



**Commentary on
“Wind turbine noise and human health impacts in Fairlie, North
Ayrshire” produced by Health Protection Scotland, July 2017.**

**by
Mariana Alves-Pereira, Ph.D.
August, 2021**

*Document included in the Closing Submission to the Planning Application
Appeal, Public Inquiry regarding the Arecleoch Wind Power Plant Extension.
[WIN 370-2 and RIGGHILL WIND POWER STATION PPA-310-2034 (PLANNING
PERMISSION APPEAL) 20/00248/PPM (NORTH AYRSHIRE COUNCIL)]*

A. Introduction

1.

I have been asked to provide a commentary on the document produced in July 2017, by Health Protection Scotland (HPS), today Public Health Scotland (PHS) (Doc1). I have also been asked to include a review of three emails, exchanged between Mr. Paul Brennan (Environmental Health Officer, North Ayrshire Council) and Ms. Joy Tomlinson (Interim Director of Public Health, National Health Services of Ayrshire and Arran) on 27 May—5 June, 2020 (Doc2).

2.

My area of expertise is the biological response to infrasound and low frequency noise exposure, in which I began working in 1988, integrated in a multidisciplinary team of medical scientists within the Portuguese Air Force. Although a copy of my CV as well as a list of Publications has already been submitted to the Reporters of this Appeal Hearing, I would like to reiterate my knowledge base for this subject matter: I hold a Bachelor of Science degree in Physics from the State University of New York at Stony Brook, a Master in Science degree in Biomedical Engineering from Drexel University in Philadelphia, PA., and a Doctorate degree in Environmental Sciences from the Nova University of Lisbon, Portugal.

B. Goal

3.

The documents I have been asked to scrutinize make reference to several scientific papers in which very complex matters are discussed in detail. It is my objective to facilitate the understanding of the more relevant scientific complexities to the Reporters of this Appeal Hearing.

C. 2017 HPS Document “Wind turbine noise and human health impacts in Fairlie, North Ayrshire” – Part 1

4.

This document (Doc1) is authored by Dr. Colin Ramsay, MBChB, MSc, MBA, DRCOG, FFPH. As I understand it, this means that Dr. Ramsey is a medical doctor, with a specialization in Obstetrics and Gynecology, a Master of Science degree (in Epidemiology, presumably), a Master’s degree in Business Administration, and he is a Fellow of the Faculty of Public Health.¹ Figure 1 shows an excerpt of Dr. Ramsay’s LinkedIn profile, detailing his expertise as an HPS Consultant Epidemiologist in Environmental Public Health, for the past 22 years.

¹ <https://www.researchgate.net/profile/Colin-Ramsay>

Experience



Health Protection Scotland

22 yrs 7 mos

Consultant Epidemiologist in Environmental Public Health

Feb 1999 – Present · 22 yrs 7 mos

Development of the Environmental Public Health Programme of Health Protection Scotland to address issues relating to the adverse impacts on health of exposure to environmental hazards and assessing the burden of ill health associated with exposure to environmental factors generally.

Provision of support to a wide range of stakeholders in relation to risk assessment, risk management, risk communication, with respect to the health impacts of exposure to environmental hazards.

Consultant Epidemiologist, Environmental Public Health

Feb 1999 – Present · 22 yrs 7 mos

Meridian House, 5 Cadogan Street, Glasgow G2 6QE

Responsible for the Environmental Public Health (EPH) programme of Health Protection Scotland (HPS) involving the provision of expert advice and support to NHS Boards, Local Authorities, Scottish Government and other stakeholders on risk assessment, risk management and risk communication related to environmental hazards and their health impacts. The programme also includes surveillance of environmental hazards and health impacts; supporting the local response to environmental incidents posing a risk to public health and assessing the impact of environmental factors generally on health.

Figure 1. LinkedIn profile of Dr. Colin Ramsay (excerpt).²

5.

In 2017, the residents of Fairlie, North Ayrshire submitted several research publications to the National Health Services of Ayrshire and Arran, regarding the potential for deleterious health effects due to the existence of industrial wind turbines in the vicinity of residential areas. These research publications (items) were reviewed by Dr. Ramsay on behalf of HPS, and an “HPS Assessment” was provided for each one, under the following guidelines:

“HPS considered each of these items in terms of their contribution to the evidence on the potential association between exposure to noise generated by (industrial) wind turbines and adverse human health impacts. An assessment is provided based on a critical appraisal of the methods, findings and conclusions drawn” (p. 3).

6.

At this point, I would like to point out to the Reporters of this Appeal Hearing two examples of the “HPS Assessment.”

a)

Regarding item 7) *Infrasound levels near windfarms and in other environments (2013)*:

“Due to the technical nature of the subject matter, HPS cannot assess the technical competence of this study” (p. 10).

² <https://www.linkedin.com/in/colin-ramsay-52021171/>

b)

Regarding item 8) *Low frequency noise from large wind turbines (2011)*:

“[T]he technical nature of the subject matter is outside HPS expertise” (p. 10).

7.

Since HPS claims to not have the expertise to evaluate studies concerning the measurement of infrasound and low frequency noise, I searched the charter of HPS to determine if this public institution is, *de facto*, mandated to possess such expertise.

D. Charter of Health Protection Scotland and Public Health Scotland

8.

The charter of responsibilities for HPS is given in its website (see Fig. 2).

9.

It is now relevant to point out to the Reporters of this Appeal Hearing that, in Medical Sciences, agents of disease are classified into 4 different categories:

- Biological
- Chemical
- Physical
- Psychosocial

Infrasound and low frequency noise (ILFN) fall into the category of *physical* agents of disease.

10.

All infectious diseases generally fall under the category of *biological* agents of disease, while ILFN falls under the umbrella of “environmental hazards” (Fig. 2), which encompasses all categories of agents of disease.

