Rosebud Sioux Wind Energy Project
Rosebud Sioux Tribe
DOE Grant DE-FC36-99R810676

Final Report

RST Utilities Commission

April, 2008

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The Rosebud Sioux Tribe

Executive Summary

Today members of the Rosebud Sioux Tribe with a population estimated at 26,000 are the descendants from the Sicangu Oyate (Brule or Burnt Thigh Nation). The Sicangu are a part of the Tetonwan Lakota Oyate (Dwellers of the Plains), more commonly known to history as the Great Sioux Nation. The people of the Sioux Nation, from west to east, refer to themselves as Lakota, Nakota or Dakota, which means friend or ally. The expansive, rolling prairies, the shallow, winding creeks and rivers, and the ever-present winds are all integral parts of the continuing history, culture and remaining economic base upon which the Lakota people who call Rosebud home. Many of the Tribal members of the Rosebud Sioux Tribe reside on the one million acre reservation, the nation's 6th largest, in South Central South Dakota.

In 1998, through the vision of the late Alex "Little Soldier" Lunderman (1928-2000) and through the efforts of the Rosebud Sioux Tribal Utilities Commission, and with assistance from Intertribal Council on Utility Policy (COUP), and Distributed Generation, Inc (DISGEN). The Rosebud Sioux Tribe applied and was awarded in 1999 a DOE Cooperative Grant to build a commercial 750 Kw wind turbine, along with a 50/50 funding grant from the Department of Energy and a low interest loan from the Rural Utilities Service, United States Department of Agriculture, the Rosebud Sioux Tribe commissioned a single 750 kilowatt NEG Micon wind turbine in March of 2003 near the Rosebud Casino. The Rosebud Sioux Wind Energy Project (Little Soldier "Akicita Cikala") Turbine stands as a testament to the vision of a man and the Sicangu Oyate.

On February 27th, the first native owned, on tribal land, large utility scale 750 kW NEG MICON wind turbine was installed on the Rosebud Sioux Indian Reservation. This took 8 years of preparation, beginning in 1995 when the Rosebud Sioux Tribe, Tribal Utility Commission and the Rosebud Casino began measuring the wind resources through an arrangement using a Zond wind anemometer. After gathering 18 months of wind data and having the data analyzed it has proven to be a Class 5/ Class 6 (17.91 mph) wind resource. This 750 kW turbine can produce enough electricity to serve about 200 to 250 houses. This NEG MICON wind turbine is producing more than 2 million kilowatt hours per year.

The Tribe is providing the renewable energy it generates from the 750 kW wind turbine to Basin Electric for local use, with a multi-year sale of "green power" to Ellsworth Air Force Base, near Rapid City, to be delivered through a cooperative effort with Basin Electric, Nebraska Public Power and the Western Area Power Administration. Through a separate arrangement, the Tribe has negotiated the first tribal sale of the bulk of the "green tags" generated by this turbine to NativeEnergy of Vermont, which has marketed the tags to thousands of individual green power supporters, including Ben & Jerry's Ice Cream, the Dave Mathews Band, the National Resource

Defense Council for their Rolling Stones' climate change awareness benefit concert and other parties interested in the development of renewable energy on Indian lands.

The Rosebud Sioux Tribe installed the 750-kw NEG Micon wind turbine adjacent to their casino and motel complex at the south end of the Rosebud Sioux Reservation. The turbine can supply an annual average of 80% of the electrical energy needs of the complex. Realizing that the turbine will at times generate more energy than can be utilized by the Rosebud Casino complex, the tribe negotiated a power purchase arrangement with the regional electric cooperative to buy the excess energy. As of early 2002, the Tribe signed a loan agreement with the Rural Utility Service of the US Department of Agriculture to provide approximately $566,000 toward the purchase of the turbine and installation expenses. The owner of the project is the Rosebud Sioux Tribe and the interconnection is to the Rosebud Casino and also through the Cherry-Todd Electric Cooperative (an REC), to Rushmore Electric Power Cooperative, and Basin Electric Power Cooperative, which interconnects to the Western Area Power Administration grid system. The Tribe also purchased the existing transformer and interconnection equipment owned by Cherry-Todd Electric Cooperative.

Development services to the Tribe were provided by Distributed Generation Systems, Inc. (Disgen), Evergreen, Colorado, in partnership with the Rosebud Utility Commission and the Tribal Council. The extended development process is precedent-setting in that the tribe worked out an institutional arrangement among all parties interconnected in the regional electric power delivery system. The lessons learned will provide a trail for other tribes in the region to develop wind energy projects to serve both on-reservation needs and access to other green power markets.

Part of the purchase contract with NEG Micon included a two-year warranty for parts and labor, which includes operations and maintenance (O&M). The Tribe also purchased a three-year extension of the warranty and O&M period for a total of five years coverage. During the initial two-year period, NEG Micon had agreed to provide initial O&M training sessions for tribal members.

Concurrent with development and operation of the Rosebud Sioux Wind Energy project, the Tribe initiated a study, including environmental impacts, of the feasibility of developing a 30 MW wind farm on the reservation. This vision is carried on through the project and the Department of Energy grant in 2003, in which the Rosebud Sioux Tribe was awarded a $448,551.00 for pre-construction activities in the development of a 30Mw wind farm located near the Community of St. Francis titled the Owl Feather War Bonnet Wind Farm.

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Project Overview

Background: The Rosebud Sioux Wind Energy Project objectives is to site and install a NEG Micon 750 kW wind turbine on the Rosebud Reservation, to service the Rosebud Casino and Convention Center energy load and/or sell the energy or excess energy out on to the power grid through a power purchase agreement.

Land Resource: The Rosebud Sioux Energy Wind Project is located on Rosebud Sioux Tribal Land of approximately 60 acres adjacent to the central South Dakota and northern Nebraska boarder on U.S. Hiway 83. The actual location of the NEG Micon 750kW wind turbine is located in the NW portion of the Rosebud Casio complex.

Wind Resource Assessment: The wind resource measured on the Rosebud Sioux Tribal reservation over an 18-month period indicated an annual wind speed of 17.91 miles per hour wind resource at the Rosebud Casino project site. There are other areas with potentially higher wind speed and consistency where meteorological data is being collected and analyzed.

Transmission Interconnection: The interconnection is to the Rosebud Casino and also through the Cherry-Todd Electric Cooperative (an REC), to Rushmore Electric Power Cooperative, and Basin Electric Power Cooperative, which interconnects to the Western Area Power Administration grid system. The Tribe also purchased the existing transformer and interconnection equipment owned by Cherry-Todd Electric Cooperative.

Environmental Studies: For the Rosebud Sioux Wind Energy Project the Rosebud Sioux Tribe used the exiting December1993 "Environmental Assessment for the Rosebud Casino".

Power Purchase Agreement: The power purchaser was Basin Electric Power Cooperative for local use, and who had a contract with the United States Air Force Ellsworth Air Force Base to purchase green tags. When the Rosebud Sioux Wind Energy Project began in 2003 the power purchase agreement was with Basin Electric Power Cooperative. Now that the power purchase agreement between the Rosebud Sioux Tribe and Basin Electric Power Cooperative expired. The current power purchase agreement is with Cherry Todd Electric Cooperative (REC).

