COMMONWEALTH OF VIRGINIA
BEFORE THE
STATE CORPORATION COMMISSION

APPLICATION OF	)	
	)	
TRANS-ALLEGHENY INTERSTATE LINE COMPANY	)	**Case No. PUE-2007-000____**
	)	
For approval and certification of electric transmission facilities under Va. Code § 56-46.1 and the Utility Facilities Act, Va. Code § 56-265.1 *et seq.*	)	

APPLICATION OF TRANS-ALLEGHENY INTERSTATE LINE COMPANY FOR APPROVAL AND CERTIFICATION OF ELECTRIC FACILITIES FOR THE CONSTRUCTION OF 500 kV TRANSMISSION LINE

DIRECT TESTIMONY OF WILLIAM H. BAILEY, Ph.D.

April 19, 2007

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is William H. Bailey. My business address is Exponent, 420 Lexington Avenue, Suite 1740, New York, NY 10170.

Q. WHAT IS YOUR POSITION AT EXPONENT, INC.?

A. I am a Principal Scientist in the Health Sciences practice of Exponent Inc. ("Exponent") and the Director of the Exponent New York office.

Q. PLEASE DESCRIBE YOUR CURRENT RESPONSIBILITIES AND PROFESSIONAL EXPERIENCE.

A. Exponent is a research and consulting firm engaged in a broad spectrum of activities in science and technology. My practice specializes broadly in the health sciences and, more specifically, in human exposure assessment. My work involves reviewing, analyzing, and conducting research. One of the areas in which I have done a great deal of work over the past 25 years relates to potential biological and health effects of electrical facilities, such as transmission lines, substations, and electrified railroad lines.

EDUCATION AND EXPERIENCE

Q. PLEASE SUMMARIZE YOUR EDUCATION AND YOUR ACADEMIC AND RESEARCH EXPERIENCE.

A. I earned a Ph.D. in neuropsychology from the City University of New York. My education includes a B.A. from Dartmouth College in 1966, and an MBA from University of Chicago, awarded in 1969. Since 1986, I have been a visiting

research scientist at the Cornell University Medical College. I also have been a visiting lecturer at Rutgers University, the University of Texas (San Antonio), and the Harvard School of Public Health. From 1983 to 1987, I was head of the Laboratory of Neuropharmacology and Environmental Toxicology at the New York State Institute for Basic Research. For the nine previous years, I was an Assistant Professor and Postdoctoral Fellow in Neurochemistry at The Rockefeller University.

Q. PLEASE OUTLINE YOUR SCIENTIFIC RESEARCH EXPERIENCE CONCERNING ELECTRIC AND MAGNETIC FIELDS.

A. I have studied and conducted research on electric and magnetic fields ("EMF") for 25 years. My research has included laboratory, exposure assessment, and epidemiological studies concerning alternating current ("AC") electric and magnetic fields and studies on direct current ("DC") electric fields and air ions.

Q. HAVE YOU SERVED AS A REVIEWER AND SCIENTIFIC ADVISOR ON HEALTH-RELATED ISSUES FOR STATE AND FEDERAL AGENCIES OR SCIENTIFIC ORGANIZATIONS?

A. Yes. I have reviewed research for the National Institutes of Health, the National Science Foundation, and other government agencies. Concerning transmission lines in particular, I served on a Scientific Advisory Panel convened by the Minnesota Environmental Quality Board to review health aspects of a high-voltage transmission line. In addition, I served as a consultant on transmission line health and safety issues to the Vermont Department of Public Service, the New York State

Department of Environmental Conservation, and the staffs of the Maryland Public Service Commission and the Maryland Department of Natural Resources.

I also have worked with the National Institute of Occupational Health and Safety, the Oak Ridge National Laboratories, the U.S. Department of Energy, and the Federal Railroad Administration to review and evaluate health issues related to electric and magnetic fields from other sources. I also assisted the U.S. EMF Research and Policy Information Dissemination Program to evaluate biological and exposure research as part of its overall risk assessment process.

Most recently, I worked with scientific experts from 10 countries to evaluate possible hazards from exposures to static and extremely low frequency ("ELF") EMF for the International Agency for Research in Cancer ("IARC"), a division of the World Health Organization located in Lyon, France. I also contributed to a workshop convened in March 2006 by the International Committee on Non-Ionizing Radiation Protection ("ICNIRP") to update guidelines for human exposures to AC electric and magnetic fields.

