

BEFORE THE
PUBLIC UTILITIES COMMISSION
STATE OF SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION OF DAKOTA RANGE I, LLC AND DAKOTA
RANGE II, LLC FOR AN ENERGY FACILITY PERMIT TO CONSTRUCT
A WIND ENERGY FACILITY

SD PUC DOCKET EL18-003

PREFILED TESTIMONY OF MARK ROBERTS
ON BEHALF OF DAKOTA RANGE I, LLC AND DAKOTA RANGE II, LLC

April 6, 2018

1 **I. INTRODUCTION AND QUALIFICATIONS**

2

3 **Q. Please state your name and business address.**

4 A. My name is Dr. Mark Roberts. I am employed by Exponent, Inc. (“Exponent”), and my
5 office is located at 525 West Monroe Street, Suite 1050, Chicago, Illinois 60661.

6

7 **Q. Please describe your background and your duties.**

8 A. I am a Principal Scientist in the Chicago office of Exponent, a scientific research and
9 consulting company headquartered in Menlo Park, California. I have worked at Exponent
10 since November 2003.

11

12 Prior to working at Exponent, I held a series of positions with advancing responsibility in the
13 areas of public health, occupational medicine, and academia. I was employed at the
14 Oklahoma State Department of Health from 1972 to 1990 and held a series of positions
15 culminating in my appointment as the State Epidemiologist, a post that I held from 1979 to
16 1982, followed by the position of Consulting Medical/Environmental Epidemiologist from
17 1983 to 1990. In both of these capacities, I directed epidemiologic investigations consisting
18 of a broad range of health concerns, from food-borne outbreaks to cancer clusters.

19

20 I was a faculty member of the Department of Preventive Medicine at the Medical College of
21 Wisconsin from 1990 to 1997, and I completed my tenure as Associate Professor and Acting
22 Chairman of the Department. I have also served as Corporate Medical Director for several
23 global companies. While on faculty at the Medical College of Wisconsin in Milwaukee,
24 Wisconsin, I was contract Medical Director for Wisconsin Centrifugal, a foundry in
25 Waukesha, Wisconsin. In this role, I supervised the health monitoring programs, both
26 company-mandated and Occupational Safety and Health Administration (“OSHA”) required,
27 in addition to the day-to-day clinical aspects of the employee health service. My
28 responsibilities included biological surveillance of employee population as well as worksite
29 reviews and inspections.

30

31 I earned an M.S. in Education in 1972, an M.P.H. in Epidemiology and Biostatistics in 1974,
32 and a Ph.D. in Epidemiology and Biostatistics in 1979. I completed medical school in 1986,
33 an internship in Family Medicine in 1987, and a residency/fellowship in Occupational and
34 Environmental Medicine in 1990.

35
36 I am a Fellow of the American College of Occupational and Environmental Medicine. I have
37 unrestricted licenses to practice medicine in Oklahoma and Wisconsin. In addition to my
38 employment experience, I am a past member (2000–2007, 2008–2011) of the Board of
39 Directors, Vice President (2013-2014), and President (2015-2016) of the American College
40 of Occupational and Environmental Medicine in Arlington Heights, Illinois. I have been a
41 member of the Board of Directors of Vysis, Inc. in Downers Grove, Illinois and the Board of
42 Scientific Counselors for the Agency for Toxic Substances and Disease Registry in Atlanta,
43 Georgia. In addition, I have served as an active participant on numerous state and national
44 professional committees. My statement of qualifications is attached as Exhibit 1.

45
46 **Q. Did you previously provide prefiled testimony in this docket?**

47 A. No.

48
49 **II. PURPOSE OF TESTIMONY**

50
51 **Q. What is the purpose of your testimony?**

52 A. The purpose of my testimony is to (i) give an overview of public health and epidemiology
53 principles implicated by an inquiry into the health effects of wind turbines; (ii) generally
54 assess health claims that have been attributed to wind turbines in light of the peer-reviewed
55 and published scientific literature; and (iii) specifically address health concerns relating to
56 epilepsy and autism raised during the public input hearing for the proposed Dakota Range
57 Wind Project (“Project”).

