

**BEFORE THE PUBLIC UTILITIES COMMISSION**

**OF THE STATE OF SOUTH DAKOTA**

IN THE MATTER OF THE APPLICATION BY PREVAILING WIND PARK, LLC FOR A  
PERMIT OF A WIND ENERGY FACILITY IN BON HOMME COUNTY, CHARLES MIX  
COUNTY AND HUTCHINSON COUNTY, SOUTH DAKOTA, FOR THE  
PREVAILING WIND PARK PROJECT

EL18-026

**PREFILED TESTIMONY OF PROF. MARIANA ALVES-PEREIRA**

ON BEHALF OF INTERVENORS

1 **I. ACADEMIC AND PROFESSIONAL BACKGROUND**

2

3 **Q: Please state your name, address and academic affiliation.**

4 A: My name is Mariana Alves-Pereira. My mailing address is Rua do Viveiro, 402, 1E,  
5 Estoril, 2765-294 Portugal. I am currently affiliated with Lusófona University, in Lisbon  
6 Portugal.

7

8 **Q: Please describe your academic qualifications and research expertise.**

9 A: I hold a B.S. in Physics from the State University of New York at Stony Brook, a M.Sc. in  
10 Biomedical Engineering from Drexel University in Philadelphia, and a Ph.D. in  
11 Environmental Sciences from the New University of Lisbon. I am an expert in the field of  
12 the biological responses to exposures to infrasound and low frequency noise (ILFN).

13

14 In 1988, before attending undergraduate studies in the U.S., I was employed by the  
15 Portuguese Air Force where I worked as a technical translator. I soon became involved  
16 with the onsite biomedical research team (founded in 1980 and led by Col. Nuno A. A.  
17 Castelo Branco, MD, pathologist) that was studying the 'non-auditory' effects of  
18 occupational noise exposure. Thus began my interest and involvement in this matter.  
19 Since then, I published my first peer-reviewed paper in 1999 and the latest in 2017.

20 Please see:

21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40

- *Exhibit 1: Curriculum Vitae 2018 – Mariana Alves-Pereira*
- *Exhibit 1a: Annex to Curriculum Vitae - List of Publications*

Research into the ‘health-effects’ of ILFN exposure is (necessarily) a multidisciplinary topic, requiring familiarity with a) the physics of acoustics, acoustical propagation and measurement, b) biomechanical properties of mammalian tissue, c) cellular architecture and cellular biology, d) histological and ultra-structural features of tissue and cellular organization in health and in disease, e) non-invasive and invasive clinical evaluations, f) laboratorial animal studies and studies among human populations, and g) patient anamnesis. Over the past thirty years, I have been involved in all these aspects in order to gain a deeper understanding into the biological response to ILFN exposure.

**II. PURPOSE OF TESTIMONY**

**Q: What is the purpose of your testimony?**

A: The purpose of my testimony is to provide the South Dakota Public Utilities Commission with scientific information regarding the health-effects associated with ILFN exposure.

**Q: What documents related to this case have you reviewed in preparation of your testimony?**

41 A: For the purposes of providing expert testimony at these hearings, I have reviewed the  
42 following documents:

- 43 • Applicant's burden of proof, SDCL § 49-41B-22
- 44 • Prevailing Wind Park Sound Study, prepared by Burns & McDonnell, dated  
45 30MAY18. Docket #: Appendix M
- 46 • Chris Howell Direct Testimony, dated 30MAY18, SD PUC Docket #: EL 18-026
- 47 • Dr. Mark Roberts Supplemental Direct Testimony, dated 10AUG18, SD PUC  
48 Docket #: EL-18-026
- 49 • Bon Homme County, Article 17 – Wind Energy Systems
- 50 • David M. Hessler Direct Testimony, dated 04MAY18, Docket #: EL18-003
- 51 • I have also been provided with the PUC's final decisions on the Crocker Project  
52 and the Dakota Range Project.

53

54 **Q: Please provide a brief summary of your opinion on these matters.**

55 A: When 'something' is suspected of being an agent of disease, then, for a scientist, the  
56 priority is to figure out a way to *quantify* said agent of disease.

57

58 Once the agent of disease is quantified, dose-response relationships can be sought.

59 These relate a certain amount of the agent of disease to a particular health-endpoint(s).

60 These health-related endpoints must be in the form of useful *scientific* data, i.e., capable  
61 of being clinically-corroborated.

62  
63 The above assertions are in compliance with the Scientific Method (which, among other  
64 aspects, requires that parameters under study be of an *objective* nature), and with its  
65 corollary, that of Evidence-based Medicine (which, among other aspects, requires that  
66 medical endpoints be *objective* in nature, i.e., capable of being clinically corroborated).

67  
68 When it comes to studying the health effects of ILFN exposure, however, these  
69 fundamental axioms of the Scientific Method and Evidence-based Medicine are  
70 somehow forgotten, or deemed not applicable.

71  
72 Specifically:

73 **1.** The dBA metric *does not* quantify ILFN, hence, the dBA unit is not useful for  
74 establishing, denying or predicting *de facto* health effects on humans and animal  
75 populations exposed to anthropogenic (human-made) or to natural ILFN.