Q. HAVE YOU PRESENTED THE RESULTS OF YOUR RESEARCH IN THIS AND OTHER AREAS TO THE SCIENTIFIC COMMUNITY?

A. I have published or presented more than 50 scientific papers on this and related subjects.

Q. ARE YOU A MEMBER OF ANY PROFESSIONAL ORGANIZATIONS?

A. I am a member of The Rockefeller University Chapter of Sigma Xi, a national scientific honor society; the Health Physics Society; the International Committee

on Electromagnetic Safety, Subcommittees 3 and 4 – Safety Levels with respect to Human Exposure to Fields; the Bioelectromagnetics Society; the IEEE Engineering in Medicine and Biology Society; the American Association for the Advancement of Science; the New York Academy of Sciences; the Society for Neuroscience; the Air & Waste Management Association; the Society for Risk Analysis, and the International Society for Exposure Analysis.

Q. ARE 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 attached as Exhibit WHB-1. In addition, the publications and other documents referred to in my testimony and used to support my conclusions are listed in Exhibit WHB-2, attached to my testimony.

Q. HAVE YOU EVER APPEARED AS A WITNESS BEFORE REGULATORY AGENCIES?

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

Q. WILL THE USE OF VARIOUS TERMS IN YOUR TESTIMONY BE CONSISTENT WITH THE DEFINITIONS ASSIGNED TO THOSE TERMS IN THE TABLE OF NOMENCLATURE ATTACHED TO THE APPLICATION AS EXHIBIT 2?

A. Yes. In addition, I may define other specific terms in my direct testimony.

PROJECT EVALUATION

Q. WHAT IS EXPONENT'S ROLE IN THIS PROJECT?

A. Trans-Allegheny Interstate Line Company ("TrAILCo") requested that Exponent calculate the EMF levels and other electrical parameters associated with the operation of the proposed 500 kV Trans-Allegheny Interstate Line ("TrAIL"). The relevant segment of TrAIL for purposes of this testimony is the portion of the line from the Virginia-West Virginia state line, passing through the Meadow Brook Substation and continuing to the point approximately 300 feet from the western boundary of the Appalachian Trail property ("Virginia Segments"), as described in greater detail in the testimonies of TrAILCo witnesses Jack Halpern, Cyril Welter and Alan Fleissner. The results of field calculations for profiles across the transmission line rights-of-way are summarized in the testimony of Dr. Gary Johnson filed on behalf of TrAILCo in this proceeding. TrAILCo also requested that Exponent evaluate these data and provide information about the current status of health-related research on EMF, which is the subject of my testimony here.

Q. WHAT IS THE PROPOSED ROUTE OF THE TRAIL LINE IN VIRGINIA?

A. TrAIL will be 28.0 miles long in Virginia. The route has two major segments. The first segment extends east from the West Virginia/Virginia border for approximately 12.3 miles to the Meadow Brook Substation on a 400- to 425-foot-wide right-of-way. In this segment, the line will be constructed on a new right-of-way adjacent to the right-of-way of an existing 500-kV transmission line and will also parallel multiple existing 138-kV transmission lines for 5.43 miles.

The second segment of TrAIL continues southeast from the Meadow Brook substation for 15.7 miles to the Appalachian Trail. Over most of this route (15.73 miles), the line would be adjacent to an existing 500-kV transmission line. On portions of this segment, TrAIL will parallel 138-kV lines (0.65 miles), will have 138-kV underbuild (over 7.52 miles), or will have 34.5-kV underbuild (over 4.94 miles).

Q. WHAT EMF LEVELS ARE ASSOCIATED WITH THE TRAIL IN VIRGINIA?

A. The EMF levels associated with TrAIL as proposed in Virginia have been calculated by standard methods and are described in the testimony of Dr. Johnson. In general, the EMF levels will be highest directly under the conductors, and will decrease with distance from the line. Because of the wide right-of-way, the levels of EMF will have diminished at the right-of-way edges and beyond to levels similar to those outside the rights-of-way of the more common lower voltage transmission lines in the state. The range of magnetic field levels will be similar to those we experience when we are near other sources: on or near the right-of-way the magnitude of the magnetic field is similar to appliances, further from the right-of-way the magnitude is similar to that of distribution lines which run in front or behind our houses, and, at greater distances, the field from the line will drop to background levels commonly measured in residences, schools and workplaces. This is illustrated in Exhibit WHB-3.

