Technical Description

GE's 1.6-100 wind turbine is a three-blade, upwind, horizontal axis wind turbine with a rotor diameter of 100 meters. The turbine rotor and nacelle are mounted on top of a tubular steel tower providing hub heights of 80 meters and 96 meters. The machine uses active yaw control to keep the rotor pointed into the wind. The turbine is designed to operate at a variable speed and uses a doubly fed asynchronous generator with a partial power converter system.

Specifications:

1.6-100 Wind Turbine:

- Designed to IEC 61400-1
- Standard and cold weather extreme options
- Standard tower corrosion protection; C2 internal and C3 external with optional C4 internal and C5 external available
- Rotational direction: Clockwise viewed from an upwind location
- Speed regulation: Electric drive pitch control with battery backup
- Aerodynamic brake: Full feathering of blade pitch

Features and Benefits

- Higher AEP than its 1.6 predecessors
- Highest capacity factor in its class
- Designed to meet or exceed the 1.5 MW platform's historic high availability
- Grid friendly options are available
  — Enhanced Reactive Power, Voltage Ride Thru, Power Factor Control
- Wind Farm Control System; WindSCADA*
- GE proprietary 48.7 meter blade
- Available in both 50 Hz and 60 Hz versions for global suitability

Construction

Towers: tubular steel sections provide hub heights of 80 meters or 96 meters

Blades: GE 48.7 meter blades

Drivetrain components: GE's 1.6-100 uses proven design gearboxes, mainshaft and generators with appropriate improvements to enable the larger rotor diameter on the 1.6 MW machine

Enhanced Controls Technology

The 1.6-100 wind turbine employs two enhanced control features:

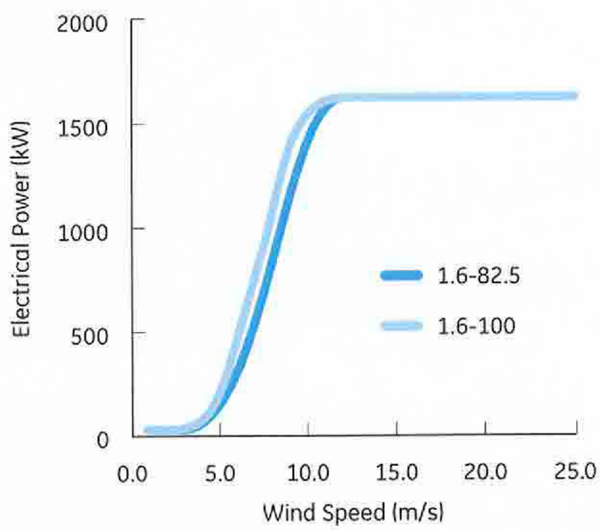
- GE's patented Advanced Loads Control reduces loads on turbine components by measuring stresses and individually adjusting blade pitch
- Controls developed by GE Global Research minimize loads including at near rated wind speeds to improve Annual Energy Production (AEP)

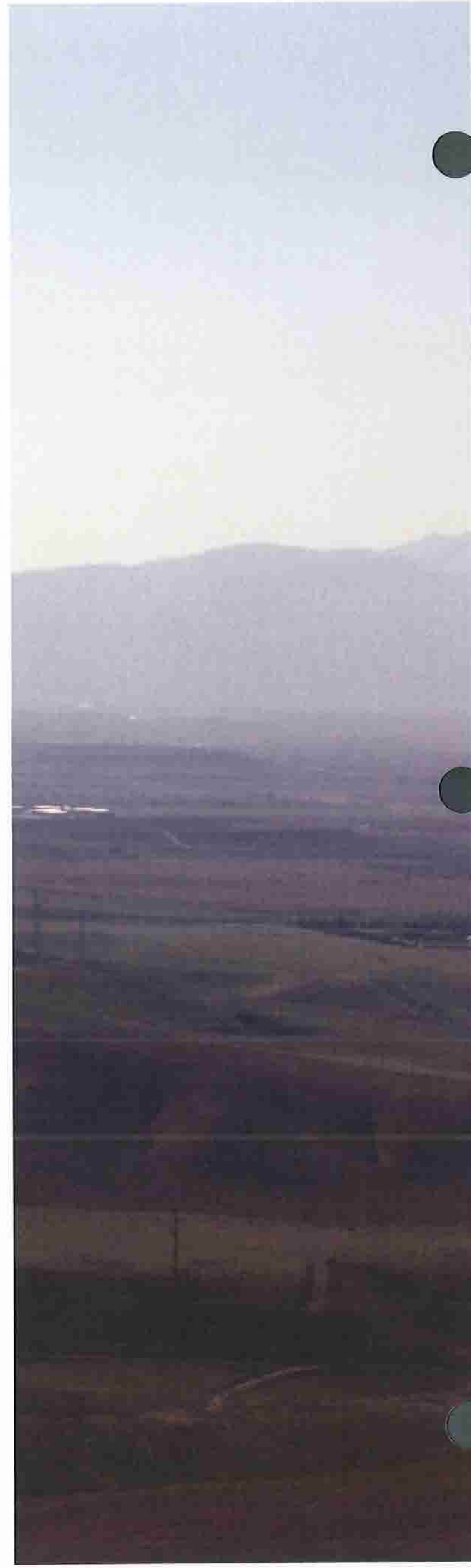
Condition Monitoring System (option)

GE's Condition Monitoring System (CMS) and SCADA Anomaly Detection Services, a complementary suite of advanced condition monitoring solutions, proactively detect impending drive train and whole-turbine issues enabling increased availability and decreased maintenance expenses. Built upon half a century of power generation drivetrain and data anomaly monitoring experience, this service solution is available as an option on new GE Units and as an upgrade.

1.6-100 Specifications

Power Curve Improvement

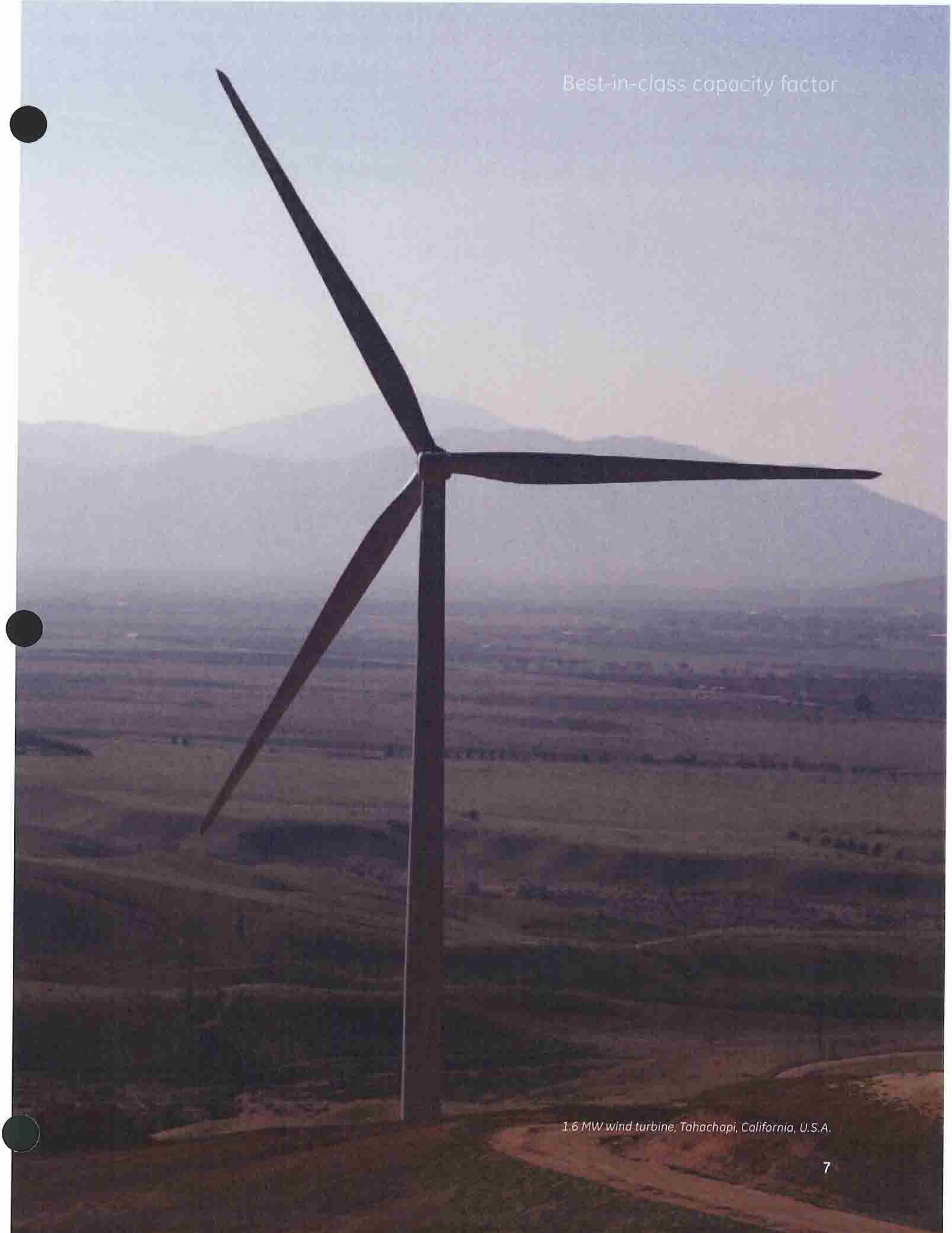




Highest capacity factor in its class

- **Value.** Best in Class Capacity Factor, 53% @ 7.5 m/s
- **Reliability.** GE fleet at 98%+ availability
- **Experience.** 17,000+ wind turbines installed globally
- **Finance-ability.** Evolutionary design using "proven technology" from GE 1.5 MW and 2.5 MW platforms

Best-in-class capacity factor



1.6 MW wind turbine, Tahachapi, California, U.S.A.

Powering the world...responsibly.

