THE IICC AMENDMENT ON NOISE AND LOW FREQUENCY SOUND FOR THE PUBLIC HEALTH OF RESIDENTS OF RIGA TOWNSHIP, MICHIGAN

April 19, 2011

f. Sound.

(a) Audible Sound Limits.

(i) Night Time Sound

Sound emanating from the operation of a Utility Scale WES, WEGF or Conditional Use MET Tower shall not exceed five (5) dB above the average lowest Background Sound level present between the hours of 10:00 pm and 6:00 am measured at the closest property line of a Non-Participating Parcel. The Background Sound level shall be measured in accordance with Appendix A.

At no time between the hours of 10:00 pm and 6:00 am shall the sound emanating from the operation of a Utility Scale WES, WEGF or Conditional Use MET Tower exceed thirty-five (35) dB(A) measured at the closest property line of a Non-Participating Parcel in accordance with Appendix A.

(ii) Day Time Sound

During the hours of 6:00 am to 10:00 pm no Utility Scale WES, WEGF or Conditional Use MET Tower shall exceed Forty (40) dB(A) measured at the closest property line of a Non-Participating Parcel in accordance with Appendix A. If the Background Sound exceeds Forty (40) dB(A) during short term events, the standard shall be Background Sound plus five (5) dB(A) and shall be measured from the nearest property line of a Non-Participating Parcel.

(iii) Non-Conformity

Any Utility Scale WES, WEGF or Conditional Use MET Tower that exceeds the aforementioned audible sound limits for more than Ninety (90) consecutive minutes shall be deemed unsafe and the Township will request, and owner(s) shall immediately halt the operation of the offending structure.

(b) Low Frequency Sound Limit.

Low Frequency Sound (LeqC and L90C) emanating from the operation of a Utility Scale WES, WEGF or Conditional Use MET Tower shall not exceed the lower of either:

1. LeqC – L90A greater than 20 dB outside any occupied structure, or
2. A maximum not-to-exceed sound level of 50 dBC (LeqC) at the closest property line of a Non-Participating Parcel, measured in accordance with Appendix A.

(c) General Sound Limit

Sound emanating from the operation of a Utility Scale WES, WEGF or Conditional Use MET Tower shall not exceed 35 dBA within 100 feet of any occupied structure located on a Non-Participating Parcel at any time.

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Section 8. Amendment of Article 16, Section 16.01. Section 16.01, entitled Definitions, of the Zoning Ordinance of Riga Township is hereby amended to add the defined terms as follows:

Wind Energy Facilities and Systems: As used in this Ordinance the following definitions shall apply to wind energy facilities and systems:

Ambient. All sound present in a given environment, being a composite of sounds from many sources near and far, including ,but not limited to, intermittent noise events, such as barking dogs, aircraft flying overhead, wind gusts, mobile farm or construction machinery, vehicles on a nearby road, as well as sound from nearby insects, birds, animals, and people. Such transient events are NOT considered to be part of the Background Sound.

Background Sound (L_{90}). The sound level (dBA and dBC) present at least 90% of the time. Background sounds are those heard during lulls in the ambient sound environment. That is, when transient sounds from flora, fauna, and wind are not present. Nearby electrical noise from street lights, transformers, A/C units, etc. must also be excluded from background sound.

ANSI. American National Standards Institute.

Blade Passage Frequency (BPF). The frequency, expressed in terms of Hertz, at which the blades of a turbine pass a particular point during each revolution (e.g. lowest point or highest point in rotation) in terms of events per second.

dB(A). The sound pressure level in decibels. Refers to the "a" weighted scale defined by ANSI S1.43-1997. A method for weighting the frequency spectrum to mimic the human ear.

dB(C). The sound pressure level in decibels of frequencies below 1k Hz. Refers to the "c" weighted scale defined by ANSI S1.43-1997.

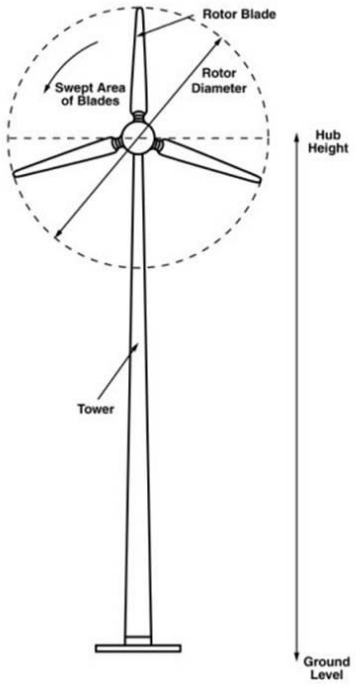
Decibel (dB). The unit of measure used to express the magnitude of sound pressure and sound intensity.