Q. WILL TRAIL CONTRIBUTE SIGNIFICANTLY TO THE EXPOSURES OF THE PUBLIC IN VIRGINIA?

A. No. We all encounter EMF at varying levels in our homes, schools, workplaces, and other locations in our communities. Given the nature of the proposed route, it is very unlikely that people will experience higher, average background levels of EMF because of the line. The proposed route is situated mainly in rural areas at a distance from most residences. Exposures to fields from the proposed line would be of limited duration and intermittent, such as those experienced by persons hiking on trails or crossing the right-of-way. Riders in vehicles passing under the line would be largely shielded from exposures to the electric field.

The electric fields associated with the new line would contribute little to exposures at residences because of distance from the line and the effective blocking of these fields by trees, fences, shrubbery, and buildings. Likewise, the magnetic fields from the line would likely contribute little to the average background levels inside nearby residences because of their distance from the line.

Q. ARE THERE ANY STATE OR FEDERAL STANDARDS THAT TRAILCO MUST MEET IN REGARD TO EMF AND HEALTH?

A. There are no federal standards for either magnetic fields or electric fields from power lines or other sources at power frequencies, and there are no state standards in Virginia.

Q. WILL THE EXPECTED TRAIL EMF LEVELS BE BELOW THOSE RECOMMENDED IN EXPOSURE GUIDELINES BY INTERNATIONAL ORGANIZATIONS?

A. The United States government has not adopted the exposure guidelines recommended by the International Committee on Electromagnetic Safety (ICES, 2002) or the limits adopted by the European Union based on recommendations of the ICNIRP (EC, 1999) to protect public health and safety of the general public. However, the levels of EMF associated with operation of the line would be lower than the limits recommended in these guidelines (ICES – 10 kV/m on transmission line right-of-way; EC – induced current density $\leq$ 2 millamperes/m^2 at locations where people spend significant time).

Q. IS THE ROUTING AND DESIGN OF THE PROPOSED LINE ALSO CONSISTENT WITH THE RECOMMENDATIONS OF THE DIRECTOR OF THE NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES AND THE WORLD HEALTH ORGANIZATION REGARDING MEASURES TO MINIMIZE POTENTIAL MAGNETIC FIELD EXPOSURES?

A. Yes. In light of marginal scientific support for concerns that exposure to EMF might be a health hazard or what aspect of exposure may be important, *e.g.*, intensity, duration, frequency, alignment with the geomagnetic field, etc. these organizations have suggested that utilities voluntarily undertake measures to minimize public exposure through siting practices or design. In this project, the strategy of attempting to avoid routing TrAIL near residences, where possible, will result in lower EMF exposures. The paralleling of other transmission line rights-of-way, where available, also reduces potential exposure at other land uses. In addition, the transmission of electric power at a higher voltage (*e.g.*, at 500 kV)

reduces the current flow on the line to a level below that required for transport of the same amount of power over lower-voltage lines, and therefore reduces magnetic field levels.

SCIENTIFIC METHODS FOR ASSESSING EMF AND HEALTH

Q. THERE HAS BEEN CONSIDERABLE RESEARCH ON EXPOSURE TO EMF AND HEALTH. ARE THERE STANDARD METHODS FOR INTERPRETING A LARGE BODY OF RESEARCH LIKE THIS?

A. Yes. The standard methods for assessing potential health risks from the relevant scientific research call for a process that involves evaluating all of the evidence, and giving more weight to studies of better quality. For example, the IARC defines this risk assessment process as follows:

> Each *Monograph* reviews all pertinent epidemiological studies and cancer bioassays in experimental animals. Those judged inadequate or irrelevant to the evaluation may be cited but not summarized. (p. 5, IARC, 2006)

IARC, like many other scientific organizations, considers pertinent studies to be those reports of scientific research or reviews that have been published or accepted for publication in the openly-available scientific literature (IARC, 2006).

Q. WHAT KINDS OF DATA ARE CONSIDERED IN MAKING JUDGMENTS ABOUT POTENTIAL RISKS TO HUMAN HEALTH?

A. To assess the potential health effects from any exposure, data from several types of studies must be critically evaluated: epidemiologic observations in people, experimental studies with laboratory animals, and other biological test systems.

Q. WHAT ARE EPIDEMIOLOGIC STUDIES?

A. Epidemiology is the science that studies the patterns of health and disease in human populations in their normal environments. The objective of environmental epidemiology studies is to quantify and evaluate the associations between exposures to environmental factors (*e.g.*, vegetables in diet) and health outcomes (*e.g.*, diabetes).

