

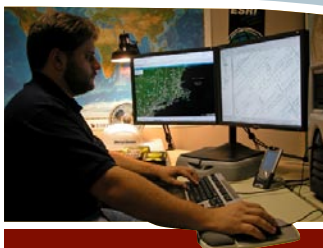
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Weston&Sampson[®]

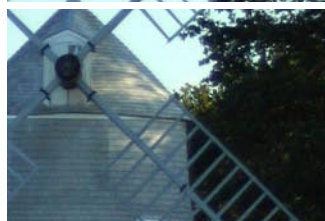
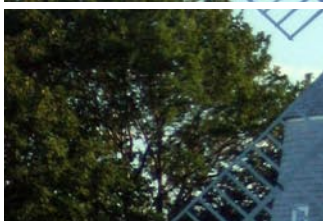
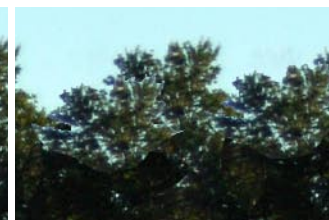
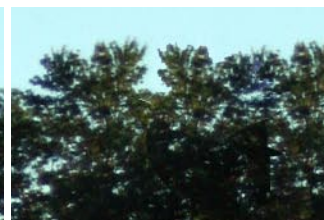
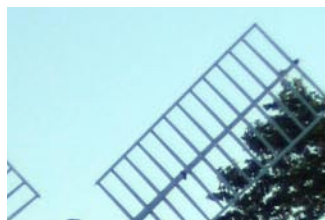
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Wind Turbine



financial feasibility study report



Town of

Orleans

MASSACHUSETTS

Wind Energy Facility
Financial Feasibility Study

February 2009



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EXECUTIVE SUMMARY

An economic feasibility study has been completed for the proposed construction of a commercial-scale wind turbine in the Town of Orleans, Massachusetts. The following report presents a comprehensive review of the critical factors and considerations analyzed as part of the economic feasibility study for installing a single commercial scale wind turbine at the site. This feasibility study incorporates evaluation of prior reports, existing published wind data; review of the electricity usage and rates, estimates of construction, operation and maintenance costs, in our evaluation of the market value of wind generated electricity, including the assessment of Renewable Energy Certificate credits associated with development of a single commercial-scale wind turbine in the Town watershed property.

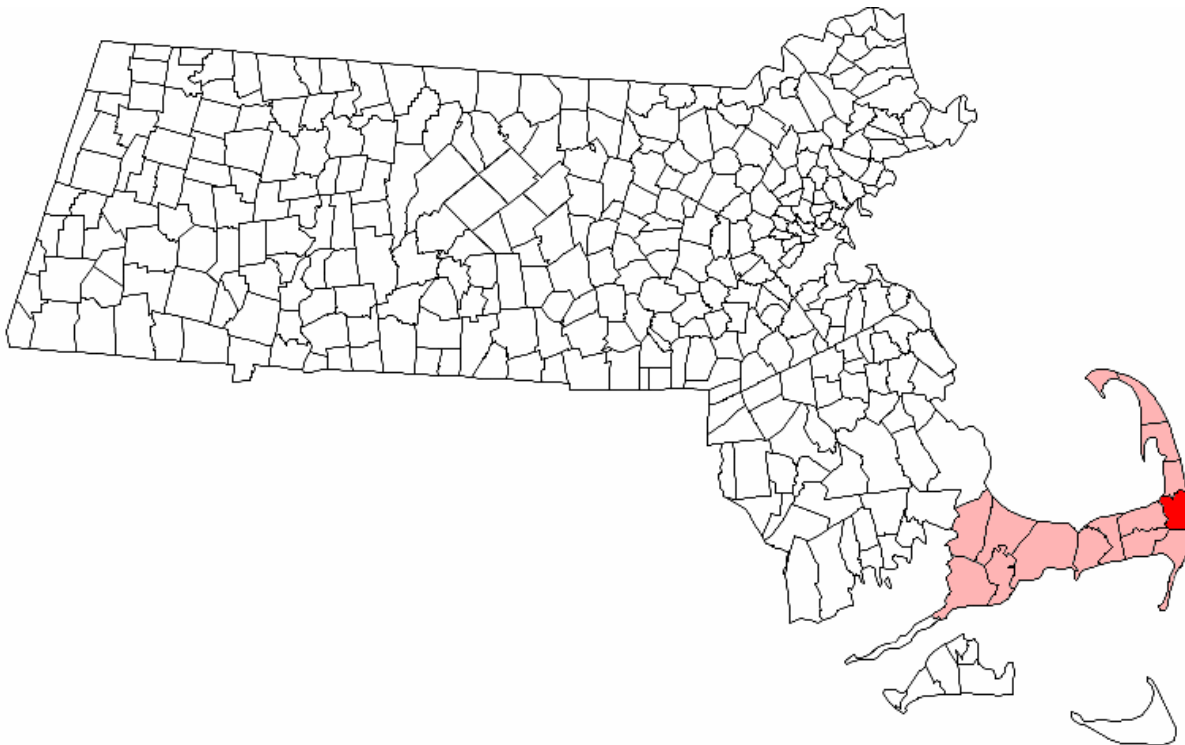
The economic analysis indicates the estimated cost to design, permit and construct a single 600 kW wind turbine would be approximately \$2,300,000. The Net Present Value of a single 600 kW wind turbine is estimated to be \$859,000 using a discount rate of 4% over 20 years. Average net annual cash flows of \$70,000 are estimated from a 600 kW wind turbine, with a net cash flow of \$1,400,000 over 20-years. Based on a one year construction schedule, during which time no energy was produced and debt service was due, the project would have a positive cash flow by the fifth year of operation. The benefit to cost ratio of the project would be 1.31, which is considered economically attractive. There are a number of factors which can influence the economic performance of the project, including actual wind speeds, reduced costs from potential grant funding, changes in energy rates and final net metering rules, which have yet to be promulgated. It should be noted that the preliminary economic projections are also very sensitive to initial capital costs, which are subject to market fluctuations.

1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

Weston & Sampson Engineers, Inc. has completed an updated economic analysis of the cost and benefits of the development of a single wind turbine in the Town of Orleans, MA. The analysis was completed in accordance with the Request for Quotes issued by the Town of Orleans, our quote dated December 4, 2008 and subsequent contract with the Town. The Town of Orleans is located on lower Cap Cod where some of the best wind resources in the State are available (see Fig 1-1), and to capitalize on this fact the Town created the Renewable Energy Wind Committee (REWC) to evaluate and develop an action plan for renewable energy for the Town. This study supports the efforts of the Town in that regard.

Figure 1-1: Site Location Map



1.2 Background

Wind energy has previously been studied for the Town of Orleans. In March 2005 a report entitled *Town of Orleans Wind Energy Feasibility Study* was prepared by Global Energy Concepts LLC and R.W. Beck Incorporated. A *Wind Data Report* for Orleans was prepared by the Renewable Energy Research Laboratory (RERL) for the Massachusetts Technology Collaborative (MTC) in October, 2005, which summarized nearly two years of wind monitoring data. A public/private model for a two turbine wind project was proposed for the Town of Orleans in the watershed by MTC under the Community Wind Collaborative.

Based on review of information provided by the Town summarizing the benefits of the proposed community wind project, it appears the project would have provided approximately \$89,000 in annual revenue to the Town in consideration for the Town allowing a private developer to procure, own and operate two wind turbines on the watershed property. The benefits were to be derived from lease hold payments, payments in lieu of property taxes, and savings from reduced energy rates from the operation of two Vestas V-82 1.65 MW wind turbines. Other benefits included credits for Town administration and payments for access to right-of-way easements formed the basis of a public/private model proposal presented to the Town. The project was considered, but not approved by the Town, and the project was terminated in September 2007.

In response to the passage of the *Green Communities Act* in July 2008, the Town of Orleans issued a Request for Quotes for an updated economic analysis. The updated analysis was requested to evaluate the benefits of net metering on a smaller scale project than originally contemplated under the Community Wind Collaborative. The following report provides the detailed analysis as requested in the RFQ.

1.3 Turbine Location

The 2005 feasibility study identified up to six sites within the watershed for the installation of a wind turbine. A MET tower was erected on Site 1, the nearest to the Water Department water treatment plant. This site was also the site of the avian risk assessment and the NSTAR interconnection study. The 2005 feasibility study stated that if only one turbine were to be

installed, any of the six locations identified would be suitable. This economic assessment was performed using available information for Site 1 as identified in the 2005 Wind Feasibility Study Report. This location is generally considered representative with respect to applying site development costs to another location within the watershed, within a feasibility-level cost estimate range of 25%; however, additional consideration should be given to the cost of improving site access and electrical interconnection when considering other sites within the watershed by adjusting the relative area of clearing and grading and the length of electrical lines, as appropriate.

The Town of Orleans watershed area occupies approximately 500 acres of conservation land. It is located in the area between U.S. Route 6 and Massachusetts Route 28 and south of Route 6A. The watershed area has six groundwater wells and a water treatment plant operated by the Town of Orleans. There are several buildings and structures on the watershed site used for pumping, maintenance, water treatment, and other water supply-related activities. The building that uses the greatest electrical load is the water treatment plant. The site is otherwise accessible to the public for passive recreation, such as hiking, with numerous walking trails.

Site 1 is on a hill approximately 900 feet north-northwest of the water treatment plant. An area approximately one acre has been cleared at this location. The remaining trees are estimated to be 30 to 45 feet tall. The nearest residential dwelling units are located approximately 1,200 feet or more away from this site, as illustrated on Figure 1-2 below.

1.4 Electricity Usage and Costs

Based on existing load usage data covering January 2007 to March 2008 the Town of Orleans Water Department has an annual electricity use of 755,229 kWh at a cost of \$126,672. Con Edison Solutions supplies the electrical energy via NSTAR transmission lines at an average of \$0.1713 per kWh. Due to demand management charges, the actual avoided retail electric generation charges can vary from location to location and were estimated to be \$0.15 per kWh. This study uses an electrical rate escalator of 2% per year. Under the Green Communities Act, excess energy generated by the turbine can be used to offset future energy purchases or credited to another facility within the same ISO-NE zone. For the purposes of this study, excess energy created by the wind turbine will be credited to other Town-owned meters. Electricity use and cost data can be found in **Appendix A**.

2.0 ESTIMATE OF WIND ENERGY PRODUCTION LEVELS

The following section details the predicted output of a typical 600 kW turbine on the site, based on available wind resources. Raw wind speed data was obtained from the Orleans 2005 Wind Data Report for the period from October 2003 through May 2005. The RFQ requested to evaluate the output of a typical 1 MW or similar wind turbine on the site; however, an informal market survey of manufacturers indicated that a single 1 MW wind turbine would not likely be commercially available. Therefore, Weston & Sampson based this report on the use of a 600 kW class machine, which is the next largest wind turbine size that is commercially available. Furthermore, current market pricing, terms and availability are readily obtained from the suppliers of this size machine. The Elecon Turbowinds T600-48 was modeled as a representative machine in this class.

2.1 Review of Wind Monitoring Data

Weston & Sampson reviewed the 2005 *Wind Data Report* prepared by the Renewable Energy Research Laboratory (RERL) at the University of Massachusetts, Amherst. This report includes information about installation and decommissioning of the meteorological tower and instrumentation, and the data analysis and reporting which was performed by the RERL. The temporary MET tower was installed at the town watershed and collected data with a monitoring and data logging device. The tower was on a cleared hilltop, surrounded by trees. The location of the tower base was reported to be 41.7584° North, 69.9933° West using the NAD83 datum reference.

The MET tower recorded wind speed data from October 27, 2003 through August 3, 2005. The station consisted of two sets of two anemometers mounted at a height of 50 meters (164 feet) and at 40 meters (131 feet); one anemometer at 20 meters (66 feet) and wind vanes at the same heights. The average wind speed was reported to be 5.77 meters per second (12.9 miles per hour) at a height of 50 meters. The prevailing wind direction at 40 meters (131 feet) was from the southwest. The maximum wind speed recorded was 19.6 meters per second. The turbulence intensity recorded was 0.2 with a shear coefficient of 0.40.

Weston & Sampson also reviewed the AWS TrueWind Map model of wind speeds for the watershed location considered in this study. The predicted annual average wind speeds obtained from Mass GIS database, are summarized in Table 2-1 below.

**Table 2-1: AWS Predicated Wind Speeds (m/s) at
Various Heights Above Ground Level (m)**

Location	30 m	50 m	70 m	100 m
Site 1	5.4 m/s	6.2 m/s	6.8 m/s	7.6 m/s

The AWS TrueWind estimates are useful for site screening and, while they do not replace the accuracy of site specific anemometry, they are typically considered to be reliable with a 94% factor of confidence.

Weston & Sampson also reviewed 3TIER's global wind map, their wind speeds were compared with publicly available wind speed observations from more than 4,000 globally distributed meteorological stations from the National Centers for Environmental Prediction (NCEP) Automated Data Processing (ADP) surface observations dataset.

The 3TIER data claims that the difference is less than 0.5 m/s at 50% of the stations, and the difference is less than 1 m/s at 78% of the stations. The overall bias is +0.05 m/s relative to NCEP ADP observations, and the root mean square error (RMSE) is 0.93 m/s. The 3TIER range of wind speeds are summarized in Table 2-2 below:

**Table 2-2: 3TIER Predicated Range of Wind Speeds (m/s) at
Various Heights Above Ground Level (m)**

Location	20 m	50 m	80 m
Site 1	4.3 - 7.2 m/s	5.3 - 7.5 m/s	5.7 - 7.7 m/s

The data and wind speed values obtained from the on site anemometers was used in this study to predict energy production.

2.2 Wind Turbine Characteristics

Weston & Sampson used the raw data collected by RERL and WindPRO® computer modeling software to predict energy production for a 600 kW wind turbine. Based on the measurements at the MET tower and the wind resource modeling, the wind speed and direction distribution were derived at the selected wind turbine hub height of 65 meters. At a hub height of 65 meters and rotor diameter of 48 meters, the overall height of the turbine would be 89 meters or 292 feet, which is below the Determination of No Hazard height of 397 feet issued by the FAA.

The wind speed distribution gives the number of hours that a particular wind speed blows per year. Using WindPRO® modeling software, this wind speed distribution was then combined with the power curve of the selected wind turbine to obtain the gross annual wind energy production, corrected for availability and electrical grid efficiency to obtain an estimate for the net annual wind energy production.

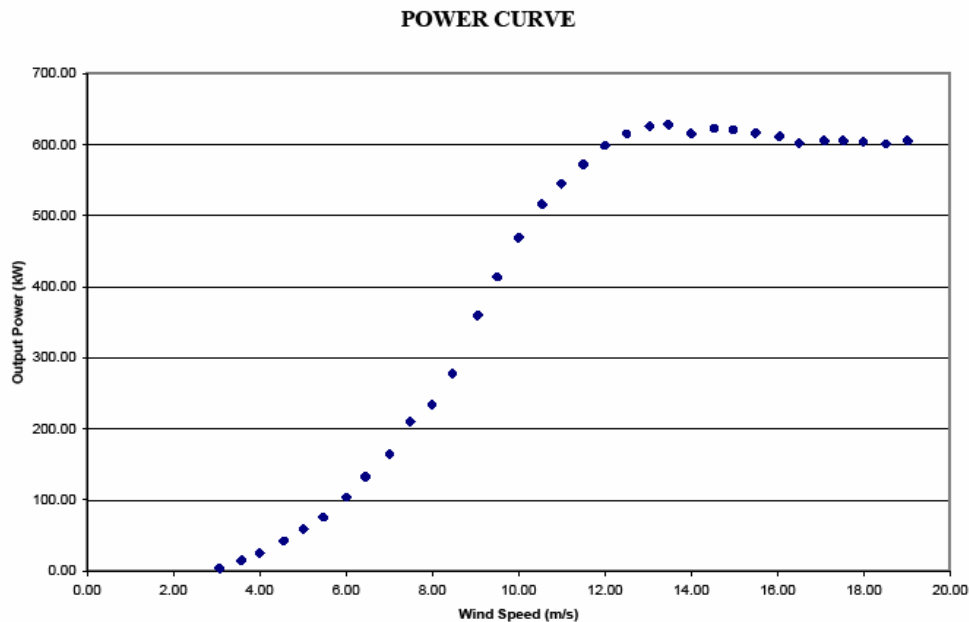
The model selected for analysis is an Elecon Turbowinds T600-48 wind turbine with dual generators (120/600 kW) and a rotor diameter of 48 meters. A summary of the specifications for the Elecon T600-48 are given in Table 2-3, below:

Table 2-3: Elecon T600-48 Turbine Specifications

<u>Turbine</u>	<u>Elecon T600-48</u>
Rated Power	120/600 kW (Duel)
Rotor Diameter	48 m
Hub Height	65 m
Cut-in wind speed	3.5 m/s
Nominal wind speed	12.5 m/s
Cut-out wind speed	25 m/s
Electrical Generator	60 Hz/690V

The power curve for the Elecon T600-48 machine has been obtained for modeling purposes. The power curve presented below is from a marketing brochure for the Elecon T600-48.

Figure 2-1: Elecon T600-48 Power Curve



The percent of time that a wind turbine is capable of producing power is known as the total availability. The factors affecting availability include grid connection efficiency, turbine availability, turbine icing and blade fouling, substation maintenance, utility downtime, and high wind speed conditions. The Specifications for the Elecon T600-48 machine are included in **Appendix B**.

Grid connection efficiency. The efficiency of the grid connection is estimated to be 97%. This includes the losses in the transformer and the transmission line. This should be confirmed by an electric loss calculation once the grid connection has been defined.

Turbine availability. The technical availability of the turbine is assumed to be 97%. This figure is based on data from modern operational wind farms. Technical availability may be a part of the contract terms between the project owner and the wind turbine supplier. It is worth noting that manufacturers may not guarantee technical availability at the 97% level for small, one or two

turbine projects. It is advisable to review this figure when the terms of the warranty are established.

Turbine icing and blade fouling. Serious icing conditions can prevent a wind turbine from operating, as the turbine shuts down if there is imbalance of the blades. Undoubtedly there is the prospect for ice to collect on turbine blades in a location such as the Orleans watershed. Three days has been given as the likely total occurrence per year of icing events, which equates to an availability of 99.2%. Blade fouling is not expected to occur, as this is primarily a problem in very hot climates where severe insect fouling can affect the aerodynamics of the turbine blades.

Substation maintenance. The connection to the grid may have to be temporarily shut down for maintenance.

Utility downtime. Most wind turbines will fail to efficiently produce energy during lower wind conditions when the grid does not actively supply electricity for the machine's control systems due to a grid power outage. This is expected to occur, on average, approximately eight hours per year.

High wind speed hysteresis. During very high wind conditions, a wind turbine will shut down to protect its electrical and mechanical components. The machine will only restart when wind conditions fall significantly below the cut-off wind speed. This factor is used to compensate for power loss during this restarting delay. Because Orleans rarely experiences winds above the 25 m/s cut-out speed, high wind speed hysteresis is not expected to have a significant effect on power output. The factors and values used to compute turbine availability at the Orleans site are summarized in Table 2-4.

**Table 2-4: Factors Affecting the Availability of Turbine
Energy Production**

Factor	Percent/yr
Grid connection efficiency	97.0%
Turbine availability	97.0%
Turbine icing and blade fouling	99.2%
Substation maintenance	99.8%
Utility downtime	99.9%
High wind speed hysteresis	100%
Total Availability	93.0%

The total annual availability of a turbine was computed to be 93%. The electrical generation computation from the WindPRO modeling software uses a standard default of 90% availability. The more conservative value is used in the following energy production calculations.

2.3 Calculation of Net Energy Production

Based on the wind resource in Orleans and the power curve for the Elecon T600-48 wind turbine, mounted on a 65 meter tall tower, a total of 1,339 MWh of electricity are estimated to be produced. A summary of the output profile for the Elecon Turbowinds T600-48 600 kW turbine is presented in Table 2-5 below:

Table 2-5 - Parameters Relating to Energy Production

Wind Turbine	Elecon T600-48
Site Elevation (ft)	78
Hub Height (m)	65
Mean Wind Speed (m/s)	5.77
Turbine Capacity (kW)	600
Gross Output (MWh/yr)	1,488
Net Output (MWh/yr)	1,339
Capacity Factor (%)	28.3

The estimated average annual energy production for a 600 kW Turbowinds T600-48 turbine with a 65 meter hub height would be approximately 1,339 MWh using an availability of 90%. The capacity factor of the wind turbine is expected to be 28.3% at a hub height of 65 meters. Increasing to a taller hub height (80 meters) would produce higher capacity factor (34.5%) and greater energy output (1,632 MWh), but the cost of purchasing and installing the taller towers could increase the initial costs by approximately \$200,000. Net output of the turbine has conservatively taken into account a 90% availability factor for the issues discussed above. Copies of the modeling output reports are also included in **Appendix C**.

3.0 POTENTIAL VALUE OF WIND GENERATED ELECTRICITY

This section provides an analysis of the various benefits and revenue factors associated with the typical behind the meter commercial scale wind turbine project. Estimates of project costs are considered later in this report. One of the key drivers of this project is the economic value of having the Town of Orleans utilize the electricity generated by the wind turbine under a “virtual net metering” framework. Provisions included in the recent *Green Communities Act* would allow the town to utilize all of the electricity produced by a turbine to offset Town-wide electricity use, not just electricity used at time and location of generation. Further discussion regarding these scenarios is provided in the following sections.

3.1 Net Metering

Net metering included in the Green Communities Act legislation, signed into law July 2, 2008 allows for net metering up to 10.0 MW for government owned projects, subject to final rule making. This would allow the town to utilize all of the electricity produced by a turbine to offset total electricity use at the facility, not just electricity used at time of generation. If a wind turbine were to produce more energy than the town would consume in a given month, the credit would be carried forward to the next month. If there were unused credits at the end of the year, it is not yet clear how the credits would be applied. In addition, the *Green Communities Act* has a provision for “virtual” net metering, which would allow the excess energy to be credited to another facility (or facilities) within the same ISO-NE load zone.

A 600 kW wind turbine would be classified as a Class II wind net metering facility. A Class II net metering facility is defined as an agricultural net metering facility, solar net metering facility, or wind net metering facility with a generating capacity of more than 60 kilowatts but less than or equal to 1 megawatt; provided, however, that a Class II net metering facility owned or operated by a customer which is a municipality or other governmental entity may have a generating capacity of more than 60 kilowatts but less than or equal to 1 megawatt per unit.

The net metering credit allowable under the Green Communities Act provides for a credit equal to the excess kilowatt-hours by time of use billing period, if applicable, multiplied by the sum of the distribution company's: (i) default service kilowatt-hour charge in the ISO -NE load zone where the customer is located; (ii) distribution kilowatt-hour charge; (iii) transmission kilowatt-hour charge; and (iv) transition kilowatt-hour charge; provided, however, that this shall not include the demand side management and renewable energy kilowatt-hour charges set forth in sections 19 and 20 of chapter 25.

If the electricity generated by the Class II net metering facility during a billing period exceeds the customer's kilowatt-hour usage during the billing period, the customer will be billed for 0 kilowatt-hour usage and the excess Class II net metering credits shall be credited to the customer's account. Credits may be carried forward from month to month. A Class II wind net metering facility may designate customers of the same distribution company to which the Class II wind net metering facility is interconnected and that are located in the same ISO -NE load zone to receive such credits in amounts attributed by the Class II wind net metering facility. Written notice of the identities of the customers so designated and the amounts of the credits to be attributed to such customers shall be in a form as the distribution company shall reasonably require.

It is important to note that the Act allows the distribution company to impose tariffs, as may be approved from time to time, regarding necessary interconnection studies and the type, costs and timeframe for installing metering and distribution system upgrades to accommodate these installations. Such tariffs also require that all facilities maintain adequate insurance. Distribution companies shall be prohibited from imposing special fees on Class II net metering facilities, such as backup charges and demand charges, or additional controls or liability insurance, as long as the facility meets the other requirements of the interconnection tariff and all relevant safety and power quality standards.

