

Environment Quick News



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Dear Environment Sector members:

The year 2008 has started with a bang. As you all know, I have been appointed as Vice President of the newly consolidated Environment and Generation Sector. We believe that this action will create new opportunities for cross-sector activities, leading to new and innovative solutions for fossil-based generation and environmental protection. More details of the consolidation will be announced over the coming months as we search for opportunities to improve operational efficiency and provide value to our members.

Within the Environment portion of the new sector, we have made some additional organizational changes effective March 1. Tom Wilson will assume the role of Senior Program Manager for Climate, and Kent Zammit will assume a similar role in charge of the Water programs. This will allow greater focus and direction in these two key strategic issues. The change will allow Naresh Kumar and Babu Nott to focus more on the Air and Land/Groundwater areas, which are also critical areas of research for you and our broad stakeholder community. Naresh will also be helping us with the transition issues in the consolidation of the sectors, and Babu will work with the joint sector team on growing our research program in carbon storage.

We are excited about the new opportunities brought about by the consolidation and the changes in roles for some of the staff. We have a strong team that will only get better as we implement the merger. We look forward to your input into the process and working with you in these new capacities.

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Program 42: Air Toxics Health and Risk Assessment

Expanded Model Predicts Wet Deposition of Both Sulfate and Mercury

Vijayaraghavan, K., et al. "Development and application of a multi-pollutant model for atmospheric mercury deposition," *Journal of Applied Meteorology and Climatology*, 46 (2007) 1341–1353 (E224120). This research adds comprehensive treatment of mercury processes to a multi-pollutant model (CMAQ-MADRID), which is then used to simulate atmospheric deposition of sulfate and mercury across the United States. For a 1996 simulation using the expanded model, the correlation coefficient relating model prediction to actual sulfate wet deposition was 0.91 and the correlation coefficient relating model prediction to actual mercury wet deposition was 0.41. The expanded model adequately reproduces the spatial pattern of sulfate wet deposition, showing a gradient of increasing deposition from the upper Midwest to the Northeast—upwind to downwind of large sulfur dioxide sources in the Ohio River Valley. However, the model tends to overestimate northeastern mercury wet deposition downwind of Ohio River Valley sources that also emit significant amounts of mercury. This so-called "Pennsylvania anomaly" may be due to partial misrepresentation of the mercury reduction–oxidation cycle in the model, or to other factors. CMAQ-MADRID combines the Community Multiscale Air Quality model with the Model of Aerosol Dynamics, Reactions, Ionization, and Dissolution. For more information, contact Leonard Levin, (650) 855-7929, llevin@epri.com.

Technical Update Compares Mercury Deposition Under Federal and State Regulatory Scenarios

[U.S. Mercury Deposition Under Alternative Regulatory Scenarios](#) (1014059). This technical update shows how U.S. mercury deposition patterns will change if regulated power plants all follow the Federal Clean Air Interstate Rule/Clean Air Mercury Rule (CAIR/CAMR), or if some follow stricter rules imposed by individual states. Both scenarios are viewed in relation to the limiting case in which all U.S. power plant mercury emissions are zeroed out. For a 2004 base case, modeling shows that about 0.4% of the continental United States receives deposition with half or more of its mercury originating at domestic power plants. For these locations, full implementation of the federal regulations by 2020 would cause a significant decrease in U.S. mercury deposition. Applying stricter controls mandated by individual states would bring about little further drop in deposition because these controls would remove mostly elemental mercury that enters the global cycle instead of depositing locally. Furthermore, state-sponsored rules discourage the installation of the strictest mercury controls by eliminating economic incentives provided by emissions trading. Thus, modeling shows that implementation of stricter state rules may actually result in slightly higher mercury deposition in some instances than implementation of federal rules. For more information, contact Leonard Levin, (650) 855-7929, llevin@epri.com.

Soils May Be Sources or Sinks for Atmospheric Elemental Mercury

Xin, M. and Gustin, M.S. "Gaseous elemental mercury exchange with low mercury containing soils: Investigation of controlling factors," *Applied Geochemistry*, 22 (2007) 1451–1466 (E224122). Soils with natural background mercury concentrations (less than 0.1 microgram per gram) may be a source or sink for atmospheric elemental mercury. This paper describes controlled laboratory studies in which researchers measured elemental mercury exchange between air and dry soil. They identified factors influencing air–soil exchange for pure soil constituents (particles) and natural soil samples. Mineralogical composition determined whether particles would release or adsorb elemental mercury. For 26 of 35 natural soils, air–soil exchange increased as air elemental mercury concentration increased, and air–soil exchange was typically higher in the light than in the dark. The influence of factors affecting air–soil exchange—such as soil mercury concentrations, light/dark, pH, and organic matter—depended on elemental mercury concentrations in the air. For more information, contact Leonard Levin, (650) 855-7929, llevin@epri.com.