58
59 **Q. Please provide a brief summary of the opinions you are offering in your Supplemental
60 Testimony.**

61 A. My opinions can be summarized as follows:

- 62 1. Wind turbines as a cause of specific adverse health effects has not been proven by
63 peer-reviewed, published scientific literature;
- 64 2. The tried and true scientific method of developing a hypothesis, testing that
65 hypothesis, publishing the results and having others attempt to repeat the research has
66 not demonstrated that wind turbines are a causative agent of specific adverse health
67 effects;
- 68 3. An accumulation of anecdotal testimony from persons living near a wind turbine does
69 not constitute an epidemiological study and is not sufficient to determine causation;
- 70 4. Several well-respected governmental agencies charged with protecting public health
71 have evaluated the available evidence and have concluded that wind turbines are not a
72 cause of adverse health effects; and
- 73 5. The published literature has shown some association between wind turbine noise
74 emissions and annoyance. However, the level of annoyance is often more closely tied
75 to visual impacts and attitudes regarding wind turbines than to actual sound levels.
76 While annoyance is at times associated with various symptoms, it is not a disease.
77 Instead, those varied symptoms represent a normal physiological response.

78

79 **Q. What Exhibits are attached to your Direct Testimony?**

80 A. The following Exhibits are attached to my Supplemental Testimony:

- 81 • Exhibit 1: Statement of Qualifications.
- 82 • Exhibit 2: Australian National Health and Medical Research Council (2010). *Wind*
83 *Turbines and Health: A Rapid Review of the Evidence*. This report was updated in
84 2014 and 2015.
- 85 • Exhibit 2a: Australian National Health and Medical Research
86 Council (2014). *Review of Additional Evidence for NHMRC*
87 *Information Paper: Evidence on Wind Farms and Human Health –*
88 *Final Report*.
- 89 • Exhibit 2b: Australian National Health and Medical Research
90 Council (2015). *NHMRC Statement: Evidence on Wind Farms and*
91 *Human Health*.

- 92 •
- 93 • Exhibit 2c: Australian National Health and Medical Research
94 Council (2015). *Systematic Review of the Human Health Effects of*
95 *Wind Farms.*
- 96 • Exhibit 3: French National Agency for Food Safety, Environment and Labor
97 (“ANSES”) (2017). *ANSES Opinion regarding the expert appraisal on the*
98 *“Assessment of the health effects of low-frequency sounds and infrasounds from wind*
99 *farms.”*
- 100 • Exhibit 4: Wisconsin Wind Siting Council (2014). *Wind Turbine Siting – Health*
101 *Review and Wind Siting Policy Update.*
- 102 • Exhibit 5: Joseph Rand and Ben Hoen (2017). Thirty Years of North American wind
103 energy acceptance research: What have we learned? Energy Analysis and
104 Environmental Impacts Division, Lawrence Berkeley National Laboratory, Electricity
105 Markets and Policy Group.
- 106 • Exhibit 6: Public Service Commission of Wisconsin (2015). *Review of Studies and*
107 *Literature Relating to Wind Turbines and Human Health. Prepared for the Wisconsin*
108 *State Legislature.*
- 109 • Exhibit 7: Massachusetts Departments of Environmental Protection and Public Health
110 (2012). *Wind Turbine Health Impact Study: Report of the Independent Expert Panel.*
- 111 • Exhibit 8: Letter, Kim Malsam-Rysdon, Secretary of Health, South Dakota
112 Department of Health (Oct. 13, 2017), *In the Matter of the Application by Crocker*
113 *Wind Farm, LLC for a Permit of a Wind Energy Facility and a 345 kV Transmission*
114 *Line in Clark County, South Dakota, for Crocker Wind Farm*, Docket No. EL17-055.
115 available at: <https://puc.sd.gov/commission/dockets/electric/2017/e117-055/DK4.pdf>
116

117 **III. OVERVIEW OF PUBLIC HEALTH AND EPIDEMIOLOGY PRINCIPLES**

118
119 **Q. What is the practice of Occupational and Environmental Medicine?**

120 A. Occupational and Environmental Medicine is a medical subspecialty that is recognized by the
121 American Board of Medical Specialties and is one of the population-based specialties of

122 Preventive Medicine. Specialists in this area are physicians with advanced training in
123 prevention-based medical care of populations. Occupational and Environmental Medicine
124 focuses on environment/health interactions, including workplace-related illnesses and
125 injuries, and workplace effects on non-work-related conditions. Occupational and
126 Environmental Medicine physicians are also trained to assess the possible causes of a
127 worker's health condition. This specialty draws heavily on the key tenets of epidemiology,
128 biostatistics, industrial hygiene, risk assessment, and toxicology. I relied extensively on my
129 training in this field to reach my conclusions noted above.