3.2 Value of Wind Turbine Generated Electricity

The revenue from the wind turbine project is the sum of the avoided electricity cost plus the excess power credit plus the sale of REC credits (discussed in the next section) for each MW hour of electricity produced. The value of the avoided cost of electricity is estimated based on the current monthly per kWh charges. Given typical monthly usage of 39,440 kWh, the total charges would be \$6,757. A summary of the charges and presented in Table 3-1 below:

Table 3-1: Estimated Value of Net Metering Credits

Monthly Water Department Use:	39,440	kWh
	Rate (kWh)	Total Amount
Customer Service/Demand	0.01636	\$ 645
Distribution	0.01354	\$ 534
Transition	0.02082	\$ 821
Transmission	0.00761	\$ 300
Energy Use	0.10999	\$ 4,338
Renewable Energy	0.00050	\$ 20
Energy Conservation	0.00250	\$ 99
Total Electric Cost	0.17132	\$ 6,757
Value of Retail Offset	0.15196	kWh
Value of Excess Power	0.15196	kWh

The amount of electricity generated by the Elecon T600-48 wind turbine is expected to be 1,338 MWh annually. Based on the rates above, the value of the avoided electricity cost is estimated to be approximately \$114,000 per year. The value of the excess power credit, that is the amount of electricity produced which is not used by the water department, is estimated to be an additional \$88,000 per year. The value of the REC credits, based on the total MWh of electricity produced by the wind turbine, is estimated to be \$53,000 per year. The total annual first year benefit is therefore estimated to be approximately \$255,000 per year. The value of the benefit is expected to increase and decrease with rising and falling energy costs. The model uses a 2% annual

increase for electricity cost. The demand side charges and basic service rate class may be subject to change, based on the net metering facility status and actual energy use at the site.

3.3 REC Market Pricing

Renewable energy certificates (RECs), also known as green certificates, green tags, or tradable renewable certificates, represent the environmental attributes of the power produced from renewable energy projects and are sold separate from commodity electricity. Customers can buy green certificates whether or not they have access to green power through their local utility or a competitive electricity marketer. And they can purchase green certificates without having to switch electricity suppliers.

In April 2002, the Massachusetts Division of Energy Resources (DOER) adopted Renewables Portfolio Standards (RPS) that require all retail electricity providers in the state to utilize new renewable-energy sources for a portion of their power supply. Renewable Energy Certificate (REC) credits are currently sold by renewable energy generators to various entities in Massachusetts and other locations, at rates determined by a range of factors. With the passage of the Green Communities Act of 2008, the RPS increases one percent of the total retail sales after 2009.

Twenty-four retail electricity suppliers had RPS obligations in 2007. The supply surplus notwithstanding, eight of the twenty-four retail electricity suppliers did not acquire the necessary RECs for compliance, and they used the Alternative Compliance Payment mechanism to cover their 11 GWh of REC shortfall. The resulting REC surplus amounted to 88 GWh, of which 81 GWh were banked forward by fourteen suppliers to use towards their compliance in 2008 or 2009.

DOER received filings from 24 Retail Electricity Suppliers (“Suppliers”) that served retail load in Massachusetts during 2007. These included four investor-owned, distribution and 20 competitive suppliers that are licensed, but not regulated. All of the suppliers except for one complied with their RPS obligations, with more than 99% of the compliance met by New

Renewable Generation, as opposed to using RECs banked from 2006 compliance surplus. Less than one percent of the 2007 compliance obligation was met using by making Alternative Compliance Payments (ACPs) to the Massachusetts Technology Collaborative (MTC). In 2007, the value of all ACPs totaled only \$623,740.40 (10,920 MWh at \$57.12/MWh). This is in stark contrast to the ACPs of the previous three compliance years, 2004-06, which were in excess of ten million dollars each year.

A supply surplus for 2007 RPS compliance replaced the supply shortages of the previous four years of RPS, 2003-2006. The total supply of qualified electricity from New Renewable Generation Units exceeded the demand for the first time since the program began in 2003. The total retail load obligation in 2007 was about 50,978 GWh, of which the three percent RPS obligation was about 1,529 GWh. The total supply of RECs was about 1,606 GWh. The RPS obligation in 2007 was three percent. As a result, REC credits were purchased at an average rate of \$57.12 per MWh.

Under the Community Wind Collaborative, Standard Financial Offer, Phase II REC Contract Offer (Revised March 3, 2008), the MTC was offering to purchase REC at \$40 per MWh for qualified projects. In a press release from October 25, 2007, Evolution Markets Inc. announced that it had completed a forward auction of RECs for the MTC in which all of the Massachusetts “New” Renewable Certificates sold at auction for an average price of \$52.52. A total of 25,000 vintage 2008 REC (Quarters 1 through 4) were offered, with the highest bid reported to be \$53.00 per REC (where 1 REC equals 1 MWh).

The more general concept of green power marketing refers to selling green power in the competitive marketplace, in which multiple suppliers and service offerings exist. Electricity markets are now fully or partially open to competition in more than a dozen states. To date, competitive marketers have offered green power to retail or wholesale customers in District of Columbia, California, Illinois, Maryland, New Jersey, New York, Pennsylvania, Texas, Virginia, and several New England states.

Residential REC market data, maintained by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy (EERE) report that the national residential REC prices ranged from \$5 to over \$50 and average just over \$20 per MWh. The REC prices varies regionally, based on the retail electric rates. The average residential REC prices for New England were reported to be approximately \$50, which were near the highest in the nation. The residential REC market supports projects for those electric customers who want the energy they purchase to be derived from clean, renewable sources. There are five marketers of green energy listed in Massachusetts, including the Cape Light Compact.

Under the Cape Light Compact Green program, customers can purchase 100% of their electricity from renewable energy sources including run of the river hydro (75%), landfill gas or wind (24%), and solar (1%) for 8.9¢/kWh, or a premium of 1.768¢/kWh over the Compact's standard electricity product. Alternatively, customers can choose a 50% renewable energy option for 8.3¢/kWh, which represents a premium of 2.336¢/kWh for the green power portion. Initially, 25% of the product will come from "new" renewable resources. A portion of the renewable energy premium can be deducted from federal taxes. Additionally, the state will match up to 75% of the premium to provide funds for community-based renewable energy projects and similar initiatives for low-income residents across the state.

Based on review of the market data referenced above, Weston & Sampson believes that a conservative market value of REC is on the order of \$40 MWh, at least for the first few years after commissioning. For the purpose of this study, we have assigned a value of \$40 first 10 years of production, falling to \$30 MWh for the period from 11 to 20 years, noting that predicting energy prices and market value into the future is inherently uncertain.

4.0 ESTIMATE OF PROJECT COST

4.1 Wind Turbine Costs

This section provides an analysis of the various direct costs associated with a typical behind the meter commercial scale wind turbine project. For a given wind turbine project, a general rule is the larger the turbine, the lower the cost per unit of energy produced. The number of turbines can also influence the unit cost of energy, due to economies of scale in planning, permitting, design and construction.

Market demand for wind turbines over the last several years has increased dramatically, resulting in increased pricing for equipment and decreased availability and longer lead time for delivery of turbines and related equipment. In today's rapidly evolving wind turbine market, many utility scale turbine manufactures will not sell only one or two wind turbines and have minimum orders ranging from 20 to 50 megawatts of total power. Manufacturers of smaller turbines often have similar minimum order restrictions. The leading manufactures in the U.S. market, according to the American Wind Energy Association (AWEA) include GE, Vestas, Siemens, Gamesa and Mitsubishi. Most of the leading manufactures dedicate most, if not all, of their production capacity to larger scale wind farm projects and do not typically offer single turbine units for sale.

For the purposes of this study, Weston & Sampson has selected the Elecon Turbowinds T600-48 as a representative commercial scale turbine. The selection was based on manufactures' responsiveness to pricing requests and willingness to sell a single unit in the New England market. The cost of the Elecon Turbowinds T600-48 on a 65 meter tall tower delivered to the site is estimated at \$1,100,000.

4.2 Site Development Costs

Site development costs would include clearing, grading, foundation, and electrical interconnection. The cost estimate presented herein is based upon the minimum improvements anticipated with installation at Site 1 in the Town Water Department property. Temporary access

through the existing water treatment plant is assumed, as it would require the least amount of temporary improvements. The amount of cut was estimated to be 2,350 cubic yards, with a net import of 1,100 cubic yards for filling low lying areas to create slopes passable by crane and materials delivery vehicles. The temporary access roads would be removed at the completion of the project so that the existing water main will be accessible.

4.3 Engineering and Other Related Costs

The cost estimate includes “soft” costs for the required studies, permitting, design and other related efforts in addition to capital costs for the procurement and installation of the turbine; construction of foundation, electrical interconnection, and erection of the turbine, commissioning, and testing costs. Legal costs, public relations, and a budget for contingency items were not included in the cost estimate, but should be considered as with any capital improvement project. The total cost for developing a single 600 kW wind turbine is estimated to be on the order of \$2,300,000. Table 4-1 summarizes the estimated cost of development of a single 600 kW wind turbine.

Table 4-1: Estimated Costs for 600 kW Wind Turbine

<u>Description</u>	<u>Estimated Cost</u>
Turbine, Blades and Tower - Delivered (Elecon T-600)	\$1,100,000
Design and Permitting	125,000
Mobilization	40,000
Erosion Control Measures	5,000
Access Road to Turbine Site	75,000
Access Improvements at Water Treatment Plant	3,500
Improvements at Entrance	3,500
New Gate at Water Treatment Plant	2,500
Construction Staging Area	85,000
Chain Link Fencing	11,000
Electrical Duct Bank Trenching	30,000
Relocate Water main	20,000
Turbine Foundation Excavation & Backfill	60,000
Turbine Foundation (Concrete, Steel)	160,000
Electrical Interconnection	250,000
Electric Utility Equipment (Required Buyout)	125,000
Erect Wind Turbine (Crane, Rigging)	150,000
<u>Commissioning, Startup and Training</u>	<u>75,000</u>
Total	\$ 2,320,500
Cost per kW	\$ 3,868

4.4 Operation of Wind Turbine

Given that the Town does not have the staff with the training or experience to operate and maintain a wind turbine, this service must be obtained through a service contractor. There are a limited number of contractors who are currently providing such service in Massachusetts, based on the few, but growing number of turbines currently in operation. Some manufacturers will also offer a service agreement with the sale of their turbine. Still other manufacturers will typically only offer certain performance guarantees if the manufacturer is contracted to provide the regular and unscheduled maintenance.

Wind turbines are designed to operate, unmanned, in vary wind conditions, often in remote areas. Historically, the industry has experience a large number of gearbox failures. The failures have occurred across a wide variety of sizes, designs and manufactures. Operation and maintenance costs can be a significant component of the overall cost of a wind project. O&M cost data

compiled for 89 wind projects installed in the US between 1982 and 2005 were reviewed by the National Renewable Energy Lab in Berkley, CA. The annual cost for operation and maintenance of a wind turbine varies from approximately \$25 to \$40 per kilowatt nameplate capacity. The U.S. DOE, in its Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006, published in May of 2007, suggests a range of 0.02 to 0.04 cents per kWh for larger scale wind farms. Little data is available for small scale wind turbine projects. Weston & Sampson conservatively estimates that the annual operation and maintenance costs for a 600 kW turbine would be on the order of \$24,000 annually, or \$40 per kilowatt nameplate capacity.

4.5 Insurance Requirements

Grid-connected distributed generators, including wind turbines, are required to carry insurance under Department of Public Utility (DPU) requirements. Insurance limits, which are subject to change from time to time, are based on the nameplate capacity, where \$5M in general liability is required for 5 MW or greater; \$2M for facilities with greater than 1 MW, but less than or equal to 5 MW; \$1M for greater than 100 kW, but less than or equal to 1 MW; and \$500,000 in general liability coverage for generators of 10 kW up to 100 kW. No statutory insurance is required for generators less than 10 kW. Insurance is to be issued by a MA-licensed insurer having an AM Best rating of "A-". In similar interconnection applications, NSTAR has offered to provide the required insurance at a rate of \$8.75 per kW. The cost of providing insurance for a 600 kW turbine would therefore be \$5,250 annually.

Additional long-term costs, including principal and interest payments for financing of the project, annual operation, maintenance, service agreements, escrows for decommissioning and major equipment parts replacement and insurance costs are considered in the business model economic evaluation discussed in the following sections.

5.0 MUNICIPAL OWNERSHIP MODEL

5.1 Project Financing

Under the municipal ownership model requested in the RFQ, the Town of Orleans would secure financing for the development of the project. Sources for the loan or bond funds would be sought through State Revolving Loan Funds, the Town's conventional municipal bond market or federal assistance through Clean Renewable Energy Bond (CREB) financing. Due to its tax-exempt status, a Town financed project would not be able to take advantage of either of the two major federal tax benefits designed to spur investment in wind power development: the Production Tax Credit (PTC) and the 5-year accelerated depreciation mechanism. The PTC is a credit against tax liability currently at the rate of 2.1 cents per kWh (originally 1.5 cents per kWh, and indexed to account for inflation). The PTC applies to all energy generated in the first 10 years of operation, and it results, therefore, in a significant offset to the cost of producing energy from wind projects that qualify. The PTC has been extended several times since its inception in 1992, most recently through the American Recovery and Reinvestment Act of 2009. The PTC is applicable to tax-paying entities only.

5.2 Clean Renewable Energy Bonds

The Federal Energy Tax Incentive Act of 2005, under Title XIII of the Federal Energy Policy Act of 2005, established Clean Renewable Energy Bonds (CREBs) as a financing mechanism for public sector renewable energy projects. This legislation originally allocated \$800 million of tax credit bonds to be issued between January 1, 2006, and December 31, 2007. Following the enactment of the federal Tax Relief and Health Care Act of 2006, the Internal Revenue Service made an additional \$400 million in CREBs financing available for 2008 through Notice 2007-26. In February 2008, the IRS announced 312 projects eligible to be financed with tax-credit bonds under the CREBs program. Renewal of CREBs funding is expected, and if this should happen then bonds at or near 0% interest could be available to the Town.

Unlike normal bonds that pay interest, tax credit bonds pay the bondholders by providing a credit against their federal income tax. In essence, the new tax credit bonds will provide interest-free financing for clean energy projects. Because the federal government essentially pays the interest via tax credits, the U.S. Internal Revenue Service must allocate such credits in advance. However, tax credit bonds require the investment of a bondholder that will benefit from the federal tax credits, and those investors may be hard to find in the current economic climate. To try to draw more investment, a separate measure in the tax bill will allow regulated investment companies to pass through to their shareholders the tax credits earned by such bonds. Yet another measure adds a prevailing wage requirement to projects financed with CREBs or energy conservation bonds.

CREB financing has been expanded by the American Recovery and Reinvestment Act of 2009. The act authorizes the allocation of up to \$1.6 billion in new financing, double the previously authorized annual limit of \$800 million. The act also authorizes \$2.4 billion in qualified energy conservation bonds, up from the current limit of \$800 million. These tax credit bonds are allocated to states and large local governments to finance a variety of clean energy projects. It should be noted however, that in the 2007 CREBs issue, applications exceeded funding by a margin of three to one.

5.3 Massachusetts Technology Collaborative Grants

The MTC has awarded grants under the Large On-Site Renewables Initiative (LORI), providing funding for renewable energy projects. Applications are made for grants on a biannual basis. Up to \$125,000 is available for a design and up to \$275,000 for a construction, with awards not to exceed \$400,000. Grant estimates are based on LORI Round 6 criteria, which is subject to change. The Town would be eligible to submit an application for such a grant as a customer of an investor-owned utility having paid into the renewable energy trust; however, Weston & Sampson understands that the LORI program will be replaced in favor of an alternative program which has not yet been announced. It is expected that the program will continue to support the development of commercial scale wind turbines, perhaps under a rebate program similar in concept to the Commonwealth Solar program.

5.4 Case Study

The Town of Falmouth is a relevant case study for development of a municipally-owned wind turbine project in Massachusetts. The Town of Falmouth began exploring a wind turbine project in 2002. One year of on site wind monitoring was completed in 2004 and a feasibility study was completed in 2005. The Board of Selectmen approved a Town-owned 1.5 MW turbine in 2007 and Town vote approved \$4 million for the project in November 2007. Special legislation (State Law Chapter 200, H.B. 3769) enabling the Town to become a distributed generator of power, to own and operate a wind turbine facility, issue bonds to obtain financing, create an enterprise fund and other related provisions was passed in November 2007. It should be noted that similar enabling legislation was created for all municipalities under the Green Communities Act.

An engineering design and invitation to bid package completed in May 2008. Six bids were received for the project in July 2008, where the low bid was in excess of the \$4 million dollars originally approved by the Town. Subsequent to another Town vote, a contract was awarded in December 2008 for \$4.3M and construction of the project is currently underway. As part of the Town approval to appropriate additional funds, an updated independent economic analysis was completed. The analysis, completed by Sustainable Energy Advantage, LLC of Framingham, MA, included a statement of project cost, estimates of operation and maintenance costs and anticipated annual cash flows needed to support the project, including the sale of excess power REC credits.

The Falmouth model assumptions included financing through a contract for advanced REC payments in excess of \$1,000,000 and a revenue bond amount of \$4,000,000 at a rate of 4.5% over a 16 year term. Annual energy production estimates were estimated to range from 3,080 to 3,624 MWh per year and total net cash flow from \$2,056,000 to \$4,023,000 over 20 years. The Falmouth model predicted a worst case positive cash flow after the first year of \$465,000. A summary of the Falmouth municipal ownership model case study is included in **Appendix D**.

6.0 ECONOMIC ANALYSIS AND SUMMARY OF FINDINGS

The estimated costs and benefits are analyzed over the over the term or useful life of the project and are then factored into a simple economic model of discounted cash flows, which returns a Net Present Value and other financial figures of merit. For this study, we have model the cost and benefits of a single 600 kW wind turbine, assuming a project funded using a debt service with 20 year term and a rate of 4%, without any grant funding. These are summarized in the Table 6-1 below:

Table 6-1: Economic Model Variable Input

Project Term	20 years
Initial Value of Retail Energy Credit	\$151.96 MWh
Value of Renewable Energy Certificates (Y1-10)	\$40.00 MWh
Value of Renewable Energy Certificates (Y11-20)	\$30.00 MWh
Discount/Loan Rate	4.0%
Energy Escalation Rate	2.0%
Inflation Escalation Rate	2.0%

6.1 Net Present Value

An industry-standard economic metric for a wind turbine project is the net present value (NPV). The NPV is defined as the present value of the initial investment, plus all future cash flows. For a wind turbine, cash flows are evaluated over the useful life of the equipment, usually 20 years, but sometimes 25 to 30 years, depending upon the manufacturer and care taken during the maintenance of the equipment.

6.2 Benefit to Cost Ratio

Another useful measure is a time-adjusted benefit-cost ratio (BCR). The BCR is the present value of cash inflows divided by the present value of cash outflow. An investment which has

BCR which is greater than 1.00 predicates a positive return on the investment and anything less than 1.00 costs more than the benefit of the investment. A project with a BCR of 1.00 is considered breakeven.

6.3 Project Cash Flow

Project cash flow is based upon the amount of retail power which can be off set by the turbine, sale of any excess energy which may be produced and the sale of RECs to the market.

6.4 Summary of Economic Results

The present value benefits are calculated to be \$3,600,000 and the present value cost is \$2,760,000, yielding a NPV of nearly \$860,000. A net cash flow of \$1,400,000 is expected over 20 years, with annual positive cash flows occurring during the fifth year of the project. The model conservatively assumes that repayment of principal and interest would be begin before the wind turbine began producing revenue. Repayment terms would be dependent upon the structure of the loan or bond. A summary of the results is provided in Table 6-2 below:

Table 6-2: Economic Results Summary

Turbine Size, kW	600
Project Cost	\$2,320,500
Cost per kW	\$3,868
Capacity Factor, %	28.3%
Annual Energy Output, kWh	1,338,703
NPV (Discount Rate of 4%)	\$859,468
Net Cash Flow (Over 20 Years)	\$1,439,320
BCR	1.31

The economic performance would improve when factoring in grant funding or other subsidies, decreasing the loan rate and overall project cost. Other economic factors which have an impact

the project economics are the general and fuel-related energy costs. The economic performance erodes as the discount rate and general inflation rise. The economic modeling herein assumes that the project will be paid for through debt financing. Based on the estimated annual operation, maintenance and insurance cost of the wind turbines, the project is considered economically viable and an attractive investment. In addition, the model conservatively assumes that the project has no value at the end of the 20 year term. Economic projections for similar projects often use a residual value of between 10%- 40% of development costs.

Year to year cash flow calculations and all model variable inputs are included in **Appendix E**.