Responsibilities

We plan and deliver effective and specialist national services which co-ordinate, strengthen and support activities aimed at protecting the people of Scotland from infectious and environmental hazards.

We do this by providing advice, support and information to the following groups:

- health professionals
- national and local government
- the general public
- a number of other bodies that play a part in protecting health

Our functions include:

- surveillance and monitoring the hazards and exposures affecting people and the impact they have on their health
- co-ordination of national health protection programmes, for example, immunisation and antimicrobial resistance
- expert advice and horizon scanning
- effective preparation and response to outbreaks and incidents
- enabling good professional practice
- supporting the ongoing development of a confident and competent health protection workforce
- support commissioning specialist/reference lab services
- research and innovation to provide evidence for action

Figure 2. Responsibilities of Health Protection Scotland (excerpt).³

11.

In 2017, it was the responsibility of HPS to:

“[P]lan and deliver effective and specialist national services...aimed at protecting the people of Scotland from...environmental hazards.”

It was claimed that one of HPS functions included:

“[S]urveillance and monitoring the hazards and exposures affecting people and the impact they have on their health”

12.

Today, HPS has become a department within PHS (see Fig. 3) that:

“[W]ill continue to provide effective and specialist national services to protect the people of Scotland from environmental hazards,”

while PHS will:

“[P]rovide advice, support and information to health professionals, national and local government, the general public and other bodies that lay a part in protecting health.”

³ <https://www.hps.scot.nhs.uk/about-us/>

Specific roles of PHS regarding “environmental hazards such as flooding, air, water and land contamination” include:

“[S]urveillance and monitoring of hazards and exposures.”

Overview of how we work to protect health

Health Protection Scotland will continue to provide effective and specialist national services to protect the people of Scotland from infectious and environmental hazards, including COVID-19, from within Public Health Scotland.

We will provide advice, support and information to health professionals, national and local government, the general public and other bodies that play a part in protecting health.

Environmental hazards

We also provide specialist operational support and advice to stakeholders around environmental hazards such as flooding, air, water and land contamination. This includes:

- Advice during acute incidents and also for chronic exposures resulting from incidents that extend over a longer period of time
- Surveillance and monitoring of hazards and exposures
- Fostering a new post-Brexit UK-wide collaborative approach to the surveillance of communicable diseases and health problems associated with environmental hazards, including training and the development of a shared strategy

Figure 3. Operational information of Public Health Scotland (excerpt).⁴

13.

It should, therefore, be clear to the Reporters of this Appeal Hearing that there is an incongruence between HPS’ self-reported lack of expertise and HPS’ mandated responsibilities.

14.

This situation seems to carry over into PHS, since Doc2 (emails between Mr. Brennan and Ms. Tomlinson) informs:

“[T]he review carried out by Health Protection Scotland (dated July 2017) is still considered to be an accurate assessment of the balance of evidence on this topic at this time” (Email from Ms. Tomlinson to Mr. Brennan, 05 June 2020).

⁴ <https://publichealthscotland.scot/our-areas-of-work/protecting-our-health/overview-of-how-we-work-to-protect-health/>

E. Unanswered Questions – Part 1

15.

If HPS is responsible for “surveillance and monitoring the hazards and exposures affecting people and the impact they have on their health” how, then, does it self-report the absence of expertise when the potentially hazardous environmental exposure is ILFN?

16.

Could it be that ILFN exposure is not considered potentially hazardous by HPS/PHS?

If so, would such a position make any scientific sense, given what is known to date on this subject matter? (See Section O)

F. Example of a study deemed “sound and reliable” by HPS in 2017

17.

Returning to Doc1, let us now look at an item where the HPS Assessment was ‘favorable’. This item will be used to touch upon several aspects of the subject matter at hand; some of these may be a bit more technical, others merely require common sense.

Regarding item 5) *Health effects related to wind turbine noise exposure: A systematic review (2014)* (p. 6), this was the corresponding HPS Assessment:

“The paper is judged to be methodologically sound and reliable in terms of the conclusions drawn. The findings add to the existing body of epidemiological evidence on the relationship between exposure to wind turbine noise and adverse health effects” (p. 8).

18.

For the benefit of the Reporters of this Appeal Hearing, let us, then, examine, what type of research publication this is: a systematic review. This means that a search was performed on all the published papers on health effects and wind turbine noise exposure, after which, in the words of Dr. Ramsay:

“Of 1231 relevant studies initially identified and then screened, 36 were suitable for inclusion in the final review” (p.6).

Scrutiny of these 36 studies revealed, in Dr. Ramsay’s words:

“[The authors] note a lack of studies investigating specific aspects of WT generated infrasound and health effects; none of the finally selected studies specifically investigated “*the relationship of health effects and exposure to low frequency noise or infrasound.*” The authors considered that “*it remains unknown if exposure to infrasound from wind turbines does cause adverse health effects or if these potential health effects are the result of psychological mechanisms*” [author’s italics] (p. 7).

19.

This means that the research publication that was deemed “sound and reliable” by HPS, one in which “the findings add to the existing body of epidemiological evidence on the relationship between exposure to wind turbine noise and adverse health effects,” admits that none of the 36 studies that were included in the systematic review covered infrasound and low frequency noise health effects.

Is this not incongruent?

20.

Another incongruence emerges with the acknowledgement that:

“Noise annoyance is not usually studied directly as a health outcome” (p. 7);

And yet, it is accepted that:

“There was evidence of a threshold effect with a reduction in reported annoyance with noise levels below 35 dB(A) (...) The main conclusions are that there is sufficient evidence to confirm that wind turbines noise increases the risk of annoyance and sleep disturbance; with risk increasing as noise exposure increased (a positive dose-response relationship)” (p. 7).

21.