76  
77 **2.** Annoyance *is not* an objective parameter and hence, in accordance with the  
78 axioms of Evidence-based Medicine, cannot be used to ascertain *de facto* health effects.

79

80           **3.**       It is often put forth that people living in ILFN-contaminated homes (whatever the  
81 source), and who attribute their deteriorating health to anthropogenic sources of ILFN  
82 are, in reality, suffering from a 'nocebo effect', i.e., effects that have no real organic basis  
83 and are of a psychosomatic origin. In accordance with the axioms of Evidence-based  
84 Medicine and, even more fundamentally, the Scientific Method, *psychosomatic illnesses*  
85 *must also be clinically corroborated*; their proposed existence based on mere assertions  
86 is not scientifically valid.

87

88 **III.       CONTEXTUALIZATION OF THE MATTER – THE dBA METRIC**

89

90 **Q:       Why do you claim that the dBA metric does not quantify ILFN?**

91 A:       Complex mathematical concepts are sometimes best understood with the aid of images.  
92 For this purpose I am including the image below (line 100, Figs 1-3) showing that when  
93 the dBA metric is used to measure the acoustic energy at 10 Hz (classically considered to  
94 be within the infrasound range), the difference between what is measured and what is  
95 actually present in the environment is 70 dB.

96 This image is separately attached to this Testimony as

- 97           • *Exhibit 2 – Pictorial explanation of the dBA metric*

98 The dBA curve was developed in the 1920's for the purposes of improving telephone  
99 acoustics, for which ILFN was considered irrelevant.

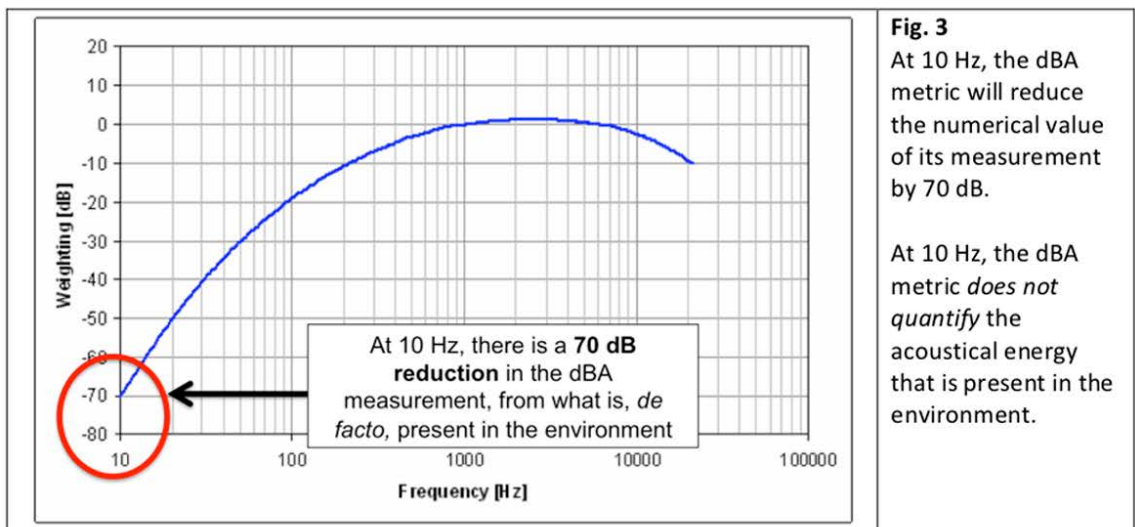
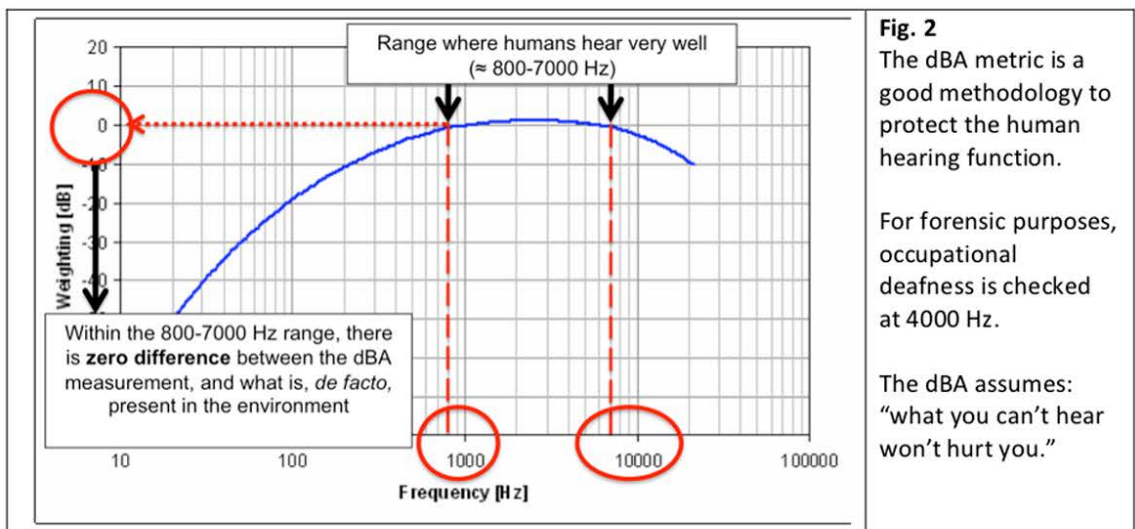
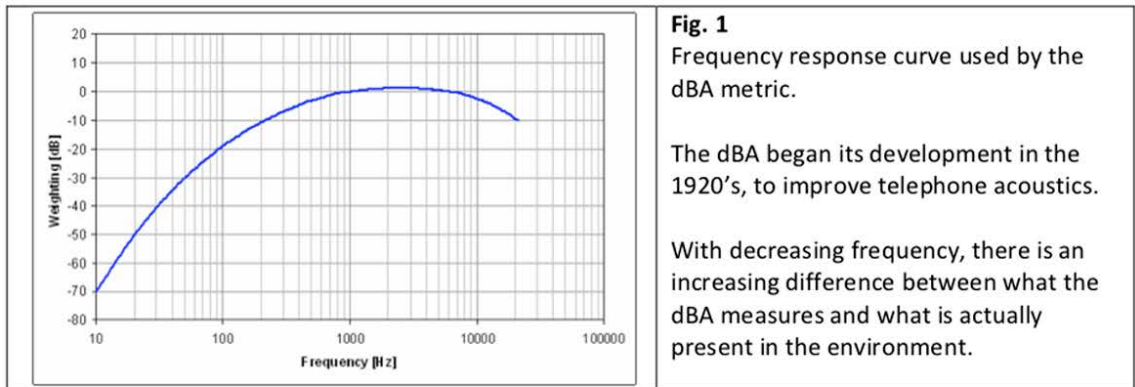


