EXTREMELY LOW FREQUENCY MAGNETIC FIELDS HEALTH ISSUES

ISSUE STATEMENT

EMF health issues continue to be raised by the scientific community, the media and the public. New studies and attendant media reports about EMF health impacts, IARC’s classification of EMF as a possible human carcinogen (Group 2B), and concerns frequently raised at public meetings underscore the importance of addressing this issue with high quality science. Public confidence in safe and reliable operation of the power delivery system is crucial as the power grid is expanded, upgraded, and modernized to accommodate emerging transmission and distribution (T&D) technologies.

Costs for construction and/or upgrades of T&D facilities and their operation and maintenance are very high. Environmental and health-related concerns are frequently raised during the expansion, refurbishment and maintenance of the T&D infrastructure and can result in significant additional cost and delay. These added costs can include: longer permitting process, rerouted lines (adding more miles) including design changes (such as undergrounding) to mitigate purported EMF levels, and high right-of-way payments. Construction of new or upgraded transmission lines and installation of distributed generation technologies along with deployment of electric transportation infrastructure has fueled public concern about possible human health risks from exposure to power frequency electromagnetic fields (EMF).

There are significant remaining scientific uncertainties about the potential health effects of EMF exposure. The primary concern focuses around the childhood leukemia issue. However, other outcomes, such as neurodegenerative diseases, adverse pregnancy outcomes and asthma also continue to be of interest and concern. Resolution of these scientific uncertainties will be crucial to enable and facilitate the planning and execution of major T&D infrastructure developments and to demonstrate a constructive approach in risk communication.

DRIVERS

A number of underlying rules, regulations, and public perception issues are driving the need for research on enhancing and improving the environmental compatibility of the T&D system.

Public Perception Drivers

• Public opposition to siting new transmission lines and other T&D infrastructure – As new transmission lines and other T&D facilities are proposed to move power from remote locations to population centers, the public is becoming increasingly concerned about potential health effects, in some cases resulting in significant delays. In the absence of federal regulations, the EMF issue is driven heavily by public perception and public health concerns.

• Stakeholder and ad hoc policy reports – Organizations, such as the Bioinitiative Working Group, are becoming more forceful in impacting transmission line siting and smart meter projects and are taking a strong stance on the potential health hazards of EMF exposures.

• Public pressure on regulatory agencies – Public citizen organizations have intervened with regulatory agencies, such as the Federal Communications Commission and the California Public Utilities Commission, calling for more stringent EMF limits and other regulations, guidelines, and/or standards.

Regulatory Drivers

• U.S. Occupational Safety and Health Administration (OSHA) requirements – OSHA establishes and enforces workplace regulatory exposure limits.
• **State and local regulations** – The State of California, Department of Education, has setback rules for transmission lines to protect school children from EMF exposure.

• **European Directive** – A directive to monitor occupational exposure levels of electromagnetic fields for purposes of assuring compliance with exposure limits (e.g., those published by the International Commission on Non-Ionizing Radiation Protection) was first put forth in 2004. Implementation has been pushed back from its original schedule, and is now expected within the next two years. The Directive will result in increased levels of required workplace surveillance.

**Non-Regulatory Drivers**

• **World Health Organization (WHO)** – The WHO, based on scientific evidence from childhood leukemia epidemiologic studies, has classified ELF/EMF as a possible human carcinogen (Group 2B).

• **International Committee on Non-Ionizing Radiation Protection (ICNIRP) and IEEE** – These two organizations establish extremely low frequency field (ELF) exposure guidelines and standards (IEEE) that are used world-wide to establish adequate human exposure levels.

• **Development of precautionary policies internationally** – The precautionary principle is aimed at avoiding or minimizing harm, if such indications exist and reasonable avoidance can occur. Its application is strong in Europe and is growing in the U.S.

**RESULTS IMPLEMENTATION**

A comprehensive plan has been developed to address the near term and longer-term research needs on ELF EMF health issues. EPRI research results have been used in risk evaluations by national and international expert panels (e.g., NIEHS, IARC, WHO) and contributed to a better understanding of potential health effects of EMF exposure. Research results are also used to inform other regulatory agencies, decision makers, industry and the public.

• Research results are available to members to help manage their needs in a cost-effective manner and to make objective scientific information available to their customers on a timely basis.

• Results are accessible to other scientific organizations to inform the appropriate standard and guideline setting processes; the health effects information also is available to non-governmental agencies as well as to the public.

Results of EPRI ELF health research conducted over the past 35 years have been communicated to and used by industry and the public in several forms:

• EPRI members who interact with constituents on EMF siting issues, draw on information provided by EPRI through advisory council meetings and research reports.