130

131 **Q. What is epidemiology?**

132 A. Epidemiology is the study of distribution and dynamics of factors in populations. It is
133 considered the cornerstone methodology in all of public health research, and is highly
134 regarded in evidence-based medicine for identifying risk factors for disease and determining
135 optimal treatment approaches to clinical practice. Epidemiology is the scientific study of
136 factors affecting the health and illness populations, and in this capacity, it serves as the
137 foundation and logic of interventions made in the interest of the public's health and
138 preventive medicine.

139

140 Epidemiological studies are generally categorized as descriptive, analytic (aiming to examine
141 associations and commonly hypothesized causal relationships), and experimental (a term
142 often equated with clinical or community trials of treatments and other interventions). Case
143 reports and case series are not epidemiological studies because they have no comparison
144 group. Epidemiology addresses whether an agent can be linked to a cluster of cases, but not
145 whether an agent caused a specific individual's disease. So while epidemiologists cannot
146 diagnose individuals, they can establish the defining characteristics of clusters of illnesses,
147 such as the point in time at which a given pathogen from a specific source began to cause
148 problems and when it stopped.

149

150 In this case, epidemiologic methods are the appropriate tool to guide the determination of
151 whether wind turbines are the cause of disease in people living nearby. The practice of
152 medicine, in contrast, is devoted to preventing, alleviating or treating diseases and injuries in

153 individuals. Concerned with disease in populations, epidemiology is used to determine what
154 is sometimes called “general causation.” However, it does not establish the cause of an
155 individual’s disease, which is sometimes referred to as “specific causation.”

156

157 **Q. How are “epidemiology methods” used to determine causation?**

158 A. Epidemiology is the basic methodology used to characterize a health condition among groups
159 of people. Epidemiology incorporates the methods needed to identify associations and,
160 ultimately, is used to determine causation. Epidemiological research starts with a scientific
161 hypothesis which is then investigated and the information is critically reviewed and shared
162 with the scientific community by being published. The totality of this research then forms
163 the material to answer the question, “Is there an association between exposure and the health
164 condition?” Mere association is not the same as causation. Two things can be associated,
165 but one does not necessarily cause the other. Determination of causation is a higher level of
166 data assessment including assessment of the totality of published literature relevant to the
167 subject and requires transparent analysis of the data before it is concluded that the observed
168 association is actually causal. Not all associations turn out to be causal. If the data is not
169 carefully reviewed, a causal relationship may be erroneously assigned to the relationship,
170 which is why peer review is so critical to the process.

171

172 **Q. Can you provide more detail about what the terms “association” and “causation” mean,
173 as used in epidemiology?**

174 A. There have been clinical observations (case reports and series) that stimulated a number of
175 now classic epidemiology research efforts identifying important associations and ultimately
176 the determinants of causal relationships. Case studies and case reports, however, cannot be
177 used to determine causation. A causal association can only be established by the evaluation
178 of well-designed and executed epidemiologic studies that have undergone peer review, in
179 addition to research from other disciplines (e.g., exposure, toxicology). A landmark
180 discussion of the process of moving from a disease being associated with a risk factor to
181 concluding the association is causal was put forth by Sir Austin Bradford Hill in 1965. It was
182 during this time that a number of papers, including the Surgeon General Report in 1964,

183 began to more formally delineate the scientific process for concluding that an exposure is
184 causally related to a disease.

185
186 The process of moving from “association” to “causation” is a complex process, but a key
187 point emphasizing the process was made by Sir Bradford Hill when he started his discussion
188 of causation by stating:

189
190 Disregarding then any such problem in semantics we have this situation. Our
191 observations reveal an association between two variables, perfectly clear-cut and
192 beyond what we would care to attribute to chance. What aspects of that association
193 should we especially consider before deciding that the most likely interpretation of it
194 is causation?

195
196 (Hill 1965.) Sir Bradford Hill’s nine criteria for causation have been described in a number
197 of ways. They are commonly referred to as strength, consistency, specificity, temporality,
198 biological gradient, plausibility, coherence, experiment, and analogy. (Hill 1965.)

