United States District Court
for the
District of Vermont

Vermonters for a Clean Environment, Inc., Justin Lindholm, Annette Smith, John David Geery, Thomas E. Shea, George S. Halford, Kathy Halford, and Tyler Resch, Plaintiffs, vs. Colleen Madrid, Forest Supervisor of the Green Mountain National Forest, Bob Bayer, Project Coordinator of the Deerfield Wind Project, Manchester District, Charles L. Myers, Regional Forester of the Eastern Region, in their official capacities as employees of the U.S.D.A. Forest Service, Defendants.	))))))))))))))))))))	Civil Action No.1:12-cv-73

DECLARATION OF RICHARD R. JAMES

1. My name is Richard R. James. I am the Owner and Principal Consultant for E-Coustic Solutions, of Okemos, Michigan (P.O. Box 1129, Okemos MI 48805).

2. The purpose of my declaration is to point out the numerous ways in which the noise analysis relied on by the Forest Service in issuing its Final Environmental Impact Statement ("FEIS") was scientifically invalid and severely flawed. For instance, the Forest Service purports to have analyzed the noise impact of the developer's wind turbines on the adjacent Aiken Wilderness Area, yet its consultant never collected any noise data from within the Aiken. Additionally, a recent sound study conducted at the Sheffield Wind Project (a highly analogous site) completely undermines the

assumptions relied on and the conclusions reached by the developer's consultant in its modeling in this case.

Background and Qualifications

3. I have been a practicing acoustical engineer for 40 years. Prior to that, I received my degree, Bachelor of Science in Mechanical Engineering, from the General Motors Institute (n/k/a Kettering Institute) in 1971. I have been actively involved with the Institute of Noise Control Engineers (INCE) since I started my career in the early 1970s. I have full member status in the Institute of Noise Control Engineers.

4. My clients include many large manufacturing firms, such as, General Motors, Ford, Goodyear Tire & Rubber, and others who have operations involving both community noise and worker noise exposure.

5. In addition, I have worked for many small companies and private individuals. I have used computer models based on the same methods and algorithms as those used by Resource Systems Group, Inc. ("RSG") since the early 1970s. I am very familiar with the uses and limitations of such models.

6. My academic credentials include appointments as Adjunct Professor and Instructor to the Speech and Communication Science Departments at Michigan State University and Central Michigan University.

7. Specific to wind turbine noise, I have worked for clients in over 60 different communities. I have provided written and oral testimony in approximately 30 of those instances. I have authored or co-authored four papers covering topics such as how to set criteria to protect public health, and others demonstrating that wind turbine sound emissions are predominantly comprised of infra sounds (*i.e.*, sounds that that are between 0 and 10 Hz, such that they are felt and not heard).

THE NOISE STUDY RELIED ON BY THE FOREST SERVICE WAS SCIENTIFICALLY INVALID AND SEVERELY FLAWED

8. I have reviewed the Forest Service's FEIS relative to this project. (Administrative Record [A.R.] at 03C.00490-03C.00985.) In particular, I carefully reviewed FEIS at Section 3.4 Noise (pp. 96-118; A.R. 03C.00597-03C.00621), as well as the FEIS "Noise Primer" (FEIS Appendix B; A.R. 03C.00016 - 03C.00029).

9. I have also reviewed the Public Service Board testimony on behalf of the developer by Kenneth Kaliski (A.R. 09C6.00058 - 09C6.00067; 11B.00441 - 11B.00476; 11B.00515 - 11B.00521; 11B.00589 - 11B.00592; and 11B.00860 - 11B.00869), on whose work the Forest Service has heavily relied, as well as several studies prepared by Mr. Kaliski's firm ("RSG Deerfield Wind Project-Noise Impact Study," Dec. 28, 2006; A.R. 11B.00300 - 11B.00341; "Revised Noise Impact Study," Nov. 28, 2007; A.R. 10B.12510 - 10B.12553; and "Noise Impact Study Addendum," July 1, 2008; A.R. 11B.00852 - 11B.00859.) Mr. Kaliski's work, as contained in the above documents and testimony, and as adopted by the Forest Service in its own documents (hereinafter referred to in the singular as the "Noise Study"), is inaccurate and scientifically invalid in multiple ways as set forth more fully below.

LACK OF BACKGROUND SOUND DATA FROM INSIDE THE AIKEN WILDERNESS

10. The Noise Study contains no sound data collected from inside the Aiken Wilderness. Instead, it depends on a sound monitoring instrument placed outside and to the east of the Wilderness. (FEIS Section 3.4.1.3 Methodology of Background Sound Level Monitoring, pg. 101 and description of MB-1 in Section 3.4.1.4, pg. 101; both at A.R. 03C.00604.) This factor renders the Noise Study unscientific and invalid.

