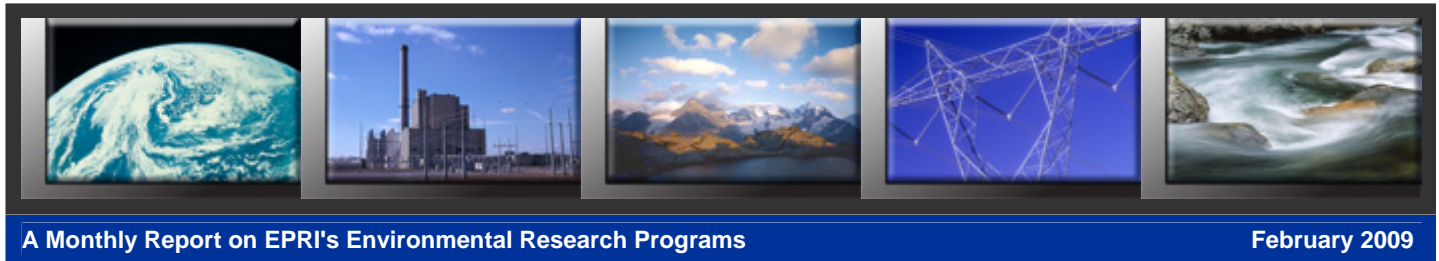


Environment Quick News



Program members can use their EPRI.com ID and password to download Acrobat PDF files of EPRI technical reports. For assistance, contact the EPRI Customer Assistance Center at (800) 313-3774.

Dear Environment Sector members:

Happy New Year. We hope you all had a wonderful holiday. It is hard to believe a month of 2009 has now passed, we have a new president, and the economy is still topic #1 (along with the Super Bowl, at least for you Pittsburgh fans).

We are in the process of planning for the upcoming March advisory meetings in San Diego. We hope you are all planning to attend, although we know that some of you have potential travel constraints. We are in the process of finalizing agendas and expect to provide you with important updates to ongoing research and to discuss topical issues, such as how we are revising our research portfolios to respond to the ever-changing regulatory, legislative, and external environment scene.

At this meeting, we will also be discussing our draft 2010 research program and seeking your feedback on funding priorities. This is an important function that you play, as it helps us understand more clearly where we need to be focusing our efforts to meet your needs. The advisors from each research program will set priorities, and the Sector Council will look across all of EPRI's environmental research programs and provide perspectives on the big picture in terms of importance and value. That information helps us decide how to price our programs, develop new supplemental projects, and assign staff priorities.

We are looking forward to seeing you in San Diego.

Bryan Hannegan
Vice President, Environment
bhannegan@epri.com
(650) 855-2858

Michael Miller
Director, Environment
mmiller@epri.com
(650) 855-2455

Tina Taylor
Director, Env. Business Development
tmtaylor@epri.com
(650) 855-2819

Energy Sustainability Interest Group Plans for 2009

EPRI's Energy Sustainability Interest Group met in Portland, OR, on Oct 28–29, 2008, for its final workshop of the year and to make plans for 2009. The workshop focused on exchanging experiences and exploring together various topics related to sustainability—in particular, what sustainability goals and metrics companies have adopted and what activities they have been involved in to address those goals. In addition, guest speaker Andrew Savitz, author of *The Triple Bottom Line*, gave an overview of sustainability success stories in other industries. The workshop was well attended, and members were enthusiastic about continuing the group's activities in 2009. Areas of focus for this year will include collecting information on how companies' internal sustainability goals may differ from their external goals, identifying processes and tools that are being used or could be used to implement sustainability, and continuing a series of "webinars" focusing on the activities of individual group member companies. Approximately 30 webinars are planned for 2009; they will be posted on the EPRI Events calendar under Environment. Group members feel that the interactive webinars are particularly valuable, allowing them to continue learning from each other. The next workshop is scheduled for April 22–23 at EPRI's Knoxville offices and will include a tour of EPRI laboratories. The group's activities are open only to group members. To learn more about the group and to become a member, see "[Energy Sustainability Interest Group](#)" (1018599) or contact Tina Taylor, (650) 855-2819, tmtaylor@epri.com.

Program 42: Air Toxics Health and Risk Assessment

Estimating Emissions From Uncontrolled Coal Fires

Wherever there are significant coal deposits there may be uncontrolled coal "wildfires" burning in the subsurface. It is estimated that these coal wildfires burn up to 600 megatons of coal (10% of global coal production) per year, releasing air toxics and greenhouse gases into the atmosphere. To reduce uncertainty about the global scale and impact of these fires, EPRI is launching a pilot program to develop observational methods that can be used to quantify coal wildfire carbon consumption and measure pollutant releases. Sites in North America—such as the Powder River Basin, where coal wildfires have burned for hundreds of years—are good candidates for observations using airborne infrared remote sensors to measure heat flux and calculate carbon emissions. Ultimately, these measurements will be used to create a quantitative global inventory of greenhouse gases and air toxics emitted by coal wildfires. For more information, contact Arnout Ter Schure, (650) 855-2753, aterschu@epri.com.

Long-Range Transport of Asian Pollutants Measured at Mount Bachelor Observatory

MBO: The Mount Bachelor Observatory (1018413). At the Mount Bachelor Observatory (MBO) in Oregon, EPRI is sponsoring research to assess the impact of pollutants originating in Asia on western North American atmospheric composition and air quality. Continuous sampling through 2010 is documenting levels of mercury, ozone, nitrogen oxides, and particulates that reach North America *via* long-range transport from Asia. Observations to date indicate the following:

- The ratio of total airborne mercury to carbon monoxide measured at MBO can be used—with prior estimates of carbon monoxide emissions from different source types—to estimate regional elemental mercury emissions. According to these calculations, it is estimated that Chinese anthropogenic sources emit about 620 tons of elemental mercury per year.
- Previous work may have underestimated elemental mercury emissions from Asia by a factor of two but is believed to have accurately estimated emissions from global biomass burning.
- *In situ* oxidation of elemental mercury to reactive mercury may occur in the upper free troposphere.
- There is growing concern that industrial NO_x emissions from Asia are stimulating ozone production in the Pacific Northwest. Measurements indicate that Asian pollutants double the levels of acyl peroxy nitrates (which transport nitrogen oxides) and increase ozone mixing ratios at Mount Bachelor.
- Almost 17% of the mean observed ozone in western North America comes from Asian ozone-forming pollution, according to simulations of ozone observations at MBO.

For more information, contact Arnout Ter Schure, (650) 855-2753, aterschu@epri.com.

Field and Laboratory Studies Characterize Mercury Chemistry in Power Plant Plumes

[State of Knowledge on Mercury Chemistry in Power Plant Plumes](#) (1018412). This Technical Update reviews growing field and laboratory evidence for the rapid chemical transformation of reactive mercury to elemental mercury in power plant plumes. Because elemental mercury is insoluble in water, it travels through the atmosphere and typically deposits at some distance from a power plant source. Thus, understanding the form of mercury in power plant plumes is essential to accurately describing mercury source–receptor relationships. In the present research, aircraft flying through plumes found reductions in reactive mercury downwind from two U.S. coal-fired power plants. A third study employed a dirigible for extended sampling and used laser-induced fluorescence measurements to identify mercuric chloride as the chemical form of reactive mercury emitted at the plant stack. Results from five laboratory studies conducted in plume dilution chambers support these field observations. Scientists hypothesize that the transformation of reactive mercury to elemental mercury in power plant plumes may result from reactions involving light, carbon monoxide, and sulfur dioxide; these reactions are the subject of future laboratory work. For more information, contact Arnout Ter Schure, (650) 855-2753, aterschu@epri.com.

Program 91: Assessment Tools for Ozone, Particulate Matter, and Haze

Fact Sheet on AMIGAS Project

“2008 August Mini-Intensive Gas and Aerosol Study” (1018636) will be available soon. This Fact Sheet describes the motivation and methodologies of the August Mini-Intensive Gas and Aerosol Study, which brought together an extensive suite of measurement instruments and technologies to collect atmospheric data at two sites in Georgia from Aug. 1 to Sept. 15, 2008. Data collection, which took place at two SEARCH stations (urban Atlanta and rural Yorkville, GA), was in addition to standard SEARCH measurements and was designed to let researchers examine in detail

- differences between daytime and nighttime aerosol sources and processes;
- relative impacts of anthropogenic versus biogenic contributions to aerosol;
- atmospheric chemical processes, including effects of aerosol acidity; and
- other topics of interest.