Q. WHAT ARE LABORATORY STUDIES?

A. In contrast to epidemiology investigations, laboratory studies are designed to control exposures of the experimental subjects (human volunteers, animals, tissues, cells, molecules) to other things in the environment, so that the effects of exposure to just one variable at known intensities and durations can be studied in relative isolation to determine cause and effect relationships.

Q. WHY ARE BOTH KINDS OF STUDY IMPORTANT?

Epidemiologic studies can help to suggest associations, but they usually cannot be used as the sole basis for inferences about cause-and-effect relationships, and they usually provide information about only a limited range of exposures. To establish cause-and-effect relationships, laboratory research designed to test specific hypotheses under controlled conditions is generally required. Conversely, the results of laboratory studies, by themselves, may be difficult to extrapolate directly to the human population. Hence, the data from epidemiology studies and laboratory experiments are complementary, balancing the precision of laboratory studies with the real world experience of epidemiology.

It is therefore both desirable and important that biological responses to agents that could present a potential health threat be explored by epidemiologic methods in human populations, whenever feasible, as well as under controlled conditions in the research laboratory.

Q. WHY IS IT IMPORTANT TO EVALUATE ALL OF THE PERTINENT RESEARCH STUDIES?

A. It is essential to evaluate all of the studies, regardless of the direction of their results, in order to ensure that studies are not singled out from those available to support a preconceived position. It is considered a biased approach to evaluate only those studies that support a specific position. The appropriate question to keep in mind is "how strong is the evidence to support the hypothesis of cause and effect?"

Q. WHY IS IT FURTHER IMPORTANT TO CONSIDER THE QUALITY OF EACH STUDY — EXPERIMENTAL LABORATORY STUDIES AS WELL AS EPIDEMIOLOGY STUDIES?

A. Valid conclusions cannot be drawn from studies presenting data that are incomplete, or flawed in their methodology, execution, or interpretation. Hence, it is critically important to evaluate each study and give data from studies with better quality design and analysis more weight in a weight-of-evidence evaluation.

Q. IS RELIANCE ON RESEARCH THAT IS PUBLISHED AND PEER REVIEWED A FIRST STEP IN THE EVALUATION OF ITS QUALITY?

A. Yes. Peer review is the process by which research proposals and studies reporting research are reviewed and evaluated by other scientists before they are approved for funding or publication. Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Although it is not a guarantee of validity and varies widely across journals, peer review provides an indication that the data, interpretations and conclusions of the authors have passed a minimal level of scientific assessment and review. Without the procedure of peer review to screen and evaluate material, we could be inundated by material that is incomplete, poorly written, and unsubstantiated.

Q. WHAT IS THE UNIQUE ROLE OF EXPERIMENTAL LABORATORY STUDIES (*I.E.*, ANIMALS AND *IN VITRO* STUDIES) IN THE EVALUATION OF HEALTH RISKS TO HUMANS?

A. For obvious reasons, studies in humans are limited to either naturally occurring exposure, as in epidemiologic studies, or short-term exposure with presumed reversible effects (laboratory studies). Experimental studies can use higher exposures, for long time periods, and study processes in cell and tissues to directly examine for any carcinogenetic effects of EMF. In addition, experimental studies are designed to isolate the effects of a single variable from other factors. Moreover, they can minimize potential bias and systematic error because the subjects are randomly assigned to exposed and unexposed (control) groups.

Q. HAVE EXPERIMENTAL STUDIES BEEN SHOWN TO PLAY AN IMPORTANT ROLE IN THE IDENTIFICATION AND STUDY OF CANCER-CAUSING AGENTS?

A. Yes. This role was highlighted by the IARC:

> All known human carcinogens that have been studied adequately for carcinogenicity in experimental animals have produced positive results in one or more animal species. (p. 14, IARC, 2006)

And, more generally, experimental studies are the primary basis by which we evaluate the safety of all of our drugs and medicines.

Q. WHAT ORGANIZATIONS HAVE CONDUCTED WEIGHT-OF-EVIDENCE REVIEWS OF RESEARCH STUDIES OF EMF AND HEALTH?

A. Numerous scientific organizations have performed weight-of-evidence reviews of EMF research, including IARC, ICNIRP, the Health Council of Netherlands ("HCN"), UK National Radiological Protection Board ("NRPB"), and the National Institutes of Environmental Health Sciences ("NIEHS"). The scientific consensus among these agencies is that the evidence is insufficient to conclude that EMF is a cause of any long-term health effect.

