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Direct Testimony

Dr. Peter Valberg

Before the Public Service Commission of
The State of North Dakota

In the Matter of the Application of
BASIN ELECTRIC POWER COOPERATIVE
For a Waiver of Procedures and Time Schedules
and a Consolidated Certificate of Corridor Compatibility
and Route Permit for the
AVS-Neset 345-kV Transmission Project

Case No. PU-11-696

1. Q. Could you state your name and occupation for the Commission?

   A. Yes. My name is Peter Valberg. I am a senior health scientist and a Principal at Gradient, an environmental consulting firm.

2. Q. What's your business address?

   A. My business address is 20 University Road, Cambridge, Massachusetts.

3. Q. What is the purpose of your testimony here today?

   A. I'm here today to discuss electric and magnetic fields (EMF) and their nature and to help provide information on the scientific research that has been conducted on the possible health effects of power-line EMF.

4. Q. Could you please summarize your educational background?

   A. I have a Bachelor of Arts degree in physics and mathematics from Taylor University in Indiana. I have Master's and Doctoral degrees in physics from Harvard University. I also have a Master's degree in Human Physiology from Harvard University School of Public Health.

5. Q. Could you summarize your employment experience and your professional credentials?

   A. Yes. I was a faculty member at the Harvard - School of Public Health for about 25 years. In that position I researched and taught in the areas of public health and toxicology and environmental health. I've served on advisory panels for the National Institutes of Health, the Health Effects Institute, the Environmental Protection Agency and the World Health Organization. I am a member of the International Society of Environmental Epidemiology, the Health Physics Society, the Society for Risk Analysis, the Society of Toxicology, and the Bioelectromagnetics Society.

6. Q. Have you served on any committees or as a board member?

   A. Yes. I was on the Committee on Man and Radiation, which is a committee that looks at standards of exposure of electromagnetic fields to human beings, as well as on the board of directors of the Bioelectromagnetics Society. At Harvard University, I served on the "Harvard Advisory Committee on EMF and Human Health" and the "Peer Review Board on Cellular Technology and Human Health."

7. Q. Could you please discuss your experience in the area of EMF?

A. I started working in biological effects of magnetic fields at the Harvard - School of Public Health. I had a grant from the National Institutes of Health, whose title was: Magnetic Field Effects on Macrophages, and it was a grant that was funded by the National Cancer Institute. This research resulted in a number of peer-reviewed publications on the behavior and magnetic-field manipulation of magnetic particles within the body.

I also assisted the Health Effects Institute (HEI), which is a nonprofit, part government, part private industry institute, located in Boston, Massachusetts, that provides funds to researchers investigating health effects. HEI was considering funding a research program on electric and magnetic fields, and I helped them evaluate the pros and cons of initiating such a program.

I've chaired a number of symposia on electric and magnetic fields. One was at the International Congress of Radiation Research in Dublin, and I spoke on the physical aspects of how EMF acts on biological systems. I and other scientists organized a conference in the Boston area on EMF exposure as a possible risk factor in childhood leukemia. The results of that workshop were published in a peer review journal called *Environmental Health Perspectives*.

I've worked with the World Health Organization studying the health effects of EMF from cellular phones. The results of that project were published in the journal *Environmental Health Perspectives.*

8. Q. I show you what has been marked as Exhibit _____ Can you identify it for me please?

A. Yes. Exhibit _____is my biographical information. It lists my education, publications, research grants and so forth.

9. Q. Dr. Valberg what is EMF?

A. It is a general term referring to electric and magnetic fields and sometimes only refers the magnetic field.

10. Q. Do any objects besides transmission lines produce extra low frequency EMF?

A. Yes. Anything in our society that uses electric power also creates EMF. The lights in this room produce EMF at 60 Hz. The strengths of the EMF of various electric appliances are depicted in Exhibit _____. As we can see in comparison with Exhibit _____, (**Mr. Silva's report**) these levels can be much higher than found at the edge of the right-of-way for the proposed AVS-Neset transmission line, as has been calculated in Mr. Silva's EMF report.

11. Q. Are electric and magnetic fields present in the natural environment?

A. Yes, they are. Compasses respond to a magnetic field from the earth called the geomagnetic field, and their needles turn to point north. The earth's natural magnetic field, a steady field, is about 590 milligauss (mG) in North Dakota. And, likewise, because the clouds in the atmosphere are always electrically charged (*i.e.*, they have an excess of positive or negative charges), it means that there's also a steady electric field of about a hundred volts per meter all the time. Even though these steady fields do not have the "60 Hz" time variation of power-line EMF, when you move about in steady fields, they appear as time-varying fields to your body.