EPRI Reviews Studies of Methylmercury Exposure and Cardiovascular Disease

["Current Scientific Evidence on the Relationship Between Methylmercury Exposure and Cardiovascular Diseases"](#) (1016246). This *issue brief* summarizes EPRI's review of the 17 epidemiologic studies available to date and concludes that there is not enough evidence to support the hypothesis that risk of cardiovascular disease (CVD) increases with exposure to methylmercury at levels observed in the U.S. population. In these studies, populations exhibiting a positive association between methylmercury exposure through fish

consumption and CVD ate more fish and had considerably higher methylmercury levels than people living in the United States. They also had lifestyles and other related health risk factors for CVD that were atypical of the U.S. population. However—since heart attacks are the leading cause of death in the United States—it will be important to conduct well-designed studies that can assess the balance between potential adverse effects of methylmercury exposure and beneficial effects of eating fish rich in omega-3 fatty acids that protect against CVD. To accomplish this, EPRI proposes a prospective, case-control study of adequate statistical power with controls for confounding and bias. For more information, contact Arnout Ter Schure, (650) 855-2753, aterschu@epri.com.

Latest Nutrition Data Used to Estimate Methylmercury Exposure in U.S. Women of Childbearing Age

Allen, B.C., et al. “Use of Markov Chain Monte Carlo analysis with a physiologically-based pharmacokinetic model of methylmercury to estimate exposures to U.S. women of childbearing age,” *Risk Analysis*, 2007, 27, 947–959. This paper reports that less than 1% of U.S. women of childbearing age have mercury exposures greater than the EPA reference dose (safe intake level) of methylmercury. Researchers reached this conclusion by using Markov Chain Monte Carlo analysis to evaluate the variability of methylmercury exposure in this population. Variability was estimated from the most recent data released by the National Health and Nutrition Survey (NHANES) on blood and hair mercury concentrations in U.S. women 16–49 years old, combined with EPRI’s physiologically based pharmacokinetic model of methylmercury distribution and clearance in the body. The analysis showed that typical exposures may be greater than previously estimated from food consumption surveys such as NHANES, but the variability in exposure may be less than previously assumed. For more information, contact Sharan Campleman, (650) 855-2331, scampleman@epri.com.

After Accounting for Systematic Errors, Faroe and Seychelles Neurodevelopmental Test Scores Overlap

Goodman, M., et al. “Estimating uncertainty in observational studies of associations between continuous variables: example of methylmercury and neuropsychological testing in children,” *Epidemiologic Perspectives & Innovations*, 2007, 4, 9–13. The Faroe Islands Study concluded that low-level prenatal methylmercury exposure significantly lowers children’s scores on the Boston Naming Test (BNT), while the Seychelles Child Development Study fails to find this effect. The BNT asks children to name objects shown in black-and-white line drawings, and performance on the test has been linked to language comprehension in reading and writing. Sensitivity analyses reported in this paper show that systematic errors related to confounding, selection bias, and information bias can move BNT scores either up or down, causing results of the two studies to overlap. Thus, it is impossible to draw definitive conclusions about the presence or absence of neurodevelopmental effects due to prenatal methylmercury exposure at levels reported in these studies. For more information, contact Sharan Campleman, (650) 855-2331, scampleman@epri.com.

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

“[Power Plants and Ozone](#)” (1016247). This *fact sheet* presents basic information on the relationship of power plants and other sources of pollutants to ozone formation. It discusses the basics of formation of ground-level ozone (smog) from the reaction of volatile organic compounds (VOCs) with nitrogen oxides (NOx); sources of VOCs; sources of NOx, including power plants; difficulties in attributing atmospheric ozone formation to specific sources; development of models of atmospheric ozone formation and transport; current regulations related to ozone, including national ambient air quality standards (NAAQS), the Clean Air Interstate Rule (CAIR), and state implementation plans (SIPs); current knowledge about human health effects of ground-level ozone; and EPA’s proposed new NAAQS. This *fact sheet* will be useful for utilities needing to provide basic information on ozone formation to customers, regulators, and others.

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

Updated Summary of EPRI Research on Impacts of PM on Human Health

[Impacts of Particulate Matter on Human Health: An Updated Summary of EPRI Research](#) (1016262). This technical update first provides an historical context for PM and its regulation, then describes in detail EPRI’s PM/Health Research Program. Following discussions of EPRI’s epidemiological, toxicological, exposure assessment, and integrative studies, the report discusses and draws conclusions about the consistency of EPRI results with the scientific literature, whether results observed in chronic studies can be related to those reported in acute studies, and ways to tie the epidemiology and toxicology communities more closely together.

