THE STATE OF NEW HAMPSHIRE

BEFORE THE

SITE EVALUATION COMMITTEE

DOCKET NO. 2015- 06

PRE-FILED DIRECT TESTIMONY OF GARY B. JOHNSON, Ph.D.

IN SUPPORT OF THE
APPLICATION OF NORTHERN PASS TRANSMISSION LLC
AND PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
D/B/A EVERSOURCE ENERGY
FOR A CERTIFICATE OF SITE AND FACILITY TO CONSTRUCT A NEW HIGH VOLTAGE TRANSMISSION LINE AND RELATED FACILITIES IN NEW HAMPSHIRE

October 16, 2015

Qualifications and Purpose of Testimony

Q. Please state your name and business address.

A. My name is Gary B. Johnson. My business address is Exponent, 4580 Weaver Parkway, Suite 100, Warrenville, IL 60555.

Q. What is your position at Exponent?

A. I am a Senior Managing Engineer in Exponent's Electrical Engineering and Computer Science Practice.

Q. Please describe your current responsibilities and professional experience.

A. Exponent is an engineering and scientific consulting firm engaged in a broad spectrum of activities in science and technology. My work in this practice relates to electrical issues particularly involving the electrical environment of power systems. I have extensive experience in modeling and measuring extremely low frequency electric and magnetic fields ("EMF") from transmission and distribution systems as well as the audible noise ("AN"), radio noise ("RN"), and other phenomena associated with high voltage power systems. Among the projects that I have managed are those relating to the measurement and calculation of the electrical environment around direct current ("DC") and alternating current ("AC") transmission lines.

Q. Please summarize your education and research experience.

A. I obtained my Ph.D. in Electrical Engineering from the University of Illinois in 1979. I have a M.S. degree in Physics and a B.S. degree in Engineering Physics, also from the University of Illinois. From 1979 to 1996, I was employed at the High Voltage Transmission Research Center in Lenox, Massachusetts, where I performed research, measurements, and studies related to high voltage power lines and power systems. General Electric and the Electric Power Research Institute (EPRI) primarily operated the Center and performed studies for a number of clients, including utilities and state and federal agencies. Since 1996, I have been involved in a variety of power line studies involving measurements, modeling, and calculations related to the performance of power lines related to EMF, AN, RN, nuisance and ground currents, and stray voltage, initially as head of Power Research Engineering, and since 2001 as part of Exponent's Electrical Engineering and Computer Science Practice.

Q. Please outline your engineering and research experience concerning electric and magnetic fields and other electrical phenomena.

A. I have made measurements and performed investigations of the electrical and magnetic performance of power lines and power systems for over 30 years. My research has included measurements, modeling, and calculations of the electrical characteristics of AC and DC power lines, including electric and magnetic fields, AN, RN, and air ions.

Q. In the course of your investigations have you had the occasion to evaluate potential safety risks from transmission lines and other electrical sources?

A. Yes. I have evaluated power lines for their compliance with the National Electric Safety Code ("NESC"), estimated the levels of currents and voltages coupled onto vehicles near power lines, determined the probable cause and origin of injuries to persons and animals from contact with electrical facilities, and investigated electrical fires and their probable causes.

Q. Have you served as a technical advisor or researcher to government agencies?

A. Yes. I worked for the Vermont Department of Public Service performing tests and measurements on a proposed high voltage DC transmission line. I have worked for the U.S. Department of Energy performing research on DC transmission lines, and also assisted the U.S. EMF Research and Policy Information Dissemination (RAPID) Program in the identification and evaluation of engineering issues related to EMF as part of its overall risk assessment program.

Q. Have you published any of the results of your research in engineering journals?

A. I have published or presented more than 35 papers on this and related subjects.

Q. Are you a member of any professional organizations?

A. Yes. I am a member of the IEEE Power Engineering Society, the American Association for the Advancement of Science, the Bioelectromagnetics Society, and Tau Beta Pi, a national engineering honor society.