Frequency. The number of oscillations or cycles per unit of time. Acoustical frequency is expressed in units of Hertz (Hz) where one Hz is equal to one cycle per second.

Height. The total distance measured from the grade of the property (as existed prior to the construction of the wind turbine at its based to its highest point.

Hertz. Frequency of sound expressed by cycles per second.

Horizontal Axis Wind Energy System. A wind turbine design in which the shaft is parallel to the ground and the blades are perpendicular to the ground.



Hub Height. The vertical distance measured from the grade of the property prior to the construction of the wind turbine to the center of the turbine hub.

MET (meteorological) Tower. The structure and equipment used to determine the placement or potential placement of a WES, containing instrumentation such as anemometers designed to provide wind data.

(WES) Non-Participating Parcel. A parcel of record not subsidized in any way by the implementation of an On-Site WES, Utility Scale WES, MET Tower (of any size), or Wind Energy Generation Facility.

On-Site Use Wind Energy System ("On-Site WES"). A WES with the purpose of providing energy to only the property where the structure is located, or to adjacent

properties under the same ownership or control as the property where the structure is located, or to adjacent properties with the consent of the owners of the property where the structure is located and the owners of the adjacent properties.

(WES) Participating Parcel. A parcel of record where the placement of a Utility Scale WES, MET Tower, a transmission line or any other WEGF related devices or easements which accompany the implementation of a WES has rendered a monetary gain to be rendered by the property owner. For On-Site WES, the Participating Parcel is the parcel where the structure is located.

Qualified Independent Acoustical Consultant. Qualifications for persons conducting baseline and other measurements and reviews related to the application for a WES or for enforcement actions against an operating WES include, at a minimum, demonstration of competence in the specialty of community noise testing. An example is a person with Full Membership in the Institute of Noise Control Engineers (INCE). There are scientists and engineers in other professional fields that have been called upon by their local community for help in the development of a WES Noise Ordinance. Many of these scientists and engineers have recently spent hundreds of hours learning many important aspects of noise related to the introduction of WES into their communities. Then with field measurement experience with background data and wind turbine noise emission, they have become qualified independent acoustical consultants for WES siting. Certifications such as Professional Engineer (P.E.) do not test for competence in acoustical principles and measurement and are thus not, without further qualification, appropriate for work under this document. The Independent Qualified Acoustical Consultant can have no financial or other connection to a WES developer or related company.

Qualified Landowner. Owners of record, and/or their legitimate heirs or assigns, of real property located within two (2) miles of any Utility Scale WES, Conditional Use MET Tower, or WEGF

Sensitive Receptors. Places or structures intended for human habitation, whether inhabited or not, public parks, state and federal wildlife areas, the manicured areas of recreational establishments designed for public use, including but not limited to golf courses, camp grounds and other nonagricultural state or federal licensed businesses. These areas are more likely to be sensitive to the exposure of the noise, shadow or flicker, etc. generated by a WES or WESF. These areas include, but are not limited to: schools, daycare centers, elder care facilities, hospitals, places of seated assemblage, non-agricultural businesses and residences.

Shadow Flicker. Alternating changes in light intensity caused by the moving blade of a WES casting shadows on the ground and stationary objects.

Sound Pressure. The instantaneous difference between the actual pressure produced by a sound wave and the average or barometric pressure at a given point in space.

Sound Pressure Level (SPL). The sound pressure mapped to a logarithmic scale and reported in decibels (dB). Specifically, 20 times the logarithm, to the base 10, of the ration of the pressure of sound measured to the reference pressure, which is 20 micronewtons per square meter. Expressed in equation form as SPL (dB) = 20 log p/pr.

Third Party Qualified Professional. A professional with all necessary licensing, training or other credentialing who is not an employee of the Wind Energy System Owner (including its subsidiaries or affiliates), nor Township. Township retains the right to make final determinations as to whether or not an entity or individual qualifies as a Third Party Qualified Professional.