Recommendations for future EPRI research conclude the document. The scientific community has made significant progress in advancing knowledge of the effects of air pollution, including PM, on health, and EPRI-supported research has played a major role. Although much effort has been expended to better understand the PM-health relationship, significant knowledge gaps remain, in particular the degree to which specific PM components or properties contribute to health outcomes. Over the next 5 years, EPRI's continuing research activities in epidemiology, toxicology, exposure assessment, and integrated studies will help fill in those gaps. For more information, contact Ron Wyzga, (650) 855-2577, rwyzga@epri.com, or Annette Rohr, (650) 855-2765, arohr@epri.com.

Research Begins on the Health Effects of PM From Tire Wear

EPRI Manager Annette Rohr has received EPRI Technology Innovation (TI) funding to begin work on a toxicology project focused on tire debris. Limited epidemiological and toxicological data suggest that this material may be important from a health standpoint. The data include some unpublished findings from ARIES research, which show an association between coarse-particle zinc—a marker for tire wear—and urgent care visits for childhood asthma. This TI-funded research will be conducted by researchers at the University of Milan, Italy, who have experience with the generation and toxicity testing of tire debris and have previously published *in vitro* toxicology papers on this material. The research will involve *in vivo* testing in laboratory mice and will include evaluation of multiple biological endpoints, including acute toxicity, inflammation, macrophage function, and oxidative stress. Results are expected by the end of 2008. For more information, contact Annette Rohr, (650) 855-2765, arohr@epri.com.

GLOBAL CLIMATE CHANGE

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Program 102: Global Climate Policy Costs and Benefits

EPRI Reports Published on Integrated Approach to Economic Analysis of California Climate Initiatives

Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach, Volume 2: Full Report (1014862) and *Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach, Volume 3: Modeler's Appendices* (1014863) are now available. The State of California has set ambitious climate policy goals to reduce greenhouse gas (GHG) emissions by 80% by 2050. This three-volume study, the first of its kind, used a comprehensive model of the state's economy and the U.S. electricity market and power grid to measure the potential gains or losses to the state's economic welfare under a range of implementation options. Volume 1 is a summary for policymakers and contains a high-level discussion of the current California policy milieu and the major findings of the analysis. Volume 2 is a full report of the work and its results. Volume 3 contains two appendices describing the modeling framework used in the analysis. EPRI combined two widely accepted state-of-the-art economic models—the Multi-Region National (MRN) model and the North American Electricity and Environment Model (NEEM)—to conduct a detailed analysis of 20 different implementation scenarios of various policy options, including industry-specific command-and-control regulations as well as market-based cap-and-trade programs. Major results include the following:

- Implementation options based on a broad, market-based cap-and-trade program will likely be more cost-effective than a sector-specific program of command-and-control regulations or approaches that cover only one part of the state's economy.
- All scenarios analyzed showed real economic costs to the state, with costs increasing as future GHG emissions decrease. Depending on the implementation scenario, cumulative real costs to the state's economy could range from \$100 billion to \$511 billion through 2050.
- Establishing a maximum price on CO₂ (an allowance price safety valve) reduces the economic uncertainty of a market-based cap-and-trade system. The safety valve would be a way to limit economic costs if low-cost reduction options fail to achieve the desired reductions. However, under such a scenario, the GHG reduction target would not be met.

- California's Climate Action Team report suggests that various in-state forestry activities could provide offsets that would augment the cap. Using estimates from this report, EPRI found that forestry offsets provide a cost savings of \$33 billion through 2050.
- The role of out-of-state electric generation needs to be carefully examined. There is the potential for increased GHG emissions from nearby states if those states shift low-carbon electricity to California and send higher-carbon electricity elsewhere.

For more information, contact Tom Wilson, (650) 855-7928, twilson@epri.com.