199

200 **Q. Are Hill’s nine criteria still valid today?**

201 A. Yes. The criteria presented by Sir Bradford Hill are most often referred to as the guidance
202 used to progress in a scientifically defensible manner from a claim of association to one of
203 causation.

204

205 **Q. Please describe some recent examples of how initial studies moved from association to**
206 **causation and the ultimate results of those research efforts.**

207 A. Beyond the classic studies of lung cancer and smoking, we now know that there is an
208 increase in lung cancer from secondhand smoke and from radon exposures. It seems that
209 not a week goes by that we do not hear about a new disease association often related to
210 cancer or heart disease. Take butter for example, it has fallen in and out of favor multiple
211 times over the years.

212

213 **Q. Why is it important that scientific research be published in peer-reviewed scientific**
214 **journals?**

215 A. In this computer age, we are awash in “information” without clear evidence of its validity.
216 With the advent of the Internet, views, opinions, hypotheses, and mere speculation can be
217 made to appear just as valid as sound science, but without the rigor of critical and objective
218 review. For example, an internet search on December 5, 2017 using the terms “wind turbine
219 health” returned 2.37 million listings. Thus, when making decisions about potential impacts
220 to human health, such as determining whether wind turbines are a cause of human disease, it
221 is vitally important that we rely on sound science and recognized scientific methods, as
222 supported by peer-reviewed scientific articles. The act of submitting an article for
223 publication in a peer-reviewed journal indicates that there is a rigorous process of review and
224 analysis to assess its scientific merit, its contribution to the scientific body of knowledge in
225 the specific area, and its pertinence to the area covered by the journal. The growth of
226 research and the number of researchers has increased the competition for publication space in
227 journals worldwide. Unfortunately, this growth has also led to publication resources that are
228 not as rigorous in their review process which can result in opinion pieces being published
229 with the appearance of a science basis (e.g. pseudo-science).

230
231 Today, manuscripts get reviewed at the journal editor level and those that are judged worthy
232 of consideration (approximately 25 percent) are sent to the peer review panel members, and
233 roughly 10 percent of those get accepted for inclusion in the journal. The peer review
234 publication process carefully scrutinizes the major aspects of the manuscript down to
235 checking the numbers in the tables. Wind turbines have generated a large amount of interest
236 and information as evidenced by the millions of results a Google search of “wind turbine
237 health” will yield. However, volumes of unscientific material should not be taken as proof of
238 causation. Many of the opinions voiced are not supported by review using a rigorous
239 application of the scientific method of discovery.

240
241 **Q. What is the scientific method of discovery?**

242 A. In the process of an idea or an observation being assimilated into the science knowledge
243 base, it must first come to someone’s attention. That can be an astute observation or a series

244 of events that catches the attention of a science-minded individual (a researcher). The
245 individual weighs the observation against what they know and makes a decision to pursue the
246 observation further.

247
248 The attention of the scientific community is alerted to the opinion, which is usually in the
249 form of case reports or case series. It should be recognized by all that case reports and case
250 series are merely observations. Case reports or case series are seldom if ever accepted for
251 publication by the leading science journals, partially due to the fact that case reports are seen
252 as observations without quantification or other indication of validity. This quantification or
253 validation comes from the careful study of the opinion using well-designed epidemiologic
254 studies.

255
256 A well-designed epidemiologic study allows the researcher to make comparisons between
257 those with and those without the condition or effect in order to determine if an association is
258 apparent. That is, those that are “exposed” are more likely to manifest the health condition
259 than the “non-exposed” or the “expected number.” A good example of this is the
260 investigation of a foodborne outbreak where epidemiologists compare the rate of occurrence
261 of objective indications of illness in those persons who ate the suspect food item to the rate of
262 similar illness among those that did not eat the suspect food item. The key to this step in the
263 scientific method is that there is a comparison group to compare objective signs of illness. A
264 comparison group is not present in a case report or a series, where the researcher is
265 speculating (also known as a hypothesis) but cannot make a statement about the risk (strength
266 of the association). In an epidemiological study, a method of comparison is included that
267 will allow the researcher to evaluate the strength of the association. Furthermore, one
268 epidemiological study does not prove causation. The researcher who publishes the first
269 epidemiological study is the one that alerts his or her peers and hopefully stimulates them to
270 do more research to explore the association. Once a sufficient body of knowledge has been
271 produced, then the question of causation can be addressed either by governmental agencies or
272 professional organizations.