Total Height. Vertical distance measured from the ground level at the base of the tower to the uppermost vertical extension of any blade, or the maximum height reached by any part of the Wind Energy System (WES) whichever is greater.

Utility Scale Wind Energy System. A WES designed and constructed to provide electricity to the local municipal electric utility grid and either (1) possesses a Total Height of equal to or greater than One Hundred Twenty Five (125) feet or (2) occupied by a number of turbines that exceed a combined total potential power output greater than a maximum of ten (10) kW per hour or both.

Vertical Axis Wind Energy System. A wind generator design where the rotating shaft is perpendicular to the ground and the cups or blades rotate parallel to the ground.

WES Rotor Diameter. The distance measured across the central potential swept area of a WES blade's pattern.

Wind Energy System (WES). Equipment that converts and then stores or transfers energy from the wind into usable forms of energy and includes any base, blade, foundation, generator, nacelle, rotor, tower, transformer, turbine, vane, wire, or other component used in the system. Also refers to the term "wind turbine" or "wind generator".

Wind Energy Generation Facility (WEGF). Electricity generating facility consisting of one or more Utility Scale wind turbines under common ownership or operational control, and includes substations, MET Towers, cables/wires and other buildings accessory to such facility, whose main purpose is to supply electricity to off-site customers.

APPENDIX A

Riga Township Measurement Protocol for Sound and Vibration Assessment of Proposed and Existing Wind Energy Systems.

I. Instrumentation

All instruments and other tools used to measure audible, inaudible and low frequency sound shall meet the requirements for ANSI or IEC Type 1 Integrating Averaging Sound Level Meter Standards The principle standard reference for this document is ANSI 12.9/Part 3 with important additional specific requirements for the measuring instrumentation and measurement protocol.

II. Measurement of Pre-Construction Sound Environment (Base-line)

An assessment of the proposed WES project areas existing sound environment is necessary in order to predict the likely impact resulting from a proposed project. The following guidelines must be used in developing a reasonable estimate of an area's existing background sound environment. All testing is to be performed by an Independent Qualified Acoustical Consultant approved by the Township as provided in the body of the Ordinance. The WES applicant may file objections detailing any concerns it may have with the Township's selection. These concerns will be addressed in the study. Objections must be filed prior to the start of the noise study. All measurements are to be conducted with ANSI or IEC Type 1 certified and calibrated test equipment per reference specification at the end of this section. Test results will be reported to the Township or its appointed representative.

A. Sites with No Existing Wind Energy Systems (Baseline Sound Study)

1. Sound level measurements shall be taken as follows:

    a. The results of the model showing the predicted worst case L_{Aeq} and L_{Ceq} sound emissions of the proposed WES project will be overlaid on a map (or separate L_{Aeq} and L_{Ceq} maps) of the project area.

    b. The test points shall be located at the property line bounding the property of the turbine's host closest to the wind turbine. Additional sites may be added if appropriate. A grid comprised of one (1) mile boundaries (each grid cell is one (1) square mile) should be used to assist in identifying between two (2) to ten (10) measurement points per cell. The grid shall extend to a minimum of two (2) miles beyond the perimeter of the project boundary. This may be extended to more than two (2) miles at the discretion of the LGA. The measurement points shall be selected to represent the noise sensitive receptor sites based on the anticipated sound propagation from the combined WT in the project. Usually, this will be the closest WT. If there is more than one WT nearby then more than one test site may be required.

    The intent is to anticipate the locations along the bounding property line that will receive the highest sound immissions. The site that will most likely be negatively affected by the WES project's sound emissions should be given first priority in testing. These sites may include sites adjacent to occupied dwellings or other noise sensitive receptor sites. Sites shall be selected to represent the locations where the background soundscapes reflect the quietest locations of the sensitive receptor sites.

Background sound levels (and 1/3 octave band sound pressure levels if required) shall be obtained according to the definitions and procedures provided in the ordinance and recognized acoustical testing practice and standards.

c. All properties within the proposed WES project boundaries will be considered for this study. One test shall be conducted during the period defined by the months of April through November, with the preferred time being the months of June through August. These months are normally associated with more contact with the outdoors and when homes may have open windows during the evening and night. Unless directed otherwise by the Township, the season chosen for testing will represent the background soundscape for other seasons. At the discretion of the Township, tests may be scheduled for other seasons.

d. All measurement points (MPs) shall be located with assistance from the Township and property owner(s) and positioned such that no significant obstruction (building, trees, etc.) blocks sound and vibration from the nearest proposed WES site.

