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VIA HAND DELIVERY

July 7, 2010

Mr. Nick Ucci
Principal Policy Associate
Energy Facility Siting Board
89 Jefferson Boulevard
Warwick, RI 02888

Re: **Docket No. SB-2008-02**
In re: The Narragansett Electric Company d/b/a National Grid
(Rhode Island Reliability Project)

Dear Nick:

I am enclosing for filing ten (10) copies of a report prepared by Dr. William H. Bailey of Exponent on behalf of National Grid. This report is in response to the suggestion by Dr. Sullivan that National Grid undertake a Longitudinal EMF Health Study along the Rhode Island Reliability Project right-of-way.

Please call if you have any questions.

Sincerely,



Peter V. Lacouture

PVL/lgo
Enclosure

CC: Elia Germani, Esq. (via Hand Delivery)
Mr. Kevin Flynn (via Hand Delivery)
W. Michael Sullivan, Ph.D. (via Hand Delivery)
Patricia S. Lucarelli, Esq. (via Hand Delivery)
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M E M O R A N D U M

TO: Peter Lacouture, Esq.
Robinson & Cole LLP

FROM: William H. Bailey, Ph.D.
Meghan E. Wagner, M.P.H.

DATE: July 7, 2010

PROJECT: Rhode Island Reliability Project (RIRP)
0802706.000

SUBJECT: Discussion of Rhode Island Longitudinal EMF Health Study

You have requested that we address the issues raised by Commissioner Sullivan's request that National Grid design and implement a "longitudinal health study" of the effects of electric and magnetic field (EMF) exposure on abutters to the proposed RIRP right-of-way, compared with persons who do not live along the right-of-way, over perhaps a 20-year period. This request was made at a recent meeting of the Energy Facility Siting Board (EFSB).

While we do not intend to discourage research, the goal of this memo is to provide context on 1) the value and feasibility of such a study and 2) the existing landscape of research on EMF and health, including studies already partially funded by National Grid.

Additional scientific research on power-frequency EMF is necessary and important to resolve the remaining uncertainty in this field. This additional research should be conducted in a targeted and high-quality fashion, taking into account the large body of existing research, the focused questions that remain, and the large expense of conducting such studies. The results of low-quality studies will continue to burden the scientific literature with results that lack internal validity, and such results add little to no weight to the existing body of research.

Any proposed health study should meet, at a minimum, three criteria: 1) the study should address an identified gap in knowledge; 2) the study should be scientifically valid and based on established methodological principles designed to yield relevant data; and 3) the study should be cost-effective. As proposed, the longitudinal health study presented by Commissioner Sullivan does not appear to address an existing research gap, is not logistically feasible, and would be cost-prohibitive. The best source of information about the possible health effects of EMF

exposure is the large body of existing research on this topic, rather than a small study of a restricted geographic area.¹

In its Environmental Health Criteria review and evaluation of research on EMF and health, the World Health Organization (WHO) called for additional research on selected topics that it believes will address gaps in existing knowledge (see Attachment 1). The highest priority identified by the WHO is to address the statistical association between childhood leukemia and high average exposures to magnetic fields:

Resolving the conflict between epidemiological data (which show an association between ELF magnetic field exposure and an increased risk of childhood leukaemia) and experimental and mechanistic data (which do not support this association) is the highest research priority in this field. It is recommended that epidemiologists and experimental scientists collaborate on this. For new epidemiological studies to be informative they must focus on new aspects of exposure, potential interaction with other factors or on high exposure groups, or otherwise be innovative in this area of research. In addition, it is also recommended that the existing pooled analyses be updated, by adding data from recent studies and by applying new insights into the analysis (p. 17-18).

A similar recommendation for research has been put forth by the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), one of the independent scientific committees that advise the European Commission on matters of consumer safety, public health and the environment. Based on its review of the evidence as of January 2009, the top priorities for research are the resolution of the discrepancy between the association observed for magnetic fields and childhood leukemia and the lack of supporting evidence for such an association either in animal models or *in vitro* studies, and epidemiological and experimental investigations of the apparent association between magnetic fields and the development of Alzheimer's disease (SCENIHR, 2009).

Although the topic of a possible longitudinal health study was not specified by Commissioner Sullivan, childhood leukemia would be the top scientific priority.² However, given the rarity of childhood leukemia (3 cases per 100,000 per year), the relatively small population abutting the RIRP right-of-way, and the very few persons within this small population who might have high time-averaged magnetic field exposures, even collecting data for the next 20 years would yield neither a sufficiently large number of childhood leukemia cases, nor a sufficiently exposed population to provide any statistically meaningful resolution of a difference between the exposures of children with and without leukemia.