11. In order to conduct a valid study, monitoring instruments should have been placed in various areas within the Wilderness which are representative of the varying topography and atmospheric conditions there, in order to give an accurate baseline of existing conditions. This is necessary, because, by way of example, the 15 wind turbines are proposed for placement on ridgelines, where wind speed can be very high, thereby creating maximum turbine noise, while in the valleys within the Aiken, wind speeds would remain relatively low, thereby making the turbine noise relatively loud to the human ear.

12. I have measured background sounds in other wilderness areas and found background sound levels in the range of 20 to 25 dBA (LA90) on a routine basis. RSG states in Table 3 of the 2006 document that the LA90 sound level at its MB-1 test site is 28 dBA at night. ("Noise Impact Study," Dec. 28, 2006, Figure 4, pg. 11; A.R. 11B.00313.) However, the graph for Figure 4 shows nighttime LA90 (sound level that represents the quietest 10% of the time at night) sound levels of 22 to 26 dBA. The 26 dBA measurement was concurrent with a high wind on the ridge condition. Winds in valley areas shielded by ridges are often low or calm, resulting in little or no wind induced noise when winds on the ridges are at high speeds. The report, however, never points this out, instead focusing on the 28 dBA from the summary table.

INACCURATE COMPUTER MODEL

13. The computer model used in the Noise Study is derived from a standard test procedure (IEC 61400-11) (Wind Turbine Generator Systems, Part 11: Acoustic Noise Measurement Techniques) that is valid only for wind turbines placed where the topography is flat and without trees, such as areas in the American Midwest. Locating

turbines on mountain ridgelines results in increases in noise levels, particularly at night, of 6 to 13 dBA or more.

14. If the computer model had taken into account the mountain ridgeline placement of the wind turbines, the increase in sound levels taken at the MB1 test site would not be the 7 dBA reported (FEIS at 106; A.R. 03C.00509); , but rather in the range of 13 to 20 dB. The nighttime sound levels from the wind turbines would be raised from the 22-25 dBA predicted to a range of 29 to 38 dBA along the eastern edge. Such an increase is highly significant from a scientific standpoint and would create very noticeable sound impacts from within the Aiken Wilderness.

<u>NO DISCLOSURE OF FLUCTUATING SOUND LEVELS AND THEIR EFFECT ON HUMANS</u>

15. The Noise Study inaccurately sets forth an average sound level, and does not inform the public of the minimum and maximum sound levels of the wind turbines from within the Aiken. (*See*, *e.g.*, "Noise Impact Study," Dec. 28, 2006, p. 19 section 5.1; A.R. 11B.00321.)

16. Nighttime operation of wind turbines, particularly those on ridgelines where winds are turbulent, have a distinctive swishing, whooshing, or thumping sound-burst associated with blade rotation. For example, when a turbine is operating at full power production (*i.e.*, 20 rpm), this sound-burst occurs once every second. Fluctuating noises such as those associated with wind turbines are far more annoying to humans than steady sound, and far more likely to result in sleep disturbance.

17. To visitors to the Aiken Wilderness who camp overnight in tents, these annoying fluctuations in sound will be the dominant aspect of the wind turbine noise. The Forest Service Noise Study makes no mention of this environmental impact.

Failure to Take Into Account "Line Source" Sound Propagation

18. The Noise Study fails to take into account the fact that the wind turbines are proposed for spacing in a linear fashion across the ridgelines. (FEIS at Figure 2-2 "Project Layout, Reduced West Alternative"; A.R. 03C.00446.) It inaccurately assumes that the turbines will be placed in a non-linear, "point source" fashion. But "line source" wind turbines such as these propagate noise for far greater distances than those inaccurately assumed by the Forest Service. The decay rate of sound propagation for a "line source" is only half that of "point source" sound propagation. Hence the noise levels from the Deerfield wind turbines will be significantly greater within the Aiken Wilderness than the Forest Service has stated.