One of the most comprehensive reviews of the relevant research was performed by the IARC Working Group, which consisted of scientists (including myself) drawn from 10 countries.

ASSESSMENTS OF EMF RESEARCH BY MULTIDISCIPLINARY SCIENTIFIC REVIEW PANELS

Q. WHAT WERE THE CONCLUSIONS OF THE IARC WORKING GROUP REGARDING EMF AND HEALTH?

A. The Working Group examined both the epidemiologic and experimental research literature. It concluded that the epidemiologic studies do not provide support for an association between childhood leukemia and residential magnetic fields at intensities less than 4 mG. Yet, because a statistical association between higher-level (*i.e.*, >3-4 mG) average residential magnetic fields and childhood leukemia was reported in pooled studies, the evidence was judged as providing "limited" epidemiologic evidence for a cancer risk. The IARC Working Group also evaluated the data on animals exposed to EMF and concluded that they were "inadequate" to support a risk for cancer. Overall, magnetic fields were categorized as "possibly carcinogenic to humans" (Group 2B), based on the statistical association of higher magnetic fields with childhood leukemia. In the rating system used by IARC, the recognition of an association between exposure and cancer in epidemiology studies is considered 'limited evidence' of carcinogenicity. A rating of "limited evidence" for epidemiology studies requires that the exposure be categorized as a "possible carcinogen," even without any evidence from laboratory studies that an exposure might pose a cancer risk, and even though chance, bias and confounding cannot be ruled out with reasonable confidence (IARC, 2002).

Q. CAN YOU PROVIDE SOME ADDITIONAL PERSPECTIVE ON THE CONCLUSIONS OF THE IARC REPORT?

Yes. It is important to understand that we concluded that the EMF data do not merit classification as "carcinogenic to humans" or "probably carcinogenic to humans." Moreover, the classification of EMF in the 2B category as a "possible carcinogen" does not mean that magnetic fields cause cancer, nor does it mean that they are likely to do so, but only that a possibility exists, given the weak evidence for the association. The category of all possible events includes highly unlikely events.

Many hypotheses have been suggested and tested to explain possible carcinogenic effects of electric or magnetic fields; however, no scientific explanation for carcinogenicity of these fields has been established (IARC, 2002). The Working Group did not find that the scientific evidence supported associations between magnetic fields and any other type of cancer or between electric fields and cancer. Coffee (IARC, 1991), pickled vegetables (IARC, 1993) and gasoline engine exhaust (IARC, 1989) are some other common exposures that have been classified in the Group 2B category. In other words, the scientific evidence to date suggests that magnetic fields (but not electric fields) at certain levels *might* bear some relation to one type of cancer, putting EMF in the same IARC risk category as pickled vegetable beets and coffee.

Q HAVE ANY OF THE SUBSEQUENT MULTIDISCIPLINARY SCIENTIFIC REVIEWS PERFORMED FOR NATIONAL OR INTERNATIONAL AGENCIES REACHED DIFFERENT CONCLUSIONS?

A. No. Consideration of additional epidemiology and experimental studies has not prompted agencies including the HCN (2006), ICNIRP (2003), NRPB (2004), or Sweden's Radiation Protection Authority (2007) to change the basic conclusions of IARC regarding cancer, or to prompt concern about potential adverse effects of EMF on health.

Q. YOU JUST STATED THAT CONCLUSIONS OF THE IARC WORKING GROUP AND OTHER AGENCIES THAT HAVE ASSEMBLED MULTIDISCIPLINARY PANELS TO REVIEW EMF RESEARCH ARE GENERALLY CONSISTENT. ARE THEY ALSO GENERALLY CONSISTENT WITH THE CONCLUSIONS OF A REVIEW BY THREE SCIENTISTS FROM CALIFORNIA DEPARTMENT OF HEALTH SERVICES (CDHS, 2002)?

A. No, the review by these three scientists gave more weight to the body of research on other health outcomes, expressing their belief that EMF to one degree or another may pose a possible risk of adult leukemia, adult brain cancer, miscarriage, and amyotrophic lateral sclerosis. However, there are a number of procedures used in the preparation of the California report that are of concern and, in my opinion, caused the discrepancy between the reviewers' conclusions and the conclusions of the other scientific reviews. The review represented the opinions of just three scientists and lacked the multidisciplinary expertise of the other national and

international panels (specifically with regard to biological sciences) and, in contrast to the other reviews, did not adequately consider animal studies or other types of laboratory studies, as is required for a valid health risk assessment.