Q. Is your educational and professional experience summarized elsewhere?

A. Yes. Additional details of my educational and professional experience are summarized in my *curriculum vitae*, which is Attachment A.

Q. Have you ever appeared as a witness before regulatory agencies?

A. Yes. I have testified in regulatory proceedings before public utility commissions and state and provincial siting boards on behalf of public service commissions as well as project applicants.

Q. What is the purpose of your Testimony?

A. I explain the calculations of the electrical environment associated with the operation of both the DC and AC portions of the Northern Pass transmission project ("Northern Pass" or the "Project") proposed by Northern Pass Transmission, LLC ("NPT"). The results of these calculations are summarized below and the details are included in Appendix 38 of the application. I then provided my calculations to Dr. William Bailey, for his evaluation of the potential effects of EMF and space charge on public health and safety. In addition, I analyzed the AN and RN from the Project.

Electrical Environment

Q. What is the electrical environment of a power line?

A. A transmission line carrying power from one location to another has the conductors of the power line energized at some voltage and those conductors carry electric current. The voltage on the conductors produces electric fields. The voltage on conductors can also produce corona. The current carried by the conductors produces magnetic fields.

Q. What characteristics of the electrical environment of Northern Pass did you calculate?

A. I calculated magnetic fields, electric fields, air ion density, AN, and RN of the Project.

Q. How did you calculate these characteristics associated with the proposed operation of Northern Pass?

A. I used calculation algorithms developed by EPRI at the High Voltage Transmission Research Center and incorporated in the EPRI TL Workstation and by the U.S. Department of Energy, as well as models developed by the Bonneville Power Administration that have been validated and used by engineers and scientists for many years. The inputs to these models are line voltage, load flow, and the physical dimensions of the line (e.g., conductor diameter, spacing, height, etc.). NPT provided information on the design and routing of existing and proposed lines, as well as projections of expected circuit loadings.

Electric and Magnetic Fields

Q. Please describe electric and magnetic fields.

A. Electric and magnetic fields are produced by both natural and man-made sources. These fields describe properties of a location or point in space and its electrical environment, including the forces that would be experienced by a charged body in that space by virtue of its charge or the movement of charges. The voltage can be thought of as the 'pressure,' that moves the electricity through wires. The voltage also produces an electric field in the space surrounding the conductors. The electric current, which is a measure of how much electricity is flowing, produces a magnetic field. Thus, wherever electric current is flowing, there is both an electric field and a magnetic field.

The standard unit for measuring the strength of an electric field is volts per meter, (V/m). The unit in which magnetic-field levels are measured is milligauss (mG). Electric and magnetic fields are characterized by the frequency at which their direction and magnitude oscillate each second.

Q. What frequencies of electric and magnetic fields will be associated with transport of bulk power from Canada over the Project?

A. The proposed Project will be a source of electric and magnetic fields at two power frequencies associated with the bulk transport of electricity. Bulk electricity will be transported from Québec as DC electricity. The northern section of overhead transmission line will be a source of static (constant) electric and magnetic fields which do not oscillate with time (i.e., a frequency of 0 cycles per second or 0 Hertz [Hz]), unlike AC electric and magnetic fields, which have a frequency of 60 Hz in the United States and Canada.

The DC overhead conductors will connect to two underground DC cables for portions of the route between the Canadian border and the Converter Terminal located in Franklin, New Hampshire. No static electric field will be measureable above ground in the underground sections of the Project because the metallic sheaths around the conductors and the earth will block the electric field. A DC magnetic field due to the DC current in the cables will be present above ground since the earth does not readily block magnetic fields.

At the DC/AC converter terminal in Franklin, New Hampshire, DC electricity will be converted to AC electricity that oscillates at a frequency of 60 Hz. A new 345-kilovolt (kV) overhead line will carry this electricity to an existing substation located in Deerfield, New Hampshire, and will be a source of 60-Hz electric and magnetic fields.

Q. Will there be 60-Hz AC electric and magnetic fields along the DC line corridor?

A. Yes. There will be 60-Hz AC electric and magnetic fields along the portions of the DC line's path where it is placed along corridors that already contain AC lines. 60-Hz AC electric and magnetic fields are produced by these existing AC lines.