Consider an example where 100 feet is chosen as the distance where the annual average magnetic field contributed by the transmission lines might be elevated above where an

¹ For comparison, when the US Congress asked the National Cancer Institute to perform an epidemiology study of childhood leukemia, the NCI studied cases and controls drawn from nine states to assemble a sufficient number of subjects for the study (Linnet et al., 1997, <http://www.ncbi.nlm.nih.gov/pubmed/9203424>)

² A study that lumped together all health outcomes would be of no scientific value. Each type of cancer and other disease outcomes has distinct risk factors and, therefore, needs to be studied separately.

association has been observed with childhood leukemia.³ Standard calculations were conducted and approximately more than 300-400,000 *children* living within 100 feet of the proposed line and 7.5-10 million children living 100-1,000 feet of the proposed line would need to be studied in a prospective cohort analysis to detect a statistically meaningful difference in the incidence of childhood leukemia. It would take far longer than 20 years to complete such a study as there are only approximately 1,144 households within 1,000 feet of the proposed project - a much smaller population than would be required for this type of study. While this sample size calculation makes a number of assumptions,⁴ the conclusion is that a much larger population of children than those living in the vicinity of the RIRP would need to be studied to provide any meaningful results. This point is also demonstrated by the fact that only five cases of childhood leukemia were observed within ~164 feet of all overhead high-voltage transmission lines in England and Wales between 1962 and 1995. For this reason, no studies of this kind have been conducted; rather, almost all researchers have conducted case-control studies that are more efficient and where the exposures of children with leukemia are compared to the exposures of a group of similar children with no cancer.

This same issue would apply to other cancers and diseases because of the relatively small population living in the vicinity of the RIRP right-of-way and the few persons living in close proximity to the line.⁵ For example, if the same exercise were conducted with a more common disease such as Alzheimer's disease, which results in approximately 24.2 deaths per 100,000 persons per year, approximately 35-40,000 persons living within 0-100 feet would need to be studied in a prospective cohort analysis and compared to approximately 875,000-1.0 million persons living 100-1,000 feet. The calculation also assumes 80% statistical power; a two-sided test; a relative risk of approximately 2.0 (Huss et al., 2009); and a ratio of 1:25 of persons living within 100 feet vs. persons living 100-1,000 feet.

Additional complications of such studies include successfully demarcating geographic boundaries and developing methods to identify all cases of disease in the cohort (i.e., case identification and validation); developing an exposure assessment methodology that would accurately reflect EMF exposures; enrolling as many study participants as possible and tracking them when they moved, died, or were lost to follow-up; and making sure there were no major differences between persons abutting the right-of-way and persons living off of the right-of-way.

Given the knowledge gained from more than 30 years of epidemiology research on magnetic fields and health, for any future epidemiology study to be useful requires that it

³ Magnetic field calculations performed by Exponent for the proposed project show that levels range between 0.7-7.3 mG at 100 feet under average loading conditions.

⁴ The calculation for a prospective cohort analysis also assumes 80% statistical power; a two-sided test; a relative risk of approximately 2.0 (Ahlbom et al., 2000; Draper et al., 2005; Greenland et al., 2000); and a ratio of 1:25 of children living within 100 feet vs. children living 100-1,000 feet.

⁵ To address this issue, epidemiological studies on this topic are typically of the case-control design, rather than longitudinal health studies, and collect cases from large geographic areas to compare to similar control populations.

include a large study population with a large number of highly-exposed subjects, a requirement recognized repeatedly over the years. In a commentary on EMF occupational research, which applies equally to community research, Dr. David Savitz, a leading epidemiologist who has performed both community and occupational studies of EMF, cautioned on this point:

Unfortunately, the barriers to reaching definitive conclusions transcend financial limitations or a lack of ingenuity among those of us who have addressed the issue. Neither money nor creativity can overcome the inherent limitation of insufficient sizes of populations available for study or the challenge of assessing or reconstructing EMF exposures. The greatest source of ambivalence regarding the continued pursuit of the hypothesized carcinogenic effects of EMFs continues to be the lack of experimental support, and some would argue, the lack of plausibility that such support will ever be found.”⁶

We expect that funding from government sources or others could be found, if a valid and useful epidemiology study is proposed. For the reasons given above, a longitudinal study of the population abutting the RIRP right-of-way would not meet the scientific criteria that would attract or justify such funding. Furthermore, the cost of such an epidemiology study is likely to be far greater than \$1.0 million, a reflection of the higher costs of human epidemiology studies than many other types of research, as is evident from the costs associated with ongoing projects discussed below.