273

274 Thus the scientific knowledge base is strengthened by the collective work of different
275 researchers, using different epidemiological methods, in different study populations
276 combining their research. This body of research around the original observation is then
277 evaluated to see if there is sufficient scientific information to support that a cause for the
278 condition has been identified and is scientifically justifiable.

279

280 **Q. Why utilize scientific methodology when there are case studies and/or personal**
281 **testimonials asserting that wind turbines can cause adverse health effects?**

282 A. The scientific methodology is an accepted process used to evaluate epidemiologically-based
283 evidence, and make sound, scientifically supportable decisions. There have been numerous
284 examples where an agent first thought to be the cause of a disease was not confirmed to be so
285 as a result of the scientific process of hypothesis generation, research, and peer review. For
286 example, in the following instances associations between an exposure and disease were
287 disproven: coffee and pancreatic cancer (ACS 2011); silicone breast implants and
288 autoimmune diseases (Hölmich et al. 2007); saccharin and bladder tumors (NCI 2009);
289 Bendectin and birth defects (McKeigue et al. 1994). In some instances, an alternative cause
290 is proven: spicy food and ulcers (turns out many are caused by bacteria) (NIH 2010).
291 Clearly, initial observations and hypotheses are not always supported by more thorough
292 scientific investigation. Even strongly held beliefs by groups of people do not provide proof
293 of causation and at times can be detrimental to the scientific process and to public health. A
294 timely example of such a situation is the current belief by some that immunizations cause
295 autism.

296

297 The multiple governmental reviews and reports of public health officials show that concerns
298 related to wind turbines' potential for adverse health effects have been and are being taken
299 quite seriously. However, the subjective, non-specific complaints, which show a great deal
300 of variability, are simply insufficient evidence that wind turbines are the cause of adverse
301 human health effects.

302

303 **IV. ASSESSMENT OF HEALTH CLAIMS ATTRIBUTED TO WIND TURBINES**

304

305 **Q. What have government agencies concluded about wind turbines?**

306 A. Several agencies (State, National and International) have concluded that wind turbines are
307 not associated with adverse health effects in humans. Following are a few examples of those
308 studies:

- 309 • In 2010, the Australian National Health and Medical Research Council conducted
310 a review of the evidence and concluded that “wind turbines do not pose a threat to
311 health if planning guidelines are followed.” Exhibit 2. The results of the 2010
312 Australian National Health and Medical Research Council study were confirmed
313 in subsequent studies. In 2015, the NHMRC concluded that there is no consistent
314 evidence that wind farms cause adverse health effects in humans. *See* Exhibit 2a
315 and Exhibit 2b. The 2014 NHMRC Final Report found no reliable evidence that
316 wind turbine emissions cause adverse health effects by biological pathways.
317 Exhibit 2c.
- 318 • In 2017, the French National Agency for Food Safety, Environment and Labor
319 (ANSES) conducted a review of the available experimental and epidemiological
320 data, and did not find any adequate scientific arguments for the occurrence of
321 health effects related to exposure to noise from wind turbines, other than
322 disturbance related to audible noise and a nocebo effect, which can help explain
323 the occurrence of stress-related symptoms experienced by residents living near
324 wind farms. Exhibit 3.
- 325 • In 2014, the Wisconsin Siting Council concluded that no association between
326 wind turbines and health effects has been scientifically shown. Exhibit 4.
- 327 • Researchers at the Lawrence Berkeley National Laboratory similarly found no
328 link between wind turbines and adverse health effects. Exhibit 5.
- 329 • The Public Service Commission of Wisconsin (2015) concluded that: “Presently,
330 the recent literature on this subject continues to reach conclusions similar to those
331 identified in the 2014 WSC report. The studies have found an association between
332 exposure to wind turbine noise and annoyance for some residents near wind
333 energy systems. Some studies show this as a causal relationship between wind
334 turbines and annoyance. There is more limited and conflicting evidence
335 demonstrating an association or a causal relationship between wind turbines and

336 sleep disturbance. There is a lack of evidence to support other hypotheses
337 regarding human health effects caused by wind energy systems.” Exhibit 6.