Interconnection Agreement (IA): Currently the interconnection agreement is with Cherry Todd Electric Cooperative (REC).

Financing Structure: The Rosebud Sioux Wind Energy Project financing for this project came from the Department of Energy Cooperative grant in the amount of $566.00. And from a low interest loan from the Department of Agriculture, Rural Utilities Services in the amount of $660.804.

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Objectives

The Rosebud Sioux Tribe objectives concerning the Rosebud Sioux Wind Energy Project is to ensure that a commercial size wind turbine is installed at the Rosebud Casino Complex. This to help the Tribe use the energy generated to offset electricity purchased from Cherry Todd Electric Cooperative (REC), or some or all of the energy will be sold at a predetermined price to the REC, or its parent organization, Rushmore Electric, Basin Electric Power Cooperative, or to Western Area Power Administration.

As described in the original grant proposal, there are a number of project objectives included as condensations for the funding, such as three years of performance monitoring, training for tribal personnel, and feasibility for expansion of reservation wind development.

1. The Tribe will establish an ongoing monitoring.

2. Provide training for Tribal personnel.

3. Feasibility studies and Environmental Impact Assessment will be undertaken towards expanded development of a Reservation wind farm.

4. In order for public support of the Rosebud Casino wind turbine and future reservation wind development. The Tribe will provide public information meetings and newspaper articles. Six Community meetings will be held on the Reservation as part of the project.

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Description of Activities Performed

1999

The Rosebud Sioux Tribe in 1999 started a working relationship with Earth, Energy & Environment (E3) based out of Kansas. E3 assisted the Tribe in developing and putting together the original Department of Energy Cooperative grant that was awarded in 1999.

2000

Starting in late 1999 and leading into 2000 E3 and the Rosebud Sioux Tribe (RST) Utilities Commission were working together to develop a working relationship to complete the objectives of the awarded DOE grant. E3 proposed a draft E3/RST Energy Development Partnership Agreement to the Utilities Commission and Tribal Council. After the Commission's attorney reviewed the document E3 proposed, the Utilities Commissioners recommended to the Tribal Administration and Council not to sign the E3 proposal.

In July and August of 2000 the Utilities Commission notified the Tribal Administration and Tribal Council that the Commission on behalf of the Tribe would need to research, educate and come up with a solution to develop the completion of the DOE Grant.

End of 200 and Early 2001

The Rosebud Sioux Tribe (RST) went into partnership with Disgen, Incorporated and the Intertribal Council on Utility Policy (ICOUP) to work together to find solutions to complete the DOE grant. The DOE was notified of the partnership arraignment.

The RST began work on seeking matching funds to the DOE 50-50 awarded grant. And with consultation with Disgen and ICOUP talks began with the USDA Rural Utilities Service for the Tribe to ask for a low interest rate loan. Disgen provided the Tribe with a project pro-forma that would customarily be used to arrange project financing. However, a pro-forma would normally be used on a much larger wind project and is included herein as methodology for determining acceptable economics. When applying the value of the DOE grant to the project, the cost savings realized by the Rosebud Sioux Tribe from reduced energy consumption from the REC more than provided for the funds necessary to service the debt under the RUS Loan application.

In May of 2001, less than 1000 feet from the Western edge of the proposed site, RST Tribal Utilities Commission placed 5 anemometers and 3 wind vanes, at the 30, 40, and 50 meter height on an existing 500' radio tower used by KINI radio station.

Disgen started working with NEG Micon to select a wind turbine. The grant application to DOE, and subsequently awarded, included the NEG Micon turbine as the turbine of choice. Disgen confirmed, based on its extensive experience in wind development, that the prices for this single turbine and its installation are excellent.

The Tribe and its partners noted that Rosebud had two options for the use of the energy produced by the wind turbine.

1. The Tribe could offset the electricity currently being consumed by the Tribal Casino and adjacent hotel/conference center, or
2. Rosebud could sell the energy to Rushmore G&T. Undoubtedly, the Tribe will benefit by offsetting its charges from the REC, but there are other considerations as well. The Tribe would make a decision prior to ordering the materials.

Rosebud, Disgen and ICOUP began talks concerning entering into interconnection agreements with the local REC Cherry Todd Electric, Rushmore Electric, Basin Electric and Western Area Power Administration.

Public information was provided to the all twenty communities on the Rosebud Reservation on the Tribes goal of installing a large commercial wind turbine at the Rosebud Casino.

2002

The Rosebud Sioux Tribe, ICOUP and Disgen negotiated an interconnection agreement, including interconnection equipment purchased from Cherry-Todd Electric Cooperative, to serve the electric load at the Rosebud Casino and Convention Center. The partnership negotiated with Rushmore Electric, a subsidiary, and Basin Electric Power Cooperative on a power purchase contract with Basin Electric and green tag sales to Ellsworth Air Force Base and Native Energy. On agreement an interconnection study was completed as required by the Western Area Power Administration.

Throughout 2002 the Tribe provided educational and information to the Council and communities on the benefits and progress of the Rosebud Casino wind turbine project.

In September 2002 the Rosebud Sioux Tribe and USDA Rural Utility Service signed a RUS loan contract in the amount of $566,000 for the required DOE grant 50-50 matching funds.

The Tribe and Disgen purchase from NEG Micon a 750 Kw wind turbine to be shipped and installed in early 2003.

Cherry Todd Electric Cooperative (REC) installs most of the required electrical components and transformers for the Rosebud Casino wind turbine.

ICOUP develops a Construction Plan and Schedule for the Rosebud Wind Turbine Project SD 53 "A8" Rosebud. The Rosebud Sioux Tribe Wind Turbine Project is identified as project code 1301.

RST Utilities Commission, Disgen and with assistance from RST Resource Development Office begin work on a DOE Wind Development Grant to be submitted in 2003

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2003

Foundation construction begins in January and February 2003 at the Rosebud Casino complex.

The RST and Disgen submit the DOE Wind Development Grant to DOE.

The NEG Micon 750 Kw wind turbine is delivered and installation and construction begins in February 2003. NEG Micon provides training of the installation and operations of the wind turbine to Jim Harp (Rosebud Casino employee) and John Carr.

Cherry Todd Electric (REC) completes its required electrical components and transformers for the Rosebud Casino wind turbine. The Rosebud Casino Wind Turbine goes on line in February 2003.

In March of 2003 the Rosebud Sioux Tribe Wind Turbine is commissioned and is generating electrical power.

Western Area Power Administration, Cherry Todd Electric (REC) and the RST Utilities Commission are provided and trained on monitoring software provided by NEG Micon.

On April 30, and May 1st the Rosebud Sioux Tribe hosts the Kick the Tires Indian Workshop and Wind Turbine Dedication Ceremony at the Rosebud Casino complex.

Throughout 2003 the Rosebud Sioux Tribe will provide tours for the public and schools at the Rosebud Casino wind turbine.

The Tribe installs three wind anemometer towers at the Bristol Ranch, Mission/Antelope and Rosebud Community sites. The data from the wind turbine and the installation of three meteorological towers is being collected and analyzed by Disgen to assess wind speed and direction at the sites. A report on feasibility of expanded wind farm development, environmental assessment, and market availability will be done by Disgen and presented to the Tribal Council for their consideration.