It is, to me, extraordinary that despite the acknowledgement that “noise annoyance” is not a usually studied health outcome, the use of “noise annoyance” is nevertheless accepted by a medical practitioner as a *bona fide* parameter to assess health effects caused by exposure to a physical agent of disease.

Usually, it is the professional acousticians who insist on the notion that “noise annoyance” is an objective measure of human health, but medical practitioners are expected to know better.

G. Why is it that “noise annoyance” cannot be considered a measure of health outcome, under the axioms of The Scientific Method and Evidence-based Medicine?

22.

a) The term “noise annoyance” first emerged in the 1960’s and 1970’s, mostly associated with airport noise. It used to be called “noise nuisance.” But, the term “nuisance” has legal implications, including liability of the party responsible for producing the nuisance, while “annoyance,” of course, does not...

b) Noise annoyance is a *subjective* parameter, meaning it varies with subjective issues of the individual. As Dr. Ramsay pointed out in his assessment of the “sound and reliable” systematic review:

“By contrast, economic benefit (derived from the presence of wind turbines) was “*negatively associated with annoyance*”” [author’s italics] (p.7).

23.

When dealing with a *physical* agent of disease, dose-response relationships can only be achieved if proper and relevant clinical measures can be associated with quantified doses of the agent of disease. “Noise annoyance” is not a clinical measure. Again, this is usually something that has to be explained to professional acousticians, but not to medical practitioners.

24.

In Dr. Ramsay’s defence, his acceptance of the dBA metric to quantify acoustical energy generated by industrial wind turbines is understandable although, yet again, highly unscientific.

H. Why dose-response relationships using the dBA metric for quantifying acoustic energy is an unscientific proposition when IFLN is a concern.

25.

To the Reporters of this Appeal Hearing, this is where some of the aforementioned technical complexity arises. I have often found that pictures are helpful aids in explaining complex issues.

26.

Figure 4 shows two noise graphs reflecting a 10-min average of the acoustic environment, recorded inside the master bedroom of a home located in the vicinity of a wind power station. (A) was recorded on 29 July 2020 at 04:00, and (B) was recorded on 22 July 2020, at 04:00.

These images are the end product of the mandated guidelines for the assessment of “noise pollution,” and are called 1/3rd octave band analyses. The red bars reflect the acoustic energy measured in dBA, as mandated by guidelines. The grey bars reflect the acoustic energy actually present in the environment, measured in dB-Linear (without the mandated A-weighted frequency filter).

27.

As is clearly visible to any layperson, the red bars merely reflect a minute portion of the entire acoustical environment.

What is also clearly visible to any layperson is the visual similarity between 4A and 4B.

Why, then, am I providing both them to you?

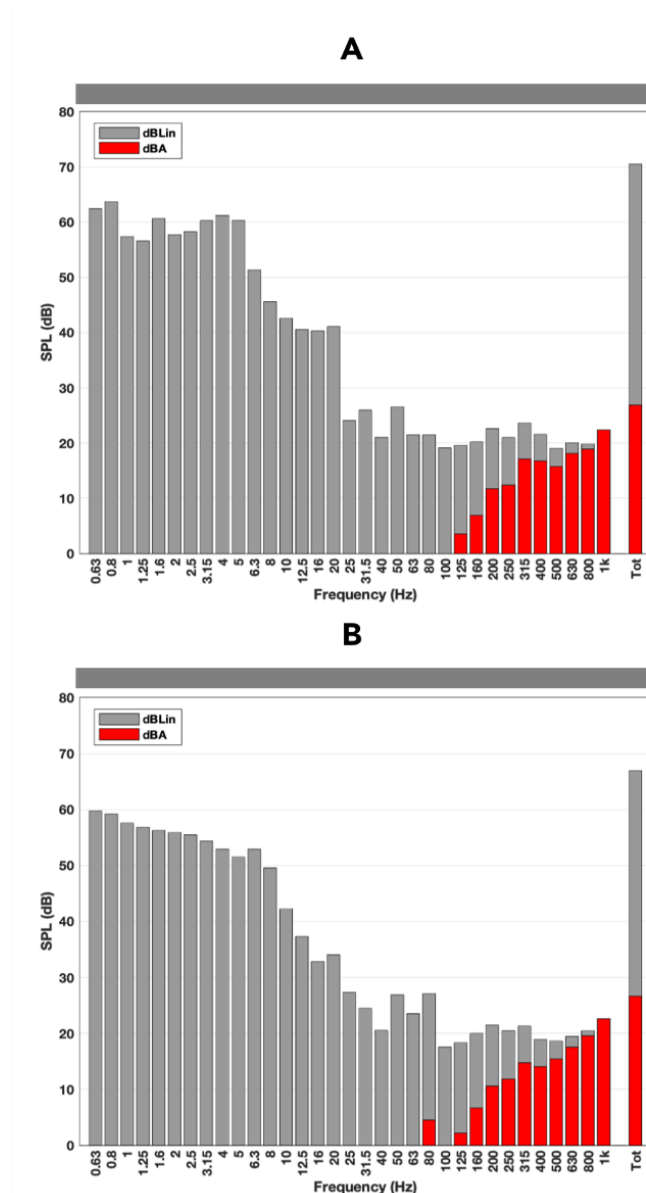


Figure 4. Ten-minute average of the acoustic environment inside the master bedroom of a home located in the vicinity of a wind power station (in Europe), analyzed in 1/3rd octave bands, and using the dBA metric (red bars) as well as the dBLin metric (grey bars).

(A) 29 July at 04:00.

(B) 22 July at 04:00.

The red bars, in dBA, reflect what legislation mandates be measured within the context of “noise pollution.”

The grey bars reflect the amount of acoustical energy that is present in the environment, but not account for by the dBA metric.

Overall, there appears to be very little difference between A and B, and a significant difference between the acoustic energy represented by the red bars when compared to that represented by the grey bars.⁵

This is the type of information obtained under mandated guidelines (such as ETSU-R-97).