19. Table 1 (below) shows the sound level predicted by RSG and shown in its Noise Impact Study Addendum for increasing distances from the centerline of the western turbines to MB-1 (shown as 31 dBA on the cited map, FEIS Figure 3.4-5). (FEIS at Figure 3.4-5 "Project-Related Sound Levels From the Reduced West Alternative"; A.R. 03C.00456.) The 4-7 dB difference for each doubling of distance seen in the third column (RSG Predicted Sound Level from Turbines to MB-1) shows that the RSG model of Deerfield is a "point" source model and that is uses a 6 dB decay rate. The source graphic used for scaling and estimating the line source propagation sound levels was from the 2011 RSG Noise Study, reflected in the FEIS at figure 3.4-5. (*See id.*)

Table 1 RSG Model Predicted Levels Along Line From West Turbines To MB-1 Compared To Levels For A Line Source Model At Equivalent Distances				
No:	Distance from Centerline of West Turbines (miles)	RSG Predicted Sound Level from Turbines to MB-1	Expected Level using 3 dB decay rate for "line" sources to MB-1	Increase in RSG's dBA at each distance to account for Line Source Propagation
1	0.1	55	55	Assumed equal
2	0.2	49	52	+3 dBA
3	0.4	43	49	+6 dBA
4	0.8	38	46	+7 dBA
5	1.6	31	43	+11 dBA

20. Table 1, column 2, shows distance from the western ridge turbines measured along a line drawn from them to the MB-1 test site outside the eastern boundary of Aiken. It starts at a point 0.1 miles from the centerline of the line of turbines where the predicted sound level is 55 dBA (Leq). For the sake of this example, it is assumed that the sound levels at this location are 55 dBA for both a point and line source model. Doubling this distance to 0.2 miles and inspecting the contour map shows the RSG predicted level to be 49 dBA (Leq). This is roughly 6 dB lower than at 0.1 miles as would be expected for a point source model.

21. If the line-source decay rate was used, the level would be approximately 52 dBA (Leq). (*See* Column 4, Expected Level using 3 dB Decay rate.) Doubling the distance again to 0.4 miles from the centerline of the west ridge turbines shows RSG predicting 43 dBA (Leq) while the line model would be 49 dBA (Leq). Doubling it again to 0.8 miles (half the distance between the ridge turbines and MB-1) shows RSG at 38 while the line model would be 46 dBA (Leq). At 1.6 miles the RSG model shows 31 dBA at MB-1 while the line source model would have been 43 dBA (Leq).

22. This analysis demonstrates that any claims by RSG that the model it used follows the line-source propagation rate are not demonstrated by the model's predictions. It is clear that the RSG model sound drops off at a rate closer to 6 dB than 3 dB per doubling of distance. Further, had the RSG model used a line-source decay rate, the impact of the wind turbines along the west ridge could have been 43 dBA (Leq), at least 12 dBA higher than RSG predicts.

23. The Forest Service's uncritical reliance on RSG's models was part of the basis for its decision that there were no significant adverse impacts on the Aiken Wilderness (in spite of the RSG study not including the Wilderness in its evaluation). Given that the model was not appropriate for the arrangement of the western Deerfield turbines the Forest Service's determination is in error, and the impact of the wind turbines much greater at the MB-1 site than disclosed in the documents it used to support its decision.

24. If the combination of errors and omissions disclosed above were all considered there would be strong evidence that the Deerfield project would in fact cause a significant adverse impact to the Wilderness area.

No Consideration of the Impact of Low-Frequency Sound

25. The Noise Study significantly de-emphasizes the total acoustic energy emanating from the wind turbines by using only the dBA scale, which does not adequately take into account low-frequency noise. The Noise Study briefly mentions low-frequency sound in the context of whether it will cause buildings to vibrate. ("Noise Impact Study," Dec. 28, 2006, at p. 32, Section 7.3; A.R. 11B.00334.) But, that statement only considers the acoustic energy in the frequency bands from 31.5 Hz and higher. ("Noise Impact Study Addendum," July 1, 2008, p. 31, Section 7.3 Low Frequency Sound; A.R. 11B.00859.)

26. The Noise Study ignores the ways in which people perceive these low-frequency sounds and looks only at the effect on structures. The highest levels of acoustic energy emitted by wind turbines are in the frequency range below 20 Hz. The Noise Study considered only about 10% of the acoustic energy emitted by the wind turbines and even then did not address its effects on people or wildlife. The low-frequency noise generated by wind turbines propagates farther and has a significantly higher human annoyance potential.

WIND TURBINES SOUND NOTHING LIKE NATURAL WIND

27. Because RSG's analyses ignore both the low-frequency and fluctuating aspects of wind turbine sounds, the Noise Study is able to make the grossly incorrect (and frankly astounding) assertion that "[w]ind turbines are special sound generators in that their sound emissions are often masked by noise from the wind moving through trees and other vegetation . . . ." ("Noise Impact Study," Dec. 28, 2006, at p. 20, Section 6 "Sound from Wind Turbines – Special Issues"; A.R. 11B.00322.)

