as well as design assistance on the Entegrity Wind Turbine. They are instrumental in promotion of wind energy projects around the nation. Key excerpts and information are included with the encouraging letter.

Idaho Energy Division – Water Resources Letter

The Idaho Energy Division is familiar with Entegrity Turbines with an installation just outside of Boise, Idaho.

October 1, 2007

Jerald Brown
Vice President
Bering Straits Native Corporation
PO Box 1008
Nome, Alaska 99762
jbrown@beringstraits.com

SUBJECT: BEARING STRAITS NATIVE CORPORATION WIND PROJECT PROPOSAL TO THE U.S. DEPARTMENT OF AGRICULTURE HIGH ENERGY COST PROGRAM

Dear Mr. Brown:

Idaho National Laboratory (INL) is a Department of Energy (DOE) laboratory based in Idaho Falls, Idaho. Our office provides regional support for Wind Powering America, supports the Idaho Wind Working Group, and regional anemometer loan programs. We also provide support to surrounding states, and have done work throughout Alaska in support of several US Air Force and other wind and energy projects. I have been briefed on your proposed wind power project to install approximately ten 50 KW Entegrity wind turbines on 100 foot towers, and connect to nearby electrical distribution at 25 kV. We are familiar with the location of the project and have some knowledge of wind resource in the area. INL would like to voice our support of the proposed wind project in Nome, Alaska.

INL has been involved with wind energy in Alaska for several years now, doing wind data collection and analysis, feasibility studies, and conceptual design work for the Air Force at several remote military installations. This work has led to the current plans to install 250 KW of wind power at an Air Force installation near Tin City. We have studied wind resources in other areas of the Western coast of Alaska including sites in Cape Romanzof, Cape Lisburne, Cape Newenham and others. Our work in Alaska has also included support for reduction of issues with wind and radar interaction on the Fire Island wind project near Anchorage.

Having been involved in several wind-diesel hybrid power system studies, designs, and implementations over the years, INL is keen on seeing wind power installed in areas such as yours. Wind energy just makes sense on many levels when there is a reasonable wind resource co-located with high fuel use and cost associated with electric generation from diesel generators. We believe from our work and the work of others that the wind resource in the Nome area is good enough to make a significant impact on fuel savings and reduction of electricity costs, not to mention all of the other economic, quality of life, and environmental benefits that wind power can bring to Alaska.

We also support the idea of using the Entegrity 50 KW wind turbines for this project. They have been deployed on several projects throughout Alaska and have been proven to operate well in that environment over time. This wind turbine is small enough to make the remote installation aspects much easier to deal with, and for these types of applications it is nice to have multiple units for reliability reasons as opposed to a single, larger wind turbine.

INL supports your proposal to install a wind power project in the Nome area. I look forward to seeing your grant application go in for the USDA High Energy Cost grant program and am hopeful that this will lead to more development and installation of wind power in Alaska. As we have worked throughout Alaska on wind prospecting and development activities, we would be interested in continued opportunities to help you make this project a success.

Please call me at (208) 526-5022 or Gary Seifert at (208) 526-9522, if you have any questions.

Sincerely,

Kurt S. Myers

Kurt S. Myers, MSEE, PE
Biofuels and Renewable Energy Technologies Dept

KSM:mak

cc: G.D. Seifert

A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

NREL National Renewable Energy Laboratory

Innovation for Our Energy Future

September 28, 2007

To whom it may concern;

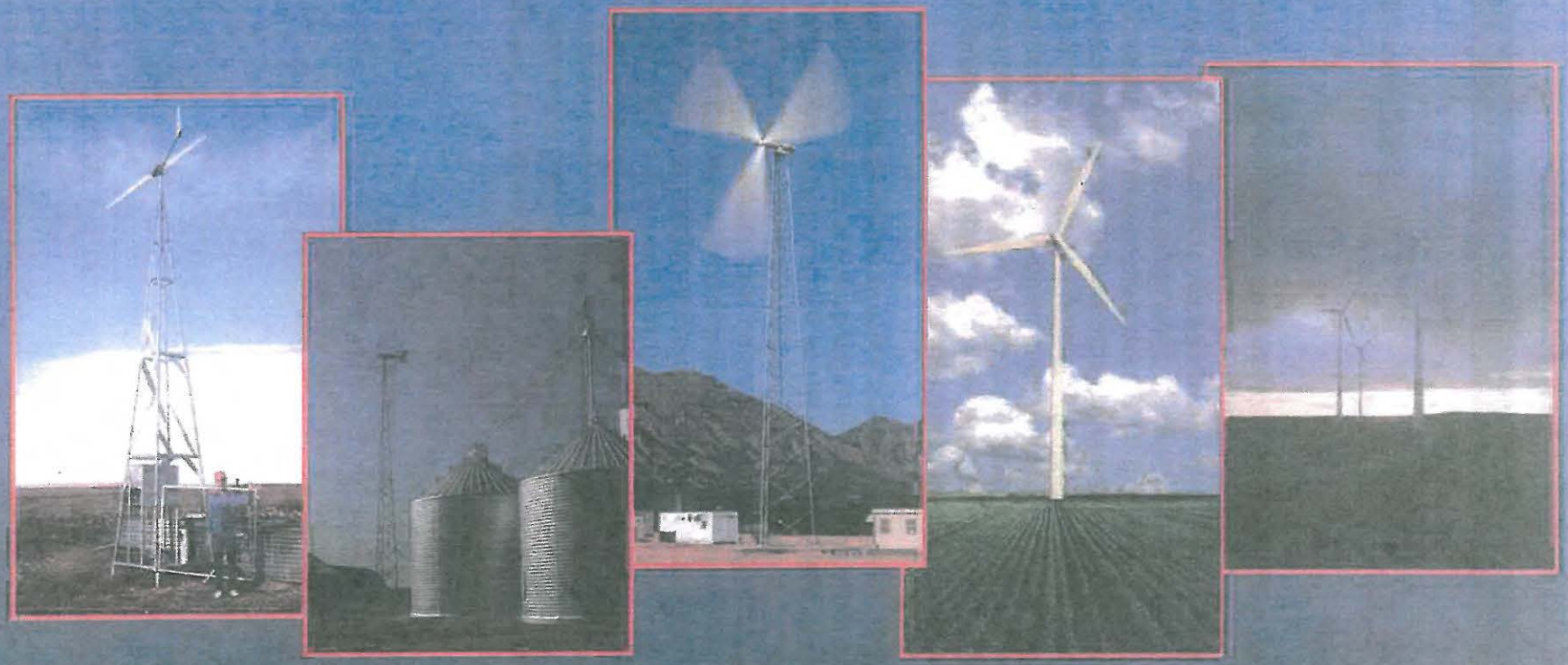
The National Renewable Energy Laboratory has been involved in the application of wind-diesel systems for remote communities for more than a decade, during which time our hybrid systems team has been involved with several Alaska village electric systems that have incorporated wind technologies and the various entities which design, evaluate, implement and operate them. We have worked with the Alaska Energy Authority to measure wind resources and map the wind resources for most of Alaska in a cooperative attempt to help appropriately implement wind systems to augment diesel in rural villages. We are particularly interested in working with hub communities, which have the capacity to demonstrate effective wind-diesel systems, train operators and service personnel, maintain a spare parts inventory, and provide operation and maintenance support capability for the more remote communities.

This project proposed for Nome Alaska looks like an interesting step in this direction and we would look forward to assisting with the systems analysis portion of the project, as part of our technical assistance to the State of Alaska, one of our priority Wind Powering America program states. We do feel that it is very important to ensure that all parties, including the local utility, are well informed and actively participate in all phases of the project. It is particularly important to assure a sustainable approach to the operations and maintenance of the system through training and developing local capacity. Because we have not had the opportunity to study the specifics of this proposal in any detail, this is not an endorsement of its technical, economical, or institutional soundness, rather an expression of interest in it conceptually and the potential that wind technologies could play a role in reducing the communities dependence on high cost, imported diesel fuel. We look forward to a successful collaboration.

Regards, Larry Flowers
Team Leader
National Wind Technology Center

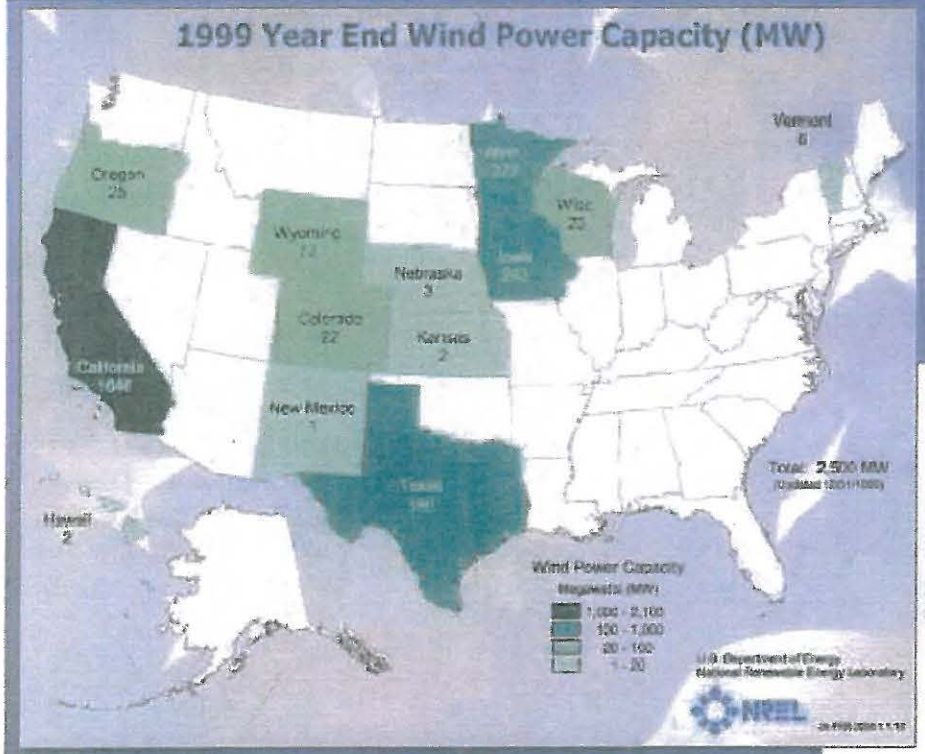
1617 Cole Blvd. • Golden, CO 80401-3393 • (303) 275-3000
NREL is operated by Midwest Research Institute • Battelle

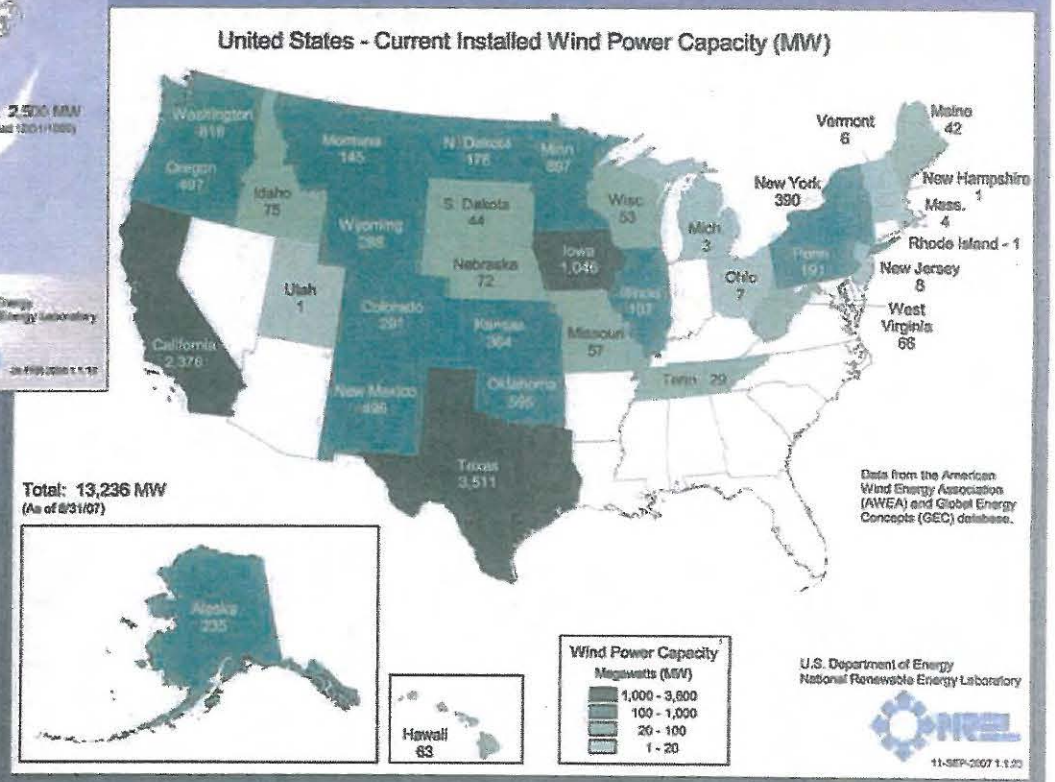
20% Wind Vision



Larry Flowers
National Renewable Energy Laboratory
September 2007

Installed Wind Capacities ('99 – Aug 07)





A New Vision

For Wind Energy in the U.S.

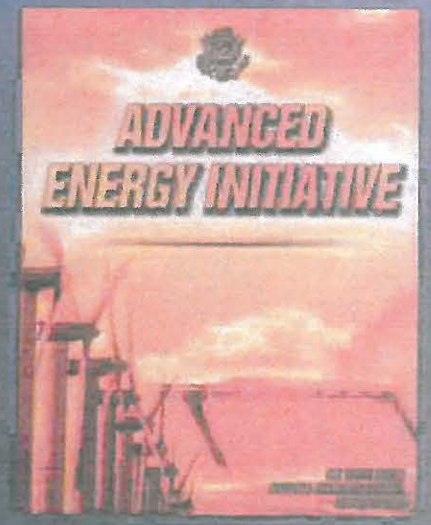
White House photo by Eric Draper

State of the Union Address

"...We will invest more in ... **revolutionary** and...**wind technologies**"

Advanced Energy Initiative

"Areas with good wind resources have the potential to **supply up to 20% of the electricity** consumption of the United States."



20% Wind-Electricity Vision

Wind energy will provide 20% of U.S. electricity needs by 2030, securing America's leadership in reliable, clean energy technology. As an inexhaustible and affordable domestic resource, wind strengthens our energy security, improves the quality of the air we breathe, slows climate change, and revitalizes rural communities.

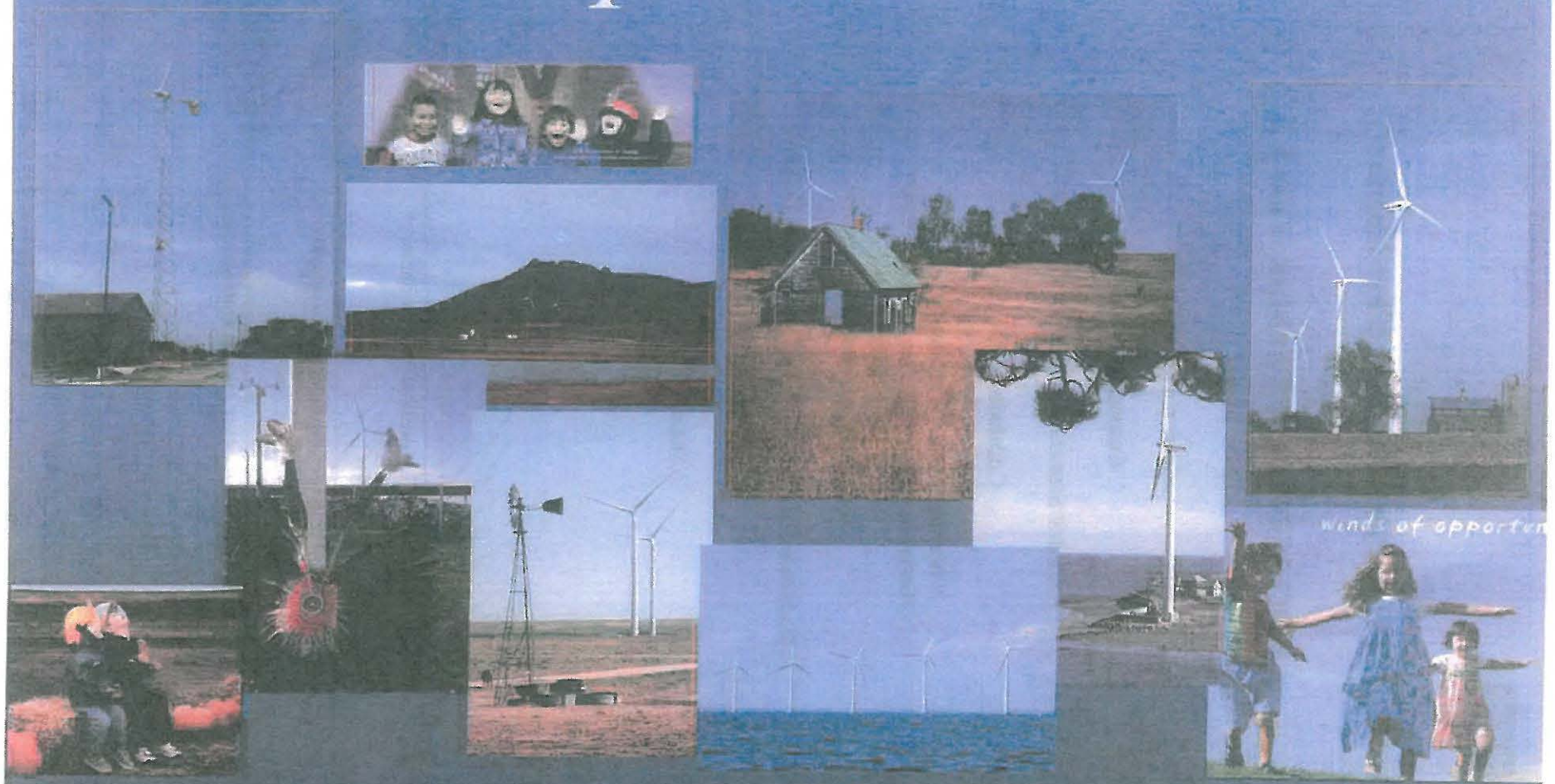
awea

american wind energy association

12 Key Messages

1. Wind energy provides multiple benefits at the national, regional, state, and local levels
2. Targeted messages and education are needed for the diverse set of stakeholder interests and perspectives, including regional variations in same.
3. Convergence of energy security, carbon liability and fuel uncertainty concerns is likely to transform the market for US electricity supply.
4. Federal and state policies are needed for a diversified and robust wind energy portfolio
5. Community and distributed wind are important building blocks for public acceptance of a 20% wind future.
6. Resource planning and procurement should maximize use of low marginal cost, zero-emissions energy resources, which displace more expensive fossil fuel

Carpe Ventem



www.windpoweringamerica.gov

Power Performance Test Report

for the

AOC 15/50 Wind Turbine, Test B

in

Golden, Colorado

Conducted for

United States Department of Energy

Conducted by

National Wind Technology Center
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

