



October, 2000

QUARTERLY REPORT

2nd Quarter, Issue #1

### Mission Statement

The mission of the U.S. Department of Energy (DOE) Wind Energy Field Verification Program (FVP) is to enable U.S. industry to complete the research, testing, and field verification needed to fully develop advanced wind energy technologies that lead the world in cost-effectiveness and reliability. The Program includes cost-shared research with industry partners that leads to the development of advanced technology wind turbines and support for projects that verify performance of wind turbine technologies in actual operational applications. Small wind turbine ( $\leq 100$  kW) manufacturers can benefit from DOE's Field Verification Program, which provides them with opportunities to operate and monitor their turbines under a range of distributed power applications and environments throughout the United States. This experience helps U.S. firms validate and improve the performance and reliability of their wind turbine technology, while expanding regional experience with wind energy technologies.

### Purpose of the Field Verification Program (FVP)

The objectives of the FVP for small wind turbines are to:

1. Provide U.S. manufacturers with opportunities to verify performance and reliability of their small (0.3–100 kW) wind turbines.
2. Evaluate the applicability and effectiveness of small wind turbines that serve a range of distributed power needs in various regions of the United States, under diverse ownership and operating scenarios.



*mounting a turbine for testing*

### Implementation and Scope of the Field Verification Program

In 1999, under a competitive procurement (#DE-PS36-99GO10383), DOE's Golden Field Office (GO) established the FVP by selecting six recipients. However, one project was discontinued at the recipient's request. Currently five projects, encompassing 13 host sites, with a range of distributed power applications (see Table 1) are being funded. Recipients are required to perform two project components using small wind turbines (SWTs) that are manufactured in the United States and marketed in domestic and/or foreign markets:



*The National Wind Technology Center located south of Boulder, Colorado.*

1. Purchase, install, and test a SWT at the National Renewable Energy Laboratory's (NREL's) National Wind Technology Center (NWTC) for safety, performance (IEC 61400-12), noise, and duration. The duration test is defined as at least 1500 hours of run time that includes 250 hours of normal operation at hub height, wind speeds greater than or equal to 10 meters per second (m/s), and 25 hours at greater than or equal to 15 m/s.

2. After the successful completion of the testing at the NWTC, extended reliability tests of the turbine(s) are conducted at a host site location(s) under various applications.

FVP recipients are required to report their quarterly progress to the DOE/GO. The reports include performance data, activities, and issues during the quarterly test period. After receiving the electronic quarterly reports from the host site organizations, NWTC personnel summarize turbine performance data and publish the highlights in the Field Verification Program Quarterly Report, which is electronically available to the public at <http://www.nrel.gov/wind/>.



## Host Sites

There are 13 different sites managed by the five organizations. Figure 1 and Table 1 show the names of the organizations and contacts, locations, turbine types, and applications. One FVP project was cancelled at the turbine manufacturer's request; field installation sites for that turbine were to be located in Wisconsin, California, and Texas.

