Robert W. Rand, ASA, INCE (Member Emeritus)
RAND ACOUSTICS, LLC
65 Mere Point Road
Brunswick, ME 04011
E-mail: rrand@randacoustics.com
Telephone: 207-632-1215

July 1, 2021

Ms. Lisa Linowes
The WindAction Group
286 Parker Hill Road
Lyman, NH 03585

Re: Technical Memorandum
Comments on 2021 Complaint Response Report
Antrim Wind Facility, Antrim, NH

Per your request, I respectfully submit these comments relative to my Complaint Response technical report summarizing Antrim Wind noise monitoring and post-analysis for a survey from March 18 to April 9, 2021.

The comments below are informed by over forty years of work in acoustics including numerous noise surveys and complaints investigations for wind turbine, industrial, and commercial noise sources. My comments are based on *experience* in noise control engineering and investigations; not conjecture or bias.

1. MEASURE LEQ USING 0.125s INTERVAL

I understand there may be some confusion about the technical capacity for modern Type 1 Sound Level Meters to measure and report the Fast response and Leq metrics using a 0.125-second interval. Most people don't know how a sound meter works, so the confusion is understandable.

The NH Site 301.18(e)(6) specifies the measurement interval: "*All sound measurements during post-construction monitoring shall be taken at 0.125-second intervals measuring both fast response and Leq metrics*".

There is no problem measuring Leq in measurement intervals such as 0.125 seconds (8 times per second). Most Type 1 Meters provide 0.1-second, 1-second and other measurement intervals for recording both Fast response sound pressure level and Leq energy-equivalent level metrics. But how do they do it?

How do meters measure Leq (and Fast response sound pressure level) at regular intervals?

Interval is the time spacing between each measurement.

The interval of 0.125-second is not the same thing as the Fast response.

The "Fast response" is a decay time used on sound meters (originally used for controlling meter needle movement). The meter response is present all the time. The interval sets the spacing for storing data.

Meters can measure both Fast response sound pressure levels AND Leq energy-equivalent levels simultaneously *at the measurement interval set by the operator*. The measurement interval spacing (0.125 seconds) is *completely independent of* the decay time used for the meter response (Impulse, Slow, Fast).

At each interval time:

1. The meter reads and stores the instantaneous Fast response sound pressure level.

2. The meter computes and stores the Leq energy equivalent sound level for that interval.

The Larson Davis Model 824, a well-known Type 1 Sound Level Meter used for decades by scores of noise consultants, can be set to acquire Leq with an interval of 0.125-second. Internally the Model 824 continuously converts the microphone voltage to digital values at a rate of 32 times per second. When the Model 824 is set for 1/8-second intervals, it uses 4 internal data values to compute the Leq-0.125s. If the Model 824 is set to 1-second intervals, it uses 32 internal digital values to determine the Leq-1s.

The Svantek 977 Type 1 Sound Meter used by Rand Acoustics can be set to intervals acquiring Leq and Fast response sound levels ranging from *0.002 seconds* to 1 hour (2 ms, 5 ms, 10 ms, 20 ms, 100 ms, 200 ms, 500 ms, 1 second to 59 seconds, 1 minute to 59 minutes, and 1 hour). Internally the 977 continuously converts the microphone voltage to digital values at a rate of 48000 Hz. For example, to determine the Leq for a 0.002 second interval, the 977 uses 48000*0.002=96 digital values. During the Antrim turbine sound surveys Rand Acoustics conducted at the Berwick property, the Svantek 977 interval was set to 0.100 seconds, as close as possible to and conservative for the NH SEC Rule's 0.125-second interval. The Svantek 977 uses 48000*0.1=*4800* digital values to determine the Leq-0.1s, and records the Fast response sound pressure level at the same time for each interval, and does so over and over up to the available storage. There is no problem doing this.

A block diagram for the Svantek 977 is shown in Figure 1 below. The Svantek 977 computes the Fast response AND the Leq simultaneously via parallel data. Again, the Leq is measured at the selected time interval. This simultaneous measurement of Fast and Leq is consistent with the NH SEC Rule 301.18(e)(6)) "sound measurements during post-construction monitoring shall be taken at 0.125-second intervals measuring *both* fast response and Leq metrics."