12. Q. Has scientific research been conducted on the possible health effects of power line EMF?

A. Yes. The volume of scientific research began to become increase around 1980, and for more than 30 years, scientists have been looking at potential biological effects of power-line EMF. Over this period of time, the focus has been primarily on the magnetic field component.

13. Q. And, what led initially to the scientific research on the possible health effects of power line magnetic fields?

A. An article that appeared in 1979 reported a weak statistical correlation between the frequency of childhood leukemia cases and the proximity of electrical structures. The authors had observed a relationship between distance to a nearby electrical structure, not necessarily a transmission line, and an increased incidence of childhood leukemia. Subsequently, the United States Congress allocated funds to the National Institutes of Health for additional research that could test if, in fact, some sort of EMF effect could be duplicated in the laboratory along those lines to possibly support the reported statistical association.

14. Q. You mentioned that there were later laboratory studies. What type of study was this initial study?

A. This initial study was an epidemiologic study. It was a study of disease patterns human populations of the "case-control" design that used statistics to examine differences in leukemia rates in two different populations of children.

15. Q. Could you just explain those types of studies a little bit further?

A. Epidemiology, as you might guess from the name itself, is the statistical study of "epidemics," or disease patterns, in the population. Epidemiologists investigate whether the rate of diseases observed in populations is correlated to factors such as diet, occupation, air quality, water quality, and other exposures.

The goal of epidemiology is to try to find some sort of statistical correlation between the pattern of disease and the pattern of exposure. When you're interpreting these epidemiological results, it's very important to remember that they are just statistical correlations, and not necessarily a cause-and-effect link.

16. Q. Could you explain a bit more what those terms of bias, confounding and misclassification, mean?

A. Yes. I'll start with bias. I'll provide an example to explain it. For example, if an epidemiologist wanted to study the possible causes of headache, she would recruit a group of study subjects, maybe by telephone calls or advertisements. Then she would divide the people into two groups, namely, people that report having a headache and people that do not. Then the epidemiologist might ask, were you recently exposed to a loud noise such as a jackhammer, did you experience extremes of hot or cold, what about bright lights? and so forth. What is known to often happen is that a large number of the people with the headache may answer, yes, I did hear a noise. But, if you are experiencing a headache, you are likely to remember noises much better than someone who does not have the discomfort of a headache. So, collecting data by questionnaire invokes this recall bias phenomenon. This preferential recall will make any statistical correlations hard to interpret and not likely to indicate a causal link.

Another problem is called confounding. Suppose an epidemiologist wanted to investigate possible causes of high blood pressure. He hypothesizes that wearing reading glasses causes high blood pressure. Again, the scientist recruits a group of subjects and divides them into people with high blood pressure and those that do not have high blood pressure. Then he asks both groups if they wear reading glasses. Indeed, he finds that a larger fraction of the people that use reading glasses have high blood pressure. Yet, as you might already appreciate, it is not reasonable to conclude that reading glasses cause high blood pressure, because both "reading glasses" and "high blood pressure" increase with age. Here, "age" is called a “confounder” in your study of the effect of reading glasses on blood pressure.

17. Q. What has the scientific community concluded with respect to those epidemiologic studies of power-line EMF, and with respect to the possible health effects of power line magnetic fields in general?

A. Several power line EMF epidemiology studies have shown a statistical association between assumed magnetic-field exposure levels and childhood leukemia, and scientists have struggled with whether these correlations have any causal basis.

One recent review was the President's Cancer Panel, which met in 2008 to 2009.[1] The Panel issued a report in April of 2010 and pointed out that these EMF studies could not establish that EMF *per se* increased leukemia risk, because of the difficulty in isolating and quantifying multiple possible exposures. In many of the epidemiology studies, the magnetic fields were not measured and were assumed to be a function of distance, or assumed as a function of the style of transmission lines, and so forth, and this led to exposure misclassification bias. Secondly, there could have been an issue of confounding bias, because what happens is that there tend to be more electrical structures of a higher density that are aboveground in older, less affluent areas. Older communities also tend have aging housing stock, perhaps with a greater prevalence of moisture and mold and deteriorating paint.

Another serious problem of the EMF epidemiology studies is selection bias, due to the "case-control" design made necessary because leukemia is such a rare disease. That is, investigators recruit the "case" and "control" subjects in two entirely different ways. To get the leukemia cases, they go to cancer registries, hospitals, and doctors to identify the leukemia cases are. But in order to get the comparison population, the "controls," investigators have to use an entirely different procedure. They either put out ads in the newspaper, or you do something called "random digit dialing." Thus, because these two subject-selection methods are so different, finding some difference between them in "EMF exposure" factors may not be the difference relevant to leukemia risk, but rather results from differences in the recruitment methods. The two populations end up not being comparable in the way you would want them to be, that is, in each and every aspect, aside from their presumed EMF exposure.