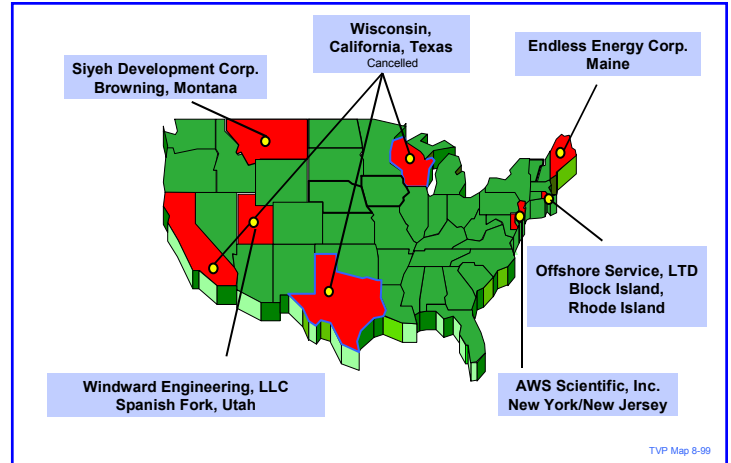


Figure 1. DOE Field Verification Program Turbine Locations

**Table 1. Field Verification Program Locations and Participating Organizations**

Organization/Contact	SWT #	Turbine Location	Quantity/Type of Turbine	Application
Woodward Engineering 4661 Holly Lane Salt Lake City, UT 84117 Contact: Craig Hansen/Dean Davis	Turbine #1	Spanish Fork , Utah	One Whisper H40 (previously named Whisper 900)	Grid Connected
Endless Energy Corporation 9 Castle Road New Gloucester, ME 04260 Contact: Harley C. Lee/Michael Boice	Turbine #1	Allen Blueberry Plant, Orland, Maine	One AOC 15/50	Grid Connected
	Turbine #2	Monhegan Island, Rockland, Maine	One AOC 15/50	Grid Connected
Siyeh Development Corporation P. O. Box 1989 Browning, MT 59417 Contact: Dennis Fitzpatrick	Turbines #1-4	Water Treatment Facility, Town of Browning, Browning, Montana	Four Bergey Excel-S/E 10 kW	Pumping and Purification
Offshore Service, LTD P. O. Box 457 Block Island, RI 02807 Contact: Henry G. duPont	Turbine #1	Block Island Goose and Garden Greenhouse, Block Island, Rhode Island	One Bergey Excel-S/E 10 kW	Residential Consumption
	Turbine #2	TBD	One Bergey Excel-S/E 10 kW	Residential Consumption
	Turbine #3	TBD	One Bergey Excel-S/E 10 kW	Residential Consumption
	Turbine #4	TBD	One Bergey Excel-S/E 10 kW	Residential Consumption
	Turbine #5	Jonathan & Jo-An Evans Residence Block Island, Rhode Island	One Bergey Excel-S/E 10 kW	Residential Consumption
AWS Scientific, Inc. 251 Fuller Road CESTM, Suite B220 Albany, NY 12203-3656 Contact: Bob Putnam/Dan Bernadett	Turbine #1	Webster, New York	One Bergey Excel-S/E 10 kW	Distributed Generation
	Turbine #2	Liberty Science Center Jersey City, New Jersey	One Bergey Excel-S/E 10 kW	Distributed Generation
	Turbine #3	Environmental Education Center Babylon, New York	One Bergey Excel-S/E 10 kW	Distributed Generation
	Turbine #4	Potomac Land Trust	One Bergey Excel-S/E 10 kW	Distributed Generation



## Second Quarter Status and Statistics Summary

Windward Engineering, LLC

Windward Engineering is a wind engineering organization located in Spanish Fork, Utah. Staff are testing a Whisper H40 (previously named Whisper 900) connected to the Spanish Fork City Utility grid at an existing wind energy test site (see Figure 2). Another Whisper H40 has been tested at the NWTC since February 2000. Windward Engineering will not only collect these data required under the cooperative agreement but will also collect yaw and furl angle data for comparison to an ADAMS model (a system dynamic model).



Figure 2. Whisper H40 at the host site, Spanish Fork, Utah.

### Spanish Fork, Utah

Quarterly test results show that the turbine at Spanish Fork produced 298 kWh for this time period and an average of 625 watts (without correction for sea level air density) at a wind speed of 13.0 m/s at a hub height of 9.3 meters (30.5 feet). The turbine at the host site operated at 100% turbine availability and 80% system availability. Downtime was due to testing operations, not turbine system faults. Although Windward Engineering completed an ADAMS model of the turbine, it has not yet completely verified the model input data. They also collected hundreds of hours of rotor yaw and furl angle data with a LabView-based high-speed computer data acquisition system and presented the results at the NWTC Furling Workshop held in July. Windward Engineering's Web site at <http://www.windwardengineering.com> contains updated information.

The following tables, provided by Windward Engineering, contain the test results of the Whisper H40 at the Spanish Fork, Utah, site. Table 2 shows the project summary through June 2000. Note that the maximum power was derived from a measurement and has not been corrected for air density.

**Table 2. Project Summary**

Quarterly Summary								
SWT #	kWh Total	kWh/m <sup>2</sup>	Capacity Factor****	Unavailable Hours*	Turbine Availability	Max. Watt**	Concurrent Wind Speed***(m/s)	Ave. Wind Speed at Hub Height (m/s)
1	298	83.4	15%	436.3	100.0%	745	14.6	5.45

- \* Unavailable hours events are shown in Table 3 and include data from the DAS system and from the site operation log
- \*\* Maximum power is the peak 10-minute-average output
- \*\*\* The concurrent wind speed is a 10-minute-average wind speed
- \*\*\*\* Rated output is 900 watt