Q. What are typical sources of static electric and magnetic fields?

A. A static electric field exists naturally due to charge in the air and clouds overhead. This static electric field can have either a positive or negative polarity with intensities ranging from a few hundred volts per meter to several thousand volts per meter or occasionally even tens of thousands of volts per meter (20 kV/m to 40 kV/m) with storm fronts. Fair weather static electric fields often are approximately 130 V/m (0.13 kV/m). The static cling one sometimes feels between the body and clothes is an electric field in the 100 to 500 kV/m range. The earth has a natural static magnetic field that varies between approximately 200 mG to 700 mG going from the equator to the north and south poles. Much higher static magnetic fields in the tens to hundreds of Gauss (i.e., 10,000 to 100,000 mG) are present from common items such as magnets used to hold on name badges, clip notes, and paper to refrigerators or metallic note boards. Even higher static magnetic fields, in the range of 15,000 Gauss (15,000,000 mG) and above, are produced in some medical devices such as magnetic resonance imaging machines.

Q. What are typical sources of 60-Hz EMF?

A. Typical sources of these fields include power lines (both transmission and distribution lines), building wiring, home and office appliances, tools, and electric currents flowing on water pipes. The importance of these sources to overall exposure varies considerably. For example, if a residence is very close to a transmission line or a distribution line (which runs near most residences), these sources could be the dominant, but not necessarily the only, source of magnetic fields in the home. Depending on the circumstances, other sources may be of equal or greater importance. For example, a random survey of 1,000 residences in the

United States reported that electric currents flowing on water pipes and on other components of house grounding systems are twice as likely as outside power lines to be the source of the highest magnetic fields measured in homes (Zaffanella, 1993)**.**

Q. Are cellular phones or their base station antennas sources of 60-Hz EMF?

A. No. Mobile phones do not operate at the power frequency of 60-Hz. They operate in the radiofrequency (RF) range, at approximately 800 million Hz, 1,900 million Hz, or 2,500 million Hz (i.e., 800 megahertz [MHz], 1,900 MHz, or 2,500 MHz). Fields at these high frequencies have different characteristics than 60-Hz fields, which affect their interaction with conductive objects (including biological organisms), and therefore are studied separately with regard to potential health and biological effects.

Q. What factors affect the level of electric and magnetic fields associated with a transmission line?

A. AC electric-field levels depend primarily on the AC line's voltage; the higher the voltage on the line, the higher the electric-field levels associated with that line. Little variation is expected with AC electric-field levels from a power line because the AC line's voltage does not vary significantly. DC electric-field levels (static electric-field levels) depend on both the DC line's voltage and the number of air ions (space charge) that it is producing and which diffuse between the conductors and ground. Although the voltage on the DC line will not vary significantly, the number of air ions produced (corona activity) can vary considerably with weather condition and season and thus the total static electric field can vary considerably. Because of these variations, static electric fields are reported for both fair weather and foul weather conditions during the summer. The highest levels of static electric fields are expected during the summer with levels being higher during foul weather than during fair weather. AC or static electric-field levels decrease rapidly with distance from the transmission line and in addition, conducting objects including fences, shrubbery, and buildings, easily block AC or static electric fields.

AC and static magnetic-field levels depend primarily on the electric current, or load, flowing on the line; as electricity demand increases and the current on the line increases, the magnetic-field levels associated with the line increase. Though not blocked by most everyday objects magnetic-field levels decrease rapidly with distance from a distribution or transmission line.