R. Jacobson, M. Meadors, E. Jacobson, H. Link

Revision 3

8August 2003

Approval By: Harold F. Link — 1/Oct/2003
Harold F. Link, NREL Certification Test Engineer — Date

Approval By: Harold F. Link — 1/Oct/2003
Harold F. Link, NREL Certification Test Manager — Date

Approval By: C. P. Butterfield — 6/10/03
C. P. Butterfield, NREL Certification Quality Manager — Date

June 2003 NREL/EL-500-34017

Wind Turbine Generator System

Duration Test Report

for the

Atlantic Orient 15/50 Wind Turbine

by

National Wind Technology Center
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

Jeroen van Dam
Eric Jacobson
Hal Link
Mark Meadors

April 14, 2003

Approval By: _____ 19 May 2003
Jeroen van Dam, NREL Test Engineer — Date

Approval By: _____ 19 May 2003
Hal Link, NREL Certification Test Manager — Date

Approval By: _____ 5/28/03
Sandy Butterfield, NREL Certification QA manager — Date

June 2003 NREL/EL-500-34382

Wind Turbine Generator System

Safety and Function Test Report

for the

Atlantic Orient 15/50 Wind Turbine

by

National Wind Technology Center
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

12 June 2003

Approval By: _____ 19 June 2003
Jeroen van Dam, NREL, Certification Test Engineer — Date

Approval By: _____ 19 June 2003
Hal Link, NREL Certification Test Manager — Date

Approval By: _____ 6/19/03
Charles P. Butterfield, NREL, Certification QA manager — Date

May 2003 NREL/EL-500-34021

ACCREDITED
Certificate No. 1239-01

Wind Turbine Generator System

Acoustic Noise Test Report

for the

AOC 15/50 Wind Turbine

at the
National Wind Technology Center
Golden, Colorado

by

National Wind Technology Center
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

July 1, 1999

Approval By: Arlinda Huskey — 7 July 99
Arlinda Huskey, NREL Certification Test Engineer — Date

Approval By: Harold F. Link — 7 July 99
Harold F Link, NREL Certification Senior Test Engineer — Date

Approval By: C P Butterfield — 7/26/99
Charles P Butterfield, NREL Certification QA Manager — Date

State of Idaho
DEPARTMENT OF WATER RESOURCES
322 East Front Street, P.O. Box 83720, Boise, Idaho 83720-0098
Phone: (208) 287-4800 FAX: (208) 287-6700 www.idwr.idaho.gov

C.L. "BUTCH" OTTER
Governor

DAVID R. TUTHILL, JR.
Director

September 29, 2007

Jerald Brown
Vice President
Bering Straits Native Corporation
PO Box 1008
Nome, Alaska 99762
jbrown@beringstraits.com

RE: Bering Straits Native Corporation wind project proposal to the U.S. Department of Agriculture High Energy Cost Program

Dear Mr. Brown,

I would like to lend my vote of support for this project in Nome. The state of Idaho is almost in as bad a shape as rural Alaska in terms of the percent of energy it imports. For Nome, it is obviously 100% but in Idaho it is still 80%. Fortunately for Idaho, the imported electricity is from coal at relatively low cost. Trade is good if you can't provide that commodity or resource better locally. In Nome's case, it has a great wind resource and it can provide much of its own electricity with this resource more efficiently than importing oil.

I worked in Nome for the Alaska Gold Company for several summers in the late 1970s and early 1980s. At that time the company thought it would reduce its operating cost by switching to oil-fired turbines instead of the old piston diesel engine generator sets it had used for decades. It's reasoning was that the maintenance costs would be much lower. But there was a fuel-efficiency difference, probably 35% for the diesel engines and only 20% for the turbines. In two years the company could see the costs of fuel were killing it. It switched back to the diesel generators.

The same case applies to Nome's overall power generation now. Wind can reduce overall costs while reducing the export of fuel dollars. For several reasons the choice of Entegrity turbines is a good one. First, the company has much experience with installations in arctic conditions. There are already several of these turbines in Kotzebue. The incremental size of the Entegrity (50kW) is good for a relatively small grid (2 MW average load, 10 MW peak). This size also gives a great deal of flexibility to project expansion compared to 2.5 MW turbines, for example. Equipment for installation already exists in Nome, whereas it would be very difficult to get the size of cranes needed for installation of larger turbines into Nome.

While it is true that in the lower 48 with larger electric grids and access to specialized equipment, larger turbines would come in at lower costs than Entegrity turbines, these are not the circumstances in Nome. The choice of Entegrity turbines for the first phase of what will likely be far more installation of wind is brilliant. Nome has one of the larger micro-grids in rural Alaska, making it an excellent demonstration site for wind integration. Still, the 50 kW size of the Entegrity makes it ideal demonstration for wind additions to much smaller grids.

Brian Jackson of Renaissance Engineering and Design has worked with me over several years to build a wind industry in Idaho. Idaho now has 75 MW of installed wind capacity. He and his company have extensive experience in all aspects of wind project development, from site selection to project completion. He was the primary project engineer for the two-Entegrity turbine Idaho Synthetic Energy, Inc. hydrogen production project about 20 miles southeast of Boise, which has been operating well for over a year.

This proposal looks great to me. It addresses several of the issues dealing with the selection of larger turbines that could have stalled another project in mid-stream. I think the likelihood of success with this project is very high and I encourage the funding agency to support it. A success integrating wind into a rural Alaska micro-grid at this time of looming approach of global peak oil production, cannot help but make everyone involved look very good.

Sincerely,

Gerald Fleischman

Gerald Fleischman, P.E., MBA
Engineer, Technical 1, Wind and Geothermal Power Development
Energy Division

6b. Project Management

This project team is completely experienced in the implementation of every aspect of this project. Not only in a general sense, but in the specific installation of this exact turbine model and in the climate and harsh conditions that can affect Nome. Additionally, Kotzebue Electric Association has been very helpful in sharing information that helps develop a detailed solution for the connection to the Nome Joint Utility system.

The project will be managed through contractual arrangements as indicated. Preliminary verbal cost estimates and quotes have been negotiated and will be finalized upon notice to proceed. Each entity listed has specifically committed the appropriate time and resources to make this project a priority next year. This project starts saving Nome money the minute it is online.

Note that Eagle Electric is an affiliated entity (completely owned by Bering Straits). The contract will be managed, however, as if the relationship does not exist on a competitive procurement basis.

Resumes

Brian Jackson – Renaissance – Project Engineer

Jerald Brown – Bering Straits Native Corp – Financial Accounting

Mitch Erickson – Local Manager – Data Collection and Reporting

Matt Bergan – Experience Installing, Operating, Maintaining Entegrity Turbines

Eagle Electric – Electrical and General Contracting

Idaho Tower Company – Experienced Tower Erection Crew

HARNESSING THE WIND IN NOME ALASKA

10 ENTEGRITY WIND TURBINES
500 KW RATED
650 KW MAXIMUM OUTPUT

FIRST COMMERCIAL WIND FARM IN NOME

SITNASAUK NATIVE CORP
LANDOWNER SHARE OF REVENUES

BERING STRAITS NATIVE CORP
TURBINE OWNER - PROJECT OWNER

JERALD BROWN, VP

- GRANT ADMINISTRATION
-CONTRACT MANAGEMENT
-MAIN CONTRACTING
-ACCOUNTING
- CONTRIBUTES >10% OF PROJECT
-DEDICATES 50% OF PROFITS TO RURAL VILLAGE RENEWABLE ENERGY SYSTEMS

- Experience with Grant Administration, Accounting, Auditing

RENAISSANCE ENGINEERING & DESIGN

BRIAN D. JACKSON, PE

-Project Design
-Project Engineer
-Construction Management
- Experience with Entegrity

IGLOO ENERGY SYSTEMS

MITCH ERICKSON
MATT BERGAN PE
BRIAN JACKSON PE

-Installation Supervision
- SCADA Programming
-Special Data Draker Sentalis Installation
-Data Collection
-O&M 24/7 On-Call
-Data Analysis
-Report Compilations
- Experience with Entegrity in this region

ENTEGRITY WIND SYSTEMS
-WIND TURBINES
-WARRANTY
-O&M PACKAGE

DRAKER
SENTALIS ENERGY DATA PACKAGE AND INTERNET FRONT END

EAGLE ELECTRIC LLC

GENERAL CONTRACTOR
- Foundation Excavation
-Anchor Supply and Installation

ELECTRICAL CONTRACTOR
-Turbine and Panel Wiring
-Transformer Procurement and Installation
-Distribution Pole and Wire Procurement and Installation
-Utility Interconnection Relay and Equipment Procurement and Installation

IDAHO TOWER CONSTRUCTION COMPANY

TOWER ERECTION CONTRACTOR

-Mechanical Assembly of Turbine Towers
- Crane coordination and supervision
-Complete Erection Services for Wind Turbine Installation
- Experience with Entegrity
-Experience with towers and construction logistics.in difficult locations

EXPERIENCED PROJECT TEAM WITH PROVEN ABILITY TO GET THIS JOB DONE.

DIRECT EXPERIENCE IN EACH REQUIRED CATEGORY INCLUDING SPECIFICALLY WITH THIS TURBINE MODEL AND IN THE DIFFICULT ALASKAN TERRAIN

RENAISSANCE
Engineering & Design

2792 Desert Wind Road
Oasis, Idaho 83647-5020
208-796-2222
www.clever-ideas.com

Brian D. Jackson, PE MBA BSME CEM
President
Cell: 208-859-1882
brian@clever-ideas.com

COMPANY DESCRIPTION:

Renaissance Engineering & Design, PLLC is a full-service engineering company providing consulting, system design, and construction supervision services. Established in the year 2000, Renaissance Engineering & Design provides services across a broad range of disciplines and sciences. The company strives to incorporate Leonardo da Vinci's principles of "Virtutem, Forma, Decorat" (Merit, Beauty, Honor) in developing solutions that have value and make sense.

We are experts at designing small & medium-scale renewable energy and distributed power generation projects from several kilowatts to several megawatts. Our clients include farmers and ranchers, cooperatives, Native American Indian Tribes, businesses and other project developers.

Renaissance Engineering & Design specializes in:

- **Feasibility Studies and Grant Application Assistance** for renewable energy projects of all kinds in any location
- **Renewable Energy Distributed Power Generation** system design and project management (wind, solar, hydro, anaerobic biomass digestion, biomass gasification, and geothermal)
- **Electrical Generation, Cogeneration, and Interconnection** products and services (diesel and gas engine sets, gas turbines, microturbines, fuel cells, hydrogen).

The greatest values on projects can typically be achieved through strategically targeting specific elements with the greatest payback potential. Renaissance Engineering & Design is committed to seeking this greatest payback for customers through the beauty of simplicity and efficiency. Whether incorporating new technology or evaluating existing systems for improvement, this goal is always present.

RENEWABLE ENERGY AND SUSTAINABILITY:

We provide complete solutions, assessing a given site's resources and designing a renewable energy system that takes advantage of those resources. We are experienced with all types of energy generation technologies and the integration into a simple or multi-faceted solution. In short, we design the system to work with the environment not against it. We carry out everything from researching the available natural resources and gathering data to designing the best system to match those resources. We deliver the solutions with structured, efficient project management services as well as offering packages for on-going operation, remote monitoring and maintenance of the renewable energy systems.

Our team experiences range from project management of an 18 kW photovoltaic project to engineering on multi-million dollar wind and hydroelectric projects. Current projects include several medium-sized (~20 MW) wind energy projects on farms and sites in Idaho; assessing the wind resource at the Duck Valley Indian Reservation and also for Clark County in Idaho & Nevada; small wind farm development in Oregon; and operation, maintenance, retrofitting & expanding Idaho's first commercial wind farm. Prior work was done on pelletization and biomass gasification of poultry waste and agricultural crops. We successfully obtained four USDA grants in the summer of 2005 for clients to build renewable energy projects. These are in addition to several previous grants during the past few years. One of those projects is a hydrogen generation project powered by wind energy near Boise, ID. This project consists of two 50 kW wind turbines that supply power to hydrolyzers which produce 99.999% pure hydrogen. Renaissance was the project engineer on that development. That project is fully operational and produced almost a dozen full tanker trucks of hydrogen during the rest of the year after the project kickoff in early 2006. The other grants in 2005 were for medium-scale on-farm wind projects 1.5 to 2 MW each in Colorado. In 2006 we installed multiple anemometers across the state in conjunction with assessing the wind resource for the Couer D'Alene tribes in Northern Idaho and in support of a grant project awarded in late 2006 to assess the wind resource in the Camas Prairie for farmers in that region utilizing 5 strategically located towers. Our knowledge and experience in designing sustainable renewable energy systems makes our company an indispensable asset for any project that seeks to utilize available energy resources without sacrificing environmental integrity.

Engineering Consulting Services:
Wind resource assessment (anemometer data collection & analysis); Renewable Energy System Design, Inventions, Product Design & Development, Prototyping, Simulation, Feasibility Studies, Business Planning, Financial Modeling & Analysis, Energy Evaluations.

Field Work:
Wind resource assessment (anemometer installations), Calibration, Troubleshooting and Instrument Setup/Installation Work, Energy Monitoring Installations and Energy Efficiency Surveys, General Data Collection, Analysis & Reporting.

CONSULTING PROJECTS – 6 Years (2001-2007):

- Three new rural Oregon Wind Farms: Project engineering, feasibility, development 1.8 MW $3.6M each project, Three $500k USDA grant awards for the separate projects.
- Assessing the Wind Resource in Camas Prairie Grangeville Idaho, involving 5 anemometer installations and resource comparison across the entire region USDA Value Added Grant $24,000 grant $48,000 project
- Project Engineering Wind to Hydrogen Commercial Demonstration Project Two Wind Turbines and Two Proton Exchange Membrane Hydrolyzers–Construction Completed Early 2006 - $900,000 Total Project.
- Feasibility Study: Assessing the Wind Resource on the Duck Valley Indian Reservation for the Shoshone Paiute Tribes in Southern Idaho $36,000 Contract
- 3 Farmer Owned Wind Turbine Feasibility Studies: USDA Grant Awards, Eastern Colorado, $1,500,000 total grants
- Special Grant Feasibility Study: Hydrogen Generation with Two Wind Turbines $200,000 grant application assistance
- Anemometer Installations and Wind Study Resource Evaluations, Early Project Development Assistance 30MW Wind Farm Buhl Idaho
- 3 Research Projects involving $140,000 in Grants for Biomass Gasification, Control and Automation, Pelletizing Crop Residue, Developing Pre-production prototype downdraft gasifier unit.
- Small Hydropower Feasibility Site Study Baker Oregon and Hagerman Idaho
- Wind Resource Compilation and Grant Assistance for Shoshone Bannock Tribes in Blackfoot Idaho
- Tall Tower installation assistance 250' and resource compilation for 200MW Wind Farm Albion Idaho
- Net Metering 20kW Wind Project, $10,000 grant - $40,000 project, Engineering Assistance
- Energy analysis and Generation Evaluation Wind Farm Hagerman Idaho: 3 separate clients and projects 10 to 40 MW in size
- Early Project Development and Grant Application Burley Idaho: Farmer Owned Wind Project 1.5MW, $500,000 grant - $2.6 Million Project
- Feasibility Analysis for Commercial Wind Farm Burley Idaho: $20,000 Grant - $40,000 Project
- Geothermal Generation Plant Flow Test Metering and Specification Assistance Raft River: US Geothermal Project 10+ MW generation
- Feasibility Study, PPA Negotiation, Early Development Idaho Falls: Farmer Owned Wind Project 1.5MW to 18MW, $400,000 grant - $1.6m Million Project
- Feasibility Study and Early Project Development Idaho Falls: Farmer Owned Wind Project 1.5MW to 10.5 MW, $500,000 grant - $2.5 Million Project
- Multiple Farm and Ranch Site Analysis Work
- Multiple Anemometer Installations and Data Analysis Work across Idaho, 20m-50m+

Brian D. Jackson, PE, MBA, BSME, CEM – President

Project Management, Design Engineering, Business Consulting and Feasibility Studies, Energy Analysis & Efficiency Evaluations

Brian Jackson is a Professional Engineer with a master's degree in business administration. He combines 17 years of engineering experience in consulting, electrical generation, and project management to provide effective consulting services that are relevant to a client's bottom line through increased productivity and profits or significant savings. He is also a Certified Energy Manager with the American Association of Energy Engineers and spent 11 years working for Idacorp/Idaho Power Company in the field of power generation. Several years as a utility generation engineer involved focusing on various types of renewable energy sources including multi-megawatt hydro-electric power plant construction, photovoltaics, wind, and biomass. He also spent several years working with commercial and industrial customers in the areas of distributed generation and cogeneration.

Mr. Jackson has experience in conducting feasibility studies and writing several successful grant applications for internal projects as well as outside clients. He also has written various business plans for corporate and private ventures. The latest projects involve commercial wind farm analysis and feasibility studies. He has experience in power generation interconnection issues as well as generator and engine operation. He has been in key leadership roles in small startup subsidiary companies spun off from the electric utility during his role there. He was the key Idaho Power representative managing a business study including complete feasibility and business planning for a distributed/isolated electric power generation business opportunity in Indonesia for villages and off-grid communities during 1995 and 1996 involving several business trips to Asia meeting with Government leaders as well as field work.

Mr. Jackson has been involved in other startup business ventures including retail sales and residential construction projects. He has managed multiple employees and supervised contractors and subcontractors.

BRIAN D. JACKSON - IDAHO POWER WORK EXPERIENCE – 11 Years:

July 2000-December 2001; On-Site Energy Manager, IDACORP Solutions

Officially became part of separate company from the utility Idaho Power. IDACORP Solutions provided energy related products and services related to energy information, power quality, and on-site energy for commercial and industrial customers throughout the Western United States. Personal responsibility was for on-site energy systems including complete facility evaluation, analysis, and marketing of generation, HVAC, and cogeneration services. Generation products ranged from multiple sizes and configurations of diesel and natural gas reciprocating gensets 10kW to 5MW in size to evaluation of two grid connected microturbine installations. Evaluated and analyzed next phase products including smaller aeroderivative gas turbines, and special technologies like flywheels, flow-cells, and commercial fuel cells. Responsibilities included all types of on-site facility needs evaluations and preparing and presenting technical feasibility studies for on-site backup and prime power generation alternatives. Also involved local permitting and emissions evaluations as well as sales presentations to customers for the packaged project implementation services themselves. This included project management services to coordinate complete installation and follow-up commissioning of equipment at the end of the project.

January 1999-June 2000; Energy Information Project Manager, Idaho Power Commercial and Industrial Marketing Business Unit

Focused specifically on selection and installation of customer energy metering systems gathering data from utility electric and gas meters as well as water, steam, and subload electrical meters throughout several customers' facilities. Responsibilities included customer site evaluations, developing sales proposals and making sales presentations, as well as managing subcontractors and coordinating with customers' personnel for installation work.