28. The two have some similar characteristics when looked at in aggregate data such as the dBA readings used in the Noise Study. However, the experience of actually listening to wind turbine noise is far different. Wind turbine noise fluctuates with blade swishes that are related to rotation speed. The specific frequencies and amplitudes of wind turbine noise, which are associated with machine sounds, are far different from those heard in nature. People describing them often compare them to the sounds from helicopters or overhead aircraft that never leave.

29. I have personally conducted acoustic measurements at numerous industrial-scale wind energy utilities. Thirteen of these test locations included observations during weather conditions which produced both wind noise and wind turbine noise. Many of

these were in locations where wind moving through trees and other vegetation was the source of the wind induced noise. This includes projects in Maine, New York, Pennsylvania, West Virginia and Michigan which operate in primarily rural and/or wilderness locations. Based on my own experience I can say without any reservation that the two sounds are separate and distinct, and that the sound of natural wind does not mask the noise generated by these enormous industrial-scale machines.

THE NOISE STUDY'S PREDICTED SOUND LEVEL IS CONTRADICTED BY A RECENT STUDY CONDUCTED AT THE SHEFFIELD WIND PROJECT

30. The predicted sound level at MB-1 and east of the Aiken Wilderness East border is much lower than measured sound levels at similar distances from other analogous wind projects, such as the Sheffield Wind Project.

31. The developer of the Sheffield Wind Project recently submitted a study, documenting "sound compliance monitoring" at that site, to the Vermont Public Service Board. (Report No. 1838-060312-A, Issued June 8, 2012, "Operational Sound Level Compliance Test, Springtime Conditions, Sheffield Wind Project.") (Relevant excerpts from that study are attached hereto, as Ex. 1.) In my experience, measurements (such as those from the Sheffield site) trump theoretical models (such as those conducted by RSG here).

32. Ten of the turbines modeled for the Deerfield site are model Gamesa G87, which have a rating of 106.5 dBA Lw. (FEIS at 116; A.R. 03C.00619.) The remaining five are model Gamesa G80 turbines, which have a rating of 105 dBA Lw. (*Id.*) The Sixteen Sheffield turbines are Clipper – Liberty 2.5 MW wind turbines. Twelve have a 93-meter blade (model C93) and four have a 96-meter blade (model C96). (*See* Ex. 1, at p. 1 "Introduction.") All sixteen have a rating of 106 dBA Lw. (Relevant excerpts from the

Clipper – Liberty 2.5 MW brochure are attached as Ex. 2; the "Technical Specifications" page provides the dBA level of the turbines, at "Noise Performance[.]") Accordingly, two-thirds of the Deerfield turbines have a marginally higher dBA rating than the Sheffield turbines. However, the differences in sound levels, from machines producing similar sound characteristics (such as different model turbines), of less than three dBA are generally considered to be non-detectable to listeners. Accordingly, the Sheffield turbines and the proposed Deerfield turbines are functionally the same in sound power. Additionally, there would be no measurable difference between the sound levels generated by the sixteen turbines at Sheffield and the fifteen turbines proposed for the Deerfield site, under the selected "reduced turbines in the western project site alternative[.]" (FEIS at 116; A.R. 03C.00619.) Therefore, we can assume that the sound proposed is within the range shown at Sheffield.

33. The natural setting of Sheffield is a close approximation of the Deerfield Project western turbines, with turbines on a ridge and the test location at a lower elevation and with trees and vegetation between the ridge and receiving location.

34. The Sheffield study (Ex. 1) summarizes the findings of the compliance tests in Table 1.1.1 on page 2. One of the test sites, SM2 is located 1.8 miles from the nearest turbine in the Sheffield Wind Project. The report concludes that turbine sounds at this site average 38 dBA (Leq) with levels of 45 dBA (Leq) being a typical maximum or high-noise condition. The tests found levels as high as 54 dBA (Leq) from the turbine sounds at this location.

35. This study supports the points made herein. Specifically, while RSG's model has assumed the most favorable conditions possible, in order to present low sound readings,

the real-world analysis conducted at the Sheffield site completely undermines RSG's rosy, best-case assumptions and attendant conclusions.

36. RSG's ultimate prediction of 31 dBA (Leq) to the east of the Aiken Wilderness is not an accurate portrayal of the impact of the turbine noise. The Forest Service's uncritical, and apparently unqualified, reliance on it as the basis for approving the Deerfield project shows that it failed to take a hard look at the potential for wind turbines as proposed for the Deerfield Wind Project to cause significant noise impacts. The real-world measurements from a similar project at a similar distance were in agreement with the increased sound levels that would be expected were RSG to adequately address the issues raised above.

CONCLUSION

37. In my opinion, the Noise Study is without any substantial or reliable scientific basis and is on its face invalid.

I declare under penalties of perjury that the foregoing is true and correct. 28 U.S.C. § 1746.