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APPENDIX A

ELECTRICAL USE AND COST DATA

NSTAR ELECTRIC

account no.	site	bill date	read date	est kwh	demand			demand charge	delivery total	delivery-		supplier \$/kw	supplier total	qt	use mon	bill mon	num
					demand kw	rate; > 10 kw	demand \$/kw (est.)			demand \$/kw (est.)	supplier						
1626 148 0012	well 1	01/04/07	12/28/06	684	4.7	\$ 4.86	\$ -	\$ 54.58	0.080	0.100	\$ 68.33	\$ 122.91	Dec/2006	Jan/2007	1		
1400 878 0018	well 6	01/05/07	01/02/07	3,721	22.0	4.86	58.32	287.84	0.062	0.100	371.73	659.57	Dec/2006	Jan/2007	3		
2731 512 0017	wtp	01/04/07	12/28/06	15,920	148.8	4.86	674.57	1,024.28	0.022	0.100	1,590.41	2,614.69	Dec/2006	Jan/2007	5		
2731 512 0017	wtp	12/15/06	12/14/06	8,720	122.4	4.86	546.26	700.18	0.018	0.100	871.13	1,571.31	Nov/2006	Dec/2006	5		
1400 798 0015	wells 2 & 3	01/04/07	12/28/06	1,440	57.6	4.86	231.34	340.12	0.076	0.100	143.86	483.98	Dec/2006	Jan/2007	7		
1394 578 0016	fac 1	01/04/07	12/28/06	1,746	6.6	4.86	-	130.71	0.075	0.100	174.43	305.14	Dec/2006	Jan/2007	9		
1597 826 0014	well 7	01/05/07	01/03/07	1,863	27.8	4.86	86.51	224.78	0.074	0.100	186.11	410.89	Dec/2006	Jan/2007	11		
1395 143 0019	tank 1	01/04/07	01/03/07	142	0.0	4.86	-	15.67	0.110	0.100	14.19	29.86	Dec/2006	Jan/2007	13		
1400 797 0016	tank 2	01/04/07	01/03/07	279	0.0	4.86	-	25.42	0.091	0.100	27.87	53.29	Dec/2006	Jan/2007	15		
1626 148 0012	well 1	02/05/07	01/28/07	777	4.8	\$ 4.86	\$ -	\$ 57.92	0.075	0.100	\$ 77.62	\$ 135.54	Jan/2007	Feb/2007	1		
1400 878 0018	well 6	02/05/07	02/02/07	5,072	22.0	4.86	58.32	322.39	0.052	0.113	573.14	895.53	Jan/2007	Feb/2007	3		
2731 512 0017	wtp	02/08/07	01/28/07	38,320	162.4	4.86	740.66	2,275.70	0.040	0.100	3,828.17	6,103.87	Jan/2007	Feb/2007	5		
1400 798 0015	wells 2 & 3	02/06/07	01/28/07	480	35.2	4.86	122.47	160.37	0.079	0.100	47.95	208.32	Jan/2007	Feb/2007	7		
1394 578 0016	fac 1	02/05/07	01/28/07	2,533	7.2	4.86	-	169.51	0.067	0.100	253.05	422.56	Jan/2007	Feb/2007	9		
1597 826 0014	well 7	02/06/07	02/03/07	2,431	26.0	4.86	77.76	242.28	0.068	0.113	274.70	516.98	Jan/2007	Feb/2007	11		
1395 143 0019	tank 1	02/05/07	02/01/07	147	0.0	4.86	-	15.37	0.105	0.113	16.61	31.98	Jan/2007	Feb/2007	13		
1400 797 0016	tank 2	02/05/07	02/01/07	307	0.0	4.86	-	26.10	0.085	0.113	34.69	60.79	Jan/2007	Feb/2007	9		
1626 148 0012	well 1	03/07/07	02/28/07	827	4.9	\$ 4.86	\$ -	\$ 60.91	0.074	0.113	\$ 93.45	\$ 154.36	Feb/2007	Mar/2007	1		
1400 878 0018	well 6	03/09/07	03/08/07	6,125	22.0	4.86	58.32	355.31	0.048	0.113	692.13	1,047.44	Feb/2007	Mar/2007	3		
2731 512 0017	wtp	03/09/07	02/28/07	43,440	164.0	4.86	748.44	2,458.98	0.039	0.113	4,908.72	7,367.70	Feb/2007	Mar/2007	5		
1400 798 0015	wells 2 & 3	03/09/07	02/28/07	480	49.6	4.86	192.46	230.14	0.079	0.113	54.24	284.38	Feb/2007	Mar/2007	7		
1394 578 0016	fac 1	03/07/07	02/28/07	3,795	8.0	4.86	-	215.93	0.057	0.113	428.84	644.77	Feb/2007	Mar/2007	9		
1597 826 0014	well 7	03/08/07	03/03/07	3,058	48.3	4.86	186.14	372.75	0.061	0.113	345.55	718.30	Feb/2007	Mar/2007	11		
1395 143 0019	tank 1	03/07/07	03/06/07	174	0.0	4.86	-	17.04	0.098	0.113	19.66	36.70	Feb/2007	Mar/2007	13		
1400 797 0016	tank 2	03/07/07	03/06/07	400	0.0	4.86	-	31.98	0.080	0.113	45.20	77.18	Feb/2007	Mar/2007	15		
1626 148 0012	well 1	04/05/07	03/28/07	658	4.5	\$ 4.86	\$ -	\$ 46.51	0.071	0.113	\$ 74.35	\$ 120.86	Mar/2007	Apr/2007	1		
1400 878 0018	well 6	04/06/07	04/04/07	3,556	22.0	4.86	58.32	248.61	0.054	0.113	401.83	650.44	Mar/2007	Apr/2007	3		
2731 512 0017	wtp	04/06/07	03/28/07	31,120	159.2	4.86	725.11	1,824.92	0.035	0.113	3,516.56	5,341.48	Mar/2007	Apr/2007	5		
1400 798 0015	wells 2 & 3	04/05/07	03/28/07	2,880	48.0	4.86	184.68	352.58	0.058	0.113	325.44	678.02	Mar/2007	Apr/2007	7		
1394 578 0016	fac 1	04/05/07	03/28/07	2,595	11.6	4.86	7.78	166.28	0.061	0.113	293.24	459.52	Mar/2007	Apr/2007	9		
1597 826 0014	well 7	04/06/07	04/03/07	2,207	43.0	4.86	160.38	303.36	0.065	0.113	249.39	552.75	Mar/2007	Apr/2007	11		
1395 143 0019	tank 1	04/05/07	04/04/07	143	0.0	4.86	-	14.44	0.101	0.113	16.16	30.60	Mar/2007	Apr/2007	13		
1400 797 0016	tank 2	04/05/07	04/04/07	338	0.0	4.86	-	26.59	0.079	0.113	38.19	64.78	Mar/2007	Apr/2007	15		
1626 148 0012	well 1	05/07/07	04/28/07	567	4.1	\$ 4.86	\$ -	\$ 40.92	0.072	0.113	\$ 64.07	\$ 104.99	Apr/2007	May/2007	1		
1400 878 0018	well 6	05/10/07	05/04/07	2,312	21.0	4.86	53.46	203.01	0.065	0.113	261.26	464.27	Apr/2007	May/2007	3		
2731 512 0017	wtp	05/07/07	04/28/07	30,960	148.0	4.86	670.68	1,769.97	0.036	0.113	3,498.48	5,268.45	Apr/2007	May/2007	5		
1400 798 0015	wells 2 & 3	05/07/07	04/28/07	6,880	51.2	4.86	200.23	501.19	0.044	0.113	777.44	1,278.63	Apr/2007	May/2007	7		
1394 578 0016	fac 1	05/07/07	04/28/07	1,864	10.4	4.86	1.94	123.82	0.065	0.113	210.63	334.45	Apr/2007	May/2007	9		
1597 826 0014	well 7	05/08/07	05/03/07	1,386	49.1	4.86	190.03	282.10	0.066	0.113	156.62	438.72	Apr/2007	May/2007	11		
1395 143 0019	tank 1	05/07/07	05/04/07	137	0.0	4.86	-	14.08	0.103	0.113	15.48	29.56	Apr/2007	May/2007	13		
1400 797 0016	tank 2	05/07/07	05/05/07	304	0.0	4.86	-	24.51	0.081	0.113	34.35	58.86	Apr/2007	May/2007	15		
1626 148 0012	well 1	06/07/07	05/28/07	445	3.9	\$ 4.86	\$ -	\$ 33.31	0.075	0.113	\$ 50.29	\$ 83.60	May/2007	Jun/2007	1		
1400 878 0018	well 6	06/12/07	06/05/07	2,464	21.0	4.86	53.46	208.04	0.063	0.113	278.43	486.47	May/2007	Jun/2007	3		
2731 512 0017	wtp	06/07/07	05/28/07	33,440	158.4	4.86	721.22	1,903.28	0.035	0.113	3,778.72	5,682.00	May/2007	Jun/2007	5		
1400 798 0015	wells 2 & 3	06/07/07	05/28/07	11,680	51.2	4.86	200.23	660.51	0.039	0.113	1,319.84	1,980.35	May/2007	Jun/2007	7		
1394 578 0016	fac 1	06/07/07	05/28/07	581	3.6	4.86	-	41.80	0.072	0.113	65.65	107.45	May/2007	Jun/2007	9		
1597 826 0014	well 7	06/07/07	05/03/07	1,033	48.3	4.86	186.14	256.17	0.068	0.113	116.73	372.90	May/2007	Jun/2007	11		

NSTAR ELECTRIC

account no.	site	bill date	read date	est kwh	demand			demand charge	delivery total	delivery-		supplier total	qt	use mon	bill mon	num
					demand kw	rate; > 10 kw	demand \$> 10 kw			demand \$/kw (est.)	supplier \$/kw					
1395 143 0019	tank 1	06/06/07	05/04/07	125	0.0	4.86	-	13.33	0.107	0.113	14.13	27.46	May/2007	Jun/2007	13	
1400 797 0016	tank 2	06/07/07	05/05/07	299	0.0	4.86	-	24.21	0.081	0.113	33.79	58.00	May/2007	Jun/2007	15	
1626 148 0012	well 1	07/12/07	06/28/07	694	38.8	4.86	\$ 139.97	\$ 188.84	0.070	0.113	\$ 78.42	\$ 267.26	Jun/2007	Jul/2007	1	
1400 878 0018	well 6	07/10/07	07/09/07	5,317	22.0	4.86	58.32	307.60	0.047	0.113	600.82	908.42	Jun/2007	Jul/2007	3	
2731 512 0017	wtp	07/06/07	06/28/07	42,560	132.0	4.86	592.92	2,077.49	0.035	0.113	4,809.28	6,886.77	Jun/2007	Jul/2007	5	
1400 798 0015	wells 2 & 3	07/06/07	06/28/07	16,960	49.6	4.86	192.46	827.88	0.037	0.113	1,916.48	2,744.36	Jun/2007	Jul/2007	7	
1394 578 0016	fac 1	07/06/07	06/28/07	148	3.1	4.86	-	14.77	0.100	0.113	16.72	31.49	Jun/2007	Jul/2007	9	
1597 826 0014	well 7	07/09/07	07/03/07	9,652	48.0	4.86	184.68	577.69	0.041	0.113	1,090.68	1,668.37	Jun/2007	Jul/2007	11	
1395 143 0019	tank 1	07/06/07	07/03/07	102	0.0	4.86	-	11.90	0.117	0.113	11.53	23.43	Jun/2007	Jul/2007	13	
1400 797 0016	tank 2	07/11/07	07/10/07	313	0.0	4.86	-	25.07	0.080	0.113	35.37	60.44	Jun/2007	Jul/2007	15	
1626 148 0012	well 1	08/09/07	07/28/07	902	4.0	4.86	\$ -	\$ 61.86	0.069	0.113	\$ 101.93	\$ 163.79	Jul/2007	Aug/2007	1	
1400 878 0018	well 6	08/07/07	08/03/07	3,249	15.0	4.86	24.30	204.92	0.056	0.110	357.07	561.99	Jul/2007	Aug/2007	3	
2731 512 0017	wtp	08/06/07	07/28/07	42,000	149.6	4.86	678.46	2,144.46	0.035	0.113	4,746.00	6,890.46	Jul/2007	Aug/2007	5	
1400 798 0015	wells 2 & 3	08/06/07	07/28/07	18,720	49.6	4.86	192.46	886.26	0.037	0.113	2,115.36	3,001.62	Jul/2007	Aug/2007	7	
1394 578 0016	fac 1	08/06/07	07/28/07	115	0.8	4.86	-	12.71	0.111	0.113	13.00	25.71	Jul/2007	Aug/2007	9	
1597 826 0014	well 7	08/07/07	08/03/07	16,651	46.7	4.86	178.36	803.54	0.038	0.110	1,829.94	2,633.48	Jul/2007	Aug/2007	11	
1395 143 0019	tank 1	08/06/07	08/03/07	101	0.0	4.86	-	11.83	0.117	0.110	11.10	22.93	Jul/2007	Aug/2007	13	
1400 797 0016	tank 2	08/06/07	08/03/07	214	0.0	4.86	-	17.79	0.083	0.110	23.52	41.31	Jul/2007	Aug/2007	15	
1626 148 0012	well 1	09/10/07	08/28/07	16,597	50.2	4.86	\$ 292.08	\$ 988.33	0.042	0.106	\$ 1,755.88	\$ 2,744.21	Aug/2007	Sep/2007	1	
1400 878 0018	well 6	09/07/07	09/06/07	3,814	22.0	4.86	58.32	257.69	0.052	0.110	419.16	676.85	Aug/2007	Sep/2007	3	
2731 512 0017	wtp	09/05/07	08/28/07	41,200	141.6	4.86	639.58	2,079.04	0.035	0.110	4,527.88	6,606.92	Aug/2007	Sep/2007	5	
1400 798 0015	wells 2 & 3	09/05/07	08/28/07	20,000	49.6	4.86	192.46	928.72	0.037	0.110	2,198.00	3,126.72	Aug/2007	Sep/2007	7	
1394 578 0016	fac 1	09/05/07	08/28/07	127	0.7	4.86	-	13.46	0.106	0.110	13.96	27.42	Aug/2007	Sep/2007	9	
1597 826 0014	well 7	09/10/07	09/03/07	16,089	43.3	4.86	161.84	768.36	0.038	0.110	1,768.18	2,536.54	Aug/2007	Sep/2007	11	
1395 143 0019	tank 1	09/05/07	09/04/07	110	0.0	4.86	-	12.41	0.113	0.110	12.09	24.50	Aug/2007	Sep/2007	13	
1400 797 0016	tank 2	09/05/07	09/04/07	299	0.0	4.86	-	24.21	0.081	0.110	32.86	57.07	Aug/2007	Sep/2007	15	
1626 148 0012	well 1	10/04/07	09/28/07	11,750	39.9	4.86	\$ 145.31	\$ 607.93	0.039	0.110	\$ 1,291.33	\$ 1,899.26	Sep/2007	Oct/2007	1	
1400 878 0018	well 6	10/05/07	10/03/07	3,552	26.0	4.86	77.76	268.43	0.054	0.110	390.36	658.79	Sep/2007	Oct/2007	3	
2731 512 0017	wtp	10/04/07	09/28/07	41,280	175.2	4.86	802.87	2,244.98	0.035	0.110	4,536.67	6,781.65	Sep/2007	Oct/2007	5	
1400 798 0015	wells 2 & 3	10/04/07	09/28/07	16,320	51.2	4.86	200.23	814.42	0.038	0.110	1,793.57	2,607.99	Sep/2007	Oct/2007	7	
1394 578 0016	fac 1	10/04/07	09/28/07	109	0.6	4.86	-	12.32	0.113	0.110	11.98	24.30	Sep/2007	Oct/2007	9	
1597 826 0014	well 7	10/05/07	10/03/07	3,137	42.8	4.86	159.41	336.31	0.056	0.110	344.76	681.07	Sep/2007	Oct/2007	11	
1395 143 0019	tank 1	10/04/07	10/03/07	110	0.0	4.86	-	12.41	0.113	0.110	12.09	24.50	Sep/2007	Oct/2007	13	
1400 797 0016	tank 2	10/04/07	10/03/07	290	0.0	4.86	-	23.65	0.082	0.110	31.87	55.52	Sep/2007	Oct/2007	15	
1626 148 0012	well 1	11/05/07	10/28/07	9,161	40.6	4.86	\$ 148.72	\$ 525.44	0.041	0.110	\$ 1,006.79	\$ 1,532.23	Oct/2007	Nov/2007	1	
1400 878 0018	well 6	11/06/07	11/02/07	4,060	26.0	4.86	77.76	285.28	0.051	0.110	446.19	731.47	Oct/2007	Nov/2007	3	
2731 512 0017	wtp	11/05/07	10/28/07	36,480	172.8	4.86	791.21	2,074.11	0.035	0.110	4,009.15	6,083.26	Oct/2007	Nov/2007	5	
1400 798 0015	wells 2 & 3	11/05/07	10/28/07	6,720	51.2	4.86	200.23	495.99	0.044	0.110	738.53	1,234.52	Oct/2007	Nov/2007	7	
1394 578 0016	fac 1	11/05/07	10/28/07	171	4.7	4.86	-	16.22	0.095	0.110	18.79	35.01	Oct/2007	Nov/2007	9	
1597 826 0014	well 7	11/08/07	11/03/07	386	27.9	4.86	86.99	116.62	0.077	0.110	42.42	159.04	Oct/2007	Nov/2007	11	
1395 143 0019	tank 1	11/05/07	11/02/07	122	0.0	4.86	-	13.15	0.108	0.110	13.41	26.56	Oct/2007	Nov/2007	13	
1400 797 0016	tank 2	11/05/07	11/02/07	298	0.0	4.86	-	24.15	0.081	0.110	32.75	56.90	Oct/2007	Nov/2007	15	
1626 148 0012	well 1	12/05/07	11/28/07	7,295	41.1	4.86	\$ 151.15	\$ 465.99	0.043	0.110	\$ 801.72	\$ 1,267.71	Nov/2007	Dec/2007	1	
1400 878 0018	well 6	12/06/07	12/04/07	5,422	28.0	4.86	87.48	340.19	0.047	0.110	595.88	936.07	Nov/2007	Dec/2007	3	
2731 512 0017	wtp	12/05/07	11/28/07	29,760	173.6	4.86	795.10	1,855.09	0.036	0.110	3,270.62	5,125.71	Nov/2007	Dec/2007	5	
1400 798 0015	wells 2 & 3	12/06/07	11/28/07	800	51.2	4.86	200.23	255.72	0.069	0.110	87.92	343.64	Nov/2007	Dec/2007	7	
1394 578 0016	fac 1	12/05/07	11/28/07	1,279	9.8	4.86	-	85.40	0.067	0.110	140.56	225.96	Nov/2007	Dec/2007	9	

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account no.	site	bill date	read date	est kwh	demand			demand charge	delivery total	delivery-		supplier \$/kw	supplier total	qt	use mon	bill mon	num
					demand kw	rate; > 10 kw	demand \$/kw			est.)	supplier						
1597 826 0014	well 7	12/06/07	12/03/07	1,096	20.5	4.86	51.03	124.99	0.067	0.110	120.45	245.44	Nov/2007	Dec/2007	11		
1395 143 0019	tank 1	12/05/07	12/04/07	147	0.0	4.86	-	14.71	0.100	0.110	16.16	30.87	Nov/2007	Dec/2007	13		
1400 797 0016	tank 2	12/05/07	12/04/07	361	0.0	4.86	-	28.07	0.078	0.110	39.67	67.74	Nov/2007	Dec/2007	15		
1626 148 0012	well 1	01/07/08	12/28/07	7,689	41.2	4.86	\$ 151.63	\$ 479.52	0.043	0.110	\$ 845.02	\$ 1,324.54	Dec/2007	Jan/2008	1		
1400 878 0018	well G	01/08/08	01/04/08	6,149	30.0	4.86	97.20	382.02	0.046	0.110	675.78	1,057.80	Dec/2007	Jan/2008	3		
2731 512 0017	wtp	01/07/08	12/28/07	27,840	178.4	4.86	818.42	1,814.73	0.036	0.110	3,059.62	4,874.35	Dec/2007	Jan/2008	5		
1400 798 0015	wells 2 & 3	01/07/08	12/28/07	480	52.8	4.86	208.01	243.51	0.074	0.110	52.75	296.26	Dec/2007	Jan/2008	7		
1394 578 0016	fac 1	01/07/08	12/28/07	2,109	5.9	4.86	-	137.20	0.065	0.110	231.78	368.98	Dec/2007	Jan/2008	9		
1597 826 0014	well 7	01/08/08	01/03/08	2,257	26.8	4.86	81.65	230.32	0.066	0.110	248.04	478.36	Dec/2007	Jan/2008	11		
1395 143 0019	tank 1	01/07/08	01/04/08	162	0.0	4.86	-	15.86	0.098	0.110	17.80	33.66	Dec/2007	Jan/2008	13		
1400 797 0016	tank 2	01/07/08	01/04/08	368	0.0	4.86	-	28.98	0.079	0.110	40.44	69.42	Dec/2007	Jan/2008	15		
1626 148 0012	well 1	02/06/08	01/28/08	8,509	41.4	4.86	\$ 152.60	\$ 585.31	0.051	0.110	\$ 935.14	\$ 1,520.45	Jan/2008	Feb/2008	1		
1400 878 0018	well G	02/07/08	02/01/08	5,122	20.0	4.86	48.60	343.08	0.057	0.110	563.37	906.45	Jan/2008	Feb/2008	3		
2731 512 0017	wtp	02/06/08	01/28/08	27,680	150.4	4.86	682.34	1,925.85	0.045	0.110	3,042.03	4,967.88	Jan/2008	Feb/2008	5		
1400 798 0015	wells 2 & 3	02/06/08	01/28/08	480	51.2	4.86	200.23	240.10	0.083	0.110	52.75	292.85	Jan/2008	Feb/2008	7		
1394 578 0016	fac 1	02/06/08	01/28/08	2,358	7.4	4.86	-	172.58	0.073	0.110	259.14	431.72	Jan/2008	Feb/2008	9		
1597 826 0014	well 7	02/06/08	02/03/08	2,534	29.5	4.86	94.77	277.27	0.072	0.110	278.71	555.98	Jan/2008	Feb/2008	11		
1395 143 0019	tank 1	02/05/08	02/04/08	159	0.0	4.86	-	17.07	0.107	0.110	17.49	34.56	Jan/2008	Feb/2008	13		
1400 797 0016	tank 2	02/06/08	02/05/08	383	0.0	4.86	-	33.31	0.087	0.110	42.13	75.44	Jan/2008	Feb/2008	15		
1626 148 0012	well 1	03/06/08	02/28/08	8,418	41.5	4.86	\$ 153.09	\$ 590.19	0.052	0.110	\$ 925.90	\$ 1,516.09	Feb/2008	Mar/2008	1		
1400 878 0018	well G	03/11/08	03/06/08	6,145	29.0	4.86	92.34	431.07	0.055	0.110	675.89	1,106.96	Feb/2008	Mar/2008	3		
2731 512 0017	wtp	03/06/08	02/28/08	27,520	148.8	4.86	674.57	1,938.21	0.046	0.110	3,026.92	4,965.13	Feb/2008	Mar/2008	5		
1400 798 0015	wells 2 & 3	03/06/08	02/28/08	480	51.2	4.86	200.23	240.57	0.084	0.110	52.80	293.37	Feb/2008	Mar/2008	7		
1394 578 0016	fac 1	03/06/08	02/28/08	2,818	7.1	4.86	-	194.78	0.069	0.110	309.95	504.73	Feb/2008	Mar/2008	9		
1597 826 0014	well 7	03/07/08	03/03/08	2,457	42.5	4.86	157.95	337.11	0.073	0.110	270.25	607.36	Feb/2008	Mar/2008	11		
1395 143 0019	tank 1	03/11/08	03/07/08	164	0.0	4.86	-	17.42	0.106	0.110	18.04	35.46	Feb/2008	Mar/2008	13		
1400 797 0016	tank 2	03/06/08	03/05/08	333	0.0	4.86	-	29.68	0.089	0.110	36.63	66.31	Feb/2008	Mar/2008	15		
1626 148 0012	well 1	04/04/08	03/28/08	5,017	40.3	4.86	\$ 147.26	\$ 437.19	0.058	0.110	\$ 551.82	\$ 989.01	Mar/2008	Apr/2008	1		
1400 878 0018	well G	04/07/08	04/02/08	4,332	20.0	4.86	48.60	308.90	0.060	0.110	476.48	785.38	Mar/2008	Apr/2008	3		
2731 512 0017	wtp	04/04/08	03/28/08	24,320	150.4	4.86	682.34	1,807.52	0.046	0.110	2,674.96	4,482.48	Mar/2008	Apr/2008	5		
1400 798 0015	wells 2 & 3	04/04/08	03/28/08	320	38.4	4.86	138.02	166.77	0.090	0.110	35.20	201.97	Mar/2008	Apr/2008	7		
1394 578 0016	fac 1	04/04/08	03/28/08	2,169	8.3	4.86	-	162.87	0.075	0.110	238.57	401.44	Mar/2008	Apr/2008	9		
1597 826 0014	well 7	04/07/08	04/03/08	2,084	43.2	4.86	161.35	318.05	0.075	0.110	229.22	547.27	Mar/2008	Apr/2008	11		
1395 143 0019	tank 1	04/04/08	04/03/08	137	0.0	4.86	-	15.46	0.113	0.110	15.07	30.53	Mar/2008	Apr/2008	13		
1400 797 0016	tank 2	04/04/08	04/03/08	343	0.0	4.86	-	30.41	0.089	0.110	37.73	68.14	Mar/2008	Apr/2008	15		
1626 148 0012	well 1	05/06/08	04/28/08	5,434	38.9	4.86	\$ 140.45	\$ 448.44	0.057	0.110	\$ 597.69	\$ 1,046.13	Apr/2008	May/2008	1		
1400 878 0018	well G	05/08/08	05/06/08	5,045	27.0	4.86	82.62	373.76	0.058	0.110	554.90	928.66	Apr/2008	May/2008	3		
2731 512 0017	wtp	05/06/08	04/28/08	27,920	146.4	4.86	662.90	1,943.84	0.046	0.110	3,070.92	5,014.76	Apr/2008	May/2008	5		
1400 798 0015	wells 2 & 3	05/06/08	04/28/08	640	51.2	4.86	200.23	252.18	0.081	0.110	70.39	322.57	Apr/2008	May/2008	7		
1394 578 0016	fac 1	05/06/08	04/28/08	1,272	6.6	4.86	-	97.80	0.077	0.110	139.91	237.71	Apr/2008	May/2008	9		
1597 826 0014	well 7	05/07/08	05/03/08	863	48.7	4.86	188.08	256.22	0.079	0.110	94.92	351.14	Apr/2008	May/2008	11		
1395 143 0019	tank 1	05/06/08	05/05/08	145	0.0	4.86	-	16.04	0.111	0.110	15.95	31.99	Apr/2008	May/2008	13		
1400 797 0016	tank 2	05/06/08	05/05/08	352	0.0	4.86	-	31.07	0.088	0.110	38.72	69.79	Apr/2008	May/2008	15		
1626 148 0012	well 1	06/05/08	05/28/08	5,767	23.9	4.86	\$ 67.55	\$ 389.94	0.056	0.110	\$ 634.31	\$ 1,024.25	May/2008	Jun/2008	1		
1400 878 0018	well G	06/11/08	06/06/08	3,482	25.0	4.86	72.90	296.42	0.064	0.110	382.99	679.41	May/2008	Jun/2008	3		
2731 512 0017	wtp	06/05/08	05/28/08	30,320	145.6	4.86	659.02	2,043.82	0.046	0.110	3,334.90	5,378.72	May/2008	Jun/2008	5		
1400 798 0015	wells 2 & 3	06/05/08	05/28/08	5,440	51.2	4.86	200.23	508.47	0.057	0.110	598.35	1,106.82	May/2008	Jun/2008	7		