⁵ This data is part of ongoing judicial proceedings, and is therefore kept anonymous.

28.

On July 29, at 05:00, the man living in this home was compelled to take medication (benzodiazepines) because of 'the noise.'

On the morning of July 22, the couple slept peacefully until 07:00.

But there is practically no difference in these two environments (Fig 4A and B)!

Can it be '*all in their heads*'?

Please see Figure 5.

29.

Figure 5 shows the *exact same numerical data* as in Figure 4: (A) 10-minute segment recorded on 29 July 2020 at 04:00 and (B) 10-minute segment recorded on 22 July 2020 at 04:00.

What's the difference?

a) Figure 5 is looking at the numerical data with a 1-second time resolution (each image covers a 600-second period of time) instead of the mandated 10-min time average (Fig. 4), and

b) Figure 5 reflects a frequency resolution of $1/36^{\text{th}}$ of an octave, instead of the mandated $1/3^{\text{rd}}$ of an octave (Fig.4).

30.

For the layperson (and also, perhaps, for the medical practitioners), this is analogous to transitioning from a magnifying glass to a microscope.

And now, a clear difference can be seen when comparing Figs 5A and 5B: Figure 5A has horizontal lines crossing the entire image and Figure 5B does not.

So, maybe it is not '*all in their heads*'...

31.

What are these lines?

These horizontal lines (Fig 5A) reflect the peaks of pulsed, airborne pressure waves that are emitted from industrial wind turbines. This series of peaks is called the wind turbine acoustic signature, and it mathematically matches the blade-pass-frequency of the model of the industrial wind turbine that is used in this particular wind power station.

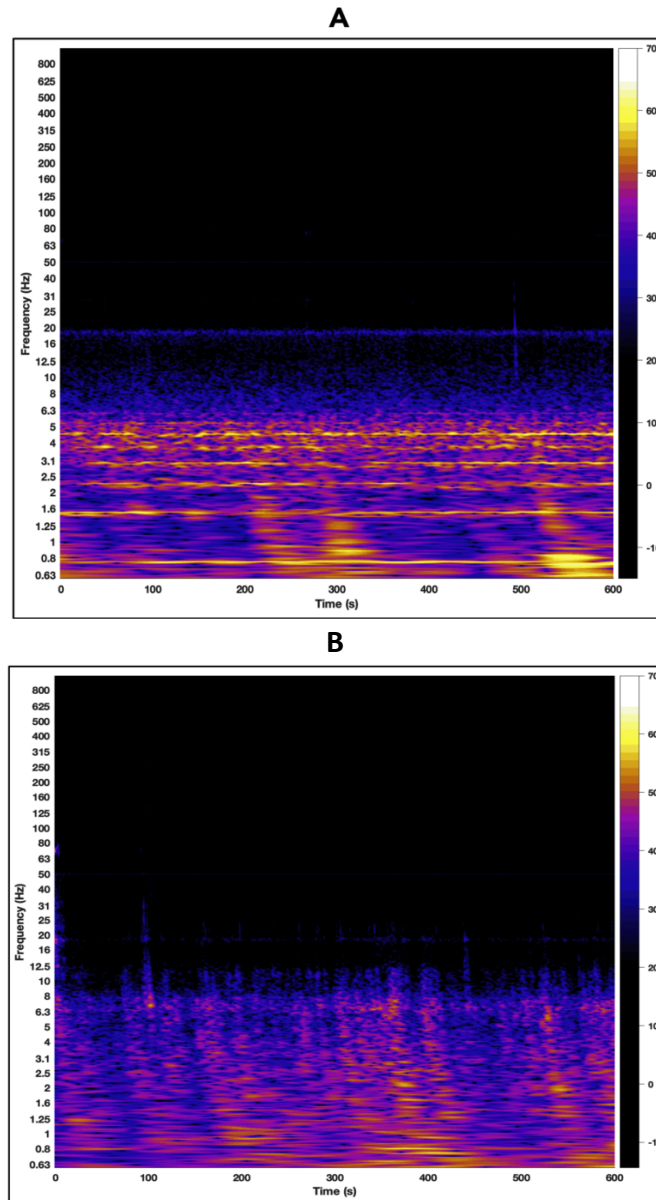


Figure 5. Acoustic environment inside the master bedroom of the home located in the vicinity of a wind power station (in Europe), analyzed in $1/36^{th}$ octave bands, spanning 10 minutes with 1-second temporal resolution (600 seconds), and using the dBLin metric only (color-coded scale on the right).

(A) 29 July at 04:00.

(B) 22 July at 04:00.

However, image (A) now exhibits straight horizontal lines that are continuously present for the entire 10-min period, while in image (B), these lines are absent. (see text)⁶

This is the same exact numerical data as shown in Figure 4.

⁶ This data is part of ongoing judicial proceedings, and is therefore kept anonymous.

32.

For the information of the Reporters of this Appeal Hearing (and for any medical practitioners who can take a deeper interest in this subject matter), dose-response relationships for 'noise' emitted by industrial wind turbines *cannot* rely on the dBA metric, 1/3rd octave band analyses and 10-min time averages to characterize the physical agent of disease.

In Figure 4, we are looking at the acoustic environment through a magnifying glass.

In Figure 5, we have switched to a microscope and identified acoustic phenomena that was previously undetectable.

I. Psychosomatic origins of symptoms developed by people living near wind power stations

33.

Figures 4 and 5 now allow the Reporters of this Appeal Hearing to understand a very important situation, as pointed out in the words of Dr. Ramsay referring to the 2014 "sound and reliable" systematic review (see Parag. 18 above):

"The authors considered that "it remains unknown if exposure to infrasound from wind turbines does cause adverse health effects or if these potential health effects are the result of psychological mechanisms" [author's italics] (p. 7).