The EFSB should recognize that National Grid both in the United States and in the United Kingdom has a long and outstanding history of supporting independent investigators to learn more about EMF and health issues. The National Grid budget for research support this year is about \$1.2 million (£800,000). National Grid has supported research in the following ways;

- National Grid assisted The Childhood Cancer Research Group (CCRG) at the University of Oxford in conducting a computerized study of childhood cancer in relation to residential proximity to power lines in the UK. The study, also known as the Draper study, looked at 35,000 cases of childhood cancer diagnosed across the UK from the 1950s to the present, which makes it the largest study of this sort ever conducted. National Grid assisted the researchers by calculating distances from the home of each study subject to the nearest power line and then estimating magnetic fields from historical records of loading data. The Commission will recall that the Draper et al. study was thoroughly discussed in our reports and in Dr. Bailey’s testimony.
- National Grid is funding the independent research trust, The EMF Biological Research Trust, in the amount of \$604,000 [£400,000] per year. The Trust is a UK-based medical research charity which funds basic research on the biological effects of ELF-EMF with total independence from industry. The research program is recommended and administered by an independent Scientific Advisory Committee. The Trust encourages publication of results of the work it funds and the content of such publications is entirely the responsibility of grantholders.

⁶ Savitz DA. Invited commentary; Electromagnetic fields and cancer in railway workers. *Amer J. Epidem.* 153:836-838, 2001, p. 836

- National Grid conducts in-house research, principally into sources of ELF-EMF exposure and ways of categorizing them. This has involved significant work on net currents, which are the most common source of exposure for the general public, and power lines.
- National Grid is a member of the Energy Networks Association, the industry body for UK energy transmission and distribution license holders and operators. With other members of the Energy Networks Association, National Grid supported a research program that provided funding to The Leukaemia Research Fund for The United Kingdom Childhood Cancer Study (UKCCS), the world's largest ever study of its type into childhood cancer, and to the University of Birmingham's Institute of Occupational Health for a study of 80,000 employees of Central Electricity Generating Board to look for associations between magnetic fields and leukemia, brain cancer and heart disease.
- National Grid belongs to the Electric Power Research Institute (EPRI), the main research organization for utilities in America, and supports their EMF research program. EPRI is currently the only organization in North America funding long-term, multidisciplinary EMF research. EPRI performs much of its research through the sponsorship of independent scientists affiliated with major universities, laboratories, and consulting organizations. In addition, an external, blue-ribbon scientific advisory committee provides guidance for the EMF program's research activities. Research findings are published in peer-reviewed journals.

The current EPRI research program on EMF for 2011 calls for a \$5 million budget that will:

- use both epidemiologic and laboratory research strategies to investigate the basis for the epidemiologic association between residential magnetic fields and childhood leukemia;
- continue a feasibility assessment for an innovative epidemiologic study of EMF and miscarriage;
- investigate the feasibility of laboratory biological models that can address potential links between EMF and childhood leukemia, and between EMF and neurodegenerative diseases (Alzheimer's, amyotrophic lateral sclerosis);
- investigate occupational health and safety issues relevant to power-frequency EMF as well as RF environments, including neurodegenerative disease risk and interference with implanted medical devices (such as cardiac pacemakers);
- conduct research relevant to EMF exposure guideline formulation, develop exposure monitoring instrumentation relevant to the safety of workers with implanted medical devices, and monitor guideline revisions and related developments;

- investigate cutting-edge RF safety issues, such as RF burns, and create relevant RF safety products, including RF safety tutorials;
- develop an educational DVD as part of a series that provides a comprehensive background on all aspects of the EMF health issue;
- address emerging concerns about potential EMF effects on animal behavior and health; and
- maintain a vital and creative communications effort that reaches both EMF/RF program members and the larger stakeholder community.

Three studies of interest are currently being partially funded by EPRI, with support from National Grid. These studies address important research gaps to move this area of research forward and, given the high standards this research must meet in terms of size and exposure assessment, entail a substantial cost.