The campaign also allowed for field testing and cross-comparison of two EPRI-developed instruments for measurement of organic and inorganic nitrogen: the Chemical Ionization Aerosol Time-of-Flight Mass Spectrometer, and the Inorganic Continuous Aerosol Monitoring System. The Fact Sheet describes details of the measurements undertaken by each of the labs participating in the study. Additional chemical analyses and data analyses will continue into 2009. For more information, contact Stephanie Shaw, (650) 855-2353, sshaw@epri.com.

Program 92: Assessment of Air Quality Impacts on Health and the Environment

Success Story Published on EPRI's Air Pollution and Health Research

[“Air Pollution: Utility Perspectives on EPRI's Health Effects Research”](#) (1018370). This Success Story presents interviews with Tom Burnett, Environmental Senior Specialist for the Tennessee Valley Authority, and Fred Starheim, Manager of Environmental Permitting and Compliance for FirstEnergy, discussing the value to their companies of EPRI's research on air pollution and health. Among the benefits they noted were EPRI's groundbreaking research on the different health effects of different PM components, quick access to EPRI's nationally recognized research staff, and publications such as Fact Sheets and Issue Briefs to help in communicating with regulators, customers, and community groups. The Success Story discusses EPRI's three-pronged approach (epidemiology, toxicology, and exposure) to air pollution and health effects research and summarizes its recent projects, including ARIES, TERESA, and Tri-City CAPS. For more information, contact Annette Rohr, (650) 855-2765, arohr@epri.com.

CAPAS Scientific Advisory Meeting Held

On Dec. 10, the Children's Air Pollution Asthma Study team met with the project's external Scientific Advisory Committee (SAC) to review progress to date. As of the time of the meeting, two field sampling seasons (winter and summer 2008) were complete, and the third (winter 2009) was under way. A portion of the exposure data from the first two seasons was available for presentation, including data on indoor PM-10, PM-2.5, black carbon, ozone, NO₂, and SO₂. All of the health data were available, although analyses to link the exposure and health data had not yet been carried out. SAC members were very pleased with progress to date; in particular, they indicated that study management appears excellent, recruitment is going very well, subject characteristics (asthmatics with substantial symptoms and a history of emergency room visits for asthma) are very suitable for this study design, and exposure measurement is proceeding according to plan, with a high degree of acceptance of the protocol and equipment by the participating families. The Committee made several recommendations, including thoroughly checking daily diary and pulmonary function data for any anomalous values, retraining subjects on pulmonary function measurements midway through the 14-day monitoring period, and geocoding subjects' residences and collecting traffic data to enable a more robust assessment of the impact of traffic on asthma exacerbation. For more information, contact Annette Rohr, (650) 855-2765, arohr@epri.com.

Michigan Integrated Cohort and Animal Particle Study Moves Forward

The Michigan Integrated Cohort and Animal Particle Study has been officially launched, and field work is scheduled to begin this summer. The study, to be conducted in Dearborn, MI, involves a hybrid epidemiological panel study/controlled human exposure component coupled with animal exposures to concentrated ambient particles (CAPs). Healthy subjects with low background levels of exposure to air pollution will be transported to Dearborn, where they will be exposed to ambient pollution for 5 hours for 5 consecutive days. A suite of cardiovascular health impacts will be evaluated. At the same time, rats will be exposed to CAPs at the same location and similar effects monitored. This study will be instrumental in further elucidating the role played by specific air pollution components in human health effects. It is truly novel because of the integrated human/animal approach. For more information, contact Annette Rohr, (650) 855-2765, arohr@epri.com.

GLOBAL CLIMATE CHANGE

Visit the Global Climate Webpage

Program 102: Global Climate Policy Costs and Benefits

Article Discusses Issues in Designing U.S. Climate Change Policy

Aldy, J.E., and W.A. Pizer. "[Issues in Designing U.S. Climate Change Policy](#)." This article, based on EPRI-supported research, is available as a Discussion Paper at the Resources for the Future website. It discusses six key policy design issues that will determine the costs, cost-effectiveness, and distributional impacts of domestic climate policy: program scope and coverage, cost containment, use of offsets, revenues and allowance allocation, mechanisms to address competitiveness, and complementary R&D and technology policies. Among the authors' conclusions are the following points:

- "Broader coverage and the inclusion of more emission sources under a single emission pricing policy lowers the cost of any policy goal...."
- "Providing cost certainty can increase the political acceptance of a climate policy, deliver better investment incentives, and facilitate more ambitious long-term emission reduction goals by serving as insurance against unexpectedly high costs...."
- "Policies to promote increased research and development are necessary to complement a market-based climate policy ... The private incentives to invest in R&D, even in the presence of an emission mitigation policy, will still be weak because of the public good nature of information ... Government support for basic science can yield quite substantial returns on the investment, especially after accounting for positive spillovers of knowledge creation."

The authors conclude, "While there is a tendency to put a premium on getting started as soon as possible, with as strong a policy as possible, these observations suggest some important considerations for getting started with *as good a design as possible*." For more information, contact Geoff Blanford, (650) 855-2126, gblanford@epri.com.

EPRI Research Will Be Presented at International Scientific Conference on Climate Change

EPRI's Steven Rose will make two presentations at the International Scientific Conference on Climate Change, to be held Mar. 10–12 in Copenhagen, Denmark. Dr. Rose's presentations will be based on work that he began before joining EPRI and that he is continuing to pursue as part of EPRI's Global Climate Change research group.

- "Climate Policy Design and Forest Carbon Sequestration" describes a study of the effects of less-than-comprehensive global forest carbon market designs, such as staggered participation and limitations on which forest-related actions are considered creditable (e.g., reduced deforestation). Preliminary results suggest that a policy allowing credit only for afforestation is significantly less efficient than a comprehensive policy allowing credit for afforestation, reductions in deforestation, and changes in forest management (e.g., increases in management intensity and adjustments in rotation ages).
- "Modeling Marginal Biophysical Responses to Assess Cropland Greenhouse Gas Abatement Potential" evaluates the need for modeling biophysical interactions among crop management changes designed to mitigate GHG emissions from croplands. Initial results suggest that estimating incremental yield, soil, and GHG responses for sequential or simultaneous changes in management is important for more accurately estimating cropland abatement costs and potential.

The Congress is being organized by the International Alliance of Research Universities. Its focus is on providing a picture of the major issues that the scientific community feels policymakers need to understand, especially policymakers attending the 15th U.N. Conference on Climate Change (COP15), being hosted by Denmark at the end of 2009. A synthesis report of abstracts from the Congress will be handed to decision makers at COP15 by the Danish government, which is supporting the conference. For more information, contact Steven Rose, (202) 293-6183, srose@epri.com.

Program 103: Greenhouse Gas Reduction Options

Report Published on First Two Years of Study on Reducing N₂O Emissions in Crop Production

Developing Greenhouse Gas Emissions Offsets by Reducing Nitrous Oxide (N₂O) Emissions in Agricultural Crop Production: Project Overview and Preliminary Results from Years 1 and 2 (1018364). This Technical Update covers the first two years of a three-year project investigating an innovative approach to developing large-scale and potentially cost-effective greenhouse gas (GHG) emissions offsets that could be implemented across broad geographic areas of the U.S. and internationally. The project has five primary objectives:

- to determine the technical potential and economic cost to offset GHG emissions by reducing N₂O emissions in agricultural crop production across representative soil and crop types in the United States;
- to confirm, through field testing, that the rate of movement of N₂O from soil to the atmosphere (i.e., N₂O flux) can be reduced substantially by decreasing the amount of nitrogen fertilizer applied to cropland with little or no loss in crop productivity;
- to further refine existing computer simulation models so they can be used to predict the relationship between N₂O flux and crop yields;
- to identify, describe, and analyze socio-economic factors that may encourage or inhibit farmers from participating in N₂O emissions reduction projects, and to identify approaches to overcome potential farmer reluctance to participate; and
- to identify incentives that may be needed to encourage farmers to change cropping practices to achieve N₂O reductions.

The report documents the progress on all five objectives. In particular, results to date suggest that a significant decrease in N₂O flux could be achieved with little impact on crop yields. The tools and information developed in this project will broaden the GHG emissions offset options available to electric companies and others, and can serve as a mechanism to develop and strengthen partnerships between electric companies and the

agricultural communities they serve. For more information, contact Adam Diamant, (510) 260-9105, adiamant@epri.com.