By looking at Figure 4, and knowing that in situation A someone got sick and in situation B (exceedingly similar to situation A), no one felt ill, then, a psychosomatic origin for the symptoms of the people living in situation A could be plausible to the uniformed.

34.

In Medical Sciences, differential diagnoses can be achieved through the prescription of complementary medical diagnostic tests.

35.

Here again, some technical complexities arise.

A psychosomatic illness means that the symptoms reported by the patient in conjunction with the signs observed by the medical practitioner can lead the latter to hypothesize that there may be no organic basis for the patient's symptoms... meaning, '*maybe it's all in their heads*'.

Example:

Pseudocyesis, or false pregnancy. This is the condition where the human female exhibits all the signs of pregnancy, and yet, there is no foetus.

Question: How does the medical practitioner know whether it is a normal pregnancy or whether the patient has developed pseudocyesis?

Answer: We give them complementary medical diagnostic tests!

In the case of pseudocyesis, a simple, non-invasive ultrasound imaging of the uterus is generally sufficient to establish a differential diagnosis.

36.

It should, by now, be clear to the Reporters of the Appeal Hearing that the way in which ‘noise pollution’ is being measured, as mandated by government-approved guidelines (Fig. 4), *technically precludes* higher resolution information from being gathered.

37.

Without this higher-resolution information, it is impossible to quantify the potential agent of disease—a *sine qua non* condition for establishing scientifically-valid dose-response relationships.

38.

Another *sine qua non* condition for establishing proper dose-response relationships is a *bona fide* clinical measure of the response, for which the “noise annoyance” parameter (usually quantified through self-reported questionnaires or surveys) does not qualify.

J. Unanswered questions – Part 2

39.

Why hasn’t the medical community been prescribing complementary diagnostic tests to the people who are complaining of symptoms that they attribute to ‘wind turbine noise’?

40.

Why have not the General Practitioners of Scotland been made aware of the World Health Organization’s (WHO) codes for these types of symptoms?

“W42 - Exposure to Noise

Sound waves

Supersonic waves

W43 – Exposure to Vibration

Infrasound waves”

In: WHO *International Classification of Diseases (2010)*

“NF08.2Y – Other specified effects of vibration

Vertigo from infrasound

QD70.Z – Problems associated with the natural environment or human-made changes to the environment

Problems associated with exposure to vibration”

In: WHO *International Classification of Diseases (2020)*

K. 2017 HPS Document “Wind turbine noise and human health impacts in Fairlie, North Ayrshire” – Part 2

41.

Let us now take another look at the 2017 HPS document.

Which research publications (items) were actually scrutinized?

1. Material hosted on Wind Concerns Ontario website.
2. *Low frequency noise-induced pathology: contributions provided by the Portuguese wind turbine case (2015).*
3. *How does wind turbine noise affect people? (2014)*
4. *Environmental noise pollution: has public health become too utilitarian? (2017)*
5. *Health effects related to wind turbine noise exposure: a systematic review (2104).*
6. *Wind turbine amplitude modulation review, Phase 2 Report (2016).*
7. *Infrasound levels near windfarms and in other environments (2013).*
8. *Low frequency noise from large wind turbines (2011).*
9. *Wind turbines and health. A critical review of the literature (2014).*

42.

Curiosity: Items 7 and 8 were “additional papers [that HPS] identified as relevant” (p. 2). These two items were the only ones for which the HPS Assessment self-reported their lack of technical expertise.

43.

Question: Of all the items evaluated by HPS, which reflect basic science?

Meaning, which item is actually detailing medical evaluations of the complainants?

Systematic reviews and critical reviews of the literature, while useful in some fields of study and in some points in time, are mostly useless for the subject matter at hand because most of the studies on which these reviews are based:

- a) *assess noise* in dBA, 10-min time averages and 1/3rd octave band resolution;
- b) *evaluate health endpoints* through self-reported questionnaires or surveys; and
- c) *consider the impact of wind turbine noise* to be solely based on audible phenomena.

44.

The research publication items based on literature reviews were evaluated as to their methodology in *selecting* the papers on which to base their review, *and not* on the scientific methodology employed by each individual study that was included in the review. Example:

HPS Assessment of Item 5):

“This paper was assessed using the AMSTAR [Assessing the Methodological Quality of Systematic Reviews⁷] objective appraisal tool for systematic reviews. The paper meets

⁷ https://amstar.ca/Amstar_Checklist.php

many of the criteria required of a good quality, objective and systematic review. The review gives a clear description of the key questions addressed and the methods used to search for, identify and critically appraise relevant literature. A comprehensive literature search method was used to access peer-reviewed and non-peer-reviewed sources. Duplicate reviews were carried out to evaluate and screen candidate papers; critical analysis of the full text papers reviewed was carried out to assess quality; the role of selection and information bias in the evidence identified was considered (though not explicitly publication bias), as were the implications of bias on the conclusions drawn” (p. 8).

45.

I would like to invite the Reporters of this Appeal Hearing to click on the website offered in footnote 7, and view the checklist that establishes whether or not a systematic review should be considered valid.

L. Occupational Medicine is the ‘canary in the mine’ for Environmental Medicine—Every medical practitioner knows this...

46.

There are numerous examples in the History of Medicine where an agent of disease (of whatever category) was first identified within occupational settings and, subsequently, restricted or eliminated from all environmental settings (asbestos, for example).

47.

I am co-author of research publication item number 2

Therefore, initially, I had decided *not* to comment on this item, due to the possibility of issues being raised related to the potential existence of conflict of interests.

Particularly since the HPS Assessment of item 2 was:

“The evidence in this paper is essentially a case report of a particular situation in Portugal. The anecdotal findings cannot be generalised to situations elsewhere. It is not possible to assess the evidence presented independently to determine if the health effects reported by the family involved were caused by exposure to noise generated by the wind turbines. The paper therefore adds little new to the body of existing epidemiological evidence on wind turbines and their potential impacts on human health” (p.4).