e. Duration of measurements shall be a minimum of ten (10) continuous minutes for all criteria at each location. The duration must include at least six (6) minutes that are not affected by transient sounds from near-by and non-nature sources. Multiple ten (10) minute samples over longer periods such as 30 minutes or one (1) hour may be used to improve the reliability of the L_{A90} and L_{C90} values. Record the maximum wind speed at the microphone during the ten minute sample. A single measurement of the temperature and humidity at the microphone should be recorded for each hour or each new location, whichever occurs more often. The ten (10) minute sample with the lowest valid L_{90} values will be used to define the background sound. A ten (10) minute measurement contains valid data provided that: (1) both LA10 minus LA90 and LC10 minus LC90 are not greater than 10 dB; and (2) the maximum wind speed at the microphone is less than 2 meters per second during the same ten (10) minute period as the acoustic data.

f. The tests at each site selected for this study shall be taken during the expected 'quietest period of the day or night' as appropriate for the site. For the purpose of determining background sound characteristics the preferred testing time is from 10pm until 4 am. If circumstances indicated that a different time of the day should be sampled the test may be conducted at the alternate time if approved by the Township.

g. Sound level measurements shall be made on a weekday of a non-holiday week. Weekend measurements may also be taken at selected sites where there are weekend activities that may be affected by WT sound.

h. Measurements must be taken with the microphone at 1.2 to 1.5 meters above the ground and at least 15 feet from any reflective surface following ANSI 12.9 Part 3 protocol including selected options and other requirements outlined later in this Section.

i. Time of measurements and prevailing weather: The atmosphere must be classified as stable with no vertical heat flow to cause air mixing. Stable conditions occur in the evening and middle of the night with a clear sky and surface wind speed is less than two (2) meters per second. Sound measurements are only valid when the measured wind speed at the microphone is less than two (2) meters per second. Any deviations

from this condition needed to test for a specific condition (i.e., - compliance with sound limits) must:

a. specifically describe the atmospheric conditions, including whether atmospheric conditions are stable, neutral or unstable;
b. Provide supplemental data specifying hub level wind speeds;
c. Provide supplemental data specifying turbine power production.

2. Reporting

a. For each Measurement Point, and for each qualified measurement period, provide each of the following measurements:

i. L_{Aeq}, L_{A10}, and L_{A90}, AND L_{Ceq} , L_{C10}, and L_{C90}

ii. A narrative description of any intermittent sounds registered during each measurement. This may be augmented with video and audio recordings.

iii. A narrative description of the steady sounds that form the background soundscape. This may be augmented with video and audio recordings.

iv. Wind speed and direction at the microphone (Measurement Point), humidity and temperature at time of measurement will be included in the documentation. Corresponding information from the nearest 10 meter weather reporting station shall also be obtained. A windscreen of the type recommended by the monitoring instrument's manufacturer must be used for all data collection.

v. Provide a map and/or diagram clearly showing (Using plot plan provided by Township or Applicant):

- The layout of the project area, including topography, the project boundary lines, and property lines.
- The locations of the Measurement Points.
- The distance between any Measurement Points and the nearest WT(s).
- The location of significant local non-WES sound and vibration sources.
- The distance between all MPs and significant local sound sources. And,
- The location of all sensitive receptors including but not limited to: schools, day-care centers, hospitals, residences, residential neighborhoods, places of worship, and elderly care facilities.

B. Sites with Existing Wind Energy Systems

Two complete sets of sound level measurements must be taken as defined below:

1. One set of measurements with the wind generator(s) off unless the Township elects to substitute the sound data collected for the background sound study. Wind speeds must be suitable for background sound tests as specified elsewhere in this ordinance.

2. One set of measurements with the wind generator(s) running with wind speed at hub height sufficient to meet nominal rated power output or higher and less than 2 m/s below at the microphone location. Conditions should reflect the worst case sound emissions from the WES project. This will normally involve tests taken during the evening or night when winds are calm (less than 2m/sec) at the ground surface yet, at hub height, sufficient to power the turbines.

Sound level measurements and meteorological conditions at the microphone shall be taken and documented as outlined in Appendix A(II)(A)(1).

III. Post-Construction Measurements

A. Post Construction Measurements should be conducted by a Qualified Independent Acoustical Consultant selected by and under the direction of the Township. The requirements of this Appendix for Sites with Existing Wind Energy Systems shall apply.