In September 0f 2003 the Tribe begins making its loan payments to the Rural Utilities Service from funds generated by the Rosebud Casino wind turbine.

Also, in September 2003 the Rosebud Sioux Tribe is awarded a Department of Energy grant for the "Wind Energy Development on the Rosebud Sioux Reservation".

2004

Quarterly loan payments are made to the Rural Utilities Service from funds generated by the Rosebud Casino wind turbine.

Throughout 2004 the Rosebud Sioux Tribe provides tours for the public and schools at the Rosebud Casino wind turbine.

Western Area Power Administration (WAPA), Cherry Todd Electric Cooperative (REC) and the RST Utilities Commission continued to monitor NEG Micon 750 kW wind turbine.

2005

Quarterly loan payments are made to the Rural Utilities Service from funds generated by the Rosebud Casino wind turbine.

Throughout 2005 the Rosebud Sioux Tribe provides tours for the public and schools at the Rosebud Casino wind turbine.

Western Area Power Administration (WAPA), Cherry Todd Electric Cooperative (REC) and the RST Utilities Commission continued to monitor NEG Micon 750 kW wind turbine.

2006

Quarterly loan payments are made to the Rural Utilities Service from funds generated by the Rosebud Casino wind turbine.

Throughout 2006 the Rosebud Sioux Tribe provided tours for the public and schools at the Rosebud Casino wind turbine.

Western Area Power Administration (WAPA), Cherry Todd Electric Cooperative (REC) and the RST Utilities Commission continued to monitor NEG Micon 750 kW wind turbine.

2007

The Basin Electric power purchase agreement expires. Cherry Todd Electric Cooperative (REC) and the Rosebud Sioux Tribe sign an “Interconnection and Commercial Wind Energy Purchase Agreement”.

Quarterly loan payments are made to the Rural Utilities Service from funds generated by the Rosebud Casino wind turbine.

Western Area Power Administration (WAPA), Cherry Todd Electric Cooperative (REC) and the RST Utilities Commission continued to monitor NEG Micon 750 kW wind turbine.

Throughout 2007 the Rosebud Sioux Tribe provided tours for the public and schools at the Rosebud Casino wind turbine.

2008

Quarterly loan payments will be made throughout 2008 to the Rural Utilities Service from funds generated by the Rosebud Casino wind turbine.

Western Area Power Administration (WAPA), Cherry Todd Electric Cooperative (REC) and the RST Utilities Commission will continue to monitor NEG Micon 750 kW wind turbine.

Throughout 2008 the Rosebud Sioux Tribe will continue to provide tours for the public and schools at the Rosebud Casino wind turbine.

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Conclusions and Recommendations

In reviewing this project, the biggest problem the Tribe ran into was educating the Tribal Council and the local public on how everyone would benefit from this clean energy project. With the Tribal Administration and Council changing every two years is was difficult to educate the council on how the project was started, funded and developed into the wind farm development the Tribe is into on the Reservation today.

Also, the difficultly of educating ourselves that is the Tribe and ICOUP involved in the development of this project. Understanding the economics of the wind project and researching and finding matching funds was a learning experience. Learning from the mistakes that were made in 1999 and 2000.

When Disgen, Incorporated became a partner they brought forth the expertise, knowledge and know how on how to get this project going. This led to the final construction of the Rosebud wind turbine. Without Disgen this project might not of happen.

A recommendation for any Native American Tribe that would want to built a large commercial size wind turbine. Is to do your research and find a dependable and trustworthy wind developer, which is willing to support and respect your ideas, culture and has no problems in educating your Tribe, on how to develop a project similar to the Rosebud Wind Energy Project.

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Lessons Learned

Through the vision of the late Alex "Little Soldier" Lunderman (1928-2000) it was his wish that the lessons learned, will provide a trail for other tribes in the region to develop wind energy projects to serve both on-reservation needs and provide access to green power markets.

The economic potential through wind development for the Rosebud Sioux Tribe cannot be understated or even fully realized and as the tribe moves forward in wind development. The Tribe builds on a foundation of education and experience, allowing the Sicangu Oyate an opportunity at building a better life for the Tribe's children and grandchildren, by continuing this vision.

Preliminary Wind Resource Assessment and Theoretical Energy Estimate

Rosebud Sioux Reservation, South Dakota

Prepared For:

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April 2003

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1.0 Introduction and Summary

A preliminary wind resource assessment is prepared for a site in south central South Dakota near the Town of St. Francis on the Rosebud Sioux Reservation.

The average wind speed measured at 65 meters above ground level is 18.2 mph. A theoretical energy estimate, made for the GE 1.5MW turbine using a hub height wind speed at 70 meters agl, indicates a gross capacity factor of 42% and a net capacity factor after losses of 39%.

2.0 Site Description

The monitoring equipment is installed on an existing communications tower near the Town of St. Francis, South Dakota. Wind speed sensors are installed at 30 meters, 40 meters, and 65 meters above ground level.

The wind resource for South Dakota is presented in Figure 1. This map, prepared by staff at the National Renewable Energy Laboratory, indicates that the site location, marked by an arrow, is in an area classified as having a good to excellent wind resource. The local topography is typical of the central plains with generally flat terrain with minor hills and ridges and deep gullies. Land use is dry land farming and cattle ranching.

3.0 Meteorological Data

3.1 On-Site Meteorological Monitoring Program

Three levels of wind speed sensors and two levels of wind direction sensors are mounted on an existing communications tower. Two wind speed sensors, Maximum #40, are installed at each of three levels, 30 meters, 40 meters, and 65 meters. The wind speed sensors are installed on the east and west side of the towers so data can be obtained which minimizes the tower solidity effects. Wind direction sensors, NRG #200P, are mounted at 40 meters and 65 meters above ground level. The data are collected using an NRG Systems 9300SA logger. Flashcards are pulled once each month and the data are downloaded and stored in a digital data file. The data collection program started on May 1, 2001.

3.2 Average Wind Speed

The annual average wind speeds are presented in Table 1 for the 30 meter, 40 meter, and 65 meter levels. The annual average wind speed at the 65-meter level is 18.2 mph. The diurnal wind speed pattern indicates a daytime minimum and nighttime maximum for the each level, most pronounced at the 65-meter level. This diurnal pattern is very typical of a Great Plains site.