Q. For what conditions did you calculate the magnetic fields from the Project?

A. The magnetic fields were calculated to predict the typical and maximum values that could be measured near the proposed line, one meter (3.28 feet) above ground, in accordance with IEEE Std. 644-1994. Magnetic-field values are dependent on the orientation of current-carrying conductors and the amount of current they carry. The magnetic-field levels for the Project were calculated for the maximum possible power flow on the Northern Pass lines and associated 115-kV and lower voltage distribution lines under normal operating conditions. In addition, magnetic-field calculations were also performed for reduced power flow cases on the Northern Pass lines or associated 115-kV and lower voltage distribution lines. The calculations used a conservative minimum height of 30 feet above the ground for the overhead conductors of the proposed DC line and minimum heights of 30 and 35 feet for the 115-kV and 345-kV AC transmission lines, respectively. A minimum height of 25 feet was used for the lower voltage distribution lines.

Q. What are the calculated magnetic-field values?

A. The magnetic field is highest under the conductors of the respective lines within the ROW, and decreases with distance from the respective lines. At the edge of the ROW, the static magnetic-field level due to the DC line is calculated to be 79 mG or less along the line route under full loading conditions for the Project. At the edge of the ROW, the AC magnetic-field level due to the AC lines was calculated to vary between 0.1 and 92 mG along the NPT route except for a short distance of ROW, approximately 2000 feet in length, where it will be 127 mG or less under full loading conditions for the Project. Exact details and profiles of the magnetic field for various cross sections along the route are available in Appendix 38 of the application.

Q. For what conditions did you calculate the electric fields from Northern Pass?

A. Electric fields were calculated for the same conductor positions and heights as the magnetic fields at 1 meter (3.28 feet) above ground in accordance with IEEE Std. 644-1994. The voltage of the proposed DC line was set at a 1% overvoltage (±323.2 kV/m). The voltage of AC lines was set at a 5% overvoltage. These voltages are the maximum voltages expected on the lines.

Q. What are the calculated electric-field values?

A. The electric field is highest under the conductors of the respective lines and decreases with distance from the respective lines. At the edge of the ROW and beyond, the static electric-field levels from the DC line are 8.8 kV/m or less in foul weather and 5.7 kV/m or less in fair weather. At the edge of the ROW, the AC electric-field level due to the AC lines is calculated to vary between 0.0 and 1.7 kV/m along the Project's route except for a short distance of ROW, approximately 2,000 feet in length, where it will be 2.7 kV/m or less. Exact details and profiles of the electric field for various cross sections along the route are available in Appendix 38 of the application.

Q. Are the maximum field levels you calculated below the limits for human exposure set by international organizations?

A. Yes. As described in the report of Dr. William H. Bailey in Appendix 37 of the application, the maximum field levels I calculated for the proposed Project and associated existing lines are below the limits set by the International Commission on Nonionizing Radiation Protection and the International Committee on Electromagnetic Safety.

Corona – Air Ions, Audible Noise and Radio Noise

Q. What is corona?

A. Corona is a small electrical discharge (spark) into the air if the voltage on conductor results in a conductor electric field surface gradient sufficient to cause a local breakdown of the air (ionize the air) adjacent to the conductor. Power lines are designed so that their conductor surface gradients are below the level needed produce corona for a smooth clean conductor. The surface gradient at sharp edges or points on water droplets, such as from precipitation, or debris, such as insects, however, can be intensified such that it can ionize the nearby air producing corona.

Q. What is the result of corona?

A. The small electrical discharge (spark) into the air on the surface of the conductor, produces air ions, AN, and RN. These effects are most pronounced directly underneath the line conductors, and decrease with distance from the transmission line. If there is sufficient corona activity, air ions, AN, and RN can be noticeable within a few hundred feet of the transmission line.

Q. Where and when is corona activity more likely to occur?

A. Corona activity depends on a number of factors: altitude, line voltage, conductor size, conductor geometry, and weather conditions. The breakdown strength of air is approximately 30 kilovolts per centimeter (kV/cm) at sea level and decreases with increasing altitude. For a particular altitude, conductor size and line voltage are taken into consideration when designing a transmission line so that the electric fields at the conductor surface do not exceed the breakdown potential of air. Any irregularities on the conductor surface (e.g., nicks, water droplets, or debris), however, may create points where the voltage gradient is intensified sufficiently to produce corona. In foul weather, raindrops or snowflakes accumulating on the conductor surface will also act as points for corona inception. Corona activity is, therefore, most likely to occur on lines at higher altitudes, and is most pronounced during foul weather or when there is surface contamination such as insects or other debris on the conductor.