Image source: Dirac Dirac Delta Science & Engineering Encyclopedia (2018) A-Weighting.  
<http://www.diracdeltaco.uk/science/source/a/w/awweighting/source.html#.W45nwy2ZORs>

102 **Q: If the dBA unit is so inadequate to quantify ILFN, why, then, do the vast majority of**  
103 **studies from Governmental Agencies and Research Centers use the dBA metric?**

104 A: For several reasons:

105

106 1. The purpose of measurement is oftentimes not scientific, but legal, i.e., to  
107 ascertain compliance with existing regulations. Indeed, since ILFN is not regulated, why  
108 measure it at all? And since the vast majority of regulations are expressed in dBA units,  
109 why measure with anything else? Even if ILFN is quantified, science has not yet  
110 determined the appropriate dose-response relationships for human exposures.  
111 Therefore its numerical quantification is deemed as unnecessary by many professional  
112 acousticians.

113

114 2. “What you can’t hear won’t hurt you.” Since the dBA curve describes the human  
115 *auditory* threshold, and since noise exposure is (erroneously) assumed to only affect  
116 humans via the ear, the dBA metric is therefore (erroneously) considered sufficient to  
117 establish, deny or predict health-effects of noise exposure on human populations. Most  
118 medical schools do not cover the topic of ILFN as an agent of disease. Health-complaints  
119 due to noise exposure are, classically, dealt with by otolaryngologists (ear-nose and  
120 throat specialists), who are taught that the human auditory threshold, represented by  
121 the dBA curve, is the only issue of concern.



122

123 3. There are larger issues that are beyond my area of expertise: conceding that the  
124 dBA unit is insufficient to protect populations against 'noise' would necessarily imply a  
125 massive shift in the way we protect people from this agent of disease; it would  
126 potentially open the floodgates for lawsuits related to occupational exposures (similar  
127 to those seen with occupational deafness and asbestosis) and/or class actions due to  
128 environmental exposures.

129

130 4. Because that is how it has always been done...

131

132 **IV. CONTEXTUALIZATION OF THE MATTER – HEALTH EFFECTS**

133

134 **Q: What are 'self-reported' health complaints and what is their scientific validity?**

135 A: Any health condition usually begins with health complaints that, when reported by the  
136 individual, are, by definition, considered as 'self-reported'. When these complaints are  
137 'self-reported' to a medical doctor, they become part of the *anamnesis*, i.e., the  
138 documentation of the patient's medical history and current complaints that is partially  
139 obtained through information that is 'self-reported' by the patient.

140

141 For self-reported complaints to acquire any type of scientific validity, the intervention of  
142 a medical doctor is required. Based on the patient's self-reported complaints (called  
143 *symptoms*) and based on medical doctors' trained observations (called *signs*), a  
144 hypothesis will be put forth as to the cause of the medically observed *signs* that occur in  
145 conjunction with the patient's ('self-reported') *symptoms*.

146  
147 Self-reported symptoms become scientifically-valid data when the results of relevant  
148 and pertinent medical diagnostic tests become available. These would then have the  
149 attributes of 'objective, and clinically-corroborated' parameters, a *sine qua non*  
150 condition to be considered scientifically valid.