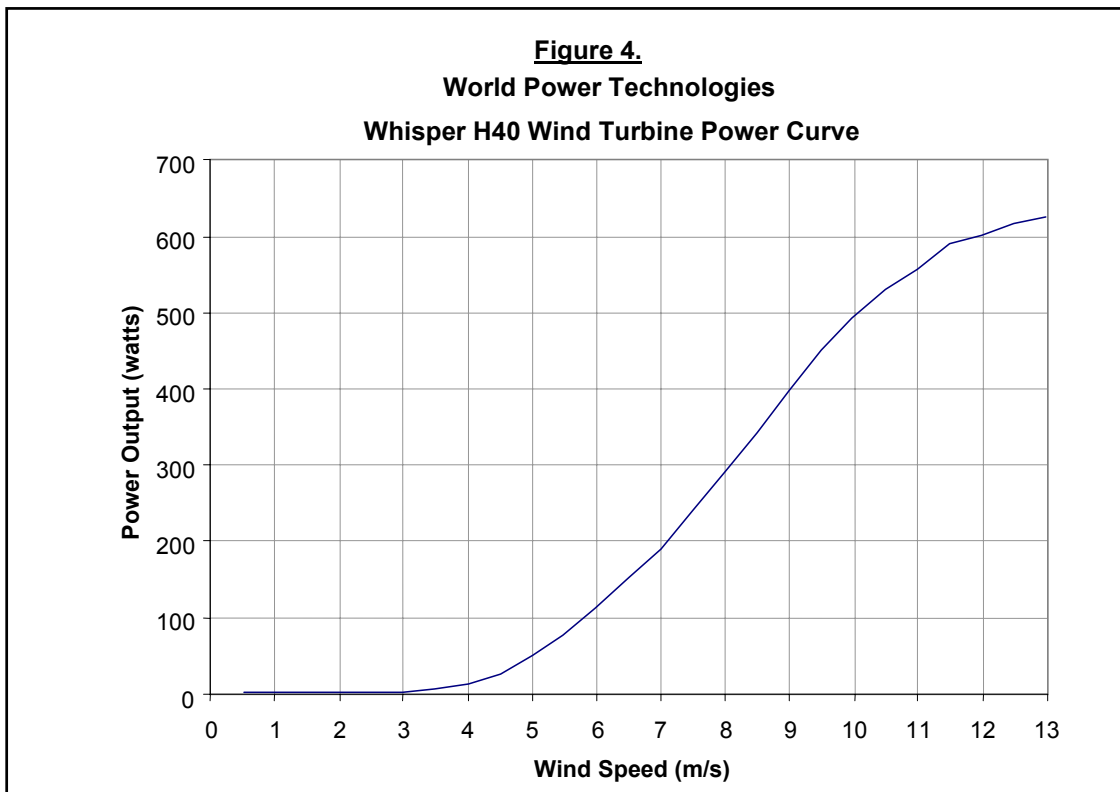
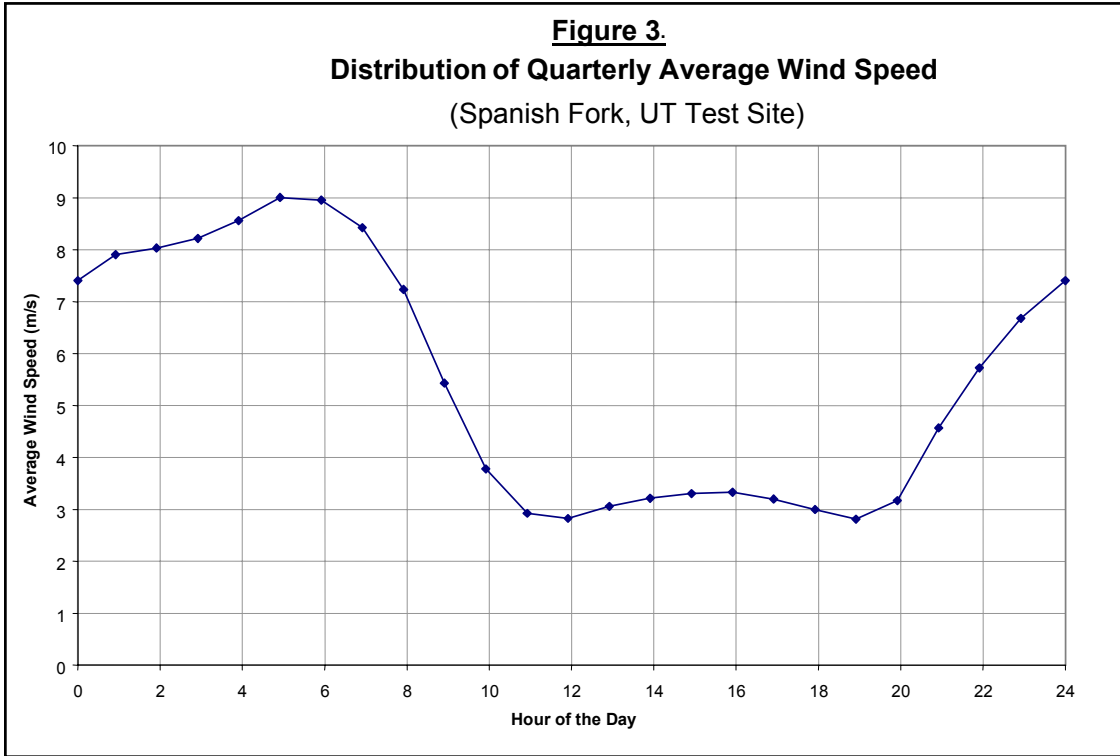
Table 3 shows the frequency of and the reasons for the turbine's downtimes. Host sites are required to collect these data on a quarterly basis for project review and reporting.