Report Summarizes Three 2008 GHG Emissions Offset Policy Dialogue Workshops

The EPRI Greenhouse Gas Emissions Offset Policy Dialogue (1015633). This Technical Update, which is publicly available, summarizes EPRI's 2008 work and 2009 plans for its Greenhouse Gas (GHG) Emissions Offset Policy Dialogue project. The goals of this project are to inform key constituencies involved in the development of U.S. climate mitigation strategies and policies about GHG emissions offset-related policies and design issues, and to provide a forum in which representatives of key sectors of the U.S. economy and communities involved in the ongoing debate on climate change policies can discuss these issues. This report provides a comprehensive overview of existing GHG offset systems, their key design elements, and their performance. It also explores design alternatives being considered for offset programs that may be incorporated in climate change policies under development. Finally, this report describes alternative approaches that potentially can be developed to enable offset programs to achieve environmental and economic objectives. Background materials developed by EPRI and Natsource Advisory and Research are included for three related workshops held in 2008, along with summaries of the discussions that took place at each workshop. For more information, contact Adam Diamant, (510) 260-9105, adiamant@epri.com.

Interim Report on Climate Policy Impacts on Electric Company Compliance and Investment Decisions

Understanding the Impact of Climate Policy on Electric Company Compliance and Investment Decisions (1015635). This Technical Report presents interim results of a multiyear effort to better understand how climate policy could impact electric power sector investment and operating decisions. The research focuses on extending prior analyses to determine the effects of CO₂ emission constraints on individual generators and to provide guidance on how they can develop appropriate compliance strategies. The report covers five separate but related analyses that make the following key points:

- With a cap-and-trade program, compliance strategies for individual power generators will need to be based strongly on the price of CO₂ emission allowances, rather than on tons of emissions per se.
- Market simulations of the impact of a CO₂ price on Western power markets show that a CO₂ price of approximately \$50/ton will be needed to stabilize electric sector emissions growth, and an even higher CO₂ price will be needed to reduce emissions below existing levels. This will have a dramatic impact on electric rates; however, with time the electric sector can greatly reduce emissions, primarily by displacing existing coal generation with low- and nonemitting generation and with price-induced conservation.
- An adaptation of EPRI's PRISM analytical framework to the company level shows how advanced technologies can help cut emissions, but also reveals the high likelihood that companies will have to cover a large fraction of their emissions with market purchases of allowances.
- Based on these results, an integrated analysis was performed for a hypothetical coal-based utility. This analysis concluded that, under stringent climate policy, the utility will either have to rely heavily on power purchases in the market or replace its existing coal generation with generation from low- or nonemitting sources.
- The prior analysis logic was then applied to decisions about retrofitting or retiring existing coal generation because of environmental compliance concerns other than for CO₂. The results show that the immense value to be realized by keeping these units going can, under many plausible scenarios, more than offset the potential losses from their possible early demise under a stringent climate policy.

For more information, contact Victor Niemeyer, (650) 855-2744, niemeyer@epri.com.

Report on Potential of Emissions Borrowing to Reduce Costs of GHG Cap-and-Trade Programs

Evaluation of Borrowing as a Method to Contain Costs in a Greenhouse Gas Emissions Cap-and-Trade Program (1015634). This Technical Update evaluates the potential ability of borrowing emissions from future-year emissions allowances to help reduce the costs and cost volatility of cap-and-trade programs for GHG emissions. Borrowing has not generally been included as a cost-containment measure in prior programs because of issues such as the possibility that borrowers might not repay borrowed emissions and concerns that delaying emissions reductions would delay achievement of environmental goals. This report considers the potential promise of borrowing—both conceptually and empirically—as well as the design issues that would be

involved in developing a borrowing mechanism that would deal with potential concerns. While sources can implement borrowing in many different ways, two approaches appear particularly promising:

- **Allowing borrowers to use allowances from the next year to meet current compliance requirements.** Borrowers under this approach must obtain and retire the future allowances now, so there is no risk of default.
- **Using borrowing as part of a modified "safety valve."** With a conventional safety valve, the government sells additional allowances if the market reaches a ceiling price. The usual objection to a safety valve is that it "breaks the cap." Sources can meet this objection by taking the additional allowances from a reserve drawn from future years' caps. Thus, if the reserve is tapped, future caps automatically tighten.

This report illustrates the fact that gains from borrowing depend on relative costs in different periods, not whether the overall level of costs is high or low. The ability to borrow allowances from future caps can provide valuable cost-saving flexibility in a GHG emissions cap-and-trade program. Borrowing can reduce long-term costs when expected future costs fall over time, and can also reduce near-term costs (price spikes) when costs prove higher than expected because of some temporary situation. For more information, contact Victor Niemeyer, (650) 855-2744, niemeyer@epri.com.

Article on EPRI WECC Study Published in Public Utilities Fortnightly

The November 2008 issue of *Public Utilities Fortnightly* includes an article by EPRI's Victor Niemeyer entitled "Carbon in the West," which notes that "Prices between \$50 and \$80 a ton will trigger major market responses." The article describes EPRI's recent study on electricity generators and consumers in the Western Electricity Coordinating Council (WECC) region. It continues, "CO₂ prices in these ranges will lead to retail power prices 40 to 80 percent ... higher than they are in the WECC today ... Over the study's 18-year horizon, these higher prices also will create investment incentives for non-emitting generation, enabling such generation capacity to come online if the market functions reasonably well. This capacity will temper power-price differentials over time." For more information, contact Victor Niemeyer, (650) 855-2744, niemeyer@epri.com.

LAND AND GROUNDWATER

Program 49: Coal Combustion Products—Environmental Issues

FGD Gypsum Agricultural Network Establishes Test Plots in Six States

Flue Gas Desulfurization Gypsum Agricultural Network (1015777). Supporting the expanded use of flue gas desulfurization (FGD) gypsum in agriculture is the goal of a research network formed by EPRI, individual power generating companies, EPA, and the U.S. Department of Agriculture's Agricultural Research Service. Current utility production of nearly 11 million metric tons of FGD gypsum per year may triple as generating companies install or retrofit forced-oxidation wet scrubbers to meet air quality regulations. This level of production will saturate the current gypsum wallboard market and create new marketing opportunities if FGD gypsum can be shown to be effective and safe for agricultural use. To address this potential new market, researchers are growing a variety of crops (such as wheat, corn, cotton, and mixed pasture grass) in various soils at ten test plot sites located in six states. The research follows a standard protocol at each site: Test plots receive applications of FGD gypsum or commercial gypsum at different rates, while a control plot remains untreated. Preliminary results show that

- FGD gypsum contains more mercury than commercial gypsum, but all samples analyzed had less than 0.7 mg/kg mercury;
- after treatment with gypsum, soils from two North Dakota sites had higher calcium and sulfur content but no elevated concentrations of trace metals;
- at three sites, crop yields tended to be higher on plots treated with gypsum (as expected from previous applications of commercial gypsum), but yield differences were not statistically significant; and
- crops grown on treated and untreated plots did not differ in crop chemistry.

For more information, contact Ken Ladwig, (262) 754-2744, keladwig@epri.com.

New Reports Describe CCP Leachate Constituents: Arsenic and Thallium

Two new Technical Reports offer comprehensive information on the behavior of arsenic and thallium in the environment. Managers can use this information to evaluate the transport and fate of these constituents at coal combustion product (CCP) management sites.

Chemical Constituents in Coal Combustion Product Leachate: Arsenic (1015550).

- ***Occurrence in soil and water.*** Arsenic occurs in a wide range of environmental media, sometimes naturally exceeding the maximum contaminant level (10 µg/L) in groundwater or the ambient water quality criterion (0.018 µg/L) in surface water. U.S. soil contains an estimated average background concentration of 7.2 mg/kg arsenic.
- ***Occurrence in CCPs.*** Arsenic is present in fly ash at concentrations ranging from a few mg/kg to about 1300 mg/kg. The median concentration for arsenic in fly ash in the EPRI dataset was 49 mg/kg, and typical concentrations were less than 100 mg/kg.
- ***Leaching characteristics.*** Arsenic leaching from coal ash is limited by the solubility of minerals that contain the arsenic. Once released, arsenic's tendency to adsorb and coprecipitate limits its mobility under oxidizing and acidic environmental conditions. Factors controlling arsenic leachate concentrations under field conditions are discussed.
- ***Effects on human health and ecology.*** Based on studies of human populations outside the United States, arsenic has been classified as a human carcinogen by EPA and as carcinogenic to humans by the International Agency for Research on Cancer. It is likely that arsenic carcinogenicity has a threshold and that assuming a linear dose–response relationship overestimates cancer risk from arsenic exposure.
- ***Geochemistry.*** Pentavalent (As+5) and trivalent (As+3) forms of arsenic are typical in the environment. Arsenic is a redox-sensitive element, and its speciation governs its mobility in groundwater. As+3 is more mobile than As+5.
- ***Treatment and remediation options.*** Arsenic can be removed from water by coagulation and filtration (the most common water treatment method), anion exchange, coprecipitation, adsorption, phytoremediation, and reverse osmosis. These options are most effective for oxidized As+5, the form commonly found in coal ash leachate.