April 1998-December 1998; Technical Product Development, Idaho Power Commercial and Industrial Marketing Business Unit

Assigned to new business group to help with development of products and services beyond simply selling energy in the form of electricity and natural gas. New unit was extremely profit oriented and functioned entirely as a separate business unit from Idaho Power Company as much as possible at that time. Responsibilities included project management and engineering design and evaluation of existing and new technologies.

1996-1998 International Project Director, Idaho Power Resources Corporation.

Assigned to Idaho Power Strategic Planning Group to work specifically on business development for International Initiatives, particularly Project Indonesia (project budget over $700,000). Traveled to many executive events and functions across United States. Three trips to Indonesia totaling about 3 months during 1996 in that country. Trips to Indonesia included meeting with very senior government officials and business executives. Extensive field travel (thousands of road miles) throughout the islands of Borneo, Sulawesi, Java, Sumatra, Timor, Roti, Bali, Nusa Penida. Tremendous experience dealing with local people in outer areas of Indonesia. Quickly learned basic language skills in Bahasa Indonesia. Helped develop extensive business plan and financial models to analyze many potential opportunities in Indonesia for Idaho Power. This entire project was ultimately abandoned due to escalating economic risks.

1994-1995 Business Development Associate, Hydro Services Group:

Assigned to Re-Engineering team responsible for changing direction and focus of Generation Engineering Department. Various tasks and duties including development of a business from initial plans and descriptions to market investigation and supplemental positioning analysis.

- Involved directly with full scale marketing efforts of Engineering and Maintenance Services to other companies. Developed contacts both domestic and international for projects and potential partnering possibilities as well as contacts at the project financing level including the World Bank and affiliated financing institutions.
- Responsibility for International Project Evaluation and Recommendations.
- Developed extensive bid spreadsheet models for Ice Harbor and Shasta Hydro Refurbishment bids to account for every detail yet allow small changes and customization of bid in any area.
- Site Engineer for the Lucky Peak Valve Project included inspection and evaluation recommendations, managing the project work sequence, billing customer for Engineering and crew time, and completing the final written report for the client.
- Applying Business Education classes and principles to developing new Business Venture.

1992-1995 Project Engineer, Solar Photovoltaic Projects:

Basic business and engineering work as team member to develop and implement the photovoltaic tariff for marketing custom designed PV systems up to 3 kW to customers. Helped to establish "standard package" systems issues. Involved with component selection and specification. Designed and managed procurement and assembly of PV Demonstration Trailer with complete mobile system including PV array, building, generator, and propane tank mounted on trailer.

Project Manager for grid connected 18 kW 90 module Rooftop Photovoltaic System. This involved complete coordination of contract with EPA, EPRI, and Ascension Technology as well as local contractors. This project involved building permits and street closure permitting and coordination for helicopter airlift of entire crated system to Idaho Power Corporate Headquarters Rooftop. Subsequent dedication ceremony involved coordination with press, City of Boise Mayor's Office, and various officials from Idaho Power, EPRI, and others. Continued system monitoring and expanded data collection efforts to include data from the Bureau of Reclamation Agri-MET System Sites. Managed Idaho Power's additional related data project with Bonneville Power Administration, Pacificorp, Portland General Electric, and Eugene Water and Electric Board and the University of Oregon.

Completely designed and initiated fabrication of the metal framework for the 80kW Air Force Photovoltaic System at Grasmere, Idaho. This design involved extensive 3-D work in Autocad to minimize cost, while maximizing safety of design factors and ease of minimally supervised field installation. Fabrication and installation processes went extremely well.

1992-1994 Generation Engineer, Twin Falls Project ($50 Million):

Assignment to this project concurrent with other assignments for initial mechanical engineering design review for Twin Falls Hydroelectric Project.

- Preparation of FERC License Article Submittals.
- Detailed Review and Comments on Specifications and Drawings as well as bid evaluation.
- Shop inspection of Draft Tube and Penstocks.

1991-1993 Generation Engineer, Milner Project ($70 Million):

Initial duties as assistant to the Project Engineer on Milner Hydroelectric Project; included various contract management tasks and invoice payment approvals as well as mechanical and civil engineering design review.

- Invoice tracking and approval for project contracts and deliverables-some at several $Million.
- Significant efforts for contract bid preparation, evaluation, and award.
- Extensive on-site inspection of contractor fabrication items for Penstocks, Intake and Radial Gates, Trashrack and Trashrake.
- Completely designed and managed construction of buoy line system across spillway at Milner Dam.
- FERC Construction Reports, monthly; Project Record Drawing Review and Approval; Final FERC "As-Built" Drawing Preparation and Submittal.
- Extensive work for analysis, study and final preparation of video for ramp rate and target flow issues in response to FERC License Requirement amendment case.

CONFERENCES & TRAINING:

Developmental Classes and Training

Utility Wind Interconnection Workshop, UWIG, Albuquerque, NM Apr 18-20, 04, Trip:Taiban Mesa Wind
Comprehensive 5 Day Energy Manager Training Program, Assoc. of Energy Engineers, New Orleans, Dec 2001
MS Word Long Documents Class, Boise, Idaho November 15, 2001
Project Management Boot Camp, Knight Associates, Boise, Idaho September 17-20, 2001
Industrial Process and Energy Optimization, ETSI Consulting, Boise, Idaho August 28-29, 2001
E-Myth Business Systems Strategy, E-Myth Worldwide, Boise, Idaho Training, May 3-4, 2001
Generac Generators- Authorized Service Technician Training, Spring 2000
Utility Meter Data Gathering Seminar, TECOM, Participant and Presenter, San Diego, February 1999
Lessons in Leadership, Series Seminar by Stephen Covey, Tom Peters, Peter Senge, Fall 1996.
Stephen Covey's: Seven Habits of Highly Effective People, IPCo Training; June 8, 1995.
Staying On Top!: How to Sustain a Competitive Marketing Advantage, BSU Outreach; May 18, 1995.
Turning Customers into Devoted Fans, Ken Blanchard, One Minute Manager; BSU Outreach; March 29, 1995.
Increasing Human Effectiveness II, IPCo Training; June 1993.
Pre-Supervisory Program, IPCo Training; Jan-Feb 1992

Major Professional Conferences and Seminars

- **NW Sustainability Conference,** Boise, Idaho March 3-4, 2005 **Presented Wind Projects Session**
- **Idaho American Indian Summit-Wind Power Development,** Coeur d'Alene, Idaho June 15 & 16, 2004
- **Idaho State Energy Office Wind Road Show,** March 8-13, 2004: **Presented Farm Options for Wind**
- **4th Annual Harvesting Clean Energy Conference,** Portland Oregon January 20,21, 2004.
- **Small Timber Products Outlook: A Focus on Energy,** Post Falls, Idaho, November 20, 2003: **Presented Selected Biomass Gasification Case Studies**
- **AWEA Wind Project Financing Workshop,** Palm Springs, CA, November 10-12,2003
- **Windpower for Home, Farm, Ranch, or Business,** Lewiston, Idaho, Sept. 25, 2003: **Presented Farm and Ranch Applications and Models**
- **3rd Annual Harvesting Clean Energy Conference,** Boise, Idaho February 10-12, 2003
- **Bioenergy 2002,** Boise, Idaho September 22-26, 2002: **Presented Downdraft Gasification Projects**
- **Power-Gen 2001,** Las Vegas, December 10-13, 2001
- **Idaho Wind Power Conference,** Boise, Idaho, October 22, 2001
- **Distributed Generation Applications and Interconnection,** EUCI, Denver, August 6-10, 2001
- **Interconnecting Distributed Generation Conference;** Western Energy Institute, March 21-23, 2001 San Diego: **Presented Microturbine Applications Session**
- **Distributech 2001,** San Diego, February 2001
- **Idaho Energy Conference,** Sun Valley, Idaho Novemer15-17, 2000
- **Distributech 2000,** Miami Beach, February 2000
- **Distributech 1999,** San Diego, February 1999
- **Energy Information Conference,** Boston, Fall 1998: **Presented Hospital Energy Submetering Installation and Application Case Study**
- **World Bank Roundtable Meeting for Rural Electrification,** Washington DC, April, 1997
- **NREL Annual Village Power Workshop,** Washington DC, February, 1996 and April, 1997
- **Soltech/UPVG Annual Conference,** Palm Springs, April 9-12, 1996
- **World Renewable Energy Congress,** Denver, June 15-21, 1996.
- **International Executive Conference on Strategic Photovoltaic Business Opportunities for Utilities,** Sun Valley, Idaho; September 17-20, 1995. **Presented Focus Group Analysis Results**
- **International Summit on Hydropower Projects in Emerging Markets,** New York; Sept. 11-13, 1995.
- **WaterPower 95 Hydro Conf., Booth Exhibitor for Hydro Services Group,** San Francisco, CA; July 1995.
- **ASME Bearing Selection and Maintenance Seminar;** June 6, 1995.
- **Contract Administration and Claims Avoidance Seminar,** Meuleman, Miller & Cummings; September 1993.
- **Solar 94, ASES International Solar Energy Conference,** San Jose, CA; June 1994.
- **Solar Insolation Measurement Workshop,** NREL, Denver, CO; May 1993.
- **Photovoltaic Powerplant Design, Operation, and Maintenance Seminar,** PG&E, EPRI, and Siemens Solar; Davis, CA; April 6-8, 1993.
- **Compressed Air System Design and Selection Seminar,** MISCO, Boise, ID; Nov. 12, 1992.
- **Hydro Turbine Maintenance Seminar,** Hydropower Technologies Inc., Hells Canyon, ID; April 28-30, 1992.
- **Lawrence Pump Design Selection Seminar,** MISCO, Boise, ID; Feb. 1991

JERALD J. BROWN
P.O. Box 1972
Nome, Alaska 99762

March 1994 to Present: Bering Straits Native Corporation

Vice President for an ANCSA Regional Corporation headquartered in Nome. Responsible for general administration and finances of the parent corporation (BSNC), and its subsidiaries. This includes management of the investment portfolios, involvement in daily operations for BSNC and all subsidiaries as well as direct oversight of the accounting department. Joined BSNC in March of 1994 as accounting clerk, promoted to Assistant Controller in June 1995, Controller in April 1996, V.P. of Finance in January 2000, and full Vice President in August 2000. Additionally appointed as Vice President of Finance for all subsidiary companies in April 2001.

Placed in charge of Alternative energy programs for BSNC in 2005. Currently overseeing installation of 17 kilowatt array of solar panels on the BSNC office building.

May to August 1993: ARA Denali National Park

Night Auditor at hotel resort located in Denali National Park

June 1985 to June 1992: Glacier Park Inc., Subsidiary of Dial Corporation

Computer Operations Manager, 1991-1992, responsible for training seasonal and permanent staff in use of applications on computers and cash registers. Glacier Park was a summer resort destination with 700+ rooms & lodge accommodations in Montana and Canada. Winters were spent in Phoenix corporate office concluding seasonal reporting and preparing for the next seasons activities.

Accounting Supervisor, 1988 to 1990, responsible for training and supervision of accounting staff in payroll, accounts receivable, revenue audit and other related accounting functions. Payroll included compliance with Canadian and U.S. tax rules.

Night Auditor, Summers of 1985 through 1987

February 1982 to February 1984: United States Army, Calvary Scout, 6th Calvary Ft. Houston, TX Honorable Discharge

EDUCATION:

Ferris State College: Received B.S. in Accountancy June 1987, GPA 3.63
Delta College: A.A. degree in Business Administration, May 1985, GPA 3.78
AZ CPA Cert No. 7544-E (Lapsed)

MITCHELL A ERICKSON
511 Round the Clock Drive
PO Box 1967
Nome, Alaska 99762
907.443.4830
email: mitchvicky@gci.net

PROFESSIONAL EXPERIENCE

March 2004 to Present **Nome Chamber of Commerce** Nome, Alaska
Executive Director

March 2005 to Present **Arctic Western Development** Nome, Alaska
Owner

- Gold mining properties, gold properties and land reclamation services

October 2000 to March 2004 **Alaska Gold Company** Nome, Alaska
Vice President and Land Resource Manager

- Created Land Management Plan to classify land resources
- Responsible for Environmental
- Managed land, sand, gravel and gold resources

May 1997 to November 1999 **Sitnasuak Native Corporation** Nome, Alaska
Vice President and Human Resource Director for operating subsidiaries including Bonanza Fuel, Nanuaq, Inc, Nanuaq Construction and Nome Native Community Enterprises.

- Supervised fuel operations including wholesale and retail home heating fuel sales, Avgas, gasoline as well as two gas stations.
- Developed feasibility study, business plan and construction financing for new Anvil City Station.
- Incident Commander for Oil spill Response team.
- Managed 64 apartment rental units as well as four commercial buildings.
- Oversaw management of the 18 unit motel complex "Nanuaq Manor."
- Responsible for budgeting, marketing and profitability as well as regulatory compliance.
- Reviewed new business proposals as directed by President and Board.
- Human Resource Director for staff of 75.

March 1984 to April 1997 **National Bank of Alaska** Anchorage, Alaska
Branch Manager of Skagway and Nome Branches.

- Managed staff up to ten people.
- Responsible for internal and external compliance of banking rules and regulations.
- Provided customer service, compliance and lending training to staff.
- Branch lending officer (mortgage, consumer and commercial loans)

December 1981 to December 1983 **Sedcore Exploration, Ltd.** Fairbanks, Alaska
Project Supervisor, core drilling

EDUCATION

- Hotel Administration - University of Nevada, Las Vegas 1976-1980
- Continuing education - University of Wisconsin, Madison - Banking and Finance;
- University of Alaska, Anchorage - Accounting and Real Estate; University of Alaska, Fairbanks - Banking.

INTERESTS

- President - Nome Youth Hockey Association
- Secretary and Treasurer - Nome Aviation & Military Museum
- Past President - Nome Rotary Club, Skagway and Nome Chamber of Commerce
- Past Board Member - Nome Rotary Club, Nome Chamber of Commerce, Skagway Chamber of Commerce, Skagway Elks
- Nome Iditarod volunteer - 1992 to present
- Election Judge - Bering Straits Native Corporation, King Island Native Corporation

912A Rurik Way
P.O. Box 1164
Kotzebue, Alaska 99752

907-442-2960
bergan@otz.net

Matthew I. Bergan, P.E.

Objective

Design, engineer and manage energy and infrastructure projects in Alaska.

Experience

1998–Present *Kotzebue Electric Assoc., Inc. (KEA)* *Kotzebue, AK*

Project /Mechanical Engineer

- Installed, operated and maintained wind power projects in Kotzebue, Wales and Selawik, Alaska. These are the first utility-grade turbines installed in Alaska.
- Worked in conjunction with the City of Kotzebue to design, engineer, and procure the recently commissioned City-KEA ad-heat system. Revenues from the project are kept in the community this reducing the cost of energy and utilities.
- Installed and maintained a supervisory control and data acquisition system (SCADA) to remotely monitor and record the Kotzebue wind turbine site.
- Collaborated with the NWABSD to install a 2.8 kW solar energy system at the Alaska Technical Center in Kotzebue, Alaska.

2003–Present *UAF - Chukchi Campus* *Kotzebue, AK*

Math/Science Tutor

- Tutor Chukchi College students to reinforce and review course materials.

1997–1998 *Atlantic Orient Corporation, Inc.(AOC)* *Norwich, VT*

Field Service Engineer

- Updated and revised an outmoded product bill of materials and vendor sources for AOC 15/50 wind turbine, achieving more efficient manufacturing.
- Project engineer for turbine installations in Morocco, Canada and United States.

1985–1998 *William B. Bergan, LS* *Haddam, CT*

Rodman

- Assisted with all aspects of family land surveying business after school hours and during the summer. Developed initial interests in Engineering.

Licensure

Professional Mechanical Engineer, State of Alaska, License No. ME10572

Professional Affiliations

- American Society of Mechanical Engineers.
- National Society of Professional Engineers.
- Alaska Professional Design Council.

Education

1993–1997 Norwich University Northfield, VT

- Bachelor of Science, Mechanical Engineering.
- Norwich University Corps of Cadets.

Eagle Electric LLC

A Subsidiary of Bering Straits Native Corporation

6937 Old Seward Highway
Anchorage, Alaska 99507
907.344.7121 + 907.344.0827 Fax

Eagle Electric is pleased to submit the following Corporate Profile.

Eagle Electric is part of the Bering Straits Native Corporation family of companies. We are committed to partnership that benefits both our shareholders and the broader community in which we both serve. We actively pursue our commitment to improve the quality of life of our people, protect our land, and preserve our culture and heritage.

Eagle Electric's commitment includes offering training and employment opportunities to Alaska natives and tribal members. Eagle Electric provides an apprentice program in conjunction with Kawerak, Inc. Kawerak's organizational goal is to assist Alaska Native people to take control of their future. With programs ranging from education to housing, and natural resource management to economic development, Kawerak seeks to improve the Region's social, economic, educational, cultural and political conditions.

Eagle Electric supports Kawerak's Education Employment and Training division, which is designed to provide support and assistance to tribal members who are looking for job training while they are continuing their education. The purpose of these programs is to provide applicants the opportunity to gain work experience, promote good work ethics and provide a public service to their community. Fifty-percent of Eagle Electric's employees in Nome have been trained in this Kawerak division.

In addition, Eagle Electric is actively involved in developing a new training program with Kawerak to train village residents. In 2001, Kawerak began the implementation of village-based skills training programs. These 2-4 week programs are designed for apprentices and are registered by the federal Department of Labor. Each training program uses a standard curriculum that is approved by the National Center for Construction Education and Research (NCCER). Participants earn college-credit through Northwest College/University of Alaska.

To be successful in any industry, quality is of the utmost importance. We offer more than satisfactory service, with the goal of becoming the service provider of choice. Our reputation is sustained by making customers active partners. We value working relationships with full and open communication. It is only through this process we learn our customer's needs and insure the highest performance levels and complete customer satisfaction.

We appreciate your interest in partnership with Bering Straits Native Corporation and Eagle Electric. We look forward to serving with you.

Sincerely,
Michael London, Senior Vice President

Eagle Electric LLC

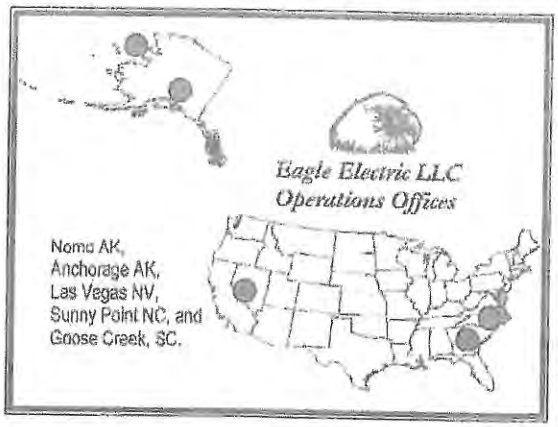
"Building Our Future" and "Doing It Right" with effective partnerships

Overview

Eagle Electric has served 20 years as a construction, renovation, maintenance, and electrical service contractor. In the early 1980s, the majority of our work was concentrated on residential (single and multi-family housing) to small/large scale hotel complexes.