Program 103: Greenhouse Gas Reduction Options

Report Published on Costs of Reducing Electricity Sector CO₂ Emissions

The Costs of Reducing Electricity Sector CO₂ Emissions (1014044). This report presents a high-level analysis of some of the critical challenges associated with cutting U.S. electricity sector CO₂ emissions and an order-of-magnitude sense of the costs of meeting emission-reduction targets now under consideration. Three basic strategies to limit emissions are examined to illustrate the tradeoff between CO₂ reductions and additional costs inherent in several generation choices. Regional power market system simulations are then conducted across a range of assumptions to provide more-robust insights into the effects of limiting CO₂ emissions from the power sector as a whole. In particular, the impact of CO₂ price on emissions levels and wholesale power prices is analyzed. The analysis shows that the costs of controlling CO₂ emissions will be substantial and will be deeply affected by critical decisions about how to approach the task—particularly by the timing of emission reduction targets and by how large a role nuclear power and coal with carbon capture and storage (CCS) are allowed to play. Near-term reduction costs are high because they would have to be achieved solely by using the current generation fleet differently, leading to electricity price shocks. In contrast, over the longer term, new low- and non-CO₂-emitting plants, such as nuclear power, CCS, and renewables, can offer more cost-effective ways to reduce emissions. The effect of CO₂ emission costs on wholesale electricity prices and technology choices changes investments in new generation. Generally speaking, investment in new nuclear plants would be stimulated by any CO₂ emission costs over \$20/ton, while coal with CCS would require CO₂ costs over \$50/ton, although there is wide variation among different regions of the country. Areas with rapid electricity demand growth would choose these technologies at lower CO₂ prices than would regions having lower demand growth. For more information, contact Adam Diamant, (510) 260-9105, adiamant@epri.com.

Comprehensive Overview of Project-Based Mechanisms to Offset GHG Emissions Published

A Comprehensive Overview of Project-Based Mechanisms to Offset Greenhouse Gas Emissions (1014085). This report describes emission-trading systems in the European Union and in New South Wales (Australia) conducted under the Kyoto Protocol. It also discusses project-based mechanisms in the United States, in particular the Northeast Regional Greenhouse Gas Initiative (RGGI), and growing voluntary markets for GHG emissions reductions. The report then details rules and regulations for projects; analyzes volumes, prices, and trends; and outlines the main price drivers and risks of the market. Two factors are especially critical to the successful development of markets for GHG offsets: first, guaranteeing the environmental integrity and credibility of the credits generated by GHG reduction projects, and second, ensuring that markets are linked globally, thereby enabling reductions to occur in the most cost-efficient location. The markets are currently nascent and fragmented, but they have the potential of growing into a single large commodity market in the next decade. Readers will acquire a deeper understanding of the following key issues:

- what GHG offsets or credits actually represent and how they are created,
- how GHG offsets can be used to reduce potential climate change–related compliance costs while satisfying strict requirements to ensure environmental integrity,
- how carbon markets are organized and which options are available to U. S. electric companies and others in GHG abatement project development or GHG offset trading, and
- what financial and operational risks are associated with GHG offset investments, and how specific risks relate to the expected acquisition costs of offsets.

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

EPRI Hosts 7th Policy Design Forum on GHG Emissions Accounting

On Jan. 11, EPRI hosted its “7th Global Climate Policy Design Forum on GHG Emissions Accounting Inventories.” This webcast event was designed to provide members of Programs 102 and 103 with a comprehensive overview of corporate GHG emissions accounting, the various GHG emissions accounting protocols in use today, and the similarities and differences among these protocols. In the absence of a national approach, a variety of GHG accounting protocols have been developed, including the WRI/WBCSD Corporate GHG Accounting Protocol, the California Climate Action Registry (CCAR) Power Utility Protocol, the DOE 1605(b) program, and EPA’s Climate Leaders. Recently, 41 states signaled their intent to participate in the development of The Climate Registry, which is expected to go live in 2008. Knowledge of these protocols and their continuing development will help electric companies planning to begin voluntary reduction efforts or preparing for the possibility of mandatory requirements. This EPRI webcast was conducted by the nonprofit Greenhouse Gas Management Institute (www.ghginstitute.org). EPRI Program 102 and 103 members can download the webcast presentation [here](#). The 8th Global Climate Policy Design Forum, focused on identifying and evaluating approaches to CO₂ cost containment, will be held on March 5 in Washington, DC. More information will be posted on the [EPRI Events Calendar](#) as available. For more information, contact Adam Diamant, (510) 260-9105, adiamant@epri.com.

LAND AND GROUNDWATER

Program 49: Coal Combustion Products—Environmental Issues

Ammonia Contamination Does Not Curtail Ash Sale or Disposal

[Experience With Ammoniated Fly Ash](#) (1014269). Fly ash contaminated by ammonia slip from NO_x control devices is routinely disposed of or sold without problem, according to survey responses reported in this technical update. Owners of power plant units equipped with selective catalytic reduction (SCR) or selective noncatalytic reduction (SNCR) for NO_x control (44 SCR units and 8 SNCR units) responded to a 2007 EPRI questionnaire requesting information on ammonia source, boiler and fuel characteristics, ash properties, and general experience with ammonia-contaminated ash disposal or sale. Ammonia contamination in ash from these facilities was usually less than 50 parts per million (ppm). Contaminated ash was sold for cement and concrete manufacture or sent to landfills or ponds. Although ash marketers routinely place limits on the allowable ammonia contamination in ash offered for sale and independently measure ammonia concentration, survey responses overwhelmingly showed that these factors did not govern ash sales. Perhaps this is because operators of plants relying on ash sales maintain tight ash quality control. The primary complaint noted in survey responses was about odors associated with ash ponds. Regulators required some units to measure and report ammonia contamination in pond water, but placed no restrictions on disposal. This report is available at no additional cost to participants in Program 78. For more information, contact Ken Ladwig, (262) 754-2744, keladwig@epri.com.

