

## INTERPRETATION FOR APPLYING MOE NPC TECHNICAL PUBLICATIONS TO WIND TURBINE GENERATORS

Noise impacts of proposed wind turbine generators, i.e. wind turbines, are considered in the course of assessing an application for a Certificate of Approval (Air), in accordance with Section 9 of the Environmental Protection Act. The purpose of this guidance document is to assist proponents of wind turbine installations in determining what information should be submitted when applying for a Certificate of Approval (Air). It has been developed in order to provide consistency in the submissions and to streamline the review and approval process.

As a minimum, the information package must include details of the wind turbine design and operation, location of the wind turbine within the specific site and surrounding area as well as summary of compliance applicable to noise. The following defines a template for reports to be submitted to the MOE. This information is supplementary to the information in MOE Publication NPC-233, Information to be Submitted for Approval of Stationary Sources of Sound.

### REFERENCES

- [1] NPC-102 - Instrumentation
- [2] NPC-103 - Procedures
- [3] NPC-104 - Sound Level Adjustments
- [4] NPC-205 - Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban)
- [5] NPC-206 - Sound Levels due to Road Traffic
- [6] NPC-232 - Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)
- [7] NPC-233 - Information to be Submitted for Approval of Stationary Sources of Sound
- [8] IEC 61400-11 - "Wind turbine generator systems - Part 11: Acoustic noise measurement techniques - International Restrictions", Dec. 2002
- [9] ISO 9613-2 - "Acoustics-Attenuation of sound during propagation outdoors - Part 2: General method of calculation", Dec. 1996
- [10] ETSU-R-97 - "The Assessment and Rating of Noise from Wind Farms", Final Report, September 1996

### TECHNICAL DEFINITIONS

#### "Class 1 Area"

means an area with an acoustical environment typical of a major population centre, where the background noise is dominated by the urban hum.

#### "Class 2 Area"

means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours.

Other characteristics which may indicate the presence of a Class 2 Area include:

- i. absence of urban hum between 19:00 and 23:00 hours;
- ii. evening background sound level defined by natural environment and infrequent human activity; and
- iii. no clearly audible sound from stationary sources other than from those under consideration.

### "Class 3 Area"

means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as the following:

- i. a small community with less than 1000 population;
- ii. agricultural area;
- iii. a rural recreational area such as a cottage or a resort area; or a wilderness area.

### Point of Reception

"Point of Reception" means any point on the premises of a person within 30 m of a dwelling or a camping area, where sound or vibration originating from other than those premises is received.

For the purpose of approval of new sources, including verifying compliance with Section 9 of the Act, the Point of Reception may be located on any of the following existing or zoned for future use premises: permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, camp grounds, and noise sensitive buildings such as schools and places of worship.

For equipment/facilities proposed on premises such as nursing/retirement homes, rental residences, hospitals, and schools, the Point of Reception may be located on the same premises.

## **NOISE LIMITS**

The noise limits for a wind turbine or an array of such units (referred to as a "wind farm") are set relative to the existing MOE Noise Guidelines in NPC-205/NPC-232 as well as to the wind generated background noise. The proponents are required to demonstrate compliance with the following sound level limits:

### **Wind turbine installations in Class 1 & 2 Areas (Urban)**

#### **Wind speeds below 8 m/s**

The lowest sound level limit at a Point of Reception in Class 1 & 2 Areas (Urban), under conditions of average wind speed up to 8 m/s (29 km/h), expressed in terms of the hourly equivalent sound level (Leq) is 45 dBA or the minimum hourly background sound level established in accordance with requirements in Publications NPC-205/NPC-233, whichever is higher.

