PRECOGNITION

Re: Planning Application Appeal Public Inquiry: WIN-370-3 Clauchrie Wind Power Plant

Mariana Alves-Pereira, Ph.D.
10 May 2021

1. *Background*

1.1
My scientific credentials have already been put forth to this Planning Inquiry (**SC 2 CV** and **SC 4 Publications list)**. Having read the report submitted by Hayes McKenzie – Consultants in Acoustics, as prepared by Acoustician, Mr. Mike Craven (**APP4.1**), I would like to provide the Reporters of this Inquiry with insight on the issue of infrasound generated by industrial wind turbines (IWT) and its potential health effects.

1.2
Professional acousticians are limited to, and bound by, the methodological requirements of guidelines, such as the ETSU-R-97 in the UK, or the DIN 45680 in Germany, or the RGR-9/2007 in Portugal (among others in all nations). As Scientists however, my colleagues and I are not constrained by government-endorsed guidelines. Instead, we abide by and adhere to the axioms of The Scientific Method and its corollary, Evidence-based Medicine.

1.3
It is understood that the purpose of firms who consult in the area of Acoustics *must* abide by the methodological constraints imposed by governmental guidelines and, consequently, are precluded from conducting any investigative or exploratory work not covered by, in this particular case, ETSU-R-97.

1.4
It will be shown that many of the assertions made in the Hayes McKenzie Report (HMR) are outdated and much of the scientific evidence that has come to light over the past few years no longer supports certain positions defended in the HMR.

2. *An example of an ETSU-R-97 constraint: using the L_{A90} measure*

2.1
Referring to Paragraph 3.4 of the HMR, relevant permissible noise exposure levels, both day and night, are based on the L_{A90} measure. This means that all numerical values of measured noise are submitted to the A-weighting filtering system, yielding the dBA metric. As a result, for example at a frequency of 10 Hz (below the classical human hearing threshold), at least 70 dB is subtracted from the numerical real-value measured in the field. Images illustrating this complex technical issue are provided in the Noise Objection submitted by Ms. Susan Crosthwaite, dated 18 Sept 2020 (Fig. 4).

Subsequently, these now adulterated values are subjected to 10-minute averaging techniques. This is what ETSU-R-97 requires.

2.2
Since our objective is the *quantification* of noise, we look at the numerical values that are read directly in the field measurements, and not adulterated by any filtering system as imposed by ETSU-R-97. These real-number values (measured in dB Linear, i.e., no filtering system is applied) paint a different picture of what happens to the acoustic environments within homes near IWT. Given the technical complexity of this matter, a visual aid is given in the next section.

3. *"A German Study"*

3.1
Paragraph 5.23 of the HMR refers to "A German study (**CD10.4**) published in 2016…". This study was conducted by the State Institute for the Environment of Baden-Württemberg (LUBW) and was, naturally, subjected to the impositions of the German noise guideline, DIN 45680. The LUBW report was updated in February 2020, and was reviewed by IARO (International Acoustics Research Organization) in October 2020 (**SC 24**).

3.2
I would like to direct the Reporters' attention to Figure 6 on page 12 of **SC 24**, where dBA measurements (values submitted to the A-weighted filtering system) are shown in red bars, while the grey bars show the real-number values (no filtering system applied). As can be quickly surmised, merely by layperson visual inspection, the red bars only quantify a minute amount of the entire acoustic environment. Although the grey bars more accurately reflect the acoustic energy present in an environment, the ETSU-R-97 imposition of the L_{A90} measure precludes professional acousticians from gathering real-value numerical quantification of infrasound levels.