Program 50: MGP Site Management

Model Predicts Toxicity of MGP Sediments to Freshwater Crustaceans

[Bioavailability and Toxicity of Polycyclic Aromatic Hydrocarbons in River Sediments Near the Old Fort Wayne Indiana Former Manufactured Gas Plant Site](#) (1016288). Research described in this technical report provides site-specific information on the bioavailability and toxicity of polycyclic aromatic hydrocarbons (PAHs) in river sediments near a former MGP site. The goal was to combine this information with other site-specific data to define sediment zones that pose a risk to benthic invertebrates (small freshwater crustaceans) and zones where risks—as judged by measured and predicted toxicity—are low or negligible. In this research, actual toxicity to crustaceans was compared with predicted PAH bioavailability and toxicity. Despite the presence of PAHs and MAHs in river sediments near the former MGP site, only 3 of 8 contaminated sediments were significantly more toxic to crustaceans than sediments from upstream and downstream reference areas. Researchers found that an equilibrium partitioning model including natural organic carbon and black (pyrogenic) carbon as PAH binding matrices gave the most accurate predictions of observed toxicity. Methods that accurately measure or predict bioavailability and toxicity provide a way to reduce uncertainty and focus remedial actions at MGP sediment sites. For more information, contact Andrew Coleman, (650) 855-2249, acoleman@epri.com.

Technical Update Describes Reactive Capping for Sediment Remediation

[Reactive Capping for Coal Tar-Impacted Sediments](#) (1016311). This technical update describes the first phase of a project to design, implement, and monitor a reactive cap for remediation of contaminated sediments at a former MGP site. Successful reactive capping would offer an attractive alternative to sediment removal at sites where dredging is impeded by structures such as utility crossings and bridge abutments. Sorbent materials in a reactive cap sequester hydrophobic organic contaminants such as nonaqueous phase liquids. When placed over coal tar-impacted sediments at the demonstration site, the reactive cap will control and contain sediment contamination. In the first phase of the project, researchers have evaluated existing conditions at the site, developed a conceptual design for an organoclay cap, and devised an approach for monitoring its performance when installed in a field-scale demonstration. In the second phase of the project, they will finalize cap design, install the cap, monitor its performance, and prepare a final report. Use of a reactive cap for sediment remediation follows regulatory guidance by EPA and the National Academy of Sciences suggesting that alternatives to dredging should be considered when appropriate. For more information, contact Andrew Coleman, (650) 855-2249, acoleman@epri.com.

Program 59: PISCES—Plant Multimedia Toxics Characterization

Sorbent Trap Materials Evaluated in Laboratory Tests

[Evaluation of Sorbent Materials for Flue Gas Mercury Measurement](#) (1014046). This technical update provides information plant owners can use to evaluate the performance of sorbent trap sampling and analysis for measuring vapor-phase mercury concentrations at the stack. Continuous mercury monitoring, mandated by the Clean Air Mercury Rule, must be implemented at U.S. coal-fired plants by 2009. Sorbent traps may be used for this purpose, as well as for relative accuracy test audits of continuous mercury monitors. In this research, EPRI gave volunteer laboratories sorbent traps pre-spiked with elemental mercury. Tests determined how much of the mercury was lost as synthetic flue gas passed through the traps. When the mercury spike was added to the third bed of the sorbent trap (a required quality control measure), a significant amount of mercury was lost from both brominated and iodated carbon sorbents over seven days of synthetic flue gas exposure. Placing the mercury spike on the leading edge of the sorbent bed reduced losses, but adding it at higher temperature did not. Analysis of mercury in brominated sorbent was more prone to chemical interference than analysis of mercury in iodated sorbent. Mixing sorbent trap carbon with a ball mill and subjecting portions of the mixed sample to direct combustion mercury analysis was as precise as whole-sample analysis. For more information, contact Naomi Goodman, (650) 855-2193, ngoodman@epri.com.

Studies of Halogen Addition for Mercury Oxidation Published

Recent studies have shown that adding halogens such as bromine, chlorine, iodine, or fluorine can enhance the oxidation of elemental mercury in subbituminous flue gas, promoting its capture as soluble oxidized species in wet scrubbers. These papers extend knowledge of the conditions controlling oxidation enhancement in different flue gas environments when halogens are added.