## Wind Turbine Installations in Class 3 Areas (Rural)

### Wind speeds below 6 m/s

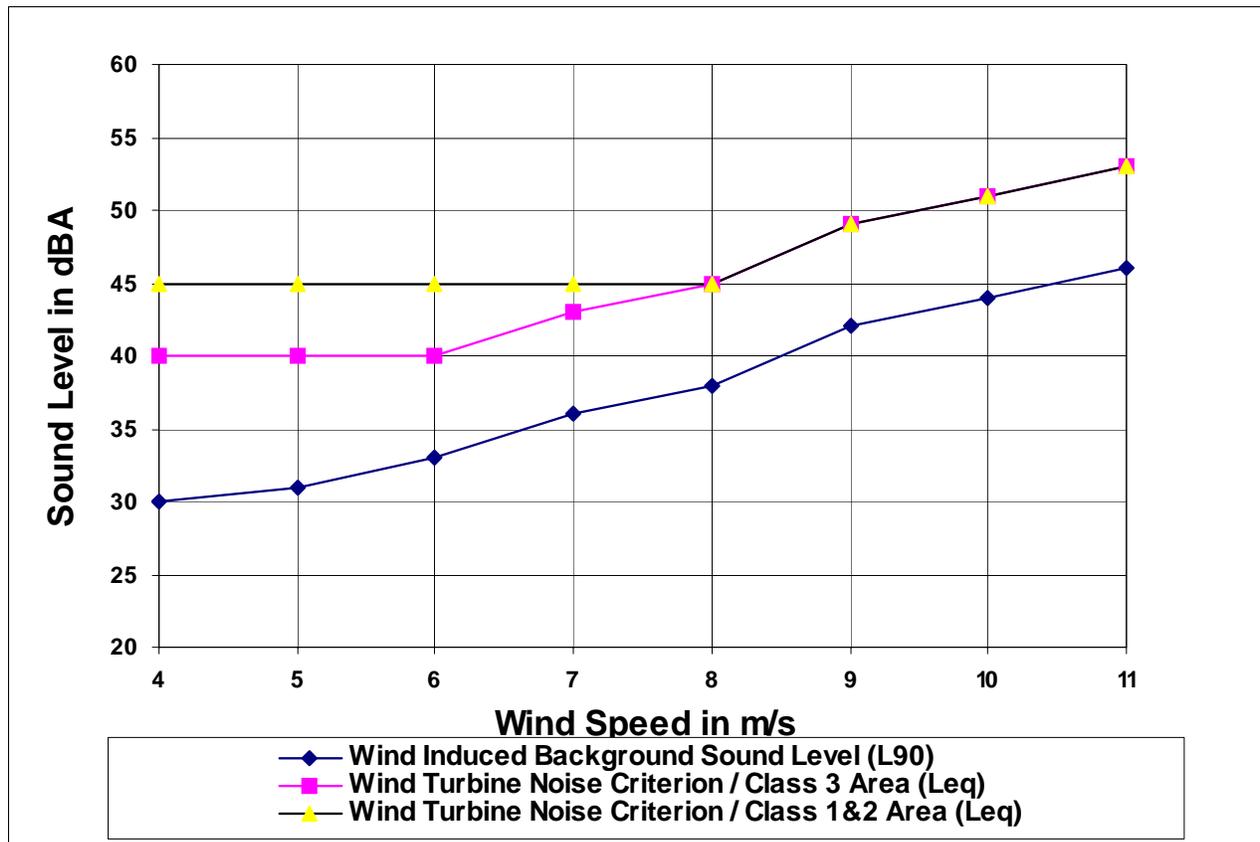
The lowest sound level limit at a Point of Reception in Class 3 Areas (Rural), under conditions of average wind speed up to 6 m/s (22 km/h), expressed in terms of the hourly equivalent energy sound level (Leq) is 40 dBA or the minimum hourly background sound level established in accordance with requirements in Publications NPC-232/NPC-233, whichever is higher.

## Wind Turbine Installations in Class 1& 2 and Class 3 Areas

### Wind speeds above 8 and 6 m/s respectively

The sound level limit at a Point of Reception in Class Areas 1 & 2 (Urban) or in Class 3 Areas (Rural), under conditions of average wind speed above 8 m/s and 6 m/s respectively, expressed in terms of the hourly equivalent energy sound level (Leq), is the wind induced background sound level, expressed in terms of ninetieth percentile sound level (L<sub>A90</sub>) plus 7 dB, or the minimum hourly background sound level established in accordance with requirements in Publications NPC-205/NPC-232/NPC-233, whichever is higher.

A summary of the above limits is shown in figure and table below.



Wind Speed (m/s)	4	5	6	7	8	9	10	11
Wind Turbine Noise Criterion NPC-232 (dBA)	40	40	40	43	45	49	51	53
Wind Turbine Noise Criterion NPC-205 (dBA)	45	45	45	45	45	49	51	53

## NOTE:

1. The measurement of wind induced background sound level is not required to establish the applicable criterion. The wind induced background sound level reference curve in the figure above was determined by correlating the ninetieth percentile sound level ( $L_{A90}$ ) with the average wind speed measured at a particularly quiet site.
2. If the existing minimum hourly background sound level, established in accordance with requirements in Publications NPC-205/NPC-232/NPC-233, is selected as the sound level limit, the measurement of wind speed (for the purpose of determination of wind induced background sound level) is not required. The selected limit applies in the entire range of wind speed under consideration from 4 m/s to 11 m/s with exception of the wind turbine noise criterion values higher than the existing minimum hourly background sound level.
3. Wind Turbine Noise Criterion at wind speeds expressed as fractional values of m/s should be interpolated from the above graph.