Chemical Constituents in Coal Combustion Product Leachate: Thallium (1016801).

- ***Occurrence in soil and water.*** Thallium occurs naturally in a wide range of environmental media. EPA has established a relatively low maximum contaminant level of 2 µg/L in drinking water. Thallium concentrations in U.S. soil are 3 mg/kg or less.
- ***Occurrence in CCPs.*** Thallium concentrations in U.S. coal range up to 85 mg/kg, with a median of 7.5 mg/kg for bituminous coal fly ash. Thallium most likely resides in fly ash as an oxide or in the nonvolatilized sulfide fraction.
- ***Leaching characteristics.*** Thallium leaching from CCPs may be a result of mineral solubility or cation exchange with ammonium. Median field leachate concentrations are less than 1 µg/L, and are higher at bituminous than subbituminous coal ash sites and at impoundments than landfills.
- ***Effects on human health and ecology.*** There is no evidence that thallium is carcinogenic. Ingestion of thallium results in gastrointestinal problems and hair loss. EPA recently suggested a fourfold lowering of its thallium risk level. However, more research is needed to resolve uncertainties in the Agency's derivation and revision of the thallium oral reference dose, which it bases on a new interpretation of existing data on hair loss in female rats.
- ***Geochemistry.*** Most thallium in aqueous solutions occurs as the thallium ion Tl (+1). Limited information suggests that thallium can be mobile under acidic pH conditions but is relatively immobile under typical pH conditions at most coal ash facilities.
- ***Treatment and remediation options.*** Chemical oxidation is the most effective technology for thallium remediation, followed by chemical precipitation with hydroxide compounds, settling, and filtration.

These are the third and fourth in a series of reports synthesizing data collected by EPRI over the past 25 years on the behavior of individual inorganic constituents in the environment. Previous reports describe beryllium (1012583) and boron (1005258). For more information, contact Ken Ladwig, (262) 754-2744, keladwig@epri.com.

Program 50: MGP Site Management

Sediment Capping Resource Guide Features Practical Case Studies

Sediment Capping Resource Guide for Manufactured Gas Plant Sites: With Highlighted Case Studies

(1015557). This Technical Update provides managers with tools they need to evaluate and design effective sediment capping remedies for former manufactured gas plant (MGP) sites. MGP sites present multiple and unique cleanup challenges not found in other types of sediment remediation. For example, it is especially important to characterize MGP sediments for the potential presence of nonaqueous phase liquid (NAPL) and the degree to which the NAPL is mobile. To address these challenges, the report describes the applicability of conventional granular cap design to conditions commonly found at MGP sites and presents new approaches for active cap design. It includes a number of practical case studies describing cap designs and cap construction experience and details management and monitoring techniques used to ensure long-term cap effectiveness. The report is intended to be used with EPRI's 2007 *Handbook of Remediation Alternatives for MGP Sites with Contaminated Sediments* (1012592). For more information, contact Jeff Clock, (845) 608-0642, jclock@epri.com.

Research Mines Database to Distinguish Sources of PAHs in Urban Soil

Examination of the Sources of Polycyclic Aromatic Hydrocarbon (PAH) in Urban Background Soil

(1015558). A database of surface soil samples, previously analyzed for 17 polycyclic aromatic hydrocarbons (PAHs), has yielded important new information that will help site owners distinguish PAHs related to former MGP operations from urban background PAHs. Researchers used forensic data-mining techniques to extract this information from soil samples collected at 318 urban sites in three states between 2000 and 2005. They looked for potential diagnostic and indicator compounds, statistical distributions, and data trends. They found that some PAH ratios (or combinations of ratios) are consistently different when comparing MGP-derived PAHs with background PAHs. For example, the ratio of benz(a)anthracene to chrysene is greater in coal carbonization MGP tars and creosote from coking operations than it is in background PAH sources. This and other diagnostic ratios can be used for PAH source attribution. In fact, this study reveals that most of the urban background PAHs in soils analyzed during previous EPRI investigations come from non-MPG sources. For more information, contact Jim Lingle, (414) 355-5559, jlingle@epri.com.

Manual Describes Best Practices for Assessing MGP Sites With Fractured Bedrock

MGP Site Characterization Best Practices Manual for Bedrock (1018276). This manual provides a step-by-step analysis of options for assessing MGP sites where coal tar interacts with underlying fractured bedrock. It offers an approach based on mathematical and geologic principles to predict the extent of coal tar contamination with minimal site disturbance. Assessment of these sites is challenging because coal tar exists as a dense nonaqueous phase liquid (DNAPL) and heterogeneous fracture patterns in bedrock offer transport pathways. Using converging lines of evidence to delineate bedrock coal tar zones, determining groundwater hydraulic gradients that can significantly influence the direction of coal tar migration in the bedrock, and performing stability analyses of the coal tar plume all play an important role in site assessment. It is essential to avoid drilling directly through coal tar in bedrock fractures since this can widen the spatial extent of the contamination. Utility managers can use this manual to cite specific examples of calculations and scenarios that can be tailored to assessing coal tar DNAPL migration in bedrock at their MGP sites. For more information, contact Jeff Clock, (845) 608-0642, jclock@epri.com.

EPRI MGP 2010 Symposium

Registration is now open for the 2010 EPRI MGP Symposium, scheduled for next January in San Antonio, TX. This meeting is the most recent in a series of popular symposia presenting advances in the technologies used to investigate and clean up former MGP sites. The meeting will emphasize the latest information on case studies, data, methods, and tools for cost-effective and environmentally protective MGP site management. Attendance will be limited to the first 200 registrants. For more information, contact Jeff Clock, (845) 608-0642, jclock@epri.com or Jim Lingle, (414) 355-5559, jlingle@epri.com.

Program 59: PISCES—Plant Multimedia Toxics Characterization

Report Describes Multimedia Fate of Selenium and Boron

Multimedia Fate of Selenium and Boron at Coal-Fired Power Plants Equipped With Particulate and Wet FGD Controls (1015615). This Technical Update reviews data from previous studies to characterize the multimedia fate of selenium and boron in coal-fired power plants equipped with particulate control devices and wet flue gas desulfurization (FGD) systems. These controls not only remove particulate matter and sulfur dioxide from flue gas but also remove trace elements such as selenium and boron, which are ultimately transferred to plant liquid and solid by-products or wastes. Power plant owners and operators face increasing regulatory pressure to manage these environmental releases so they do not exceed potential water discharge limits and solid waste guidelines. Key findings of this report include:

- **Selenium.** Overall coal-to-stack selenium flue gas removal ranged from 50% to 99%, with 10–90% of the selenium partitioning to fly ash, depending on coal sulfur content. Forced, inhibited, and natural oxidation FGD systems all removed similar amounts of selenium from flue gas. However, 60–80% of selenium at the outlet of inhibited oxidation (high-sulfite) systems partitioned to FGD solids, while partitioning to solids varied (16–88%) at the outlet of forced oxidation (low-sulfite) systems.
- **Boron.** Overall coal-to-stack boron flue gas removal ranged from 83% to more than 99%. Removal across the particulate control device varied from negligible to 90%, decreasing with increasing coal sulfur content. Further tests are needed to confirm these conclusions, which are based on a limited number of reports from five test sites.

Most of the studies used to prepare this report focused on flue gas measurements. Because of uncertainties about the consistency of solid and aqueous stream data, readers should exercise caution in extrapolating conclusions of the report to specific power plant applications. EPRI has also published *Multimedia Mercury Fate at Coal-Fired Power Plants Equipped With SCR and Wet FGD Controls* (1014095). For more information, contact Paul Chu, (650) 855-2812, pchu@epri.com.

LARK-TRIPP Users Group Workshop

The LARK-TRIPP Users Group Workshop will be meet March 3–4 in Charlotte, NC. The purpose of the workshop will be to train new and current users in the application of EPRI's Toxics Release Inventory (TRI) reporting software and to introduce new features of the software's RY2008 version. A special training session for new users will be offered on Tuesday morning, March 3. This session will focus on program basics and is targeted at users who have never prepared a facility file. For more information, contact Naomi Goodman, (650) 855-2193, ngoodman@epri.com.