1. Approximately \$3 million⁷ was awarded to Dr. Pat Buffler at the University of California at Berkeley and other contractors to supplement a study of childhood leukemia and environmental exposures; the intent of the additional support was to evaluate the relationship between contact currents and magnetic fields and assess whether these currents could have a confounding effect on the association between magnetic fields and childhood leukemia. The study enrolled over 500 children and the results are expected to be published in the coming year. The total cost of the Northern California Childhood Leukemia study between 1995 and the present is estimated at \$20 million.
2. EPRI is also providing a grant to the University of Southern California and UCLA for the study “Residence near Power Lines and Childhood Cancer.” This study will replicate the 2005 Draper study, which reported that children with childhood leukemia were more likely to reside within 600 meters of overhead transmission lines. The goal of the study is to see if the results from the UK can be replicated regarding distance from transmission lines but also use calculated magnetic fields to directly assess exposure and to evaluate socio-demographic and other factors not considered in the Draper study. The estimated cost of this study is approximately \$3 million, which does not include the manpower to be provided by four California utilities. The results are expected to be published in a peer-reviewed journal by the end of 2012.
3. Finally, to address the challenge of finding a large population with sufficiently high magnetic field exposures, EPRI is planning for a “Study of Residences Located Above Transformer Stations (TransExpo Study).” The TransExpo Study, an international study of magnetic fields and leukemia among children living in apartment buildings with transformer rooms, is designed to minimize selection bias and to examine a highly

⁷ On short notice, only informal cost estimates from knowledgeable sources could be obtained.

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exposed study population. This multi-million dollar project is still in its early stages and so no better estimates of cost are available.

Thus, National Grid is funding important research through various funding mechanisms. The results of this research will be more valuable to an assessment of ELF-EMF than a study of abutters of the RIRP right-of-way.

Attachment 1 (p. 19-20 of WHO, 2007)

Table 1. Recommendations for further research	
Sources, measurements and exposures	Priority
Further characterization of homes with high ELF magnetic field exposure in different countries.	Medium
Identify gaps in the knowledge about occupational ELF exposure, such as MRI.	High
Assess the ability of residential wiring outside the USA to induce contact currents in children.	Medium
Dosimetry	
Further computational dosimetry relating external electric and magnetic fields to internal electric fields, particularly concerning exposure to combined electric and magnetic fields in different orientations.	Medium
Calculation of induced electric fields and currents in pregnant women and in the fetus.	Medium
Further refinement of microdosimetric models taking into account the cellular architecture of neural networks and other complex suborgan systems.	Medium
Biophysical Mechanisms	
Further study of radical pair mechanisms in immune cells that generate reactive oxygen species as part of their phenotypic function.	Medium
Further theoretical and experimental study of the possible role of magnetite in ELF magnetic field sensitivity.	Low
Determination of threshold responses to internal electric fields induced by ELF on multicell systems, such as neural networks, using theoretical and in vitro approaches.	High
Neurobehaviour	
Cognitive, sleep and EEG studies in volunteers, including children and occupationally exposed subjects, using a wide range of ELF frequencies at high flux densities.	Medium
Studies of pre- and post-natal exposure on subsequent cognitive function in animals.	Medium
Further study of opioid and cholinergic responses in animals.	Low
Neurodegenerative disorders	
Further studies of the risk of amyotrophic lateral sclerosis in "electric" occupations and in relation to ELF magnetic field exposure and of Alzheimer's disease in relation to ELF magnetic field exposure.	High
Immunology and haematology	
Studies of the consequences of ELF magnetic field exposure on immune and haematopoietic system development in juvenile animals.	Low
Reproduction and development	
Further study of the possible link between miscarriage and ELF magnetic field exposure.	Low

Table 1. Continued

Cancer

Update existing pooled analyses of childhood leukaemia with new information.	High
Pooled analyses of existing studies of childhood brain tumour studies.	High
Update existing pooled and meta-analyses of adult leukaemia and brain tumour studies and of cohorts of occupationally exposed individual.	Medium
Development of transgenic rodent models of childhood leukaemia for use in ELF studies.	High
Evaluation of co-carcinogenic effects using in vitro and animal studies.	High
Attempted replication of in vitro genotoxicity studies.	Medium

Protective measures

Research on the development of health protection policies and policy implementation in areas of scientific uncertainty.	Medium
Further research on risk perception and communication focused on electromagnetic fields.	Medium
Development of a cost–benefit/cost-effectiveness analysis for the mitigation of ELF fields.	Medium