**Table 3. Downtime Summary by Type for Whisper H40**

Category	Hours	Lost Energy kWh	Remarks
Fault: Wind Turbine			
Fault: Inverter			
O&M			
Turbine measurements (related to modeling)	120.0	24.2	Mass properties
Ground Testing (related to modeling)			
Instrumentation installation or calibration	314.7	63.4	Installation of yaw and furl instrumentation
DAS disable	1.7	0.6	DAS momentarily down due to grid power loss
Host site system disable			
Battery over voltage			
Blown fuse			
Brake cooling cycle			
Inverter faults			
Unknown			
Others			
<b>Total</b>	<b>436.3</b>	<b>88.3</b>	



Figures 3 and 4 show the results from measured values for the Windward Engineering testing for the period of April – June 2000. Figure 3 shows the wind distribution for the test site, and figure 4 shows the resulting power curve from that period of time. Note that the power curve has not been corrected for air density.





### Endless Energy Corporation

Endless Energy Corporation will install two AOC 15/50 turbines along the windy Maine coast for several commercial power customers. The goals of the project are to verify the performance of the turbine under harsh coastal conditions and to create a model for commercially competitive wind power installations in small, distributed settings. The project will benefit from the confluence of essential factors for successful wind powered generation: windy, buildable locations; the use of well-engineered wind turbines; and the existence of the necessary regulatory scheme and power markets for financial success.

#### *Allen Blueberry Plant, Orland, Maine*

Final purchase and sale agreement was completed and in late June, the foundation was poured, the anchor bolts placed, and the conduit that runs from the foundation to the building that houses the turbine controls was buried. A mechanic has been tentatively identified and lives off-grid with a vintage 3-kW Jacobs wind generator that he restored. If everything goes as planned, the Atlantic Orient Corporation (AOC) wind turbine will be delivered to Endless Energy for final site work during the fourth quarter of 2000.

#### *Monhegan Island, Rockland, Maine*

The Monhegan Island site has been put on standby status because of a breakdown in the negotiation process. Endless Energy is now looking for a potential site near an elementary school on Deer Isle, Maine. Negotiations with the school board are currently under way.

### Siyeh Development Corporation

Siyeh Development Corporation (of the Blackfeet Indian tribe), in conjunction with the Town of Browning, Bergey Windpower, the Indian Health Service (IHS), the Blackfeet Indian Housing Authority and Glacier Electric Cooperative will partner to install four Bergey turbines at Browning's Water Treatment Facility. These project partners represent a broad base of experience and interests ranging from local government and utility functions to state-of-the-art wind turbine systems engineering. It is believed that the project will assist in the improvement of the community water treatment system and promote a cohesive and integrated experience base for future wind power development.

#### *Water Treatment Facility, Town of Browning, Browning, Montana*

Four Bergey 10 kW wind turbines and a GridTek10 inverter (an inverter designed by Trace Technology) were installed and are undergoing system checkout. In the meantime, a data acquisition system (DAS) and instrumentation have been purchased from Campbell Scientific, Ohio Semitronics, and Second Wind, and site wiring work was completed. Progress on this project has been slower than anticipated during this quarter due in part to the resignation of the Project Manager from Siyeh Development Corporation. In addition, on June 29, 2000, reimbursement of costs under Cooperative Agreement, DE-FC36-99GO10459 was suspended by the Department of Energy pending the receipt of a satisfactory plan to proceed from Siyeh Development Corporation. Siyeh Development proposed a draft memorandum of agreement (MOA) be executed between the Town of Browning and Siyeh that will allow the project to proceed in continued cooperation. A draft agreement has been presented to the city council, and the council has requested that the mayor and Siyeh further refine certain terms. Once this work is completed and a document is crafted that is mutually acceptable, Siyeh will present this MOA to DOE for approval.