1. Sound level measurements shall be conducted annually, within fourteen (14) days of the anniversary date of the pre-construction background sound measurements. Post-construction sound level measurements shall be taken both with all WES(s) running and with all WES(s) off except as provided in this Ordinance.

2. Owner(s) and/or Operator(s) of the Utility Scale WES, WEGF or conditional use MET Tower shall provide the Qualified Independent Acoustical Consultant performing the Post Construction Measurements with the following information to verify that the tests performed represent the worst case noise emissions:

    a. Power production of the turbine during measurement period;
    b. Wind direction during measurement period;
    c. Nacelle direction during measurement period;
    d. Wind speed at nacelle during measurement period.

3. Report post-construction measurements to the Township using the same format as used for the background sound study. Said report shall also include data regarding the wind speeds at the nacelle of the nearest turbine and turbine power production during each measurement period.

IV. REFERENCE STANDARDS

A. ANSI S12.9 Part 3 with Required Amendments

1. ANSI/ASA S12.9-1993/Part 3 (R2008) - American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 3: Short-Term Measurements with an Observer Present.

    This standard is the second in a series of parts concerning description and measurement of outdoor environmental sound. The standard describes recommended procedures for measurement of short-term, time-average environmental sound outdoors at one or more locations in a community for environmental assessment or

planning for compatible land uses and for other purposes such as demonstrating compliance with a regulation. These measurements are distinguished by the requirement to have an observer present. Sound may be produced by one or more separate, distributed sources of sound such as a highway, factory, or airport. Methods are given to correct the measured levels for the influence of background sound.

2. Wind Turbine Siting Acoustical Measurements -ANSI S12.9 Part 3 Selected Options and Requirement Amendments

   For the purposes of this Ordinance, specific options provided in ANSI S12.9-Part 3 (2008) shall apply with the additional following requirements to Sections in ANSI S12.9/Part 3:

   5.2 background sound: Use definition (1) 'long-term'

   5.2 long-term background sound: The L_{90} excludes short term background sounds

   5.3 basic measurement period: Ten (10) minutes $L_{90(10\ min)}$

   5.6 Sound Measuring Instrument: Type 1 Integrating Meter meeting ANSI S1.43 or IEC 61672-1. The sound level meter shall cover the frequency range from 6.3 Hz to 20k Hz and simultaneously measure dBA L_N and dBC L_N. The instrument must also be capable of accurately measuring low-level background sounds down to 20 dBA.

   6.5 Windscreen: Required

   6.6(a) An anemometer accurate to ± 10% at 2m/s. to full scale accuracy. The anemometer shall be located 1.5 to 2m above the ground and orientated to record maximum wind velocity. The maximum wind velocity, wind direction, temperature and humidity shall be recorded for each ten (10) minute sound measurement period observed within 5 m. of the measuring microphone.

   7.1 Long-term background sound

   7.2 Data collection Methods: Second method with observed samples to avoid contamination by short term sounds (purpose: to avoid loss of statistical data)

   8 Source(s) Data Collection: All requirements in ANSI S12.18 Method #2 precision to the extent possible while still permitting testing of the conditions that lead to complaints. The meteorological requirements in ANSI S12.18 may not be applicable for some complaints. For sound measurements in response to a complaint, the compliance sound measurements should be made under conditions that replicate the conditions that caused the complaint without exceeding instrument and windscreen limits and tolerances.

   8.1(b) Measuring microphone with windscreen shall be located 1.2m to 1.8m (1.5m preferred) above the ground and greater than 8m from large sound reflecting surface.

8.3(a) All meteorological observations required at both (not either) microphone and nearest 10m weather reporting station

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8.3(b) For a 10 minute background sound measurement to be valid the wind velocity shall be less than 2m/s (4.5 mph) measured less than 5m from the microphone. Compliance sound measurements shall be taken when winds shall be less than 4m/s at the microphone.