WATER AND ECOSYSTEMS

Program 53: Water Quality Criteria Development and Assessment

Article Published on Mercury Deposition in Boreal Areas

Graydon, J.A., et al. "Long-Term Wet and Dry Deposition of Total and Methyl Mercury in the Remote Boreal Ecoregion of Canada," *Environ. Sci. Technol.*, 2008, 42 (22), pp. 8345–8351. This article is based on research cofunded by EPRI as part of the Mercury Experiment to Assess Atmospheric Loading in Canada and the United States (METAALICUS) study. Numerous studies have established the positive relationship between atmospheric loadings of inorganic mercury to watersheds and concentrations of methylmercury in fish, some of which have mercury content that exceeds the currently stated safe concentration for human consumption. Quantifying net wet and dry deposition of mercury to watersheds, however, is still challenging. This study quantified concentrations and loadings of total mercury and methylmercury in open-area wet deposition, throughfall (mercury through the tree canopy), and litterfall (leaves and pine needles) at the Experimental Lakes Area, a remote boreal ecoregion in northwest Ontario, Canada. The study showed that net mercury and methylmercury loadings in this study site were lower than in any other forested region previously studied. Litterfall represented the largest input of total mercury on an annual basis, and throughfall loadings were higher than loadings in the open. Mercury loadings also varied depending on the canopy: The highest levels were found under old growth spruce and firs; intermediate levels under wetland spruce, pine, alder, and young jack pine; and the lowest levels under deciduous maples. Measurements of dry deposition that took into account

photoreduction and emission of wet-deposited inorganic mercury from canopy foliage resulted in higher estimates than the “direct” method (a combination of throughfall, litterfall, and open loadings) used in other studies. The authors conclude that total mercury and methylmercury loading can be extremely variable in a forested area with numerous types of trees and that mercury photoreduction and emission from foliage should be considered when estimating dry deposition of mercury. This study, and others like it, assist regulators in understanding how increases or decreases in atmospheric mercury emissions will translate into increased or decreased bioavailability of mercury through the environment and food chain. For more information, contact John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com.

Technical Update Published on Upgrades to Dynamic Mercury Cycling Model

Dynamic Mercury Cycling Model Upgrade (1015568). This Technical Update describes the status of activities to upgrade the Dynamic Mercury Cycling Model (D-MCM), an EPRI simulation model that predicts mercury cycling and bioaccumulation in lakes. The D-MCM is recognized by the scientific community and regulators as a leading technical model for mercury cycling and bioaccumulation in lakes. The project team is working to improve and demonstrate the predictive capability of the D-MCM, given advances in the state of knowledge in the past six years and the broader range of datasets now available. Activities to date have included the assembly of data from the METAALICUS project, the Florida Everglades, flooded reservoir studies at the Experimental Lakes Area (ELARP, FLUDEX) in Ontario, and seven Wisconsin seepage lakes (the Mercury in Temperate Lakes study). Some of the data that will be used to improve the treatment of specific processes in D-MCM in this study are from rivers and estuaries. While the D-MCM is a lake model, study results also will serve as a building block for extending the model to simulate other ecosystem types. The current study will help EPRI maintain a leading technical position for the model. It will provide EPRI members with a stronger basis to evaluate the effects of mercury releases to the environment and to translate the EPA methylmercury fish tissue criterion to a water discharge permit. For more information, contact John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com.

Report Available on Arsenic Bioaccumulation and Speciation in Aquatic Organisms

Evaluation of U.S. Environmental Protection Agency's Arsenic Ambient Water Quality Criteria: Speciation and Bioaccumulation Issues (1015570). This Technical Update is an interim report on a project on arsenic bioaccumulation. It includes a summary of a literature review on arsenic bioaccumulation and speciation in aquatic organisms. It also describes a study plan for the second phase of the project, which will involve laboratory experiments designed to better define the relationship between arsenic bioaccumulation and the concentration of arsenic in the water and the form of arsenic species accumulated in these organisms. Key findings from the literature review include:

- Arsenic bioaccumulation potential declines up through the fresh- and saltwater aquatic food web, especially from trophic level 2 (primary consumers) to trophic levels 3 (primary forage fish species and predatory insects) and 4 (top predator fish species).
- Arsenic bioaccumulation potential decreases with increasing concentration of arsenic in ambient surface waters (fresh and salt) in a similar and predictable fashion for all trophic levels.
- Arsenic bioaccumulation factors (BAFs) are similar between fresh- and saltwater and between lotic (flowing) and lentic (still) freshwater ecosystems when water arsenic concentration ranges are similar. At any given trophic level, however, BAFs appear to be slightly higher in saltwater.
- Arsenic in whole body and soft (edible) tissues of upper trophic level (2, 3, and 4) organisms (particularly wild-caught) is present predominantly in the organic form—for example, as arsenobetaine (AsB).

These results and future laboratory experiments will be used to develop a more comprehensive understanding of the complex interactions of bioaccumulation and biotransformation of arsenic in freshwater and marine fish and shellfish used for human consumption. Such an understanding will assist EPA in setting science-based limits on arsenic in aquatic environments through the Total Maximum Daily Load (TMDL) and Ambient Water Quality Criteria (AWQC) programs. For more information, contact John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com.

Program 54: Fish Protection at Steam Electric Power Plants

Feb. 26–27 Workshop on BMPs for Preventing Cooling Water Intake Blockages

Blockage of cooling water intakes occurs frequently at nuclear and fossil power plants worldwide. A 2006 study by the World Association of Nuclear Operators (WANO) found that there have been 44 such events at nuclear plants since 2004. Because equipment and site maintenance at fossil-fueled electric power plants can be less rigorous than at nuclear plants, these problems could be more frequent and severe at coal- and oil-fired power plants. Through a supplemental project, EPRI is working with members to survey the industry and develop a best management practices (BMP) manual to provide procedural and O&M guidance, event analysis-prediction-management tools, and state-of-technology information. As part of this effort, EPRI has organized a two-day workshop to share information, review preliminary plans for the BMP technical resource manual, and identify future research needs. The workshop will be held on Feb. 26–27 in Crystal River, FL. The first day will be devoted to presentations of site visit results, case studies, and survey results. It will include discussions of successful and unsuccessful mitigation of various types of debris, and open discussions of other potential solutions. The second day will include presentations by vendors of technologies to address blockage, plus a tour of Progress Energy's Crystal River cooling water intakes. EPRI will compile a proceedings document (CD/DVD) for the workshop. The program is free to funders of Program 54; the price for others is \$500. Registration is available at the [event website](#). For more information, contact Kent Zammit, (805) 481-7349, kezammit@epri.com.

Report Published on Study of Fish Barrier Net Designs for Large Rivers

[Numeric and Physical Model Study of Fish Barrier Net Designs for Large Rivers](#) (1016808). This report documents development of a barrier net design applicable to cooling water intake structures (CWISs) located on rivers with moderate to high currents and debris loading. Three designs were selected for numeric modeling: a basic net design, a partial depth curtain wall, and a barrier net with a sheetpile deflector wall. The preferred option (a barrier net with the sheetpile deflector wall) was determined based on results of numeric modeling. The design was then evaluated in a physical model and tested using natural and synthetic debris. Results showed that, subject to field evaluation, a barrier net installation including a deflector and curtain wall could be effective in reducing impingement mortality. The ultimate efficacy would be determined by the mesh size of the net, the fish species composition in the vicinity of the CWIS, and the ability of the net to maintain its deployment integrity in large rivers. Results of this study provide the basis for a potentially successful engineering design and deployment of a barrier net located in high river currents and debris conditions. For more information, contact Doug Dixon, (804) 642-1025, ddixon@epri.com.

Program 55: Strategic Water Issues

2009 Deliverable Rankings Include Ongoing Work and New Issues

The Program 55 Program Steering Committee has selected and ranked twelve potential deliverables. The highest-ranked deliverable, Test of the Water Sustainability Framework, is a continuation of efforts begun in 2008; a report on the first year's work will be published in March. The second and third rankings went to emerging issues that were not part of the 2008 portfolio: implications of water resource changes and trends for power generation; and stormwater characterization, effluent limits, and treatment and reuse issues. EPRI's 2008 Technical Report [Management of Non-Cooling Water Releases](#) (1014023) addressed aspects of the latter issue. Both of these new research studies are planned as two-year efforts. The number of deliverables chosen for 2009 funding will depend on total funds received by the Program for 2009; those that cannot be funded this year will go into future-year portfolios or could be considered for supplemental funding. Program advisors will finalize the selection at the March advisory meetings. For more information, contact Robert Goldstein, (650) 855-2593, rogoldst@epri.com.

Program 56: Effluent Guidelines and Water Quality Management

Report Published on ZLD Water Management Installations at U.S. Power Plants

[Summary of Zero Liquid Discharge \(ZLD\) Water Management Installations at U.S. Power Plants](#) (1015592). This Technical Update presents an inventory of ZLD water management systems currently operating at U.S. power generating stations. A total of 146 ZLD operations were identified, and 49 stations were contacted and their operating staff interviewed to obtain their perspectives. The report discusses the various treatment methods used at these ZLD facilities along with each method's advantages and limitations. The main ZLD

technologies are brine concentrators, conventional and specialized reverse osmosis systems, evaporation ponds, staged cooling towers, and dry cooling towers. Some ZLD operations consist of feeding plant wastewater to the plant's flue gas desulfurization (FGD) operations, discharging to the sewer, land applications, or deep-well injection. No significant correlations were found between power plant fuel type (gas or coal) and the ZLD technology in use. The ZLD inventory developed in this project, while not comprehensive, will allow power industry members to find working systems for reference and to contact the operating staff. More importantly, the report will facilitate sharing of design and hands-on operating experience. For more information, contact Paul Chu, (650) 855-2812, pchu@epri.com.