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account no.	site	bill date	read date	est kwh	demand			demand charge	delivery total	delivery-		supplier \$/kw	supplier total	qt	use mon	bill mon	num
					demand kw	rate; > 10 kw	demand \$/kw			demand \$/kw (est.)	supplier						
1394 578 0016	fac 1	06/05/08	05/28/08	814	4.3	4.86	-	64.58	0.079	0.110	89.53	154.11	May/2008	Jun/2008	9		
1597 826 0014	well 7	06/06/08	06/03/08	633	44.5	4.86	167.67	219.12	0.081	0.110	69.62	288.74	May/2008	Jun/2008	11		
1395 143 0019	tank 1	06/05/08	06/04/08	125	0.0	4.86	-	14.59	0.117	0.110	13.75	28.34	May/2008	Jun/2008	13		
1400 797 0016	tank 2	06/05/08	06/04/08	284	0.0	4.86	-	26.13	0.092	0.110	31.24	57.37	May/2008	Jun/2008	15		
1626 148 0012	well 1	07/07/08	06/28/08	6,791	22.6	4.86	61.24	427.94	0.054	0.110	746.94	1,174.88	Jun/2008	Jul/2008	1		
1400 878 0018	well 6	07/08/08	07/02/08	4,446	21.0	4.86	53.46	318.69	0.060	0.110	489.02	807.71	Jun/2008	Jul/2008	3		
2731 512 0017	wtp	07/07/08	06/28/08	36,240	152.8	4.86	694.01	2,334.97	0.045	0.110	3,986.04	6,321.01	Jun/2008	Jul/2008	5		
1400 798 0015	wells 2 & 3	07/07/08	06/28/08	16,160	51.2	4.86	200.23	972.32	0.048	0.110	1,777.44	2,749.76	Jun/2008	Jul/2008	7		
1394 578 0016	fac 1	07/07/08	06/28/08	147	3.0	4.86	-	16.19	0.110	0.110	16.17	32.36	Jun/2008	Jul/2008	9		
1597 826 0014	well 7	07/08/08	07/03/08	4,062	44.8	4.86	169.13	417.74	0.061	0.110	446.78	864.52	Jun/2008	Jul/2008	11		
1395 143 0019	tank 1	07/07/08	07/03/08	98	0.0	4.86	-	12.65	0.129	0.110	10.78	23.43	Jun/2008	Jul/2008	13		
1400 797 0016	tank 2	07/07/08	07/03/08	265	0.0	4.86	-	24.75	0.093	0.110	29.15	53.90	Jun/2008	Jul/2008	15		
1626 148 0012	well 1	08/05/08	07/28/08	7,827	22.7	4.86	61.72	473.24	0.053	0.110	860.89	1,334.13	Jul/2008	Aug/2008	1		
1400 878 0018	well 6	08/08/08	08/06/08	6,247	21.0	4.86	53.46	396.61	0.055	0.128	801.24	1,197.85	Jul/2008	Aug/2008	3		
2731 512 0017	wtp	08/05/08	07/28/08	39,440	141.6	4.86	639.58	2,419.00	0.045	0.110	4,338.01	6,757.01	Jul/2008	Aug/2008	5		
1400 798 0015	wells 2 & 3	08/05/08	07/28/08	17,760	51.2	4.86	200.23	1,041.55	0.047	0.110	1,953.42	2,994.97	Jul/2008	Aug/2008	7		
1394 578 0016	fac 1	08/05/08	07/28/08	141	1.1	4.86	-	15.76	0.112	0.110	15.51	31.27	Jul/2008	Aug/2008	9		
1597 826 0014	well 7	08/06/08	08/03/08	15,759	45.1	4.86	170.59	925.33	0.048	0.128	2,021.25	2,946.58	Jul/2008	Aug/2008	11		
1395 143 0019	tank 1	08/05/08	08/04/08	101	0.0	4.86	-	12.85	0.127	0.128	12.95	25.80	Jul/2008	Aug/2008	13		
1400 797 0016	tank 2	08/05/08	08/04/08	306	0.0	4.86	-	27.73	0.091	0.128	39.25	66.98	Jul/2008	Aug/2008	15		
1626 148 0012	well 1	09/04/08	08/28/08	6,319	22.6	4.86	61.24	407.51	0.055	0.128	810.47	1,217.98	Aug/2008	Sep/2008	1		
1400 878 0018	well 6	09/05/08	08/01/08	2,733	21.0	3.56	39.20	210.89	0.063	0.128	350.53	561.42	Aug/2008	Sep/2008	3		
2731 512 0017	wtp	09/05/08	08/28/08	42,400	179.2	4.86	822.31	2,729.80	0.045	0.128	5,438.22	8,168.02	Aug/2008	Sep/2008	5		
1400 798 0015	wells 2 & 3	09/05/08	08/28/08	14,720	51.2	4.86	200.23	910.01	0.048	0.128	1,887.99	2,798.00	Aug/2008	Sep/2008	7		
1394 578 0016	fac 1	09/04/08	08/28/08	136	1.2	4.86	-	15.39	0.113	0.128	17.44	32.83	Aug/2008	Sep/2008	9		
1597 826 0014	well 7	09/05/08	09/03/08	12,066	44.6	4.86	168.16	763.10	0.049	0.128	1,547.59	2,310.69	Aug/2008	Sep/2008	11		
1395 143 0019	tank 1	09/04/08	09/03/08	108	0.0	4.86	-	13.36	0.124	0.128	13.85	27.21	Aug/2008	Sep/2008	13		
1400 797 0016	tank 2	09/04/08	09/03/08	287	0.0	4.86	-	26.35	0.092	0.128	36.81	63.16	Aug/2008	Sep/2008	15		
1626 148 0012	well 1	10/03/08	09/28/08	5,504	23.5	4.86	65.61	376.62	0.057	0.128	705.94	1,082.56	Sep/2008	Oct/2008	1		
1400 878 0018	well 6	10/06/08	09/28/08	3,811	18.4	4.86	40.82	278.58	0.062	0.128	488.80	767.38	Sep/2008	Oct/2008	3		
2731 512 0017	wtp	10/06/08	09/28/08	38,800	180.8	4.86	830.09	2,581.82	0.045	0.128	4,976.49	7,558.31	Sep/2008	Oct/2008	5		
1400 798 0015	wells 2 & 3	10/08/08	09/28/08	16,320	51.2	4.86	200.23	979.25	0.048	0.128	2,093.20	3,072.45	Sep/2008	Oct/2008	7		
1394 578 0016	fac 1	10/03/08	09/28/08	147	1.4	4.86	-	16.19	0.110	0.128	18.85	35.04	Sep/2008	Oct/2008	9		
1597 826 0014	well 7	10/08/08	10/03/08	534	44.3	4.86	166.70	210.97	0.083	0.128	68.49	279.46	Sep/2008	Oct/2008	11		
1395 143 0019	tank 1	10/03/08	10/02/08	110	0.0	4.86	-	13.52	0.123	0.128	14.11	27.63	Sep/2008	Oct/2008	13		
1400 797 0016	tank 2	10/06/08	10/03/08	289	0.0	4.86	-	26.49	0.092	0.128	37.07	63.56	Sep/2008	Oct/2008	15		
1626 148 0012	well 1	11/04/08	10/28/08	3,946	24.4	4.86	69.98	313.58	0.062	0.128	506.11	819.69	Oct/2008	Nov/2008	1		
1400 878 0018	well 6	11/04/08	10/28/08	3,182	25.4	4.86	74.84	285.38	0.066	0.128	408.12	693.50	Oct/2008	Nov/2008	3		
2731 512 0017	wtp	11/04/08	10/28/08	33,040	181.6	4.86	833.98	2,336.46	0.045	0.128	4,237.71	6,574.17	Oct/2008	Nov/2008	5		
1400 798 0015	wells 2 & 3	11/07/08	10/28/08	6,720	51.2	4.86	200.23	563.85	0.054	0.128	861.91	1,425.76	Oct/2008	Nov/2008	7		
1394 578 0016	fac 1	11/04/08	10/28/08	459	5.4	4.86	-	38.83	0.085	0.128	58.87	97.70	Oct/2008	Nov/2008	9		
1597 826 0014	well 7	11/05/08	11/03/08	612	53.4	3.74	162.32	212.25	0.082	0.128	78.50	290.75	Oct/2008	Nov/2008	11		
1395 143 0019	tank 1	11/04/08	11/03/08	139	0.0	4.86	-	15.61	0.112	0.128	17.83	33.44	Oct/2008	Nov/2008	13		
1400 797 0016	tank 2	11/04/08	11/03/08	333	0.0	4.86	-	29.68	0.089	0.128	42.71	72.39	Oct/2008	Nov/2008	15		
1626 148 0012	well 1	12/04/08	11/28/08	3,334	24.2	4.86	69.01	286.12	0.065	0.128	427.62	713.74	Nov/2008	Dec/2008	1		
1400 878 0018	well 6	12/04/08	11/28/08	3,608	25.4	4.86	74.84	303.81	0.063	0.128	462.76	766.57	Nov/2008	Dec/2008	3		
2731 512 0017	wtp	12/04/08	11/28/08	26,400	191.2	4.86	880.63	2,095.80	0.046	0.128	3,386.06	5,481.86	Nov/2008	Dec/2008	5		

NSTAR ELECTRIC

account no.	site	bill date	read date	est .	demand kwh	demand rate; kw	demand >10 kw	demand charge	delivery total	delivery-demand \$/kw (est.)	supplier \$/kw	supplier total	gt	use mon	bill mon	num
1400 798 0015	wells 2 # 3	12/10/08	11/28/08	*	6,880	51.2	4.86	200.23	570.78	0.054	0.128	882.43	1,453.21	Nov/2008	Dec/2008	7
1394 578 0016	fac 1	12/04/08	11/28/08		1,471	6.3	4.86	-	112.24	0.076	0.128	188.67	300.91	Nov/2008	Dec/2008	9
1597 826 0014	well 7	12/05/08	12/03/08		1,382	33.8	4.86	115.67	221.45	0.077	0.128	177.26	398.71	Nov/2008	Dec/2008	11
1395 143 0019	tank 1	12/04/08	12/03/08		140	0.0	4.86	-	15.69	0.112	0.128	17.96	33.65	Nov/2008	Dec/2008	13
1400 797 0016	tank 2	12/04/08	12/03/08		342	0.0	4.86	-	30.34	0.089	0.128	43.86	74.20	Nov/2008	Dec/2008	15

use month	2007	2008
Jan	\$ 8,376	\$ 8,785
Feb	10,331	9,095
Mar	7,898	7,506
Apr	7,978	8,003
May	8,798	8,718
Jun	12,591	12,028
Jul	13,341	15,355
Aug	15,800	15,179
Sep	12,733	12,886
Oct	9,859	10,007
Nov	8,243	9,223
Dec	8,503	
wtp	73,013	
total	\$ 124,452	



RESIDENTIAL

BUSINESS

Financial Assistance

Rates & Tariffs

Safety

Gas Heating Programs

FAQ

Home > Residential > E-Bill

Bill Summary

My Bill

- Bill Summary (Home)
- Bill Detail
- Usage Detail
- Bill Messages
- Print-Friendly Bill

Payments

- Pay Now
- Pay Multiple Accounts
- Recurring Schedule
- Transaction Activity
- Terms & Conditions

My Profile

- Linked Accounts
- Bank Accounts
- Customer Settings

Account Nickname: 292 RTE-28 Account Number: 27315120017

Customer: towater
[Settings](#) | [Log Out](#) | [E-Bill FAQ](#)

Current Balance: \$6,103.49 [Pay Now](#) [Add a Bank Account](#)

"Go Paperless" and enjoy hassle free, paperless billing.

Billing Period: Aug 5, 2008

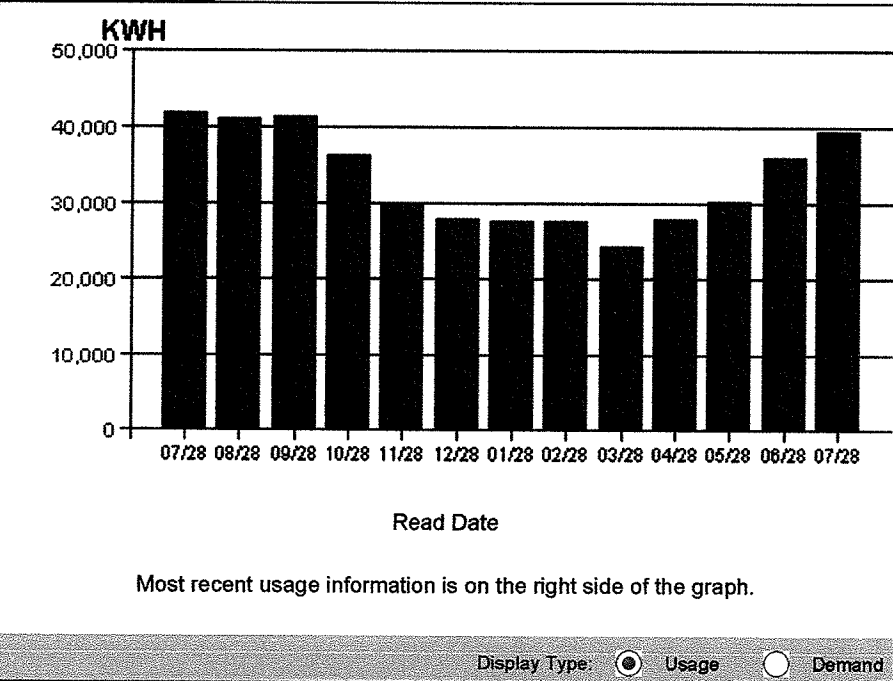
NSTAR Bill Summary [Download](#)

Account Number	2731 512 0017
Billing Date	Aug 5, 2008
Next Read Date	Sep 3, 2008
Previous Bill	4,370.91
Payments - Thank You	-5,381.47
Total Delivery Charges	2,419.00
Delivery Svcs Balance	\$1,408.44

Supplier Bill Summary [Download](#)

Previous Bill	7,308.09
Payments - Thank You	-7,308.09
Current Supplier Charges	4,338.01
Supplier Balance	\$4,338.01

Usage Summary



Bill Higher Than Usual?

- [Billing Rights](#)
- [Budget Billing](#)
- [Customer Communications](#)
- [Home Analyzer](#)
- [Mailing Address Change](#)
- [Make a Comment](#)
- [Report a Payment](#)
- [Set Up a Payment Plan](#)
- [Stop Service](#)
- [Transfer Service](#)
- [Update Telephone Number](#)
- [Understanding Your Bill](#)

HOME HEATING PROTECTION PLANS

24-HOUR GAS HEAT REPAIRS

Last 5 Transactions

Date	Amount
01/20/2009	-\$5,481.86
01/14/2009	\$6,345.60
12/23/2008	\$43.68
12/23/2008	-\$5,378.72
12/01/2008	-\$6,574.17

All Transaction Activity



Search

RESIDENTIAL

BUSINESS

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Safety

Gas Heating Programs

FAQ

Home > Residential > E-Bill

Bill Detail

Account Nickname 292 RTE-28	Account Number 27315120017	Customer: towater Settings Log Out E-Bill FAQ
---------------------------------------	--------------------------------------	---

Display Billing Period **Aug 5, 2008**

Utility Charges		Download	
Delivery Services	Customer Charge		5.53
	Distribution Demand Charges		
	1st 10 KW	No Charge	0.00
	Over 10 KW	4.86	X 131.6 KW 639.58
	Distribution Energy Charges		
	1st 2300 KWH	.04111	.072 X 2300 KWH 94.55
	Over 2300 KWH	.01184	X 37140 KWH 439.74
	Transition *	.02082	X 39440 KWH 821.14
	Transmission	.00761	.043 X 39440 KWH 300.14
	Renewable Energy	.00050	X 39440 KWH 19.72
	Energy Conservation	.00250	X 39440 KWH 98.60
	Delivery Services Total		2419.00

- My Bill**
- Bill Summary (Home)
 - Bill Detail
 - Usage Detail
 - Bill Messages
 - Print-Friendly Bill

- Payments**
- Pay Now
 - Pay Multiple Accounts
 - Recurring Schedule
 - Transaction Activity
 - Terms & Conditions

- My Profile**
- Linked Accounts
 - Bank Accounts
 - Customer Settings

Supplier Charges		Download	
Supplier Account Number	Previous Bill		7,308.09
134665	Payments - Thank You		-7,308.09
Conedison Solutions 701 Westchester Ave Suite 300 East White Plains Ny 10604 (800)381-9192	Current Supplier Charges		4,338.01
	Supplier Balance		\$4,338.01
	Supplier Activity Detail		
	Rate CLC NMUNI06 Jun 28, 2008 - Jul 28, 2008		
	Energy Charge	.109990	X 39440 KWH 4,338.01
	Current Supplier Charges		\$4,338.01

Bill Messages

The following messages pertain to your account.

* PART OF WHAT WE COLLECT IN THE TRANSITION CHARGE IS OWNED BY CEC FUNDING LLC CHARGES ARE SUBJECT TO 1.12% INTEREST AFTER 55 DAYS.

APPENDIX B

WIND TURBINE SPECIFICATIONS



**ELECON - TURBOWINDS
DESIGN AND SUPPLY OF T600**

TECHNICAL DATA

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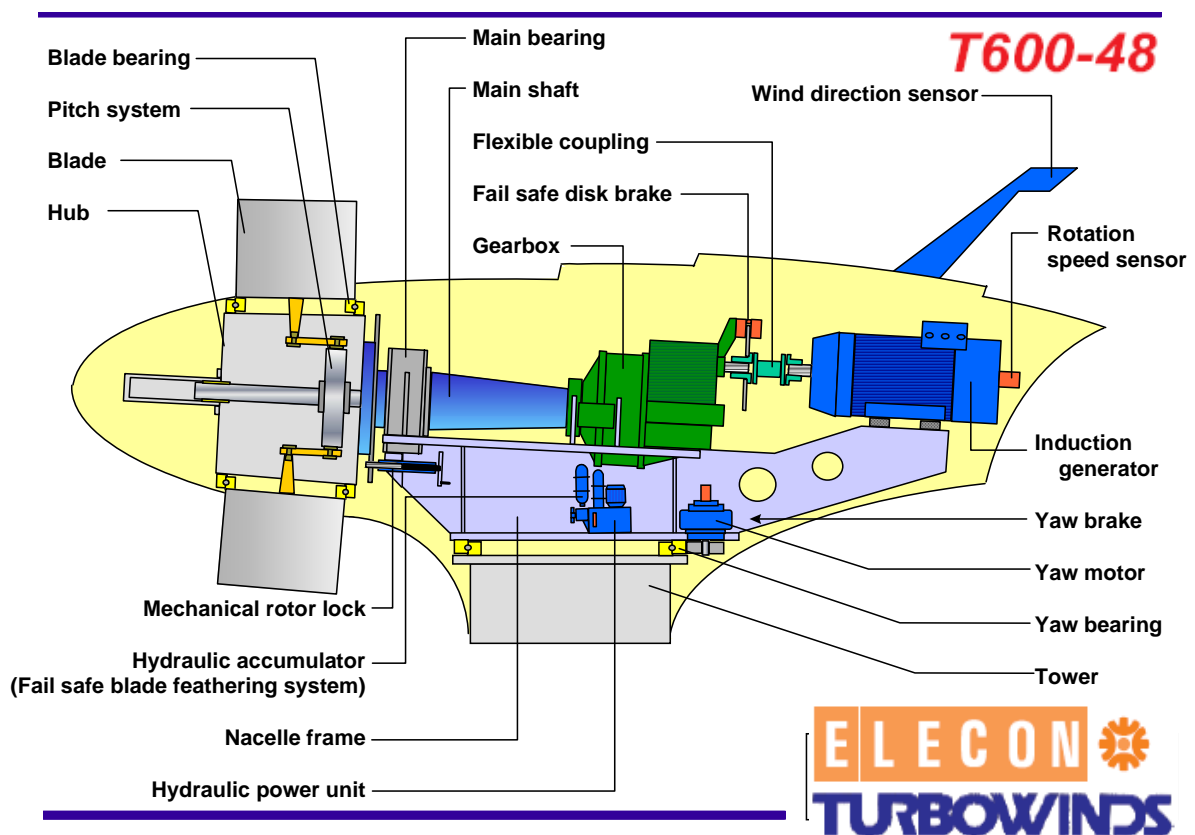
1 GENERAL DESCRIPTION

The T600 is designed to allow wind turbine generators to function automatically on an unmanned basis. Depending upon wind conditions, this includes automatically starting, normal generator operation, automatically stopping and in abnormal circumstances automatic trip/lockout.

The WTG is a horizontal axis wind turbine with an upwind rotor. The size of the T600 is 600 kW with a rotor diameter of 48 m.

The generator offered is a dual speed generator, 600/120 kW.

The blade pitch control is ACTIVE STALL.



1.1 Standards

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 61400-1 Wind turbine generator systems

TECHNICAL DATA

<u>TECHNICAL INFORMATION</u>	T600-48 TURBOWINDS
1 <u>Wind Turbine</u>	
Manufacturer	ELECON - TURBOWINDS N.V.
Type and Model number	T600-48 DS
Rated power, kW	120 / 600 kWatt (dual speed)
Wind speed at hub height:	
Cut-in, m/s	3.5 m/sec
Rated, m/s	12.5 m/sec
Cut-out, m/s	25 m/sec
Maximum designed (survival), m/s	60 m/sec
Rotor diameter	48 m
Hub height	50 m
Method of control	full blade pitch active stall
System design life for all components, yr	20 years
Approval / type - certification Quality control system certification Power curve certification	C-WET ELECON CIWI Holland
2 <u>Rotor</u>	
Number of blades	3
Diameter, m	48 m
Speed, rpm	15.3 / 23 rpm
Swept area	1809 m²
Direction of rotation (looking upwind)	clock-wise
Location relative to tower	upwind
Type of Hub	Rigid
Tilt angle	4 degrees
Cone angle	-2 degrees
Method of speed control	pitch regulation + active stall
3 <u>Blade</u>	

Manufacturer	LM
Type and model	23.3P
Length, m	23.2 m
Material	Fibre glass
Weight, kg/blade	2300 kg
Blade bearing diameter (internal/external), m	1.25 m / 1.46 m
4 <u>Drive Train</u>	
Shaft speeds:	
Low speed, rpm	15.3 / 23 rpm
High speed, rpm	1200 /1800 rpm
Main shaft :	
Material	34CrNiMo6
Length and diameter	2.05m - 0.48m
Bearings	SKF
Gear Box:	
Manufacturer and type	ELECON / Flender , planetary-parallel
Ratio	65.2
Rating, kW	600 kW
Service factor	1.3
Efficiency (at rated power conditions)	96 %
Lubrication	splash
Bearings	SKF
dba at 1 meter distance	80 dba
Brake:	
Manufacturer and type	SIME
Location, HSS/LSS	HSS
Flexible coupling :	
Manufacturer and type	ELECON/ Flender GKG
5 <u>Yaw Drive</u>	
Manufacturer and type	
Yaw rate, deg/sec	0.5 deg r/sec
Yaw error dead band	5 degrees
Yaw drive (electric/hydraulic)	Hydraulically
Yaw brake	Hydraulically yaw brakes
Turntable	ball bearings
Pressure	180 bar
Moment , Nm	23.8 kNm
6 <u>Pitch Drive</u>	

Manufacturer and type	Parker or Equivalent
Pitch rate, Deg./sec.	4.6 deg/sec
Pitch mechanism, electric/hydraulic	Hydraulically
Pressure	225 bar
Cylinder force ,kN	250 kN
Feathering system (including backup)	Hydraulically
7 <u>Tower</u>	T600-48 TURBOWINDS
Type and Material	ST 42
Height, m	50 m
Diameter and Thickness at top, cm	209.4 cm - 1.2 cm
Diameter and Thickness at base, cm	314.0 cm - 2.5 cm
Tower Layout	cylindrical – tapered
First bending frequency , Hz	0.9 Hz
Access to nacelle	inside tower
Corrosion prevention	3 coat painting
Withstanding seismic loads	0.35 g
8 <u>Power Generation System</u>	
<u>Generator:</u>	
Manufacturer	ABB / Siemens
Type and Model number	M2CG 400 XL 4/6
Rating, kW	120/ 600 kW
Rated current	123/566 Amp
Slip	0.7 % / 0.9 %
Power Factor (100%-75%-50%-25%)	0.89 - 0.88 - 0.85 - 0.68
Voltage, V	690 VAC
Frequency, Hz	60Hz
Speed, rpm	1200/1800 rpm
Insulation	class F
Maximum working temperature, C	45 degrees ambient temp
Efficiency (100%-75%-50%-25%)	96.9 % - 96.7 % - 96.2 % - 94.1% respectively
Winding protection type	IP 55
Safety device	3 PTC's per generator
dBA at 1 meter distance	< 85 dBA
Connection to grid, direct/soft	soft started
<u>Electricals:</u>	T600-48 TURBOWINDS
Reactive power compensation &APFC	50/150 kVar ,& 175KVAR,

	8 steps
Net power factor after compensation (100-75-50-25 %)	0.97 - 0.99 - 0.99 - 1
Grid control	Voltage-Current-Asymmetry
Power control	active power transducer
Main supply	690 VAC
Protection	Power varistors
Contactor/light supply	110VAC/220VAC
Control system supply	24VAC-> 24 VDC + batteries
Independent over speed control	master and back-up brake
9 <u>Control System</u>	T600-48 TURBOWINDS
Manufacturer	Turbowinds
Type of supervisory	microprocessor INTEL
digital inputs	48 inputs (opto-isolated)
digital outputs	48 outputs (opto-isolated)
analog inputs	16 analog inputs (10 bits)
analog outputs	4 analog outputs (8 bits)
synoptical panel	96 colour leds , LCD display
remote control	RS232 full remote control
battery back-up	2 months
lightning protection	transorbs
10 <u>Turbine controls</u>	
Software	Turbowinds (assembler)
Power	full blade pitch - active stall
Software controls	
Over speed rpm's	1823 rpm's , 1890 rpm's
voltage	10 %
frequency	1 Hz
asymmetry	5 %
Wind speed	3.4 m/sec - 25 m/sec
Hardware controls	
Over speed relay rpm's (in controller)	1920 rpm's
Over speed brake rpm's (independent , fail safe)	1950 rpm's
11 <u>Weights (in kg.)</u>	
Wind turbine total (excluding tower)	35.000 kg
Tower (50 m)	54,000 kg
Rotor (including blades)	12.000 kg
Above tower (including rotor)	35.000 kg

Gear Box	4.500 kg
Generator	3.100 kg
Heaviest piece to be handled during erection	tower and nacelle

2 MECHANICAL

2.1 Rotor

The rotor assembly consists of the blades and hub including the connection of the blades to the hub. The blades are connected to the hub through a bearing connection allowing the blades to be rotated during operation. The rotor will be self-starting.

a) Blades

The blades are fibreglass and manufactured in materials, which do not create any interference to television or FM radio reception.