- Cao, Y. et al. "Investigation of mercury transformation by HBr addition in a slipstream facility with real flue gas atmospheres of bituminous coal and Powder River Basin coal," *Energy & Fuels*, 2007, 21, 2710–2730. In this slipstream reactor study, researchers investigated oxidation of elemental mercury in flue gas and mercury adsorption to fly ash while adding hydrogen bromide to bituminous or subbituminous Powder River Basin (PRB) flue gas. Hydrogen bromide was added at a rate of 3–15 ppm at controlled temperatures, and concentrations of mercury species were measured using semi-continuous mercury emission monitors. At higher temperatures (300–350°C), hydrogen bromide promoted mercury oxidation but not adsorption; adsorption was enhanced at lower temperatures (150–200°C). In PRB flue gas with higher chlorine content, chlorine species seemed to compete with bromine species in the mercury oxidation process. For example, mercury oxidation reached 55% in low-chlorine PRB flue gas with hydrogen bromide addition (3 ppm at 330°C), but only 20% in high-chlorine bituminous flue gas. Further investigation is needed to define the role that flue gas chlorine and sulfur dioxide may play in elemental mercury oxidation with hydrogen bromide addition.
- Cao, Y. et al. "Impacts of halogen additions on mercury oxidation in a slipstream selective catalyst reduction (SCR) reactor when burning sub-bituminous coal," *Environmental Science & Technology*, 2008, 42, 256–261. In this study at a slipstream SCR reactor, researchers added various halogens to PRB flue gas and compared their impact on the oxidation of elemental mercury, with and without SCR catalysts. In order of their impact on mercury oxidation, the halogens were hydrogen bromide, hydrogen iodide, hydrogen chloride, and/or hydrogen

fluoride. For example, adding 3 ppm of hydrogen bromide resulted in 80% elemental mercury oxidation, while adding 5 ppm of hydrogen iodide resulted in 40% oxidation. Commercial SCR catalyst no. 1 provided better nitrogen oxide reduction and mercury oxidation than catalyst no. 2. Adding ammonia inhibited mercury oxidation, probably because ammonia reduction competed with mercury oxidation on the surface of the catalysts.

For more information, contact Paul Chu, (650) 855-2812, pchu@epri.com.

Area News

Environment Sector Welcomes Robert Trautz

Robert Trautz has joined the Land and Groundwater Area as a Senior Project Manager. He will be working in the CO₂ Capture and Storage research program that is jointly managed by the Generation and Environment Sectors. Robert has many years of experience in geologic sequestration of CO₂—most recently at Lawrence Berkeley National Laboratory, where he managed many important projects, including the West Coast Regional Carbon Sequestration Partnership Phase II and Phase III pilot programs. He holds a B.S. degree in Geology from Michigan State University and an M.S. in Hydrology from the University of Arizona. For more information, contact Robert Trautz on the Palo Alto campus in Room A-2058, (650) 855-2088, rtrautz@epri.com.

Brookhaven “Science Highlights” Feature EPRI Work on Leaching Potential of Arsenic and Selenium in Fly Ash

EPRI-sponsored research characterizing physical properties of arsenic and selenium related to their potential for leaching from coal fly ash was recently featured as a science highlight on the Brookhaven National Synchrotron Laboratory [website](#). Researchers used X-ray adsorption fine structure spectroscopy (XAFS) at Brookhaven’s National Synchrotron Light Source and Stanford’s Synchrotron Radiation Laboratory to make direct spectral measurements of arsenic and selenium present in 10 fly ash samples collected from U.S. and Canadian power plants burning either eastern bituminous or western subbituminous coals. These measurements revealed the oxidation states and species of the two elements—factors that determine their toxicity and how soluble they are in water. Arsenic was present predominantly in the As(V) oxidation state in arsenate species; selenium was present in the Se(IV) oxidation state in selenite species. Higher oxidation states such as As(V) are more soluble but less toxic than lower oxidation states such as As(III), which was found in minor amounts. Two distinct spectra were observed for each element, depending on whether the fly ash was derived from iron-rich eastern bituminous or calcium-rich western subbituminous coal. However, the spectral fine structure for bituminous fly ash was similar for the two elements, suggesting that they were captured together by iron, the major component of that ash; similar conclusions were drawn for subbituminous fly ash and capture by calcium. This work is relevant to research pursued in EPRI programs 49, 56, and 59, and complements other studies of fly ash arsenic and selenium leachability. Results were published in Huggins FE, et al., “Selenium and arsenic speciation in fly ash from full-scale coal-burning utility plants,” *Environmental Science & Technology*, 2007, 41 (9), 3284–3289. For more information, contact Ken Ladwig, (262) 754-2744, keladwig@epri.com, or Paul Chu, (650) 855-2812, pchu@epri.com.