I also want to mention that when the President's Cancer Panel reviewed power-line EMF studies, they pointed out a couple other problems having to do with how you interpret the EMF epidemiology. Namely, the individuals who have the greatest EMF exposure, and thus, potentially greatest risk of disease would be line workers, electricians, and people who work in power plants, because the EMF levels they get exposed to are high. But, for these highly exposed populations, there is no increased leukemia risk. So, the only epidemiology studies suggesting an increased risk are the statistical correlations observed in low-EMF-exposure, residential populations.

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[1] http://deainfo.nci.nih.gov/advisory/pcp/annualReports/pcp08-09rpt/PCP_Report_08-09_508.pdf ; pages 59-61.

Such EMF epidemiology correlations caused scientists to design and undertake many laboratory studies where they examined the EMF-leukemia hypothesis in the lab and asked, -- "Are power-line EMF exposures going to change an animal's biology, are they going to change cell function, are they going to alter biomolecules in such a way as to increase the risk of cancer?" And, the laboratory scientists were unable to find evidence for changes that would lead to increased cancer risk. The laboratory investigations are very powerful because all the possible variables can be made subject to experimental control. You can compare exposed to unexposed animals, and carefully examine them for precancerous changes. You can do what is truly a scientific experiment, as opposed to the epidemiology, which is only observational and statistical. Thus far, the laboratory evidence has not supported any connection between power-line magnetic field exposure and childhood leukemia risk.

In 2010, the International Commission on Nonionizing Radiation Protection (ICNIRP), which has been developing safety guidelines for electric and magnetic field exposure for many, many years, again reviewed the scientific evidence on power-line EMF. ICNIRP had issued guidelines for power line EMF in 1998, and in 2010, they re-examined those guidelines, considering all the new research that had been published. In terms of the electric field general-public allowable-exposure guideline, ICNIRP did not change it from the earlier, 4.2 kV/m value. In terms of the magnetic field guideline, ICNIRP actually allowed a higher level of magnetic field exposure that they had determined back in 1998. For 60 hertz magnetic fields, ICNIRP increased the safety guideline for the general public from 833 mG up to 2,000 mG. The ICNIRP guidelines were adopted by the WHO, the European Union, and by the Health Agencies in many countries.

18. Q. Have any scientific studies been conducted with respect to EMF and the reproductive health of livestock?

A. Yes. Laboratory animal research studies on EMF effects have already demonstrated that power line EMF do not appear to have adverse effects on reproductive function in biological organisms. The "laboratory-animal" tests were not on livestock specifically, but laboratory animal studies would be expected to be predictive of effects both in humans and livestock. With respect to livestock in particular, there was a considerable amount of research on EMF and livestock that was conducted by the Bonneville Power Administration in Washington state and by investigators in Quebec, Canada. For example, research published in the Bioelectromagnetics Journal showed that the EMF exposure to Holstein cows did not change their hormonal profiles. The study in Quebec concluded that there were no harmful effects on the health, productivity, fertility, reproduction, or behavior of livestock exposed to power line EMF.

19. Q. Is the Quebec study the only study done on livestock?

A. No. There have been multiple studies. Among the studies done in the context of the Bonneville Power Administration in Washington, the investigators housed sheep and other farm animals directly under power lines, and they did not find any consistent health effects in those animals *versus* farm animals living far away from power lines.

The Quebec, Canada, results were actually five or six separate studies, each resulting in published papers. The summary of those papers concluded that some small effects had been seen, but these effects were not consistent and reproducible. The pattern of results was not supportive of the idea that animals' health and function were affected by power-line EMF.

20. Q. Would you opine that EMF has been determined to be a problem for public health or the reproductive cycles of livestock?

A. No. However, among the many studies that have been done, some do report "effects" that have been difficult to interpret and replicate. A person could go to the internet and find a list of people who believe EMF is a problem, and offer arguments that purport to show adverse effects. The way to get a balanced viewpoint is to look at reports from legitimate public health agencies, for example, the World Health Organization, the American Medical Association, ICNIRP, and so forth. These associations recognize that both the strength and weight of the evidence must be evaluated, and that science cannot "prove a negative." The agencies critically examine whether results reported in single articles have been replicated (*i.e.*, repeated) by other, independent investigators.