Eagle Electric has grown substantially, performing larger commercial, industrial, and military projects. Continued expansion now involves on-going facility operations and maintenance support services. Our nationwide operations are now managed from offices in

- Nome AK,
- Anchorage AK,
- Las Vegas NV,
- Sunny Point NC, and
- Goose Creek, SC.



Eagle Electric's growth has resulted in the addition of trained management personnel, skilled estimators, and competent project managers. Our management staff has over 100 years' cumulative experience in the construction and services industry. Project leaders have successfully completed projects that vary in scope and size to over $20M in construction value.

Goal and Purpose

Eagle Electric is committed to:

(1) Exceptional workmanship,
(2) Competitive pricing,
(3) A successful project—from the very start,
(4) Responsive performance,
(5) Safety as a primary concern,
(6) Guarantees on electrical systems we install,
(7) Meeting each timeline and project schedule,
(8) complete customer satisfaction,
(9) Professional & friendly relationships, and
(10) Repeat business!

Professional Affiliations:

- Design-Build Institute of America
- Construction Financial Management Association
- Society of American Military Engineers
- Associated General Contractors of Alaska
- Construction Specifications Institute
- National Association of Women in Construction
- The Alaska 8(a) Association

Construction and Service Specializations

Eagle Electric is a full-service firm performing electrical contracting, facility maintenance and operations services. Our general contracting expertise is in design-build, new construction, renovation, restoration, construction management, and services work.

Eagle Electric serves as a prime contractor and subcontractor to the U.S. Government Agencies in multiple capacities. Contracts involve extensive NAS, safety and quality control requirements and procedures. Eagle Electric has excelled in meeting regulatory and safety requirements. Current contracts involve:

- Electrical System Remodeling and Improvements
- Installation and Maintenance of
  - Lighting
  - Fire Alarm Systems
  - Telephone & Data Systems
  - Communication Systems
  - Emergency Standby Power Systems
  - Nurse Call / Emergency Call systems
  - Sound and Intercom Systems

☑ Licensed
☑ Bonded
☑ Insured
☑ SBA 8(a) Certified
☑ DBE Certified

- Switchgear
- Electrical Testing
- Electrical Distribution
- Electrical Transfer Station Installations
- Roadway and Grounds Improvements
- Fiber Optic Systems Installation
- Switchgear Installation

Current & Recently Completed Projects

INDUSTRIAL

Baroid (Halliburton) Prudhoe Bay, Alaska
Prudhoe Bay Mud Plant Expansion & New Motor Control Centers & related electrical

Cooper Industries Prudhoe Bay, Alaska
Industrial Machine Shop Oilfield related equipment i.e.; Blow Out Preventers
Class I Division I & II Explosion Proof Electrical Installations

Nome Joint Utilities (Alaska Gold) Nome, Alaska
Three mile power line extension to Rock Creek Mine

GOVERNMENT

US Army COE Sunny Point, NC
Upgrade Deployment Staging & Storage Areas

US Army COE Sunny Point, NC
River Road Improvements

US Army COE Sunny Point, NC
North and South Wharf Lighting

Federal Aviation Administration Bettles, Alaska
Flight Service Station Electrical Upgrade

National Parks Service Nome, Alaska
Employee Housing Electrical Upgrade

Bureau of Land Management Anchorage, Alaska
Federal Building Upgrade & Installation of Electrical Office Furnishings

Social Security Administration Anchorage, Alaska
Federal Building Upgrade & Installation of Electrical Office Furnishings

National Park Service. King Salmon, Alaska
Upgrade Lighting

Tunanek Post Office Selawick, Alaska
Electrical Systems Installation for New Construction

Residential Housing Selawick, Alaska
Electrical Systems Installation for New Construction

RESTAURANTS & THEATERS

Benihana Anchorage, Alaska
Tempura Kitchens Anchorage, Alaska
Baskin Robbins Wasilla, Alaska
Gesine's Anchorage, Alaska
Wayne's Texas Barbeque Anchorage, Alaska
Peking Restaurant Palmer, Alaska
Bear Tooth Grill & Theater Pub Anchorage, Alaska
Various Espresso Stands in Anchorage & Mat-Su Valley, Alaska

MALLS & SHOPPING CENTERS

Country Village Mall Wasilla, Alaska
Tenant Improvements

Dimond Center Anchorage, Alaska
Tenant Improvements
Wal*Mart Anchorage, Alaska
Electrical & Lighting Upgrades at two Stores
Payless / Rite-Aid Anchorage, Alaska
Lighting Upgrades at Four Stores

COMMERCIAL BUILDINGS

Hilton Garden Inn Anchorage, Alaska
Installation of Electrical Systems for New Construction of 125 Room Hotel
Dimond Center Hotel Anchorage, Alaska
Installation of Electrical Systems for New Construction of 109 Room Hotel
Big Lake Public Library Big Lake, Alaska
Installation of Electrical Systems for New Construction
Palmer Pioneer Home ADRD Unit Palmer, Alaska
Electrical and Fire Alarm Systems Upgrade and Repair
Security Self Storage Eagle River, Alaska
Installation of Electrical Systems for New Construction
Denali Retail Center Anchorage, Alaska

Wagner Building Anchorage, Alaska
Electrical Upgrades in BLM Offices and Maintenance Shop
Alaska Laser Wash Anchorage, Alaska
Installation of Electrical Systems for New Construction
Merrill Field (General Aviation Airport) Anchorage, Alaska
Twenty-Four Airplane Hangars
Las Vegas Country Club Las Vegas, Nevada
Installation of Electrical Systems for New Construction & Upgrades to Existing Systems
North West Family Park Las Vegas, Nevada
Installation of Electrical Systems for New Construction & Upgrades to Existing Systems
Installation of Electrical Systems for New Construction & Upgrades to Existing Systems
Pioneer Park Las Vegas, Nevada
Installation of Electrical Systems for New Construction & Upgrades to Existing Systems
Fire Station 44 Las Vegas, Nevada
Installation of Electrical Systems for New Construction & Upgrades to Existing Systems
UMC Hospital Las Vegas, Nevada
Upgrades to Existing Electrical Systems
Boulevard Mall Las Vegas, Nevada
Upgrades to Existing Electrical Systems

MULTI-FAMILY HOUSING

Hampstead Heath Anchorage, Alaska
Installation of Electrical Systems for New Construction of 88 Units with Clubhouse
Brittany Estates Anchorage, Alaska
Installation of Electrical Systems for New Construction
Prestige 4-Plexes Anchorage, Alaska
Installation of Electrical Systems for New Construction
Foxwood Condominiums Anchorage, Alaska
Installation of Electrical Systems for New Construction of 56 Units
Turnberry Tower Condominiums Las Vegas, Nevada
Installation of Electrical Systems for New Construction
Park Tower Condominiums Las Vegas, Nevada
Installation of Electrical Systems for New Construction

CUSTOM HOUSING

Sable Ridge	Las Vegas, Nevada
Spanish Trails	Las Vegas, Nevada
Southern Highlands	Las Vegas, Nevada
The Enclaves	Las Vegas, Nevada

Installation of Electrical Systems for New Construction

Business Information

Type of Business:	Electrical Contractor
Date Business Established:	1987
Federal Employer I.D. No.:	92-0164963
State of Alaska Employer I.D. No.:	0001358626
Dun & Bradstreet No.:	602061046-1046
Alaska Business License No:	255681
Alaska Contractor's License No.:	25788

Service Classification NAICS Codes

238210 - Electrical Contractors
236116 - Multifamily Housing Construction
236210 - Industrial Building Construction
236220 - Commercial & Institutional Building Construction
541330 – Engineering Services
561210 – Facilities Operations and Support Services
811310 – Commercial & Industrial Machinery & Equipment (except Automotive & Electronic) Repair and Maintenance)

Service

Our service team tailors preventive maintenance plans to suit specific needs and concerns. Ensuring proper operation of equipment can help extend equipment life, resulting in fewer equipment breakdowns, reducing emergency service calls and increasing operating efficiency.

On larger projects, we employ program managers to help assure that the projects are organized with a single point of contact for our customers and our project personnel.

Selected Experience

The following projects have been selected to demonstrate Eagle Electric's capabilities and qualifications in providing prime contracting, building operation, maintenance and electrical services for a variety of project types.

- **Chugach View Senior Housing Complex**, Contract Amount - $590,689.00 Total of approved Change Orders was $250,121.67 Revised Contract Amount is $840,811. Complete wiring to remodel complex to house seniors while occupied. Project consisted of upgrading systems and fire alarm monitoring and emergency systems.
- **Town Square Manor- 90 unit**, Contract Amount is $310,000. Electrical services included wiring for 90 unit apartment complex with garages – including power, lights, and fire alarm system.

- **Lowe's Retail Facility, Fairbanks**, Contract Amount - $1,011,669
  Total of (24) Change Orders for approximately $ 150,000. The project consisted of all electrical and systems wiring within this almost 200,000 square foot facility. The building management systems include emergency generator, Novar lighting, automated temperature controls, remote humidity sensors, and occupancy sensors. The General Contractor is Roger Hickel Contracting.

- **Anchorage Pioneer Home Fire Alarm Replacement.**, Contract Amount $ 492,333
  This State funded project consisted of providing a new code compliant fire alarm system for the Anchorage Pioneer Home and removing the two existing systems. The Client is the State of Alaska.

- **Nome Youth Facility**, Contract Amount - $284,729.00
  General Contractor is Hankal Construction. Scope of work included a new 600 amp service, all new lighting, approximately 100 fixtures, design and installation of new central lighting control.

- **Multi Purpose Facility, King Island Native Community** Nome, Amount - $96,360
  Scope of work included 3,000 sq. ft., complete new 200 amp service, and fire alarm service. The building houses a recreation area, carving room, community conference room and a store.

- **Old Federal Building – BSNC New Headquarters.** Scope of work included renovation of the entire 3rd floor, including new panels, lights, telecommunications, and updating existing wiring to bring it up to current code.

- **Anvil Mountain Correctional Facility Fire Alarm Replacement in Nome.** Contract Amount is $125,000. Owner is the State of Alaska, Department of Corrections. Project consists of a complete reinstallation/ replacement of the fire alarm system.

Eagle Electric LLC

"Building Our Future" and "Doing It Right" with effective partnerships

Selected Nationwide Customers

Johnson Controls

Star Software Corporation

U.S. General Services Administration

U.S. Air Force

Stryker

Safeway

Sytex, A TSGI Company

Symvionics, Inc.

Selected Local Customers

US Army Corps of Engineers

Wal-Mart

U.S. Air Force, Elmendorf Air Force Base

Industrial Drilling Products

GCI

Halliburton

Social Security Administration

Schlotzsky's Deli

Cooper

University of Alaska Anchorage

National Park Service

The Home Depot

Hawthorn

Hilton

Alaska USA Federal Credit Union

Office Depot

NAC Northern Air Cargo

Sperry-Sun Drilling Services

Goodyear

Alaska Pipeline

Baskin Robbins

Lowe's, Let's Build Something Together

Prudential Financial, Growing and Protecting Your Wealth

Honeywell

Long House

Rapids Camp Lodge, Legendary Alaska Fishing

Sears

Southcentral Foundation

Bear Tooth Grill

Rural CAP

Electrical Contractors | Commercial, Industrial, Residential, Service & Maintenance | Licensed, Bonded & Insured

Idaho Tower Construction Company

P. O. Box 4944 • Ketchum, ID 83340 (208) 578-3636 www.idahotower.com

September 30, 2007

John Campbell

Communications and Wind Tower experience

John Campbell is the owner of the Idaho Tower Company. Formerly, he was the owner of the Puerto Rico Tower Company and the BC Construction Group of the Virgin Islands and Puerto Rico. Since 1992 he has personally erected over 400 self support towers, guyed towers, and monopoles.

John's steel erection experience began as an Ironworker, erecting the steel frames of office buildings, airplane hangars, and metal buildings. After Hurricane Hugo decimated most of the communication towers in the Virgin Islands, he started replacing them. As his reputation spread for doing high quality work in a fast and efficient manner, he started building towers in Puerto Rico as well. BC Group became the "go to" company for difficult towers on challenging sites with difficult access or other extraordinary site conditions. When a series of hurricanes blasted through the islands two years later, and every one of the BC Group towers emerged unscathed, his business flourished.

After selling his company in 2000, John moved to Idaho, and started the Idaho Tower Company. In addition to building communications towers, the Idaho Tower Company pursued various wind projects, including turbine erection, and anemometer tower installation.

With experience in working in Alaska (John Campbell worked in Anchorage for two summers), with experience erecting over 100 Rohn self support towers, with experience installing the Integrity turbines, and with experience building projects in extremely challenging conditions at challenging sites with difficult access, Idaho Tower is uniquely qualified to work on the Nome Wind Power project.

Please call to discuss any questions or concerns.

Idaho Tower Construction Company

P. O. Box 4944 • Ketchum, ID 83340 (208) 578-3636 www.idahotower.com

Who we are:

We have been a turnkey provider for over 400 self-support towers, from 35 ft to 400 ft tall, throughout the northwest (ID, WY, NV, MT, WA) and Caribbean since 1992.

Our experience and expertise gained from the communication tower business has made for a smooth transition into the wind energy market. We look forward to being a major contributor to wind energy development in the American northwest.

Services Provided and Experience:

•Turbines:
Shipping and Unpacking
Transport of all Machinery
Excavation
Foundation Engineering and Construction
Erection and Iron Work

•Anemometers:
Anemometer Tower Installations
Wiring and set up of anemometers, wind vanes, and data loggers

•Cranes:
Hydraulic: up to 250 tons with 330 feet of boom and jib.
Lattice: up to 400 tons with 380 feet of boom and jib.

•Foundations:
Pad and pier as large as 400 cubic yards.
Pile
Rock Anchor. We have designed and constructed rock anchor foundations to handle tower reactions of uplift and compression in excess of 1,000 Kips.

•Safety:
We pride ourselves on a spotless safety record.

•Organizations:
N.A.T.E.
Climbers certified by Commtrain

•Last Projects:
*Erected two Integrity turbines for Synthetic Energy in Shoshone, ID.
*Hung anemometers and wind vanes on 220' Sabre self-support towers at Puget Sound Energy's Wild Horse Wind Farm for Global Energy Concepts.
*Numerous Installations of NRG tilt up anemometer towers in ID, MT, and NV.

• References

Tim Lang
UPC Wind
519-272-7545
519-273-8019 fax
tlang@upcwind.com

Jennifer Bredt
Renewable Energy Specialist
Division of Energy and Mineral Development
12136 W. Bayaud Ave. Suite 300
Lakewood, CO 80228
720.407.0660

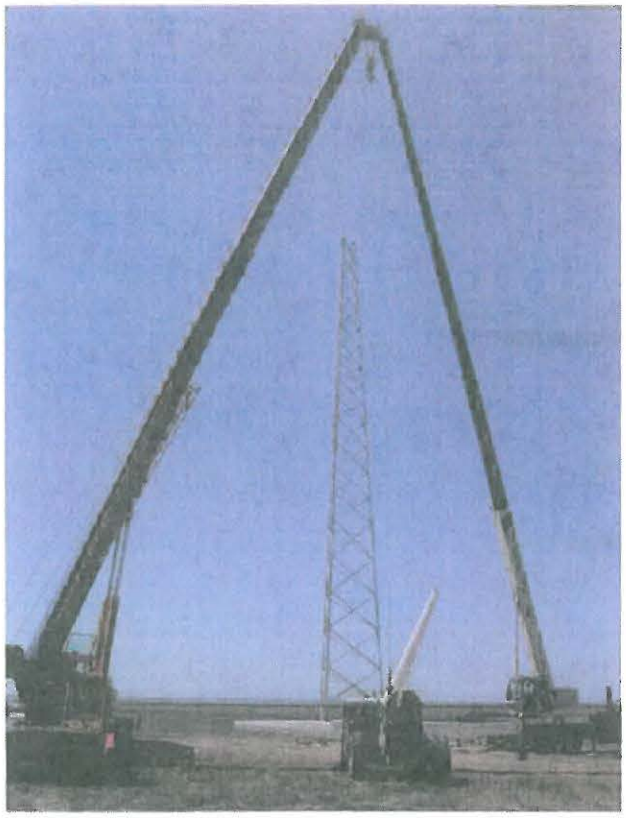
Brian Jackson
Renaissance Engineering and Design
2792 Desert Wind Rd.
Oasis, ID 83647-5020
208.796.2222

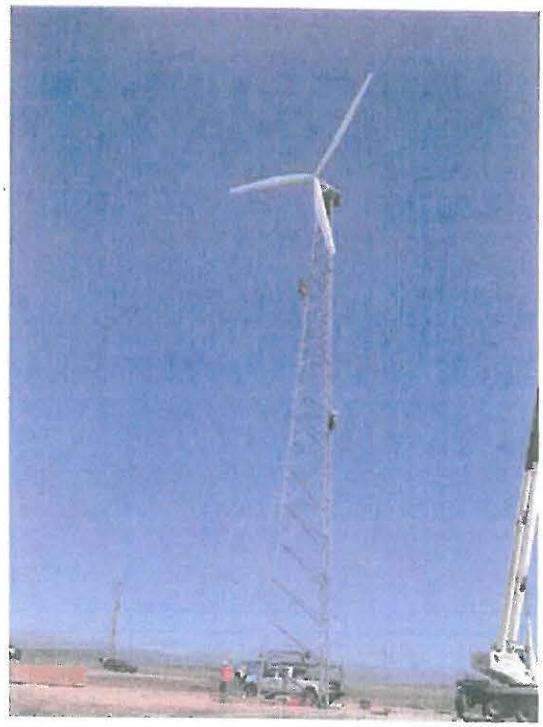
Thomas Griffith
Synthetic Energy
Ketchum, ID 83340
208.727.0070

John Lyons
Lead Test Technician
Global Energy Concepts
1809 7th Avenue Suite 900
Seattle, WA 98101
206-387-4242 (office)
206-387-4201 (fax)

For more information please contact:
Eric Demment,
Vice President of Business Development
ericd@idahotower.com
208.578.3636 office
208.578.7682 fax
208.309.0742 cell
Or visit our website at www.idahotower.com