The instrument calculates the sound measurement results for three profiles. The calculation flow diagram for one profile is presented below:

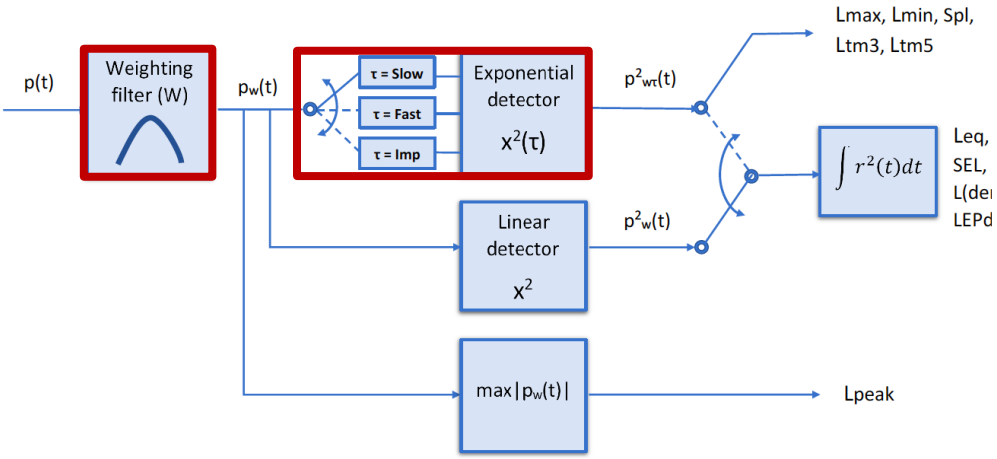


Figure 1. Svantek 977 signal flow diagram (SVAN 977 User Manual - Appendix D.1.2). The Weighting filter (dBA) and meter response (Exponential detector) are outlined in red.

The Svantek 977 can acquire both the Fast response sound pressure level and interval Leq energy-equivalent level *simultaneously* for each interval, and, operate three separate profiles (example, dBA, dBC, dBZ) simultaneously with the selected measurement interval setting.

The Weighting filter (W) is where the "weighting" is selected. The Weighting filter operates independently of "interval". The Weighting used for the Antrim survey was "A", consistent with the NH SEC Rule.

The Exponential detector is where the meter "response" is selected for the Fast, Slow, or Impulse. The Exponential detector operates "upstream of" and independently of the 0.125-second measurement "interval". The meter response used for Antrim surveys was "Fast", consistent with the NH SEC Rule.

> *Note: IF investigators use a meter which is not capable of acquiring Leq at 0.125 second or to be conservative, 0.1 second intervals, that shortcoming is the responsibility of the investigators.*

2. MEASURING L90 USING 1/8 SECOND INTERVAL MEASUREMENTS

I understand there may be some confusion about how to measure the L90 during a survey, or that perhaps some may have gained an impression that it's not possible to measure L90 when using an interval such as 0.125-seconds. Again, most people don't know how a sound meter works, so the confusion is understandable.

The L90 is the level exceeded 90 percent of the time during a time period. Fast-response sound level data acquired at 0.125-second intervals can be grouped (or "concatenated' together in time sequence) over time periods, and sorted to obtain the time period's L90.

A statistical value such as L90 acquired over a long period of time is only as useful as the operator's understanding of the noises occurring during that period of time. For example, attempting to measure the background L90 at locations near the Antrim turbines when the turbines are operating will yield contaminated data that do not represent non-turbine L90 background.

3. COMPLAINT SURVEY METHODS VS "POST-CONSTRUCTION MONITORING"

I understand there may be some confusion from objections raised to the Rand report not reporting L10 and L90 statistical levels for the complaint response investigation.

L90 and L10 statistical values aren't directly relevant to noise complaints. I'll explain why.

The primary objective during complaint investigations is to determine if the Facility is exceeding the noise limit. This objective is prompted by the Order's finding, page 153, that "*The Subcommittee finds that so long as the Project complies with the noise level requirements set forth in the rules, that it will not have an unreasonable adverse effect on health and safety*." The NH SEC rule is based on the Leq metric for compliance assessment. The NH Site 301.18(e)(6) specifies the measurement interval: "*All sound measurements during post-construction monitoring shall be taken at 0.125-second intervals measuring both fast response and Leq metrics*".

The language governing complaint investigations is in 301.18(i), "*Validation of noise complaints submitted to the committee shall require field sound surveys, except as determined by the administrator to be unwarranted, which field studies shall be conducted under the same meteorological conditions as occurred at the time of the alleged exceedance that is the subject of the complaint*." Other than matching meteorological conditions, there are no other specific requirements listed for conducting complaint response field studies.