July 23, 2012

/s/ Richard R. James
Richard R. James

EXHIBIT #1

Dunkiel Saunders
ELLIOTT | RAUBVOGEL | HAND

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Mark A. Saunders
Karen L. Tyler

June 11, 2012

By First Class Mail

Mrs. Susan Hudson, Clerk
Vermont Public Service Board
112 State Street, Drawer 20
Montpelier, VT 05620-2701

Re: Docket No. 7156

Dear Mrs. Hudson:

On behalf of Vermont Wind, LLC, enclosed please find the *Operational Sound Level Compliance Test, Springtime Conditions* (Hessler Associates, June 8, 2012). The report reflects the second quarterly testing of the Year One sound compliance monitoring, in accordance with Section 3.0 of the Board-approved Noise Monitoring Plan and pursuant to Condition 10 of the CPG. The report finds that based upon the data collected, the operation of the Project has not resulted in any exceedances of the noise limits set in Condition 8 of the CPG.

Thank you for your attention to this matter, and please do not hesitate to contact me should you have any questions.

Sincerely,

Andrew Raubvogel, Esq.
Dunkiel Saunders Elliott Raubvogel & Hand, PLLC

Enclosures

cc: Service List

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REPORT NO. 1838-060312-A

REV: A
DATE OF ISSUE: JUNE 8, 2012

OPERATIONAL SOUND LEVEL COMPLIANCE TEST
SPRINGTIME CONDITIONS

SHEFFIELD WIND PROJECT

SHEFFIELD, VERMONT

PREPARED FOR:

Vermont 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.

1.0 INTRODUCTION

Hessler Associates, Inc. has been retained by Vermont Wind, LLC to conduct a field survey of the sound emissions produced by the Sheffield Wind Project in order to determine whether or not the project complies with the noise standards imposed on the project by the Vermont Public Service Board (PSB). In essence, the sound emissions due exclusively to the project are limited to 30 dBA inside of residences or King George School structures in the vicinity of the project.

The project, which consists of 12 Clipper C93 wind turbines and 4 of the C96 model, is located on the summit of Granby Mountain within the boundaries of the Town of Sheffield, VT. The slopes of the mountain are forested and the nearest permanent residences in any direction are approximately 1 mile away from the project perimeter at substantially lower elevations.

The survey was carried out in accordance with a project-specific "Noise Monitoring Protocol" (Appendix A) approved in advance by the Vermont PSB. The procedure requires measurements during all four seasons and this report summarizes the results of the springtime test, which was performed in April and May of 2012.

1.1 EXECUTIVE SUMMARY

A field survey of the sound emissions produced by the Sheffield Wind Project was carried out in late April and May of 2012 under springtime conditions in order to determine whether or not the project complies with the noise standards contained in Condition 8 of the project's Certificate of Public Good (CPG), which limits project noise to 30 dBA inside of residences or King George School structures in the vicinity of the project.

The survey was carried out in accordance with a project-specific "Noise Monitoring Protocol" approved in advance by the Vermont Public Service Board. The procedure requires measurements during all four seasons and this survey represents the springtime test.

In brief, the test procedure involves long-term (14 day) measurements at four pre-determined receptor points (Sound Measurement positions, SM1 through SM4) supplemented by various background monitoring positions in order to derive the project-only sound level outside each of the four principal measurement locations. This outdoor level is then converted to an indoor sound level using the results of an outside-to-inside level reduction (OILR) test.

In general, the outdoor monitoring results show that the sound signal from the project is quite weak at each of the principal test positions and, in most cases, is largely indistinguishable from, and not detectable above, the natural background level. Consequently, it is unlikely, even after applying a correction for background noise per the test protocol, that the results obtained in this survey actually quantify the project-only sound. Instead, the test results essentially indicate the maximum value that project noise could *possibly* have reached and, for the most part, are almost certainly overestimates of the true project sound level.

Sound measurements were recorded continuously day and night in 10 minute increments over an initial 16 day survey period from April 25 to May 11, 2012. Supplemental measurements were also taken over a further 14 day period from 5/17 to 6/1 at SM2 and SM4 (only) to ensure that sufficient data were collected, since two instruments did not run for the entire length of the primary survey period.

The results are evaluated in terms of both the residual sound level (the L90 statistical) and the average sound level (Leq). Because the L90 level in effect filters out contaminating noise events unrelated to project noise, it generally gives the best indication of the value of a low level underlying sound source in a complex soundscape. The Leq measure, on the other hand, is strongly affected and clouded by these interfering noise events and when the source signal of interest is weak relative to the background level, as it is in this case, the Leq makes it difficult or impossible to get a conclusive result and/or tends to grossly overestimate the value of the source signal. This latter measure is reported only because the State noise standard of 30 dBA is expressed as an Leq value.