For more information please visit www.ge-energy.com/wind.

GEA18025B (11/2011)

GE Power & Water
Renewable Energy

2.5MW
Wind Turbine Series

imagination at work

a product of
ecomagination

2002
GE enters wind industry

2004
First 2.5s turbine installed

2006
First 2.5xl technology demo unit installed

EVOLUTION OF

The Evolution of Power

Minute by minute, the world is growing. Economic development and increased attention to sustainability means the world needs a steady supply of cleaner, reliable power. GE continuously stays a step ahead, driving cutting-edge wind turbine technology.

Building on a strong power generation heritage spanning more than a century, the 2.5 MW wind turbine is evolutionary technology based on a unique design strategy. Higher efficiency, increased reliability, improved maintainability and seamless grid integration make it a powerhouse of precision. In fact, GE's 2.5 MW wind turbine leads the industry by producing the highest annual energy yield in its class, creating more value for our customers.

2008
First 2.5xl unit installed

2009
Certification for 50 Hz

2010
Certification for 60 Hz and launched in North America.

2.5 series: 200th unit installed

2011
Technology improvements and new variants: 103 meter rotor for IEC Class III

THE 2.5 MW SERIES

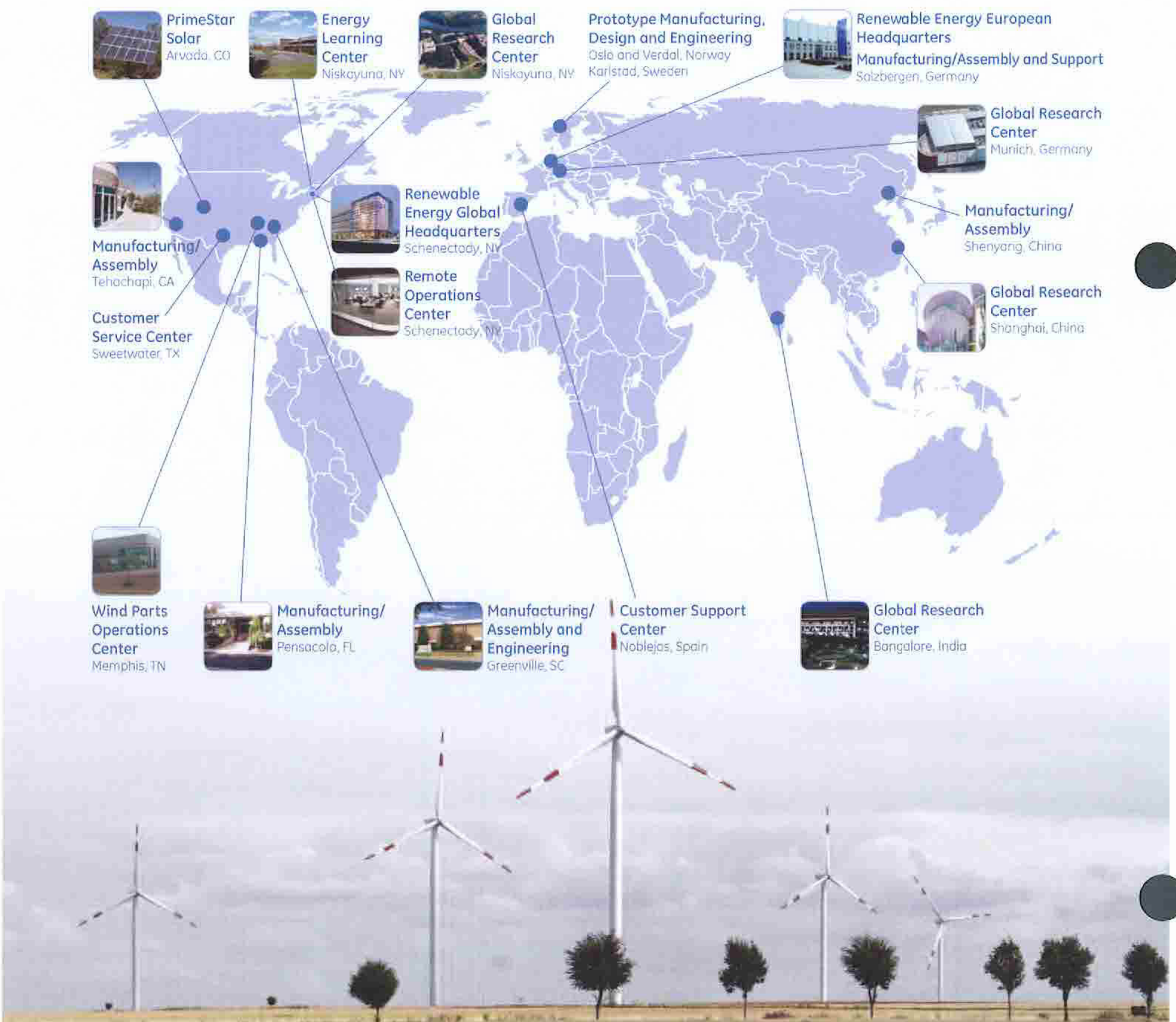
Drawing on GE's experience of more than 13,500 wind turbines in operation worldwide, the 2.5 MW wind turbine is designed to meet the growing demands of the wind industry. Product evolution is one of the things GE does best and our product strategy is focused on results that contribute to our customers' success. Our reputation for excellence can be seen in everything we do. The 2.5-100 is a product of GE's evolution in the wind industry and is a leader in the multi-megawatt wind sector. The 2.5 MW wind turbine is now available in 50 and 60 Hz, and GE continues to invest in advancing the technology for higher capacity factors and greater annual energy production for our customers.

2.5 MW Series	2004	2009
Rotor Diameter (m)	88	100/103 +15 m
Capacity Factor (%) 7.5 m/s	34.7	41.9 +7 pts
Capacity Factor (%) 8.5 m/s	39.5	48.7 +9 pts

Global Footprint

GE Energy is one of the world's leading suppliers of power generation and energy delivery technologies—providing comprehensive solutions for coal, oil, natural gas and nuclear energy; renewable resources such as wind, solar and biogas, and other alternative fuels. As a part of GE Energy—which includes the Power & Water, Oil & Gas, and Energy Services businesses—we have the worldwide resources and experience to help customers meet their needs for cleaner, more reliable and efficient energy.

GE has 11 global locations specifically devoted to wind technology. Our facilities are registered to ISO 9001:2000 and our Quality Management System, which incorporates our rigorous Six Sigma methodologies, provides our customers with quality assurance backed by the strength of GE. We believe wind power will be an integral part of the world energy mix throughout the 21st century and we are committed to helping our customers design and implement energy solutions for their unique energy needs.



The New Industry Standard

Suitable for a Wide Variety of Sites

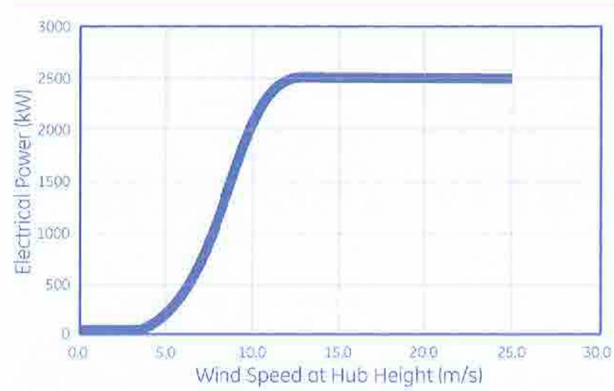
Designed for IEC Class II and Class III, the 2.5 MW wind turbine can be deployed on over 85% of the sites being developed today. The 103 meter rotor diameter optimizes the 2.5 MW turbine for IEC Class III applications and provides an increase in Annual Energy Production for IEC Class III.

The 2.5 MW wind turbine also excels on sites that are constrained by environmental regulations. GE's innovative and patented rotor blade technology provides the 2.5 MW wind turbine with very competitive acoustic performance. In fact, with the optional sound-reduced operation modes, the 2.5 MW wind turbine can be deployed even at sites with the most stringent sound constraints, while simultaneously maintaining a high energy yield.

The 2.5 MW wind turbine can be equipped with various towers resulting in hub heights of 100 meter, 85 meter and 75 meter (50 Hz only), meeting potential tip height constraints and maximizing energy yield.

With more than 210 units installed and over two million operating hours, customers in eight countries around the world are already benefiting from our advanced 2.5 MW technology. Building on GE's industry leadership with over 6,000 MW in cold weather operating conditions, the 2.5 MW wind turbine series can be equipped with a cold weather extreme option.