3.3
It was asserted more than once that infrasound generated by IWT was no different than that found in urban or natural environments (Paragraphs 5.4, 5.23, 5.25, 5.28, 5.31 of the HMR). Specifically, in Paragraph 5.23, the 2016 LUBW report (**CD10.4**) is used as evidence to support these assertions. I would like to direct the Reporters' attention, again, to IARO's review (**SC 24**) of the LUBW Report (**CD 10.4**). Specifically, I would ask the Reporters' indulgence to view and compare:

Figure 11, on page 17 in **SC 24**, with:
- a. Figure 2, on page 9 in **SC 24**, or with
- b. Figure 4, on page 11, in **SC 35** (Dochroyle Pharm Report), or with
- c. Figure 5, on page 10, in **SC 38** (Ferter Pharm Report).

Again, by layperson visual inspection, a clear difference can be seen when comparing the natural acoustic environment of the ocean (Fig. 11 in **SC 24**), with the other 3 figures (indicated above as a, b and c), where the acoustical output of operational IWT was captured.

3.4
The ocean does not acoustically present itself as well-defined, horizontal straight lines, running continuously through the sonogram (Fig 11 in **SC 24**). These types of visual features are common, however, in acoustic environments that are in the vicinity of wind power plants and IWT, and are the hallmark of *IWT acoustic signatures* (Figs referenced as a, b and c in the above Paragraph 3.3). Figure 4, on page 11 of **SC 24** shows another sonogram that has no continuous horizontal lines running through the image, meaning the IWT acoustic signature is absent (i.e., the IWT in the vicinity of this home were stopped when this particular recording was made).

3.5
It must be perplexing to the Reporters of this Inquiry as to why this type of information is not provided in the reports submitted by professional acousticians, such as the HMR and the LUBW Report. As explained above, ETSU-R-97 and the DIN 45680 restrict these professionals from obtaining this type of information.

4. *Another ETSU-R-97 constraint: octave and temporal resolutions*

4.1
Most noise guidelines require that acoustic analyses be made with a resolution of 1/3rd of an octave, and in time segments of 10-minute averages. Professional acousticians must comply, but scientists are not compelled to do so.

4.2
Instead, high-resolution analyses, using 1/36th of an octave (as opposed to 1/3rd) were carried out. In terms of time, 10-minute averages were replaced with a temporal resolution of 1-second intervals. From a layperson's perspective, this is analogous to switching from a hand-held magnifying glass to a table-top microscope.

4.3
It is not possible to identify IWT acoustic signatures by conducting data analyses with the dBA metric, in 1/3rd octave bands and with a temporal resolution of 10-minute averages. And yet, this is what ETSU-R-97 requires, and it is what professional acousticians dutifully present.

5. *An ETSU-R-97 requirement: 5 dB above background noise*

5.1
The IWT acoustic signature, visually identified as continuous horizontal lines in a sonogram (see Fig. 2 in **SC 24**, or Fig. 4 in **SC 35**, or Fig. 5 in **SC 38**), can also be seen as a well-defined sequence (harmonic series) of peaks of acoustic energy, as depicted in:

a. Figure 3, on page 10 in **SC 24**, and
b. Figure 6, on page 13, in **SC 35** (Dochroyle Pharm Report), and
c. Figure 9, on page 14, in **SC 38** (Ferter Pharm Report).

5.2
These sequences or series of peaks (also called prominences) of acoustic energy that represent IWT acoustic signatures, are mathematically matched to the blade pass frequency of each IWT model and manufacturer: the IWT blade pass frequency presents as the fundamental frequency of these harmonic series.

5.3
In the IARO White Paper on the Harmonic Prominence Measure (**SC 34**), Figure 1 shows a close-up of a IWT acoustic signature in the form of a series of peaks that rise prominently above the background noise level (hence the term *prominences*), sometimes reaching 15 to 25 dB (!) above the background level.

So why are not the ETSU-R-97 requirements on the 5 dB above background applicable for IWT acoustic signatures?

