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Suncor Adelaide Wind Power Project Acoustic Audit - Immission

Summary for Public Distribution

Introduction

The Suncor Adelaide Wind Power Project (project) operates 18 Siemens SWT-2.3-113 wind turbines located within the Municipality of Adelaide Metcalfe, Ontario. As part of the Renewable Energy Approval (REA) application process, a pre-construction acoustic computer model was created in order to satisfy the requirements of the Ministry of Environment and Climate Change (MOECC) sound level limits.

In order to confirm the acoustic model and ensure that the wind project is operating as per MOECC regulations, the project's REA requires that an "Acoustic Audit – Immission" is done once the project is in operation.

The "Acoustic Audit – Immission" is a process that measures sources of noise emissions due to the operation of the project at designated measurement locations called receptors. The results of the acoustic audit are assessed to determine compliance with the Noise Performance Limits established by the MOECC and set out in the REA. The acoustic audits were completed in the spring and fall of 2015 and were documented in two separate acoustic audit reports that have been submitted to the MOECC (March 9, 2016 and May 27, 2016). The project was found to be in compliance with the Noise Performance Limits as set out in the REA. The following provides a summary of the results of the acoustic audit reports.

How does a wind project create noise?

The main sources of noise associated with the operation of a wind project are the wind turbines and the transformer substation. Noise from wind turbines can be divided into two areas:

- Aerodynamic noise - considered the dominant source of noise and is generated by the turbine blades passing through the air.

- Mechanical noise - is generated by different components in the hub such as the direct drive generator.

At short distances from the turbine, the aerodynamic noise from the rotating blades can be noticeable. As the distance from the turbine increases, the aerodynamic noise and mechanical noise are less pronounced and ambient sound levels can sometimes mask the audibility of the turbine noise. This is why sound measurements during the acoustic audit were conducted during the night time hours when ambient noise would be reduced.

The noise produced by a transformer substation exhibits a hum, associated with the fundamental electrical frequency and its harmonics. The transformer noise is assessed separately in the "Acoustic Audit – transformer substation".

The noise produced by wind turbines, as well as ambient noise, increases with wind speed.