• EPRI EMF peer-reviewed research has been included in the IARC evaluation of EMF carcinogenicity and in the WHO Environmental Health Criteria. In addition to classifying EMF as a possible human carcinogen based on an epidemiologic relationship with childhood leukemia, these reviews also concluded that some diseases with great public health impact, such as breast cancer and cardiovascular diseases are likely not related to EMF exposure.

• EPRI has made its results available to other stakeholders including federal and state regulatory agencies, to inform the appropriate rulemaking activities; the exposure assessment and health effects information also is available to non-governmental agencies as well as to the public.

**PLAN**

EPRI’s future ELF EMF health research will focus on addressing the childhood leukemia issue and will work on the resolution of the remaining scientific uncertainties regarding the nature of the association, i.e., whether it is a non-causal or causal relationship. Other issues will be addressed as necessary and as they arise. The ultimate goal is to resolve remaining scientific uncer-
tainties regarding the relationship between power frequency magnetic field exposure and potential health outcomes (e.g., childhood leukemia, neurodegenerative diseases).

Childhood Leukemia Research

- Epidemiology: The EMF childhood leukemia issue is addressed with a threefold approach: supporting high-quality, hypothesis-based health studies; analyzing and integrating available data; and synthesizing and evaluating the state of knowledge. The key elements include: 1) the TransExpo study to examine the role of selection bias in the epidemiologic association between magnetic fields and childhood leukemia in a highly exposed population. TransExpo is an international epidemiologic study of children living in multi-level apartment-buildings with built-in transformer rooms; 2) replication of the 2005 UK power line childhood leukemia epidemiologic study, which reported a positive association of distance to power lines with childhood leukemia; 3) evaluation of the feasibility of establishing a cohort of children with Down syndrome (a group at extremely high risk of developing childhood leukemia) to assess potential EMF effects. If deemed feasible, a study of this population group may be undertaken; and 4) evaluation of potential effects of parental occupational EMF exposure on childhood leukemia development.

- Laboratory studies: Development of an in vivo mouse model of childhood leukemia adaptable to studying potential leukemogenic effects of magnetic fields and other suspected exposures, such as contact currents. Full-scale experiments are planned to evaluate the potential carcinogenic effects of magnetic fields in a transgenic mouse model of childhood leukemia with TEL-AML1 translocation.

Additional Human Health Research

- In addition to childhood leukemia, there is some epidemiologic evidence linking adverse pregnancy outcomes and neurodegenerative diseases to residential and occupational exposure to ELF EMF. This research will investigate the relationship between magnetic field exposure and miscarriage among pregnant women. Evaluation of the potential effects of magnetic fields and electric shocks on development of neurodegenerative diseases are also planned in both epidemiologic and laboratory animal models. More recent epidemiologic results linked maternal exposure to magnetic fields during pregnancy and asthma in the offspring; this will be further examined in a large scale epidemiologic study using existing databases.

Occupational Health and Safety

- Investigate occupational health and safety issues relevant to ELF environments, including interference with implanted medical devices (such as cardiac pacemakers).

Animal Health Research

- Offshore wind turbine and hydrokinetic projects are being proposed in many parts of the world. Undersea electric cables are used to connect multiple turbines, transport the electricity and connect it to the onshore grid. Concern has been raised about potential interference with navigation for groups of fish and aquatic mammals, including endangered and threatened species. Electromagnetic fields created by the electric cables running from the turbines and underwater noises and vibrations could affect orientation and navigational ability. This research will summarize the existing literature on the potential effects of EMF due to underwater high voltage cables on marine life, identify research gaps, and if necessary initiate new studies to mitigate impacts. Additional research work will evaluate potential effects of magnetic fields on behavior and well being of economically important animals (e.g., bees and cattle). Previously published literature raised concerns of potential effects on these animals.

RISK

Continued objective and independent research is necessary to resolve outstanding and emerging scientific uncertainties regarding ELF EMF health effects. EMF’s continued classification as a possible human carcinogen is likely to continue to fuel public concern and opposition to transmission line siting and expansion of the Smarter Grid. This uncertainty has and is likely
to continue to slow opportunities for energy efficient technologies, demand response programs and potential expansion of electric transportation. In the absence of reliable and authoritative research, the EMF issue can become clouded by studies and perceptions that are not scientifically rigorous and authoritative. The result may be overly conservative standards not fully supported by scientific evidence or delays in important projects, which can become costly. Credible research is necessary to objectively address issues that may become part of hearings or litigation. Increased scientific certainty about potential health and environmental risks will be valuable in defining options to mitigate those risks.