151  
152 **Q: Can you provide an example?**

153 **A:** Yes, I can. There is a group of individuals (US citizens) that began having cognitive and  
154 behavioral complaints such as: "difficulty remembering, mental fog, difficulty  
155 concentrating, feeling slowed, irritability, feeling more emotional." They also self-  
156 reported: "balance problems, dizziness and nausea," in addition to increased "visual  
157 problems, sound sensitivity," sleep disorders and headaches. All these self-reported  
158 symptoms are very similar to those made by families living in ILFN-contaminated homes  
159 (whatever the source).

160

161 Based on these self-reported complaints, this particular group of individuals received a  
162 series of pertinent medical diagnostic tests that provided scientifically valid medical  
163 data, i.e., data that was clinically-corroborated. These included: neuropsychological  
164 testing, posture and balance studies, oculomotor evaluations, audiometric assessments,  
165 and brain MRI. It was concluded that: “These individuals appeared to have sustained  
166 injury to widespread brain networks without an associated history of head trauma.”

167  
168 The hypothesis that this “constellation of acute and persistent signs and symptoms”  
169 could be of a psychosomatic etiology (i.e., a nocebo effect) does not appear to have  
170 been placed.

171  
172 The above information refers to a peer-reviewed paper, published in JAMA (Journal of  
173 the American Medical Association) in 2018, and is included in this Testimony as:

- 174 • *Exhibit 3: 2018-JAMA-Swanson et al*

175 Exhibit 3 serves as an example of the pertinent medical diagnostic tests that should be  
176 prescribed when people ‘self-report’ specific health complaints, i.e., when they manifest  
177 certain types of symptoms.

178  
179 **Q: Why are some people affected and others not within the same household?**

180 A: There are two exposure-linked factors (other factors are co-existent) that profoundly  
181 condition the onset of symptoms among families living in ILFN-contaminated homes  
182 (whatever the source):

183 1. *Prior ILFN exposure histories*, i.e., the overall, life-time exposure the  
184 individual may already have had, before being exposed to (anthropogenic) ILFN  
185 in the home.

186 2. *Residential time exposure patterns*, i.e., how much time is spent in the  
187 ILFN-contaminated home (homemakers vs. working outside the home, and sleep  
188 time).

189 3. *Individual susceptibility factors*, i.e., genetic make-up, diet, lifestyle, etc

190 This information, crucial to any health-related study on ILFN exposure, is generally not  
191 taken into account. There appears to be an (erroneous) expectation that once ILFN  
192 contamination begins in a dwelling, all family members will manifest symptoms within  
193 the same time span. This would only be true if *all* members of the family had the exact  
194 same prior noise exposure histories, *and, simultaneously*, the same schedules in terms  
195 of remaining within the contaminated home.

196 When this information is not taken into account in large-scale studies, the subsequent  
197 statistical analysis is likely to return inconclusive results.

198

199 **V. INDUSTRIAL WIND TURBINES**

200

201 **Q: When was your group first contacted about an ILFN-contaminated home caused by**  
202 **the proximity of wind turbines?**

203 A: The first family to contact our group specifically because of wind turbines was Canadian,  
204 back in the early 2000's.

205

206 **Q: And since then, how many have contacted you, specifically because of wind turbines?**

207 A: Hundreds.

208

209 **Q: Do you conduct field-research?**

210 A: Yes, I do.

211

212 **Q: What kind of data are you and your group collecting?**

213 A: We are collecting acoustical data in a manner that allows us to quantify ILFN, and we are  
214 conducting extensive interviews among the complaining populations, taking into  
215 account prior noise exposure histories and time exposure patterns within and around  
216 the residence.

217

218 **Q: Have you published any peer-reviewed results of this field data?**

219 A: Not very many, as of yet, because we have only had a new measuring equipment since  
220 2016. This new acoustical measuring equipment allows us not only to *quantify* ILFN, but  
221 also provides information on the time profile of the acoustical event, an important  
222 parameter when studying health effects.

223 Last year we published a peer-reviewed paper on the acoustics of industrial wind  
224 turbines in a mink farm in Denmark. This year, in a more informal publication, *Engineers*  
225 *Ireland*, we also published some results from our recent fieldwork in Ireland. Both these  
226 papers are submitted with this Testimony as:

- 227 • *Exhibit 4: 2017- SJAEM-Alves Pereira et al.*
- 228 • *Exhibit 5: 2018-Engineers Ireland- Alves-Pereira et al.*

229 In both papers, the wind turbine acoustic signature was clearly identified within the  
230 animal sheds of the Danish mink farm, and within a home in Ireland that has been  
231 abandoned. The youngest child of this Irish family has been formally diagnosed with  
232 epilepsy, while the oldest child has been formally diagnosed with post-traumatic stress  
233 disorder. The owner of the Danish mink farm has also been formally diagnosed with  
234 post-traumatic stress disorder.