The following table summarizes the sound levels that were measured at the four measurement locations during the survey. Three different values are given:

Peak: The highest peak level that could *possibly* be associated with the project – usually occurring during only one or two 10 minute samples out of the thousands recorded. This measurement cannot be conclusively associated with the project.

More Typical Maximum: This is generally the maximum sound level that was observed on multiple occasions. This value is roughly estimated from a visual inspection of the plotted results.

Average: The arithmetic average of all samples of apparent project-only sound, encompassing all wind and weather conditions. This value is considered the closest to the actual project sound level, although the relatively large distances from the project to the measurement positions makes it quite difficult to definitively measure the project's sound emissions as distinct from natural background noise. The general tendency is for all of the reported values, average through peak, to contain significant amounts of background contamination making the project level appear higher than it probably actually is.

Table 1.1.1 *Nominal Project Sound Levels (dBA) at All Design Points* - ***Outdoors***

Receptor Point	L90	Leq
SM1 – Peak	50	52
SM1 – More Typical Maximum	40	45
SM1 – Average	**30**	**35**
SM2 – Peak	47	54
SM2 – More Typical Maximum	39	45
SM2 – Average	**34**	**38**
SM3 – Peak	43	49
SM3 – More Typical Maximum	35	45
SM3 – Average	**29**	**33**
SM4 – Peak	50	53
SM4 – More Typical Maximum	45	49
SM4 – Average	**37**	**45**

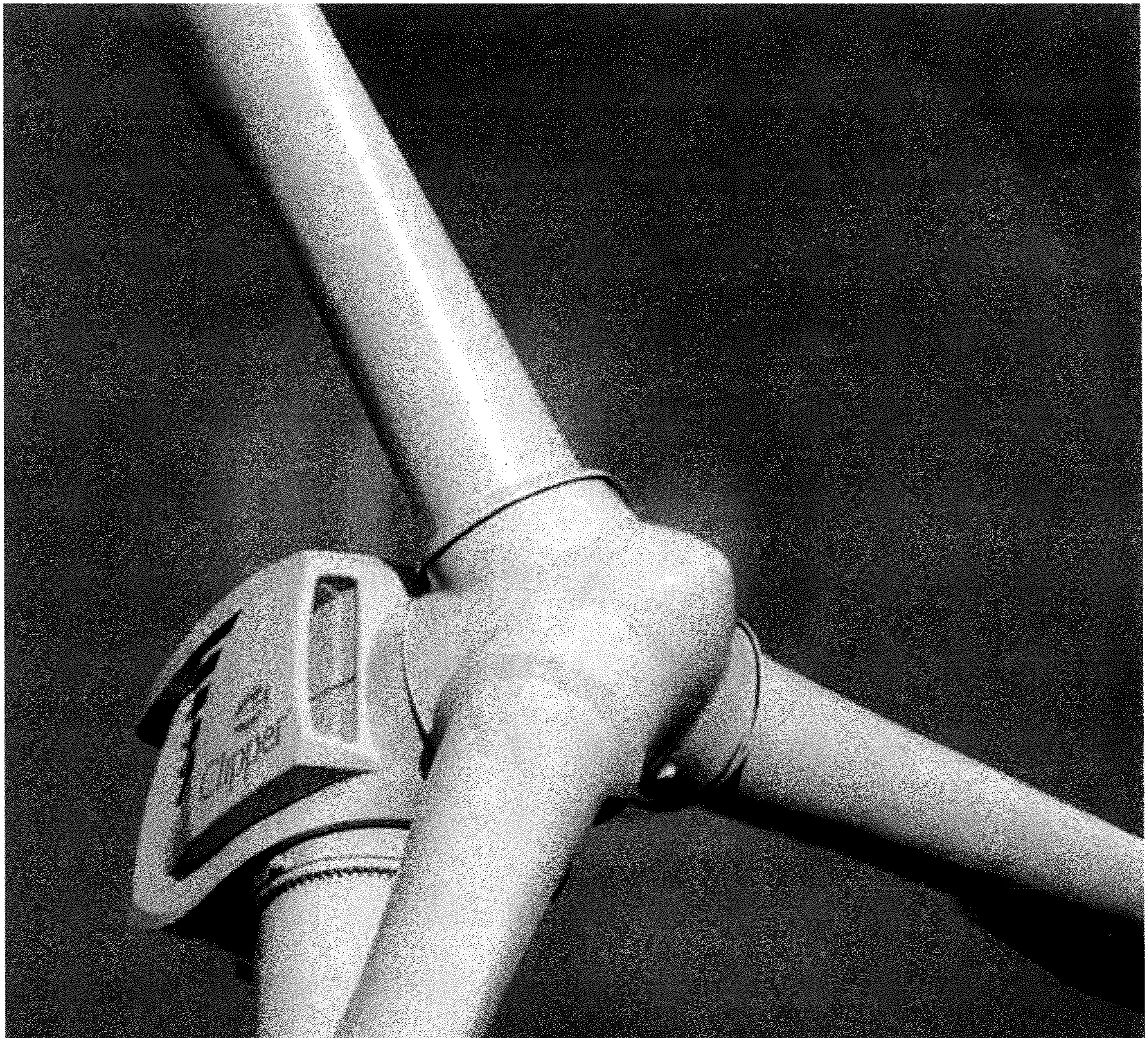
Permission to perform outside to inside field tests could only be obtained at SM2 and SM3. OILR values for SM1 and SM4 were conservatively estimated based on these results. The measured or estimated values at the four principal receptor points are tabulated below.