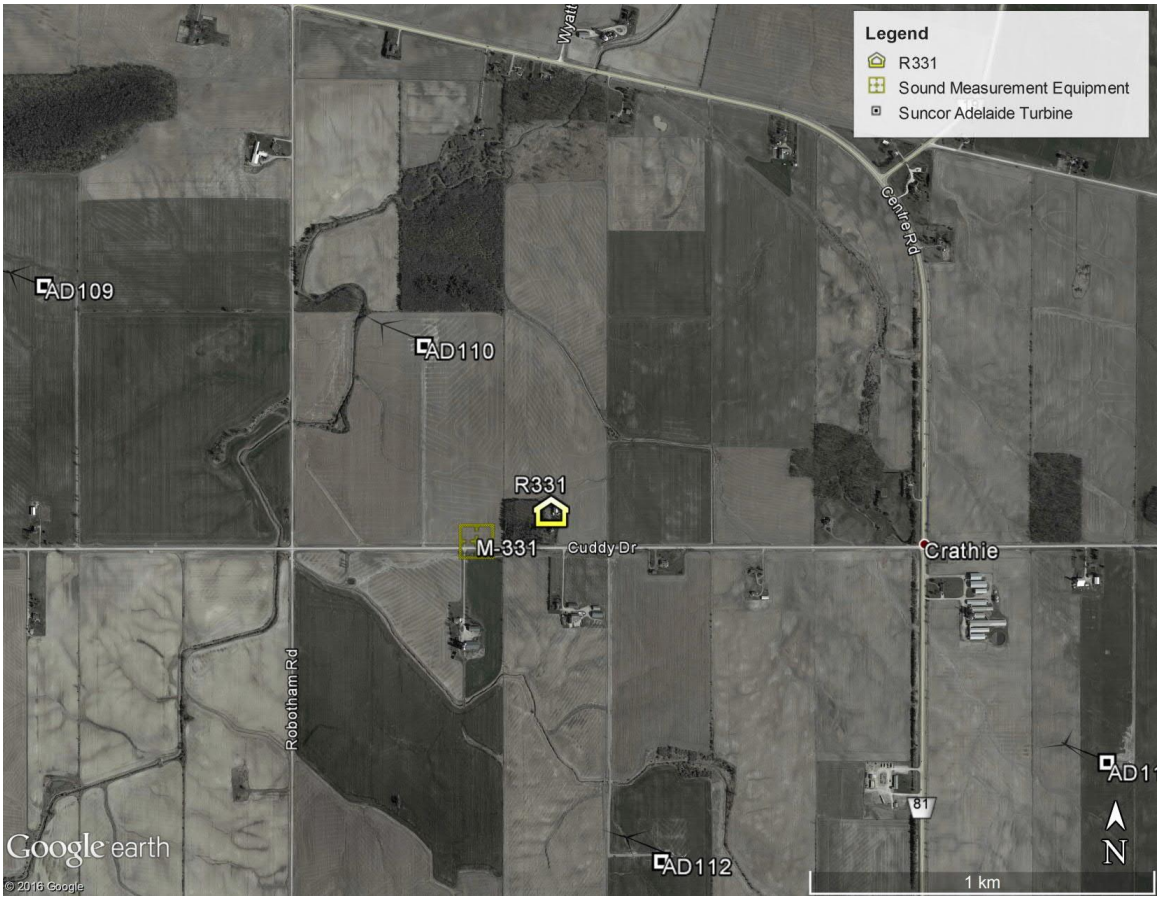
▪ The measurement locations

The acoustic audit measurements for the Project were performed at three (3) different Points of Reception that were selected using the following criteria set out in the REA:

a) The Points of Reception represent the location of the greatest predicted noise impact i.e., the highest predicted Sound Level; **and**

b) The Points of Reception were located in the direction of prevailing winds from the facility.