As in any observational analyses, the problems of interpreting epidemiology statistics must be recognized. That is, epidemiology may show an "association" between exposure A and health outcome B. But, if the majority of experimental laboratory studies conclude that a causal basis for exposure A causing disease B is implausible, then reason for the association remains unclear. Public health agencies evaluate the evidence from multiple, diverse lines of investigation when weighing the likelihood of, or lack of, a causal link between any exposure (like EMF) and a possible health outcome.

21. Q. Would you discuss the standards or guidelines that have been established regarding the public's exposure to EMF?

A. Yes. The American Conference of Governmental and Industrial Hygienists (ACGIH) provide worker guidelines and the ICNIRP provides guidelines for the public. There is also the International Committee on Electromagnetic Safety (ICES), a part of the Institute of Electrical and Electronic Engineers (IEEE), which has developed guidelines both for workers and the public. Many agencies have decided not to develop numerical exposure guidelines for EMF, in part because they feel that the science is not strong enough to come up with an EMF exposure level that can be expected to harm health.

22. Q. Have any states established EMF exposure guidelines or standards?

A. Yes. A number of states have established guidelines that are not linked to scientific research on health effects, but rather, that maintain the status quo as to levels of EMF that have existed for a long time. Those states include: Florida, Massachusetts, New York, and some others. These guidelines, as well as the ICNIRP, IEEE, and ARPANSA guidelines mentioned above, are shown in my Exhibit _____.

23. Q. Does North Dakota have an established EMF standard?

A. No, North Dakota does not have an established standard for power line EMF.

24. Q. Has any EMF standard been established at the United States federal level?

A. No.

25. Q. What are some of the magnetic field standards for the public that have been established for 60 Hz magnetic field exposure?

A. As I mentioned, in Exhibit _____, we can see that the International Commission on Nonionizing Radiation Protection, has set a health-protective guideline at 2,000 mG. The ICES / IEEE guideline is 9,040 mG. The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) draft guideline is between 1,000 and 3,000 mG. [2]

26. Q. Are you familiar with Exhibit ____? (Silva report)

A. Yes, Exhibit ___ is a report that predicts the EMF levels expected nearby the 345 kV lines of the AVS-Neset Transmission Line Project.

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[2] http://www.arpansa.gov.au/pubs/rps/dr_elfstd.pdf

27. Q. How does the magnetic field levels discussed in the EMF report compare to the various magnetic field guidelines and standards that have been established?

A. The Michael Silva / Enertech Report of August 9, 2013, on EMF levels shows in its Table 1 (page 5 of the Report) that ROW edge EMF levels will be well below applicable standards. ROW edge electric fields for all line configurations are below 1.4 kV/m, with the double-circuit configuration being lowest, with ROW edge fields below 0.25 kV/m. Recall the ICNIRP guideline for electric field levels expected to be safe is 4.2 kV/m. ROW edge magnetic fields under typical loading conditions, for all line configurations, will be below 52 mG, with the delta configuration being lowest with ROW edge fields below 30 mG. Under peak loading conditions, all line configurations have ROW edge fields below 66 mG, with the delta configuration and the double-circuit configuration being below 40 mG. Recall the ICNIRP guideline for magnetic field levels expected to be safe is 2,000 mG. Thus, the ROW levels of EMF are below the permissible levels of public exposure to EMF listed in my Exhibit _____.

28. Q. And those standards that you mentioned earlier, are they based on exposure on a 24/7 basis?

A. Yes. Those guidelines were meant for continuous exposure. The public health agencies that developed guidelines concluded that if you maintained power-line EMF exposure below the guideline levels, there would not be an anticipated adverse health effect.

29. Q. In your professional and expert opinion, are there adverse health effects to be expected due to the EMF exposures that will found in the vicinity of the AVS-Neset 345 kV electric-power transmission line project?

A. No. My review of the applicable science leads me to conclude that it is unlikely that there are any adverse health effects to be expected from EMF associated with the AVS-Neset Project. We have available to us extensive experience over many years with people and animals exposed to power line EMFs, and the links to disease remain hypothetical and unproven.

There is no evidence that would support an actual adverse health effect, but the difficulty is that science cannot prove a negative. Yet, we know that the U.S. has used electric power for over a century now and, clearly, if you follow health statistics, we are living longer and disease rates are going down. Overall, the health of the U.S. population is improving, in spite of the fact that we're continuing to use more and more electric power. I would say that, among all the multitudes of environmental exposures that we experience daily, and which we can modify (and perhaps as a consequence improve our health), power line EMF exposure remains a low priority and a hypothetical health risk.

Adequate evidence to support the idea that power-line EMF can cause adverse health effects is lacking.

30. Q. Does this conclude your direct testimony?

A. Yes