ENTEGRITY INSTALLATION IN IDAHO





6c. Regulatory and Other Approvals

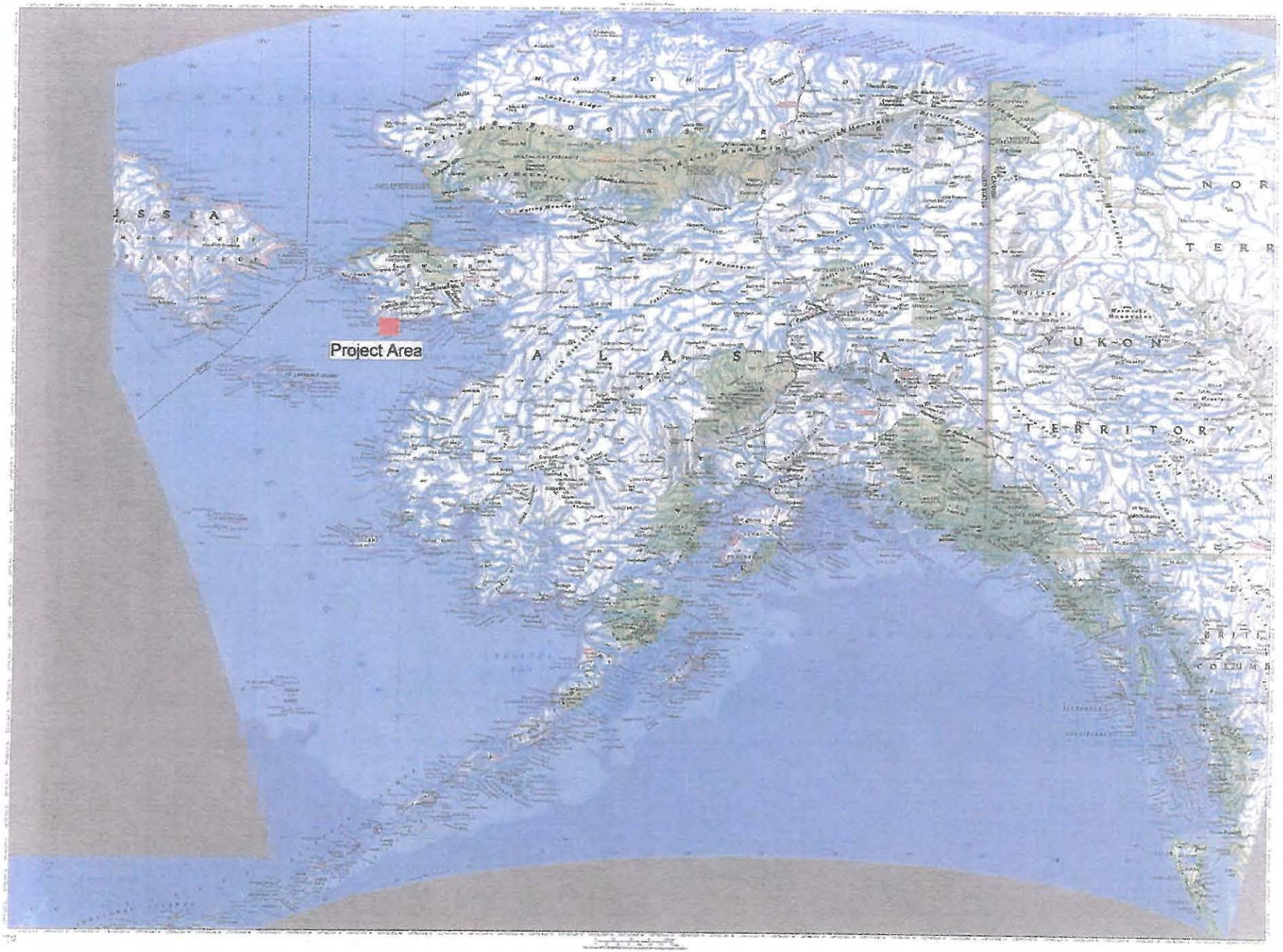
The project site is located on land owned by Sitnasuak Native Corporation. The site is located outside Nome City limits and is not subject to any local city zoning and regulatory codes. An agreement will be required with Nome Joint Utility Systems for the wind project to connect to the grid. The US Army Corp of Engineers will be consulted to determine if a USACE 404 fill permit will be needed for the Snake River site. A Phase I Environmental Review will be conducted to further determine the status of the land. Both properties are undeveloped with no expected environmental concerns. **BSNC staff anthropologist Matt Ganley will insure property meets all state and federal requirements relating to section 106 (NHPA) and environmental reviews (NEPA) and other regulations. An onsite evaluation will be conducted to ensure the project conforms to NAGPRA requirements.**

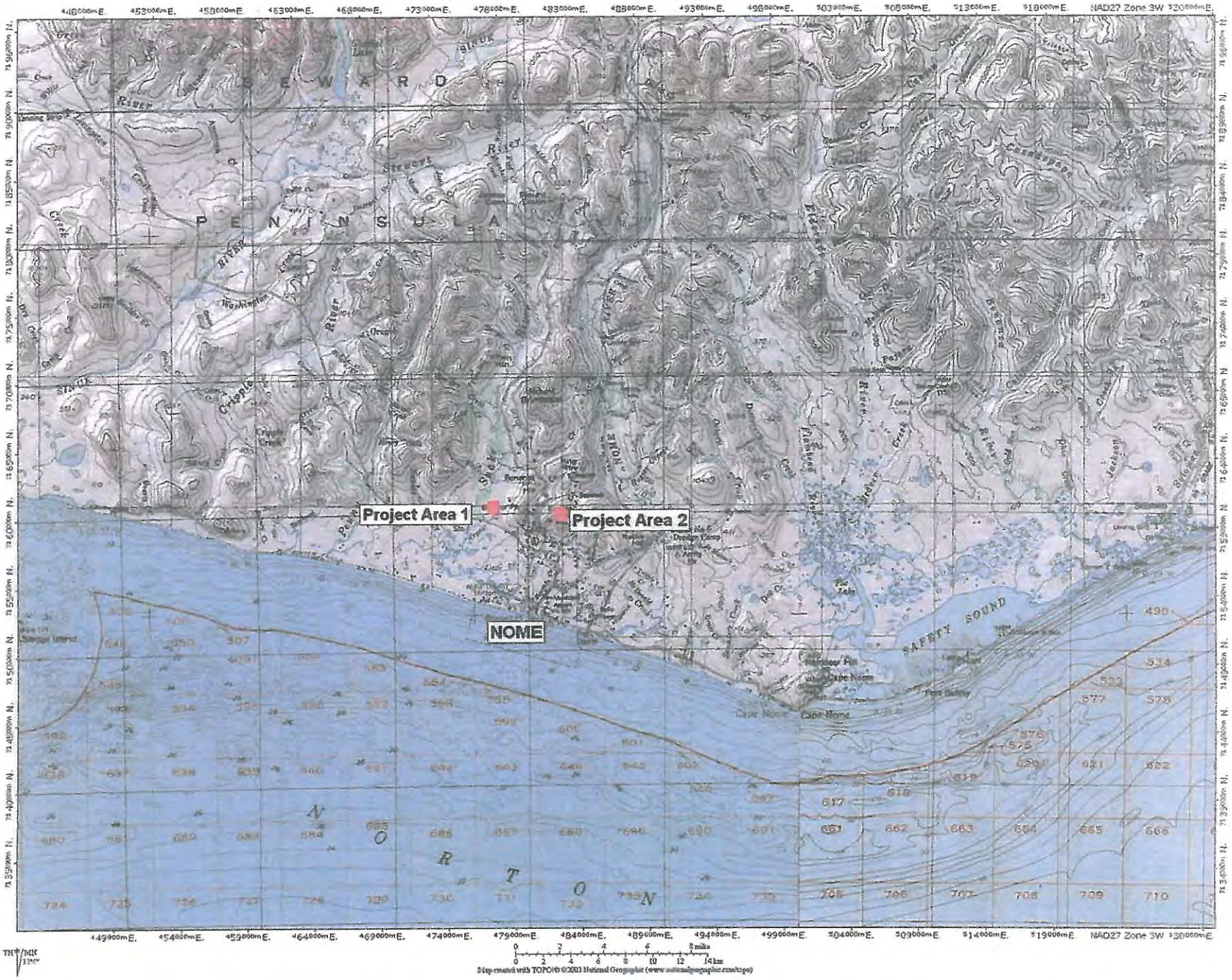
Project Location Maps

Sample Project Kotzebue Information and Photos

Alaska Interconnection Law

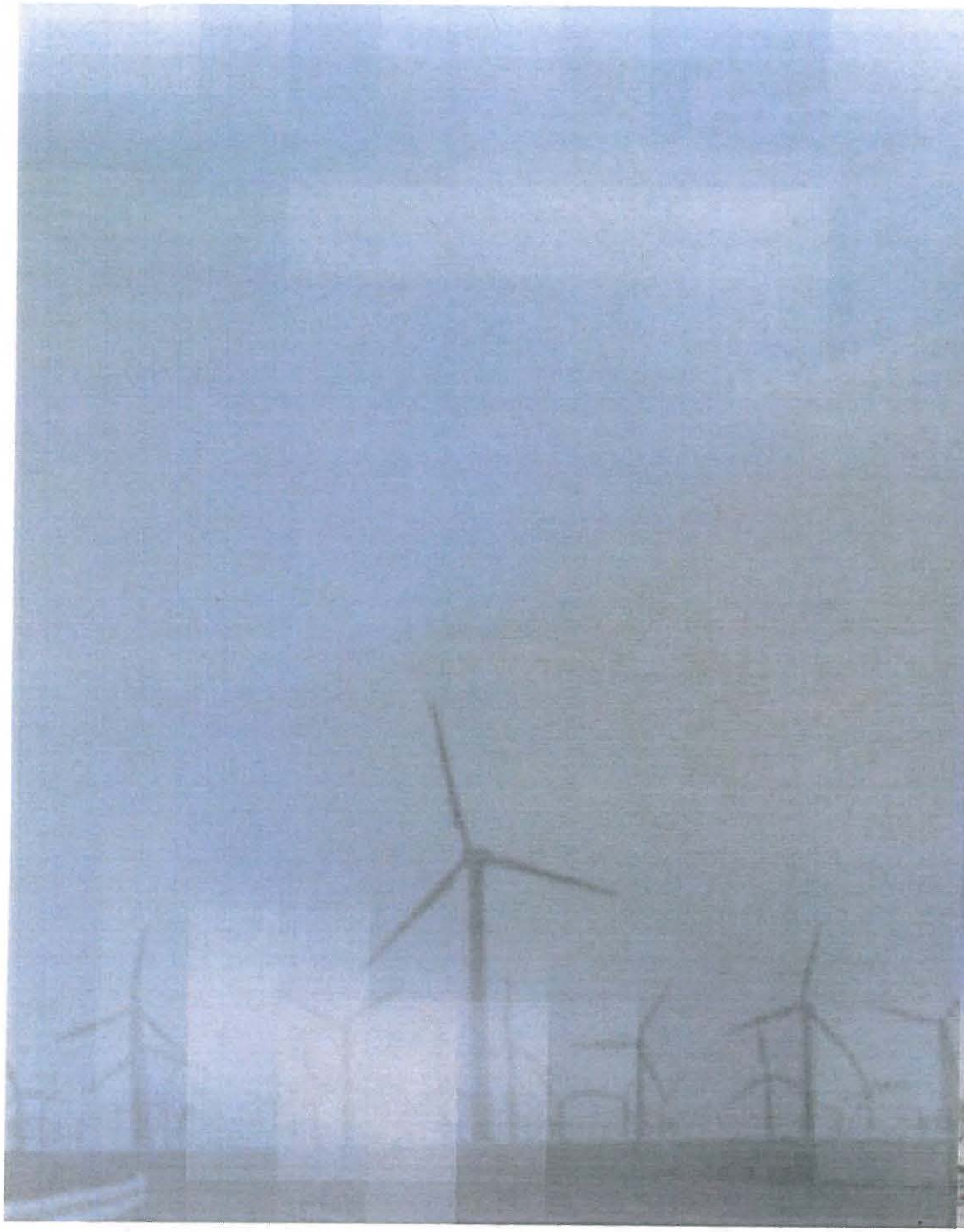
Matt Ganley VP Land and Resources Resume


Project Area
A L A S K A
YUKON
TERRITORY


Project Area 1
Project Area 2
NOME
SEWARD
PENINSULA
SAFETY SOUND
NORTON
NAD27 Zone 3W
Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

Project Area 1
Project Area 2
NOME
NORTON SOUND
NOME RIVER
CORPORATE BOUNDARY

Wind Project



NOME JOINT UTILITY SYSTEM

a component unit of CITY OF NOME

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

September 28, 2007

Jerald Brown
Bering Straits
PO Box 1008
Nome, AK 99762

Dear Jerald,

As you are aware, the Utility Board has long expressed support for and has been investigating alternative energy options that can potentially reduce reliance solely on diesel for power production in Nome. We have been collecting wind data sporadically for several years, and now believe we are close to having a full year of valid data that indicates sufficient wind resource in the Nome area to move toward the goal of adding wind power.

The Mayor of Nome requested assistance from the US Department of Energy and the Alaska Energy Authority to study various alternatives that may be available in the area, including wind, coal, geothermal, and natural gas. There are many issues that will need to be considered by the Utility to come to a final decision to proceed with any alternative energy project, including capital and operating costs, and maintenance and system-intertie considerations. The study is nearing completion and we expect it to be released soon so local decision makers can utilize it in the planning process.

I applaud the proactive attitude, initiative and support of the local community in also seeking creative solutions to the high energy costs in the community. This is to confirm our conversation and interest in the possibility of having alternate energy available to the Utility to avoid diesel use. While the Utility may pursue the installation of wind generation on its own, we encourage you to pursue your concept of installing a private wind farm that could provide energy to our grid. Existing Utility Tariffs do provide for co-generation, but these provisions have not been utilized in years, and were envisioned on a smaller scale than what you propose.

The potential of having 500kw available would not interfere with the Utility's own conceptual plans. There are numerous system and operational issues that would need to be considered, and a detailed engineering proposal developed, but we look forward to further discussions, and encourage you to pursue any funding opportunities that may be available to make wind power in Nome a reality. Should such a system be available, NJUS would be interested in pursuing a power purchase agreement that would provide a direct energy cost reduction benefit to Nome's residents.

Sincerely,

John K. Handeland
General Manager/Chief Operating Officer
NOME JOINT UTILITY SYSTEM

Providing reliable utility services to system rate payers efficiently and economically by prudently operating and maintaining system assets in a fiscally responsible manner

Article 2
Cogeneration and Small Power Production

Section

750. Application, purpose, and waiver.

760. Interconnection.

770. Purchases.

780. Sales.

790. Implementation.

800. Disconnection.

810. Disputes.

820. Definitions.

3 AAC 50.750. Application, purpose, and waiver

(a) 3 AAC 50.750 - 3 AAC 50.820 apply to all electric utilities subject to the regulatory jurisdiction of the commission under AS 42.05.361 - 42.05.441. These sections govern interconnection and purchases and sales of electric power between an electric utility and a qualifying facility.

(b) The purpose of 3 AAC 50.750 - 3 AAC 50.820 is to encourage cogeneration and small power production by setting out guidelines for the establishment of reasonable, nondiscriminatory charges, rates, terms, and conditions under which interconnection and purchases and sales of electric power will occur between an electric utility and a qualifying facility.

(c) Any requirement in 3 AAC 50.750 - 3 AAC 50.820 may be waived, in whole or in part, or be modified by order of the commission upon application and a showing of good cause. An entity shall file and the commission will consider an application in accordance with 3 AAC 48.805.

History: Eff. 11/20/82, Register 84; am 4/24/2004, Register 170

Authority: AS 42.05.141

AS 42.05.151

AS 42.05.711

3 AAC 50.760. Interconnection

(a) An electric utility shall make interconnection with a qualifying facility as may be necessary to

accomplish purchases or sales under 3 AAC 50.750 - 3 AAC 50.820.

(b) Notwithstanding (a) of this section, an electric utility is not required to interconnect with a qualifying facility if

(1) the electric utility, solely because of purchases and sales over the interconnection, would become subject to federal regulation under Subchapter II of the Federal Power Act, 16 U.S.C. § 824; or

(2) a qualifying facility does not comply with the safety and reliability standards prescribed for interconnection by the commission.

(c) An electric utility may assess a qualifying facility interconnection charges which are reasonable and nondiscriminatory with respect to other customers that have similar load characteristics.

(d) Interconnection charges may include the reasonable costs of connection, switching, metering, transmission, distribution, safety provisions, administration, and other costs incurred by the electric utility directly related to the installation and maintenance of the physical facilities necessary to permit interconnected operations with a qualifying facility, to the extent these costs are in excess of the corresponding costs which the electric utility would have incurred if it had not engaged in interconnected operations, but instead generated an equivalent amount of electric power from other sources. Interconnection costs do not include any costs included in the calculation of avoided costs.

(e) An electric utility shall offer a qualifying facility the option of reimbursing the electric utility for interconnection charges over a reasonable period of time. The electric utility may charge reasonable interest, to be prescribed in its tariff or special contract, for the financing of the interconnection costs.

(f) If a dispute arises under 3 AAC 50.810, an electric utility shall submit to the commission the information necessary to support the methodology and calculations used in developing the charges assessed to a qualifying facility for interconnection.

(g) An electric utility shall offer to operate in parallel with a qualifying facility.

(h) An electric utility shall offer a qualifying facility that has a generating capacity of 10 kilowatts or less the option of using a single detent meter during parallel operation.

History: Eff. 11/20/82, Register 84

Authority: AS 42.05.141 (a)

AS 42.05.151 (a)

AS 42.05.291 (b)

AS 42.05.301

AS 42.05.361 (a)

AS 42.05.381 (a)

3 AAC 50.770. Purchases

(a) An electric utility shall purchase, in accordance with (c) - (f) of this section, any electric power which is made available from a qualifying facility.

(b) Notwithstanding (a) of this section, an electric utility is not required to purchase electric power from a qualifying facility if

(1) due to operational circumstances, purchases from a qualifying facility result in costs greater than those which the electric utility would have incurred if it had not made such purchases but had instead generated or purchased an equivalent amount of power; if purchases have started, an electric utility seeking to stop purchase under this paragraph shall notify in writing each affected qualifying facility in time for the qualifying facility to stop the delivery of electric power to the electric utility, or the electric utility shall pay the expense it would have incurred had power continued to be purchased from the qualifying facility at established rates during the same period;

(2) during a system emergency, purchases from a qualifying facility would further contribute to the emergency; or

(3) with the agreement of the qualifying facility, the electric utility transmits the electric power to another electric utility which is obligated to purchase that electric power as if it were supplied directly by the qualifying facility.

(c) Rates for purchases of electric power must be just and reasonable and must not discriminate against qualifying facilities or adversely affect the consumers of the electric utility.

(d) For purchases from a qualifying facility which supplies non-firm power, rates must be based on the cost of energy which the electric utility avoids by virtue of its interconnection with the qualifying facility. Rates under this subsection must comply with the following requirements:

(1) Unless otherwise modified by the commission, avoided energy costs, expressed in cents per kilowatt-hour, must be determined from the sum of fuel and variable operation and maintenance expenses and the energy portion of purchased-power expense for a 12-month period, approved by the commission, updated by subsequent fuel costs, and divided by the number of kilowatt-hours sold for the same time period. Expenses and kilowatt-hours sold associated with hydroelectric generation must be specifically excluded from the computation of avoided costs for an electric utility which relies on hydroelectric generation for 25 percent or more of its total power requirements.