Figure 1 – Wind Resource Map of South Dakota

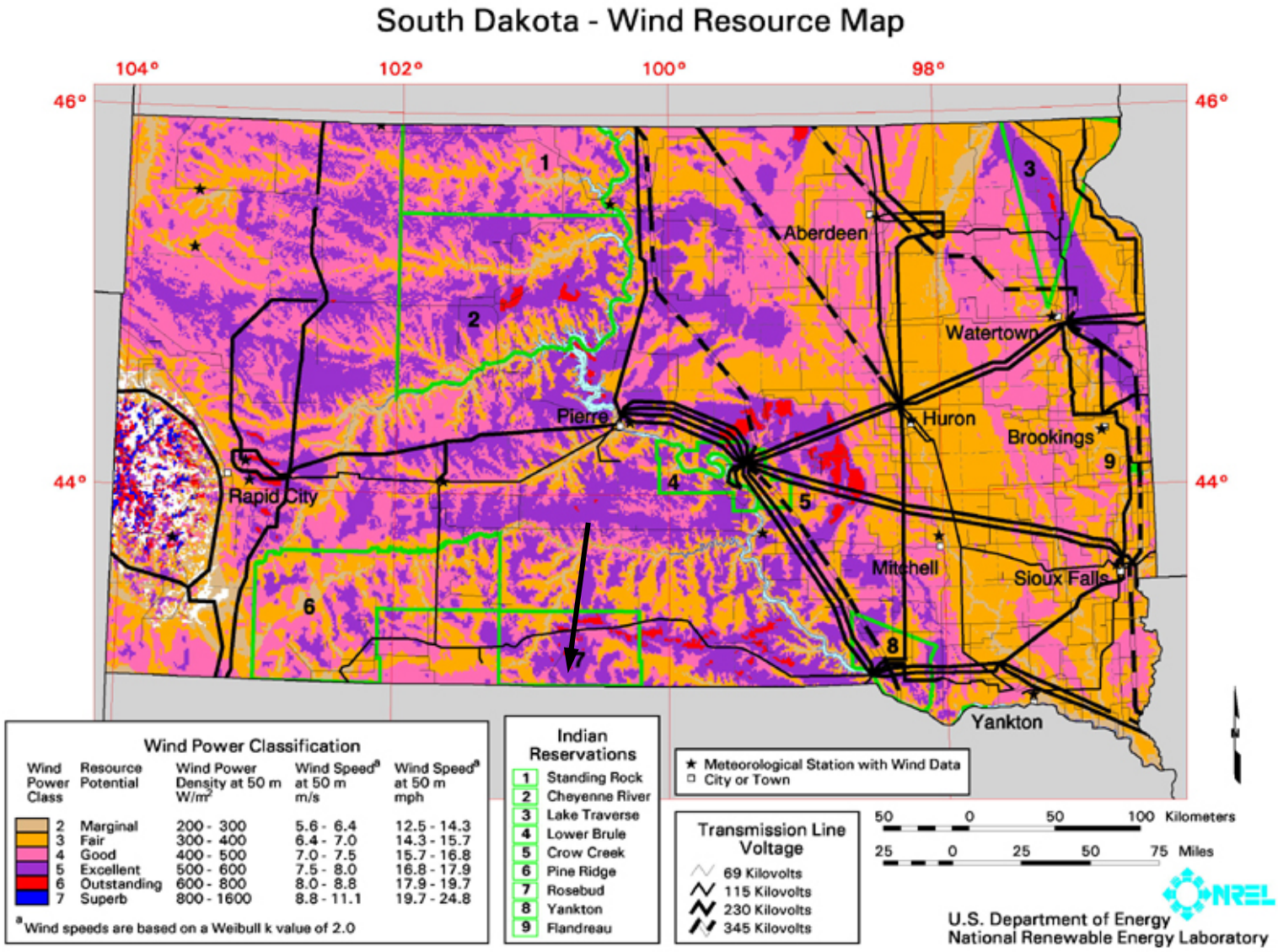

Table 1. Mean Hourly Wind Speeds

MEAN HOURLY WIND SPEEDS

ROSEBUD SIOUX TRIBE
30M WIND SPEED (CHAN 5) (MPH)

05/01/01 - 03/31/03

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	16.5	16.2	15.0	17.5	16.4	16.9	16.9	18.3	16.8	15.6	16.5	15.9	16.6
02	16.5	16.0	15.4	16.9	16.5	16.5	16.8	18.3	16.6	16.0	16.7	16.0	16.6
03	16.3	16.1	14.7	17.1	16.5	15.9	16.6	17.6	16.5	16.2	16.9	16.3	16.4
04	15.1	16.1	14.2	17.0	15.8	15.6	15.8	16.2	16.3	15.6	16.5	16.5	15.9
05	15.0	15.9	14.3	16.9	15.6	15.4	15.8	15.4	16.6	15.6	16.4	16.4	15.8
06	15.3	16.3	14.0	16.5	15.4	14.5	15.7	15.6	16.8	15.2	16.1	16.2	15.6
07	15.7	16.2	14.1	16.1	14.9	14.3	14.9	15.0	16.8	15.2	16.0	16.5	15.5
08	15.2	16.3	14.5	15.2	15.6	14.2	14.2	14.3	16.7	14.7	16.3	16.3	15.3
09	15.2	15.6	14.4	15.4	17.2	14.9	13.9	14.4	16.5	14.5	15.9	15.6	15.3
10	14.9	15.4	14.4	16.6	17.8	15.7	14.0	14.9	17.0	15.2	15.7	15.5	15.6
11	15.0	16.1	14.5	16.3	17.9	16.0	14.7	15.7	17.4	15.9	16.2	15.6	16.0
12	15.3	17.1	14.5	16.9	17.9	15.2	15.1	15.7	17.8	16.2	17.0	16.6	16.3
13	16.3	17.4	14.7	16.9	17.7	15.4	14.8	15.4	17.7	16.2	17.6	16.9	16.4
14	16.4	17.3	15.1	17.1	17.5	15.3	15.0	15.1	17.5	16.4	18.4	16.6	16.5
15	16.6	17.7	15.9	16.9	17.2	15.9	15.0	16.1	17.7	16.6	18.0	16.5	16.7
16	16.5	17.6	15.8	17.3	16.8	15.8	15.2	16.0	17.2	16.5	16.7	15.6	16.4
17	15.7	17.7	15.0	18.4	15.7	15.6	15.4	16.5	17.1	15.3	15.8	14.7	16.0
18	14.1	16.4	14.5	18.1	15.2	15.7	15.8	16.2	16.9	14.0	14.5	13.7	15.3
19	13.9	15.3	14.2	17.0	14.9	15.7	16.0	16.4	15.3	14.2	14.6	14.2	15.1
20	15.2	15.3	15.5	17.2	14.1	15.4	15.9	15.6	15.8	15.1	15.6	14.9	15.4
21	16.1	15.9	16.2	18.2	15.0	16.8	16.2	16.6	16.6	16.1	16.0	15.2	16.2
22	16.0	16.3	16.2	18.9	16.4	16.6	16.6	17.6	17.0	15.8	16.3	15.7	16.5
23	15.3	16.6	15.8	19.2	16.4	16.8	17.0	18.6	16.8	15.7	16.8	15.8	16.7
24	15.7	16.8	15.8	18.5	16.2	17.1	17.3	18.6	16.3	15.3	16.8	15.9	16.7
Mean	15.6	16.4	14.9	17.2	16.3	15.7	15.6	16.3	16.8	15.5	16.4	15.8	16.0
Good Hours	1376	1163	879	720	1472	1440	1488	1488	1440	1441	1440	1472	
Missing Hours	112	181	609	0	16	0	0	0	0	47	0	16	

15,819 Hours of Good Data 981 Hours Missing 94.2% Data Recovery

Table 1. Mean Hourly Wind Speeds (Con't)

MEAN HOURLY WIND SPEEDS

ROSEBUD SIOUX TRIBE
30M WIND SPEED (CHAN 6) (MPH)