235 We currently have several other papers undergoing the peer-review process.

236

237 **Q: What is a safe distance between wind turbines and homes?**

238 A: Science does not yet have the numerical values for that. We have picked up wind  
239 turbine acoustic signatures in homes 12 km (7.4 miles) away from the nearest industrial  
240 wind turbine. We are currently analyzing data from 8 homes around the same wind  
241 development, that distance from 1 km (0.62 miles) to 23 km (14.2 miles) to the nearest  
242 industrial wind turbine. Results are not yet available. Safe distances have not yet been  
243 established for the ILFN generated by wind turbines.

244

245 **Q: What is a 'wind turbine acoustic signature'?**

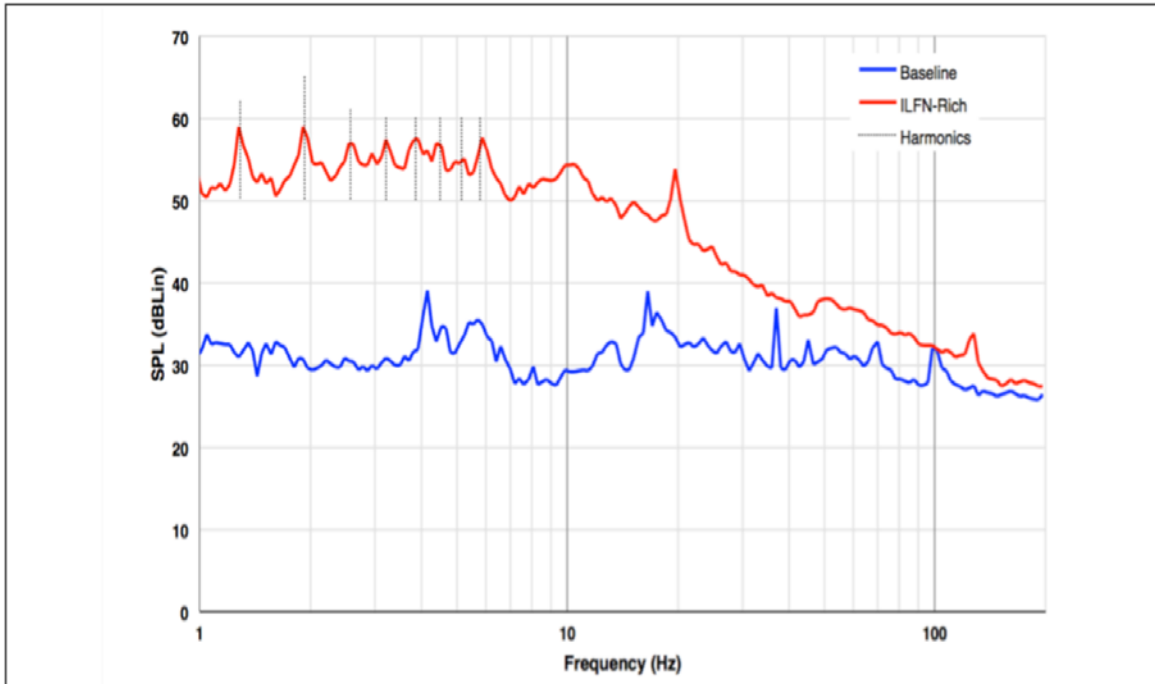
246 A: All things have acoustic signatures, such as (for example) road vehicles, aircraft, trains,  
247 etc. An acoustic signature is the periodic and identifiable characteristic of the acoustic  
248 output associated with any machinery. The acoustic signature of an industrial wind  
249 turbine is associated with the number of times a blade passes a given point, per second  
250 – this is called the *blade pass frequency* or *fundamental frequency*.

251

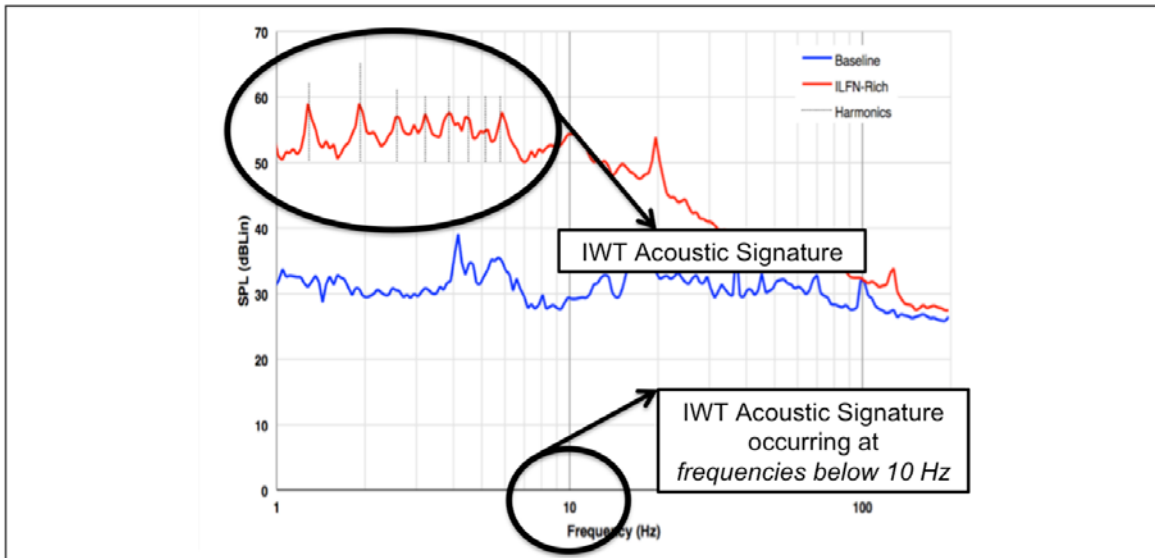
252 The image shown in line 257 (Figs 4,5) represents an industrial wind turbine acoustic  
253 signature with a blade pass frequency of 0.65 Hz. The 'signature' appears as consecutive  
254 peaks, interspaced by a mathematical sequence (harmonic series), and which is due to  
255 the periodic rotation of the blades.