Q. WHY DID THE IARC WORKING GROUP AND OTHER REVIEWERS INCLUDING THOSE FROM CDHS NOT REGARD STATISTICAL ASSOCIATIONS BETWEEN ESTIMATES OF MAGNETIC FIELD EXPOSURE AND CHILDHOOD LEUKEMIA AS EVIDENCE CONFIRMING A CAUSAL RELATIONSHIP?

A. It is widely recognized that statistical associations do not by themselves mean that one factor is the cause of another. Other factors must be considered to assess causation, including the limitations and weaknesses of these epidemiology studies, and the biological evidence. For magnetic fields, there was neither sufficient evidence from epidemiology studies that magnetic fields caused cancer in humans, nor sufficient evidence that magnetic fields caused cancer in laboratory studies of animals. Furthermore, there was no strong evidence for a biological mechanism to cause cancer.

Q. WHAT ARE THE RESULTS OF EXPERIMENTAL STUDIES THAT HAVE EXPOSED ANIMALS TO EMF?

A. There are a large number of studies in which animals and cells have been exposed to EMF over a wide range of intensities. With respect to cancer, particularly leukemia, the most important studies are those in which animals had been exposed over most of their lifetime to magnetic fields as high as 50,000 mG and then

examined for visible and microscopic evidence of cancer. These studies conducted in several species provide no evidence for a carcinogenic effect of magnetic fields.

Q. IN SOME OF THESE STUDIES, WERE ANIMALS TESTED THAT WERE ALREADY AT HIGHER RISK OF CANCER, THAT IS, MORE LIKELY TO DEVELOP LEUKEMIA OR RELATED TYPES OF CANCER?

A. Yes, a number of studies were designed to increase the possibility of finding cancer even if the increased risk of magnetic field exposure was quite small, by testing animals with increased susceptibility to these diseases. In some of the studies, mice were tested that were more sensitive to the development of cancer because they had a genetic mutation that increased their risk. In other studies, mice and rats were first exposed to a known carcinogen and then exposed to magnetic fields, to see whether more cancers developed compared to controls. Overall, this collection of studies, which consisted of large sample sizes and high doses, showed no consistent evidence of increased rates of leukemia or any related lymphohematopoietic cancers in the animals exposed to magnetic fields.

Q. HOW WOULD YOU SUMMARIZE THE EVALUATIONS OF THE OVERALL EVIDENCE BY SCIENTIFIC AGENCIES?

A. Several of the epidemiologic studies have reported statistical associations between higher, average exposure levels to magnetic fields (greater than 3-4 mG) and childhood leukemia, although potential biases and other factors cannot be ruled out as the explanation. Other epidemiologic studies provide little evidence suggesting that EMF is the cause of cancer or other long-term adverse health effects. The

experimental laboratory data do not support a causal link between EMF and any adverse health effect because a) laboratory animals were exposed to EMF over their entire lifespan, and these studies have not shown a consistent increase in any cancer including leukemia, and b) the laboratory data in animals, cells, and tissues do not provide evidence of a mechanism to explain how magnetic fields could cause cancer. In the context of all the evidence, the data do not support a cause-and-effect relationship. For these reasons, the organizations that have reviewed the research have not recommended exposure limits at the levels typically produced by sources in communities, including distribution and transmission lines, and appliances.

Q. IS THIS A SUMMARY OF THE CONSENSUS OF THE MULTIDISCIPLINARY REVIEWS UP TO THE PRESENT?

A. Yes. The conclusions in the most recent weight-of evidence review performed by eight scientists for the Swedish Radiation Protection Authority reflect the consensus expressed in earlier reviews by NIEHS (NIEHS, 1998, 1999), IARC (2002), NRPB (NRPB, 2001; NRPB, 2004), ICNIRP (2003) and HCN (2001, 2004, 2006) that the data do not support a causal link between EMF and any adverse health effects.

CONCLUSIONS

Q. IF EMF AT LEVELS TYPICALLY FOUND IN OUR COMMUNITIES WHERE INDIVIDUALS WORK AND PLAY IS NOT HARMFUL, WHY IS RESEARCH STILL CONTINUING?

A. As in other areas of science, research on EMF is an ongoing activity. Even though no adverse effects of EMF exposure at the levels found in our communities have been confirmed, research is continuing to explore new questions that arise, to attempt to replicate previous studies, and to ensure that even the smallest possibility of a risk has not been overlooked. Because essentially everyone in developed countries like the United States is exposed to EMF throughout the day from a variety of sources, even a very small risk applied to these large populations would be of public health importance. However, given the limitations of epidemiology and the absence of data from laboratory studies to suggest that magnetic fields are carcinogenic, scientists have not concluded that the research, in total, suggests that electric or magnetic field have an adverse effect on human health.