05/01/01 - 03/31/03

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	16.6	16.5	15.1	17.3	16.2	17.2	16.6	17.9	16.8	15.8	16.4	16.1	16.6
02	16.6	16.2	15.5	16.8	16.3	16.6	16.9	18.0	16.7	16.2	16.6	16.0	16.6
03	16.4	16.3	15.0	16.9	16.3	15.8	16.7	17.6	16.5	16.4	17.1	16.4	16.5
04	15.4	16.3	14.5	16.6	15.5	15.6	16.1	16.2	16.3	15.8	16.9	16.6	16.0
05	15.1	16.2	14.6	16.2	15.4	15.6	16.0	15.4	16.6	15.7	16.5	16.8	15.9
06	15.5	16.7	14.2	16.0	15.3	14.6	15.9	15.5	16.8	15.4	16.4	16.6	15.8
07	16.1	16.2	14.3	15.8	14.9	14.3	15.0	15.0	16.7	15.4	16.3	16.9	15.6
08	15.7	16.0	14.5	15.0	15.4	14.1	14.3	14.2	16.5	14.7	16.6	16.6	15.3
09	15.6	15.6	14.3	15.3	17.0	14.7	13.9	14.4	16.1	14.7	16.3	15.8	15.3
10	15.3	15.5	14.5	16.6	17.7	15.4	14.2	14.9	16.8	15.3	16.0	15.6	15.6
11	15.5	15.9	14.6	16.4	17.8	15.7	14.7	15.5	17.4	15.9	16.5	15.8	16.0
12	15.8	16.8	14.6	17.0	17.8	15.0	15.0	15.6	17.8	16.3	17.1	16.8	16.3
13	16.6	17.1	14.9	16.9	17.6	15.2	14.6	15.4	17.6	16.4	17.7	17.0	16.4
14	16.8	17.2	15.4	17.1	17.4	15.2	14.7	15.1	17.5	16.5	18.5	16.7	16.5
15	17.0	17.4	15.9	17.0	17.2	15.7	14.7	15.9	17.7	16.7	18.0	16.6	16.6
16	16.8	17.4	15.7	17.5	16.7	15.5	14.9	15.8	17.3	16.6	16.8	15.7	16.3
17	15.8	17.5	15.1	18.5	15.6	15.4	15.0	16.3	17.3	15.4	15.9	14.7	15.9
18	14.2	16.6	14.5	18.0	15.2	15.5	15.5	16.2	17.0	14.0	14.7	13.7	15.3
19	14.1	15.6	14.0	16.9	14.5	15.3	15.6	16.5	15.2	13.9	14.6	14.3	15.0
20	15.2	15.5	15.2	16.8	13.7	15.0	15.4	15.4	15.6	14.8	15.5	15.0	15.2
21	16.2	16.0	16.0	17.3	14.4	16.3	15.6	16.3	16.2	15.9	16.1	15.3	15.9
22	16.2	16.2	16.0	18.1	15.6	16.2	15.9	17.3	17.0	15.8	16.4	15.7	16.3
23	15.4	16.6	15.5	18.4	15.7	16.5	16.5	18.4	17.0	15.8	16.8	15.8	16.5
24	15.8	16.9	15.9	17.8	15.8	17.4	16.8	18.4	16.5	15.6	16.8	16.1	16.6
Mean	15.8	16.4	15.0	16.9	16.0	15.6	15.4	16.1	16.8	15.6	16.5	15.9	16.0
Good Hours	1373	1166	875	720	1472	1440	1488	1488	1440	1441	1440	1472	
Missing Hours	115	178	613	0	16	0	0	0	0	47	0	16	

15,815 Hours of Good Data 985 Hours Missing 94.1% Data Recovery

Table 1. Mean Hourly Wind Speeds (Con't)

MEAN HOURLY WIND SPEEDS

ROSEBUD SIOUX TRIBE
40M WIND SPEED (CHAN 3) (MPH)

05/01/01 - 03/31/03

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	17.5	17.1	15.2	18.5	17.5	18.3	18.3	19.6	18.1	16.7	17.7	17.1	17.7
02	17.3	16.7	15.7	17.8	17.6	17.8	18.1	19.7	17.9	17.1	17.7	17.1	17.6
03	17.0	16.7	15.0	17.9	17.6	17.1	17.9	18.9	17.7	17.2	17.8	17.3	17.4
04	16.0	16.7	14.5	17.8	16.9	16.8	17.1	17.3	17.3	16.8	17.7	17.8	16.9
05	16.0	16.6	14.7	17.6	16.7	16.6	16.9	16.7	17.6	16.8	17.7	17.6	16.8
06	16.3	17.1	14.3	17.2	16.4	15.8	16.8	16.7	17.8	16.5	17.4	17.4	16.7
07	16.4	17.1	14.8	16.9	15.9	15.5	16.0	16.1	17.7	16.5	17.1	17.7	16.5
08	16.0	16.7	14.9	15.8	16.2	14.9	14.8	15.1	17.6	15.8	17.4	17.4	16.1
09	16.1	16.3	14.7	15.6	17.5	15.2	14.2	14.8	17.0	15.4	17.1	16.6	15.9
10	15.7	15.7	14.8	16.7	18.1	16.1	14.3	15.2	17.2	15.7	16.6	16.6	16.1
11	15.6	16.2	14.7	16.3	18.2	16.4	14.9	15.9	17.7	16.2	16.7	16.4	16.3
12	15.7	17.0	14.6	16.9	18.2	15.6	15.4	15.9	18.0	16.6	17.4	17.0	16.6
13	16.6	17.3	15.0	16.9	17.9	15.7	15.1	15.7	18.0	16.7	18.0	17.1	16.7
14	16.8	17.3	15.6	17.1	17.8	15.7	15.2	15.4	17.8	17.0	18.9	17.0	16.8
15	17.1	17.7	16.2	16.9	17.5	16.3	15.3	16.3	18.0	17.1	18.5	16.9	17.0
16	17.0	17.6	16.0	17.5	17.0	16.2	15.6	16.3	17.5	17.0	17.2	16.0	16.7
17	16.1	17.6	15.1	18.6	15.9	16.0	15.8	16.8	17.6	15.7	16.3	15.2	16.3
18	14.7	16.6	14.7	18.1	15.5	16.2	16.3	16.6	17.5	14.6	15.2	14.5	15.8
19	14.5	15.8	14.4	17.1	15.2	16.4	16.5	17.0	16.1	15.1	15.4	15.2	15.7
20	16.1	15.8	15.8	17.7	14.8	16.4	16.8	16.6	16.9	16.3	16.6	15.9	16.3
21	16.9	16.7	16.8	18.9	15.9	18.2	17.4	17.8	17.8	17.2	17.0	16.4	17.2
22	16.7	17.0	16.7	19.8	17.5	18.1	18.0	18.9	18.3	16.9	17.4	16.8	17.6
23	16.1	17.2	16.3	20.2	17.5	18.2	18.5	20.0	18.1	16.7	17.9	16.7	17.8
24	16.8	17.4	16.0	19.5	17.3	18.6	18.8	20.0	17.5	16.3	18.0	17.0	17.8
Mean	16.3	16.8	15.3	17.6	16.9	16.6	16.4	17.1	17.6	16.4	17.3	16.7	16.8

Good Hours												
1381	1221	891	720	1472	1440	1488	1488	1440	1439	1440	1472	

Missing Hours												
107	123	597	0	16	0	0	0	0	49	0	16	

15,892 Hours of Good Data 908 Hours Missing 94.6% Data Recovery

Table 1. Mean Hourly Wind Speeds (Con't)