Study of Vertical Flow Wetlands for Removal of Mercury and Selenium From FGD Discharges

Vertical Flow Wetland Pilot Study (1016811). This Technical Report presents preliminary results of a study conducted by Duke Energy to test the potential effectiveness of vertical flow wetlands (VFWs) for the removal of selenium, mercury, and other related compounds from a flue gas desulfurization (FGD) discharge. These compounds commonly are found in and regulated for coal-fired utility water discharges. The main challenge of this work was identifying an organic substrate source for this site that would replicate the successes of other utility VFW treatment projects. Preliminary findings are that VFWs are very effective for removal of mercury, selenium, and related parameters from FGD wastewater. The final report for this study is expected to present this developing technology as an alternative to the current approaches and related costs of treatment for selenium and mercury at utility sites. VFWs, especially with future research on use of local by-products for organic substrates, should be applicable to many utility sites worldwide. For more information, contact John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com.

Program 58: Hydropower Environmental Issues

Dixon Will Serve on Steering Committee for HydroVision 2010

Doug Dixon has accepted an invitation to join the steering committee for the HydroVision 2010 conference, to be held in Charlotte, NC, in July 2010. The biannual conference brings together professionals in the field of water power from around the world to share experiences and expertise, consider emerging ideas and opportunities, and compare best practices and successful strategies. For more information, contact Doug Dixon, (804) 642-1025, ddixon@epri.com.

T&D ENVIRONMENTAL ISSUES

Program 51: T&D Facilities & Equipment: Environmental Issues

Technical Update Discusses Management of Treated Wood Poles Outside the United States

Treated Wood Pole Management: Foreign Practices (1015562). This Technical Update is the first known attempt to formally characterize similarities and differences in international wood pole and wood pole preservative management. In 2007, the EPRI Poles Working Group requested that EPRI gather information about foreign practices with utility structures and wood preservatives. The information was requested to provide perspective on a global basis and evaluate whether foreign practices might illuminate additional alternatives for reducing the footprint of distribution and transmission systems. The report describes available information on wood pole species, alternative materials, preservative treatments, regulations, and practices in the United States, Canada, Mexico, Central and South America, the European Union, Japan, China, Russia, India, Australia, New Zealand, Malaysia, and the Philippines. Most information is based on interviews and on website and published literature searches. Additional research will clarify regulatory positions in other countries and generate improved understanding, which will support strategic planning for U.S. utilities. For more information, contact Mary McLearn, (650) 855-2487, mmclearn@epri.com.

Program 57: ROW: Siting, Vegetation Management, and Avian Issues

Underground and Overhead Lines: Environmental Impacts of Construction and Maintenance

Assessment of Environmental Effects of Current Underground and Overhead Transmission Line Construction and Maintenance in the United States (1015597). This Technical Report provides a comparative summary of environmental impacts associated with construction and maintenance of overhead and underground transmission lines. It is designed to guide companies through a consideration of key environmental factors in

making decisions about new transmission line construction. The report assesses both beneficial and detrimental environmental impacts associated with standard construction and maintenance methods used in the U.S. utility industry. These include impacts on land use, biology, geology and soil, water, and cultural and visual resources. Of 34 potential environmental impacts of line construction and maintenance identified by the project team, 11 experienced similar detrimental effects from both underground and overhead lines, while 18 had more-detrimental and 5 had less-detrimental effects from underground lines than from overhead lines. The authors note that this assessment of potential environmental impacts can serve as a general guide, but site-specific evaluation of proposed transmission construction projects is essential and should include consideration of practical techniques to mitigate detrimental effects. For more information, contact John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com.

Wetland and Conservation Banking in Transmission ROWs

Two complementary Technical Reports discuss possibilities for establishing wetland mitigation banks and wildlife conservation banks in transmission corridor rights-of-way (ROWs). Regulators expect reliance on both types of banking to increase as development activities encroach on aquatic resources and wildlife habitats.

Wetland and Conservation Banking in Transmission Corridor Rights-of-Way: Policy and Opportunities (1014033). This report investigates whether establishing wetland mitigation banks and wildlife conservation banks in transmission corridor ROWs is a realistic prospect. Federal and state agencies have recently defined instruments used to establish wetland mitigation and wildlife conservation banks and have specified procedures for reviewing and approving the banks. In these banking operations, legally defined “credits” for conservation activities in one location can be used to offset adverse impacts on aquatic resources or wildlife habitat in other locations. The credits are earned for conservation activities performed in areas defined as wetland mitigation banks or habitat conservation banks. If such banks were established in transmission corridor ROWs, line owners could use banked credits to offset permitted impacts of their own operations, or they could sell the credits to others. Since ROWs include a variety of aquatic resources and habitats under active management, they may provide attractive locations for wetland and conservation banks. Establishing these banks could be particularly useful in urban settings where open land available for mitigation activities is severely limited. This report examines factors that may be of particular concern to ROW owners and managers in establishing wetland and conservation banks, including long-term protection of the site, consistency with electric transmission ROW operations, and cooperation with owners of underlying and adjacent land.

Wetland and Conservation Banking in Transmission Corridor Rights-of-Way: Feasibility Assessment (1015598). This report explores the feasibility of establishing wetland mitigation and wildlife conservation banks in transmission corridor ROWs. Readers will learn which factors to consider in deciding whether to pursue or allow banking on ROW land and what agreement conditions to include in banking instruments, easements, and permits. Although there is virtually no experience with wetland and conservation banking on ROW lands, current ROW conservation activities suggest that banking and ROW management can be undertaken as complementary endeavors. Authors of the report suggest that:

- ***Wetland mitigation banking deserves consideration*** when the ROW operator or utility needs or anticipates the need for mitigation credits for impacts to aquatic resources by any part of the power generation or transmission system, and sufficient aquatic resources exist within the ROW to meet or exceed these requirements.
- ***Conservation banking deserves consideration*** when the electric transmission corridor operator or utility needs to satisfy its own Habitat Conservation Plan (HCP) needs and has the opportunity to do additional conservation, or is in an area for which a regional HCP is being or has been prepared.
- ***Both wetland and conservation banking deserve consideration*** when a landowner or land trust identifies lands in and around the ROW that are suitable for banking and is interested in undertaking the procedural steps to obtain approval of the bank, as well as taking responsibility for the restoration, management, and long-term protection of the site.

ROW owners may benefit from partnerships with other organizations that have experience in establishing wetland and/or conservation banks. For more information, contact John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com.

Program 60: EMF Health Assessment and RF Safety

[Visit the EMF Health Assessment and RF Safety Public Webpage](#)

Technical Update Reviews Evidence for Link Between Night-Shift Work and Cancer

Shift Work: A Probable Carcinogen (1016818) In 2007 the International Agency for Research on Cancer (IARC) classified shift work as a probable (Group 2A) carcinogen on the basis of limited evidence in humans for the carcinogenicity of night-shift work and sufficient evidence in experimental animals for the carcinogenicity of light at night. The IARC classification was the outcome of an expert working group's assessment of the scientific evidence. The majority of epidemiologic studies reviewed found a modestly increased risk of breast cancer among long-term night-shift workers, compared with day workers. This evidence was supported by experimental studies reporting increased tumor incidence in rodents subjected to light at night, which disrupts circadian rhythms by deregulating circadian genes involved in tumor suppression and by inhibiting nocturnal melatonin secretion. Some studies in the 1980s and 1990s compared EMF to light at night in relation to cancer risk on the basis of some experimental evidence suggesting that EMF might alter melatonin levels, but a melatonin-suppressing effect of EMF was not validated. This Technical Update discusses these studies in the context of a summary of key experimental and epidemiologic studies that led to the IARC classification. For more information, contact Rob Kavet, (650) 855-1061, rkavet@epri.com.

DVD Tutorial Shows How to Measure Electric and Magnetic Fields

EMF Measurement Video Tutorial (1018334). This DVD tutorial is a training tool designed to increase the accuracy and effectiveness of EMF measurements performed by personnel at electric power companies and at environmental and scientific organizations. The 82-minute tutorial offers presentations that

- explain the basic physical characteristics of power frequency electric and magnetic fields,
- review the selection of measuring equipment that is designed for this frequency bandwidth and meets recognized instrumentation standards,
- describe measurement methods that accurately and efficiently characterize the EMF environment,
- discuss sources of measurement error, and
- provide a context for interpreting measurement results.