5.4
Because the frequencies (0.5-20 Hz: range of IWT acoustic signature as seen by the series of peaks of acoustic energy) and sound pressure levels at which the IWT acoustic signatures occur are considered to be:

> "orders of magnitude below recognised perception thresholds"
> (HMR, p. 7, Parag. 5.4, second bullet),
> i.e., "turbine levels in the infrasonic range are well below recognised perception levels"
> (HMR, p. 14, Parag. 5.23)
> And therefore, "A direct relationship between turbine related infrasound and health impacts has not been established and any such link is highly unlikely given that infrasonic turbine noise levels have repeatedly been shown to be orders of magnitude below recognised perception thresholds"
> (HMR, p. 16, Parag. 5.31).

In essence, the foundational argument against the notion of a toxic infrasound environment is: '*what you can't hear won't hurt you*.' In other words, if it cannot be perceived by the auditory system, then it cannot harm you…

5.5
And yet… in the comparative data presented in IARO's review (**SC 24**) of the LUBW Report (**CD10.4**), it was shown that when the IWT acoustic signatures were present, as measured in the bedroom, the home dwellers felt compelled to take medication (benzodiazepines). When the IWT acoustic signatures were absent, they overslept.

6. Infrasound and the Brain

6.1

As recognized by Mr. Mike Craven:

> "There is credible research that suggests a link with particularly high levels of infrasound generated by other sources (i.e., levels above perception thresholds for humans) and health effects" (HMR, p. 15, Parag. 5.28).

Presumably, this credible research refers to studies conducted within occupational environments, where infrasonic sound pressure levels are, admittedly, much higher than those encountered in contaminated homes. On the other hand, exposure times in occupational settings are much shorter than in residential settings, in which people *sleep in* the toxic environment…

6.2

Nevertheless, for many professional acousticians, it seems incredulous and "highly unlikely" (HRM: p.7, Parag. 5.4, second bullet, twice; p.16, Parag. 5.31; p.17, Parag. 5.37) that these relatively low sound pressure levels within the very low infrasonic ranges can be responsible for *any* health effects. This disbelief does not come from lack of scientific evidence, but rather from a lack of knowledge in the biological and medical fields.

6.3

'*What you can't hear can't hurt you*' is an antiquated notion, akin to saying that smoking while pregnant has zero effects on fetal health. By requiring that infrasound be perceived by the auditory system in order for it to have a pathological effect on humans is a singularly unique situation within the Medical Sciences, and as absurd as claiming that smoking is good for your health.

Why?

6.4

The human brain is a complex system that has evolved over millions of years. The fact that humans have survived for so long means that they have developed a variety of survival mechanisms, among which is the alertness to infrasonic events. Unlike the eye, the ear does not sleep, otherwise, as a species, we would have died out a long time ago.

Evolutionarily, infrasonic events are a harbinger of danger (volcanos, earthquakes, movement of large animals, etc.), and have served as warning signals to all terrestrial, airborne and water-based creatures since they came into being on planet Earth.

6.5

While the human brain does not necessarily interpret infrasonic signals as "sound", it does, nevertheless, process infrasonic information. It does so by comparing the normally present, monotonous (i.e., not dangerous) background acoustic phenomena, with the new element introduced by the sudden appearance of extra infrasonic signals (such as those heralding the proximity of predators or, in this context, IWT acoustic signatures).

The issue, therefore, of whether or not IWTs generate infrasound that is below the human audibility threshold is of no practical significance. The brain does not interpret new infrasonic signals that appear in the environment as sound, but rather as information that it compares to the ever-present background acoustic environment. These finer points of human biology are not generally considered (or even known) by professional acousticians and are certainly not incorporated into guidelines such as ETSU-R-97.

7. Final Commentary

Similar considerations as those made for the LUBW Report (**CD 10.4**) could be made for the governmental study conducted in Finland (**CD 10.5**). The statement made in HMR Parag. 4.4 as to the Ferter location being sufficiently away from other wind power plants that "any influence from the turbines would be insignificant in the context of other background noise sources" is clearly a misconception, as is clearly shown in **SC 38**, p. 10, Figure 5, and p. 14, Figure 9. Given the space constraints of this Precognition however, I am available to further discuss these issues during the Evidence in Chief.