MEAN HOURLY WIND SPEEDS

ROSEBUD SIOUX TRIBE
40M WIND SPEED (CHAN 4) (MPH)

05/01/01 - 03/31/03

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	17.8	17.3	15.9	18.7	17.1	18.3	17.8	19.2	18.0	16.8	17.9	17.4	17.7
02	17.8	17.0	16.5	18.0	17.3	17.7	18.0	19.3	17.8	17.2	18.2	17.4	17.7
03	17.7	17.2	15.8	18.0	17.4	16.9	17.8	18.7	17.6	17.4	18.6	17.9	17.6
04	16.6	17.4	15.3	17.6	16.7	16.8	17.1	17.3	17.3	16.8	18.3	18.1	17.1
05	16.6	17.3	15.0	17.4	16.5	16.7	16.9	16.6	17.6	16.8	17.9	18.3	17.0
06	16.9	17.8	14.6	17.0	16.2	15.8	16.8	16.6	17.7	16.5	17.9	18.1	16.9
07	17.4	17.5	14.7	16.9	16.0	15.4	15.9	16.0	17.7	16.4	17.8	18.4	16.7
08	17.1	17.2	14.8	15.9	16.2	14.7	14.8	15.0	17.6	15.8	18.1	18.1	16.3
09	17.0	17.1	14.9	15.8	17.4	15.0	14.1	14.7	16.7	15.5	17.7	17.3	16.1
10	16.6	16.4	15.0	16.9	18.0	15.7	14.3	15.1	17.1	15.7	17.2	17.1	16.3
11	16.2	16.6	15.0	16.5	18.1	16.1	14.9	15.8	17.6	16.2	17.1	16.9	16.5
12	16.3	17.3	14.9	17.1	18.1	15.4	15.2	15.8	18.0	16.6	17.5	17.4	16.7
13	17.1	17.4	15.2	17.1	17.9	15.6	14.9	15.7	17.9	16.7	18.1	17.6	16.8
14	17.3	17.4	15.6	17.2	17.8	15.6	14.9	15.4	17.8	16.9	19.0	17.3	16.8
15	17.4	17.7	16.1	17.1	17.5	16.0	15.0	16.2	18.0	17.1	18.5	17.2	17.0
16	17.2	17.7	16.1	17.8	17.1	15.9	15.2	16.2	17.5	16.9	17.3	16.4	16.7
17	16.4	17.8	15.3	18.8	15.9	15.8	15.3	16.7	17.5	15.7	16.5	15.5	16.3
18	14.9	16.9	14.8	18.3	15.5	15.9	15.8	16.5	17.4	14.5	15.5	14.6	15.8
19	14.8	16.1	14.4	17.3	15.0	15.9	16.0	17.0	15.9	14.7	15.5	15.5	15.6
20	16.2	16.2	15.6	17.5	14.5	16.0	16.2	16.2	16.4	15.7	16.7	16.2	16.1
21	17.4	16.9	16.7	18.4	15.4	17.6	16.8	17.5	17.4	16.9	17.1	16.6	17.0
22	17.1	17.1	16.8	19.3	16.7	17.5	17.3	18.5	18.1	16.8	17.5	17.0	17.4
23	16.6	17.4	16.3	19.8	16.8	17.7	17.8	19.6	18.0	16.8	18.2	17.0	17.6
24	17.1	17.7	16.6	19.0	16.8	18.5	18.1	19.8	17.5	16.5	18.3	17.5	17.8
Mean	16.8	17.2	15.5	17.6	16.7	16.3	16.1	16.9	17.5	16.4	17.6	17.1	16.8
Good Hours	1381	1174	889	720	1472	1440	1488	1488	1440	1439	1440	1472	
Missing Hours	107	170	599	0	16	0	0	0	0	49	0	16	

15,843 Hours of Good Data 957 Hours Missing 94.3% Data Recovery

Table 1. Mean Hourly Wind Speeds (Con't)

MEAN HOURLY WIND SPEEDS

ROSEBUD SIOUX TRIBE
65M WIND SPEED (CHAN 1) (MPH)

05/01/01 - 03/31/03

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	18.8	18.6	16.8	21.0	19.4	20.1	20.3	21.4	20.1	18.3	19.6	18.8	19.5
02	18.5	18.1	17.4	20.0	19.5	19.6	20.1	21.7	20.0	18.7	19.7	18.6	19.4
03	18.2	18.0	16.7	20.0	19.3	19.0	19.9	20.8	19.7	18.8	19.4	19.1	19.1
04	17.2	18.1	16.2	20.0	18.9	18.7	19.1	19.2	19.0	18.4	19.7	19.6	18.7
05	17.0	17.9	16.4	19.5	18.5	18.5	18.7	18.6	19.3	18.6	19.4	19.5	18.5
06	17.4	18.5	16.1	19.2	18.1	17.7	18.5	18.5	19.4	18.1	19.4	19.2	18.4
07	17.6	18.5	16.6	19.2	17.7	17.2	17.6	17.6	19.3	18.0	18.9	19.5	18.1
08	17.1	18.9	16.8	17.8	17.7	15.8	16.0	16.6	19.2	17.4	19.0	19.1	17.6
09	17.2	18.2	16.3	16.8	18.3	15.7	14.5	15.3	17.9	16.6	18.9	18.4	17.0
10	16.5	17.3	15.7	17.2	18.7	16.4	14.4	15.5	17.5	16.1	18.2	18.2	16.8
11	16.6	17.0	15.2	16.8	18.7	16.7	15.1	16.1	17.9	16.5	17.4	17.9	16.9
12	16.0	17.5	15.1	17.5	18.7	15.9	15.6	16.1	18.2	16.9	17.8	17.8	16.9
13	16.6	17.8	15.4	17.5	18.4	16.0	15.3	15.9	18.2	17.0	18.3	17.6	17.0
14	16.8	17.4	16.0	17.6	18.2	15.9	15.4	15.6	18.0	17.2	19.2	17.4	17.1
15	17.1	17.9	16.8	17.4	18.0	16.6	15.5	16.5	18.2	17.5	18.8	17.4	17.3
16	17.0	17.6	16.4	18.0	17.5	16.6	15.7	16.6	17.7	17.3	17.6	16.6	17.0
17	16.3	17.7	15.6	19.2	16.4	16.3	16.0	17.1	17.8	16.1	16.8	16.0	16.7
18	15.2	16.9	15.4	18.8	16.1	16.7	16.6	16.9	17.9	15.2	16.0	15.5	16.4
19	15.1	16.5	15.4	18.1	15.9	17.1	17.0	17.5	17.0	16.0	16.4	16.5	16.5
20	16.7	16.8	17.1	18.9	15.9	17.5	17.8	17.8	18.2	17.5	17.8	17.6	17.4
21	17.8	17.7	18.3	20.5	17.3	19.7	18.8	19.3	19.4	18.6	18.3	18.1	18.6
22	17.5	18.1	18.3	21.8	19.1	19.9	19.7	20.6	20.1	18.4	18.9	18.6	19.2
23	17.2	18.2	17.6	22.4	19.2	19.9	20.4	21.9	19.8	18.1	19.5	18.6	19.4
24	17.9	18.6	17.5	21.9	19.1	20.4	20.7	21.8	19.4	17.8	20.0	18.5	19.4
Mean	17.0	17.8	16.5	19.0	18.1	17.7	17.4	18.1	18.7	17.5	18.5	18.1	17.9
Good Hours	1442	1205	897	720	1472	1440	1488	1488	1440	1425	1440	1472	
Missing Hours	46	139	591	0	16	0	0	0	0	63	0	16	