2.5-103 Power Curve

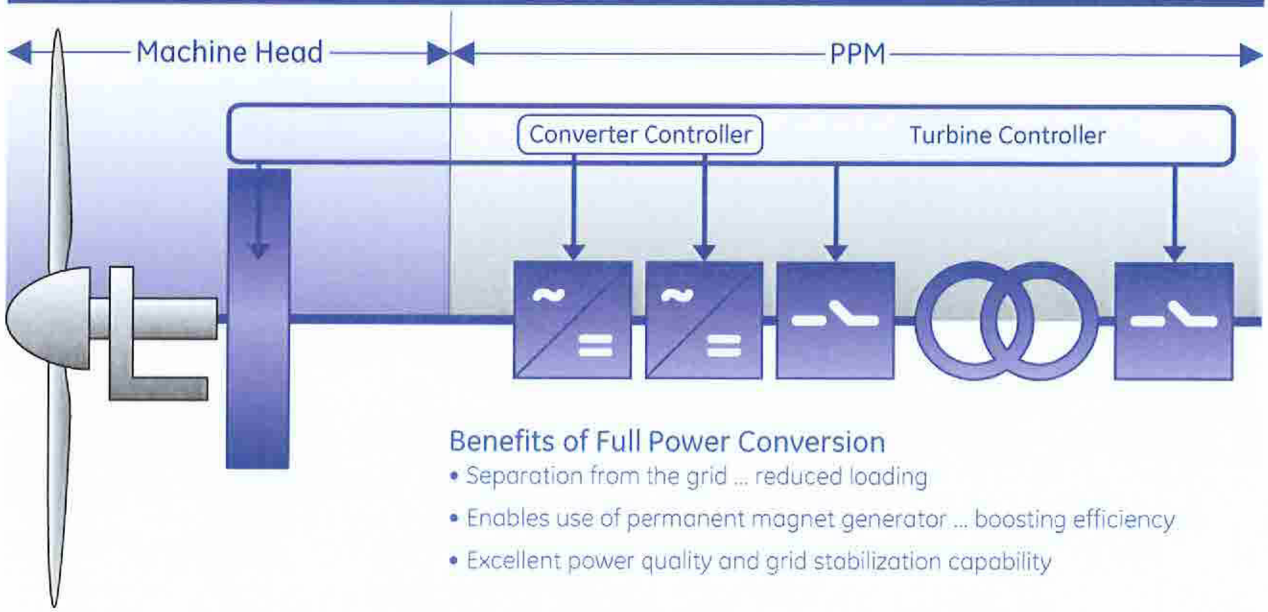


2.5 MW Series	TC3 2.5-103	TC2 2.5-100
Rotor Diameter (m)	103	100
Hub Heights (m)	85/100	75/85
Frequency (Hz)	50/60	50/60
Vavg (m/s)	7.5	8.5
Vref (m/s)	37.5	42.5
Ve50 (m/s)	52.5	59.5
Cut-In (m/s)	3.0	3.0
Cut-Out (m/s)	25	25
IEC Wind Class	IEC TC IIIA	IEC TC IIB

Higher Efficiency

The 2.5 MW wind turbine is equipped with a permanent magnet generator, ensuring high efficiency even at low wind speeds. Compared to a conventional doubly-fed system, the efficiency in the partial load range is remarkably higher, resulting in increased revenues for wind power producers. Employing magnets instead of copper coils in the generator rotor reduces electrical losses in the generator and current flow through the rotating parts of the generator.

Full power conversion system design



Benefits of Full Power Conversion

- Separation from the grid ... reduced loading
- Enables use of permanent magnet generator ... boosting efficiency
- Excellent power quality and grid stabilization capability

Optimal Maintainability

The interior of the nacelle is designed to optimize maintainability and ergonomics for the maintenance crew. It provides an environment that facilitates safe and efficient maintenance and inspection work.

Automatic lubrication systems for the grease-lubricated bearings accommodate a 12-month maintenance interval under normal operating conditions. Not only does this minimize turbine downtime and provide the opportunity to avoid maintenance in the windiest seasons, it also provides the operator of remote sites with the opportunity to plan for maintenance in the season when the turbine is most accessible.

The optional elevator and climb-assist facilitate ergonomically optimal operations and maintenance of the turbine, enabling technicians to visit more wind turbines per day. This improves availability and reduces the size of the labor force required to operate a wind plant.

Reliability by Design

With technology centers of excellence in the United States, Europe, India and China, our teams of engineers and scientists use Six Sigma methodology, coupled with the latest computational modeling and power electronic analysis tools to manufacture wind turbines with the reliability, efficiency and maintainability necessary to meet the challenges our customers face in today's energy environment.

GE's commitment to customer value and technology evolution is demonstrated by our ongoing investment in product development. Since entering the wind business in 2002, GE has invested over $750 million in driving reliability and efficient wind technology.

Gearbox

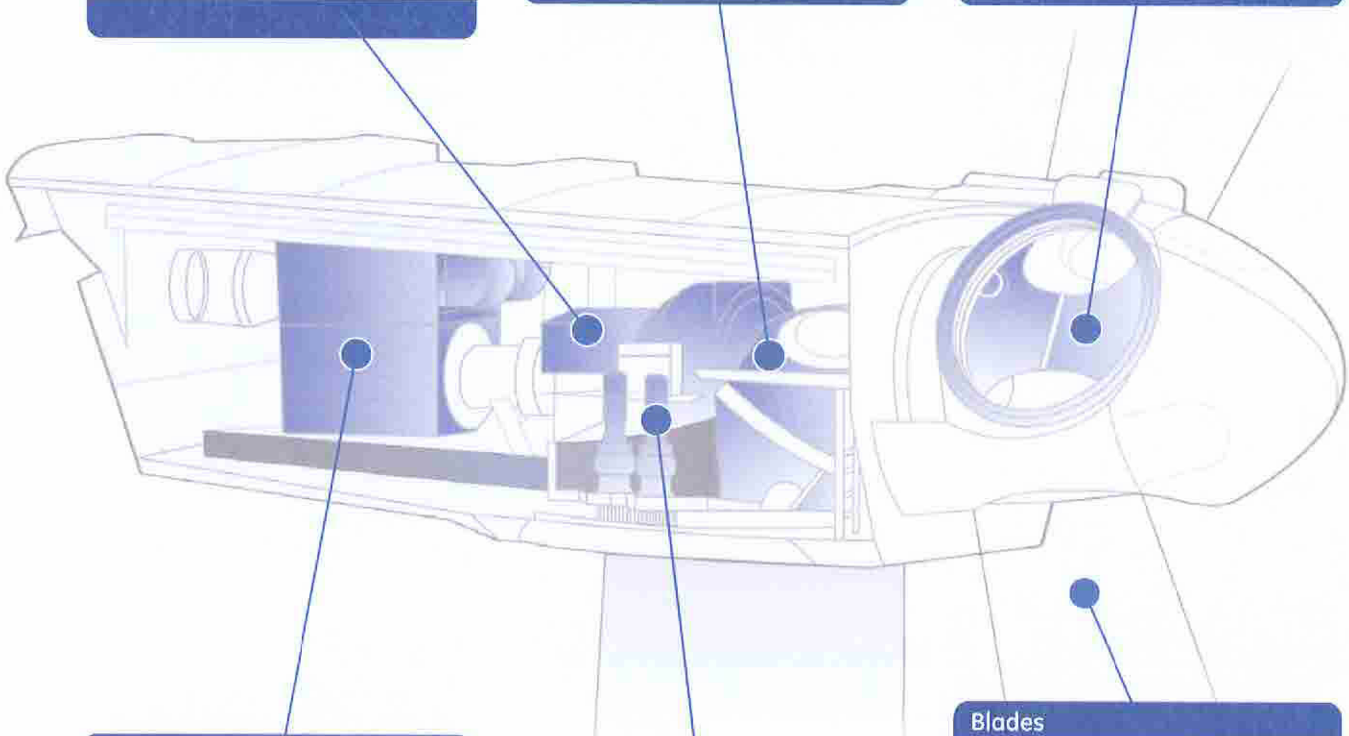
- Designed for reliability
- HALT Test to validate design assumptions
- Isolated from unpredictable grid loads

Mainframe

- Robust frame with double bearing to reduce loads on the gearbox
- Integrated rotor lock

Hub

- Integrally cast web for high stiffness and low deformation
- Integrated GE pitch system with patented load mitigating controls



Generator

- Permanent magnet generator for higher efficiency at low wind speed
- Brushless excitation for simplified maintenance

Maintenance

- Automatic lubrication system
- 12 month maintenance interval

Blades

- 100 meter/103 meter rotor resulting in high capacity factor
- Low sound blade design
- HALT test to validate design assumptions

Advancing Technology

A double-bearing main shaft minimizes gearbox thrust and bending loads by transmitting loads through the bedplate to the tower. The gearbox is only subjected to torque loading—which is controlled by the wind turbine through the converter—resulting in lower and easily predicted loads compared to conventional drive-train designs.

The double-bearing main shaft also improves overall drive-train reliability and improves gearbox life. Additionally, a full power converter separates the generator and gearbox from the grid, allowing them to remain essentially unaffected by transient grid loads. This unique system design results in robust and reliable power conversion.

The main bearings remain well lubricated even under severe conditions due to grease lubrication, which—unlike oil—requires no heating at low ambient temperatures in order to maintain its lubricating properties.

The hub design contains an integrally cast web in the blade root opening, providing high stiffness to the hub assembly. Higher stiffness results in less deflection of the hub, and therefore reduced loads on the components mounted to the hub. Consequently, stresses on the pitch bearing and pitch drive are reduced significantly when compared to conventional designs.

Designing for Reliability

The 2.5 MW wind turbine is designed according to our Design for Reliability (DFR) methodology. DFR starts with the definition of reliability goals and the environmental conditions in which the wind turbine components must operate. The reliability targets are then broken down to component level models that are developed to predict reliability.