48.

Item 2 is, indeed, a case report; in fact, a follow up from a 2007 report. It shows the 2015 medical evaluation of one man living in close proximity to industrial wind turbines, and compares it to his medical situation in 2007.

49.

It is a shame that Dr. Ramsay did not perform the due diligence (presumably required by a person of his professional standing) to actually find out what “respiratory drive” is, nor why its evaluation is important among ILFN-exposed individuals:

“Clinical findings reported included: slowing of nerve conduction times and other abnormalities in the child; pericardial thickening in the two adults; and reduced “respiratory drive” (not defined) below a normal range that the authors suggested might indicate a possible impact on the neurological control of breathing. There was no further evidence provided to support this hypothesis” (p.3).

50.

Respiratory drive is the ‘strength’ with which we inhale and that is neurologically controlled by the autonomic nervous system, i.e., the human has no conscious control over this part of breathing.

Organically, the neurological control of breathing is located in the brainstem (as any Anaesthesiologist could confirm).

For the uninformed medical practitioners: when the respiratory drive is compromised, individuals are unable to hyperventilate in the presence of excessive CO₂, i.e., the neurological control of breathing (located in the brainstem) could be impaired.

51.

In workers exposed to ILFN, brain MRI’s show lesions in the brainstem.

52.

In workers exposed to ILFN, their respiratory drive values are below normal.

53.

Research publication item 2:

- a) shows that the values of the respiratory drive of the man living near industrial wind turbines were below normal in 2007, and dropped even further by 2015;
- b) explains the reason why the respiratory drive test was given to this man;
- c) shows how the other complementary diagnostic tests prescribed to this family (deemed relevant because of the body of evidence collected among the IFLN-exposed workers) revealed ‘pericardial thickening’, which equates with cardiovascular changes and ‘abnormal nerve conduction times’ which equates with impaired cognition.

54.

Why is this respiratory drive test so important?

Because it is:

- a) *non-invasive*, and
- b) *objective*, i.e., not subject to operator or patient manipulation (such as questionnaires) or post-processing subjective analysis (such as ultrasound or MRI imaging techniques).

55.

The respiratory drive test is, then, a potential candidate for the response part of the dose-response relationships.

... as opposed to “noise annoyance.”

56.

Again, it has been my experience that professional acousticians do not generally possess the knowledge-base of Medical Sciences, and hence all the above issues have to be explained to them. However, it is not expected that these issues require explanation to medical practitioners.

57.

For the edification of the Reporters of this Appeal Hearing, additional information is given on this Portuguese case:

- Four industrial wind turbines are installed in late 2006 (The closest tower was located 200 m from the home)
- Family develops symptoms in 2007
- Legal proceedings begin in 2007
- Family moves out in 2008, except for the man
- Legal proceedings reach the Supreme Court in 2013
- Supreme Court’s decision: removal of the 4 industrial wind turbines
- Epilogue: from 2007-2013, more wind turbines were installed around this residence and these were, obviously, not included in the original legal proceedings—today, the home sits 600 m away from the closest tower.

M. 2017 HPS Document “Wind turbine noise and human health impacts in Fairlie, North Ayrshire” – Part 3

58.

Excluding research publication item 1, these are excerpts the of HPS Assessment for each corresponding item:

2. *Low frequency noise-induced pathology: contributions provided by the Portuguese wind turbine case (2015).*

“...adds little new to the body of existing epidemiological evidence...”
(p. 4).
3. *How does wind turbine noise affect people? (2014).*

“...provides little in terms of new epidemiological evidence” (p. 5)
4. *Environmental noise pollution: has public health become too utilitarian? (2017).*

“...adds relatively little new material to the body of existing epidemiological evidence...” (p. 6)
5. *Health effects related to wind turbine noise exposure: a systematic review (2104).*

“...add to the existing body of epidemiological evidence...” (p. 8)
6. *Wind turbine amplitude modulation review, Phase 2 Report (2016).*

“...findings add further to the existing body of epidemiological evidence...” (p. 9)
7. *Infrasound levels near windfarms and in other environments (2013).*

“This was not an epidemiological study...” (p. 10)
8. *Low frequency noise from large wind turbines (2011).*

“This was not an epidemiological study and so it adds nothing...” (p. 10)
9. *Wind turbines and health. A critical review of the literature (2014).*

“The review adds to the body of epidemiologic evidence...” (p.12)

59.

Dr. Colin Ramsay is mostly correct in his assessment here: most (if not all) of these studies *are not* epidemiological studies.

60.

Properly conducted epidemiological studies are, usually, *very expensive* undertakings.

61.

Proper epidemiological studies to investigate the health effects of ILFN, a physical agent of disease, are even more expensive, essentially because:

- a) physical agents require sophisticated technology to be quantified, and they must be quantified in *both* exposed and control locations.⁸
- b) a personal history is required of each individual in the study (exposed *and* controls), collected by a trained medical practitioner, i.e., a proper and comprehensive anamnesis⁹ *must* be obtained for each subject—otherwise prior exposures (especially foetal exposures) can function as a confounding factor.
- c) control groups (usually assumed to have zero exposure) do not exist; instead, a rating system is generally defined to categorize individuals as having mild, moderate or intense prior exposures to ILFN.
- d) complementary medical diagnostic tests are expensive, and for a proper epidemiological study one would need many, over certain period of time.
- e) dissemination of information to the public is also a non-trivial cost.

N. Unanswered Questions—Part 3

62.

Who would have the money to pay for something like this?

63.

The industry responsible for generating the agent of disease or the governmental agencies responsible for protecting public health?

64.