Q. Is there a difference in the characteristics of the air ions, AN, and RN produced by corona on AC and DC lines?

A. The type of air ions, AN, or RN produced by corona is the same, but they behave differently depending on whether the line is DC or AC. Since the voltage on AC lines oscillates between positive and negative 60 times per second (i.e., a frequency of 60 Hz), the positive air ions produced from corona during the positive voltage portion of the cycle are pulled back into the conductor and neutralized during the negative portion of the voltage cycle on the conductor. The same thing happens to the negative air ions that are produced by corona during the negative portion of the voltage cycle; the negative air ions are pulled back into the conductor during the positive voltage cycle and also neutralized. As a result air ion levels from corona are largely confined to the region immediately around the AC conductor. More corona activity will occur when there are droplets such as from precipitation on the conductor so levels of AN and RN will be higher during foul weather than during fair weather for an AC line.

Air ions produced by corona on a DC line will move out from the conductor towards the opposite polarity conductor or ground where they are collected since the voltage on a DC conductor is constantly the same polarity, positive or negative. Since the air ions are not immediately swept back to the same conductor, as they are for an AC conductor, more are free to diffuse outward from the conductors. This results in air ions from the corona on the conductors being measured at ground. More corona activity will occur when there are droplets such as from precipitation on the conductor so the levels of air ions will be higher during foul weather than during fair weather; however, AN and RN levels from a DC line are lower in foul weather than in fair weather.

<u>Air Ions</u>

Q. What are air ions?

A. Most everyday objects are electrically neutral meaning they have the same number of protons and electrons. An ion is a particle with a charge imbalance (i.e., more electrons than protons or vice-versa) and an air ion is thus a positively or negatively charged air molecule or particle, commonly referred to collectively as space charge.

Q. Under what conditions were air ion levels calculated for this Project?

A. Air ion levels were calculated for a height of one meter (3.28 feet) above ground during hot humid fair-weather and during foul-weather conditions. Air ion levels were calculated at midspan between towers with the lowest anticipated conductor.

Q. What are the calculated air ion levels?

A. At the ROW edge away from other transmission lines, air ion levels are less than 25,500 ions/cm^3 in fair-weather conditions and less than 33,000 ions/cm^3 in foul-weather conditions. Exact details and profiles of the air ion levels for various cross sections along the route are available in Appendix 38 of the application.

Q. Are there limits for air ions?

A. Even though there are no federal limits or state limits in New Hampshire for air ion levels, the Project has been designed in a manner such that the expected air ion levels for the line are similar to or less than the existing DC line in New Hampshire and other DC lines throughout the United States and the world that have been in operation for decades.

<u>Audible Noise</u>

Q. What is audible noise?

A. AN results from corona, the partial electrical breakdown of the air around the conductors of a transmission line that is accompanied by a small audible snapping sound. If there is sufficient corona activity on a high voltage line, many small snaps from corona sources along a conductor may be sufficient, in combination, to produce discernable AN heard as a hissing, crackling sound. The AN from corona on a transmission line decreases with distance from the line.

Q. How is audible noise measured?

A. Sound level is often measured in decibels (dB) referenced to 20 micropascals, which is approximately the threshold of human hearing at 1 kilohertz (kHz). The range of audible frequencies for the human ear is from approximately 20 Hz to 20 kHz, with peak sensitivity near 1 kHz. The change in sensitivity of the human ear with frequency is reflected in measurements by weighting the contribution of sound at different frequencies. The weighting of sound over the frequency spectrum to account for the sensitivity of the human ear is called the A-weighted sound level. When the A-weighting scale is applied to a sound-pressure measurement, the level is often reported as decibels on the A-weighted scale (dBA), referenced to the audible pressure threshold.

Q. What are typical sources of audible noise?

A. Sources of AN are all around us such as wind movement, distant traffic noise, and the activities of insects, birds, and other animals.