A key step in the DFR process is validating design assumptions on both component levels and system levels. GE conducts extensive product validation, including climate chamber testing, compliance testing and Highly Accelerated Life Testing (HALT). In the test, components are subjected to loads of the entire design life in a very short time frame.

The 2.5 MW design was validated with more than four years and 500,000 hours of operating experience. After extensive field validation, one turbine was decommissioned so that our engineers could teardown and inspect all of the major components and apply findings to technology advancements.

The last step of the DFR methodology is production auditing. While validation is focused on ensuring that the design is free of flaws, the production audit is focused on ensuring that each unit is delivered with consistent quality by understanding the impact of manufacturing variability.

DFR COMMON STEPS	TESTING & EVALUATION
1 GOAL SETTING	SHOP TESTING
2 SYSTEM MODELING	FIELD TESTING
3 DESIGN AND PREDICTION	ACCELERATED TESTING
4 TESTING AND EVALUATION	COMPLIANCE TESTING
5 PRODUCT AUDIT	

Combined Strength

GE's 2.5 MW wind turbine utilizes expertise from many areas of GE as well as from our four global research centers. The result of this combined strength is a reliable and efficient product line that is based on proven technology.

GE Energy

GE Energy Financial Services

GE Oil & Gas

GE Transportation

GE Aviation

GE Global Research Centers

$1 Billion and Growing Renewable Energy Technology Investment

Blade Innovation
- Aero elastic sweep – bend twist
- Advanced materials-carbon

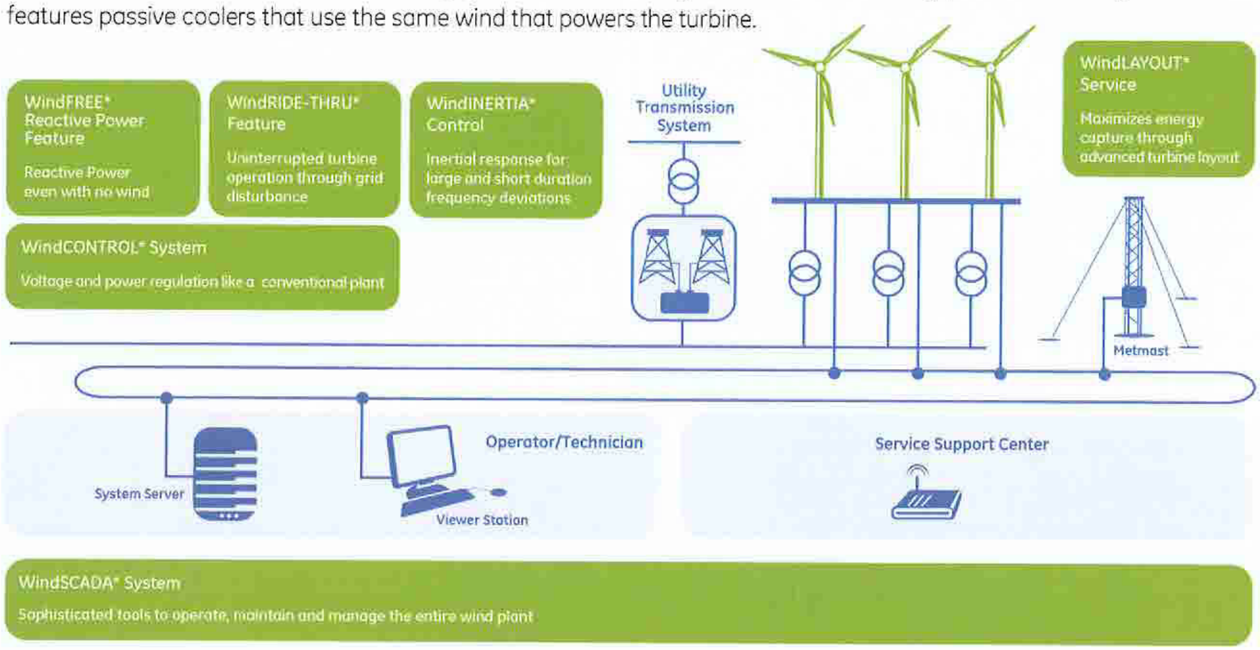
Power Conversion
- Increased power density and reliability with higher voltage
- Control for integration with weak grids

Drive Train
- Direct drive ... 50% greater output at the same weight
- Compact drive ... 25% less weight

Solar
- Thin film technology leadership through PrimeStar
- Differentiated utility-scale Brilliance* inverter

Optimized Wind Power Plant Performance

The electrical system design of the 2.5 MW wind turbine consists of a permanent magnet generator and full power conversion. In the lower tower section, the power module efficiently converts the energy from the permanent magnet generator into power that provides frequency and voltage control required by transmission system operators. The integration of the converter and transformer down tower, rather than the nacelle, ensures that vibration loads do not affect the reliability of the power electronics. However, to meet the needs of customers in regions throughout the world with varying EHS requirements, GE also now offers a pad mount transformer option. With this flexibility, customers can determine if it makes more sense for them to have the transformer in GE's scope inside the tower, or their own scope outside of the tower. The converter cooling system has been designed to minimize moving parts for reliability and features passive coolers that use the same wind that powers the turbine.



Feature	Description	Benefits
WindRIDE-THRU* Operation System	Uninterrupted turbine operation through grid disturbances Offered in two standard packages: • Low Voltage Ride Through • Zero Voltage Ride Through	Meets present and emerging transmission turbine reliability standards similar to those demanded of thermal generators
WindCONTROL* Power Regulation System	Voltage and power regulation like a conventional power plant	Provides frequency droop and power ramp limiters to help stabilize power system frequency Reduces Balance of Plant costs
WindFREE* Reactive Power System	Provides reactive power even with no wind	Provides smooth fast voltage regulation by delivering controlled reactive power through all operating conditions Eliminates the need for grid reinforcements specifically designed for no-wind conditions, and may allow for more economic commitment of other generating resources that will enhance grid security
WindSCADA* System	Tools to operate, maintain and manage the wind power plant	Intuitive operation and maintenance control Secure user-access
WindINERTIA* Control	GE's WindINERTIA control provides an internal response capability for wind turbines that is similar to conventional synchronous generators during under-frequency grid events	By utilizing the mechanical inertia of the rotor, GE's WindINERTIA power pulse characteristics can provide a 5% to 10% increase in turbine power over operational wind speeds
WindLAYOUT* Service	Maximizes energy capture through advanced turbine layout	Utilizes a powerful set of advanced optimization tools that directly integrate turbine performance, mechanical loads, site conditions, and project constraints for maximizing energy production

Flexible Wind Service Solutions

Global Resources, Local Support

GE's wind turbine fleet is one of the fastest growing and best-run fleets in the world. GE provides advanced technology solutions built from our extensive global resources, expertise, and regional capability—helping to ensure that your wind turbine assets are operating at peak performance.

24/7 Remote Monitoring and Troubleshooting:

GE's customer support and remote operations centers in Schenectady, New York and Salzbergen, Germany provide continuous monitoring and diagnostics services 24 hours c day, 365 days a year. These centers offer capabilities developed using our in-depth product knowledge, service engineering expertise and years of successful fleet operation, helping us to respond quickly and accurately to your needs.

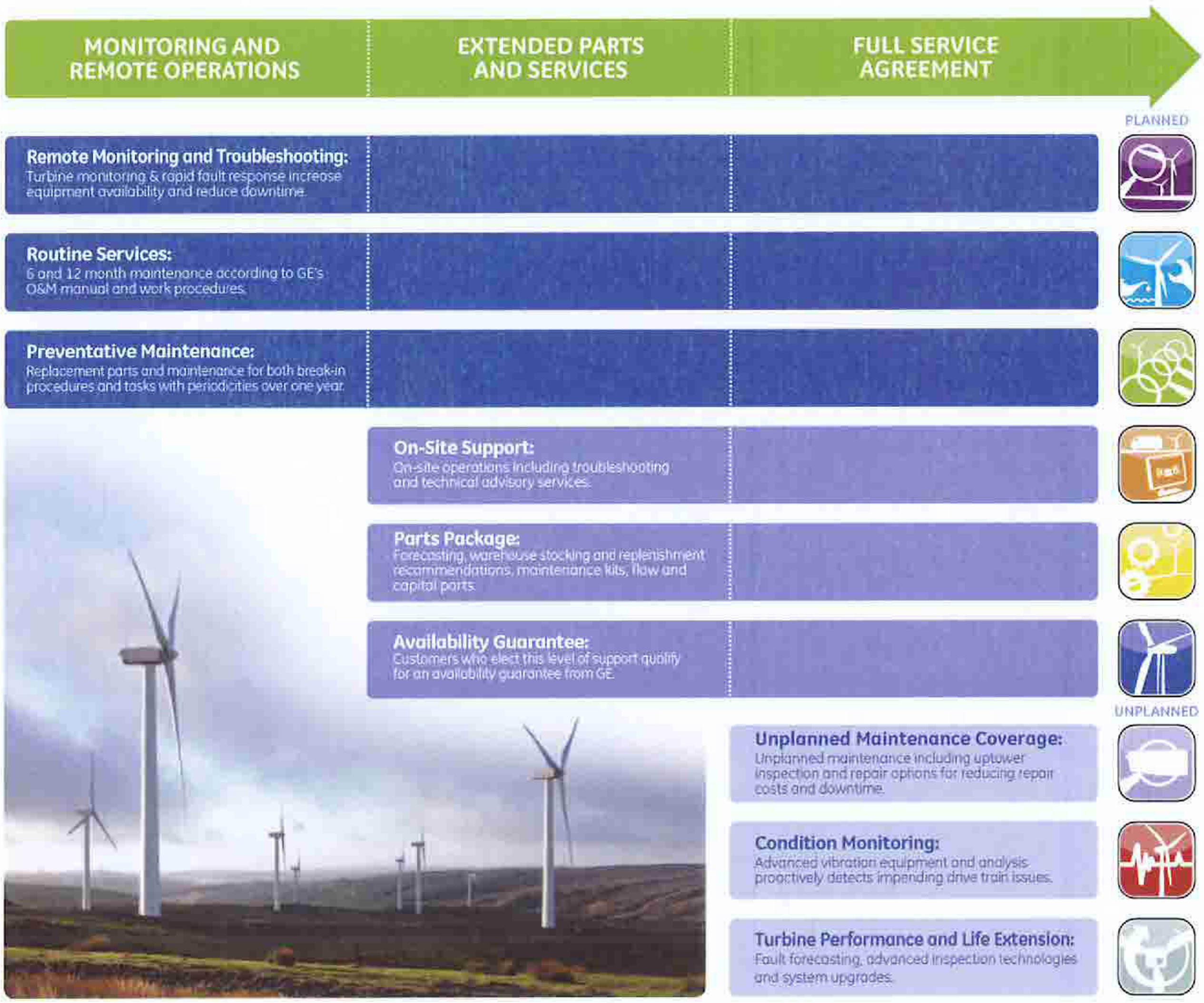
Dedicated Regional Support:

GE-trained regional technicians are available to ensure a timely resolution—whenever and wherever you need us. GE's technicians are equipped to perform procedures such as fault inspections and technical advisory services and manual resets in a timely and efficient manner. If an issue is detected, you can rely on our top-of-the-line repair and replacement capabilities and our highly skilled team to fix the issue immediately.

Wind Parts Center of Excellence:

Availability of parts is critical to wind power plant operations. GE's Wind Parts Center of Excellence provides a full range of offerings for all parts and refurbishment needs from routine maintenance kits, wear and tear, and flow parts, to vital capital parts such as gearboxes and blades. With the launch of our 24/7 parts call center (877-956-3778), and the development of online ordering tools, we are increasing the channels that our wind plant operators can utilize to order required wind turbine parts, including emergency requests for down-turbine needs.

GE's Wind Service Packages



Monitoring and Remote Operations (MRO)

This package brings GE's technical expertise to provide a defined scope of planned maintenance, including routine inspections, consumable parts replacement, and labor required in the replacement of wear and tear parts—as well as improved availability and reliability with remote operation services including 24/7 remote monitoring (with remote reset capability).

Extended Parts and Services Agreement (EPSA)

Adding coverage for manual resets, initial trouble shooting, competitive parts pricing and inventory management, and a limited availability guarantee together with performance analysis reports, the EPSA ensures the highest standards of operation for the project while offering customers competitive solutions to unplanned service events.

Full Service Agreement (FSA)

Maximize turbine operating performance and life by adding predictive Condition Monitoring services, unplanned maintenance with advanced services and uptower repairs, as well as options for turbine performance and life extension enhancement. Under this comprehensive package GE provides the customer with worry-free operation and maintenance with the highest level of performance.

Project Execution

GE understands that grid compatibility, site flexibility, and on-time delivery are critical to the economics of a wind project. For that reason, the 2.5 MW wind turbine has been engineered for ease of integration and delivery to a wide range of locations.

Our global project management and fulfillment expertise offer customers on-time delivery and schedule certainty. Regardless of where wind turbine components are delivered, GE's integrated logistics team retains ownership and responsibility for this critical step. Utilizing the GE Energy Power Answer Center, our engineering and supply chain teams are ready to respond to any technical, mechanical or electrical questions that may arise.

As one of the world's largest power plant system providers, GE is uniquely positioned to provide customers with full-service project management solutions.

With offices in North America, Europe, and Asia, our world-class Power Plant Systems division utilizes decades of fulfillment expertise in project management, logistics, plant start-up and integration from gas turbine, combined-cycle, and aero plants.

Environmental Health and Safety, a GE commitment

Maintaining high Environmental Health and Safety (EHS) standards is more than simply a good business practice; it is a fundamental responsibility to our employees, customers, contractors, and the environment we all share.

GE is committed to maintaining a safe work environment. We incorporate these values into every product, service and process, driving EHS processes to the highest standards.

Powering the world...responsibly.

For more information please visit www.ge-energy.com/wind.

GEA17007B (04/2010)