Q. DOES SCIENTIFIC RESEARCH SHOW THAT ELECTRIC AND MAGNETIC FIELDS ARE HARMFUL TO HUMAN HEALTH?

A. Electric and magnetic fields are not harmful at the levels people are exposed to under transmission lines, in homes, or near machines and electrical appliances. With some appliances, an electric shaver and hair dryer for example, the user is exposed to magnetic fields that can be tens to hundreds of times higher than transmission line fields. Electric and magnetic fields can be harmful at extremely high levels, but not at the levels found under transmission lines or even near home appliances.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

William H. Bailey, Ph.D.

Principal Scientist and Director, New York Office

Professional Profile

Dr. William H. Bailey is a Principal Scientist in Exponent's Health Sciences practice and Director of the New York office. Before joining Exponent, Dr. Bailey was President of Bailey Research Associates, Inc., the oldest research and consulting firm with specialized expertise in electromagnetic fields and health. Dr. Bailey specializes in applying state-of-the-art assessment methods to environmental and occupational health issues. His 30 years of training and experience include laboratory and epidemiologic research, health risk assessment, and comprehensive exposure analysis. Dr. Bailey has investigated exposures to alternating current, direct current, and radiofrequency electromagnetic fields, 'stray voltage', and electrical shock, as well as to a variety of chemical agents and air pollutants. He is particularly well known for his research on potential health effects of electromagnetic fields and has served as an advisor to numerous state, federal, and international agencies. Dr. Bailey was one of the scientists invited from the U.S. and 9 other countries to evaluate possible health hazards of exposures to static and extremely low frequency (ELF) electric and magnetic fields for the International Agency for Research in Cancer in 2002. Most recently, he has been invited to participate in the International Workshop on EMF dosimetry and biophysical aspects relevant for setting exposure guidelines, organized by the International Commission on Non-ionizing Radiation Protection (ICNIRP). He also participated in a working group that advises a committee of the World Health Organization on risk assessment, perception, and communication. Currently, he is involved in research on respiratory exposures to ultrafine- and nanoparticles. Dr. Bailey is a visiting scientist at the Cornell University Medical College and has lectured at Rutgers University, the University of Texas (San Antonio), and the Harvard School of Public Health. He was formerly Head of the Laboratory of Neuropharmacology and Environmental Toxicology at the New York State Institute for Basic Research, Staten Island, New York, and an Assistant Professor and NIH postdoctoral fellow in Neurochemistry at The Rockefeller University in New York.

Credentials and Professional Honors

Ph.D., Neuropsychology, City University of New York, 1975
M.B.A., University of Chicago, 1969
B.A., Dartmouth College, 1966

Sigma Xi; The Institute of Electrical and Electronics Engineers/International Committee on Electromagnetic Safety (Subcommitee 3, Safety Levels with Respect to Human Exposure to Fields (0 to –3 kHz) and Subcommitte 4, Safety Levels with Respect to Human Exposure to Radiofrequency Fields (3 kHz to 3 GHz); Elected member of the Committee on Man and Radiation (COMAR) of the IEEE Engineering in Medicine and Biology Society (1998-2001); Invited Speaker, First Institute of Neurological Sciences Symposium in Neurobiology, University of Pennsylvania (1980); Invited Speaker, National Heart and Lung Institute (1977).

Prior Experience

Bailey Research Associates, Inc., President, 1991-2000
Environmental Research Information, Inc., Vice President, 1987-1990
New York State Institute for Basic Research, Head of Laboratory of Environmental Toxicology and Neuropharmacology, 1983-1987
The Rockefeller University, Assistant Professor, 1976-1983

Publications

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Salman SL, Weiss JM, Bailey WH, Joh TH. Relationship between endogenous brain tyrosine hydroxylase and social behavior of rats. Society of Neuroscience, November 1980.

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Bailey WH, Weiss JM. Effect of ACTH 4-10 on passive avoidance of rats lacking vasopressin (Brattleboro strain). Eastern Psychological Association, April 1976.