(2) An electric utility shall submit to the commission the following information for the calendar or fiscal year preceding the date of filing, or a more recent 12-month period, to support rates for purchases of non-firm power:

(A) the data and computation of avoided energy costs specified in (d)(1) of this section; and

(B) at its option, the data and computation of avoided energy costs based on any other methodology deemed appropriate and justifiable by the electric utility.

(3) Rates for purchases of non-firm power must be adjusted contemporaneously with fuel-cost rate adjustments and with changes in avoided energy costs in general rate revisions.

(e) For purchases from a qualifying facility which supplies firm power, rates must be based on the costs of energy and capacity which the electric utility avoids by virtue of its interconnection with the

qualifying facility. Rates under this subsection must comply with the following requirements:

(1) In determining avoided energy and capacity costs, to the extent practicable, the following factors must be taken into account:

(A) the estimated avoided energy costs stated on a cents per kilowatt-hour basis for the current calendar or fiscal year and each of the next five years;

(B) the electric utility's plan for the addition of capacity by amount and type, for purchases of firm energy and capacity, and for requirements for each year during the next 10 years;

(C) the estimated capacity costs at completion of the planned-capacity additions and planned-capacity firm purchases, on the basis of dollars per kilowatt and the associated energy costs of each unit, on the basis of cents per kilowatt-hour; these costs must be expressed in terms of individual generating units and of individual planned firm purchases;

(D) the availability of capacity or energy from a qualifying facility during system daily and seasonal peak periods;

(E) the ability of the electric utility to avoid costs due to the availability of energy or capacity from the qualifying facility; and

(F) the costs or savings resulting from variations in line losses due solely to purchases from qualifying facilities.

(2) An electric utility shall submit to the commission the information necessary to support the methodology and calculations used in developing rates for purchase of firm power based on avoided energy and capacity costs.

(f) Rates for purchases from a qualifying facility, the construction of which was commenced on or after November 9, 1978, must be set at an electric utility's full avoided costs as determined under (d) or (e) of this section. Rates for purchases from a qualifying facility, the construction of which was commenced before November 9, 1978, may be set at less than full avoided costs, provided that the lower purchase rates are established in accordance with (c) of this section.

(g) An electric utility which is legally obligated to obtain all of its requirements for electric power from another electric utility shall submit to the commission the requisite avoided cost data of its supplying utility and the rates at which it currently purchases such energy and capacity. The supplying electric utility shall make the necessary information available to the purchasing electric utility at the time its wholesale power rates are approved by the commission.

(h) An electric utility or qualifying facility may agree by special contract, subject to 3 AAC 48.390, to different rates, terms, or conditions for purchases than otherwise required by this section. A contract between an electric utility and a qualifying facility is valid if the commission determines the rates, terms, or conditions for purchases are just and reasonable to the customers of the electric utility and in the public interest. The contract may not be nullified under 3 AAC 50.770(b) (1) without prior commission approval.

History: Eff. 11/20/82, Register 84

Authority: AS 42.05.141 (a)

AS 42.05.151 (a)

AS 42.05.291 (c)

AS 42.05.361 (a)

AS 42.05.391 (a)

3 AAC 50.780. Sales

(a) An electric utility shall provide service to a qualifying facility including, but not limited to, supplementary power, back-up power, maintenance power, and interruptible power.

(b) Notwithstanding (a) of this section, an electric utility is not obligated to provide supplementary power, back-up power, maintenance power, and interruptible power to a qualifying facility upon a showing to and determination by the commission, after reasonable notice and an opportunity for public comment, that compliance with that requirement will either impair the electric utility's ability to give adequate service to its customers or impose an undue burden on the electric utility.

(c) Rates for sales must be just and reasonable and in the public interest and must not discriminate against the other consumers of the utility or against a qualifying facility in comparison to rates for sales to other customers of the electric utility with similar load or other cost-related characteristics.

(d) An electric utility shall submit to the commission the information necessary to support the methodology and calculations used in developing rates for sales of electric power to a qualifying facility in conformance with applicable commission regulations.

(e) Rates for sales of back-up power and maintenance power

(1) must not be based upon an assumption that forced outages or other reductions in electric output by all qualifying facilities on an electric utility's system will occur simultaneously, or during the system peak, or both, unless the assumption is supported by factual data; and

(2) must take into account the extent to which scheduled outages of the qualifying facilities can be usefully coordinated with the scheduled outages of the electric utility's facilities.

(f) During any system emergency, an electric utility may discontinue sales to a qualifying facility, provided that the discontinuance is on a nondiscriminatory basis.

History: Eff. 11/20/82, Register 84

Authority: AS 42.05.141 (a)

AS 42.05.151 (a)

AS 42.05.291 (c)

AS 42.05.301

AS 42.05.361 (a)

AS 42.05.381 (a)

AS 42.05.391 (a)

3 AAC 50.790. Implementation

(a) The effective tariff of an electric utility must delineate and authorize interconnection and purchases and sales of electric power between an electric utility and a qualifying facility including, but not limited to, provisions for

(1) the charges, terms, and conditions for interconnection to a qualifying facility, including the method and timing of payment of interconnection charges by a qualifying facility;

(2) the rates, terms, and conditions for purchases of firm and non-firm power from a qualifying facility; and

(3) the rates, terms, and conditions for sales of power to a qualifying facility.

(b) Not later than 60 days after receipt of a written request for interconnection from a qualifying facility, an electric utility shall file with the commission for its consideration a tariff for interconnection, purchases, and sales with the requesting qualifying facility in accordance with applicable provisions of AS 42.05.361 - 42.05.441, 3 AAC 48.200 - 3 AAC 48.390, and 3 AAC 50.750 - 3 AAC 50.820.

(c) Notwithstanding (a) and (b) of this section, an electric utility may enter into a special contract with a qualifying facility specifying the charges, rates, terms, and conditions of interconnection, purchases, and sales between an electric utility and a qualifying facility, provided use of a special contract otherwise conforms to applicable commission regulations.

(d) Not later than 60 days after the effective date of 3 AAC 50.750 - 3 AAC 50.820, each electric utility shall compile and maintain for public inspection upon request the current data and information specified in 3 AAC 50.770(d) (1) and (e)(1)(A) - (e)(1)(C). and a schedule setting forth all current tariff and special contract purchase rates with qualifying facilities.

(e) By January 14, 1983, each electric utility shall submit to the commission for inclusion in its tariff, standard rates for the purchase of non-firm electric power from qualifying facilities with a design capacity of 100 kilowatts or less. These purchase rates must be based on the utility's avoided costs is determined under 3 AAC 50.770(d) .

History: Eff. 11/20/82, Register 84

RESUME

MATTHEW L. GANLEY

PERSONAL

10315 Main Tree Drive
Anchorage, Alaska 99507
Telephone: 907-644-4700
Fax: (907)868-0126

GENERAL SUMMARY

My current employment with BSNC is the culmination of past educational and work-related experience in the fields of cultural and natural resource management combined with a strong knowledge of issues and historical trends stemming from the Alaska native Claims Settlement Act. I have the requisite experience and have conducted a number Section 106 (NHPA) and Environmental Reviews (NEPA) on a project specific basis.

EDUCATION

(Ph.D.) University of Alaska, Fairbanks. Cultural Anthropology. Completed course work and language requirements.

M.A. University of Alaska Fairbanks, Fairbanks, Alaska
Cultural Anthropology, June 1990.

B.A. Lafayette College, Easton, Pennsylvania
English Literature, June, 1981.

EMPLOYMENT

January 2004 to Present

Vice President, Land and Resources
Bering Straits Native Corporation
P.O. Box 1008
Nome, Alaska 99762

Supervisor: Tim Towarak
Supervisory Experience: Supervise BSNC Land and Resource Dept.
Duties: As VP of Lands I oversee the 2.1 million acres of surface and subsurface estate granted to the residents of the BSNC region through the Alaska Native Land Claims Settlement Act of 1971. This position requires work in the fields of resource development, cultural resource preservation, tourism development, land management, and mapping. I am currently negotiating the final allocation of land

entitlements for BSNC, as well as overseeing development, tourism, and conservation effort on BSNC lands.

May 1993 to
December 2003

Archaeologist/Anthropologist
Bering Straits Foundation
P.O. Box 1008
Nome, Alaska 99762
(14(h)(1) Program, NAGPRA)

Supervisor: Vern Olson/(907)443-5252
Supervisory Experience: Supervised 1-2 individuals.
Duties: Current duties include ethnographic research and archaeological fieldwork in conjunction with Native Claims for traditional sites and consultation for the Foundation's NAGPRA program. Bering Straits Foundation has also received contracts for compliance archaeology related to Section 106 of the National Historic Preservation Act. A primary responsibility of this position is to work closely with Village Corporations and Tribal entities in matters of cultural/heritage resource preservation. In 1993, I developed a plan of organization and secured funding for the Bering Straits Foundation to assist the region's communities in their repatriation efforts (NAGPRA). That program is ongoing and has resulted in the return of numerous ancestral remains to their original resting places. Other duties included grant writing and preparation of 14(h)(1) information for use in Bering Straits Native Corporation's Land Department land status mapping program.

August 1999
To 2001

Expert Witness/Anthropological Research
Native American Rights Fund
and Native Community Eyak
420 L Street, Suite 505
Anchorage, Alaska 99501-1937

Supervisor: Lare Aschenbrenner
NARF (907)276-0680
Duties: This contract entails research and completion of the plaintiff's report in the matter of Eyak vs. Daley, a case seeking aboriginal title to the OCS waters for the communities of Eyak, Tatitlek, Chenega, Port Graham and Nanwalek. Specific work included interviewing people in the participating communities concerning their use of the outer waters, compiling Leer's place name information for use in GIS-based applications, use of the BIA/ANCSA taped interviews for historical information, and preparation of the final report which is to be submitted to the court on August 20.

April 1999
To 2004

Technical Advisor/Mapping Technician
Southeast Native Subsistence Commission
Central Council of Tlinget-Haida Indians
300 Willoughby

Juneau, Alaska

Supervisor: Tom Thornton (UAS)
Duties: Primary work includes the development of GIS based databases and maps from existing Native Place name data. The project includes the digitization of existing hard-copy maps and creation of Raster image maps for use with ArcView and ArcInfo. Large, poster maps were prepared fro each of 10 communities. In 2004, work began on a comprehensive place name atlas for the SE Alaska region.

November 1996
To May 1997

Technical Advisor/Mapping Technician
Alaska Native Language Center
University of Alaska
Fairbanks, Alaska

Supervisor: Jim Kari
Duties: Preparation of final map projections for Jim Kari's Upper Tanana Place Name inventory. This work consisted of conversion of existing place name data into GIS-based database format, digitization of work maps, and preparation of final maps for publication.

November 1996
to August 1997

Expert Witness/Anthropological Consultant
Kavairlook et. al. vs. Ryan Air

Supervisor: Marc June, Attorney
Marc June and Associates
Anchorage, Alaska
Duties: As a consulting anthropologist on this case, I collected information for the plaintiffs regarding the deceased and the their roles within the community of Koyuk, Alaska, as Tribal leaders, subsistence providers, and family members. The work and resulting report focused on the qualitative aspects of leadership: i.e. how leaders develop, how they contribute within regional, community and familial contexts, and community/familial response to the loss of individuals.

June 1991 to
May 1993

Archaeologist/Anthropologist
Ahtna, Inc. Regional Native Corporation
Land and Resource Department
Glennallen, Alaska
(14(h)(1) Program)

Supervisor: John Devenport, Land Manager/(907)822-3476
Supervisory Experience: Supervised 1-2 individuals.
Duties: Duties included ethnographic research and archaeological fieldwork in conjunction with Native Claims for traditional sites and consultation for Ahtna,

Inc. Regional Native Corporation. Other duties included Section 106 compliance archaeology for federally funded programs on Ahtna, Inc. lands.

June 1987 to
August 1987

Archaeologist
National Park Service
Anchorage, Alaska
(Survey-Krusenstern National Monument)

Supervisor: Doug Gibson
Supervisory Experience: No supervisory experience with this position.
Duties: Remote survey and documentation of sites within Cape Krusenstern National Monument were the primary duties of this position. Skills need for this work consisted of site location and mapping, use of aerial photos and USGS maps.

May 1985 to
August 1985

Archaeologist
National Park Service
Gates of the Arctic National Park
Fairbanks, Alaska
(Survey-Gates of the Arctic)

Supervisor: Mike Kunz
Supervisory Experience: Did not supervise in this position.
Duties: Remote site survey and documentation in the Chandler lake and John River areas.

August 1984 to
September 1984

Archaeologist
University of Alaska Museum
Fairbanks, Alaska
(North Alaska Range Early Man Project)

Supervisor: Roger Powers/(907)474-7288
Supervisory Experience: Did not supervise.
Duties: Remote archaeological site survey, testing and excavation within the Healy/Nenana Valley area.

July 1984 to
August 1984

Archaeological Field Assistant
Anvik Historical Society
Anvik, Alaska

Supervisor: Roger Powers/(907)474-7288
Supervisory Experience: Supervised 7 high school students from the middle-lower Yukon River area in a field school setting.
Duties: This project was initiated by the Anvik Historical Society to document the amount of erosion that has occurred at old Anvik since the time of DeLaguna's work in the 1930's. We also documented other sites in the immediate area of

Anvik with the assistance of the high school students hired through Tanana Chiefs Conference as a field crew.

July 1983 to
October 1983

Ethnographer/Archaeologist
Doyon, Ltd.
Lands Department
Fairbanks, Alaska
(Survey/Ethnohistory-Yukon Flats)

Supervisor: Dale Slaughter, Gary Lee/(907)452-4755 (Doyon, Ltd.)
Supervisory Experience: Supervised 2 high school students from Fork Yukon and instructed them in basic archaeological survey methods.
Duties: In the course of this project I was responsible for site survey and mapping, and documentation of the oral history associated with the sites located during field survey.

September 1982
June 1983

Student Assistant
Project for the Preservation of Oral
Histories and Traditions
Rasmuson Library
University of Alaska
Fairbanks, Alaska

Supervisor: William Schneider/(907)474-6672
Supervisory Experience: No supervisory experience associated with this position.
Duties: As a student assistant for the Oral History Program I assisted in the transcription and cataloging of oral history materials.

May 1982 to
October 1982

Archaeological Field Assistant
Cooperative Parks Studies Unit
University of Alaska
Fairbanks, Alaska
(14(h)(1) Survey-Bering Straits)

Supervisor: Linda Medlock
Supervisory Experience: No supervisory experience associated with this position.
Duties: Duties included site survey, mapping, and establishment of site boundaries for the purposes of fulfilling claims made by Bering Straits Native Corporation pursuant to Section 14(h)(1) of ANCSA.

6d. Benefits of Project: Goals and Performance Measures

This project is essentially the beginning of a "Pay It Forward" program for the native communities. The BSNC Board of Directors passed a Resolution requiring that 50% of all profits from this project be reinvested in renewable energy projects in the 17 villages that make up the Bering Straits region. The Board also made the decision to sell the wind energy to Nome Joint Utilities at a rate below the "avoided costs" with a goal to benefit all residents of Nome. Success of this project will lead to exporting the profits and technical expertise to the villages who are suffering even higher costs than Nome. The entire region is in a wind category ranging from Class 4 to Class 7 winds. Wind energy is classified in a scale from 1 to 7, 1 being light winds and 7 on the other end of the spectrum. Wind is a good energy resource when it hits the Class 4 scale. The majority of the villages that make up the Bering Straits region have primarily a "subsistence lifestyle" as they lack a true cash economy. Seal, walrus, moose, caribou and fish make up their primary food source. High energy costs for gas, fuel oil and electricity put an even higher burden of distress on these residents. Our native citizens make use of all of the animal resources and environment, it is time to add the wind and take advantage of what has previously been a burden and source of hardship. The primary goal is to ultimately add wind energy to all the villages of the region, and this is the start.

Complete Data Collection and Real-Time Performance System

Performance will be measured by the Draker Sentalis system detailed at the end of this section. This system provides a real-time, internet connected data and performance logging and monitoring package. The extra expense of this package is well justified to not only document the performance of the system and provide for the reporting requirements but more than that: to allow key decision makers and interested parties to monitor the performance moment by moment and see what is working. Western Community Energy, LLC will be responsible as outlined in the Management Section 6b to install and maintain that system as well as create the reports showing the performance.

Meaningful Commercial Installation NOT an Experiment

This project is a valid commercial venture as outlined in the Project Design Section 6a. This is not a demonstration project or an experiment. The data has been collected for over a year and the Nome resource is validated. The key is that as a first project in the area, it will be on point and have a high visibility. Bering Straits Native Corp has contracted with the best, most experienced people available to install a proven turbine that is simple and easy to maintain. The harsh Nome environment is well documented. This project needs the leadership that is behind it in this grant application to help make sure the results are achieved. Kotzebue has over 1,000 kW of wind and has been growing their project a little bit at a time since the 90s. Nome can now follow that example. Install a real and meaningful project. Then grow over time with more wind after this first installation.

Lower Local Energy Costs in Nome and Increase Reliability

Nome, like the rest of the United States is faced with ever increasing energy cost. Over the past several years Nome has experience double digit increases in our cost of living due to the increase in cost of oil. This is reflected in our electricity and fuel oil costs. Nome Joint Utility Systems has been

forced to pass this increase in fuel oil prices onto the consumer via a fuel surcharge. IN 2004, NJUS began adding the fuel surcharge of $.0283 to the per Kwh rate of $1875. In 2005 they added a surcharge of $.0753 and in 2006, it nearly doubled to $.1354 for a per Kwh rate of $.3129 plus a $5.00 service fee. The same fuel surcharge is added by our barge and air freight services.

The average cost for home heating fuel is $3.94 per gallon. Annual household cost for home heating is $3,209.00 per year, well above the national average and **nearly double the extremely high energy cost benchmark of $1,882 per year.**

BSNC's commitment to the development of renewable energy is also shown in their decision to install 17 Kw of photovoltaic solar panels on their three-story office building in Nome. This project was directly funded by the company without seeking grant funds. This demonstrates a commitment to renewables that will continue into the future. By pioneering a PV project in western Alaska, their success could provide an additional renewable option for the State of Alaska. BSNC has been a leading participant in Nome's drive to find and develop cheaper energy solutions. Bering Straits also wants to become an example for others to follow and is investing extra time and money into documenting and sharing the results from these endeavors. Also, lowering the percentage of imported fuel can help to make a finite resource in a finite storage tank last longer during storms or other events.

Commitment of 50% of Profit to Renewable Energy Installations in Villages

The Corporations goal to invest 50% of the profits from this venture into renewable projects in our rural villages demonstrates the corporations desire to lower the cost of living for our shareholders. Bering Straits will truly become a promoter of renewable energy through this program and directly affect the household budgets in each community in Nome as well as the rest of the region.