Exhibit N
Typical Construction
Photos & Details

EXHIBIT N

Typical Construction Photos and Details

Photo 01

Preliminary access road construction

Photo 02

Restoration of land adjacent to access road

Photo 03

Typical finished access road

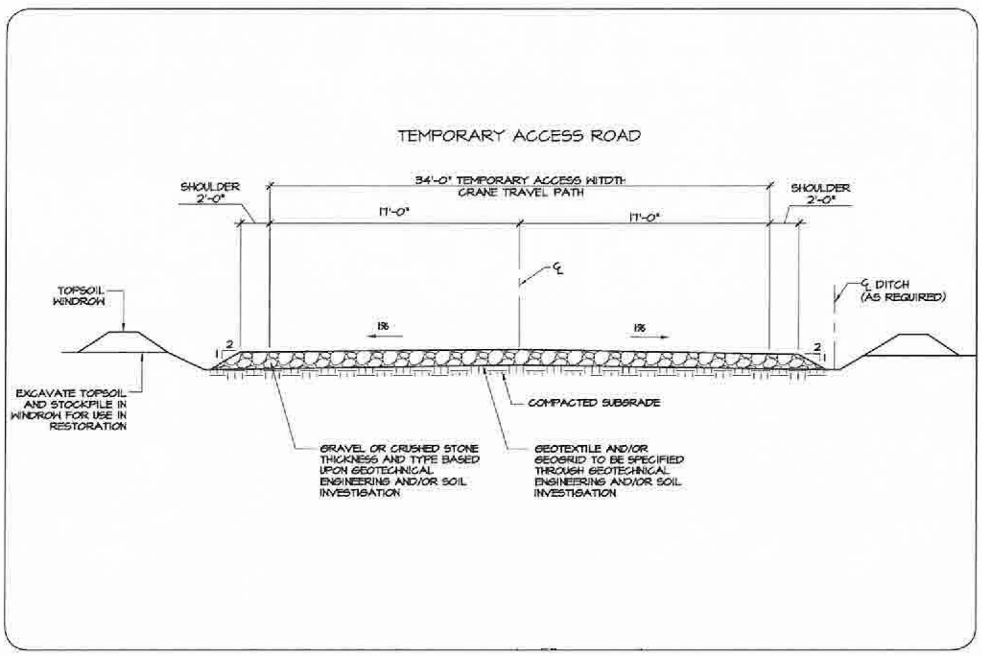


Photo 04

Access road typical detail

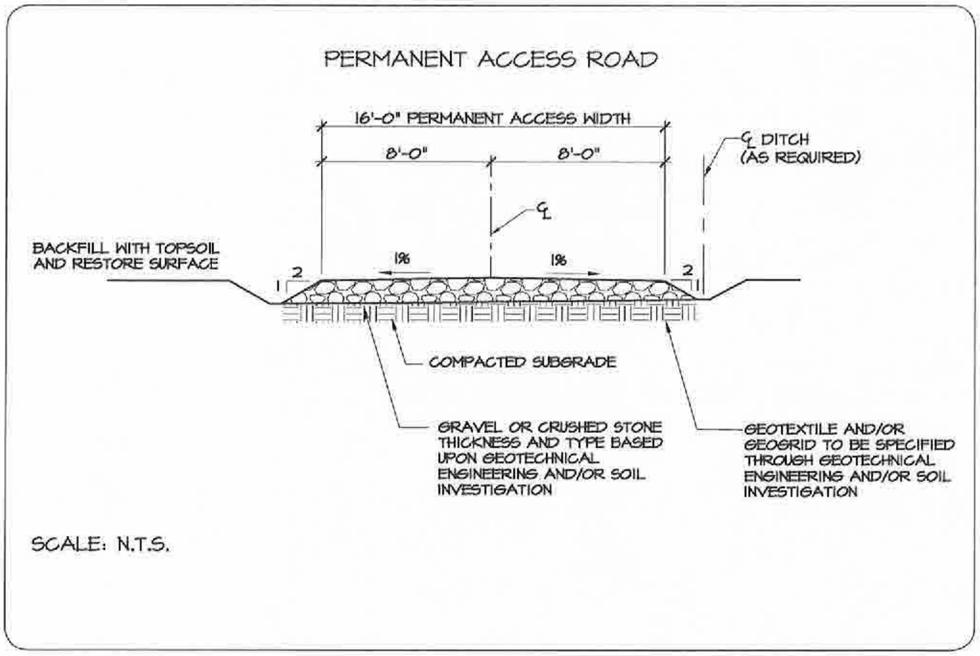


Photo 05

Access road typical detail

Photo 06

Buried interconnect installation

Photo 07

Typical trench associated with buried interconnect installation

Photo 08

In-progress restoration of buried interconnect impact

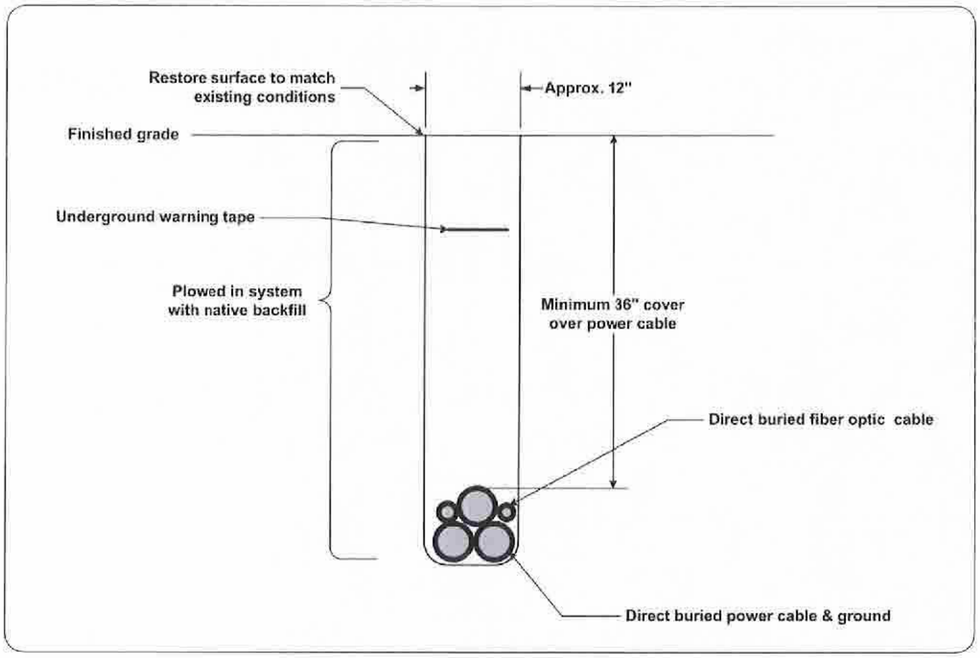


Photo 09

Buried interconnect typical detail

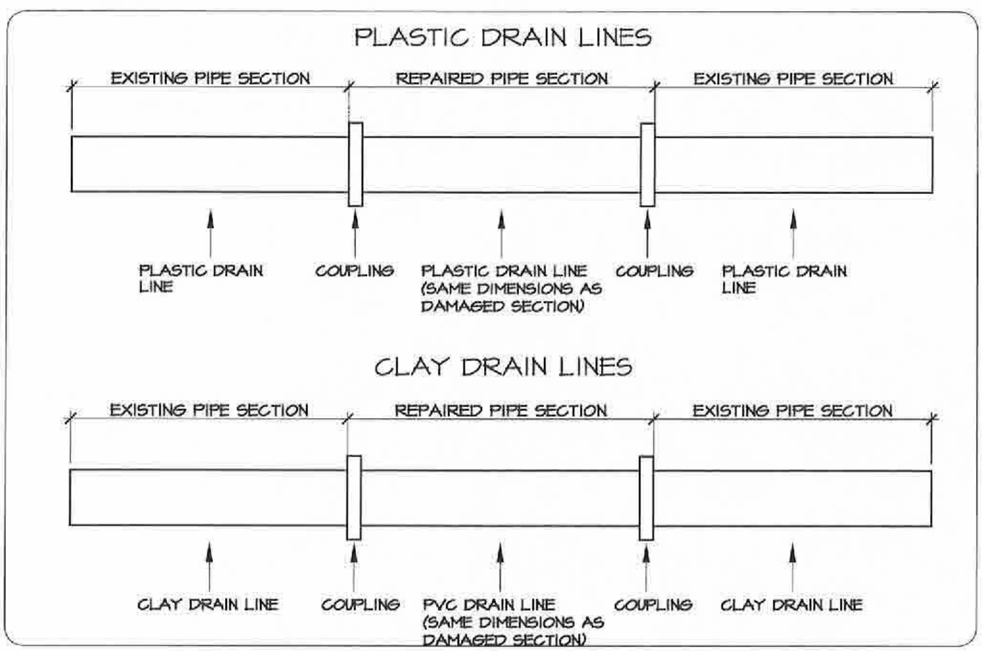


Photo 10

Drain line repair typical detail

Photo 11

Turbine foundation construction

Photo 12

Turbine foundation construction

Photo 13

Turbine foundation construction

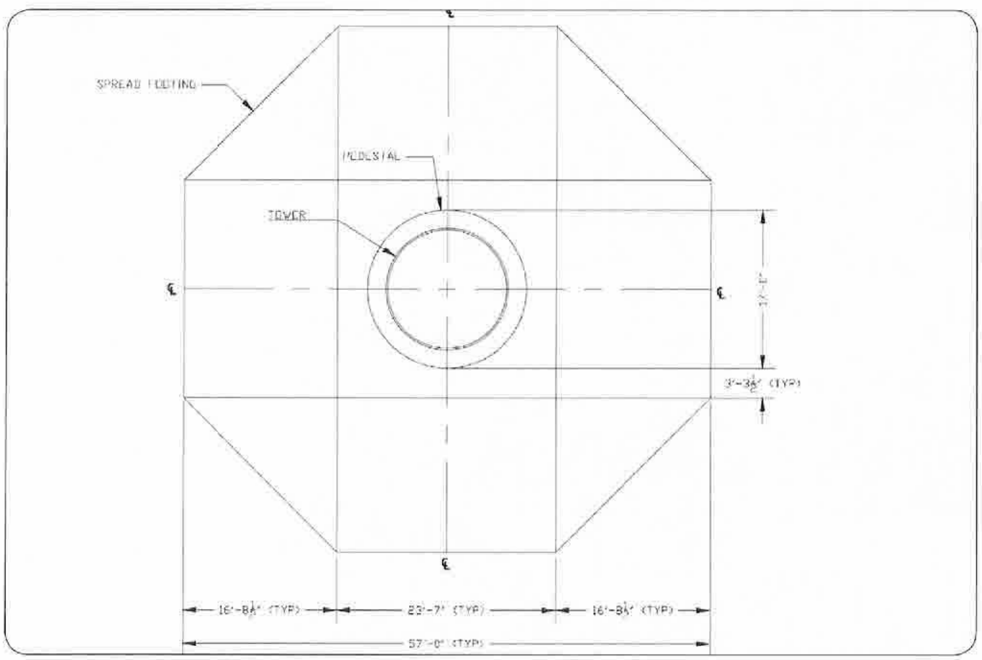


Photo 14

Turbine foundation typical detail

Photo 15

Transportation of turbine components

Photo 16

Typical turbine workspace

Photo 17

Erection of turbine

Photo 18

Typical operational turbines

Photo 19

Typical substation

Photo 20

Typical substation

Photo 21

Public road improvement

Photo 22

Turning radius public road improvement

Photo 23

Typical meterological tower

Photo 24

Base of typical meterological tower

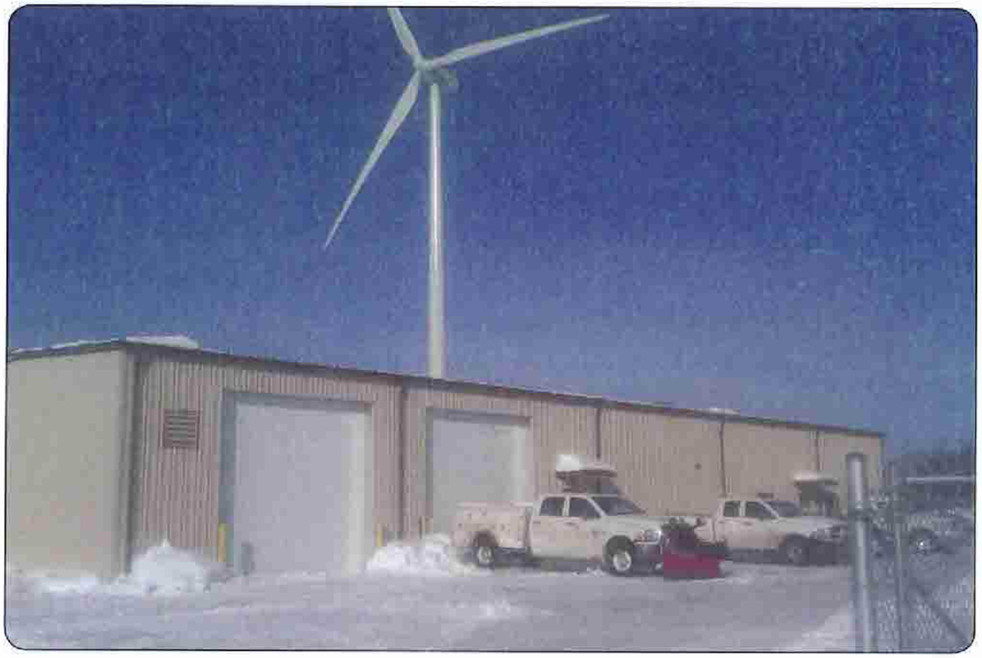


Photo 25

Typical operations and maintenance (O&M) building

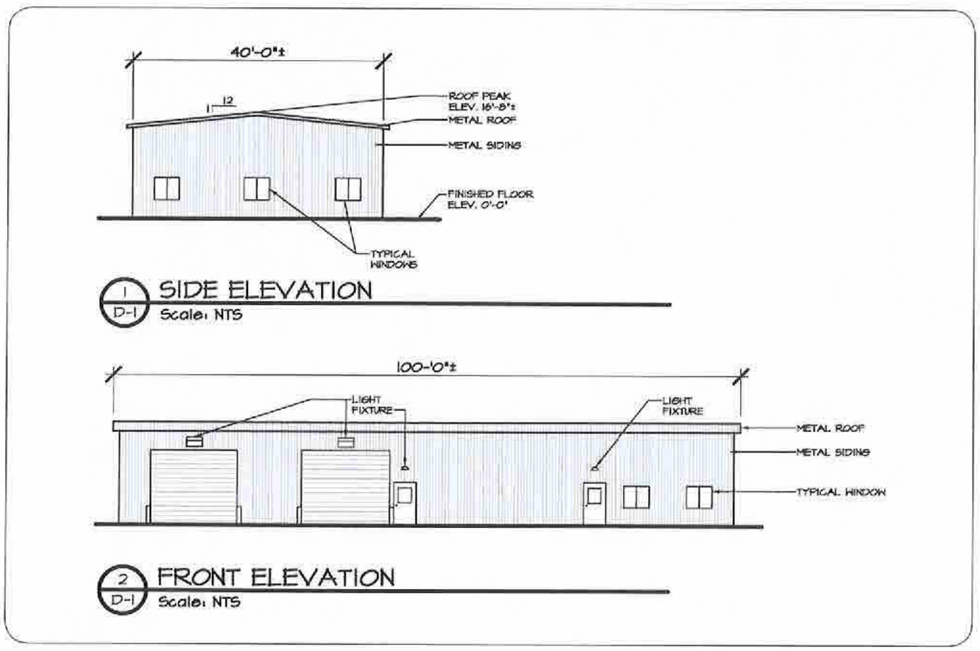


Photo 26

O&M building typical detail

Exhibit O
Sound Survey & Noise
Impact Assessment

EXHIBIT O

Environmental Sound Survey and Noise Impact Assessment

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DATE OF ISSUE: MARCH 14, 2012

ENVIRONMENTAL SOUND SURVEY AND NOISE IMPACT ASSESSMENT

BUCKEYE II WIND PROJECT

CHAMPAIGN COUNTY
OHIO

PREPARED FOR:

Champaign Wind, LLC

COMMONWEALTH OF VIRGINIA
DAVID MARK HESSLER
No. 034626
PROFESSIONAL ENGINEER

Prepared by:

David M. Hessler, P.E., INCE
Principal Consultant
Hessler Associates, Inc.

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Attachments

Graphic A	Background Sound Level Monitor Locations
Plot 1	Sound Level Contours – Buckeye II to OPSB Limit of 44 dBA
Plot 2	Sound Level Contours – Buckeye II to Ideal Design Goal of 40 dBA
Plot 3	Sound Level Contours – Buckeye II to Property Line Goal of 50 dBA
Plot 4	Sound Level Contours – Both Projects Combined to 44 dBA
Plot 5	Sound Level Contours – Both Projects Combined to 40 dBA
Plot 6	Sound Level Contours – Both Projects Combined to 50 dBA

1.0 INTRODUCTION

Hessler Associates, Inc. has been retained by Champaign Wind, LLC to evaluate potential noise impacts from the proposed Buckeye II Wind Farm Project, which is located in Champaign County, Ohio generally between the towns of Urbana and Mechanicsburg. The project consists, according to current plans, of up to 56 wind turbines generally in the 2.5 MW size class and associated access roads, electrical interconnections, etc. located on leased private lands. The site may be broadly described as a mixture of farms and private homes in a rural setting with a few gently rolling hills and scattered residences.

The present study consists of two principal phases: a background sound level survey and a computer modeling analysis of future turbine sound levels. The field survey of existing sound levels at the site was performed to determine how much natural masking noise there might be - as a function of wind speed - at the nearest residences to the project. The relevance of this is that high levels of background noise due to wind-induced natural sounds, such as tree rustle, act to reduce the audibility of the wind farm, while low levels of natural noise would permit operational noise from the turbines to be more readily perceptible. For a broadband noise source the audibility of, and potential impact from, the new noise is a function of how much, if at all, it exceeds the pre-existing background level.

In the second part of the study an analytical noise model of the project was developed to evaluate the sound level contours associated not only with the Buckeye II project but also to look at the cumulative sound emissions of both the Buckeye I and II projects potentially operating together. The Buckeye I project occurs within the same area and its turbines are interspersed with those of the Buckeye II project. These predictions will be used to evaluate the expected sound levels from one or both projects relative to the background level and in absolute terms. More specifically, the evaluation criteria for the project will be based on:

- Ohio Power Siting Board (OPSB) precedent in terms of noise standards imposed on previously approved wind projects in the state, which consists of an allowable increase relative to the background sound level
- The actual observed reaction to similar wind projects based on first-hand experience
- Rule 4906-17-08 *Social and Ecological Data*, Section (A)(2) "Noise" of the Ohio Administrative Code (OAC), which relates to the evaluation of construction and operational sound levels at the nearest property boundaries

1.1 EXECUTIVE SUMMARY

A field survey of existing sound levels throughout the proposed Buckeye II Project site area was carried out to determine how much natural masking sound there might be at residences in the vicinity of the project and how it might affect the perceptibility of sound emissions from the project.

In general, over an 18 day survey period, the equivalent energy average (Leq) and residual (L90) sound levels were measured continuously day and night at 10 locations distributed over the study area near residences with the maximum potential exposure to the proposed turbines. Over 2500 10-minute samples were collected at each location.