## REPORT CONTENTS AND FORMAT

The noise report must contain the required information, organized in a clear and concise manner. The report should include the following sections in the given sequence:

1. **Introduction**  
Objectives of report
2. **General Description of Wind Turbine Installation Site and Surrounds**  
Description of the site general environment, including: adjacent zoning, sensitive receiver locations (Points of Reception); suitable mapping of the site and surrounding area, providing elevations of source receivers and intervening structures or topography where applicable to the assessment;
3. **Description of Receptors**  
Detailed acoustical description of the area surrounding the facility including: Identification of the closest and/or the critical Points of Reception, identifying noise sensitive residential or institutional uses - (industrial, commercial uses are also desirable information); Determination of the applicable minimum hourly background sound level limit at the critical Points of Reception, in accordance with NPC 205/232 and NPC-233;
4. **Description of Sources**  
Description of the wind turbine (wind farm) including: manufacturer & model number; Design principle & geometric configuration (horizontal, vertical, upwind, downwind, rotor diameter and centre height, blade type, number of blades, tower height); Power train (direct from rotor to generator, indirect through gearbox); Operating details (single, twin or variable speed, power curve, generator rated power output and rotational speed); Park lay-out (for a wind farm);
5. **Wind Turbine Noise Emission Rating**  
Noise emission levels in terms of sound power level of the wind turbine as a function of wind speed (determined in accordance with IEC 61400-11 method), provided by the wind turbine manufacturer;

**6. Impact Assessment**

Calculation of the sound pressure level at each critical Point of Reception for each wind turbine or an aggregate of units (wind farm) using ISO 9613 method.

Noise impact assessment under a “worst case scenario” at the critical Points of Reception, up to a distance of 1000 m from the wind turbine (or closest unit in a wind farm); Impact assessment is not required for Points of Reception farther than 1000 m from the wind turbine (or closest unit in a wind farm);

Comparison with the applicable noise limit;

**7. Wind Turbine Summary Tables**

Wind Turbine Source Summary Table and Wind Turbine Assessment Summary Table; (samples attached);

**8. Conclusions and Recommendations**

Summary of impacts and verification of compliance with the noise limits;

**9. Appendices, etc.**

Details of measurements and calculations, specifications, plans, eng. dwgs, etc.

## **WIND TURBINE SUMMARY TABLES**

The noise report must contain Wind Turbine Summary Tables, summarising the results of the Acoustical Report and demonstrating compliance. The Wind Turbine Summary Tables must address pertinent source(s) and receptors (Points of Reception).

The information in the Wind Turbine Summary Tables must be presented in two tables:

1. Wind Turbine Source Summary Table
2. Wind Turbine Assessment Summary Table

The following examples of summary tables must be incorporated into the report:

**Wind Turbine Noise Emission Summary Table**  
(add rows for additional sources)

	Wind Turbine ID	Max PWL at wind speed <6 m/s	PWL at selected wind speed in m/s				
			7	8	9	10	11
1	WT6000	93	97	99	100	104	106
2							
3							

**Note:**

1. PWL denotes Sound Power Level in dB re  $10^{-12}$  Watt
2. Noise emissions of a wind farm are represented by a sum of PWL values for individual wind turbine units.

**Wind Turbine Noise Impact Assessment Summary Table**  
 Identify all receptors (add rows for additional Points of Reception)

Point of Reception ID	Receptor Description	Distance to closest Wind Turbine (m)	Sound Level Limit (dBA)														Compliance with Limit (Yes/No)
			Calculated Sound Pressure Level at Receptor (dBA) at selected Wind Speed in m/s												Applicable Background Sound Level		
			at selected Wind Speed in m/s												NPC 205	NPC 232	
			6 or <	7	8	9	10	11	6 or <	7	8	9	10	11			
R1	Residence to East	100	43	44	<b>48</b>	<b>50</b>	<b>54</b>	<b>56</b>	45	45	45	49	51	53	46		No
R2	Apt. Bldg. to South	150	40	42	45	47	51	<b>53</b>	45	45	45	49	51	53	51		No
R3	Nursing Home to West	200	37	39	42	44	48	50	45	45	45	49	51	53	47		Yes
R4	Residence to North	260	35	38	40	42	46	48	40	43	45	49	51	53		44	Yes

**Note:** Values in the table which are **underlined/bold** denote an excess over the applicable limit.