Figure 5. Siyeh Development Corporation site in Browning, Montana.



### Offshore Services, LTD

Offshore Services will install five Bergey Excel wind turbines on Block Island, Rhode Island to evaluate the effectiveness of wind power at five different locations with different types of ownership structure in a harsh marine environment. Additionally, Block Island Power Company has a number of circuits that experience low voltage at the ends of the distribution system during peak demand periods. Some of these turbines will be placed at the end of the distribution system to measure the effect of adding distributed power sources.

#### *Block Island Goose and Garden Greenhouse, Block Island, Rhode Island*

This site was awarded a building permit and its foundation was poured in April. A Bergey Excel 10 kW wind turbine was erected in May and commissioned on June 2<sup>nd</sup>. Wind velocity and direction measurements began on the day of commissioning. The data acquisition system was on line on June 11<sup>th</sup>. Offshore leased a Ford Electric Ranger pickup truck that is being charged each night with the energy produced by the wind turbine. Although the truck charging activity is outside of the agreement, the information collected for an electric vehicle would be of interest to DOE and industry as suggested by the operator. Wind data and turbine performance data for June and July were reported to DOE and are being reviewed.

#### *Jonathan & Jo-An Evans Residence, Block Island, Rhode Island*

A new residential site owned by Jonathan and Jo-An Evans replaced the original site that was cancelled because of failed negotiations. The new site did not require zoning approval. The building permit was secured, the turbine was installed, and the project is operational. The turbine is expected to be commissioned in the third quarter.

Three alternate sites from those originally proposed are being pursued.

### AWS Scientific, Inc.

AWS Scientific will install, operate, maintain, and monitor the performance of one Bergey Excel at each of its four sites. These four sites are geographically diverse and are characterized by challenging weather extremes. These projects will demonstrate the use of wind for distributed power needs for grid-connected generation under diverse ownership scenarios.

#### *Webster, New York*

An "Agreement for Professional and Technical Services" was successfully executed with Bob Bechtold to install this host site's turbine and system. Wind turbine and tower will be delivered to the site in the third quarter.

#### *Liberty Science Center, Jersey City, New Jersey*

AWS successfully negotiated an "Agreement for Professional and Technical Services" with the Liberty Science Center. The Agreement officially commits the Center to cost sharing the project and describes the specific responsibilities of each party. In the meantime, a site plan for the installation of the turbine was submitted to the Center. The wind turbine and tower were ordered and their delivery to the site is expected in the third quarter.

#### *Environmental Education Center, Babylon, New York*

The town of Babylon proposed that a new site near the Environmental Education Center replace the original site. The new location offers the same challenging marine environment with excellent exposure to the wind as the original site, but also provides a unique opportunity to challenge the Center's many guests to think scientifically about the impact of electricity production on the environment and the use of "green" energy from wind power to meet their energy needs.

One alternate site from those originally proposed is being pursued. The current proposed site is the Potomac Land Trust.



Produced for the  
U.S. Department of Energy  
1000 Independence Avenue, S.W.  
Washington, D.C. 20585



Produced by the  
National Renewable Energy Laboratory  
1617 Cole Boulevard  
Golden, CO 80401

For on-line information about the U.S. Department of Energy's Wind Program,  
visit <http://www.eren.doe.gov/RE/wind.html>

For information on DOE's National Wind Technology Center,  
visit <http://www.nrel.gov/wind/>

For more information on renewable energy,  
contact Energy Efficiency and Renewable Energy Clearinghouse (EREC)  
at 1-800-DOE-EREC (363-3732).

TP-500-28946  
October 2000

## NOTICE

This report was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof.

Available electronically at <http://www.doe.gov/bridge>

Available for a processing fee to U.S. Department of Energy  
and its contractors, in paper, from:

U.S. Department of Energy  
Office of Scientific and Technical Information  
P.O. Box 62  
Oak Ridge, TN 37831-0062  
phone: 865.576.8401  
fax: 865.576.5728  
email: [reports@adonis.osti.gov](mailto:reports@adonis.osti.gov)

Available for sale to the public, in paper, from:

U.S. Department of Commerce  
National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161  
phone: 800.553.6847  
fax: 703.605.6900  
email: [orders@ntis.fedworld.gov](mailto:orders@ntis.fedworld.gov)  
online ordering: <http://www.ntis.gov/ordering.htm>