The blades are of a standard and proven type.

The blades are designed for low aerodynamic noise generation.

The blades have a matt finish with adequate abrasion resistance to prevent appreciable degradation in performance between specified maintenance periods.

Adequate drainage is provided to prevent condensation build-up in the blades.

All blades have an identification plate which shows the year of fabrication, serial number, weight and the number (s) of the other blade (s) forming a set of blades.

(b) Hub

The design of cast hubs in general is in accordance with the appropriate national standards for cast iron .

(c) Rotor Locks

To enable maintenance to be carried out safely on the rotors, means of locking the turbine rotor shaft in the stationary position is provided.

(d) Failsafe

Pitch regulation is failsafe so that in the event of loss of control blades will return to the feather position.

2.2 Braking System

Two independent braking systems are included. Both systems are independent and fail-safe. The maximum over speed does not endanger the machine.

Braking systems are capable of being tested regularly in a manner, which does not endanger the WTG in the event of a failure.

Under normal operational conditions the braking system is be capable of bringing the rotor to idling speed and eventually to a complete stop where this is required.

The braking system is operable from the nacelle as well as from the tower base control board.

a) Hydraulic System

Provisions are included to prevent over pressure in the system.

The hydraulic system does not operate when the machine is idle unless manually operated for maintenance purposes. If the pressure falls or leaks occur in the system the WTG will be stopped.

b) Pressure Components

All pressure vessels, pipes, valves and other components, which will be subject to pressure, will be subjected to hydraulic pressure tests in the works. The test pressures will be 1.5 the maximum working pressure and will be applied for 30 minutes.

2.3 Nacelle

The turbine unit includes a nacelle to house and support the rotating machinery in board of the rotor hub and to given protection to control and instrumentation equipment that needs to be located at this level. The nacelle is fully enclosed against the elements with a robust weatherproof corrosion resistant housing for all the generating equipment. It provides sufficient access and natural light for one operator to be able to inspect all components and carry out routine maintenance e.g. oil change, greasing or brake adjustments. It is constructed in such a manner as to provide a safe working area with regard to the height above ground and the close proximity to rotating components.

There is sufficient room inside the nacelle to carry out normal maintenance on the equipment inside.

Observation of the turbine blades and hubs is possible from the nacelle. The equipment such as anemometers and wind vanes and lightning conductors are fitted on the roof of the nacelle, access to the roof is provided. Access is also provided to the external parts of the rotor. Attachment points are provided for harnesses when staff is working in exposed positions. The nacelle provides adequate noise isolation and insulation to ensure that levels of noise at ground level meet guaranteed levels.

2.4 Yawing System

A yaw system is provided to enable the turbine to face into the wind when it is operational. Each wind turbine generator has its own yaw sensor.

The yaw system automatically untwists the power cables after a specified number of turns have been experienced (one turn when not connected parallel with the grid while two turns when connected to the grid).

A mechanical locking device is provided to prevent yawing of the nacelle when maintenance is being carried out on the yaw motors and brakes.

2.5 Power Transmission

a) Main Shaft

The main shaft is designed for all relevant load conditions including extreme and fatigue loading and the material used is ductile.

b) Shafts and Couplings

Turbo winds supplies suitable shafts and couplings for supporting and connecting the main rotating components. They are designed for the maximum torque loading that can be transmitted with appropriate allowance for the continuous variation in torque, braking loads and frequency of starts and stops and loads due to generator short circuits.

Couplings are capable of accommodating the maximum misalignments and axial displacements which are expected.

c) Gear box

The gear box is of adequate strength to meet all loads imposed on them. In addition to those during normal operation these will include loads due to braking, both normal and emergency, generator short circuits and starting. They will not suffer any damage during overspeed following the operation of the overspeed trip devices. The design, manufacture and installation of the gearboxes is such that the external noise arising from them is kept to a minimum.

An oil temperature gauge is fitted on each gearbox. Filler and drain plugs are provided.

The oil is cooled by external oil cooler when a certain oil temperature level is reached.

d) Guards

All rotating and moving components including couplings will be enclosed or guarded so that it is not possible for operators to come into contact with them when the

machinery is moving or when there is any risk of it moving. Where the guards are in the form of doors, locks will be provided.

2.6 Bearings

All bearings supplied are designed for the life of the plant.

3 GENERATOR

The double speed generator is a 3-phase medium voltage induction type. The generator has a soft start system (patented soft resistor system) to avoid excessive inrush current during starting.

The generator supplied is of standard design. It is capable of operating with high reliability under all operating conditions with due allowance for the variable output imposed by the fluctuations in wind speed. It is capable of handling load rejection and other system faults including the maximum over speed that it can reach on operation of the over speed trips

The generator is connected to the grid by a “patented” soft start system to ensure a gentle increase of the current. The starting device will ensure a soft start whether the WTG is started manually or by the control system. The starting device is short circuited when the generator has been connected to the grid.

The generator is designed to avoid the build up of condensation in the windings by the use of anti-condensation heaters.

In considering the design of the generator cooling air fan Turbo winds ensures that this complies with noise limitations.

The bearings can be efficiently lubricated at all running speeds. Provision is made for preventing lubricant from gaining access to the windings or other current carrying parts.

The generator will be capable of withstanding the maximum overload conditions for the maximum conceivable duration.

The generator is constructed to withstand direct connection at synchronous speed to the grid.

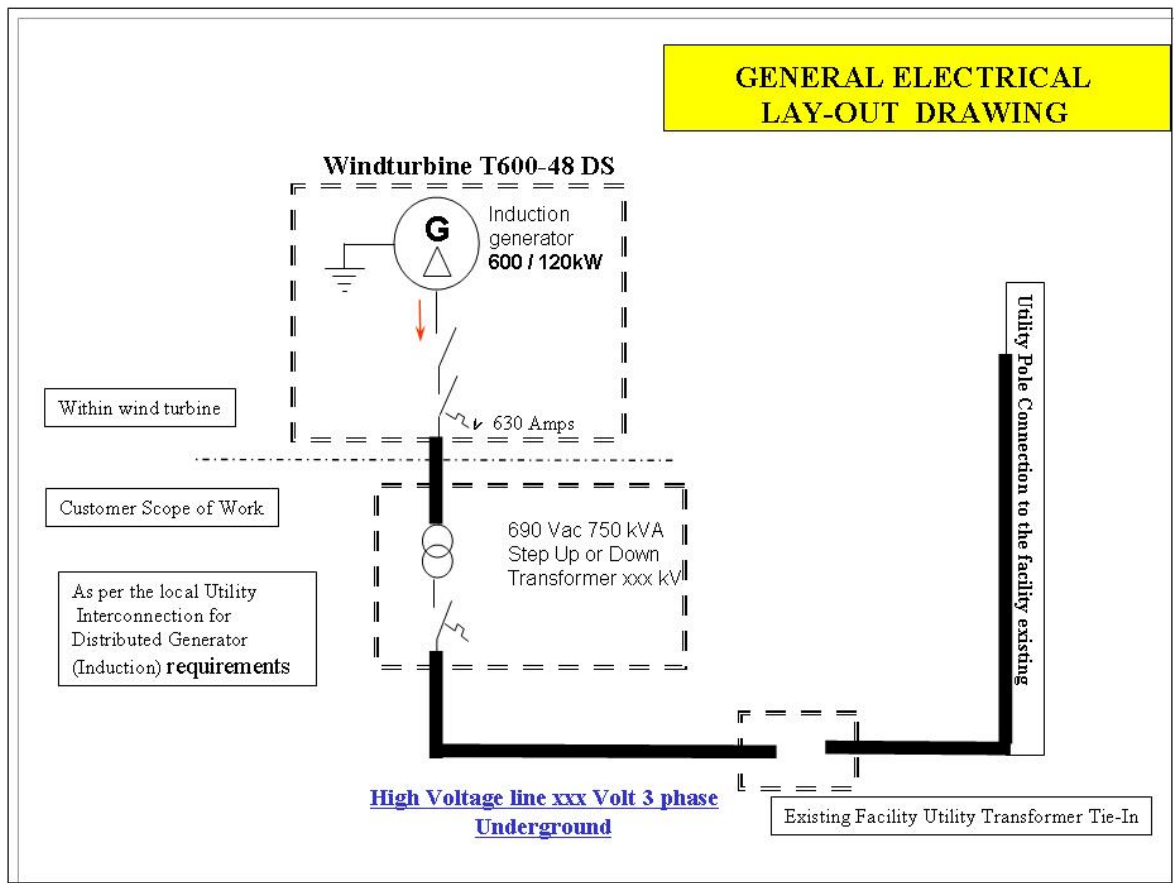
The generator is provided with temperature sensors incorporated in the stator windings for temperature protection.

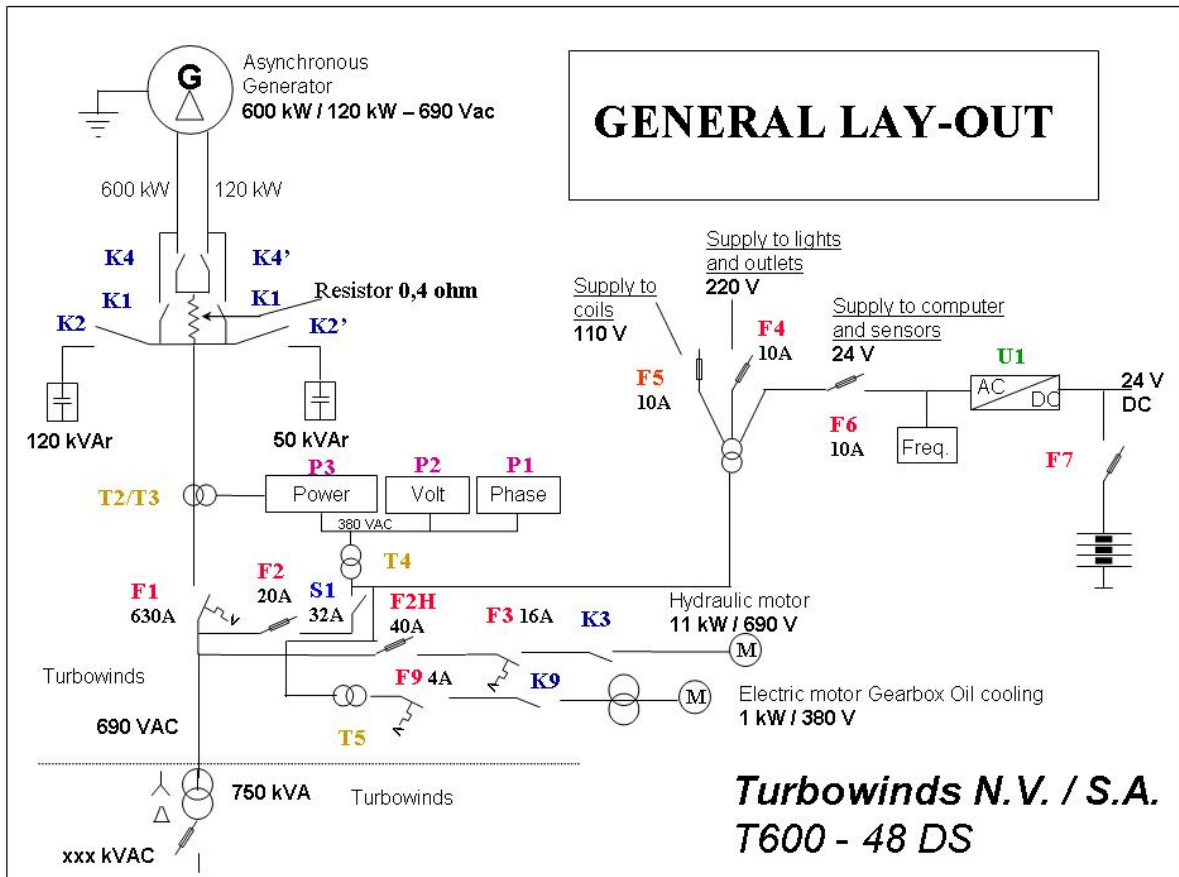
4 ELECTRICAL

The electrical installation is designed for continuous operation under the specified Site climatic conditions. Circuits with different voltages will be segregated .

Due to high humidity conditions anti-condensation heaters are needed where necessary.

Single line diagram :





Main Electrical Component Manufacturers

Main Circuit Breakers:

F1: Main Circuit Breaker (Klockner-Moeller) – UL 489 / CSA 22.2 no. 5,1

F4/F5/F6/F7 Circuit Breakers (ABB) – UL listed

K1/K2/K3/K4: Contactors – ABB – UL listed

Capacitor Bank Units – ABB

CLMD 83 690/50-120 (120 kvar)

CLMD 63 690/50-50 (50 kvar)

Reactive power compensation Schemes

For 600 KW generator the power factor at full load is 0.89 without power factor correction. Therefore reactive power consumed is approx. 307 kVAR. Switching on both capacitors banks of 170 kvar (120+50), the power factor will be 0.975

For 120 KW generator the power factor at full load is 0.82 without power factor correction. Therefore reactive power consumed is approx. 83 kVAR.

Switching on one small capacitor banks of 50 kvar, the power factor will be 0.96

4.1 Circuit Protection

Each generator has separate short-circuit protection and overload protection on all phases.

The protective devices are rated for making/breaking the maximum short-circuit current which can occur at the point of installation where it is used.

Contactors applied for connection of the generator to the grid have a breaking capacity larger than the direct on line starting current for the generator when operating as a motor.

Hydraulic pumps, yaw motor and power supplies for control circuits, have individual protection against short circuits and overload.

Over current relays are adjustable at least within the range 90-110% of the rated full load current.

4.2 Protection Requirements

The protection system for each generator should include the following:

1. Negative Phase Sequence (NPS) protection
2. Frequency
3. Over current
4. Over voltage

4.3 Capacitor Banks

Capacitor banks & APFC panel are provided to ensure that the power factor is almost unity.

The cut-in and cut-out of the banks will be automatically controlled by separate contactors.

The capacitors will be of the metallised film type, and correspond to the rated voltage and frequency.

The capacitors are provided with a means of draining the stored charge and of preventing charge build up during maintenance work.

The capacitor bank is enclosed so that persons cannot come in to accidental contact or bring conducting material into accidental contact with exposed energised parts, terminals or buses associated with them.

The enclosure and capacitor cases will be earthed for protection.

4.4 Power Transformers (For reference only)

Turbowinds recommends use of step up or step down transformer of 750 kVA from 690 V to the facility service voltage for interconnection of wind turbine generator as per the local utility requirements.

Transformers shall be located at out door on the plinth with well equipped 2 pole DP structure.

The transformers are required to design set up with off load tap changing facilities on the high voltage side with a minimum range of +5 % to -5 % in 2.5 % steps and suitable transformer impedance for the duty. Tap changers will be manually operated. Indication of tap position is clearly visible from ground level.

The transformer is accessible only to authorised personnel.

4.5 Earthing (For reference only)

The WTG earthing grid is designed for adequate dissipation capacity from earth current under the most severe conditions in high earth fault current concentration areas; grid spacing will be sufficient for maintaining voltage gradients.

A terminal bar for equipment earthing is provided and secured inside each enclosure for the attachment of the earth conductor and all the internal/external earth conductors.

The terminal bar is bonded to the cabinet and to all non current conducting parts.

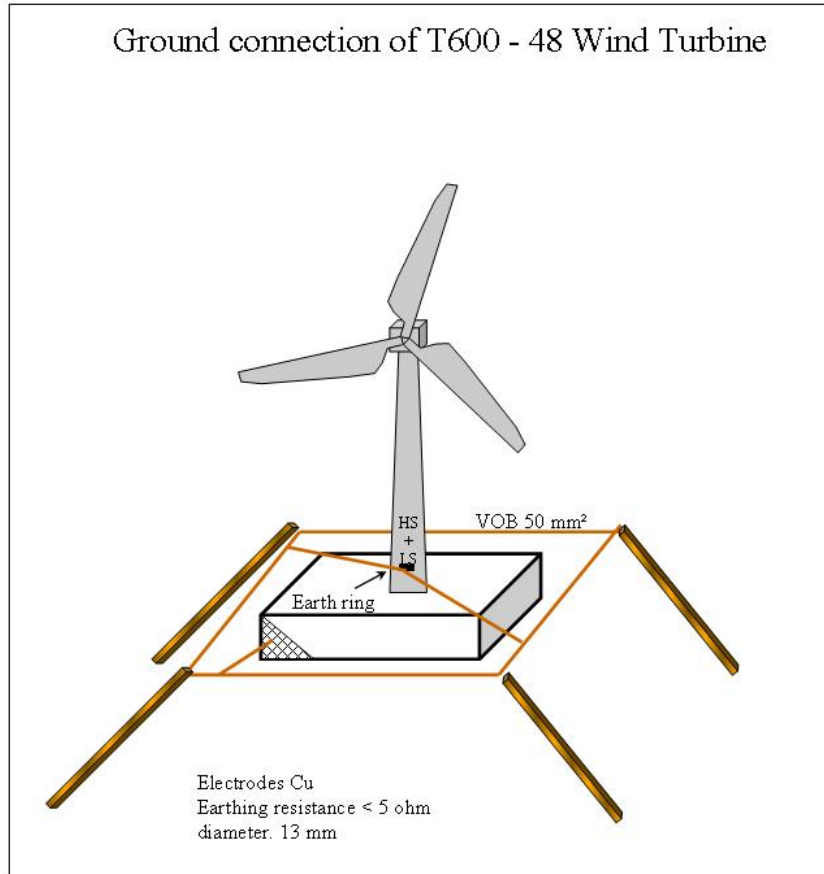
Bonding is provided where necessary to assure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

A bonding jumper is a wire, bus, screw or similar suitable conductor.

All metal parts are bonded to earth using a stranded copper conductor of minimum size 1.5 mm². All earth screws will be high strength bronze.

An earthing grid using a ring conductor with earthing rods with a minimum diameter of 13 mm will be installed to give a maximum resistance of 10 ohm at each WTG or to the requirements of local regulations. The materials used will be compatible with the existing environmental conditions. The resistance will be confirmed by means of primary injection testing prior to commissioning.

All above ground earth cables will be insulated.



4.6 Interconnection (For reference only)

The interconnection between wind turbines and step up transformers is an underground cabling system will be as per the local code requirements and utility interconnection requirements for Induction generators.

4.7 Tower Facilities

One standard 10A 220V general-purpose single phase electric outlet is installed in the base of the tower, in close proximity to the main internal light switch. The main internal light switch operates all lights within the tower. Lights are installed to provide adequate lighting in all areas within the wind turbine tower, at the base and at the top.

One standard 10A 220V general-purpose single-phase electric outlet is provided in the nacelle.

5 CONTROLS & INSTRUMENTATION

5.1 Control Principles and Scope

The control system is designed for safe and efficient operation, control and monitoring of the wind farm and individual WTGs based on an automatic, unattended operation using microprocessor systems.

Turbowinds offers proven equipment, of which Turbowinds can demonstrate satisfactory experience.

Components sensitive to extreme temperatures and/or high humidity are protected against these conditions to insure reliable operation.

The control system is self-monitoring such that a safe shutdown occurs in the case of a control system malfunction.

The control system is readily expandable to allow for future additions and modifications.

There is no possibility of self-excitation of any wind turbine due to transmission line capacitance.

Optional :

The control system provides a central monitoring and control system for the Wind Farm with individual local controllers at each WTG. These systems will include:

- (a) Information for the operator, both locally and remotely, to be able to quickly identify faults and initiate remedial action.
- (b) A comprehensive log of historical and real time information to monitor specific plant condition.
- (c) Modem and interface cards to interface for remote access.
- (d) a personnel pager interface and auto dialler whereby any alarm from the Wind Farm (in the unattended model) activates a selected pager alerting operations personnel to the alarm type.
- (e) an Uninterruptible Power Supply (UPS).
- (f) The software is developed using a standard programming language.

5.2 Wind Turbine Generator Controller

The following commands are included as a minimum for each WTG:

- Reset WTG

- Stop WTG – normal and emergency
- Start yawing right or left
- Stop yawing
- Start WTG
- Change control limits

Adequate provision is made for interlocks to prevent unsafe operation of the WTG while site personnel are working on them.

The WTG manufacturer's standard instrumentation for unattended, automatic operation is acceptable consistent with it including the minimum instrumentation required to carry out all service and set up functions required by the service manuals and the grid connection authority.

The control panel is provided with a display, to present the data and status of the WTG.

The computer system monitors and displays the following parameters for the WTG:

- Voltage (V), in rms values
- Frequency (Hz)
- Generator revolution speed (rpm)
- Actual active power production (kW)
- Accumulated energy for each WTG (kWh)
- Operation hours for each WTG (h)
- Entry alarms
- Type of fault and time for shut down (error code, month, day, hour and minute)
- Status of each Generator
- Yaw system position
- Wind speed and direction
- Trending graphs for above data

Display lay outs:

Screen 1:

RPM	BLADE	Yaw	kWsec	Mast	wind	Freq
1508	235	30046	602G	15.5	15.2	50.1 Hz

RPM's: are measured 1 rpm accurate and each 100 msec.

BLADE: blade position, measured by analog input and each 50 msec.

Yaw: yaw position, 0.05 degrees accurate and measured each 100 msec.

KWsec.: kWatt last second, 0.5 kW accurate and measured each 50 msec.

Mast: this is the windspeed sent by central datacomm computer (if available) and measured from a central windspeed mast.

Wind: this is the windspeed from the windspeed meter mounted at the back of the nacelle (1 second average).

Freq.: grid frequency, 0.1 Hz accurate and measured each 1 msec.

Screen 2:

RPMmax	RPMmin	Windmin	Volt	position
1515	1498	15.1	692	3 - 20

RPMmax: maximum rpm which has been measured while connected.

RPMmin: minimum rpm which has been measured while connected.

Windmin: this is the windspeed from the windspeed meter mounted at the back of the nacelle (1 minute average).

Volt: voltage from the grid between lines 1 and 3 measured each 100 msec and 1 Vac accurate.

position: this indicates if the windturbine is in idling mode (1), measuring mode (2), climb up mode (3) or in connected mode (4). Together with the position mode, the timer countdown is shown in seconds.

Screen 3:

kWmin	kWhour	kWhmot	Produced	Operated
602G	595G	00014	1820M872k	07613h46

kWmin: kWatt produced during last minute.


kWhour: kWatt produced during last hour.

kWhmot: kWh consumed by the windturbine due to low winds.
 Produced: total produced MWh and kWh since beginning of power production.

Operated: total hours and minutes connected to the grid.

Screen 4 to 8 :

See chapter 8 for a complete list of possible display messages on these screens.