Complaints provide prima facie evidence to this investigator of the likelihood of an unreasonable adverse effect. Thus, investigations evaluate whether the Facility is exceeding the NH SEC noise limit during times of complaints. L10 and L90 statistics fail to furnish the highest noise levels which could exceed noise limits, and hide fluctuations and modulated noise levels. The NH SEC rule is based on the Leq metric for compliance assessment. During the complaint investigations, Rand Acoustics' review focused on the 0.1-second Leq data set as a time-series to assess compliance with the NH SEC Rule on a second by second basis.

4. CURTAILMENT AS NOISE CONTROL OPTION

I understand AWE objected to mention of curtailment in my report dated May 11, 2021. Apparently the following was the report section leading to AWE's objection:

> *<u>BEST PRACTICES REQUIRE AN ADEQUATE MARGIN OF SAFETY</u>*
>
> *From years of work in power generation noise control, accepted practice includes*

assuring that a proposed facility will comply with regulatory requirements with an adequate margin of safety.

This survey documented excessive noise levels that confirm: An adequate margin of safety is absent from the noise control design of the Antrim Wind facility. Antrim Wind noise levels exceed facility noise limits by as much as 13 dBA.

At this time no reliable noise control option is known to exist that provides a 13 dBA noise reduction for the wind turbine technology used by Antrim Wind, except shutdown.

"Shutdown" is equivalent to "curtailment". This section simply reiterates the findings in the Antrim Decision and Order Granting Application For Certificate of Site and Facility dated March 17, 2017, Docket No. 2015-02, where it is indicated that AWE demonstrated that it has the technical capacity to decrease Project noise *by curtailment* or implementation of the Noise Reduction Mode if needed for compliance with the Certificate.

On page 146,

The Applicant presented evidence that the Noise Reduction Operation Mode will allow the Applicant to decrease noise associated with any turbine in one-decibel increments up to five decibels, if needed for compliance with the Certificate.

On Page 153,

"The Subcommittee finds that so long as the Project complies with the noise level requirements set forth in the rules, that it will not have an unreasonable adverse effect on health and safety. The Applicant demonstrated that it has the technical capacity to decrease the Project's noise ***by curtailment or implementation of the Noise Reduction Operation Mode****."*

The Applicant cited a 5-dB range for Noise Reduction Mode, with the corresponding reductions in power output. The Rand noise complaint survey documented facility noise levels ranging 8-13 dB over the night time 40-dBA shall-not-exceed noise limit due to large whoosh-whump fluctuations. Simple arithmetic arrives at the conclusion that the Facility Noise Reduction Mode by itself would be insufficient to comply with the NH SEC night noise limit, by 3 to 8 dBA, thus the need to discuss curtailment.

<u>A note on wind industry claims of "bias" and "anti-wind"</u>

As a neutral party, my background is in power generation noise control, community noise impact assessment, designing to meet regulations and protect health and welfare.
I worked for Stone & Webster for ten years in the Noise and Vibration Group and have designed or reviewed noise controls for most utility-scale power technologies and a number of commercial technologies. If someone levels the charge "anti-wind", they also don't know that by the same logic they'd have to apply labels such as "anti-coal", "anti-oil", "anti-nuclear", "anti-transformer", "anti-backup-generator", "anti-restaurant" and "anti-concert-hall".

In my firm's independent professional capacity, there is no particular "bias" or interest in the brand of noise-producing equipment being investigated. Rand Acoustics provides consultation for the best possible facility design ensuring that regulations are met, public safety, health and welfare is protected and complaints are prevented.

Recommendations and professional cautions are carefully developed from years of power generation experience and professional investigations. Services and opinions have proved useful for utilities, commercial clients, the military, regulators and communities alike.

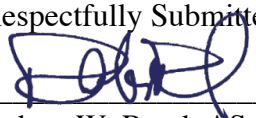
Due to materials and design challenges, at this time sufficient distance is the only reliable noise control option for large three-bladed horizontal-axis wind turbines.

Power utility clients over the years have demonstrated their commitment to their shareholders and their operations by investing in noise controls to prevent complaints and legal action. The shift to "turnkey" systems since the mid 1990s has placed greater burden on proper specifications and careful siting review.

Emotionally charged, unprofessional labels can have undesired effects of cooling customer interest in professional services. Deliberate slander or libel could destroy future income. I am aware of work lost due to libel. I consider this a serious matter and expect it to be so for the Boards and customers who work cooperatively with experts to determine the best actions that promote zoning objectives, assure compliance with regulatory limits, and protect the safety, health and welfare of the public.

Thank you for your consideration of these comments. If you have any questions, please contact me.

Respectfully Submitted,



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