
EMF/RF EXPOSURE ASSESSMENT

ISSUE STATEMENT

The electric power grid and its associated technologies are undergoing fundamental innovation and redesign to serve the goals of both enhanced reliability and efficiency. These advances are being adapted to a progressively more diverse mix of electrical energy sources, with major new contributions from renewable energy (wind and solar) integrating into the current generation mix. A backbone of the future grid is an electronic communication and control system that can manage loads in real time, pinpoint trouble spots, and accumulate electrical use data critical for near- and long-term planning. In parallel with these developments is the rapid expansion of a new generation of electrical devices equipped with power electronics. These may include appliances that operate with adjustable speed drives and inverters for rooftop photovoltaics or for charging electric vehicles.

These developments will introduce new sources of electromagnetic field emissions to which people are likely to be exposed and for which concerns about health and safety are likely to be expressed. EPRI has over 35 years of experience addressing health and safety issues associated with power frequency environments in both residential/community and occupational settings particularly with regard to 60-Hz electric and magnetic fields that accompany transmission lines and substations. EPRI's RF health and safety research was initially aimed at occupational exposure scenarios such as the co-location of cell phone panel antennas on transmission towers. Thus, research included source identification and characterization, evaluation of instrumentation, exposure assessment, near- and far-field dosimetry, exposure software, RF burn analysis, and most recently smart meter RF emission assessment.

However, looking forward to the evolution of the electrical grid with its associated technologies, it will be critical to identify and characterize the electromagnetic environments resulting from emerging technologies, and where appropriate, to quantify human exposure and conduct health studies.

DRIVERS

A number of underlying rules, regulations, and public perception issues are driving the need to accurately characterize EMF and RF environments associated with emerging technologies.

Public Perception Drivers

- **Public opposition to siting of new transmission lines and smart meters** – As new transmission lines are proposed to move power from remote locations to population centers and new grid technologies are implemented (e.g., smart meters), the public is becoming increasingly concerned about potential health effects, causing project delays and cost increases. In the absence of federal regulations, the EMF issue is driven heavily by public perception and public health concerns.
- **The need to remain proactive** – Though concern from the public is currently focused on EMF from T&D facilities (including substations) and smart meters, such concern is likely to widen with the proliferation of new technology.

Regulatory Drivers

- **U.S. Occupational Safety and Health Administration (OSHA) requirements** – OSHA establishes and enforces workplace regulatory exposure limits (e.g., RF energy based on tissue heating).

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- **State regulations** – The State of California, Department of Education, has setback rules for transmission lines to protect school children from EMF exposure.
 - **FCC Enforcement Bureau (U.S.)** – A Notice of Proposed Rulemaking on the use of dose quantities to comply with exposure guidelines is pending; the FCC develops enforceable public and occupational maximum exposure limits for RF. In July 2012, the Government Accountability Office recommended that FCC formally reassess current RF energy exposure limits.
 - **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). In 2011, the International Agency for Research on Cancer (IARC), an agency of WHO, has classified RF exposure as a possible human carcinogen as well.
- **International Committee on Non-Ionizing Radiation Protection (ICNIRP) and IEEE** – These two organizations establish EMF exposure guidelines that are used world wide to establish safe levels of human exposure.
- **International studies on the health risks of EMF exposure** – Published studies require review for implication and impact to T&D facilities siting and operation.
- **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 growing in the U.S. and is strong in Europe.

RESULTS IMPLEMENTATION

Research results are transferred in a number of ways to benefit EPRI members and other stakeholders including the public, federal and state regulatory agencies and non-governmental organizations. The information is used to inform rulemaking, provide background at public meetings, and provide the scientific community with the latest scientific findings on health and safety issues related to operation of the T&D system.

- Papers in the peer reviewed literature plus technical reports, resource papers and technical briefs and white papers that present research results or provide comment on studies conducted elsewhere
- Instructional videos on topics that include EMF and RF exposure assessment, proper measurement techniques, and frameworks for in-house safety program.

PLAN

EPRI's EMF/RF exposure assessment research will address uncharacterized technologies and environments that with time are likely to be inhabited by either the general public or occupational populations. Two 2011 workshops were hosted by EPRI's PDU and Environment Sectors on new technologies that will produce potential exposures and health effects associated with such technologies. In October 2012, the EMF health Assessment & RF Safety program held a workshop to identify the requirements for conducting an RF exposure assessment over a representative segment of the general population. In December 2012, the Environment Sector participated in a PDU Sector workshop on power quality to assess member interests and research needs. Based on these intelligence-gathering activities, foreseen research includes:

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- *Source identification and characterization:* With advances and developments in technology it becomes likely that the inventory of exposure sources will continue to expand and that the operating characteristics of existing technologies will evolve. This research will provide up-to-date knowledge of potential sources of human exposures to EMF and RF.
 - *Exposure assessment technology:* With sources identified and characterized it becomes important to develop techniques for studying exposure patterns, This will be accomplished through measuring fields in areas occupied by people and when combined with time-location-activity behavioral data, will provide estimates of exposure. Alternatively, people could be instrumented with personal monitors that log exposure in the frequency range of interest. The challenge will be to dissect exposures attributable to one source (such as smart meters) from others (such as cell phone base stations) to attribute source contribution.
 - *Human exposure assessment:* Health studies in humans cannot be conducted in the absence of valid exposure assessment. Even in the absence of an ongoing health study, exposure assessment research provides the data that allow health and safety concerns to be benchmarked against standards, such as the FCC's RF exposure limits or the EMF/RF exposure limits published by IEEE and ICNIRP.
 - *Publication and communication:* The research results must reach both public constituencies and the EPRI membership community. This will require publishing in the peer-reviewed literature, which is the gold-standard for acceptability, providing material to the public at no cost, and providing information to members, enabling them to communicate in-house and to their customer base.

The ultimate goal is to have a full understanding of exposure distribution in human populations and complete characterization of human exposure to electric and magnetic field at relevant ELF and RF frequencies.

RISK

Continued objective and independent research is necessary to resolve outstanding and emerging scientific uncertainties regarding ELF/RF 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. Objective, independent research is necessary to credibly address issues that may become the subject of hearings or even litigation. Reducing scientific uncertainties about potential health and environmental risks will be valuable in defining options to mitigate those risks.