Students of this video tutorial will avoid *ad hoc* measurement practices and poor-quality or nonstandard instruments whose use complicates identification and characterization of EMF sources. For more information, contact Rob Kavet, (650) 855-1061, rkavet@epri.com.

Study Investigates Possible Interaction Between DNA Repair Genes and EMF Exposure in Childhood Acute Leukemia

Yang Y, et al. "Case-only study of interactions between DNA repair genes (*hMLH1*, *APEX1*, *MGMT*, *XRCC1* and *XPD*) and low-frequency electromagnetic fields in childhood acute leukemia," *Leukemia and Lymphoma*, 2008; 49: 2344–2350. Chinese investigators report that a particular variant of a DNA repair gene, *XRCC1*, is found more frequently among children with acute leukemia (AL) living near power lines or transformers than in similarly ill children living farther away from these EMF sources. Four other DNA repair genes failed to show this effect. Investigators studied 123 Shanghai children with AL (cases) whose mothers estimated their residential distances from power lines and transformers. The authors conclude, "Our gene and environment combined analyses suggest that a significant interaction, which could potentially increase the risk of childhood AL, exists between the *XRCC1* Ex9+16A and the proximity of electric transformers and power lines."

EPRI notes that this is the first study of its type and that studies of potential effects of genetic variants on cancer risk often suffer from lack of replication. Also, exposure assessment in the study was severely limited, since self-reports are subject to serious inaccuracies and no distinction was made between transformers (whose fields decrease as the inverse cube of distance and become negligible at 50–100 meters) and power lines (whose fields decrease as the inverse square of distance and become negligible at 150 meters). Yang et al. claim that "Residence near electric transformers and power lines, at distances of approximately 100 meters, and magnetic fields less than 0.14 μ T may be considered a risk factor for the development of AL in children

with *XRCC1* Ex9+16A genotypes.” There is no biophysical mechanism to account for carcinogenic effects at such low exposures, and the claim does not agree with available evidence that the association of magnetic fields with leukemia does not reach significance until exposure levels reach 0.3 to 0.4 μ T. An [abstract](#) of the article is available at the journal website. For more information, contact Rob Kavet, (650) 855-1061, rkavet@epri.com.

EPRI Comments on a Study of Residence Near Power Lines and Mortality From Neurodegenerative Diseases

Huss A., et al. for the Swiss National Cohort Study. “Residence near power lines and mortality from neurodegenerative diseases: Longitudinal study of the Swiss population,” *American Journal of Epidemiology*, 15 January 2009; 169: 167–175. For this first epidemiologic study of residential proximity to power lines and mortality from neurodegenerative diseases, Huss et al. selected 4.7 million participants from the Swiss National Cohort Study, which covers the entire Swiss population. National census records linked to death records for 2000–2005 were used to determine mortality, and federal geodata were used to determine distances from residences to 230–380-kV power lines. Researchers reported a slight increase in the risk of Alzheimer disease (AD) mortality for people who lived within 50 meters of power lines, compared with those who lived more than 600 meters away. Risk increases were higher and statistically significant for people who lived within 50 meters of the lines for at least 10 or 15 years, with a twofold risk increase for 15 years. The pattern was similar for senile dementia, but associations were weaker. There was little evidence of risk increases for Parkinson disease, multiple sclerosis (MS), or amyotrophic lateral sclerosis (ALS). The investigators concluded that their results support the hypothesis that magnetic field exposure plays a role in the development of AD and senile dementia but not other neurodegenerative diseases. However, owing to the lack of a known biologic mechanism, they advised cautious interpretation of the results. They also noted that if the results are real, the public health impact appears limited since only 0.2% of study participants who died of AD or senile dementia lived within 50 meters of 220–380-kV lines.

The main strengths of this study are its large size, its inclusion of large numbers of cases (9228 deaths from AD), its cohort design, and appropriate analyses. The main limitations of the study are its reliance on death certificates, which underestimate AD and other dementia cases, and its exposure assessment method: distance from power lines provides limited information on actual exposure to electric and magnetic fields (EMF). This study should be considered in the context of a body of literature on occupational exposure to power-frequency EMF and neurodegenerative diseases. Although some studies reported an increased risk of AD with occupational exposure, inconsistencies and heterogeneities among study results and the lack of a known biologic mechanism leave the evidence far from conclusive. Further study of EMF exposure and AD is warranted. An [abstract](#) of the article is available at the journal website; EPRI comments ([1018449](#)) are available on epri.com. For more information, contact Gabor Mezei, (650) 855-8908, gmezei@epri.com.

OCCUPATIONAL HEALTH AND SAFETY

Program 62: Occupational Health and Safety

Ergonomic Handbook for Fossil-Fueled Generating Station Plant Operators and Mechanics Published
EPRI Ergonomics Handbook for the Electric Power Industry: Ergonomic Interventions for Plant Operators and Mechanics in Fossil-Fueled Generating Stations (1015631). This sixth EPRI ergonomics handbook focuses on tasks performed by plant operators and mechanics working in fossil-fueled generating stations. These tasks are physically strenuous and can expose workers to musculoskeletal disorders (MSDs), such as carpal tunnel syndrome, low back pain, or shoulder tendonitis. The research group assembled an ergonomics team at the host utility to evaluate common tasks performed by plant operators and mechanics and to generate modifications to these tasks to reduce MSD risk factors. The ergonomics team included plant and steam services operators, mechanics, supervisors, and safety personnel. The team conducted field evaluations and quantitative laboratory tests of 16 separate tasks with medium to high levels of MSD risk. The report presents a business case for one example, the use of low-rolling-resistance wheels on carts and other pieces of equipment to decrease force exerted while pushing. Six of the 16 ergonomic interventions they recommended can be implemented for less than \$500 each.. Implementation of the recommended interventions can help utilities improve occupational health of plant operators and mechanics, reduce workers' compensation costs,

and enhance the quality of work and job satisfaction of plant operators and mechanics. For more information, contact Gabor Mezei, (650) 855-8908, gmezei@epri.com.

Ninth Annual Occupational Health and Safety Report Available

Occupational Health and Safety Annual Report 2008 (1015630). This Technical Report presents illness and injury trends for electrical industry workers based on data collected for EPRI's Occupational Health and Safety Database (OHSD) program. The OHSD currently integrates personnel, injury, and claims data for 13 years (1995–2007) from 17 companies into a single data system; additional historical data were added this year. These injury data are summarized by company, occupation, work location, injury type, demographic factor (age and sex), injury source, and other factors. This year, four additional special injury topics are described: 1) analyses of injury occurrence by different days of the week and time of the year, 2) trends in vehicle accident-related injuries, 3) injuries occurring among welders, and 4) injuries occurring at generation stations. Occupational health and safety staff at participating electric companies can use the information and analyses provided by the OHSD program to monitor and control health care costs, improve health and safety programs, reduce occupational illness and injury rates, and identify health and safety research needs. For more information, contact Gabor Mezei, (650) 855-8908, gmezei@epri.com.

Environment Supplemental Projects

Environment Sector

- [Energy Sustainability Interest Group](#)

Air Quality

Program 42: Air Toxics Health and Risk Assessment

- [Screening Risk Assessments of Utility HAPs Emissions](#)
- [Environmental Assessment of Air Regulatory Scenarios](#)
- [Measurement of Mercury Chemistry in Power Plant Plumes: An Intensive Field Study](#)
- [Health Research to Inform the Revision of the Arsenic Cancer Potency Factor](#)

Program 91: Assessment Tools for Ozone, Particulate Matter, and Haze

- [Environmental Assessment of Air Regulatory Scenarios](#)
- [Non-Road Mobile Source Emissions Inventory Improvements](#)
- [Secondary Particulate Health Effects Research \(SPHERES\)](#)
- [Regional PM Characterization to Enable Source-Receptor Modeling: Data Collection](#)

Program 92: Assessment of Air Quality Impacts on Health and the Environment

- [Pittsburgh ARIES: Identification of Air Pollution Components Associated with Health Responses in Pittsburgh](#)
- [Secondary Particulate Health Effects Research \(SPHERES\)](#)
- [Children's Air Pollution Asthma Study: Part of the ARIES Program](#)
- [Health Effects of Air Pollution and Particulate Matter Components: Texas ARIES](#)

Global Climate Change

Program 102: Global Climate Policy Costs and Benefits

- [Enhanced Assessment of Costs and Benefits of Climate Policy Proposals](#)
- [Climate Science: Synthesis and Future Work](#)
- [Developing GHG Emissions Offsets by Reducing Nitrous Oxide \(N₂O\) Emissions in Agricultural Crop Production](#)