Since the background sound level at night is of the most relevance to potential disturbance from wind turbine noise, the data analysis focused primarily on the nighttime (10 p.m. to 7 a.m.) sound levels. Moreover, the Ohio Power Siting Board (OPSB) has previously approved a noise standard for other wind projects in the state, which limits the sound emissions due to wind projects to no more than 5 dBA above the average nighttime Leq sound level.

In this instance, the average daytime and nighttime Leq sound levels measured at all positions irrespective of wind speed were found to be 45 and 39 dBA, respectively. A critical wind speed analysis was also performed on the nighttime Leq data correlating it to wind speed and determining the circumstances under which project noise would be most audible. This analysis indicated that the critical design conditions would occur during 6 m/s wind conditions when the mean nighttime Leq also happened to be 39 dBA. Therefore 39 dBA has been taken as the baseline nighttime background sound level upon which to calculate the 5 dBA increase permitted by the OPSB. The daytime and nighttime Leq sound levels (measured at 3 ft. above ground level) are tabulated below as a function of wind speed for reference.

Table 1.1.1 *Mean Daytime and Nighttime Leq Sound Levels as a Function of Wind Speed*

Wind Speed at 10 m, m/s	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mean Daytime Leq, dBA	42	43	44	45	46	47	48
Mean Nighttime Leq, dBA	33	35	37	39	41	43	45

Based on these results, first-hand experience observing the actual reaction to newly operational wind projects that are very comparable to this one and OAC Rule 4906-17-08, the following evaluation thresholds were developed:

- A relative design goal of **44 dBA** at non-participating residences per OPSB precedent; i.e. an allowable increase of 5 dBA over the average nighttime Leq sound level (39 dBA).

- A recommended regulatory limit of 45 dBA at non-participating residences based on the very limited adverse response to wind projects that has been observed wherever the mean project sound level is less than 45 dBA at residences. Note that the 44 dBA criterion above takes precedence over this suggested limit.

- An *ideal* design goal of **40 dBA** is also considered in the modeling study as the point where little or no adverse reaction can largely be expected irrespective of the background sound level. This threshold level derives from the same study alluded to immediately above with reference to the recommended regulatory limit of 45 dBA.

- A design goal of **50 dBA**, applicable at the boundaries of non-participating land parcels, has been adopted in order to carry out a quantitative assessment of the operational noise provisions in OAC Rule 4906-17-08.

The sound emissions from the project, using the turbine sound power level associated with critical design conditions (6 m/s winds), were modeled and mapped over the site area in accordance with appropriate standards representing typical or normal atmospheric conditions – with the understanding that project sound levels will vary above and below the mean predicted level with changing atmospheric conditions. Comparisons between modeled sound levels and the levels actually measured at operating wind projects, as shown in several examples, indicate that ISO 9613-2 is perfectly adequate for predicting the mean project sound level.

The modeling analysis of the Buckeye II project operating alone indicates that the project will meet the primary design goal, the OSPB (nighttime Leq + 5 dBA) noise limit of 44 dBA, at all non-participating residences. This performance requires noise mitigation on 16 of the 56 units, which will need to be operated in one of several low noise modes at least during the nighttime hours. This mitigation measure is assumed for all further analyses.

The secondary, ideal design goal of 40 dBA will be satisfied at the vast majority of non-participating residences in the study area but not at all. A substantial number of non-participating homes are predicted to see mean project sound levels in the 40 to 43 dBA range. For projects such as this in similar settings, it is not the least bit unusual for this ideal design goal to be exceeded, but, based on the observed reaction at comparable projects, the possibility of complaints is likely from a small fraction (approximately 2%) of those residents where mean sound levels between 40 and 45 dBA are expected to occur.

An evaluation of property line sound levels indicates that the assumed design goal of 50 dBA, based on the regulatory limit that is typically adopted in the rare instances when such a restriction is imposed on wind projects, will be met in all but a handful of instances where mean project sound levels in the 50 to 52 dBA range might be expected near the edges of adjoining parcels.

Cumulative noise impacts were also evaluated to model the sound levels that would be possible if both the Buckeye I and II projects were built. In general, the combined sound emissions from both projects would have an ostensible effect on the community that is similar to that of Buckeye II operating by itself, in the sense that all non-participating residences remain outside of the 44 dBA sound contour (the nominal OPSB design limit). As with the initial case mentioned above, 16 of the Buckeye II turbines would need to be operated in low noise mode to achieve this result. Low noise operation is not required from any of the Buckeye I turbines to meet the OPSB noise standard.