- 338 • An independent expert panel for Massachusetts (2012) found that there was
339 limited evidence supporting an association between wind turbines and annoyance
340 or possible sleep disturbances. However, they concluded that “there is insufficient
341 evidence that the noise from wind turbines is *directly (i.e., independent from an*
342 *effect on annoyance or sleep)* causing health problems or disease.” Exhibit 7
343 (italics in original).

344

345 **Q. You conducted a review of the peer literature on health effects attributable to sound.**

346 **What did it show as it relates to sound generated by wind turbines?**

347 A. My analysis and review of the peer reviewed, published literature did not identify scientific
348 works that provide objective support for the claims being made regarding wind turbines. The
349 peer reviewed, scientific research involving the health effects of sound levels (from various
350 sources) is extensive. Research on health effects associated with human exposure to sound
351 has evolved from the study of physical damage (e.g., hearing loss) to the study of
352 psychological effects and other non-specific physical symptoms. Research has focused on
353 both the frequency and amplitude of sound, within and outside of the audible range of human
354 hearing.

355

356 Most of the available literature examines noise exposures at the workplace, as high levels of
357 noise exposure are one of the most established forms of occupational injury. Noise
358 exposures outside the workplace have not been studied as extensively yet may be just as
359 damaging (chain saws, leaf blowers, power saws and lawn mowers). However, there has
360 been research on exposures to highway traffic noise, commercial airport noise, and a variety
361 of other community noise sources that can provide valuable insight into the evaluation of
362 sound generated by the operation of wind turbines. This body of research has identified a
363 number of health-related associations with high levels of industrial sound in the workplace.
364 However, this same science has not identified a causal link between any specific health
365 condition and exposure to the sound patterns generated by contemporary wind turbine
366 models, perhaps because they generate far lower decibel levels than most vocational sources.

367 This same science has determined that there is a range of sounds (some would say noise) that
368 is clearly described by some as annoying. There have been illnesses, symptom complexes,
369 and other health events attributed to wind turbines. This is to be expected given the
370 circumstances and emotions that often surround the presence of wind turbine farms. This is a
371 common phenomenon that is associated with activities that may be perceived as a social
372 disruption or conflict of personal rights by a subset of the population.

373
374 Despite the attribution of various health events to wind turbines, there has not been a specific
375 health condition documented in the peer-reviewed published literature to be recognized by
376 the medical community or professional societies as a disease caused by exposure to sound
377 levels and frequencies generated by the operation of wind turbines.

378

379 **Q. Has the State of South Dakota addressed claims of an association between wind**
380 **turbines and health effects?**

381 A. The State of South Dakota has not specifically studied alleged health effects and wind
382 turbines. However, the Department of Health was asked to opine on the issue in another
383 docket, *In the Matter of the Application by Crocker Wind Farm, LLC for a Permit of a Wind*
384 *Energy Facility and a 345 kV Transmission Line in Clark County, South Dakota, for Crocker*
385 *Wind Farm*, Docket No. EL-17-055. The South Dakota Secretary of Health, Kim Malsam-
386 Rysdon, submitted a letter consistent with my testimony (Exhibit 8):

387 The South Dakota Department of Health has been requested to comment on the
388 potential health impacts associated with wind facilities. Based on the studies we
389 have reviewed to date, the South Dakota Department of health has not taken a
390 formal position on the issue of wind turbines and human health. A number of
391 state public health agencies have studied the issue, including the Massachusetts
392 Department of Public Health¹ and the Minnesota Department of Health². These
393 studies generally conclude that there is insufficient evidence to establish a
394 significant risk to human health. Annoyance and quality of life are the most
395 common complaints associated with wind turbines, and the studies indicate that
396 those issues may be minimized by incorporating best practices into the planning
397 guidelines.