15,929 Hours of Good Data 871 Hours Missing 94.8% Data Recovery

Table 1. Mean Hourly Wind Speeds (Con't)

MEAN HOURLY WIND SPEEDS

ROSEBUD SIOUX TRIBE
65M WIND SPEED (CHAN 2 (MPH)

05/01/01 - 03/31/03

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	19.6	19.0	17.2	20.9	19.0	20.3	20.1	21.5	20.1	18.4	20.1	19.4	19.7
02	19.7	18.7	18.2	20.0	19.3	19.7	20.2	21.6	20.0	19.0	20.5	19.4	19.8
03	19.6	18.8	17.4	20.0	19.3	18.9	19.9	20.7	19.7	19.0	20.6	20.0	19.6
04	18.4	18.6	16.8	19.7	18.7	18.8	19.2	19.4	19.2	18.4	20.3	20.3	19.0
05	18.6	18.3	17.1	19.3	18.4	18.6	18.9	18.6	19.4	18.6	20.0	20.6	18.9
06	18.9	19.4	16.7	18.9	18.0	17.6	18.8	18.5	19.6	18.3	20.2	20.3	18.8
07	19.4	19.3	17.0	18.8	17.6	17.1	17.7	17.7	19.5	18.1	20.1	20.7	18.6
08	19.0	20.0	17.1	17.8	17.7	15.7	16.1	16.7	19.2	17.5	20.2	20.4	18.1
09	18.9	19.4	16.8	16.9	18.2	15.5	14.6	15.4	17.8	16.8	19.7	19.5	17.5
10	18.3	18.5	16.4	17.3	18.7	16.2	14.6	15.6	17.5	16.4	19.0	19.2	17.3
11	18.1	17.8	15.9	17.0	18.7	16.6	15.2	16.1	18.0	16.6	18.1	18.6	17.3
12	17.3	18.1	15.6	17.6	18.7	15.9	15.5	16.2	18.4	16.9	18.2	18.4	17.3
13	17.7	18.3	15.9	17.5	18.4	16.0	15.2	16.0	18.3	17.0	18.6	18.2	17.3
14	17.9	18.2	16.3	17.7	18.3	16.0	15.3	15.7	18.1	17.2	19.5	17.8	17.3
15	18.1	18.4	16.9	17.6	18.1	16.5	15.4	16.6	18.3	17.4	19.1	17.8	17.5
16	18.0	18.4	16.6	18.3	17.6	16.4	15.7	16.6	18.0	17.3	17.9	17.0	17.3
17	17.2	18.6	15.8	19.4	16.4	16.3	15.9	17.1	18.0	16.2	17.3	16.3	16.9
18	16.0	17.9	15.4	19.0	16.1	16.6	16.4	17.0	18.0	15.1	16.6	15.8	16.6
19	16.1	17.5	15.3	18.2	15.8	16.8	16.8	17.7	16.9	15.7	16.9	17.0	16.7
20	17.6	17.6	16.9	18.8	15.7	17.3	17.6	17.8	18.0	17.2	18.2	18.1	17.5
21	18.9	18.4	18.3	20.2	16.8	19.5	18.7	19.3	19.4	18.6	18.7	18.5	18.7
22	18.4	18.7	18.3	21.4	18.5	19.6	19.3	20.5	20.1	18.5	19.2	19.1	19.3
23	18.4	18.9	17.9	21.9	18.7	19.8	20.0	21.9	20.0	18.4	20.2	19.1	19.6
24	19.0	19.3	17.9	21.7	18.8	20.6	20.4	21.9	19.5	18.0	20.4	19.5	19.7
Mean	18.3	18.6	16.8	19.0	18.0	17.6	17.4	18.2	18.8	17.5	19.2	18.8	18.2
Good Hours	1399	1152	899	720	1472	1440	1488	1488	1440	1430	1440	1472	
Missing Hours	89	192	589	0	16	0	0	0	0	58	0	16	

15,840 Hours of Good Data 960 Hours Missing 94.3% Data Recovery

3.3 Wind Rose

A wind rose, showing the joint frequency of wind speed and wind direction at the 65 meter level of the St. Francis Tower, is presented in Figure 2. The predominant wind directions appear to be south, southwest through west, and northwest.

3.4 Wind Shear

Wind shear is the change or increase in wind speed above ground level. The simple wind power law is expressed as:

$$U_2 = U1\ (Z_2/Z_1)^{alpha}$$

Where U_2 and U_1 are the wind speeds at the upper and lower levels, Z_2 and Z_1 are the upper and lower elevations, and alpha is the wind speed power law exponent. The typical value for the wind speed power law exponent is 0.14 (1/7 power law). Depending on terrain and surface roughness, the value may vary between 0.05 and 0.35. The calculated value based on the 30-meter and 65 meter hourly average wind speeds is 0.16.

3.5 Turbulence Intensity

Turbulence intensity is defined as:

TI = Standard Deviation of the Wind Speed/ Mean Wind Speed.

The turbulence intensity, calculated in each wind speed bin from 3 meters per second (mps) using the 65-meter level is presented in Table 2. Turbulence intensity is approximately 10% at 10 mps and 11% at 15mps. This site is considered a Class II. Site (IEC Classifications)

3.6 Projected Hub Height Wind Speeds

The measured wind speeds at 65 meters are combined with the wind shear at the site to estimate the average wind speeds at 70 meters above ground level:

70M Wind Speed = 65M Wind Speed X (70/65)^0.16

The 70-meter wind speed is estimated to be 18.3 mph, or 1% greater than the 65-meter wind speed.

Figure 2 - Wind Rose for the 65-Meter Level, Rosebud Sioux Site. The number in the center, 14.8%, is the percentage of time the wind speeds are less than 5 mph.