Revenue for BSNC and Sitnasuak Shareholders

Outside of Nome the majority of the shareholders of BSNC, and to some extent SNC rely heavily on subsistence activities for their livelihood. Dividends earned by the corporation not only give them a sense of ownership, but also help offset our high cost of living, a cost of living driven by high energy costs.

Inspiration for Future Installations and Future Generations

As this project is developed and shareholders are trained to provide the many services required to operate and maintain the units, a new industry will be created. There will be a need for trained technicians, installers and designers which will allow BSNC to export our technical expertise to other regions of rural Alaska, who are suffering along with us.

Renewable Energy Alaska Project Letter

Draker Sentalis Energy Data Analysis Package

Renewable Energy Alaska Project
308 G Street, Suite 218
Anchorage, Alaska 99501
907-929-7770 (phone & fax)

www.alaskarenewableenergy.org
642 South Alaska Street, Suite 200
Palmer, Alaska 99645
907-745-6000 (phone & fax)

September 28, 2007

Jerald Brown
Vice President
Bering Straits Native Corporation
PO Box 1008
Nome Alaska 99762

RE: Support Letter for Bering Straits Native Corporation's Nome Wind Farm Project

Dear Mr. Brown:

I'm writing to support Bering Straits Native Corporation in its proposal for funding from the USDA's "High Cost Energy Program" to build a 300 – 500 kW wind farm in the Nome area in partnership with Sitnasuak Native Corporation (SNC). REAP is well aware that energy prices have reached crisis proportions in rural Alaskan communities such as Nome. REAP is also impressed with all the efforts that the community in Nome is making to implement local solutions, including the large solar project you are currently undertaking.

As you know, REAP is the state's first and only renewable energy advocacy and education organization. We're a coalition of large and small Alaska electric utilities, environmental groups, consumer groups, businesses, Native organizations and state and federal agencies who share the goal of increasing the production of renewable energy in Alaska. REAP believes that replacing petroleum based energy with renewable sources in the rural villages of Alaska is critical in this time of escalating fuel prices. Renewable energy can help stabilize and reduce energy costs by displacing polluting diesel fuel. REAP also firmly believes that renewable energy development is a key to building a sustainable economy in rural Alaska.

Over the years REAP has enjoyed collaborating with proponents of renewable energy in the Nome region, and we look forward to continuing that collaboration. We wish you the best in all your endeavors related to renewable energy development. If you have any questions, please call me at 907-745-6000 (office) or 907-232-0908 (cell).

Sincerely,

Chris Rose
Executive Director, Renewable Energy Alaska Project

DRAKER LABORATORIES
22 North Street
Burlington, Vermont 05401
802.865.3866

Since 1999 Draker Laboratories has strived to provide high performance monitoring and data management solutions for renewable technologies. While capable of encompassing the whole gamut of green power technologies, Draker has focused mainly on photovoltaic, wind, solar thermal and hybrid systems. With Draker's products and services, system owners, installers and distributed utilities have a platform through which they can gain control and complete understanding of their system status. Through the use of our hardware and software you can protect your renewable energy investment with accurate data acquisition automated data management delivered in real time over the web so that you how your system is performing at all times.

When it comes to your renewable energy system performance, what you don't know can hurt you. So whether your dealing with a commercial, industrial or institutional application, we make sure that with the information and the graphical interface that we provide, you get all the necessary tools to optimize the system performance of your energy system, maximize the return on your investment, and gain access to performance-based contracts and financial incentives through our Performance Monitoring and Reporting Services.

Sentalis Product Line

Sentalis
Performance Monitoring Systems

Sentalis™ is a complete high performance monitoring system.

Even our most basic performance monitoring packages offer robust performance monitoring of PV, Wind, Solar Thermal, and Hybrid Systems. This includes natural resource assessment and revenue grade metering.

Sentalis packages include field proven performance instrumentation and web-enabled graphical representations that provide comprehensive data management solutions for green technologies. Draker's Sentalis line is designed by engineers that spend time in the field and understand the needs of the renewable energy market. Sentalis provides you with the data and tools you need to:

- **Optimize** the performance of your renewable energy system.
- **Modify** your energy use behavior.
- **Communicate** your organization's commitment to improving and safeguarding our environment, health and planet.
- **Realize** the financial benefits inherent to your renewable energy system.
- **Satisfy** the reporting requirements of performance-based contracts and government incentive programs.
- Advanced dataloggers manufactured by Campbell Scientific, known the world over for precision measurement instrumentation that is highly dependable even in remote and harsh environments.
- Integrated sensor mounts and interconnect cabling that provides for quick and easy installations.

Sentalis 1000Wind

Hardware

The Hardware of this package consists of two cup-type anemometers to provide wind speeds at different heights, a wind vane, an electronic kilowatt-hour meter, mounting hardware for the sensor clusters and a set of interconnect cables.

The hardware for the Sentalis 1000Wind can be expanded to include an rpm sensor, a vertical anemometer, mounting hardware, and cabling. The air density option adds a barometric pressure transducer, a thermistor with a gill shield, mounting hardware to position these sensors near the wind turbine hub height and an integrated cable.

For a more detailed analysis of wind turbine performance, the Sentalis 1000Wind can be equipped with additional sensor so that you can graphically interface and monitor turbine rpm, wind vector/turbulence, wind shear, tip speed, and AC power metrics.

Graphical User Interface

Through this package you will have access to graphs in two-day, past week, and past month formats of AC power and energy, wind speed, wind direction, and total system efficiency. The user can also define a custom time period for graphing any of these parameters. The statistics area displays year-to-date totals, yearly summaries, and the total energy generated over the life of the system.

Features

- Performance Monitoring Sensors incl. revenue grade power/energy meter
- Rugged Stainless Steel NEMA 4X enclosure
- Performance email & text message diagnostic alerts
- Data download ability and automated reporting
- Performance Metric Calculations
- CEC listed for PMRS
- Local Data Storage and Battery Backup
- On-site display
- Internet display in 'real-time'
- AC voltage, current and THD measurements
- Datalogger measurement auto-calibration
- Optional Components:
    - Net Energy for Building Loads
    - Wireless and Cellular link
    - Inverter Communications
    - Battery Monitor
    - Standard Weather Station
    - Advanced Weather Station
    - Kiosk Touchscreen
    - Sensor Expandability
    - Expandable on-site memory

System Enclosure

Operating Temperature Range	-25 to +50 C (non-condensing)
Storage Temperature Range	-40 to +70
Physical Size	24"x 20" x 6.0"
Rating	NEMA 4X
Material	Stainless Steel

Standard Measurements

Wind Speed (at two locations) (cup anemometer)	Starting Threshold Accuracy	1.75mph <0.1m/s (5m/s to 25 m/s)
Wind Direction (mechanical vane)	Range Linearity Dead Band	360 <1% 8 maximum, 4 typical
AC Power/Energy (including current transformers)	Accuracy	<2%

Small to Medium Commercial

Wind Speed (at two locations) (cup anemometer)	Starting Threshold Accuracy	1.75mph <0.1m/s (5m/s to 25 m/s)
Wind Direction (mechanical vane)	Range Linearity Dead Band	360 <1% 8 maximum, 4 typical
AC Power/Energy (including current transformers)	Accuracy	<2%

Advanced Weather Station

The Advanced Weather Station package expands the weather data to a total of seven measurements. These additional parameters are incorporated in order to give you a more detailed understanding of your energy potential from the natural resources available on-site.

These parameters include: horizontal irradiance, ambient temperature, wind speed, wind direction, precipitation, barometric pressure, and relative humidity. The heart of this system is a Vaisala WXT510 integrated measurement unit.

Specifications

- Ambient Temperature:
  - Accuracy: ± 1°C
- Wind Speed:
  - Type: Sonic
  - Range: 0 to 60 m/s
  - Accuracy (0 to 35 m/s): Greater of ± 0.3 m/s or ± 3%
  - Accuracy (35 to 60 m/s): ± 3%
- Wind Direction:
  - Type: Sonic
  - Azimuth: 0 to 360°
  - Accuracy: ± 3°
- Precipitation:
  - Accuracy: ± 5° (wind induced error excluded)
- Barometric Pressure:
  - Range: 600 to 1100 hPa
  - Accuracy: ± 1 hPa
- Relative Humidity:
  - Accuracy (0 to 90%RH): ± 3%RH
  - Accuracy (90 to 100%RH): ± 5%RH

Sentalis 1000PV

Hardware

The hardware in this package consists of the core DAQ-EZ™ system unit, sensors, mounting hardware and cables.

- The system unit is a waterproof (NEMA 4X) enclosure containing a Campbell Scientific data logging engine, supporting electronics, and a battery.
- The integrated battery backup provides continuous data logging during interruptions to the system unit's normal power source.
- The bottom of the system unit has weather-tight plug receptacles for matching sensor and power cables. The installer is not required to perform any hard wiring.
- The sensors include silicon Pyranometers for plane-of-array and horizontal solar irradiance, a thermistor for back-of-module temperature and an electronic revenue grade AC power and energy meter.
- The package includes mounting hardware and an integrated cable for the Pyranometers and thermistor.

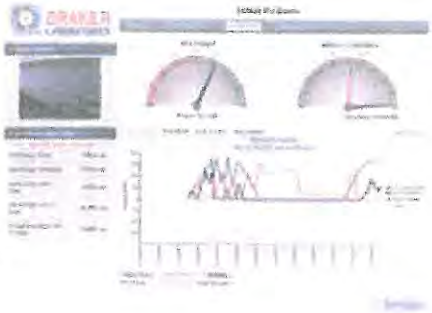
The advanced DC Monitoring option provides a more detailed picture of system performance, breaking out the solar to DC efficiency and the DC to AC efficiency.

Graphical User Interface (GUI)

A standard GUI is provided to make system performance visible. These visualizations are organized in web pages and include the following components for exploring recent and historical data trends:

- Dials - The dials, or gauges, visually give the user a quick glance into the data. They can be used to show a single value within a range, or to compare multiple values.
- Data Tables - These dynamic tables display different values depending on the type of data selected. Tabs below the graph can be used to change the type of data displayed.
- Graphs - Graphs allow the user to explore the data in more detail. They can choose to look at the last two days, 7 days, 31 days, or define a range of their own. Tabs below the graph can be used to change the type of data displayed.

Net Energy



The Net Energy package gives you the ability to monitor the net energy (to or from the grid) at the point of utility interconnection. This allows you to compare the energy generated with the energy consumed (the load). The hardware consists of a revenue-grade electronic kilowatt-hour meter mounted in an enclosure with a communications cable.

A sub-metering option can be added to this package so that you can separately monitor the energy consumption of various parts of your facility.

Company Overview

Founded in 1999 as Draker Solar Design, Draker Laboratories™ today provides high-performance monitoring and data management systems for green power technologies, including: PV, wind, solar thermal, and hybrid energy systems.

With Draker's products and services you can protect your energy investment. Accurate data acquisition, data validation, automated data processing and data management, all delivered in real time so you know how your power and monitoring systems are performing at any time.

With this information you can optimize the performance of your energy system, maximize the return on your investment and provide appropriate documentation for government and other performance based contracts.

CAMPBELL SCIENTIFIC, INC.

WHEN MEASUREMENTS MATTER

CR1000

measurement & control datalogger

A rugged instrument with research-grade performance.

CR1000 Measurement and Control System

The CR1000 provides precision measurement capabilities in a rugged, battery-operated package. It consists of a measurement and control module and a wiring panel. Standard operating range is -25° to +50°C; an optional extended range of -55° to +85°C is available.

Input/Output Connections—Individually configured for ratiometric resistive bridge, thermocouple, switch closure, high frequency pulse, low-level ac, serial sensors, and more.

Removable Power Terminal—simplifies connection to external power supply.

CS I/O Port—connects to data transfer and storage peripherals such as phone, RF, short-haul, and multi-drop modems.

Computer RS-232—provides a 9-pin electrically isolated DCE port.

Peripheral Port—one 40-pin port interfaces with a CFM100 or NL115 module, which store data on a CompactFlash card. The NL115 also supports Ethernet communications.

Features

- 4 Mbyte memory*
- Program execution rate of up to 100 Hz
- CS I/O and RS-232 serial ports
- 13-bit analog to digital conversions
- 16-bit H8S Renesas Microcontroller with 32-bit internal CPU architecture
- Temperature compensated real-time clock
- Background system calibration for accurate measurements over time and temperature changes
- Single DAC used for excitation and measurements to give ratio metric measurements
- Gas Discharge Tube (GDT) protected inputs
- Data values stored in tables with a time stamp and record number
- Battery-backed SRAM memory and clock ensuring data, programs, and accurate time are maintained while the CR1000 is disconnected from its main power source
- Measures intelligent serial sensors without using an SDM-SIO4

Storage Capacity*

The CR1000 has 2 Mbyte of FLASH memory for the Operating System, and 4 Mbytes of battery-backed SRAM for CPU usage, program storage, and data storage. Data is stored in a table format. The storage capacity of the CR1000 can be increased by using a CompactFlash® card.

Wiring Panel

The CR1000WP is a black, anodized aluminum wiring panel that is compatible with all CR1000 modules. The wiring panel includes switchable 12 V, redistributed analog grounds (dispersed among analog channels rather than grouped), unpluggable terminal block for 12 V connections, gas-tube spark gaps, and 12 V supply on pin 8 to power our COM-series phone modems and other peripherals. The control module easily disconnects from the wiring panel allowing field replacement without rewiring the sensors. A description of the wiring panel's input/output channels follows.

Analog Inputs

Eight differential (16 single-ended) channels measure voltage levels. Resolution on the most sensitive range is 0.67 µV.

**Originally, the standard CR1000 had 2 Mbytes of data/program storage, and an optional version, the CR1000-4M, had 4 Mbytes of memory. In September 2007, the standard CR1000 started having 4 Mbytes of memory, making the CR1000-4M obsolete. Dataloggers that have a module with a serial number greater than or equal to 11832 will have a 4 Mbyte memory. The 4 Mbyte dataloggers will also have a sticker on the canister stating "4M Memory".*

Pulse Counters
Two pulse channels can count pulses from high level (5 V square wave), switch closure, or low level ac signals.

Switched Voltage Excitations
Three outputs provide precision excitation voltages for resistive bridge measurements.

Digital I/O Ports
Eight ports are provided for frequency measurements, digital control, and triggering. Three of these ports can also be used to measure SDM devices. The I/O ports can be paired as transmit and receive for measuring smart serial sensors.

RS-232 Port
A PC or laptop can be connected to this 9-pin port via an RS-232 cable.

CS I/O Port
Data transfer peripherals that require power from the datalogger can be connected to this port via an SC12 cable. This port is also used for connecting the datalogger to a PC via an SC32B or SC-USB interface when optical isolation is required.

Peripheral Port
One 40-pin port interfaces with the CFM100 CompactFlash® Module or the NL115 Ethernet Interface and CompactFlash Module.

Switched 12 Volt
This terminal provides unregulated 12 V that can be switched on and off under program control.

Measurement and Control Module
The module measures sensors, drives direct communications and telecommunications, reduces data, controls external devices, and stores data and programs in on-board, non-volatile storage. The electronics are RF shielded and glitch protected by the sealed, stainless steel canister. A battery-backed clock assures accurate timekeeping. The module can simultaneously provide measurement and communication functions. The on-board, BASIC-like programming language supports data processing and analysis routines.

Communication Protocols
The CR1000 supports the PakBus® communication protocol. PakBus networks have the distributed routing intelligence to continually evaluate links. Continually evaluating links optimizes delivery times and, in the case of delivery failure, allows automatic switch over to a configured backup route.

The CR1000 also supports Modbus RTU protocol—both floating point and long formats. The datalogger can act as a slave, master, or both.

Enclosure/Stack Bracket
A CR1000 housed in a weather-resistant enclosure can collect data under extremely harsh conditions. The enclosure protects the CR1000 from dust, water, sunlight, or pollutants. An internal mounting plate is prepunched for easy system configuration and exchange of equipment in the field.

The 17565 Stack Bracket allows a small peripheral to be placed under the mounting bracket, thus conserving space. With the bracket, the CR1000 can be attached in a "horizontal" orientation (i.e., the long axis of the CR1000 spanning the short axis of the ENC10/12 enclosure). This stack bracket also places the terminals on the wiring panel at about the same height as the terminals on a PS100.

The stack bracket as viewed from the side with a CR1000 attached.

Power Supplies
Any 12 Vdc source can power the CR1000; a PS100 or BPALK is typically used. The PS100 provides a 7 Ahr rechargeable battery that should be connected to a charging source (either a wall charger or solar panel). The BPALK consists of eight non-rechargeable D-cell alkaline batteries with a 7.5 Ahr rating at 20°C. An external AA-cell battery pack supplies power while the D-cells are replaced.

Also available are the BP12 and BP24 battery packs, which provide nominal ratings of 12 and 24 Ahrs, respectively. These batteries should be connected to a regulated charging source (e.g., a CH100 connected to a unregulated solar panel or wall charger). For information about analyzing the system's power requirements, see our Power Supply product literature or Application Note 5-F. Both can be obtained from: www. campbellsci.com

Its low-power design allows the CR1000 to operate for up to one year on the PS100 power supply, depending on scan rate, number of sensors, data retrieval method, and external temperature.

Data Storage and Retrieval Options

To determine the best option for an application, consider the accessibility of the site, availability of services (e.g., cellular phone or satellite coverage), quantity of data to collect, and desired time between data-collection sessions. Some communication options can be combined—increasing the flexibility, convenience, and reliability of the communications.

Radios

Radio frequency (RF) communications are supported via narrow-band UHF, narrow-band VHF, spread spectrum, or meteor burst radios. Line-of-sight is required for all of our RF options.

Meteorological conditions measured at Lake Louise, Alberta, Canada are telemetered via phone-to-RF link to a base station.

Telephone Networks

The CR1000 can communicate with a PC using landlines, cellular CDMA, or cellular GPRS/EDGE transceivers. A voice synthesized modem enables anyone to call the CR1000 via phone and receive a verbal report of real-time site conditions.

Satellite Transmitters

Our NESDIS-certified GOES satellite transmitter provides one-way communications from a Data Collection Platform (DCP) to a receiving station. The transmitter complies with the High Data Rate (HDR) specifications. We also offer an Argos transmitter that is ideal for high-altitude and polar applications.

This station for the National Estuarine Research Reserve (NERR) in Virginia transmits data via our GOES satellite transmitter.

Multidrop Interface

The MD485 intelligent RS-485 interface permits a PC to address and communicate with one or more dataloggers over a single two-twisted-pair cable. Distances up to 4000 feet are supported.

Short Haul Modems

The SRM-5A RAD Short Haul Modem supports communications between the CR1000 and a PC via a four-wire unconditioned line (two twisted pairs).

Direct Links

A desktop or laptop PC connects directly to the CR1000's RS-232 port. If optical isolation is required, the PC is connected to the datalogger's CS I/O port via an SC32B or SC-USB interface.