8.3(c) In addition to the required acoustic calibration checks, the sound measuring instrument internal noise floor, including microphone, must also be checked at the end of each series of ten minute measurements and no less frequently than once per day. Insert the microphone into the acoustic calibrator with the calibrator signal off. Record the observed dBA and dBC reading on the sound level meter to determine an approximation of the instrument self noise. Perform this test before leaving the background measurement location. This calibrator-covered microphone must demonstrate the results of this test are at least 5 dB below the immediately previous ten-minute acoustic test results, for the acoustic background data to be valid. This test is necessary to detect undesired increase in the microphone and sound level meter internal self-noise. As a precaution sound measuring instrumentation should be removed from any air-conditioned space at least an hour before use. Nighttime measurements are often performed very near the meteorological dew point. Minor moisture condensation inside a microphone or sound level meter can increase the instrument self noise and void the measured background data.

8.4 The remaining sections starting at 8.4 in ANSI S12.9 Part 3 Standard do not apply.

3. ANSI S12.18-1994 (R2004) American National Standard Procedures for Outdoor Measurement of Sound Pressure Level

This American National Standard describes procedures for the measurement of sound pressure levels in the outdoor environment, considering the effects of the ground, the effects of refraction due to wind and temperature gradients, and the effects due to turbulence. This standard is focused on measurement of sound pressure levels produced by specific sources outdoors. The measured sound pressure levels can be used to calculate sound pressure levels at other distances from the source or to extrapolate to other environmental conditions or to assess compliance with regulation.

This standard describes two methods to measure sound pressure levels outdoors.

METHOD No. 1: general method; outlines conditions for routine measurements.

METHOD No. 2: precision method; describes strict conditions for more accurate measurements. This standard assumes the measurement of A-weighted sound pressure level or time-averaged sound pressure level or octave, 1/3-octave or narrow-band sound pressure level, but does not preclude determination of other sound descriptors.

4. ANSI S1.43-1997(R2007) American National Standard Specifications for Integrating Averaging Sound Level Meters

This Standard describes instruments for the measurement of frequency-weighted and time-average sound pressure levels. Optionally, sound exposure levels may be measured. This standard is consistent with the relevant requirements of ANSI S1.4-1983(R 1997) American National Standard Specification for Sound Level Meters, but specifies additional characteristics that are necessary to measure the time-average sound pressure level of steady, intermittent, fluctuating, and impulsive sounds.

5. ANSI S1.11-2004 American National Standard 'Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters'

This standard provides performance requirements for analog, sampled-data, and digital implementations of band-pass filters that comprise a filter set or spectrum analyzer for acoustical measurements. It supersedes ANSI S1.11-1986 (R1998) American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters, and is a counterpart to International Standard IEC 61260:1995 Electroacoustics - Octave-Band and Fractional-Octave-Band Filters. Significant changes from ANSI S1.11-1986 have been adopted in order to conform to most of the specifications of IEC 61260:1995. This standard differs from IEC 61260:1995 in four ways:

(1) the test methods of IEC 61260 clauses 5 is moved to an informative annex,
(2) the term 'band number,' not present in IEC 61260, is used as in ANSI S1.11-1986,
(3) references to American National Standards are incorporated, and
(4) minor editorial and style differences are incorporated.

6. ANSI S1.40-2006 American National Standard Specifications and Verification Procedures for Sound Calibrators

IEC 61400-11

Second edition 2002-12, Amendment 1 2006-05

IEC 61400-11

Second edition 2002-12, Amendment 1 2006-0

7. Wind turbine generator systems –Part 11: Acoustic noise measurement techniques

The purpose of this part of IEC 61400 is to provide a uniform methodology that will ensure consistency and accuracy in the measurement and analysis of acoustical emissions by wind turbine generator systems. The standard has been prepared with the anticipation that it would be applied by:

・ the wind turbine manufacturer striving to meet well defined acoustic emission performance requirements and/or a possible declaration system;

- the wind turbine purchaser in specifying such performance requirements;
- the wind turbine operator who may be required to verify that stated, or required, acoustic performance specifications are met for new or refurbished units;
- the wind turbine planner or regulator who must be able to accurately and fairly define acoustical emission characteristics of a wind turbine in response to environmental regulations or permit requirements for new or modified installations.

This standard provides guidance in the measurement, analysis and reporting of complex acoustic emissions from wind turbine generator systems. The standard will benefit those parties involved in the manufacture, installation, planning and permitting, operation, utilization, and regulation of wind turbines. The measurement and analysis techniques recommended in this document should be applied by all parties to ensure that continuing development and operation of wind turbines is carried out in an atmosphere of consistent and accurate communication relative to environmental concerns. This standard presents measurement and reporting procedures expected to provide accurate results that can be replicated by others.