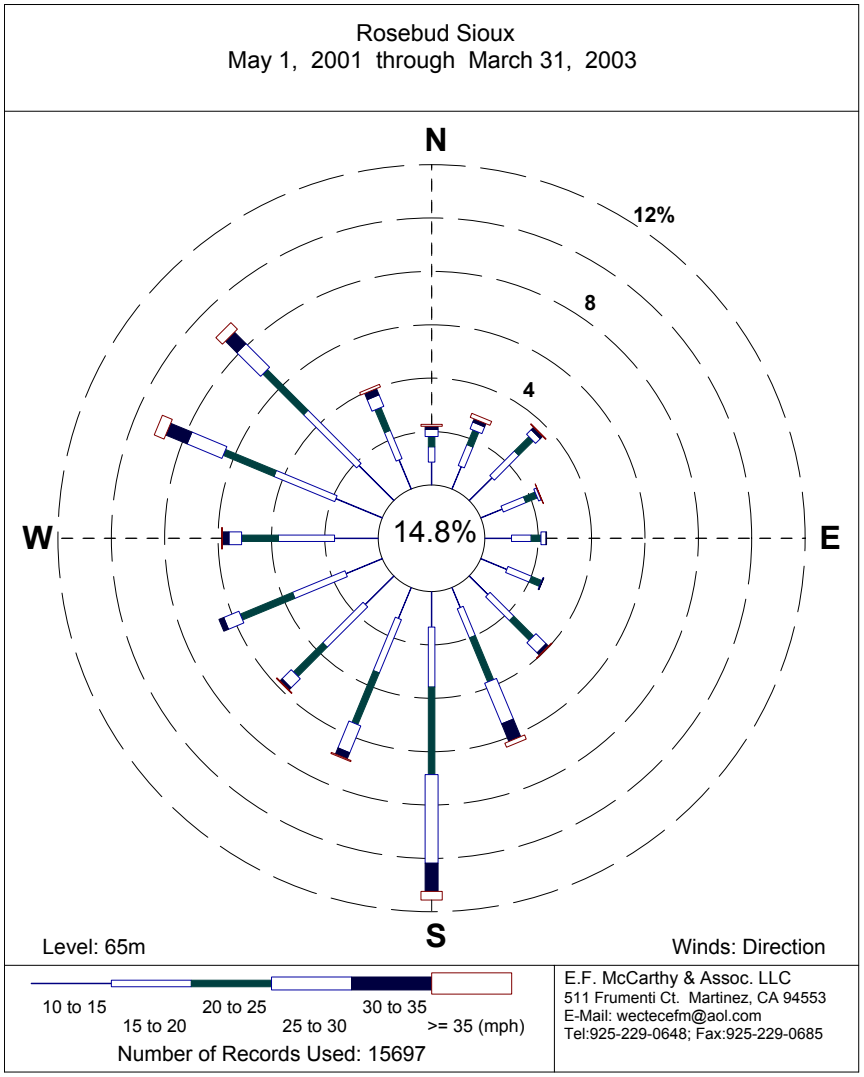

Table 2 – Turbulence Intensity By Wind Speed Bin

ROSEBUD SIOUX TRIBE
65M WIND SPEED (CHAN 2 □□

05/01/01 to 03/31/03

Wind Speed Frequency and Concurrent TI

Wind Speed (mps)	Frequency of Occurrence Hrs	%	Mean Turbulence Intensity
0-2	612	3.9	0.549
3	768	4.8	0.284
4	1090	6.9	0.221
5	1314	8.3	0.182
6	1485	9.4	0.158
7	1658	10.5	0.139
8	1835	11.6	0.122
9	1711	10.8	0.111
10	1529	9.7	0.105
11	1226	7.7	0.103
12	993	6.3	0.099
13	662	4.2	0.101
14	422	2.7	0.106
15	241	1.5	0.112
16	133	.8	0.125
17	69	.4	0.124
18	42	.3	0.131
19	19	.1	0.149
20	12	.1	0.130
21	9	.1	0.118
22	3	.0	0.095
23	3	.0	0.104
24	4	.0	0.094
25	0	0.0	*****
26	0	0.0	*****
27	0	0.0	*****
28	0	0.0	*****
29	0	0.0	*****
30	0	0.0	*****
Total Hrs	15840		15840

4.0 Wind Turbine Power Curve

The GE Wind 1.5 MW wind turbine (70M Rotor) is a three bladed, upwind, horizontal axis wind turbine employing variable pitch blade technology. The power curve for the GE Wind 1.5MW turbine for the St. Francis Site using an air density of 1.12 kg/m^3 is presented in Table 3.

Table 3
GE Wind 70M Power Curve

Wind Speed (mps)	Power (kW)	Wind Speed (mps)	Power (kW)	Wind Speed (mps)	Power (kW)	Wind Speed (mps)	Power (kW)
4	31.0	10	970.8	16	1500.0	22	1500.0
5	89.3	11	1248.4	17	1500.0	23	1500.0
6	184,0	12	1435.0	18	1500.0	24	1500.0
7	306.4	13	1488.6	19	1500.0	25	1500.0
8	471.4	14	1499.6	20	1500.0	>25	0
9	703.0	15	1500.0	21	1500.0		

5.0 Annual Energy Estimate

5.1 Gross Annual Theoretical Energy Estimate

The wind speed frequency is combined with the GE Wind power curve to create the annual theoretical energy estimate for a single turbine. The theoretical gross energy output for the 70 meter GE Wind Turbine (1.5MW) on a 70-meter tower is 5,573,000kWh. (Table 4).

5.2 Net Annual Theoretical Energy Estimate

The gross annual theoretical energy output is adjusted by various loss factors to estimate the actual or net energy delivered to the substation. These losses take into account the wind turbine out-of-service time associated with scheduled and unscheduled downtime, electrical line losses from the turbine to the substation, control system losses, array losses due to wake effects between adjoining turbines, and lost power associated with blade icing and blade soiling.

The annual net energy production for a single turbine is calculated using the following formula:

$$AEP_{net} = AEP_{gross} * (1- EL)$$

where AEP_{net} is the Annual Net Energy Production of the wind facility;

AEP_{gross} is the Annual Gross Energy Production of the wind facility;

EL is the product of individual energy losses (%);

EL is the product of the individual energy losses and is calculated as follows:

$$EL = 1-(1 - L_{array}) * (1 - L_{blade}) * (1 - L_{collect}) * (1 - L_{control}) * (1-Availability)$$

where L_{array} = Array losses

$L_{soiling}$ = Blade contamination losses

$L_{collect}$ = Collection system from turbine to grid

$L_{control}$ = Control, grid, and miscellaneous losses

Availability = Availability is the percentage of calendar time that the turbines are functional and ready to deliver power to the grid.

Table 4. Theoretical Energy Projection for a GE Wind Turbine (1.5MW) on a 65 Meter Tower.

THEORETICAL WIND TURBINE PRODUCTION 05/01/01 - 03/31/03

Wind: 65M WIND SPEED (CHAN 2
ROSEBUD SIOUX TRIBE

Wind Speeds Multiplied By 1.01

Turbine: GE 1.5 SL (1500Kw)70M ROTOR 1.12KG/M**2

Rated at: 1500 kW at 30.0 MPH
Maximum Output: 1500 kW at 30.0 MPH

		Time		Production	
Status	MPH	hrs	%	KW-hrs	%
Below Cut-in	Under 10.0	2403	15.2		
Cut-in To Rated	10.1-30.0	12365	78.1	8,469,362	84.0
Rated To Cut-out	30.1-56.0	1072	6.8	1,607,314	16.0
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		13437	84.8		

kW-hrs at Capacity / Total kW-hrs 16.0

hrs at Capacity / hrs of Operation 8.0

Mean Wind Speed 18.4 MPH

Energy Produced 10,076,680 kW-hrs

Annual Production Rate 5,572,707 kW-hrs

Capacity Factor .42

15840 hrs of Good Data 960 hrs Missing 94.3% Data Recovery

The loss factors assumed for this single turbine project include 3% for availability, 2% for electrical line losses, 1% for turbulence and control, and 2% for blade contamination losses. There are no losses assumed for array or wake effects. The gross to net ratio is 0.922

The calculated net energy production for a single turbine on a 70-meter tower using the loss factors presented above is 5,126,890. The net capacity factor is 39%.