PDAs

Customers can set the CR1000's clock, monitor real-time data, retrieve data, graph data, and transfer CR1000 programs via a PDA. PDAs with a Palm™ OS require PConnect software (purchased separately); PDAs with a Windows® Pocket PC/Windows Mobile OS require PConnectCE software (purchased separately).

Keyboard Display

The CR1000KD can be used to program the CR1000, manually initiate data transfer, and display data. The CR1000KD displays 8 lines x 21 characters (64 x 128 pixels) and has a 16-character keyboard. Custom menus are supported allowing customers to set up choices within the datalogger program that can be initiated by a simple "toggle" or "pick list".

One CR1000KD can be carried from station to station in a CR1000 network.

Ethernet

Use of an NL100 or NL115 interface enables the CR1000 to communicate over a local network or a dedicated Internet connection via TCP/IP. The NL115 also supports data storage on a CompactFlash card.

CompactFlash®

A CFM100 or NL115 module attached to a CR1000 can store data on a CompactFlash card. The PC reads the CompactFlash card using either the CF1 CompactFlash Adapter or an ImageMate® Reader/Writer. Please note that the CompactFlash card should be industrial-grade with a storage capacity of 2 Gbytes or less.

CD295 DataView II Display

This two-line, 32-character LCD displays one real-time value, a description, and units. It is typically mounted in an enclosure lid, which allows customers to view the CR1000's data on-site without opening the enclosure.

Channel Expansion

4-Channel Low Level AC Module

The LLAC4 is a small peripheral device that allows customers to increase the number of available low-level ac inputs by using control ports. This module is often used to measure up to four anemometers, and is especially useful for wind profiling applications.

The LLAC4 mounts directly to the backplate of our environmental enclosures.

Synchronous Devices for Measurement (SDMs)

SDMs are addressable peripherals that expand the CR1000's measurement and control capabilities. For example, SDMs are available to add control ports, analog outputs, pulse count channels, interval timers, or even a CANbus interface to the system. Multiple SDMs, in any combination, can be connected to one CR1000 datalogger.

Multiplexers

Multiplexers increase the number of sensors that can be measured by a CR1000 by sequentially connecting each sensor to the datalogger. Several multiplexers can be controlled by a single CR1000. The CR1000 is compatible with the AM16/32A and AM25T.

Software

Starter Software

Campbell Scientific offers easy-to-use starter software intended for first time users or applications that don't require sophisticated communications or datalogger program editing. These software products provide different functions and can be used in conjunction with each other. Starter software can be downloaded at no charge from www.campbellsci.com/downloads. Our Resource CD also provides this software as well as PDF versions of our literature and manuals.

Our SCWin Short Cut for Windows® generates straightforward CR1000 programs in four easy steps. Short Cut supports programming for our multiplexers and virtually any sensor that our CR1000 can measure.

Our PC200W Starter Software allows customers to transfer a program to, or retrieve data from, a CR1000 via a direct communications link.

Datalogger Support Software

Our general purpose datalogger support software packages provide more capabilities than our starter software. Each of these software packages contains program editing, communications, and display tools that can support an entire datalogger network.

PC400, our mid-level software, supports a variety of telemetry options, manual data collection, and data display. For programming, it includes both Short Cut and the CRBasic program editor. PC400 does not support combined communication options (e.g., phone-to-RF), PakBus® routing, or scheduled data collection; LoggerNet software is recommended for those applications.

Campbell Scientific offers the following three LoggerNet Software Packages:

- **LoggerNet**, the standard package, is recommended for those who have datalogger networks that do not require the more advanced features offered in LoggerNet Admin. It consists of a server application and several client applications integrated into a single product. This software provides all of PC400's capabilities as well as support for combined communication options (e.g., phone-to-RF), PakBus® routing, and scheduled data collection
- **LoggerNet Admin** is intended for customers who have large networks. Besides providing better tools for managing large networks, LoggerNet Admin allows customers to remotely manage a datalogger network over TCP/IP, and to remotely and automatically distribute data to other computers.
- **LoggerNetRemote** includes LoggerNet Admin clients to administer a running LoggerNet Admin server via TCP/IP from a remote PC. This software does not include the LoggerNet server.

LoggerNet provides a way to accomplish almost all the tasks customers need to complete using a datalogger.

Applications

The measurement precision, flexibility, long-term reliability, and economical price of the CR1000 make it ideal for scientific, commercial, and industrial applications.

Meteorology

The CR1000 is used in long-term climatological monitoring, meteorological research, and routine weather measurement applications.

Our rugged, reliable weather station measures meteorological conditions at St. Mary's Lake, Glacier National Park, MT.

Sensors the CR1000 can measure include:

- cup, propeller, and sonic anemometers
- tipping bucket rain gages
- wind vanes
- pyranometers
- ultrasonic distance sensors
- thermistors, RTDs, and thermocouples
- barometric pressure sensors
- RH sensors
- cooled mirror hygrometers

Data is output in a choice of units (e.g., wind speed in miles per hour, meters per second, or knots). Standard CR1000 outputs include wind vector averaging, sigma, theta, histograms, saturation vapor pressure, and vapor pressure from wet/dry bulb temperatures.

Agriculture and Agricultural Research

The versatility of the CR1000 allows measurement of agricultural processes and equipment in applications such as:

- plant water research
- canopy energy balance
- machinery performance
- plant pathology
- crop management decisions
- food processing/storage
- frost prediction
- irrigation scheduling
- integrated pest management

This vitaculture site in Australia integrates meteorological, soil, and crop measurements.

Wind Profiling

Our data acquisition systems can monitor conditions at wind assessment sites, at producing wind farms, and along transmission lines. The reliability of these systems ensures data collection, even under adverse conditions. Wide operating temperature ranges and weatherproof enclosures allow our systems to operate reliably in harsh environments.

The CR1000 makes and records measurements, controls electrical devices, and can function as PLCs or RTUs. Because the datalogger has its own power supply (batteries, solar panels), it can continue to measure and store data and perform control during power outages.

Typical sensors for wind assessment applications include, but are not limited to:

- sonic anemometers
- three-cup and propeller anemometers (up to 10 anemometers can be measured by using two LLAC4 peripherals)
- wind vanes
- temperature sensors (air, water, and equipment)
- barometric pressure
- wetness
- solar radiation

Photo courtesy npower renewables

A Campbell Scientific system monitors an offshore wind farm in North Wales.

For turbine performance applications, the CR1000 can monitor electrical current, voltage, wattage, stress, and torque.

Soil Moisture

The CR1000 is compatible with the following soil moisture measurement technologies:

- **Soil moisture blocks** are inexpensive sensors that estimate soil water potential.
- **Matric water potential sensors** also estimate soil water potential but are more durable than soil moisture blocks.
- **Time-Domain Reflectometry Systems (TDR)** use a reflectometer controlled by a CR1000 to accurately measure soil water content. Multiplexers allow sequential measurement of a large number of probes by one reflectometer, reducing cost per measurement.
- **Self-contained water content reflectometers** are sensors that emit and measure a TDR pulse.
- **Tensiometers** measure the soil pore pressure of irrigated soils and calculate soil moisture.

Air Quality

The CR1000 can monitor and control gas analyzers, particle samplers, and visibility sensors. It can also automatically control calibration sequences and compute conditional averages that exclude invalid data (e.g., data recorded during power failures or calibration intervals).

Road Weather/RWIS

Our fully NTCIP-compliant Environmental Sensor Stations (ESS) are robust, reliable weather stations used for road weather/RWIS applications. A typical ESS includes a tower, CR1000, two road sensors, remote communication hardware, and sensors that measure wind speed and direction, air temperature, humidity, barometric pressure, solar radiation, and precipitation. The CR1000 can also measure soil moisture and temperature sensors, monitor bridge vibrations, and control external devices.

Water Resources/Aquaculture

Our CR1000 is well-suited to remote, unattended monitoring of hydrologic conditions. Most hydrologic sensors, including SDI-12 probes, interface directly to the CR1000. Typical hydrologic measurements:

- **Water level** is monitored with incremental shaft encoders, double bubblers, ultrasonic level transducers, resistance tapes, or strain gage or vibrating wire pressure transducers. Some shaft encoders require a QD1 Interface. Vibrating wire transducers require an AVW1, AVW4, or AVW100 Interface.
- **Well draw-down tests** use a pressure transducer measured at logarithmic intervals or at a rate based on incremental changes in water level.
- **Ionic conductivity measurements** use one of the switched excitation ports from the CR1000.
- **Samplers** are controlled by the CR1000 as a function of time, water quality, or water level.
- **Alarm and pump actuation** are controlled through digital I/O ports that operate external relay drivers.

A turbidity sensor was installed in a tributary of the Cedar River watershed to monitor water quality conditions for the city of Seattle, Washington.

Vehicle Testing

This versatile, rugged datalogger is ideally suited for testing cold and hot temperature, high altitude, off-highway, and cross-country performance. The CR1000 is compatible with our SDM-CAN interface, GPS16-HVS receiver, and DSP4 Heads Up Display.

Vehicle monitoring includes not only passenger cars, but locomotives, airplanes, helicopters, tractors, buses, heavy trucks, drilling rigs, race cars, and motorcycles.

The CR1000 can measure:

- **Suspension**—strut pressure, spring force, travel, mounting point stress, deflection, ride
- **Fuel system**—line and tank pressure, flow, temperature, injection timing
- **Comfort control**—ambient and supply air temperature, solar radiation, fan speed, ac on and off, refrigerant pressures, time-to-comfort, blower current
- **Brakes**—line pressure, pedal pressure and travel, ABS, line and pad temperature
- **Engine**—pressure, temperature, crank position, RPM, time-to-start, oil pump cavitation
- **General vehicle**—chassis monitoring, road noise, vehicle position and speed, steering, air bag, hot/cold soaks, wind tunnels, traction, CANbus, wiper speed and current, vehicle electrical loads

Other Applications

- Eddy covariance systems
- Wireless sensor/datalogger networks
- Mesonet systems
- Avalanche forecasting, snow science, polar, high altitude
- Fire weather
- Geotechnical
- Historic preservation

CR1000 Specifications

Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; non-condensing environment required. To maintain electrical specifications, Campbell Scientific recommends recalibrating dataloggers every two years. We recommend that the system configuration and critical specifications are confirmed with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to 30 min. @ 10 ms increments

ANALOG INPUTS

8 differential (DF) or 16 single-ended (SE) individually configured. Channel expansion provided by AM16/32 and AM25T multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the A/D resolution of a single conversion. **Resolution of DF measurements with input reversal is half the Basic Res.**

Input Referred Noise Voltage

Input Range (mV)[1]	*DF Res (µV)*[2]	*Basic Res (µV)*
±5000	667	1333
±2500	333	667
±250	33.3	66.7
±25	3.33	6.7
±7.5	1.0	2.0
±2.5	0.33	0.67

[1]Range overhead of ~9% exists on all ranges to guarantee that full-scale values will not cause over-range.

[2]Resolution of DF measurements with input reversal.

ACCURACY[3]:
±(0.06% of reading + offset), 0° to 40°C
±(0.12% of reading + offset), -25° to 50°C
±(0.18% of reading + offset), -55° to 85°C

[3]The sensor and measurement noise are not included and the offsets are the following:

Offset for DF w/input reversal = 1.5-Basic Res + 1.0 µV
Offset for DF w/o input reversal = 3-Basic Res + 2.0 µV
Offset for SE = 3-Basic Res + 3.0 µV

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±2.5 mV input range; digital resolution dominates for higher ranges.

250 µs Integration: 0.34 µV RMS
50/60 Hz Integration: 0.19 µV RMS

MINIMUM TIME BETWEEN VOLTAGE MEASUREMENTS: Includes the measurement time and conversion to engineering units. For voltage measurements, the CR1000 integrates the input signal for 0.25 ms or a full 16.66 ms or 20 ms line cycle for 50/60 Hz noise rejection. DF measurements with input reversal incorporate two integrations with reversed input polarities to reduce thermal offset and common mode errors and therefore take twice as long.

250 µs Analog Integration: ~1 ms SE
1/60 Hz Analog Integration: ~20 ms SE
1/50 Hz Analog Integration: ~25 ms SE

COMMON MODE RANGE: ±5 V

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±90 nA @ 85°C

INPUT RESISTANCE: 20 Gohms typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION THERMISTOR (for thermocouple measurements):
±0.3°C, -25° to 50°C
±0.8°C, -55° to 85°C (-XT only)

ANALOG OUTPUTS

3 switched voltage, active only during measurement, one at a time.

RANGE AND RESOLUTION: Voltage outputs programmable between ±2.5 V with 0.67 mV resolution.

ACCURACY: ±(0.06% of setting + 0.8 mV), 0° to 40°C
±(0.12% of setting + 0.8 mV), -25° to 50°C
±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

CURRENT SOURCING/SINKING: ±25 mA

RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: The CR1000 provides ratiometric measurements of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Precise, dual polarity excitation using any of the 3 switched voltage excitations eliminates dc errors.

RATIO ACCURACY[3]: Assuming excitation voltage of at least 1000 mV, not including bridge resistor error.

±(0.04% of voltage reading + offset)/V_x

[3]The sensor and measurement noise are not included and the offsets are the following:

Offset for DF w/input reversal = 1.5-Basic Res + 1.0 µV
Offset for DF w/o input reversal = 3-Basic Res + 2.0 µV
Offset for SE = 3-Basic Res + 3.0 µV

Offset values are reduced by a factor of 2 when excitation reversal is used.

PERIOD AVERAGING MEASUREMENTS

The average period for a single cycle is determined by measuring the average duration of a specified number of cycles. The period resolution is 192 ns divided by the specified number of cycles to be measured; the period accuracy is ±(0.01% of reading + resolution). Any of the 16 SE analog inputs can be used for period averaging. Signal limiting are typically required for the SE analog channel.

INPUT FREQUENCY RANGE:

Input Range	*Signal (peak to peak)*[4] *Min*	*Max*	*Min. Pulse W.*	*Max*[5] *Freq.*
±2500 mV	500 mV	10 V	2.5 µs	200 kHz
±250 mV	10 mV	2 V	10 µs	50 kHz
±25 mV	5 mV	2 V	62 µs	8 kHz
±2.5 mV	2 mV	2 V	100 µs	5 kHz

[4]The signal is centered at the datalogger ground.

[5]The maximum frequency = 1/(Twice Minimum Pulse Width) for 50% of duty cycle signals.

PULSE COUNTERS

Two 24-bit inputs selectable for switch closure, high frequency pulse, or low-level ac.

MAXIMUM COUNTS PER SCAN: 16.7×10^6

SWITCH CLOSURE MODE:
Minimum Switch Closed Time: 5 ms
Minimum Switch Open Time: 6 ms
Max. Bounce Time: 1 ms open w/o being counted

HIGH FREQUENCY PULSE MODE:
Maximum Input Frequency: 250 kHz
Maximum Input Voltage: ±20 V
Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 µs time constant.

LOW LEVEL AC MODE: Internal ac coupling removes dc offsets up to ±0.5 V.

Input Hysteresis: 16 mV @ 1 Hz
Maximum ac Input Voltage: ±20 V
Minimum ac Input Voltage:

Sine wave (mV RMS)	*Range (Hz)*
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

DIGITAL I/O PORTS

8 ports software selectable, as binary inputs or control outputs. C1-C8 also provide edge timing, subroutine interrupts/wake up, switch closure pulse counting, high frequency pulse counting, asynchronous communications (UART), SDI-12 communications, and SDM communications.

HIGH FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 ohms

INPUT STATE: high 3.8 to 5.3 V; low -0.3 to 1.2 V

INPUT HYSTERISIS: 1.4 V

INPUT RESISTANCE: 100 kohms

SWITCHED 12 V

One independent 12 V unregulated sources switched on and off under program control. Thermal fuse hold current = 900 mA @ 20°C, 650 mA @ 50°C, 360 mA @ 85°C.

SDI-12 INTERFACE SUPPORT

Control ports 1, 3, 5, and 7 may be configured for SDI-12 asynchronous communications. Up to ten SDI-12 sensors are supported per port. It meets SDI-12 Standard version 1.3 for datalogger mode.

CE COMPLIANCE

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: IEC61326:2002

CPU AND INTERFACE

PROCESSOR: Renesas H8S 2322 (16-bit CPU with 32-bit internal core)

MEMORY: 2 Mbytes of Flash for operating system; 4 Mbytes of battery-backed SRAM for CPU usage, program storage and data storage.

SERIAL INTERFACES: CS I/O port is used to interface with Campbell Scientific peripherals; RS-232 port is for computer or non-CSI modem connection.

PARALLEL INTERFACE: 40-pin interface for attaching data storage or communication peripherals such as the CFM100 module

BAUD RATES: Selectable from 300 bps to 115.2 kbps. ASCII protocol is one start bit, one stop bit, eight data bits, and no parity.

CLOCK ACCURACY: ±3 min. per year

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

TYPICAL CURRENT DRAIN:
Sleep Mode: ~0.6 mA
1 Hz Scan (8 diff. meas., 60 Hz rej., 2 pulse meas.)
w/RS-232 communication: 19 mA
w/o RS-232 communication: 4.2 mA
1 Hz Scan (8 diff. meas., 250 µs integ., 2 pulse meas.)
w/RS-232 communication: 16.7 mA
w/o RS-232 communication: 1 mA
100 Hz Scan (4 diff. meas., 250 µs integ.)
w/RS-232 communication: 27.6 mA
w/o RS-232 communication: 16.2 mA

CR1000KD CURRENT DRAIN:
Inactive: negligible
Active w/o backlight: 7 mA
Active w/backlight: 100 mA

EXTERNAL BATTERIES: 12 Vdc nominal; reverse polarity protected.

PHYSICAL SPECIFICATIONS

MEASUREMENT & CONTROL MODULE SIZE: 8.5" x 3.9" x 0.85" (21.6 x 9.9 x 2.2 cm)

CR1000WP WIRING PANEL SIZE: 9.4" x 4" x 2.4" (23.9 x 10.2 x 6.1 cm); additional clearance required for serial cable and sensor leads.

WEIGHT: 2.1 lbs (1 kg)

WARRANTY

Three years against defects in materials and workmanship.

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7. Project Budget

The major project cost component is of course the supply of the wind turbines themselves. A sales agreement has been provided by Entegrity and is specifically included in Section 6a.3 along with the pertinent information about the wind turbines themselves. Note that the price of $165,000 each includes a five year extended warranty and O&M agreement. This is very valuable for the Nome installation. The shipping cost estimate of a total of $333,000 includes all handling to get the turbines actually to the installation site, uncrate them and haul away the boxes, stage them and ready the units for construction.

The turbine erection cost estimate is from John Campbell of Idaho Tower Company based on a verbal quote and his own extensive experience. The cost estimates for the Eagle Electric installation work and the Utility interconnection expenses are based on similar construction projects in the lower 48 states with an estimated increase for the Nome location. The detailed engineering required to specifically quote that part of the contract is included in the project budget. The project management budget amounts to $330,000, and there is over $470,000 in a project contingency budget item as well.

Detailed Project Itemized Budget Spreadsheet