256 There are *two noteworthy features* that are pertinent to the matter at hand:

257



**Fig 4.** The blue curve represents the acoustical environment when industrial wind turbines (IWT) are not rotating. The red curve represents the same acoustical environment while IWT were rotating. (IWT rotation confirmed with video footage during measurements.) The dotted lines (Harmonics) represent peaks of acoustical energy that fall on a mathematical sequence, and hence, cannot be attributed to wind.



**Fig 5.** The industrial wind turbine acoustic signature occurs at frequencies below 10 Hz, hence, the dBA metric is unsuitable to characterize this type of acoustical environment.

Image Source: Alves-Pereira M, Bakker HHC. *Occupational and residential exposures to infrasound and low frequency noise in aerospace professionals: Flawed assumptions, inappropriate quantification of acoustic environments, and the inability to determine dose-response.* Scientific J Aerosp Eng Mech 2017, 1(2):83-98. (Figure 5)



259 1. The fact that the wind turbine acoustic signature coincides with a  
260 mathematical sequence (harmonic series) means that blowing wind is not the  
261 cause.

262 2. The fact that the wind turbine acoustic signature occurs in a frequency  
263 range below 10 Hz means that the dBA metric is unsuitable for characterizing  
264 these types of acoustical environments.

265 The image shown below is taken from Exhibit 4, Figure 5.

266

267 **VI. GUIDELINES AND REGULATIONS**

268

269 **Q: What is your opinion on the noise requirements as stated in Article 17 – Wind Energy**  
270 **Systems?**

271 A: They are antiquated, as are many other regulations on this matter, for the reasons  
272 explained above. A single numerical value (45 dBA) is entirely insufficient to characterize  
273 the type of acoustical pollution that is generated by industrial wind turbines. In fact, for  
274 a rural area, 45 dBA is quite high given that ‘normal background noise’ in many rural  
275 areas around the world is around 25-35 dBA, or lower.

276

277 **Q: Do you have any comment on the Applicant’s burden of proof, as set forth in SDCL §**  
278 **49-41B-22?**

279 A: Yes. I would like to point out that the way in which this paragraph is worded implies that  
280 even if the applicant complies “with all applicable laws and rules,” it must *also* assure  
281 that the project “will not substantially impair the health, safety or welfare of the  
282 inhabitants.” This means that the possibility of health, safety and welfare impairment is  
283 acknowledged *even when* compliance “with all applicable laws and rules” is met. I find  
284 this to be an extraordinarily ‘open-minded’ position by implicitly putting forth the  
285 notion that “applicable laws and rules” on their own will not necessarily prevent  
286 impairment of inhabitant “health, safety or welfare”. Indeed, this is the situation in  
287 which we, as a worldwide collective, find ourselves: current laws and rules are  
288 insufficient to protect human populations.

289  
290 By applying the dBA standard, developed to protect hearing, in any and all cases  
291 regardless of the ILFN content of the environment, applicable rules and laws are being  
292 complied with, but the health of human population is not fully protected.

293  
294 **VII. COMMENTARY ON TESTIMONY OFFERED BY OTHER EXPERTS**

295  
296 **Q: You have had the opportunity to read several testimonies provided by other**  
297 **witnesses.**

298 A: Yes

299

300 **Q: Do you have any specific comments on the information provided by Dr. Mark Roberts?**

301 A: Yes. I would merely like to clarify some aspects to which Dr. Roberts makes reference.

302 1. Agents of disease are classified as:

303 a) biological (viruses, bacteria, etc),

304 b) chemical (carbon monoxide, pepper spray. etc)

305 c) physical (electromagnetic radiation, noise, etc)

306 d) psychosocial (sexual harassment, bullying, etc)

307 Industrial wind turbines in and of themselves are not considered agents of disease by  
308 the medical sciences; it is the ILFN that they generate that is the agent of disease.

309

310 While this may seem to be a question of semantics, indeed it is not, as it can lead to  
311 crucial flaws in the designs of studies that claim to investigate ILFN-induced health  
312 effects.