WATER AND ECOSYSTEMS

Program 53: Water Quality Criteria Development and Assessment

Report Published on Effects of Ammonia and FGD Wastewater on Toxicity of Power Plant Effluent

Effects of Ammonia and Flue Gas Desulfurization (FGD) Wastewater on Power Plant Effluent Toxicity

(1014019). This technical update describes progress on EPRI’s project to develop guidance for managers of power plant wastewaters regarding effects of ammonia and FGD wastewater on the toxicity of plant effluent. In selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) systems, ammonia is often injected into flue gas as part of the chemical reaction that converts NO_x to nitrogen gas. This process raises environmental concerns due to the potential “slip” of excess ammonia to the facility’s wastewater system. Of greater quantitative importance with respect to ammonia management in plant wastewater, however, is the practice of ammonia injection into flue gas to react with SO_x to form ammonium bisulfite, which is very soluble and can raise the ammonium concentration in a fly ash pond to well above the discharge limit (often ~5 mg/L). FGD units also scavenge salts, metals, and other potentially toxic constituents. Although the toxic effects of

ammonia, salts, and some metals have been studied individually, there is little or no information on their synergistic toxicities in the complex matrix of power plant ash pond water. The objectives of this phase of the research are to determine the ratio of FGD water in ash pond water that is toxic to typical Whole Effluent Toxicity (WET) test organisms, and to determine the level of ammonia in ash pond water that is toxic. For more information, contact Rick Carlton, (650) 855-2115, rcarlton@epri.com.

Additional Funds Needed for Project to Evaluate Arsenic Water Quality Criteria

A contractor has been chosen for EPRI's Tailored Collaboration (TC) project "[Scientific Evaluation of Arsenic Water Quality Criteria: Speciation and Bioaccumulation Issues](#)" (1014340), and kickoff is planned for this quarter. This project will provide data required to help EPA develop more realistic and scientifically defensible arsenic water quality criteria (AWQC). This project, to be conducted in close coordination with EPA, will involve laboratory studies of arsenic uptake by fish at exposure levels representative of those in aquatic environments. The experiments will determine both the bioconcentration factor (uptake from water only) and the bioaccumulation factor (uptake from water and food) for arsenic in fish. These experiments will also characterize the relative amounts of inorganic and organic species of arsenic in fish tissue. Published findings from an extensive literature review support use of a substantially reduced bioconcentration factor. Characterization of both aqueous and dietary arsenic uptake as a function of arsenic speciation will allow bioaccumulation of different forms of arsenic to be treated individually in AWQC determinations. About \$375,000 out of the needed \$666,000 has been committed to this important project by several utilities, but the remainder is needed in order to ensure that the project can be completed and timely information communicated to EPA. For more information, contact John W. Goodrich-Mahoney, (202) 293-7516, jmahoney@epri.com.

Program 54: Fish Protection at Steam Electric Power Plants

Updated Manual on Fish Protection Technologies for CWISs Published

[Fish Protection at Cooling Water Intake Structures: A Technical Reference Manual](#) (1014934). In this update, EPRI details all available information on fish protection technologies, including technology-specific information released by EPRI in 2004 and case studies published or released since the 2004 report. Information that is most applicable to cooling water intake structures (CWISs) is emphasized, but studies at hydroelectric, irrigation, and other water intakes also are presented. The report provides site descriptions, study equipment and methods, and effectiveness results for each of more than 28 fish protection technologies reviewed. For each technology, full-scale applications at CWISs, other full-scale applications, and pilot and laboratory studies are discussed, along with important factors that influence the technology's potential for effective use at a given site. The report also lets users find references to fish protection technologies based on species. The case studies in this report demonstrate that the potential biological effectiveness and engineering practicability of a given technology is site specific and is strongly influenced by factors such as species and life stages to be protected, plant design and operating characteristics, and environmental factors. For more information, contact Doug Dixon, (804) 642-1025, ddixon@epri.com.

Ohio River Ecological Research Program Monitoring Results for 2005 Published

[Ohio River Ecological Research Program \(ORERP\): 2005 Ohio River Monitoring Results](#) (1015422). ORERP is the largest collaborative power plant research program in the world. This report presents the results of the 2005 ORERP fish population sampling near Ohio River power stations. In 2005, the program consisted of field studies of adult/juvenile fish, habitat, and water quality near 17 electric generating stations covering nearly the entire (~1000 mile) length of the river. Among the results were the following:

- Electrofishing and seining collections yielded more than 163,000 individuals representing 95 species and three hybrids. Emerald shiner (38%) and gizzard shad (20%) strongly dominated the combined numerical catch, as they have over ORERP's 30+ years.
- Temporal comparisons of electrofishing results indicated that measures of the community (e.g., species richness, organism wellbeing, diversity) were usually significantly higher in August and/or October than in June. Relatively few statistically significant differences were noted between the upstream and downstream areas.