Q. What are typical audible noise levels?

A. The sound level of typical human speech is approximately 60 dBA, and background levels of noise in rural and urban environments along the NPT route from 18 dBA to 45 dBA have been measured during fair weather by Douglas Bell and are summarized in Appendix 38 of the application. Specific identifiable noises such as birdcalls, neighborhood activity, and traffic can produce AN levels of 50 to 60 dBA or greater.

Q. Under what conditions was audible noise from Northern Pass calculated?

A. The levels of AN for the proposed line were calculated at a height of 1.5 meters (5 feet) from the ground for hot humid fair-weather and for foul-weather conditions at the highest altitude occurring for each cross section. Overvoltages of 1% on the DC line and 5% on the AC lines as well as the lowest anticipated conductor heights were assumed for the calculation of the AN levels. The highest levels of AN would be expected to occur in these conditions. Lower levels of AN would be expected with normal operation voltage on the line and in seasons other than summer.

Q. What audible noise levels did you calculate?

A. The calculated A-weighted AN level at the edge of the ROW along the DC line route from the Canadian border to the Franklin Converter Terminal is 27 dBA or less in fair-weather conditions and 28 dBA or less in foul-weather conditions. The levels at the ROW edge along the Project's AC line from the Franklin Converter Terminal to the Deerfield Substation are 18 dBA or less in fair weather and 43 dBA or less in foul weather. The AN levels from the lines along the entire Project route fall within the range of background AN that have been measured along the line route by Douglas Bell (Appendix 39 – Report 1).

Q. How do these levels compare to relevant guidelines for audible noise exposure?

A. The AN levels in fair weather along the entire Project route are well below the 55 dBA L_{dn}, outdoor target value published by the Environmental Protection Agency (EPA, 1974) and also below the 40 dBA night time target value at a residence published by the World Health Organization (WHO 1999, 2009). The AN levels in foul weather along the Project route also are well below the EPA guideline and also meet the WHO 40 dBA guideline except for three segments along the Project's AC line route (S1-13, S1-19 and S1-20) between the Franklin Converter Terminal and Deerfield Substation. These levels, however, only occur during foul weather when higher levels of background AN from accompanying rain and wind would be expected to mask the noise and the levels are only a few dB above 40 dBA at the ROW edge; lower levels would be expected at residences, further from the ROW edge.

The AN levels are consistent with the State of New Hampshire Site Evaluation Committee's (SEC) finding in the *Antrim Wind Energy, LLC* case, SEC Docket No. 2012-01, (April 25, 2013) where the SEC relied upon the 2009 WHO Guidelines. The SEC determined that the proposed wind facility would not have an unreasonable adverse effect on public health and safety insofar as sound levels generated by the facility at the outside facades of residences, during daytime, did not exceed 45 dBA or 5 dBA above ambient, whichever is greater, and, at nighttime, did not exceed 40 dBA or 5 dBA above ambient, whichever is greater. Exact details and profiles of the calculated AN for various cross sections along the route are available in Appendix 38 of the application.

Radio Noise

Q. What is radio noise?

A. RN is the hiss or crackle you may hear on your radio. Corona activity produces impulsive currents along a transmission line. These currents cause wide-band RF noise fields that can affect some radio reception. RN from transmission line corona can produce interference to an amplitude-modulated (AM) signal such as that from a commercial AM radio station (520-1720 kHz). Frequency-modulated radio stations are generally not affected by RN from a transmission line. The RN from corona on a transmission line decreases with increasing RF and with distance from the line. The advent and use of digitally encoded radio and television signals (often transmitted at higher frequency) make these signals less susceptible to interference effects from transmission line RN.

Q. How is radio noise measured?

A. RN is measured in units of dB based on its field strength referenced to a signal level of 1 microvolt/meter (μV/m) (IEEE Standard 430-1986).

Q. What are typical sources of radio noise?

A. A common source of RN is electrical activity (lightning) in storm clouds. Other sources of RN can be electrical equipment such as motors, spark plugs in engines, or electric fences such as used for animal confinement.