313

314 By assuming that industrial wind turbines are an agent of disease, then studies  
315 comparing people who live near wind turbines with those who do not, will appear to be  
316 scientifically valid – they are not! The agent of disease is ILFN. To conduct a proper  
317 study, people living near industrial wind turbines have to be compared with people who  
318 do not live *near any major source of anthropogenic ILFN*. Otherwise, one runs the risk of

319 comparing people who live near industrial wind turbines with those who live near  
320 airports or large volume roadways. Under these circumstances, it is likely that little to no  
321 difference will be identified between both populations, and the typical ensuing  
322 conclusion is that there is no problem associated with industrial wind turbines.

323  
324 This type of study design flaw has happened before, in the 2001 Vieques Heart Study  
325 conducted by the Agency Disease Registry and Toxic Substances. Please see:

- 326 • *Exhibit 6: 2013-Vieques Final Report*

327  
328 2. In line 524 it is stated that I am the primary researcher in vibroacoustic disease. I  
329 am not. The primary researcher has always been Col. Nuno A. A. Castelo Branco, MD,  
330 who has just recently retired.

331  
332 3. In lines 526-528 it is stated that I personally have “not reconciled the difference  
333 in the intensity of the low frequency sound she as studied in aircraft maintenance  
334 workers and the low intensity of sound produced by wind turbines.” Perhaps merely  
335 reflecting the witness’ unfamiliarity with this physical agent of disease, this is,  
336 nevertheless, untrue.

337 The following was published in 2007 (eleven years ago):

- 338 • *Exhibit 7: 2017-PBMB-Alves-Pereira et al.*

339 “Not all ILFN-exposed workers have [the standard 8hr/day, 5 days/week] exposure  
340 schedule. For example, ship machinist can spend 3 weeks onboard ship (i.e.,  
341 exposed to substantial ILFN-rich environments) and 2 weeks at home (i.e.,  
342 presumably not in ILFN-rich environments) (Arnot, 2003). Other professional  
343 activities exist where the ILFN-exposure time pattern is not the standard 8-h/day  
344 exposure, such as with submarine and oil rig operators, astronauts, and  
345 environmental exposures in residential areas, where exposure can be continuous  
346 over long periods of time, and exists during sleeping hours. In these cases, the  
347 evolution of signs and symptoms could be greatly accelerated. For examples, in the  
348 case of a Dublin homemaker, epileptic seizures consistent with [vibroacoustic  
349 disease] developed after 3 years of residence within an ILFN-infested home  
350 (Monteiro et al., 2004). If the ILFN exposure is environmental and /or leisurely, the  
351 standard 8h/day model is also not applicable.”

352 The references cited in this quote are offered in this Testimony as

- 353 • *Exhibit 8: 2003-Institute of Acoustics UK, Arnot*
- 354 • *Exhibit 9: 2004-Internoise-Monteiro et al.*

355

## 356 VII-A. TIME EXPOSURE PROFILES

357 **Q: How does exposure time relate to the onset of symptoms?**

358 The time over which the person is exposed to the agent of disease makes a difference to  
359 the evolution of symptoms. Because laypersons are more familiar with radiation, lets us  
360 take the example of the common chest x-ray. Receiving a chest x-ray once or twice a  
361 year, given its relatively low-dose of radiation, is not considered harmful to humans. It is  
362 considered that whatever damage is done during that very brief period of time where x-  
363 ray exposure occurred, the body will recuperate. However, receiving 10 chest x-rays per  
364 day for a year, might indeed begin to pose a problem in terms of health effects. It is the  
365 same with ILFN.

366  
367 Occupational ILFN exposures (although usually implying exposures to higher levels of  
368 acoustical energy than in residences) *cease at the end of the workday*. The workers are  
369 afforded a recovery period during which, at the cellular level, the body restores itself  
370 from the whole-body mechanical insult.

371  
372 When anthropogenic ILFN is contaminating a home (even with lower levels than in  
373 occupational environments) the body can be exposed 24/7 (particularly in  
374 homemakers). Moreover, and perhaps more worrisome, families in ILFN-contaminated  
375 homes *are sleeping* while enveloped within an environment that is bombarding their  
376 bodies with mechanical agents of disease.

377

378 **VII-B ILFN – A PHYSICAL AGENT OF DISEASE**

379

380 **Q: You mentioned *mechanical agent of disease* and *physical agent of disease* when**  
381 **referring to ILFN. What, if any, is the difference?**

382 A: ‘Noise’ in general is classified as a *physical agent of disease* because it is composed of  
383 airborne pressure waves. Pressure means a force impacting on a particular area (like the  
384 punch of a boxer on the jaw of his/her opponent). The World Health Organization  
385 classifies noise as “inanimate mechanical forces” (ICD-10, items W42 and W43). When  
386 one is exposed to acoustical phenomena, one becomes enveloped by airborne pressure  
387 waves that ‘beat on’ the biological organism. When the airborne pressure waves have  
388 specific ‘beating’ attributes, then they ‘beat on’ the auditory hair cells, and we call it  
389 sound. With ILFN, these airborne pressure waves do not necessarily induce the  
390 perception of sound. This is particularly true in the early stages of residential exposure.