¹ <http://www.mass.gov/eea/docs/dep/energy/wind/turbine-impact-study.pdf>

² www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf

398

399 **Q. Based on your review of the available scientific literature, are there potential adverse**
400 **health effects from the sound of wind turbines?**

401 A. No, because the levels of sound and infrasound from wind turbines are significantly lower
402 than those that have been shown to cause harm. Substantial research has been done on sound
403 level exposures to humans. This body of scientific research has identified a number of
404 health-related links to high level industrial sound in the workplace. For example, OSHA has
405 set a limit of 90 A-weighted decibels (“dBA”) based on a finding that exposure to levels of
406 noise above 90 dBA in the workplace can cause hearing damage and set an 85 dBA level as
407 the set point of initiation of a hearing protection program in the workplace. However, this
408 same science has not identified a causal link between any specific health condition and
409 exposure to the sound patterns generated by contemporary wind turbine models, perhaps
410 because wind turbines generate far lower decibel levels than most vocational sources. In
411 addition to my own conclusions, several other respected organizations and agencies have
412 reached similar conclusions, as I have described previously herein.

413

414 **V. SPECIFIC HEALTH ISSUES RAISED AT PUBLIC INFORMATION MEETING**

415

416 **Q. Did you attend the public input meeting that was held on February 5, 2018?**

417 A. No, but I have been made aware of two health concerns that were raised at the meeting by a
418 woman from Codington County and a woman from Twin Brooks, Grant County.

419

420 **Q. Please describe those concerns as you understand them.**

421 A. The woman from Codington County stated that she has a son who has autism. She said she
422 was concerned about increased aggression due to proximity of turbines. She also indicated a
423 concern regarding sensory stimulation (noise, smell, light) due to turbines, and that
424 stimulation causing fear in her child. She also stated that 1 in 160 kids has autism.

425

426 The woman from Grant county stated her sister has epilepsy and is concerned that turbines
427 will be a seizure trigger. She also stated health concerns relating to shadow flicker, red
428 lights, and noise, including headaches.

429

430 **Q. What is your response to Ms. Brink's concerns relating to autism?**

431 A. Prevalence of autism spectrum disease ("ASD") is approximately 1-2% in children. The
432 symptoms can range from mild disabilities such as speech and language impairment to
433 serious developmental disabilities. The range of severity is challenging from a treatment
434 standpoint as well as for parents. Children with ASD will vary relative to symptoms as well
435 as reactions to their environments. Some children with ASD react to sound while others do
436 not. Different frequencies and sources of sound can stimulate quite variable reactions.
437 Research involving potential health effects of wind turbines has not identified an association
438 of wind turbines and adverse health effects among children with ASD. There are reports by
439 concerned parents on the internet about effects of sights and sounds associated with wind
440 turbines on children with ASD but there are no peer-reviewed studies regarding autism
441 spectrum disease and wind turbines.

442

443 **Q. What is your response to Ms. Logan's concerns relating to epilepsy?**

444 A. Epilepsy is reported to occur in 5-8 per 1,000 individuals in the general population and of
445 those approximately 2-5% may have photosensitive epilepsy. These individuals are most
446 likely to react to flashing lights at frequencies of 5-30 hertz ("Hz") which is the equivalent of
447 300 to 1,800 revolutions per minute ("RPM"). The Epilepsy Foundation has stated that light
448 flashing frequencies greater than 10 Hz (600 RPM) *may* trigger epileptic seizures but
449 seizures are unlikely at less than 2 Hz (120 RPM). This level is well below the usual wind
450 turbine operation blade passage frequency of approximately 0.5 Hz (30 RPM).

451

452 The Massachusetts expert panel similarly noted that: "Frequencies above 10 Hz are more
453 likely to cause epileptic seizures in vulnerable individuals, and seizures caused by photic
454 stimulation are generally produced at frequencies ranging from greater than 5 Hz." Exhibit 7
455 at 36. The Massachusetts expert panel concluded there was "no risk for seizures unless a
456 vulnerable individual was closer than 1.2 times the total turbine height on land and 2.8 times
457 the total turbine height in the water, which could potentially result in frequencies greater than
458 5 Hz." *Id.* All turbine locations proposed for the Project are on land and exceed the 1.2

459 times total turbine height threshold. Therefore, I conclude there is no risk of the Project
460 causing adverse health effects to a person with epilepsy.

461

462 **VI. CONCLUSION**

463

464 **Q. Does this conclude your testimony?**

465 A. Yes.

466

467 Dated this 6th day of April, 2018.

A handwritten signature in black ink that reads "Mark A. Roberts". The signature is written in a cursive style with a large, sweeping flourish at the end.

468

469 _____

470 Dr. Mark Roberts