Location 1

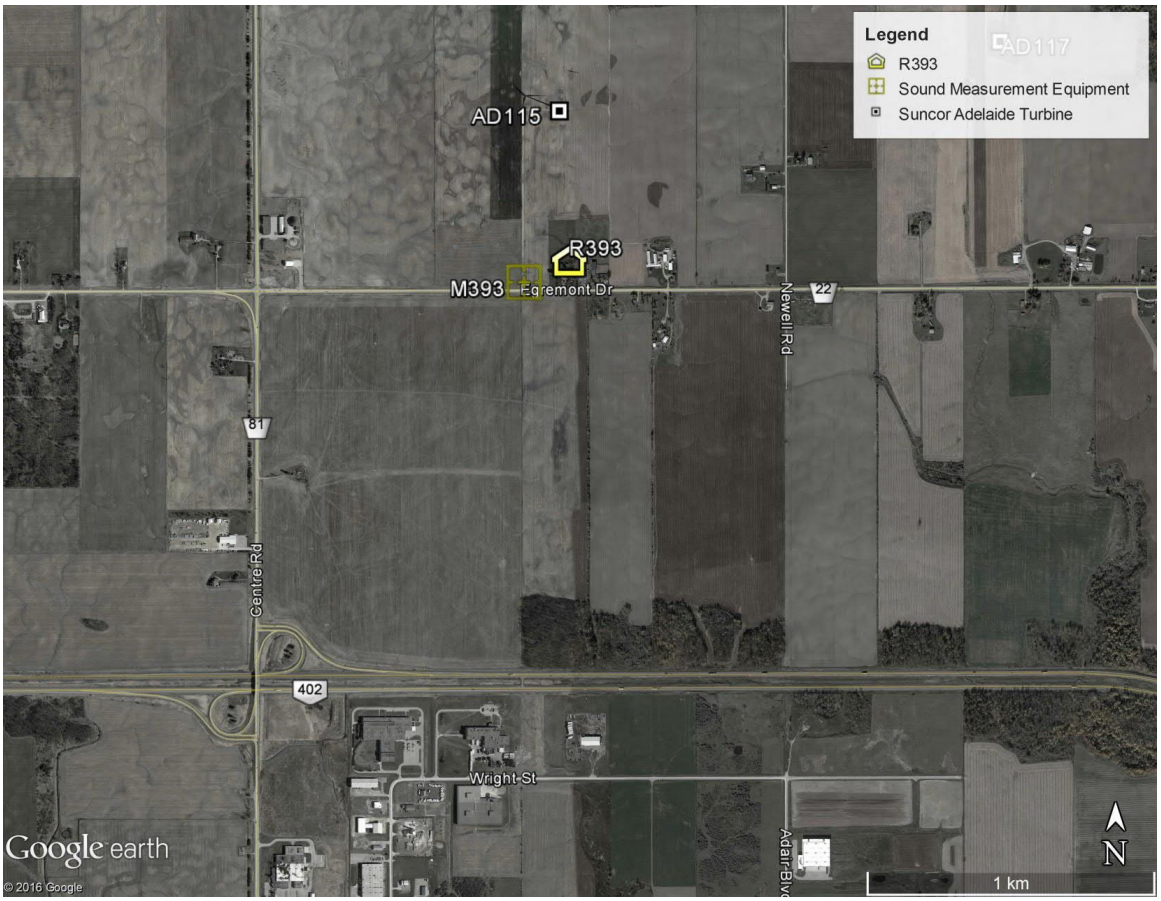


Measurement equipment at Location 1 was placed just north of Cuddy Drive near Receptor 331 identified in the Acoustic Assessment Report, facing the nearest turbine AD110 (610m from the turbine). Location 1 is also close to three (3) other turbines; AD109, AD112 and AD113.

Location 2

Measurement equipment at Location 2 was placed on the property of Receptor 347 identified in the Acoustic Assessment Report, facing the nearest turbine AD112 (757m from the turbine). Location 2 is also close to (4) four other turbines; AD111, AD113, AD114 and AD115.

Location 3



Measurement equipment at Location 3 was placed on the adjacent vacant lot (V696) to Receptor 393, facing the nearest turbine AD115 (610m from the turbine). Location 3 was chosen to represent R393 with a location away from a nearby barn, commercial building and tree line.

▪ How was the study done?

The acoustic audit measurements required in the REA were performed by Aercoustics, an Independent Acoustical Consultant, on two (2) separate occasions; Spring 2015 and Fall 2015. The acoustic audit was completed as per the methodology outlined in Part D of the "MOECC Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement".

A microphone was placed at a measurement height of 4.5m above grade, at least 5m away from any large reflecting surfaces, and in direct line of sight to the nearest turbine. The figure below shows a photo of the equipment at the project and lists the main components in the sound measurement equipment set-up.

<u>The Measurement System</u>

- 10-metre-tall mast
- Sound level meter (at base)
- Primary and secondary windscreen (4.5m high)
- Microphone (4.5m high)
- Anemometer (10m high)
- Solar panel (at base)

For the duration of the measurement time, acoustic and weather data was logged simultaneously in one-minute intervals. Measurements were conducted when the turbines were operational ("Turbine ON") as well as when the project was parked ("Turbine OFF") in order to quantify the ambient sound level.

A one-minute measurement interval was considered valid if:

- The interval occurred between 10pm – 5am: measurements were conducted during the night time in order to minimize noise contamination from ambient sources such as road traffic, farming activity etc.
- No precipitation was detected within an hour before or after the interval: measurements excluded periods of rain which would contaminate the data with rain noise as well as increased road traffic noise from wet roads.
- The maximum measured wind speed at 10m was no more than 2 metres/second (m/s) higher than the recorded average for that interval: Periods with gusty wind conditions were excluded to avoid wind induced noise which would contaminate the data set.
- The temperature was above -20°C: Below this temperature the measurement equipment (e.g. microphone) may not operate to specifications.
- Either all nearby required turbines were operating for Turbine ON measurements, or all nearby required turbines were parked for ambient measurements (Turbine OFF).
- Transient activities such as cars driving by or airplane flyover were excluded from the analysis.