391

392 **VII-C CELLULAR ARCHITECTURE IN MAMMALS**

393

394 **Q: What happens at the cellular level when these airborne pressure waves bombard the**  
395 **body?**

396 A: Cells respond to biochemical signaling and mechanical signaling. Cellular communication  
397 that is made through mechanical signals is called mechanotransduction. When a

398 mechanical force impacts a cell or group of cells, depending on the attributes of the  
399 mechanical force, the cells can be made to stretch, elongate or spread out. When the  
400 mechanical force impacting the cell is periodic and continuous, the cells have no time to  
401 recover back to their initial (and equilibrium) positions. Damage is cumulative and not  
402 instant.

403  
404 Metaphorically, this is similar to the boxer, who endures 10-12 rounds but then, the  
405 cumulative amount of mechanically induced damage (the punches) finally catches up  
406 and the boxer is knocked-out. Also similar to ILFN-induced pathology, if the boxer is  
407 afforded an appropriate recovery time, he or she can be back in the ring. However, in  
408 the hypothetical scenario that the boxer keeps getting punched, even outside the ring,  
409 then his/her recovery time will necessarily require a much longer period of time.

410  
411 **Q: Do you have any specific comments on the information provided by Mr. David M.**  
412 **Hessler?**

413 **A:** Yes. I would like to applaud Mr. Hessler's candid testimony, which I will use as an  
414 example for further clarifying for the PUC this complex subject of 'noise'-induced health  
415 effects.

416



417 In lines 11-12, page 7: "I heard nothing but complete silence, I felt nothing and I could  
418 not understand what these people were complaining about;" and in lines 14-16, page 7,  
419 quoting Mr. Steven Cooper, a well-known and highly respected acoustician from  
420 Australia: "on my first experience the noise was extremely low, could not be detected  
421 inside the dwelling and I didn't understand why these residents would be so vocal and  
422 genuinely distressed from the turbines." These very candid observations are commonly  
423 encountered among acousticians when they begin to deal with ILFN issues. Their  
424 inability to consciously perceive anything (initially) could stem from their reduced prior  
425 exposure to this type of agent of disease and hence their reduced 'sensitivity.'

426  
427 Based on Mr. Cooper's recent and exciting experiments (lines 15-22, page 6 to lines 1-2,  
428 page 7), Mr. Hessler has now become convinced that "a minority of people do have a  
429 sensitivity to minute pressure pulsations associated with the blade passing frequency  
430 which is typically extremely low; less than 1 Hz. The question is: how small or large is  
431 this minority?" (lines 2-5, page 8).

432  
433 If, indeed, the effects of ILFN exposure are cumulative, this questionable minority will  
434 certainly have a tendency to grow. Please understand that industrial wind turbines are  
435 not the only sources of residential ILFN-contamination. Many people around the world  
436 are suffering (*the same*) health effects due to residential ILFN that is unrelated to the

437 existence of industrial wind turbines. Some of these cases never get documented in  
438 scientific journals, however the following Exhibits provide examples of such cases:

- 439 • *Exhibit 6: 2013-Vieques Final Report*
- 440 • *Exhibit 9: 2004-Internoise-Monteiro et al. (case no. 4)*
- 441 • *Exhibit 10: 2004-Internoise-Castelo Branco et al.*

442 The development of symptoms and conscious perceptions occurs *over time*. Perhaps, in  
443 the near future, the ‘minority group’ will be composed of those who, after living within  
444 ILFN-contaminated residences for over one-to-two years, have not developed any  
445 clinically-corroborated health endpoints.

446

447 **Q: Do you have any further information that might be useful for the PUC regarding the**  
448 **Prevailing Wind Park Project?**

449 A: Installing industrial wind turbines as a serpentine throughout residential areas, is not a  
450 good idea *if* the health of human (and animal) populations is of any concern.

451 It is fully recognized that industrial wind turbines are being ‘sold’ as providing ‘green’  
452 energy, and this has instigated a worldwide impetus to install these types industrial  
453 complexes. Our group has as much against industrial wind turbines as we have against  
454 airports, other transportation systems, manufacturing plants, and etc. They are all  
455 acknowledged as an integral part of a modern technological society, as we know it.  
456 However, protection of public health, the precautionary principle and ethical

457 considerations preclude us from serpentine airports, transport systems and  
458 manufacturing plants among residential areas.

459  
460 Appropriate zoning laws for industrial wind turbines should be considered. However, in  
461 the absence of zoning laws based on scientific information, then the governmental  
462 agencies responsible for Public Health should step in to conduct *appropriately designed*  
463 epidemiological studies. Ideally, this would study relevant health endpoints *before* and  
464 *after* installation of the industrial wind turbines. It would also include the quantification  
465 of ILFN *before* and *after* the installations of the industrial wind turbines, with the same  
466 wind speed and wind direction, and evaluated *inside* the affected homes.

467

468 **Q: Does this conclude your Direct Testimony?**

469 A: Yes.

470

471 Dated this 10<sup>th</sup> day of September of 2018

472 

473 Prof. Mariana Alves-Pereira