Table 1.1.2 *Measured or Estimated OILR Values (dBA) at All Design Points*

Receptor Point	Outside to Inside Level Reduction, OILR
SM1 - Estimated	30
SM2 - Measured	38
SM3 - Measured	33
SM4 - Estimated	30

The final test results showing the maximum indoor sound levels nominally attributable to the project are summarized below. The higher result from the initial survey period was used in all cases, since equal or slightly lower levels were obtained in the supplemental survey.

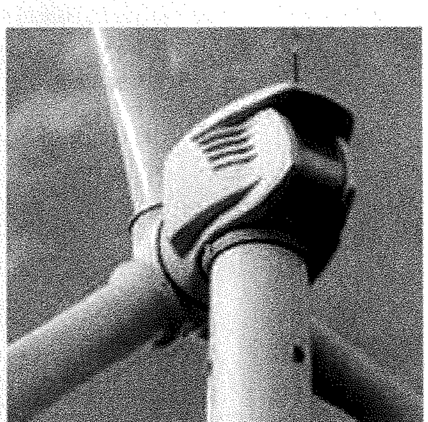
EXHIBIT #2



LIBERTY

THE LIBERTY 2.5MW WIND TURBINE...

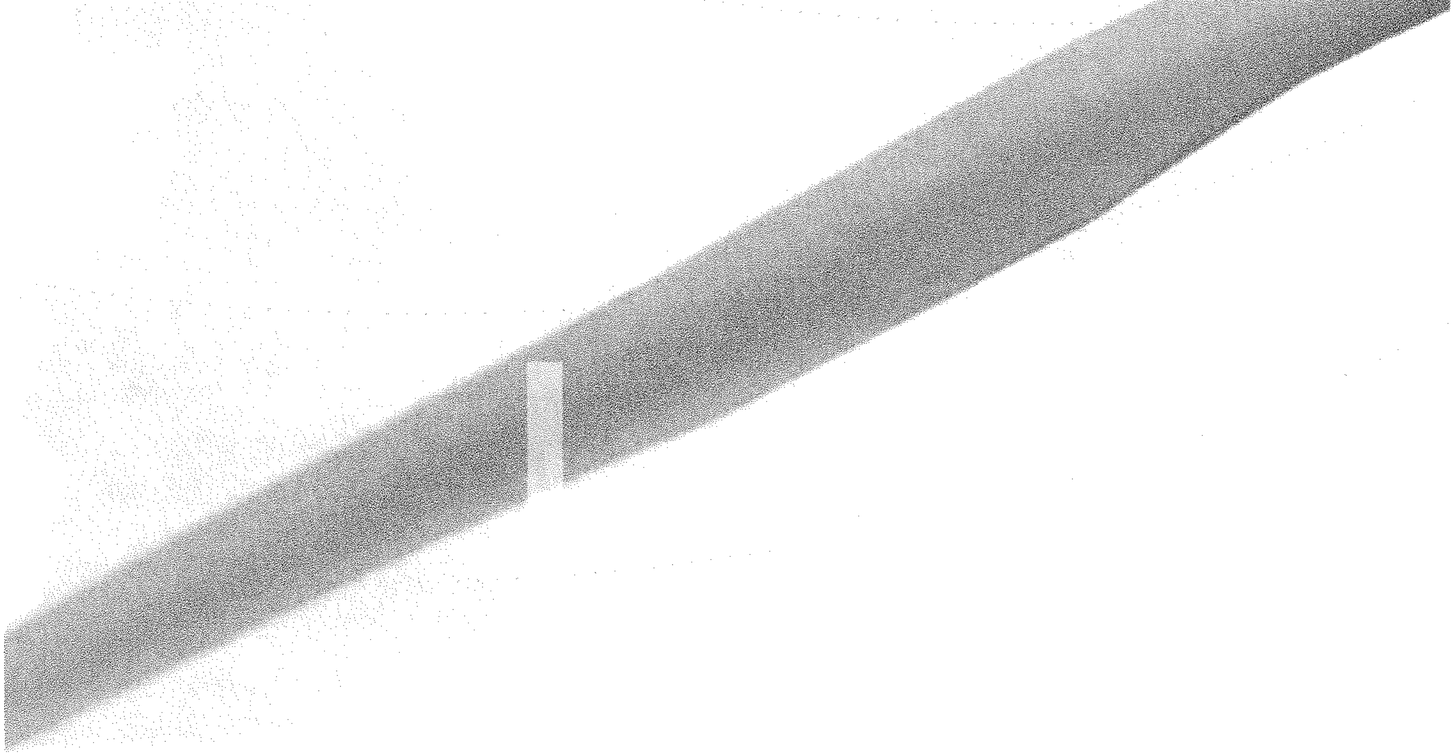
...A NEW STANDARD FOR RELIABLE PERFORMANCE AND REDUCED OPERATING COSTS.