LCD Display

OUTPUTS	DISCONNECT FOR	FAULTS	INPUTS	INPUTS	INPUTS
<ul style="list-style-type: none"> ● FREE YAW ● YAW LEFT ● YAW RIGHT ● ---- ● 24V SUPPLY ● WATCH DOG ● ---- ● RESET SAFETY RELAY ● MAIN CONTACTOR ● AUX. CONTACTOR ● HYDRAULIC MOTOR ● FEATHER VALVE ● OPTIMAL VALVE ● SAFETY VALVE ● ACCU LOAD ● RESIS. CONTACTOR 	<ul style="list-style-type: none"> ● VOLTAGE ● FREQUENCY ● MANUAL/REMOTE ● ASYMM. OPERATION ● 24V FAILURE ● BRAKE ● GENERATOR TEMP. ● POWER MEAS. FAULT ● BRAKE ON ● BRAKE OFF ● TOO LOW WIND ● GUSTY WIND ● TOO LOW RPM ● ---- ● ---- ● ---- 	<ul style="list-style-type: none"> ● FREQ VOLTS ● REVERSE DIRECTION ● ROTATION SPEED TOO HIGH ● HYDRAULIC OIL LEVEL ● ---- ● SENSOR CONTROL ● CONTACTOR CONTROL ● YAW CONTROL ● BLADE CONTROL ● INPUT FAULT ● ---- ● DATA COMMUNICATION ● CONNECTED ● CLIMB UP ● MEAS. POSITION ● IDLE 	<ul style="list-style-type: none"> ● BLADES A ● BLADES B ● BLADES REF ● RPM A ● RPM B ● SLOW RPM ● YAW A ● YAW B ● YAW REF ● EMERGENCY UP ● EMERGENCY DOWN ● VIBRATION DETECTOR ● OIL PRESS. ACCU ● HYDR. OIL LEVEL ● BRAKE OUT ● BRAKE OFF CONTROL 	<ul style="list-style-type: none"> ● FREQUENCY ● GEN. TEMP. ● SAFETY RELAY ● MAIN CONTACTOR ● AUX. CONTACTOR ● HYDR. MOT. CONTACTOR ● GEN. PROT. ● HYDR. MOT. PROT. ● COIL PROT. ● VALVE PROT. ● ASYMMETRY 3 PHASES ● BATTERY CHARGER ● ---- ● ---- ● ---- ● WIND LEFT ● WIND RIGHT 	<ul style="list-style-type: none"> ● OP. SWITCH 1 ● OP. SWITCH 2 ● DISPLAY SWITCH ● DISPLAY SWITCH ● DISPLAY SWITCH ● ---- ● RESET INT. REG. ● ---- ● HARDWARE RPM ● COMPUTER ERROR ● RESISTOR CONTACTOR ● ---- ● ---- ● ---- ● TEMP. GEARBOX ● ----

STATE

T600 - 48

6 TOWER

The wind generator support structure is a single tubular steel column with a neat and visually unobtrusive appearance designed fabricated and erected in accordance with Standard Technical Specification for Structural Steelwork.

Safe and sufficient access to the nacelle will be provided directly from the tower using an internal ladder. Tower access and cabling will be designed to avoid interference and ensure safe conditions.

A platform is provided close to the top of the tower at an adequate height for safe and easy inspection of the yaw arrangement and for access to the nacelle.

An inspection platform is also included below each tower section assembly in the case where bolted joints are used.

The internal access does not interfere with any cables, which may hang down the tower.

A floor is foreseen at the base of tower at an adequate height to ensure easy access to and readout from the controller unit.

The tower is designed to avoid critical resonances at the normal rotational speed of the wind turbine and to ensure the necessary safety against dynamic and extreme loads. The tower is designed to withstand all possible load cases.

Where bolted flange connections are used for tower section assembly adequate protection will be applied before assembling to ensure full resistance against intrusion of water and moisture.

APPENDIX C

WINDPRO MODELING OUTPUT REPORT

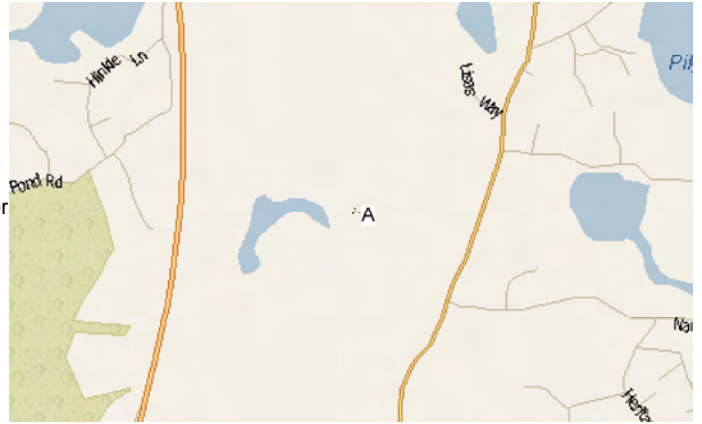
Project: Orleans, MA Wind FS	Description: Town of Orleans Wind Turbine Feasibility Study	Printed/Page 02/19/2009 3:15 PM / 1
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		Calculated: 02/19/2009 2:24 PM/2.6.1.252



METEO - Main Result

Calculation: RERL MET mast - production @ 65m

Name RERL MET Mast
Site Coordinates
 UTM NAD 83 Zone: 19 East: 417,478.63 North: 4,623,637.07
Air density calculation mode Individual per WTG
Result for WTG at hub altitude 1.237 kg/m3
Hub altitude above sea level (asl) 89.0 m
Annual mean temperature at hub alt. 9.2 °C
Pressure at WTGs 1,002.4 hPa



Meteorological Data

Calculation is based on "RERL MET Mast", giving the Weibull distribution for the wind speed on the site. Using the selected power curve, the expected annual energy production is calculated.

Weibull data 50 m above ground level

Sector	A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]	Wind gradient exponent
0 N	6.56	5.82	2.001	7.9	0.469
1 NNE	6.67	5.91	2.181	9.1	0.501
2 ENE	6.07	5.38	1.999	5.8	0.475
3 E	5.64	5.00	1.986	4.8	0.384
4 ESE	5.11	4.54	1.788	4.2	0.452
5 SSE	5.41	4.80	1.951	5.3	0.403
6 S	5.75	5.10	1.981	9.6	0.413
7 SSW	6.55	5.83	2.710	13.5	0.392
8 WSW	6.14	5.48	2.960	10.2	0.429
9 W	6.59	5.85	2.493	8.1	0.406
10 WNW	6.62	5.87	2.373	10.9	0.540
11 NNW	6.51	5.77	2.242	10.6	0.440
All	6.27	5.55	2.227	100.0	

Calculation Results

Key results for height 50.0 m above ground level

Wind energy: 1,607 kWh/m2; Mean wind speed: 5.6 m/s;

Key results for height 65.0 m above ground level

Wind energy: 2,191 kWh/m2; Mean wind speed: 6.2 m/s;

Calculated Annual Energy

Valid	WTG type	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Power curve		Annual Energy			
							Creator	Name	Result	Result-10.0%	Mean wind speed	Capacity Factor
				[kW]	[m]	[m]			[MWh]	[MWh]	[m/s]	[%]
Yes	ELECON - TURBOWINDS		T600-48 DS-600/120	600	48.0	65.0	USER	Certified Power Curve	1,487.4	1,339	6.2	28.3
Yes	GE WIND ENERGY		GE 1.5sle-1,500	1,500	77.0	65.0	EMD	Level 0 - Calculated - 10%<TI<15% - 2006	3,710.0	3,339	6.2	28.2
Yes	VESTAS		V82-1650/900-1,650/900	1,650	82.0	65.0	EMD	Level 0 - - - 11-2007	4,316.0	3,884	6.2	29.8

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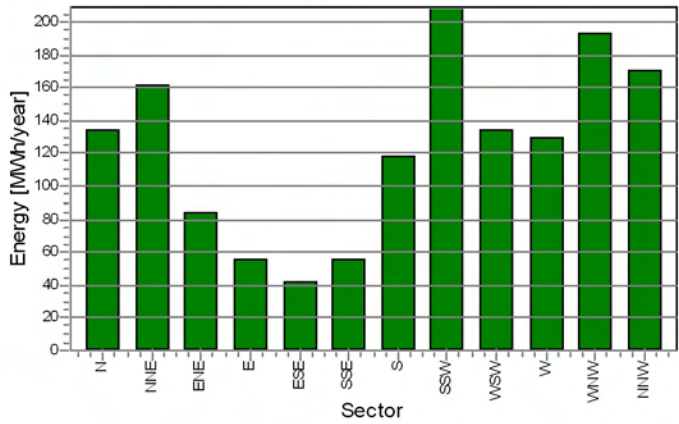
METEO - Production Analysis

Calculation: RERL MET mast - production @ 65m **WTG:** ELECON - TURBOWINDS T600-48 DS 600-120 48.0 IOI, Hub height: 65.0 m, Air density: 1.237 kg/m3

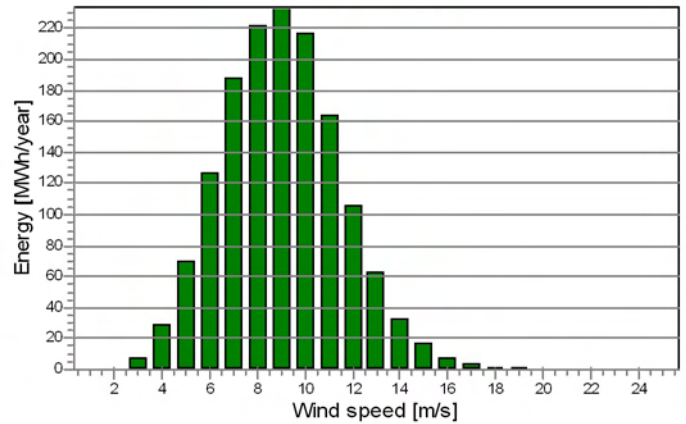
Directional Analysis

Sector	0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy [MWh]	133.8	161.9	83.7	55.5	41.7	56.3	117.7	209.1	134.3	129.2	193.4	170.9	1,487.4
Resulting energy [MWh]	133.8	161.9	83.7	55.5	41.7	56.3	117.7	209.1	134.3	129.2	193.4	170.9	1,487.4
Specific energy [kWh/m2]													822
Specific energy [kWh/kW]													2,479
Directional Distribution [%]	9.0	10.9	5.6	3.7	2.8	3.8	7.9	14.1	9.0	8.7	13.0	11.5	100.0
Utilization [%]	33.8	35.1	36.2	38.4	38.0	38.8	37.8	40.1	41.7	38.7	36.8	36.9	37.5
Operational [Hours/year]	654	760	481	400	350	441	795	1,126	851	670	909	879	8,316
Full Load Equivalent [Hours/year]	223	270	140	92	69	94	196	349	224	215	322	285	2,479
A- parameter [m/s]	7.4	7.6	6.9	6.2	5.8	6.0	6.4	7.3	6.9	7.3	7.6	7.3	7.0
Mean wind speed [m/s]	6.6	6.7	6.1	5.5	5.1	5.3	5.7	6.5	6.1	6.5	6.8	6.5	6.2
k- parameter	2.12	2.30	2.12	2.11	1.91	2.07	2.10	2.83	3.08	2.61	2.49	2.36	2.34
Frequency [%]	7.9	9.1	5.8	4.8	4.2	5.3	9.6	13.5	10.2	8.1	10.9	10.6	100.0
Power density [W/m2]													250

Energy vs. sector



Energy vs. wind speed



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METEO - Power Curve Analysis

Calculation: RERL MET mast - production @ 65m **WTG:** ELECON - TURBOWINDS T600-48 DS 600-120 48.0 IOI Certified Power Curve, Hub height: 65.0 m

Name: Certified Power Curve
Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed	Power control	CT curve type
10/28/2008	USER	11/03/2008	11/04/2008	25.0	Active stall	Standard stall

HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean	[m/s]	5	6	7	8	9	10
HP value	[MWh]	887	1,373	1,854	2,296	2,692	3,046
ELECON - TURBOWINDS T600-48 DS 600-120 48.0 IOI	[MWh]	901	1,402	1,905	2,366	2,762	3,086
Check value	[%]	-2	-2	-3	-3	-3	-1

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTG's performs quite similar - only specific power loading (kW/m²) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.
For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see WindPRO manual chapter 3.5.2.
The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.
Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

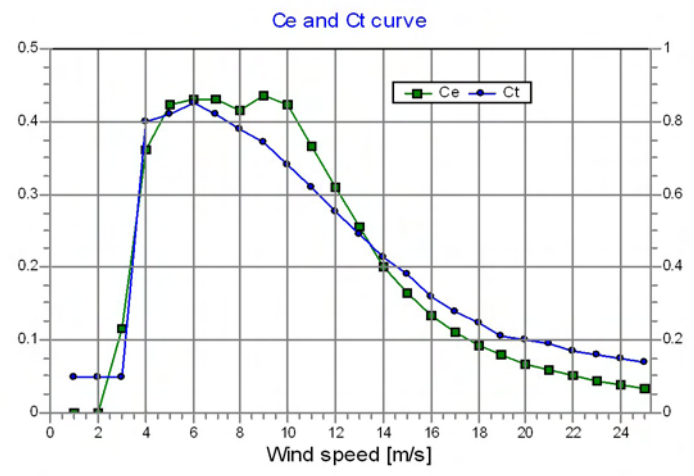
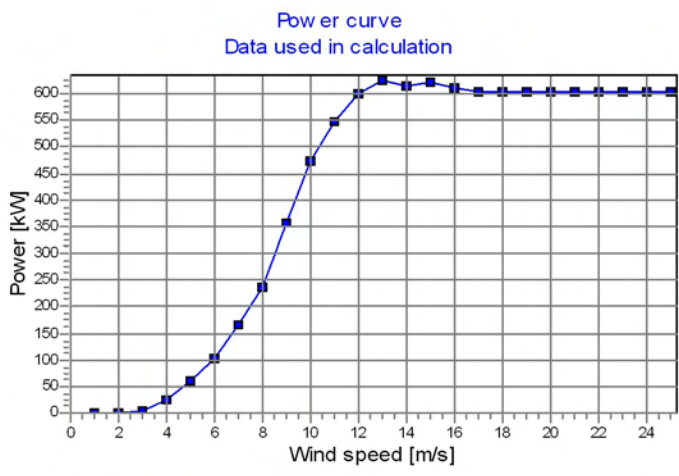
Original data from Windcat, Air density: 1.225 kg/m3

Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
1.1	-1.0	0.00	1.0	0.10
1.5	-0.7	0.00	2.0	0.10
2.0	-0.7	0.00	3.0	0.10
2.6	2.0	0.11	4.0	0.80
3.1	3.7	0.12	5.0	0.82
3.6	14.9	0.29	6.0	0.85
4.0	25.5	0.36	7.0	0.82
4.6	42.7	0.41	8.0	0.78
5.0	59.2	0.42	9.0	0.74
5.5	75.8	0.42	10.0	0.68
6.0	103.6	0.43	11.0	0.62
6.4	132.7	0.45	12.0	0.55
7.0	164.6	0.43	13.0	0.49
7.5	210.5	0.45	14.0	0.43
8.0	234.2	0.41	15.0	0.38
8.5	277.9	0.41	16.0	0.32
9.1	359.9	0.44	17.0	0.28
9.5	414.0	0.43	18.0	0.25
10.0	469.4	0.42	19.0	0.21
10.5	518.3	0.40	20.0	0.20
11.0	545.0	0.37	21.0	0.19
11.5	572.3	0.34	22.0	0.17
12.0	598.9	0.31	23.0	0.16
12.5	615.3	0.28	24.0	0.15
13.0	625.9	0.25	25.0	0.14
13.5	628.5	0.23	26.0	0.13
14.0	615.7	0.20	27.0	0.12
14.5	623.0	0.18	28.0	0.11
15.0	621.2	0.17	29.0	0.10
15.5	616.5	0.15		
16.0	611.7	0.13		
16.5	602.1	0.12		
17.1	605.4	0.11		
17.5	605.6	0.10		
18.0	603.9	0.09		
18.5	601.1	0.08		
19.0	598.1	0.08		

Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1.237 kg/m3

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc. Energy [MWh]	Relative [%]
1.0	0.0	0.00	0.50-1.50	0.0	0.0	0.0
2.0	0.0	0.00	1.50-2.50	0.6	0.6	0.0
3.0	3.5	0.12	2.50-3.50	6.7	7.2	0.5
4.0	25.8	0.36	3.50-4.50	29.1	36.3	2.4
5.0	59.0	0.42	4.50-5.50	69.5	105.8	7.1
6.0	104.1	0.43	5.50-6.50	126.1	231.9	15.6
7.0	165.6	0.43	6.50-7.50	187.5	419.4	28.2
8.0	237.4	0.41	7.50-8.50	222.1	641.6	43.1
9.0	355.4	0.44	8.50-9.50	233.6	875.2	58.8
10.0	471.7	0.42	9.50-10.50	217.2	1,092.4	73.4
11.0	546.8	0.37	10.50-11.50	163.6	1,256.0	84.4
12.0	598.9	0.31	11.50-12.50	106.2	1,362.2	91.6
13.0	625.3	0.25	12.50-13.50	62.2	1,424.4	95.8
14.0	615.7	0.20	13.50-14.50	33.1	1,457.5	98.0
15.0	621.0	0.16	14.50-15.50	16.4	1,473.8	99.1
16.0	612.1	0.13	15.50-16.50	7.7	1,481.5	99.6
17.0	604.9	0.11	16.50-17.50	3.4	1,484.9	99.8
18.0	603.9	0.09	17.50-18.50	1.5	1,486.4	99.9
19.0	605.3	0.08	18.50-19.50	0.6	1,487.0	100.0
20.0	605.4	0.07	19.50-20.50	0.2	1,487.3	100.0
21.0	605.4	0.06	20.50-21.50	0.1	1,487.4	100.0
22.0	605.4	0.05	21.50-22.50	0.0	1,487.4	100.0
23.0	605.4	0.04	22.50-23.50	0.0	1,487.4	100.0
24.0	605.4	0.04	23.50-24.50	0.0	1,487.4	100.0
25.0	605.4	0.03	24.50-25.50	0.0	1,487.4	100.0



Project: **Orleans, MA Wind FS**
 Description: **Town of Orleans Wind Turbine Feasibility Study**

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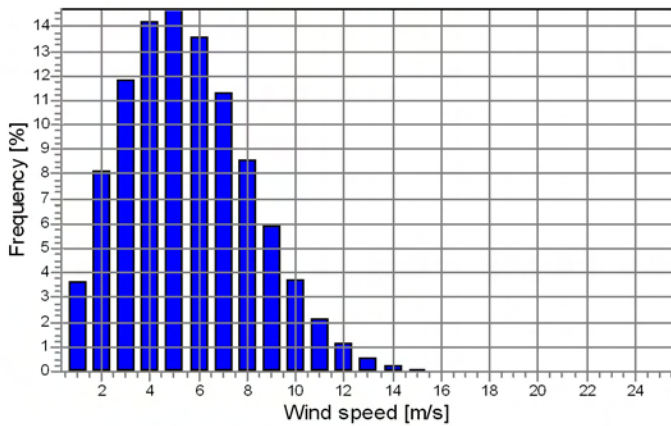
METEO - Wind Data Analysis

Calculation: RERL MET mast - production @ 65m **Wind data:** A - RERL MET Mast; Hub height: 50.0

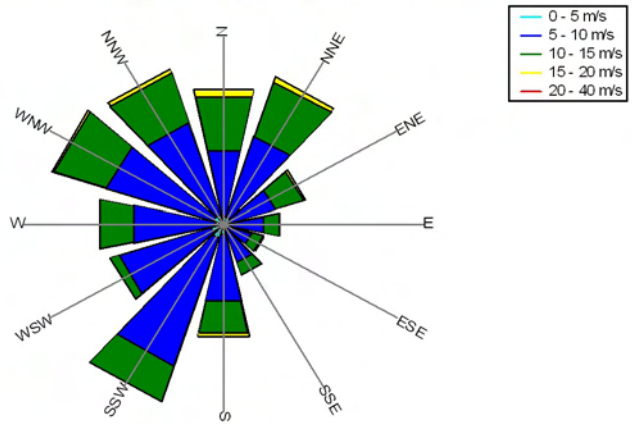
Weibull Data

Sector	A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]	Wind gradient exponent
0 N	6.56	5.82	2.001	7.9	0.469
1 NNE	6.67	5.91	2.181	9.1	0.501
2 ENE	6.07	5.38	1.999	5.8	0.475
3 E	5.64	5.00	1.986	4.8	0.384
4 ESE	5.11	4.54	1.788	4.2	0.452
5 SSE	5.41	4.80	1.951	5.3	0.403
6 S	5.75	5.10	1.981	9.6	0.413
7 SSW	6.55	5.83	2.710	13.5	0.392
8 WSW	6.14	5.48	2.960	10.2	0.429
9 W	6.59	5.85	2.493	8.1	0.406
10 WNW	6.62	5.87	2.373	10.9	0.540
11 NNW	6.51	5.77	2.242	10.6	0.440
All	6.27	5.55	2.227	100.0	

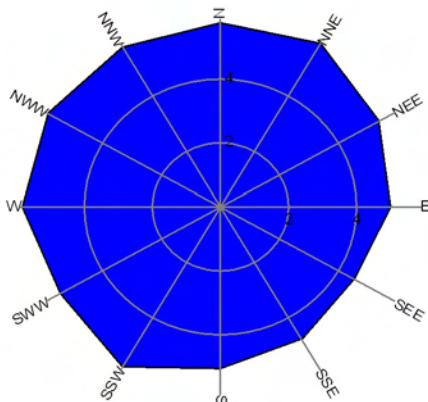
Weibull Distribution



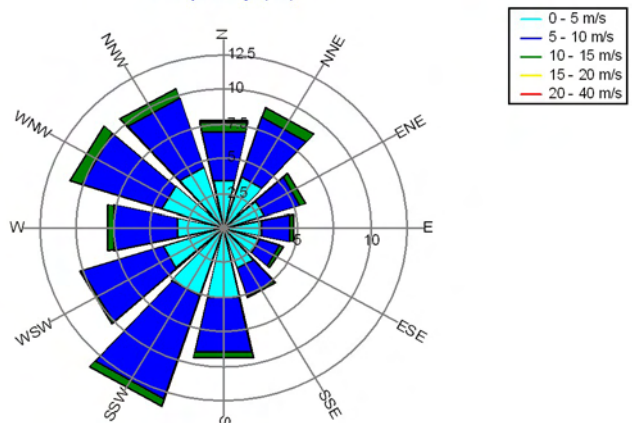
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



Project: **Orleans, MA Wind FS** Description: **Town of Orleans Wind Turbine Feasibility Study** Printed/Page: **02/19/2009 3:15 PM / 5**
 Licensed user: **Weston & Sampson Engineers Inc.**
 Five Centennial Drive
 US-PEABODY, MA 01960
 +1 978 532 1900
 Calculated: **02/19/2009 2:24 PM/2.6.1.252**



METEO - Wind profile detailed

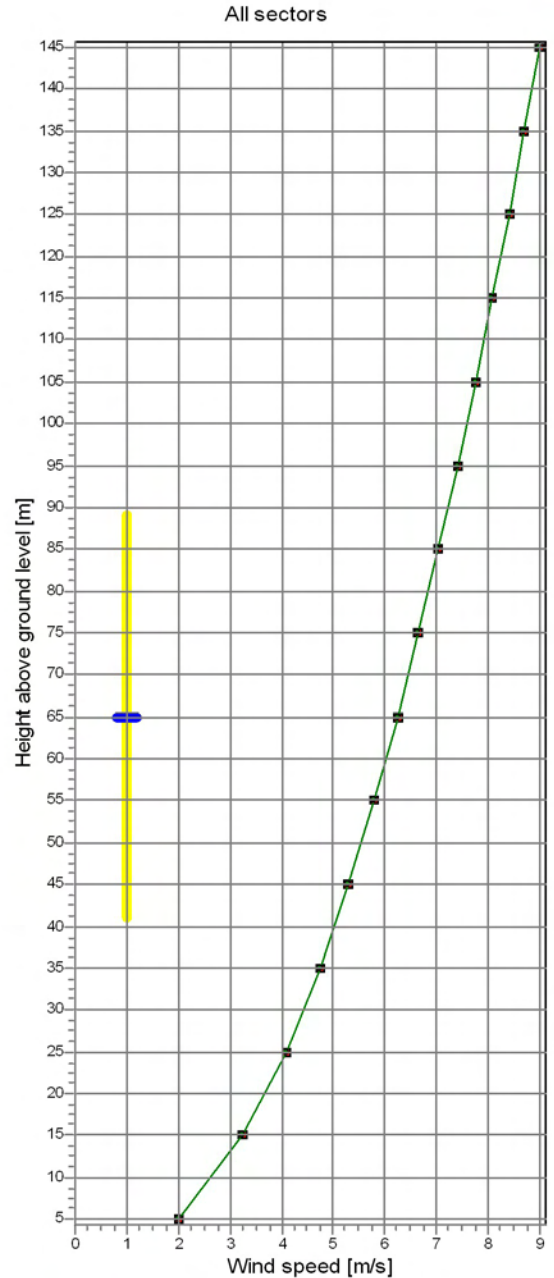
Calculation: RERL MET mast - production @ 65m **WTG:** ELECON - TURBOWINDS T600-48 DS 600-120 48.0 IOI Certified Power Curve, Hub height: 65.0 m