Turbine Only sound is determined by correcting valid Turbine ON data points by logarithmically subtracting Turbine OFF valid data points. The Turbine Only results are then compared to the Sound Level Limits.

▪ What are the REA Sound Level Limits?

The purpose of the sound measurements was to confirm whether the sound emitted by the project is in compliance with the MOECC sound level limits. The REA identifies the sound level limits, as per the table below.

Wind Speed (m/s) at 10m height	4	5	6	7	8	9	10
Sound Level Limits, dBA (decibels, hourly A-weighted)	40.0	40.0	40.0	43.0	45.0	49.0	51.0

▪ What were the results?

The following tables show the Turbine ONLY sound levels (Turbine ON with ambient adjustment) measured at each of the (3) three measurement locations. The results are presented per each wind speed bin between 4-7 m/s. The results are compared to the predicted level based on the pre-construction acoustic model and the MOECC sound level limits at each wind speed bin.

For some wind speed bins, the measured ambient level was equal or higher than the average measured level when the turbines were operating. This indicates that local ambient noise sources, rather than turbines, are dominant to the overall sound level at the receptor location. In these instances, it is known that the Turbine ONLY contribution to the receptor sound level is at least 3

dB less than the Turbine ON level (which includes ambient sources). This is a conservative assessment; in reality, the Turbine ONLY level is expected to be lower. These instances have been marked with (*) in the tables below

As per the "MOECC Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement" the results cover a wind speed range of 4-7 m/s. At wind speeds greater than 7 m/s, the wind induced noise becomes significant thereby contaminating the data set. As a result, results are only reported in the wind speed range of 4-7 m/s.

The predicted sound levels based on the acoustic model below 6m/s were not available as the manufacturer sound power information is provided from 6-10 m/s.

Measurement Location	Wind Speed at 10m height [m/s]	4	5	6	7
Location 1	Spring Audit – Turbine ONLY Sound Level (dBA)	36	37	37	<43*
	Fall Audit – Turbine ONLY Sound Level (dBA)	35	36	36	<43*
	Predicted Sound Level based on acoustic model (dBA)	-	-	38.4	38.4
	MOECC Sound Level Limit (dBA)	40.0	40.0	40.0	43.0

Measurement Location	Wind Speed at 10m height [m/s]	4	5	6	7
Location 2	Spring Audit – Turbine ONLY Sound Level (dBA)	37	<38*	<40*	<42*
	Fall Audit – Turbine ONLY Sound Level (dBA)	39	38	40	43
	Predicted Sound Level based on acoustic model (dBA)	-	-	38.4	38.4
	MOECC Sound Level Limit (dBA)	40.0	40.0	40.0	43.0

Measurement Location	Wind Speed at 10m height [m/s]	4	5	6	7
Location 3	Spring Audit – Turbine ONLY Sound Level (dBA)	<38*	<38*	37	<43*
	Fall Audit – Turbine ONLY Sound Level (dBA)	39	36	<40*	<43*
	Predicted Sound Level based on acoustic model (dBA)	-	-	37.6	37.6
	MOECC Sound Level Limit (dBA)	40.0	40.0	40.0	43.0

Both the Spring and Fall Immission audit results demonstrate that the Project is operating in full compliance with the MOECC Sound Level Limits at each of the (3) three measurement locations. The audit results also were generally in alignment with the predicted levels of the pre-construction acoustic model. The Spring and Fall Acoustic Audit reports submitted to the MOECC satisfy the requirements of Acoustic Audit Immission Section E1 and E2 of the project's REA.

Questions or further clarification on this audit can be directed to the Project team at adelaide@suncor.com or phone 1-866-344-0178.