Conventional wind turbine architecture has remained relatively unchanged since its modern beginnings in the early 1980's. Its scaling-up in size over recent years, however, has placed extreme forces on today's large megawatt-plus machines, calling for an advanced architecture appropriate for larger-scale operating requirements... namely lower rotor speed and the ability to manage exponentially higher torque in the power-train.

With a goal to create an advanced wind turbine that would simply and innovatively improve upon standard industry benchmarks and address today's wind technology deficiencies, the Liberty design was born. Through her D-GEN Quantum power-train, an evolutionary, advanced method of torque splitting, Liberty eases point loads, reduces major component failures and extends operating life.

As one might expect, a book of new patents flowed from Liberty's remarkable design. From her compact, highly durable and efficient power-train, to simpler, more effective variable speed control and voltage ride-through capability that exceeds the most stringent of planned grid standards. Liberty also achieves higher power-train efficiency through the use of four permanent magnet generators, delivering continuous power generation, even through a generator outage.



TECHNICAL SPECIFICATIONS - LIBERTY 2.5 MW WIND TURBINE

Power Output	2500 kW			
Operation	Variable Speed: 9.7 - 15.5 rpm			
Wind Class	S*	IIa	IIb	IIIb
Rotor Diameter	89m	93m	96m	99m
Swept Area	6221m^2	6793m^2	7238m^2	7698m^2
Blades	43.2m	45.2m	46.7m	48.2m

** Class S - All parameters same as IEC Class IA except 50-year return gust value is 64.5 m/s instead of 70 m/s*

Cut-in Wind Velocity	4 m/s - 10 min. avg.
Cut-out Wind Velocity	25 m/s - 10 min. avg.
Cut-out Wind Gust	29 m/s - 5 sec. exceedance
Pitch System	3X DC Electric Motors, Servo Drives and Batteries
Generator	
Type	Permanent Magnet (Synchronous)
Rated Power Each	660 kW
Number of Units	4
Voltage	1350 VDC
Controller	
Type	Embedded Motorola Power PC
Voltage 3-Phase	480 VAC, 240 VAC
Voltage, Single Phase	120 VAC
Power Converter	
Type	4X Current Sourced, IGBT Inverters
Voltage	690 VAC
Frequency	50±3Hz, 60±3Hz
Grid Compatibility	
Frequency-Continuous	50 Hz or 60Hz±3Hz
Line Voltage 690 VAC	Continuous ±10% / 5 sec. ± 20%
Line Fault Ride-Thru	-90% of Nominal Line for 3 sec.
Line Phase Imbalance	Rated Power ±5% / Cut-in ±10%
Yaw System	4 Electric Motors with Planetary Drives
Yaw Bearing	Internal Gear, Ball Bearing
Yaw Brake System	4 Discs, Active Hydraulic
Parking Brake System	2 Discs, Active Hydraulic
Parking Brake Location	Intermediate Stage of Gearbox
Tower	Tubular Steel, 4 Steel Plate Sections
Hub Height	80m Standard / Other Options Available
Noise Performance	Sound Power Level - 106 db(A), according to IEC 61400-II
Service Hoist	On-Board 2-ton Jib Hoist
Maintenance	
Post Commissioning	Once at 500 Hours, Every 6 Months Periodic Optional Periodic at 12 Months

Power Curve