Site Data RERL MET Mast
Site Coordinates UTM NAD 83 Zone: 19 East: 417,478.63 North: 4,623,637.07

Air density calculation mode Individual per WTG
 Result for WTG at hub altitude 1.237 kg/m3
 Hub altitude above sea level (asl) 89.0 m
 Annual mean temperature at hub alt. 9.2 °C
 Pressure at WTGs 1,002.4 hPa

All sectors

Height	Mean wind speed	A- parameter	k- parameter	Wind energy	Yield	Yield change
	[m/s]	[m/s]		[kWh/m2]	[MWh]	[MWh]
5	2.01	2.3	1.85	91	43	-1,444
15	3.26	3.7	1.95	370	256	-1,231
25	4.08	4.6	2.03	696	508	-979
35	4.74	5.4	2.11	1,048	764	-723
45	5.30	6.0	2.19	1,417	1,015	-472
55	5.79	6.5	2.26	1,799	1,257	-231
65	6.24	7.0	2.34	2,191	1,487	0
75	6.66	7.5	2.41	2,593	1,708	220
85	7.05	7.9	2.48	3,003	1,917	430
95	7.41	8.3	2.55	3,422	2,116	629
105	7.76	8.7	2.62	3,849	2,306	818
115	8.09	9.1	2.69	4,284	2,486	998
125	8.40	9.4	2.75	4,728	2,657	1,169
135	8.71	9.8	2.82	5,179	2,819	1,332
145	9.00	10.1	2.88	5,638	2,973	1,486



Legend:
 - Mean wind speed (red line with square)
 - WTG rotor (yellow bar)
 - Without Orography/Obstacles (green line with square)

Project: Orleans, MA Wind FS

Description: Town of Orleans Wind Turbine Feasibility Study

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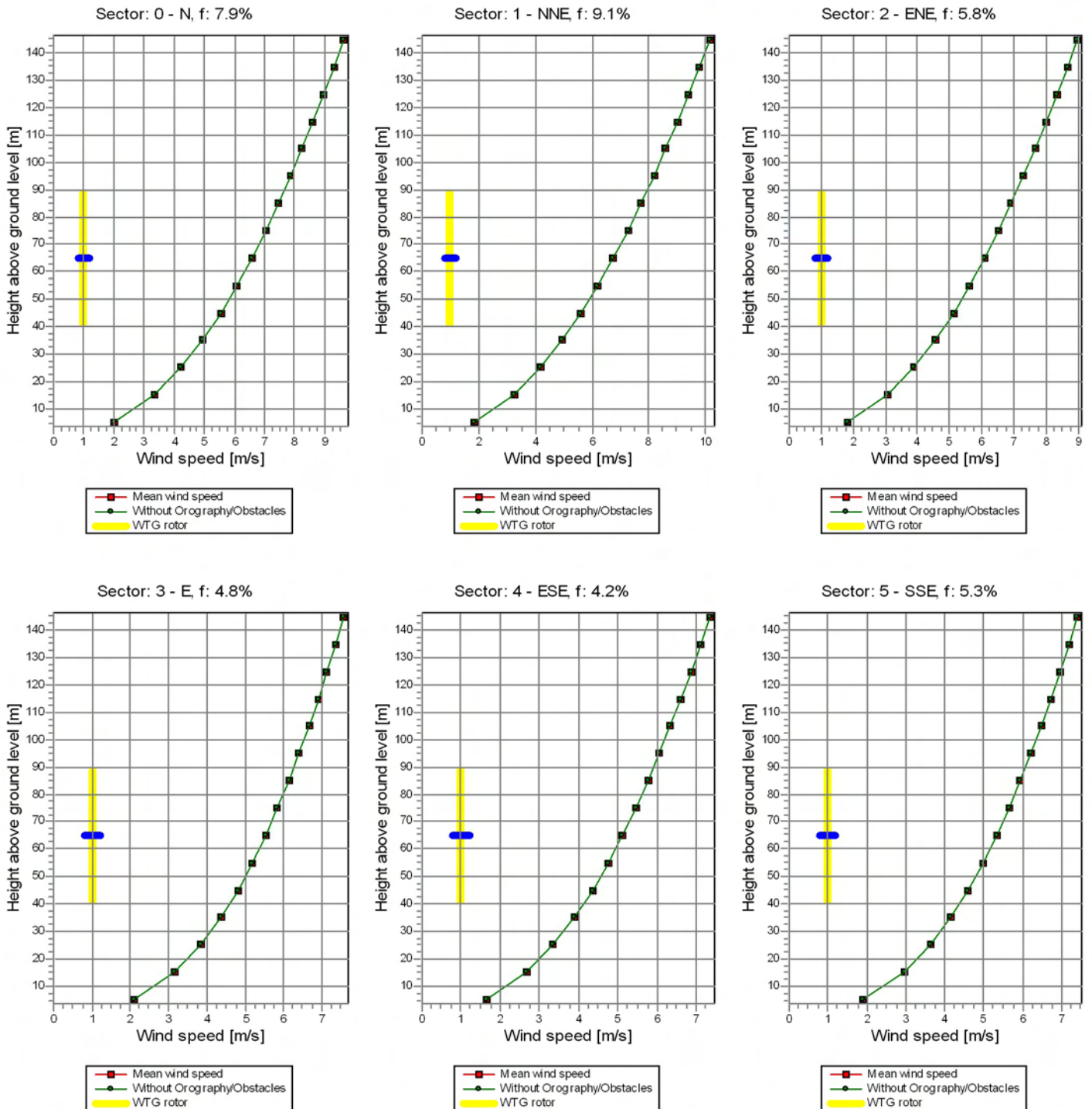
Licensed user:
Weston & Sampson Engineers Inc.
 Five Centennial Drive
 US-PEABODY, MA 01960
 +1 978 532 1900



Calculated: 02/19/2009 2:24 PM/2.6.1.252

METEO - Wind profile detailed

Calculation: RERL MET mast - production @ 65m WTG: ELECON - TURBOWINDS T600-48 DS 600-120 48.0 IOI Certified Power Curve, Hub height: 65.0 m



Project: Orleans, MA Wind FS

Description: Town of Orleans Wind Turbine Feasibility Study

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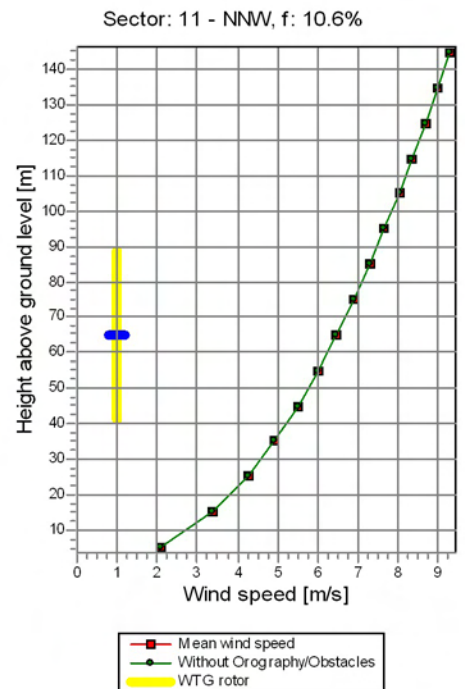
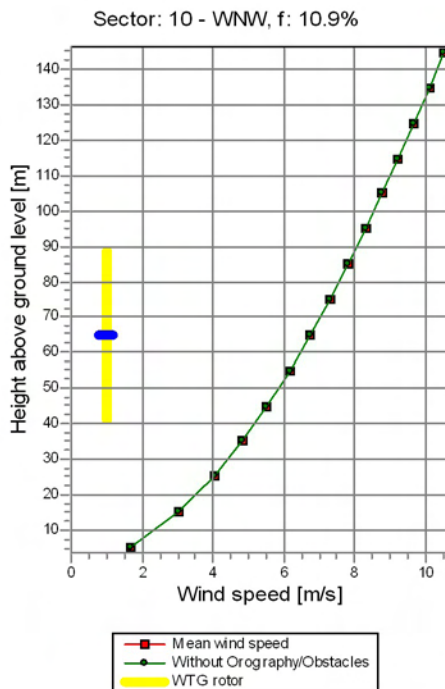
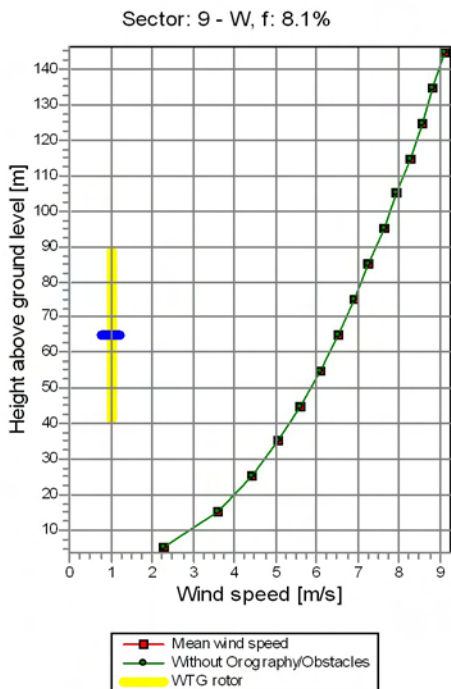
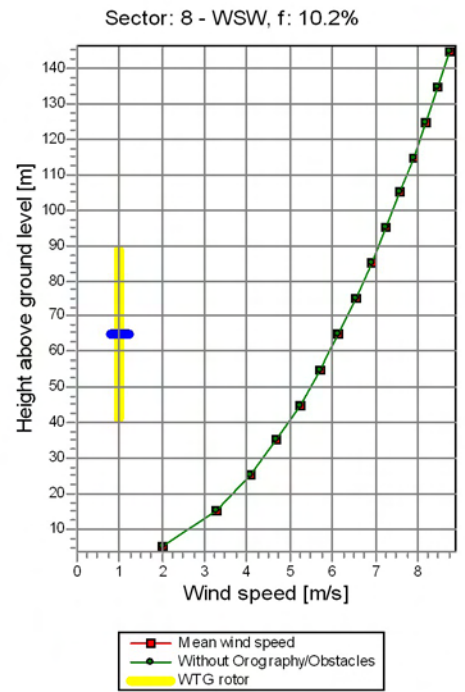
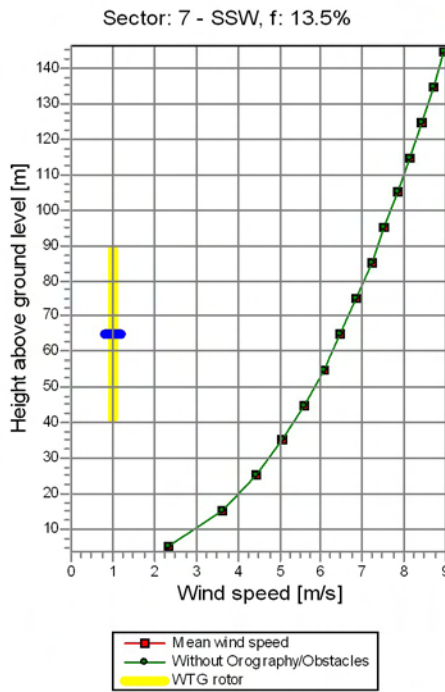
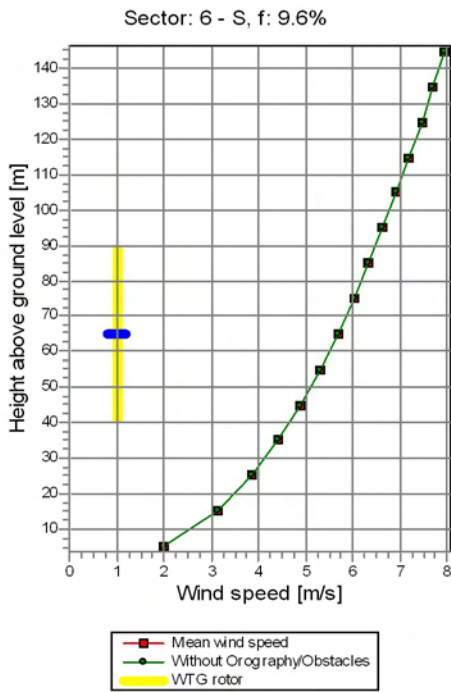
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 +1 978 532 1900



Calculated: 02/19/2009 2:24 PM/2.6.1.252

METEO - Wind profile detailed

Calculation: RERL MET mast - production @ 65m WTG: ELECON - TURBOWINDS T600-48 DS 600-120 48.0 IOI Certified Power Curve, Hub height: 65.0 m



Project: Orleans, MA Wind FS

Description: Town of Orleans Wind Turbine Feasibility Study

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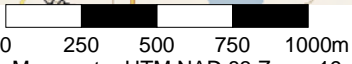
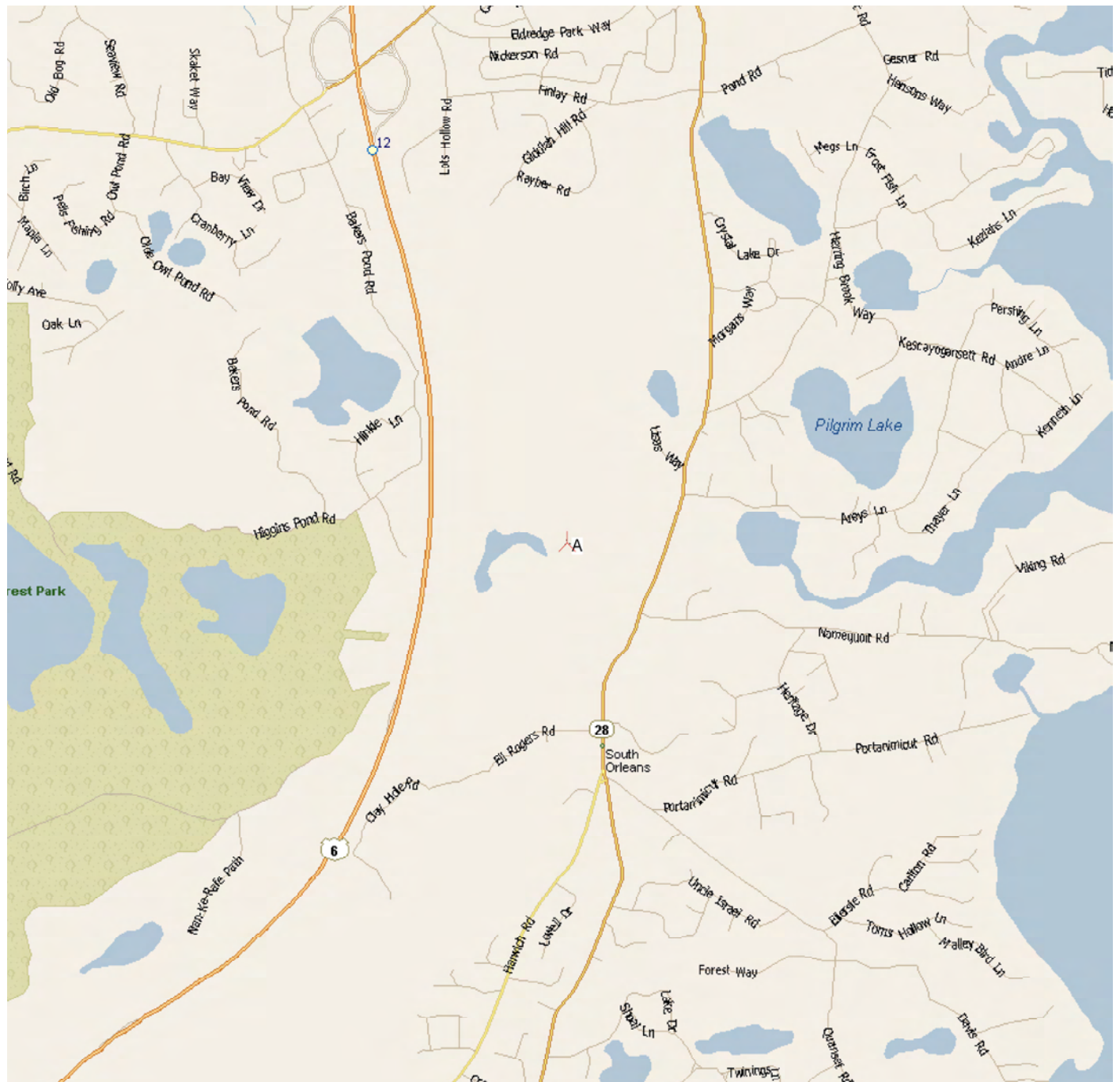
Licensed user: Weston & Sampson Engineers Inc. Five Centennial Drive US-PEABODY, MA 01960 +1 978 532 1900



Calculated: 02/19/2009 2:24 PM/2.6.1.252

METEO - DynMap2440-323

Calculation: RERL MET mast - production @ 65m File: DynMap2440-323.bmi



Map: WindPRO map , Print scale 1:25,000, Map center UTM NAD 83 Zone: 19 East: 417,469.36 North: 4,623,647.00

New WTG Meteorological Data

APPENDIX D

**MUNICIPAL OWNERSHIP MODEL
CASE STUDY**

Falmouth Wind Turbine Project

October 2008

Project Summary

- Single 1.65 MW Vestas V82 wind turbine generator
- Located at Waste Water Treatment Facility
- BOP construction and turbine installation to be performed by D&C Construction – selected through competitive process.
- Turbine will be owned by the Town of Falmouth
- Turbine will be a net metering generator
- O&M will be performed by 3rd party under long-term contract
- Est. annual production = 3,624 MWh (\approx 25% NCF)
- Useful life modeled as 20 years
 - Decommissioning reserve funded via operations

Installed Cost, Avoided Cost & REC Revenue

Project Cost:

- Turbine & Installation (winning bid): \$4,332,000
- Financing costs, Nstar interconnection costs, owner's engineer, reserves, other: \$660,000
- **Total Project Cost: \$4,992,000**

Avoided Cost:

- Net metering generator: avoids kWh generation, transmission, transition & distribution charges.
 - \$161/MWh in year 1
 - TOD- and load-weighted average of all Falmouth accounts
 - Generation rates forecasted based on NYMEX; T&D based on CPI

Revenue:

- REC revenue from sales to 3rd party
 - For 100% of production in yrs 1-5; for ≈10% of production thereafter
- MTC pays in advance for ≈90% of RECs from years 6 through 20

Project Ownership & Financing

- Owned by Town of Falmouth for entire useful life
- Majority of cost financed via General Obligation Bond
 - Supported by the Town's full faith and credit
- Initial temporary (2 year) bond
 - Interest-only payment after 12 and 24 months (from issuance)
- Convert to permanent bond financing after 24 months
 - 15-year tenor
 - 5.0% annual interest rate
 - Debt Service Reserve Account not required
 - Debt closing costs: \$30,000

Project Finance Structure

- Total Project Cost: **\$4,992,000**
 - Falmouth Revenue Bond: **\$4,000,000**
 - **MTC Advanced REC Purchase: \$1,067,397**
- MTC Advanced REC Purchase Terms:
 - **\$1,067,397** paid to Falmouth at financial closing (construction start).
 - Project delivers **90% of RECs** from years **6** through **20** (assuming Base Case production of 3,624 RECs per year).
 - RECs valued at **\$40.00**
 - Advanced payment calculated with **5%** discount rate

Pro Forma Economic Results

Base Case (expected average wind):

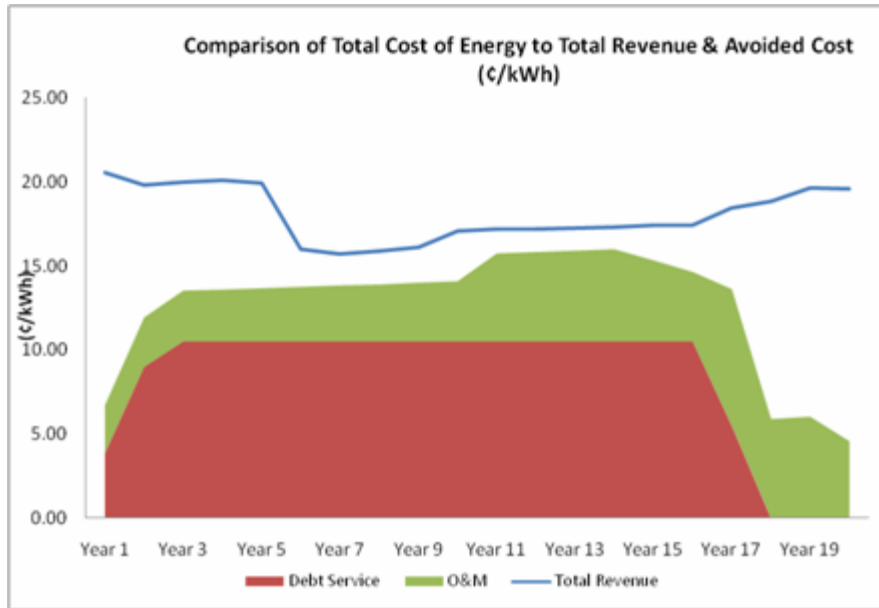
- **3,624 MWh/year ($\approx 25\%$ NCF)**
- NPV @ 5% discount rate: \$2,525,000
- Min DSCR: 1.17X
- Average DSCR: 1.34X

Sensitivity Analysis (low wind; 15% < average)

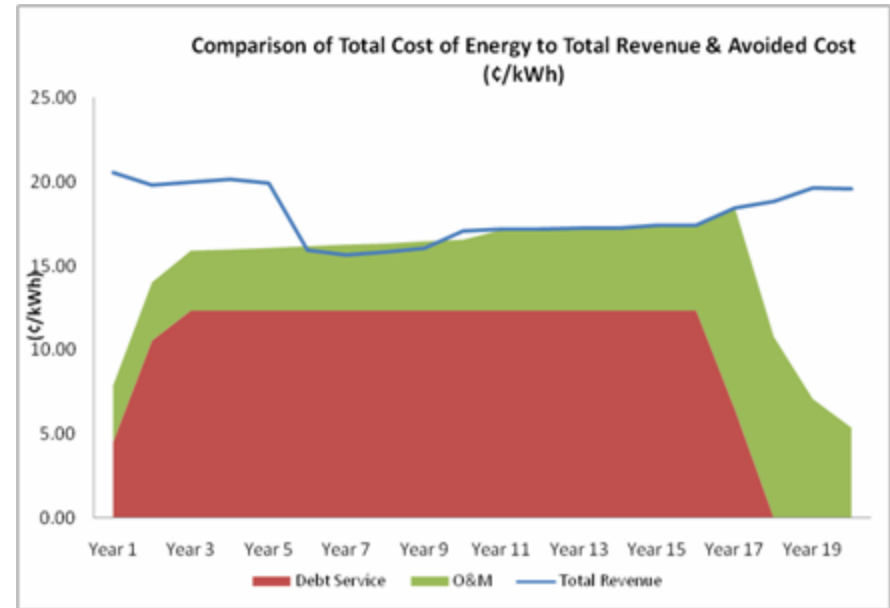
- **3,080 MWh/year ($\approx 21\%$ NCF)**
- NPV @ 5% discount rate: \$1,315,000
- Min DSCR: 0.95X
- Average DSCR: 1.08X