Besides the local residents who ‘feel’ affected, who would be sufficiently motivated to conduct *proper* epidemiological studies of the health effects of industrial wind turbine noise? Workers’ Unions?

⁸ Uninformed researchers would probably think it a great idea to study people living next to industrial wind turbines and compare them to people *not* living next to industrial wind turbines. This is an unscientific proposition. The agent of disease is not the industrial wind turbine *per se*, but what it spews. The correct study design would be to consider people who live near industrial complexes that emit artificial infrasound (whatever the source) and compare them to people who live in residential environments where artificial infrasound is minimum.

⁹ *Anamnesis* is the technical term for taking a patient’s history. As any medical student would tell you, a good *Anamnesis* is the crux of a diagnosis. The information gathered by a medical practitioner during *Anamnesis* is often confused with ‘anecdotal evidence.’ As any proper medical practitioner would tell you, *Anamnesis is not* ‘anecdotal evidence.’

O. Is infrasound an agent of disease?

65.

The WHO recognizes infrasound as a potential etiological factor for disease (see Paragraph 40).

66.

The Russian Federation has established permissible exposure levels for infrasound exposure since the 1970's. Figure 6 shows the numbers in 2000, limiting infrasound exposure in the workplace, populated areas and in residences.

Premise	Sound pressure levels, dB, in octaval bands of averaged geometric frequencies, Hz				General sound pressure level dB "Lin"
	2	4	8	16	
Different jobs inside industrial premises and production areas:					
- Different physical intensity jobs	100	95	90	85	100
- Different intellectual emotional tension jobs	95	90	85	80	95
Populated area	90	85	80	75	90
Living and public premises	75	70	65	60	75

Figure 6. Permissible exposure levels for infrasound as per legislation of the Russian Federation. Note the different specified locations (occupational vs. general public), the segmentation of the acoustical spectrum into 2 Hz, 4 Hz, 8 Hz and 16 Hz, and the expression of these numerical values in dB Linear (as opposed to dBA).¹⁰

67.

Here are some titles of peer-reviewed research papers, detailing basic science investigating the effect of infrasound on brain structures (these *are not* systematic or critical literature reviews):

- Involvement of microglial cells in infrasonic noise-induced stress via upregulated expression of corticotrophin releasing hormone type 1 receptor (2010).¹¹
- Glial cell-expressed mechanosensitive channel TRPV4 mediates infrasound-induced neuronal impairment (2013).¹²

¹⁰ Stepanov V. Biological Effects of Low Frequency Acoustic Oscillations and their Hygienic Regulation. 2000. State Research Center of Russia: Moscow. <https://apps.dtic.mil/dtic/tr/fulltext/u2/a423963.pdf>

¹¹ Du F, Yin L, Shi M, Cheng H, Xu X, Liu Z, *et al.* Involvement of microglial cells in infrasonic noise-induced stress via upregulated expression of corticotrophin releasing hormone type 1 receptor. *Neuroscience*. 2010;167:909-919. DOI: 10.1016/j.neuroscience.2010.02.060

¹² Shi M, Du F, Liu Y, Li L, Cai J, Zhang GF, *et al.* Glial cell-expressed mechanosensitive channel TRPV4 mediates infrasound-induced neuronal impairment. *Acta Neuropathologica*. 2013;126:725-739. DOI: 10.1007/s00401-013-1166-x

- Damage to hippocampus of rats after being exposed to infrasound (2016).¹³
- Inhibitive effects of FGF2/ FGFR1 pathway on astrocyte-mediated inflammation in vivo and in vitro after infrasound exposure (2018).¹⁴

I could list more such studies that focus on the impact of infrasound exposure on heart structures or on organs of the reproductive system, in order to show the Reporters of this Appeal Hearing that infrasound can, *de facto*, be a physical agent of disease.

P. Unanswered Questions – Part 4

68.

Clearly, there is sufficient international consensus to (at least) suspect that infrasound and low frequency noise may be agents of disease.

How, then, can one justify that an institution such as the HPS/PHS self-reports its lack of expertise and ineptitude to ‘survey and monitor environmental health hazards.’

69.

While Dr. Ramsay seems to be a very reputable professional, there appear to be some significant lacunae in his knowledge of the subject matter at hand.

Why, then, did HPS select Dr. Colin Ramsay to evaluate the Research Publications?

70.

Why did Dr. Colin Ramsay include 2 additional research items just to then assess that HPS lacked sufficient technical expertise to evaluate them?

Q. Emails exchanged between Mr. Brennan and Ms. Tomlinson

71.

Very little is added by the information contained in these emails where 2 additional Review Studies (2019) are listed, as well as the 2018 WHO document titled *Environmental Noise Guidelines for the European Region* (email dated 05 June 2020).

72.

If the Reporters of the Appeal Hearing have actually managed to get through my Commentary herein, then they are now able to discern for themselves the implicit and explicit incongruences inherent to these Reviews.

¹³ Zhang MY, Chen C, Xie XJ, Xu SL, Guo GZ, Wang J. Damage to hippocampus of rats after being exposed to infrasound. *Biomedical and Environmental Sciences*. 2016;29: 435-442. DOI: 10.3967/bes2016.056

¹⁴ Shi YJ, Shi M, Xiao LJ, Li L, Zou LH, Li CY, *et al*. Inhibitive effects of FGF2/ FGFR1 pathway on astrocyte-mediated inflammation in vivo and in vitro after infrasound exposure. *Frontiers in Neuroscience*. 2018;12:582. DOI: 10.3389/fnins.2018.00582

73.

Regarding the 2018 WHO Report, the word “infrasound” has one single entry, on page 85, under the section heading “Wind turbine noise”:

“Wind turbines can generate infrasound or lower frequencies of sound than traffic sources. However, few studies relating exposure to such noise from wind turbines to health effects are available. It is also unknown whether lower frequencies of sound generated outdoors are audible indoors, particularly when windows are closed.”¹⁵

74.