Although concerns are often raised with respect to low frequency or infrasonic noise emissions from wind turbines, no adverse impact of any kind related to low frequency noise is expected from this project. The widespread belief that wind turbines generate excessive or even harmful amounts of low frequency noise is evidently based on a confusion of the amplitude modulation sometimes produced by wind turbines (i.e. the periodic swishing sound with a frequency of about 1 Hz) with low frequency sound. Numerous studies show that the low frequency content in the sound spectrum of a typical wind turbine is not substantially different than that of the natural background sound level in rural areas. Wind-induced self-noise from wind blowing over the microphone, which artificially inflates the low end of the frequency spectrum, is another likely reason that low frequency noise has been incorrectly associated with wind turbines.

Unavoidable but minor noise impacts may occur during the construction phase of the project. Construction noise, sounding similar to that of distant farming equipment is anticipated to be sporadically audible at some homes within the immediate project vicinity on a temporary basis. The maximum magnitude of construction sound levels at the homes nearest to individual turbine locations is not expected to exceed 56 to 63 dBA depending on the particular activity. Higher levels up to 70 to 80 dBA are possible where homes or adjoining property boundaries are relatively close to trenching or road building activities.

2.0 BACKGROUND SOUND LEVEL SURVEY

2.1 OBJECTIVE AND MEASUREMENT QUANTITIES

The purpose of the survey was to determine what minimum environmental sound levels are consistently present and available to mask or obscure potential noise from the project at locations representative of potentially sensitive receptors close to project turbines. A variety of statistical sound levels were measured at a number of monitor locations in consecutive 10 minute intervals over an 18 day period. Of these, the average (Leq) and residual (L90) levels are the most meaningful.

The equivalent energy sound level (Leq), is literally the average sound level over each measurement interval. This measure can be influenced and elevated by sporadic, short-duration noise events, such as cars passing by, and is therefore often unrepresentative of the very quietest periods between these events. Nevertheless, it does characterize the "average" sound level that actually existed over each measurement period.

The L90 statistical sound level, on the other hand, is commonly used to conservatively quantify background sound levels. The L90, or residual sound level, is the sound level exceeded during 90% of the measurement interval; i.e. it is louder than the L90 level most (90%) of the time. This measure has the quality of filtering out relatively loud, sporadic, short-duration noise events thereby capturing the quiet lulls between such events.

These levels are graphically illustrated in the following generic example.

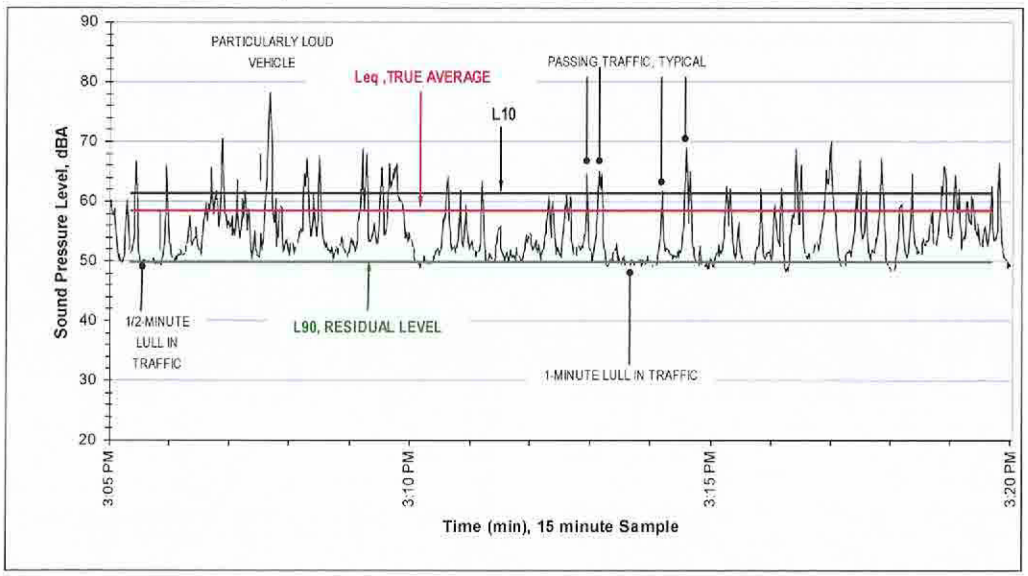

Figure 2.1.1 *Sample 15 minute Measurement Showing L90, Leq and L10 Statistical Sound Levels*

An additional factor that is important in establishing the minimum background sound level available to mask potential wind turbine noise is the natural sound generated by the wind itself. In general, wind turbines only operate and produce noise when the wind exceeds a minimum cut-in speed of roughly 3 m/s at hub height. Turbine sound levels increase with wind speed up to about 6 or 7 m/s when the sound produced generally reaches a maximum and no longer increases because the rotor has reached a predetermined maximum rotational speed. Consequently, at moderate to high wind speeds - when turbine sound levels are most significant - the level of natural masking noise is normally also relatively high due to tree or grass rustle thus reducing the perceptibility of the turbines. Pre-construction background sound levels commonly exceed 50 dBA during windy conditions. In order to quantify this effect wind speed was measured, for later correlation to the sound data, by 6 met towers distributed over the study area. Measurements from the mast top anemometers ranging in elevation from 58 to 80 m above ground level were used. Using the wind speed measured high in the air within turbine rotor plane directly relates the wind conditions associated with turbine operation to the concurrent sound levels measured at ground level at houses in the study area – locations where the wind speed can be negligible even when it is windy at the top of the met mast.

2.2 SITE DESCRIPTION AND MEASUREMENT POSITIONS

The Buckeye II project, as currently planned, consists of 56 turbines located in a number of separate groups ranging in number from a single unit to 17 turbines. The turbines are proposed on relatively large private parcels and are set back as far as possible from residences and roads.

The site terrain is made up of some gently rolling hills, sometimes wooded, interspersed with many areas that are largely flat and open. Although generally rural, there are a considerable number of homes and farmhouses within 1 mile of proposed turbine locations, most of which are located along the roads that crisscross the project area. This 1 mile zone does include portions of Mechanicsburg and Mutual, but is otherwise confined to the farmlands between population centers.

Graphic A is a map of the site vicinity showing the homes in the area, the proposed turbine locations and the 10 background sound level measurement positions adopted for the survey. These positions were selected to be representative of the acoustic environments experienced at the nearest homes to proposed future Buckeye II turbine locations and to generally cover the study area in a fairly uniform manner.

Each location is at or near a typical home in the area. In some cases, the monitor was set back from the nearest road about the same distance as typical residences on that road to replicate the exposure to local traffic noise. In all other cases the monitor was set up behind the house or at a location much further from the nearest road. The monitors were also placed away from any significant source of local contaminating noise that might be generated by human activity or machinery.

Each measurement location is described in further detail below.

Position 1 – Co Hwy 167 & Mt. Vernon Drive

Monitor 1 was situated in an open field on the east side of Co Hwy 167 across from a number of homes on Mt. Vernon Drive. The monitor was set back from CH 167 about the same distance as the houses on the opposite side. It should be noted that there are trees adjacent to houses, which produce a sound in windy conditions, whereas the monitor is in an open field remote from this noise.

Figure 2.2.1a *Monitor 1 – Looking SW towards Mt. Vernon Drive*

Figure 2.2.1b *Monitor 1 – Looking NE*

Position 2 – Ault Road

Monitor 2 was located in an open field about 150 ft. north of a sharp bend in Ault Road. The houses in this area are significantly closer to Ault Road than the measurement position.

Figure 2.2.2a *Monitor 2 – Looking SW towards Nearest House*

Figure 2.2.2b *Monitor 2 – Distant View Looking N towards Monitor (beyond utility pole)*

Position 3 – Urbana Woodstock Road

Monitor 3 was located in the front yard of a farmhouse located south of the intersection of Urbana Woodstock Road and Brand Road. The farm is set back approximately 1200 ft. from the main road and surrounded by open farm fields. The monitor was placed in the front yard of the house at a point remote from any local farm activities.

Figure 2.2.3a *Monitor 3 – Looking SW towards the Farmhouse*

Figure 2.2.3b *Monitor 3 – Looking N towards Urbana Woodstock Road (beyond the distant white house)*

Position 4 – Yocum Road

Monitor 4 was located in the front yard of a typical farmhouse on Yocum Road in the north-central part of the study area. The house is set back from the road by approximately 200 ft. Because this location is open and exposed to the wind, a temporary weather station was set up adjacent to the sound monitor principally to measure the microphone height (1 m) wind speed throughout the survey.

Figure 2.2.4a *Monitor 4 and Weather Station – Looking S*

Figure 2.2.4b *Monitor 4 and Weather Station – Looking N*

Position 5 – Co Hwy 10

Monitor 5 was located in an open grassy area behind a barn on the east side of Co Hwy 10. The position is intended to be representative of the houses that intermittently line this stretch of road; however, it should be noted that the monitor was located over 300 ft. back from the road and behind the barn visible in Figure 2.2.5b, while nearly all the houses are much closer to the road.

Figure 2.2.5a *Monitor 5 – Looking SW*

Figure 2.2.5b *Monitor 5 – Looking W towards Co Hwy 10 (in front of white house)*