Academic and Research Appointments

- Visiting Fellow, Department of Pharmacology, Cornell University Medical College, New York, NY (1986–present)
- Visiting Scientist, The Jackson Laboratory, Bar Harbor, ME (1984–1985)
- Head, Laboratory of Neuropharmacology and Environmental Toxicology, NYS Institute for Basic Research in Developmental Disabilities, Staten Island, NY (1983–1987)
- Assistant Professor, The Rockefeller University, New York, NY (1976–1983)
- Postdoctoral Fellow, Neurochemistry, The Rockefeller University, New York, NY (1974–1976)

- Dissertation Research, The Rockefeller University, New York, NY (1972–1974)
- CUNY Research Fellow, Dept. of Psychology, Queens College, City University of New York, Flushing, NY (1969–1971)
- Clinical Research Assistant, Department of Psychiatry, University of Chicago; Psychiatric Psychosomatic Inst., Michael Reese Hospital, and Illinois State Psychiatric Inst, Chicago, IL (1968–1969)

Teaching Appointments

- Lecturer, University of Texas Health Science Center, Center for Environmental Radiation Toxicology, San Antonio, TX (1998)
- Lecturer, Harvard School of Public Health, Office of Continuing Education, Boston, MA (1995, 1997)
- Lecturer, Rutgers University, Office of Continuing Education, New Brunswick, NJ (1991–1995)
- Adjunct Assistant Professor, Queens College, CUNY, Flushing, NY (1978)
- Lecturer, Queens College, CUNY, Flushing, NY (1969–1974)

Advisory Positions

- National Institute of Environmental Health Sciences/ National Institutes of Health, Review Committee, Neurotoxicology, Superfund Hazardous Substances Basic Research and Training Program (2004)
- National Institute of Environmental Health Sciences, Review Committee Role of Air Pollutants in Cardiovascular Disease (2004)
- Working Group on Non-Ionizing Radiation, Static and Extremely Low-Frequency Electromagnetic Fields, International Agency for Research on Cancer (2000–2002)
- Working Group, EMF Risk Perception and Communication, World Health Organization (1998–2005)
- Associate Editor, Non-Ionizing Radiation, *Health Physics* (1996–present)
- Member, International Committee on Electromagnetic Safety, Subcommittee 3 - Safety Levels with Respect to Human Exposure to Fields (0 to 3 kHz) and Subcommitee 4 - Safety Levels with Respect to Human Exposure (3kHz to 3GHz) Institute of Electrical and Electronics Engineers (IEEE) (1996–present)

- Invited participant, National Institute of Environmental Health Sciences EMF Science Review Symposium: Clinical and *In Vivo* Laboratory Findings (1998)
- Working Group, EMF Risk Perception and Communication, International Commission on Non-Ionizing Radiation Protection (1997)
- U.S. Department of Energy, RAPID EMF Engineering Review (1997)
- Oak Ridge National Laboratory (1996)
- American Arbitration Association International Center for Dispute Resolution (1995–1996)
- U.S. Department of Energy (1995)
- National Institute for Occupational Safety and Health (1994–1995)
- Federal Rail Administration (1993–1996)
- U.S. Forest Service (1993)
- New York State Department of Environmental Conservation (1993)
- National Science Foundation
- National Institutes of Health, Special Study Section—Electromagnetics (1991–1993)
- Maryland Public Service Commission and Maryland Department of Natural Resources, Scientific Advisor on health issues pertaining to HVAC Transmission Lines (1988–1989)
- Scientific advisor on biological aspects of electromagnetic fields, Electric Power Research Institute, Palo Alto, CA (1985–1989)
- U.S. Public Health Service, NIMH: Psychopharmacology and Neuropsychology Review Committee (1984)
- Consultant on biochemical analysis, Colgan Institute of Nutritional Science, Carlsbad, CA (1982–1983)
- Behavioral Medicine Abstracts, Editor, animal behavior and physiology (1981–1983)
- Consultant on biological and behavioral effects of high-voltage DC transmission lines, Vermont Department of Public Service, Montpelier, VT (1981–1982)
- Scientific advisory committee on health and safety effects of a high-voltage DC transmission line, Minnesota Environmental Quality Board, St. Paul, MN (1981–1982)

- Consultant on biochemical diagnostics, Biokinetix Corp., Stamford, CT (1978–1980)

Professional Affiliations

- The Health Physics Society (Affiliate of the International Radiation Protection Society)
- Society for Risk Analysis
- New York Academy of Sciences
- American Association for the Advancement of Science
- Air and Waste Management Association
- Society for Neuroscience/International Brain Research Organization
- Bioelectromagnetics Society
- The Institute of Electrical and Electronics Engineers/Engineering in Medicine and Biology Society

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