Program 103: Greenhouse Gas Reduction Options

- [Enhanced Assessment of Costs and Benefits of Climate Policy Proposals](#)
- [Creating Greenhouse Gas Emission Offsets from Avoided Deforestation in the Amazon's Xingu River Basin](#)
- [Corporate Climate Change Policy Risk Assessment](#)

- Greenhouse Gas Risk Assessment
- Developing GHG Emissions Offsets by Reducing Nitrous Oxide (N₂O) Emissions in Agricultural Crop Production

Land and Groundwater Issues

Program 49: Coal Combustion Products—Environmental Issues

- Beneficial Use of Coal Fly Ash for Road Base Fill: Environmental Monitoring
- MANAGES Forum – Support for Compliance Managers: Groundwater Monitoring, Data Management, and Site Management
- Agricultural Uses of Gypsum and Other Products from Flue Gas Desulphurization (FGD) Systems

Program 50: MGP Site Management

- Surfactant Enhanced In-Situ Chemical Oxidation Treatment of MGP Contaminants
- Soil Hydrocarbon Exposure Protocol

Program 59: PISCES—Plant Multimedia Toxics Characterization

- LARK-TRIPP User's Group 2009
- Mercury Characterization and Control Interest Group (MerCCIG)

Water and Ecosystems

Program 53: Water Quality Criteria Development and Assessment

- Site-Specific Water Quality Criteria for Selenium: Development of Implementation Analysis Protocol
- Health Research to Inform the Revision of the Arsenic Cancer Potency Factor

Program 54: Fish Protection at Steam Electric Power Plants

- Best Management Practices for Preventing Cooling Water Intake Blockage

Program 55: Strategic Water Issues

- Advanced Water-Conserving Cooling Technologies Development and Demonstration
- Assessing the Impact of Climate Change on Water Availability for Power Generation
- Western Region Research Consortium on Energy/Water Sustainability
- Watershed Management for TMDLs, Water Quality Trading, and Hydro Relicensing
- Water Demands and Availability for Power Generation

Program 56: Effluent Guidelines and Water Quality Management

- Water Utilization in Cooling Systems: Recycling, Re-use, and Dry Cooling
- Biogeochemical Management of Ash Pond Sediments

Program 58: Hydropower Environmental Issues

- 'Fish-Friendly' Hydropower Turbine Development and Deployment: Phase II

T&D Environmental Issues

Program 51: T&D Facilities & Equipment: Environmental Issues

- Environmental and Human Health Risk Management for Aging Infrastructure
- *In Situ* Fixation and Sequestration of Metallic Contaminants
- Bioavailability of Arsenic in Contaminated Soils
- Remanufacturing Out-of-Service Treated Wood Poles

Program 57: ROW: Siting, Vegetation Management, and Avian Issues

- Collaborative, Long-Term Vegetation Management Field Studies on Power Line Corridors in North America
- Assessing Performance of Integrated Vegetation Management on Electric Transmission Rights-of-Way

Program 60: EMF Health Assessment and RF Safety

- Currently no supplemental projects

Occupational Health and Safety

Program 62: Occupational Health and Safety

- Design of Electric Industry Substations for Enhanced Ergonomics and Worker Safety
- Fleet Vehicle Ergonomics for Operators and Mechanics
- Ergonomics of Vegetation Management Tasks
- Occupational Health and Safety Trends Database: Customized Analysis

Upcoming Events

Environment Sector

* denotes EPRI sponsored or cosponsored event

*** Environment Sector and Area Council Advisory Meetings**

Mar. 16–19, San Diego, CA. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

*** Environment Sector and Area Council Advisory Meetings**

Oct. 5–8, Boulder, CO. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

Air Quality

* denotes EPRI sponsored or cosponsored event

Annual EPRI/UARG Air Toxics Research Coordination Meeting

May 6–8, Palo Alto, CA. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com.

9th International Conference on Mercury as a Global Pollutant

June 7–12, Guiyang, China. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com. More information is available at the [event website](#).

Air Quality VII Conference

Oct. 25–29, Arlington, VA. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com.

Global Climate Change

* denotes EPRI sponsored or cosponsored event

*** 14th Annual EPRI Global Climate Change Research Seminar**

May 20–21, Washington, DC. Contact: Ana Montes, (650) 855-2165, amontes@epri.com.

Land and Groundwater Issues

* denotes EPRI sponsored or cosponsored event

*** LARK-TRIPP Users Group Workshop**

Mar. 3–4, Charlotte, NC. Contact: Naomi Goodman, (650) 855-2193, ngoodman@epri.com.

*** AEHS Soils, Sediments, and Water Conference**

Mar. 9–12, San Diego, CA. Contact: Jim Lingle, (414) 355-5559, jlingle@epri.com. More information is available at the [event website](#).

*** *World of Coal Ash***

May 4–7, Lexington, KY. Contact: Ken Ladwig, (262) 754-2744, keladwig@epri.com. More information is available at the [event website](#).

Annual EPRI/UARG Air Toxics Research Coordination Meeting

May 6–8, Palo Alto, CA. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com.

9th International Conference on Mercury as a Global Pollutant

June 7–12, Guiyang, China. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com. More information is available at the [event website](#).

*** *MGP Mid-Year Meeting***

June 25–26, Chicago, IL. Contact: Jeff Clock, (845) 608-0642, jclock@epri.com, or Jim Lingle, (414) 355-5559, jlingle@epri.com.

Air Quality VII Conference

Oct. 25–29, Arlington, VA. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com.

*** *EPRI MGP 2010 Symposium***

Jan. 27–29, 2010, San Antonio, TX. Contact: Jeff Clock, (845) 608-0642, jclock@epri.com, or Jim Lingle, (414) 355-5559, jlingle@epri.com. More information is available at the [event website](#).

Water and Ecosystems

* denotes EPRI sponsored or cosponsored event

*** *Advanced Water-Conserving Cooling Technologies Development and Demonstration Program Advisory Committee Meeting***

Feb. 17, Dallas, TX. Contact: Kent Zammit, (805) 481-7349, kezammit@epri.com. The purpose of this advisory committee meeting will be to discuss the various research proposals for the Advanced Cooling Technology (ACT) Program and provide input to EPRI in setting priorities for the coming year.

*** *Workshop on Best Management Practices for Preventing Cooling Water Intake Blockages***

Feb. 26–27, Crystal River, FL. Contact: Kent Zammit, (805) 481-7349, kezammit@epri.com. More information and registration are available at the [event website](#).

*** *Second Forum on Energy & Water Sustainability: Increasing Resource Productivity***

Apr. 10, Goleta, CA. Contact: Robert Goldstein, (650) 855-2593, rogoldst@epri.com. More information is available at the [event website](#).

9th International Conference on Mercury as a Global Pollutant

June 7–12, Guiyang, China. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com. More information is available at the [event website](#).

T&D Environmental Issues

* denotes EPRI sponsored or cosponsored event

29th International Congress on Occupational Health

Mar. 22–27, Cape Town, South Africa. Contact: Gabor Mezei, (650) 855-8908, gmezei@epri.com. The congress will include a special session on EMF. More information is available at the [event website](#).

The Bioelectromagnetics Society 31st Annual Meeting

June 14–19, Davos, Switzerland. Contact: Rob Kavet, (650) 855-1061, rkavet@epri.com. More information is available at the [event website](#).

*** *Mid-Year Joint Meeting of P51 (Transmission & Distribution) and P57 (Rights-of-Way)***

July 8–9, Charlotte, NC. Contact: Babu Nott, (650) 855-7946, bnott@epri.com. More information is available at the [event website](#).

*** *2009 EMF Scientific Advisory Committee Meeting*** July 20–21, Milwaukee, WI. Contact: Rob Kavet, (650) 855-1061, rkavet@epri.com.

Ninth International Symposium on Environmental Concerns in Rights-of-Way Management

Sept. 27–Oct. 1, Portland, OR. Contact: John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com. More information and a call for papers are available at the [event website](#).

Occupational Health & Safety

* denotes EPRI sponsored or cosponsored event

29th International Congress on Occupational Health

Mar. 22–27, Cape Town, South Africa. Contact: Gabor Mezei, (650) 855-8908, gmezei@epri.com. More information is available at the [event website](#).

Together...Shaping the Future of Electricity®

Electric Power Research Institute

3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

© 2009 Electric Power Research Institute (EPRI), Inc. All rights reserved. Electric Power Research Institute, EPRI, and TOGETHER...SHAPING THE FUTURE OF ELECTRICITY are registered service marks of the Electric Power Research Institute, Inc.