Traffic noise does not produce the horizontal lines seen in Fig. 5A, which characterize the wind turbine acoustic signature.

75.

The suggestion that the audibility of infrasound levels (in itself, an oxymoron) can be mitigated by closed windows clearly indicates a profound lack of knowledge of the physical attributes of propagating airborne pressure waves within the infrasound range.

76.

However, in defence of this position taken by the WHO, it must be acknowledged that its Noise Teams have restricted themselves to using the low-resolution methodologies for quantifying acoustic energy, as described in Figure 4.

R. Conclusions of the 2017 HPS Document

77.

The 2017 HPS document’s final conclusions were:

“HPS therefore remains of the view that the balance of the objectively reviewed scientific evidence does not support there being a direct causal link between the symptoms described by residents of Fairlie and the operation of nearby wind turbines.

Given the consensus on the limited quality of the current evidence base, HPS also reiterates the view that it remains difficult to categorically exclude the possibility that there might be some sort of relationship between WTN exposure and symptoms in individual cases. On balance however, the strength and consistency of the existing scientific consensus suggests that this is unlikely” (p. 14).

78.

So, paraphrasing... ‘there is no causal link between health effects and industrial wind turbine noise, but the possibility cannot be categorically excluded, however it is unlikely.’

¹⁵ <https://www.euro.who.int/en/publications/abstracts/environmental-noise-guidelines-for-the-european-region-2018>

Extraordinary!

79.

And meanwhile, citizens are falling ill with an insidious, whole-body pathology.

S. Reiteration of symptoms developed by individuals living in the vicinity of industrial wind turbines—Closing Submission to the Planning Application Appeal, Public Inquiry regarding the Arecleoch Wind Power Plant Extension

80.

SYMPTOMS DEVELOPED BY MS. PAT SPENCE AND OTHERS

Among *some* of the symptoms described by Ms. Pat Spence, from July 2019 to March 2020 are:

Nausea

(CD 21.22, Entries on 6 Jul, 3 Aug, 18 Aug, 12 Oct, 20 Oct, 4 Nov, 6-7 Nov, 10 Nov)

Dizziness

(CD 21.22, Entries on 7 Jul, 3 Aug, 13-14 Sep, 20-21 Sep, 26 Sep, 28 Sep, 24 Nov, 14-16 Jan, 27-28 Jan)

Pain in ears

(CD 21.22, Entries on 16 Jun, 18 Jun, 5-9 Jul, 15 Jul, 18 Jul, 22 Jul, 26 Jul, 31 Jul, 1 Aug, 3 Aug, 9-12 Aug, 21 Aug, 23 Aug, 13-14 Sep, 2 Oct, 4-5 Oct, 10 Oct, 17 Nov, 22 Dec, 27 Dec, 30 Dec, 1-2 Jan, 8-11 Jan, 17 Jan, 23 Jan, 26 Jan, 28 Jan, 29 Jan)

Sleep disturbances

(CD 21.22, Entries on 10 Jun, 2 Jul, 4 Jul, 14 Jul, 18 Jul, 22 Jul, 24 Jul, 13 Aug, 25 Aug, 13 Sep, 20 Sep, 12 Oct, 15 Oct, 3-5 Nov, 17 Nov, 23 Nov, 18 Jan)

These symptoms are not mutually exclusive and can occur simultaneously.

Dizziness and **sleep disturbances** are also described by Ms. Karen Brodie from Fairlie (CD 23.68).

Similarly, **nausea** and **balance disorders** are also reported by Ms. Rita Holmes, from Fairlie (CD 23.67).

Other Fairlie residents report **nausea** (CD 23.64 and CD 23.65) and **pain in ears** (CD 23.64).

Reporters of this Inquiry are reminded that Fairlie residents were exposed to (only) two IWTs (albeit designed for off-shore operations).

Ms. Cindy Aubad (CD 23.84) described **balance disorders** in her husband, but only when he is at home and, for herself, she reports **nausea**. Both report **sleep disturbances**.

In 2007, Mr. and Mrs. R (CD 23.89) reported **sleep disturbances**, while their 12-year-old's school-teacher noted that the child seemed "permanently tired" and questioned: "Does he sleep sufficient hours during the night?" By 2015 (CD 23.87), Mr. R's **balance disorders** had caused several falls requiring medical treatment.¹⁶

While not a part of the evidence already provided, all these symptoms are occurring in people living in the vicinity of IWTs all over the English and non-English-speaking world (!!)

¹⁶ This paragraph refers to the same case described in item 2 of the 2017 HPS document (See Paragraphs 48, 49, 53 and 57).

T. Conclusions and Recommendations

81.

The institutions that, in Scotland, are mandated to protect human health against environmental hazards self-report a lack of expertise in this scientific field when the environmental hazard is infrasound and/ or low frequency noise.

82.

As a result, they are unable to carry out and implement their obligations which include surveillance and monitoring of environmental hazards.

83.

Consequently, Scottish citizens with environmental health complaints that are suspected of being related to excessive exposure infrasound and low frequency noise (whatever the source) go ignored, and often even ridiculed.

84.

Since it is the health of Scottish citizens that is at play here, and since HPS/PHS has admitted to its lack of expertise of this subject, this would be my first suggestion to the appropriately competent decision-makers—a fairly inexpensive first step that could provide invaluable epidemiological data (if properly done):

Implement a mandatory notification rule for all Medical Practitioners (General Practitioners in particular) so that all patients exhibiting specific signs and symptoms suspected of being related to 'noise' exposure could be formally counted and associated with a specific geographic location and/or occupation.

85.

My second suggestion would be to the Reporters of the Appeal Hearing, to uphold the decision by North Ayrshire Council which denied permission for the installation of the Rigg hill wind power station.