Q. Under what conditions was radio noise calculated for this Project?

A. The levels of RN for the Project were calculated at 500 kHz and a height of 1 meter (3.28 feet) from the ground for hot humid fair-weather and for foul-weather conditions at the highest altitude occurring for each cross section. Overvoltages of 1% on the DC line and 5% on the AC lines were considered for the calculation of the RN levels as well as the lowest anticipated conductor heights. The highest levels of RN would be expected to occur in these conditions. Lower levels of RN would be expected with normal operation voltage on the line and in seasons other than summer.

Q. What are the calculated radio noise levels?

A. The RN at 50 feet from the nearest conductor along the Project's DC line route from the Canadian Border to Franklin Converter Terminal is 55 dB µV/m or less in fair-weather conditions and 49 dBµV/m or less in foul-weather conditions. RN at 50 feet from the nearest conductor along the Project's AC line from the Franklin Converter Terminal to the Deerfield Substation is 43 dBµV/m or less in fair weather and 60 dBA or less in foul weather. Exact details and profiles of the RN for various cross sections along the route are available in Appendix 38 of the application.

Q. Are there limits for radio noise?

A. NPT will comply with good design practices to minimize RN (IEEE, 1971) and also comply with the applicable Federal Communications Commission Rules and Regulations (Part 15, Section 15.25). Even though there are no state limits in New Hampshire on RN, the proposed line has been designed in a manner consistent with the IEEE Radio Noise Design Guide for High-Voltage Transmission Lines (IEEE, 1971) that suggests 61 dBµV/m at a distance of 50 feet from an outside conductor as a design guide.

Conclusion

Q. Is it your testimony that the AC and DC lines of the Project would not create any unreasonable adverse effects?

A. Yes. This is based upon my finding that the calculated values are below levels recommended by government and engineering bodies to avoid unreasonable adverse effects.

Q. Have you reviewed the DEIS released by the Department of Energy for the Project?

A. Yes. The findings of the DEIS are consistent with my testimony.

Q. Does this conclude your testimony?

A. Yes, it does.

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Professional Profile

Dr. Gary Johnson is a Senior Managing Scientist in Exponent's Electrical Engineering and Computer Science practice. Dr. Johnson specializes in electrically related issues particularly as they relate to the electrical environment of power systems. He has extensive experience with the electric and magnetic fields of transmission and distribution systems as well as the audible noise, radio noise, and ozone that may be produced by high voltage power systems. His work has involved the measurement, modeling, and mitigation of the electrical environment of transmission lines, transformer vaults, and underground/submarine cables. His power system experience includes issues dealing with lightning, electrical transients, ground currents, and stray voltage.

Dr. Johnson has testified on the corona and field effects of DC and AC transmission lines and been a lecturer at the EPRI Transmission Line Design Seminars. He has given numerous presentations and led several workshops on power line design and the electrical environment. He was a principal investigator in the EPRI research on magnetic field sources and methods of shielding.

Dr. Johnson has performed engineering studies related to power system fields, audible noise, radio noise, induced currents, and ground currents for clients including state and federal agencies, utilities, and site developers. Other areas of expertise include investigations of electrically-related fires in devices ranging from consumer appliances to industrial equipment, electrical injury, electrical faults, electronic component failure, code compliance, and facility wiring systems. Prior to joining Exponent, Dr. Johnson was the President of Power Research Engineering, where he worked on engineering issues related to the electrical environment and power quality.

Academic Credentials and Professional Honors

Ph.D., Electrical Engineering, University of Illinois, 1979
M.S., Physics, University of Illinois, 1976
B.S., Engineering Physics, University of Illinois (Highest Honors), 1974

Tau Beta Pi; Phi Kappa Phi

Publications and Presentations

Bishop J, Johnson G, Nilsson S, McNichol J. Performance of DC transmission line insulator strings. CIGRE Colloquium on HVDC and Power Electronic Systems Including Overhead Line and Insulated Cable Applications, San Francisco, CA, March 7–9, 2012.

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