Pro Forma Economic Results

Base Case



Low Wind Case



Pro Forma Economic Results: Base Case

Summary Statement of Cash Flows					
	<u>Total Revenue & Avoided Cost</u>	<u>Total O&M*</u>	<u>Debt Service</u>	<u>Annual Net Savings</u>	<u>Cumulative Savings</u>
Year 0	\$75,000			\$75,000	\$75,000
Year 1	\$746,000	(\$104,000)	(\$140,000)	\$502,000	\$577,000
Year 2	\$719,000	(\$107,000)	(\$326,000)	\$286,000	\$863,000
Year 3	\$726,000	(\$110,000)	(\$381,000)	\$235,000	\$1,098,000
Year 4	\$730,000	(\$112,000)	(\$381,000)	\$237,000	\$1,335,000
Year 5	\$723,000	(\$115,000)	(\$381,000)	\$227,000	\$1,562,000
Year 6	\$579,000	(\$118,000)	(\$381,000)	\$80,000	\$1,642,000
Year 7	\$569,000	(\$121,000)	(\$381,000)	\$67,000	\$1,709,000
Year 8	\$575,000	(\$123,000)	(\$381,000)	\$71,000	\$1,780,000
Year 9	\$583,000	(\$127,000)	(\$381,000)	\$75,000	\$1,855,000
Year 10	\$620,000	(\$130,000)	(\$381,000)	\$109,000	\$1,964,000
Year 11	\$624,000	(\$190,000)	(\$381,000)	\$53,000	\$2,017,000
Year 12	\$624,000	(\$193,000)	(\$381,000)	\$50,000	\$2,067,000
Year 13	\$626,000	(\$196,000)	(\$381,000)	\$49,000	\$2,116,000
Year 14	\$628,000	(\$199,000)	(\$381,000)	\$48,000	\$2,164,000
Year 15	\$631,000	(\$175,000)	(\$381,000)	\$75,000	\$2,239,000
Year 16	\$632,000	(\$150,000)	(\$381,000)	\$101,000	\$2,340,000
Year 17	\$669,000	(\$295,000)	(\$199,000)	\$175,000	\$2,515,000
Year 18	\$683,000	(\$214,000)	\$0	\$469,000	\$2,984,000
Year 19	\$713,000	(\$219,000)	\$0	\$494,000	\$3,478,000
Year 20	\$711,000	(\$166,000)	\$0	\$545,000	\$4,023,000
Cumulative Net Cash Flow to Town:					\$4,023,000
Net Present Value of Cumulative Net Cash Flow @ 5%:					\$2,525,000
<i>* Includes contributions to decommissioning reserve in applicable years</i>					

Pro Forma Economic Results: Low Case

Summary Statement of Cash Flows					
	<u>Total Revenue & Avoided Cost</u>	<u>Total O&M*</u>	<u>Debt Service</u>	<u>Annual Net Savings</u>	<u>Cumulative Savings</u>
Year 0	\$75,000			\$75,000	\$75,000
Year 1	\$634,000	(\$104,000)	(\$140,000)	\$390,000	\$465,000
Year 2	\$611,000	(\$107,000)	(\$326,000)	\$178,000	\$643,000
Year 3	\$617,000	(\$110,000)	(\$381,000)	\$126,000	\$769,000
Year 4	\$621,000	(\$112,000)	(\$381,000)	\$128,000	\$897,000
Year 5	\$615,000	(\$115,000)	(\$381,000)	\$119,000	\$1,016,000
Year 6	\$492,000	(\$118,000)	(\$381,000)	(\$7,000)	\$1,009,000
Year 7	\$483,000	(\$121,000)	(\$381,000)	(\$19,000)	\$990,000
Year 8	\$489,000	(\$123,000)	(\$381,000)	(\$15,000)	\$975,000
Year 9	\$495,000	(\$127,000)	(\$381,000)	(\$13,000)	\$962,000
Year 10	\$527,000	(\$130,000)	(\$381,000)	\$16,000	\$978,000
Year 11	\$530,000	(\$148,000)	(\$381,000)	\$1,000	\$979,000
Year 12	\$530,000	(\$148,000)	(\$381,000)	\$1,000	\$980,000
Year 13	\$532,000	(\$150,000)	(\$381,000)	\$1,000	\$981,000
Year 14	\$533,000	(\$152,000)	(\$381,000)	\$0	\$981,000
Year 15	\$537,000	(\$155,000)	(\$381,000)	\$1,000	\$982,000
Year 16	\$537,000	(\$156,000)	(\$381,000)	\$0	\$982,000
Year 17	\$569,000	(\$370,000)	(\$199,000)	\$0	\$982,000
Year 18	\$581,000	(\$333,000)	\$0	\$248,000	\$1,230,000
Year 19	\$606,000	(\$219,000)	\$0	\$387,000	\$1,617,000
Year 20	\$605,000	(\$166,000)	\$0	\$439,000	\$2,056,000
Cumulative Net Cash Flow to Town:					\$2,056,000
Net Present Value of Cumulative Net Cash Flow @ 5%:					\$1,315,000
<i>* Includes contributions to decommissioning reserve in applicable years</i>					

APPENDIX E

**ECONOMIC CALCULATIONS
AND
PROJECT COST DETAILS**

PROJECT COST ESTIMATE

Wind Turbine Installation

Orleans, MA

Nameplate Rating, kW 600

<u>Description</u>	<u>Amount</u>
Turbine, Blades and Tower - Delivered (Elecon T-600)	\$ 1,100,000
Design and Permitting	\$ 125,000
Mobilization	\$ 40,000
Erosion Control Measures	\$ 5,000
Access Road to Turbine Site	\$ 75,000
Access Improvements at Water Treatment Plant	\$ 3,500
Improvements at Entrance	\$ 3,500
New Gate at Water Treatment Plant	\$ 2,500
Construction Staging Area	\$ 85,000
Chain Link Fencing	\$ 11,000
Electrical Duct Bank Trenching	\$ 30,000
Relocate Water main	\$ 20,000
Turbine Foundation Excavation & Backfill	\$ 60,000
Turbine Foundation (Concrete, Steel)	\$ 160,000
Electrical Interconnection	\$ 250,000
Electric Utility Equipment Buyout	\$ 125,000
Erect Wind Turbine (Crane, Rigging)	\$ 150,000
Commissioning, Startup and Training	\$ 75,000
Total	\$ 2,320,500
Cost per kW	\$ 3,868

ECONOMIC SUMMARY
Wind Turbine Installation
Orleans, MA

Turbine Size, kW	600
Project Cost	\$ 2,320,500
Cost per kW	\$3,868
Capacity Factor, %	28.3%
Annual Energy, kWh	1,338,703
NPV (Discount Rate of 4%)	\$859,468
Net Cash Flow (Over 20 Years)	\$1,439,320
BCR	1.31

Wind Turbine Pro Forma
Orleans, MA

Existing Power Use and Cost Basis

Wind Turbine	Turbowinds T600-48			Existing Power Use and Cost Basis
			Water Department Use:	755,229 kWh
Turbine size (kW)	600		Tower Height	65 meters
Capacity Factor	28.30%		Average Wind Speed	6.2 m/s at 65 meter
Annual Energy Production (kWh)	1,338,703		Project Term	20 years
Annual Energy Use (kWh)	755,229		Financing	Debt
Retail Offset Rate (kWh)	\$ 0.1520		Energy Inflation	2.0%
Excess Power Rate (kWh)	\$ 0.1520		General Inflation	2.0%
REC value Y1-Y10	\$ 0.04		Discount Rate	4.0%
REC value Y11-Y20	\$ 0.03		Loan Rate	4.0%
Coincidence	100%		Project Cost	\$ 2,320,500
			Simple Payback	NA years
			IRR	NA
Net Present Value	\$859,468			
Net Cash Flow	\$1,439,320			
Present Value Benefit	\$3,620,452			
Present Value Cost	\$2,760,984			
Benefit Cost Ratio	1.31			

	Avg. Rate	
Customer Service/Demand	0.01636	\$ 12,353
Distribution	0.01354	\$ 10,226
Transition	0.02082	\$ 15,724
Transmission	0.00761	\$ 5,747
Energy Use	0.10999	\$ 83,068
Renewable Energy	0.00050	\$ 378
Energy Conservation	0.00250	\$ 1,888
Total Electric Cost	0.17132	\$ 129,383
Value of Retail Offset	0.15196	
Value of Excess Power	0.15196	

Year	Retail Offset	Excess Power Revenue	RECs Revenue	Total Annual Revenue	Cummulative Revenue	Annual O&M	Annual Insurance	Annual Principal	Annual Interest	Total Annual Cost	Net Annual Cash Flow	Cummulative Cash Flow
1	\$0	\$0	\$0	\$0	\$0	\$24,000	\$5,250	\$77,926	\$92,820	\$199,996	(\$199,996)	(\$199,996)
2	\$114,765	\$88,665	\$53,548	\$256,977	\$256,977	\$24,480	\$5,355	\$81,044	\$89,703	\$200,581	\$56,396	(\$143,600)
3	\$117,060	\$90,438	\$53,548	\$261,046	\$518,024	\$24,970	\$5,462	\$84,285	\$86,461	\$201,178	\$59,868	(\$83,733)
4	\$119,401	\$92,247	\$53,548	\$265,196	\$783,220	\$25,469	\$5,571	\$87,657	\$83,090	\$201,787	\$63,409	(\$20,323)
5	\$121,789	\$94,092	\$53,548	\$269,429	\$1,052,649	\$25,978	\$5,683	\$91,163	\$79,584	\$202,408	\$67,021	\$46,698
6	\$124,225	\$95,974	\$53,548	\$273,747	\$1,326,395	\$26,498	\$5,796	\$94,809	\$75,937	\$203,041	\$70,706	\$117,404
7	\$126,709	\$97,893	\$53,548	\$278,151	\$1,604,546	\$27,028	\$5,912	\$98,602	\$72,145	\$203,687	\$74,464	\$191,868
8	\$129,244	\$99,851	\$53,548	\$282,643	\$1,887,188	\$27,568	\$6,031	\$102,546	\$68,201	\$204,346	\$78,297	\$270,165
9	\$131,828	\$101,848	\$53,548	\$287,224	\$2,174,413	\$28,120	\$6,151	\$106,648	\$64,099	\$205,017	\$82,207	\$352,372
10	\$134,465	\$103,885	\$53,548	\$291,898	\$2,466,311	\$28,682	\$6,274	\$110,914	\$59,833	\$205,703	\$86,195	\$438,567
11	\$137,154	\$105,963	\$40,161	\$283,278	\$2,749,589	\$29,256	\$6,400	\$115,350	\$55,396	\$206,402	\$76,876	\$515,443
12	\$139,897	\$108,082	\$40,161	\$288,140	\$3,037,729	\$29,841	\$6,528	\$119,964	\$50,782	\$207,115	\$81,025	\$596,468
13	\$142,695	\$110,243	\$40,161	\$293,100	\$3,330,829	\$30,438	\$6,658	\$124,763	\$45,984	\$207,843	\$85,257	\$681,725
14	\$145,549	\$112,448	\$40,161	\$298,159	\$3,628,988	\$31,047	\$6,791	\$129,753	\$40,993	\$208,584	\$89,574	\$771,300
15	\$148,460	\$114,697	\$40,161	\$303,319	\$3,932,306	\$31,667	\$6,927	\$134,943	\$35,803	\$209,341	\$93,977	\$865,277
16	\$151,429	\$116,991	\$40,161	\$308,582	\$4,240,888	\$32,301	\$7,066	\$140,341	\$30,405	\$210,113	\$98,469	\$963,746
17	\$154,458	\$119,331	\$40,161	\$313,950	\$4,554,838	\$32,947	\$7,207	\$145,955	\$24,792	\$210,900	\$103,050	\$1,066,796
18	\$157,547	\$121,718	\$40,161	\$319,426	\$4,874,264	\$33,606	\$7,351	\$151,793	\$18,953	\$211,704	\$107,722	\$1,174,518
19	\$160,698	\$124,152	\$40,161	\$325,011	\$5,199,276	\$34,278	\$7,498	\$157,865	\$12,882	\$212,523	\$112,489	\$1,287,007
20	\$163,912	\$126,635	\$40,161	\$330,708	\$5,529,984	\$34,963	\$7,648	\$164,179	\$6,567	\$213,358	\$117,350	\$1,404,357

Wind Turbine Pro Forma
Orleans, MA

	B	C	D	E	F	G	H	I	J	K	L	M	N
1										Existing Power Use and Cost Basis			
2	Wind Turbine	Turbowinds T600-48									Water Department Use: 755229		kWh
3	Turbine size (kW)		600		Tower Height		65	meters					
4	Capacity Factor		0.283		Average Wind Speed		5.75	m/s at 50 meter					
5	Annual Energy Production (kWh)		=(D\$3*24*365*D\$4)*0.9		Project Term		20	years		Customer Service/Demand	0.016356	=M5*\$M\$2	
6	Annual Energy Use (kWh)		=M2		Financing			Debt		Distribution	0.01354	=M6*\$M\$2	
7	Retail Offset Rate (kWh)		=M15		Energy Inflation		0.02			Transition	0.02082	=M7*\$M\$2	
8	Excess Power Rate (kWh)		=M16		General Inflation		0.02			Transmission	0.00761	=M8*\$M\$2	
9	REC value	Y1-Y10	0.04		Discount Rate		0.04			Energy Use	0.10999	=M9*\$M\$2	
10	REC value	Y11-Y20	0.03		Loan Rate		0.04			Renewable Energy	0.0005	=M10*\$M\$2	
11	Coincidence		1		Project Cost		=Project Cost Estimate			Energy Conservation	0.0025	=M11*\$M\$2	
12					Simple Payback		NA	years					
13	Net Present Value		=NPV(H9,D39:W39)		IRR		NA			Total Electric Cost	=SUM(M5:M12)	=M13*\$M\$2	
14	Net Cash Flow		=SUM(D39:W39)										
15	Present Value Benefit		=NPV(H9,D27:W27)							Value of Retail Offset	=SUM(M6:M9)		
16	Present Value Cost		=NPV(H9,D36:W36)							Value of Excess Power	=SUM(M7:M9)		
17	Benefit Cost Ratio		=C15/C16										
18													
41		Retail Offset	Excess Power Revenue	RECs Revenue	Total Annual Revenue	Cummulative Revenue	Annual O&M	Annual Insurance	Annual Principal	Annual Interest	Total Annual Cost	Net Annual Cash Flow	Cummulative Cash Flow
42	Year												
43													
44	1	=D23	0	0	=SUM(C44:E44)	=SUM(F44)	24000	=8.75*D\$3	=PPMT(\$H\$10,B44,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B44,\$H\$5,\$H\$11)*-1	=SUM(H44:K44)	=F44-L44	=M44
45	2	=D6*D7	=(D5-D6)*D8	=D\$5*D\$9	=SUM(C45:E45)	=SUM(F\$44:\$F45)	=H44*(1+\$H\$8)	=I44*(1+\$H\$8)	=PPMT(\$H\$10,B45,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B45,\$H\$5,\$H\$11)*-1	=SUM(H45:K45)	=F45-L45	=SUM(\$M\$44:M45)
46	3	=C45*(1+\$H\$7)	=D45*(1+\$H\$7)	=D\$5*D\$9	=SUM(C46:E46)	=SUM(F\$44:\$F46)	=H45*(1+\$H\$8)	=I45*(1+\$H\$8)	=PPMT(\$H\$10,B46,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B46,\$H\$5,\$H\$11)*-1	=SUM(H46:K46)	=F46-L46	=SUM(\$M\$44:M46)
47	4	=C46*(1+\$H\$7)	=D46*(1+\$H\$7)	=D\$5*D\$9	=SUM(C47:E47)	=SUM(F\$44:\$F47)	=H46*(1+\$H\$8)	=I46*(1+\$H\$8)	=PPMT(\$H\$10,B47,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B47,\$H\$5,\$H\$11)*-1	=SUM(H47:K47)	=F47-L47	=SUM(\$M\$44:M47)
48	5	=C47*(1+\$H\$7)	=D47*(1+\$H\$7)	=D\$5*D\$9	=SUM(C48:E48)	=SUM(F\$44:\$F48)	=H47*(1+\$H\$8)	=I47*(1+\$H\$8)	=PPMT(\$H\$10,B48,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B48,\$H\$5,\$H\$11)*-1	=SUM(H48:K48)	=F48-L48	=SUM(\$M\$44:M48)
49	6	=C48*(1+\$H\$7)	=D48*(1+\$H\$7)	=D\$5*D\$9	=SUM(C49:E49)	=SUM(F\$44:\$F49)	=H48*(1+\$H\$8)	=I48*(1+\$H\$8)	=PPMT(\$H\$10,B49,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B49,\$H\$5,\$H\$11)*-1	=SUM(H49:K49)	=F49-L49	=SUM(\$M\$44:M49)
50	7	=C49*(1+\$H\$7)	=D49*(1+\$H\$7)	=D\$5*D\$9	=SUM(C50:E50)	=SUM(F\$44:\$F50)	=H49*(1+\$H\$8)	=I49*(1+\$H\$8)	=PPMT(\$H\$10,B50,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B50,\$H\$5,\$H\$11)*-1	=SUM(H50:K50)	=F50-L50	=SUM(\$M\$44:M50)
51	8	=C50*(1+\$H\$7)	=D50*(1+\$H\$7)	=D\$5*D\$9	=SUM(C51:E51)	=SUM(F\$44:\$F51)	=H50*(1+\$H\$8)	=I50*(1+\$H\$8)	=PPMT(\$H\$10,B51,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B51,\$H\$5,\$H\$11)*-1	=SUM(H51:K51)	=F51-L51	=SUM(\$M\$44:M51)
52	9	=C51*(1+\$H\$7)	=D51*(1+\$H\$7)	=D\$5*D\$9	=SUM(C52:E52)	=SUM(F\$44:\$F52)	=H51*(1+\$H\$8)	=I51*(1+\$H\$8)	=PPMT(\$H\$10,B52,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B52,\$H\$5,\$H\$11)*-1	=SUM(H52:K52)	=F52-L52	=SUM(\$M\$44:M52)
53	10	=C52*(1+\$H\$7)	=D52*(1+\$H\$7)	=D\$5*D\$9	=SUM(C53:E53)	=SUM(F\$44:\$F53)	=H52*(1+\$H\$8)	=I52*(1+\$H\$8)	=PPMT(\$H\$10,B53,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B53,\$H\$5,\$H\$11)*-1	=SUM(H53:K53)	=F53-L53	=SUM(\$M\$44:M53)
54	11	=C53*(1+\$H\$7)	=D53*(1+\$H\$7)	=D\$5*D\$10	=SUM(C54:E54)	=SUM(F\$44:\$F54)	=H53*(1+\$H\$8)	=I53*(1+\$H\$8)	=PPMT(\$H\$10,B54,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B54,\$H\$5,\$H\$11)*-1	=SUM(H54:K54)	=F54-L54	=SUM(\$M\$44:M54)
55	12	=C54*(1+\$H\$7)	=D54*(1+\$H\$7)	=D\$5*D\$10	=SUM(C55:E55)	=SUM(F\$44:\$F55)	=H54*(1+\$H\$8)	=I54*(1+\$H\$8)	=PPMT(\$H\$10,B55,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B55,\$H\$5,\$H\$11)*-1	=SUM(H55:K55)	=F55-L55	=SUM(\$M\$44:M55)
56	13	=C55*(1+\$H\$7)	=D55*(1+\$H\$7)	=D\$5*D\$10	=SUM(C56:E56)	=SUM(F\$44:\$F56)	=H55*(1+\$H\$8)	=I55*(1+\$H\$8)	=PPMT(\$H\$10,B56,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B56,\$H\$5,\$H\$11)*-1	=SUM(H56:K56)	=F56-L56	=SUM(\$M\$44:M56)
57	14	=C56*(1+\$H\$7)	=D56*(1+\$H\$7)	=D\$5*D\$10	=SUM(C57:E57)	=SUM(F\$44:\$F57)	=H56*(1+\$H\$8)	=I56*(1+\$H\$8)	=PPMT(\$H\$10,B57,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B57,\$H\$5,\$H\$11)*-1	=SUM(H57:K57)	=F57-L57	=SUM(\$M\$44:M57)
58	15	=C57*(1+\$H\$7)	=D57*(1+\$H\$7)	=D\$5*D\$10	=SUM(C58:E58)	=SUM(F\$44:\$F58)	=H57*(1+\$H\$8)	=I57*(1+\$H\$8)	=PPMT(\$H\$10,B58,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B58,\$H\$5,\$H\$11)*-1	=SUM(H58:K58)	=F58-L58	=SUM(\$M\$44:M58)
59	16	=C58*(1+\$H\$7)	=D58*(1+\$H\$7)	=D\$5*D\$10	=SUM(C59:E59)	=SUM(F\$44:\$F59)	=H58*(1+\$H\$8)	=I58*(1+\$H\$8)	=PPMT(\$H\$10,B59,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B59,\$H\$5,\$H\$11)*-1	=SUM(H59:K59)	=F59-L59	=SUM(\$M\$44:M59)
60	17	=C59*(1+\$H\$7)	=D59*(1+\$H\$7)	=D\$5*D\$10	=SUM(C60:E60)	=SUM(F\$44:\$F60)	=H59*(1+\$H\$8)	=I59*(1+\$H\$8)	=PPMT(\$H\$10,B60,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B60,\$H\$5,\$H\$11)*-1	=SUM(H60:K60)	=F60-L60	=SUM(\$M\$44:M60)
61	18	=C60*(1+\$H\$7)	=D60*(1+\$H\$7)	=D\$5*D\$10	=SUM(C61:E61)	=SUM(F\$44:\$F61)	=H60*(1+\$H\$8)	=I60*(1+\$H\$8)	=PPMT(\$H\$10,B61,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B61,\$H\$5,\$H\$11)*-1	=SUM(H61:K61)	=F61-L61	=SUM(\$M\$44:M61)
62	19	=C61*(1+\$H\$7)	=D61*(1+\$H\$7)	=D\$5*D\$10	=SUM(C62:E62)	=SUM(F\$44:\$F62)	=H61*(1+\$H\$8)	=I61*(1+\$H\$8)	=PPMT(\$H\$10,B62,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B62,\$H\$5,\$H\$11)*-1	=SUM(H62:K62)	=F62-L62	=SUM(\$M\$44:M62)
63	20	=C62*(1+\$H\$7)	=D62*(1+\$H\$7)	=D\$5*D\$10	=SUM(C63:E63)	=SUM(F\$44:\$F63)	=H62*(1+\$H\$8)	=I62*(1+\$H\$8)	=PPMT(\$H\$10,B63,\$H\$5,\$H\$11)*-1	=IPMT(\$H\$10,B63,\$H\$5,\$H\$11)*-1	=SUM(H63:K63)	=F63-L63	=SUM(\$M\$44:M63)

Cell	Description
D3	Turbine kW rating
D4	Capacity factor calculated from average wind speed at hub height, power rating of turbine, and diameter of rotor
D5	Product of turbine size and capacity factor over a period of 1 year. Result is reduced by 10% to account for
D6	Annual energy use as provided by the Orleans Water Department
D7	Sum of the distribution, transmission, transition, and energy use charges which are offset by on site electricity generation
D8	Sum of the distribution, transmission, transition, and energy use charges which can be credited under net metering (<10 MW for municipal entity)
D9	Renewable Energy Credits value for years 1 through 10
D10	Renewable Energy Credits value for years 11 through 20. (Amount is expected to decrease over time)
D11	A measure of the percentage of time power is being created and used on the site at the same time, in that the value of electricity is instantaneous
C13	The present value of the initial investment, plus all future cash flows
C14	Value of the net cash flow which equals the total benefits minus the total costs
C15	Equals the net present value of the benefits with an applied discount rate
C16	Equals the net present value of the costs with an applied discount rate
C17	Equals the present value of benefit divided by the present value of cost, any number greater than 1 is considered favorable
H3	Height of the wind turbine tower
H4	The average wind speed at 50 meters, taken from the 2005 Wind Data Report
H5	Length of project (years)
H6	Type of financing
H7	Energy inflation rate, this was estimated based on past energy rate inflation numbers
H8	Estimated general inflation rate
H9	Estimated discount rate
H10	Anticipated loan rate provided by the Town of Orleans
H11	Total project capital cost includes turbine equipment, electrical interconnection, foundation, access road etc.
H12	A payback estimate typically used to judge the economic merits of a project. However this is not a figure of merit in a debt financed scenario.
H13	The annualized effective compounded return rate which can be earned on the invested capital, i.e., the yield on the investment, This is not a figure of merit in a debt financed scenario
M2	Total annual electricity use as provided by the Orleans Water Department
M5	Average rate charged per kW for customer service/demand
M6	Average rate charged per kW for distribution
M7	Average rate charged per kW for transition
M8	Average rate charged per kW for transmission
M9	Average rate charged per kW for energy use
M10	Average rate charged per kW for renewable energy
M11	Average rate charged per kW for energy conservation
M13	Total electric cost is the sum of all the above rates charged per kW
M15	Sum of the distribution, transition, transmission, and energy use charges
M16	Sum of the transition, transmission, and energy use charges
N5	Total customer service/demand charge, equals the product of the average rate times the total electricity use
N6	Total distribution charge, equals the product of the average rate times the total electricity use
N7	Total Transition charge, equals the product of the average rate times the total electricity use
N8	Total transmission charge, equals the product of the average rate times the total electricity use
N9	Total energy use charge, equals the product of the average rate times the total electricity use
N10	Total renewable energy charge, equals the product of the average rate times the total electricity use
N11	Total energy conservation charge, equals the product of the average rate times the total electricity use
N13	Total annual electric cost, equals the sum of all the above total charges (N5 through N11)