- Nearly half the species showed no preference for either upstream or downstream areas. Roughly twice as many species were more common upstream than downstream, suggesting that some thermal avoidance was likely occurring.
- The 12 taxa showing no upstream/downstream preference included many of the most common, widely distributed fishes in the Ohio River (e.g., channel catfish, emerald shiner, bluegill, and smallmouth buffalo), most of whom are moderately temperature tolerant.
- Most of the species that favored areas downstream of the plants were thermally tolerant. The 11 species preferring the upstream areas were dominated by those that are more thermally sensitive, including three redbreast species, sauger, logperch, and mooneye.

This report provides valuable information on methods for assessing fish population in large rivers and determining the effects of power plants on fish communities. For more information, contact Doug Dixon, (804) 642-1025, ddixon@epri.com.

Supplemental Project: Best Management Practices for Preventing CWIS Blockage

“Best Management Practices for Preventing Cooling Water Intake Blockage” (1016319). Blockage of cooling water intakes occurs frequently at nuclear and fossil power plants worldwide and can have potentially serious impacts. A 2006 study by the World Association of Nuclear Operators (WANO) identified 44 such events at nuclear plants since 2004. It is likely that a similar rate of occurrence exists for fossil-fuel plants. Operational impacts from these blockages can include equipment damage, facility outages, and plant safety concerns—and ultimately, system reliability problems and declines in plant revenue. The causes of intake blockages change constantly but most commonly involve aquatic and terrestrial flora and fauna. EPRI has conducted some initial studies on this issue; however the recurrent nature of the problem indicates that more work is needed. This new EPRI supplemental project will seek to identify best management practices (BMPs) and technology fixes. The initial work will be the stepping stone to an R&D plan to continually evolve best management practices to coincide with plant hardware updates. In the first year, researchers will:

- Prepare a BMP manual for reducing blockage at cooling water intakes. The manual will provide procedural and O&M guidance, event analysis-prediction-management tools, and state-of-technology information.
- Organize and conduct a workshop to review practices, discuss case studies, and identify R&D needs.
- Prepare a research and development plan to address future needs.

The estimated cost to complete this project is \$250,000. Companies that fund any EPRI membership program can use TC funds for up to half their contribution. For each TC participant, the minimum cost for participating in this project is \$12,500, with \$12,500 matched by EPRI, for a total of \$25,000. Companies that have not funded any EPRI program may co-fund this project for \$25,000 per year. For more information, contact Doug Dixon, (804) 642-1025, ddixon@epri.com.

Bailey Appointed to California’s §316(b) Policy Development Expert Panel

The California State Water Resources Control Board appointed EPRI’s Dave Bailey to its Expert Review Panel that is providing scientific and engineering information related to §316(b) of the Clean Water Act. Dave’s focus will be on fish protection design and operation. His initial responsibilities include commenting on the California draft policy as reflected in a technical support document, as well as participating in meetings and workshops. The first workshop, “Understanding the Environmental Effects of Once-Through Cooling,” was held at UC Davis on Jan. 15–16. The workshop was also attended by EPRI’s Doug Dixon and Kent Zammit. California’s policy is specifically examining the potential consequences of phasing out once-through cooling (OTC) at all coastal power plants in the state. Power plants tentatively would be required to replace OTC with closed-cycle operation (cooling towers) or with an intake fish protection technology that attains fish protection performance similar to that of a closed-cycle system. Dave will continue his responsibilities through 2008 as the Board develops its policy implementation schedule. For more information, contact Dave Bailey, (703) 978-6226, d Bailey@epri.com.

Program 55: Watershed and Water Resource Management

New TI Project on Advanced Cooling Technology

EPRI has begun a new project on advanced cooling technology for nuclear, fossil, and other thermoelectric power plants. This project, funded by EPRI's Technology Innovation (TI) group, has three principal objectives:

- To support EPRI's participation in its Advanced Cooling Technology Partnership with Électricité de France (EDF).
- To assess the technical and economic feasibility and possible technical challenges of applying water-saving cooling technology to thermoelectric power plants. Specific objectives are to (1) evaluate the technical and economic feasibility and possible technical challenges of applying dry and hybrid cooling to thermoelectric power plants and, specifically, dry cooling technology to nuclear power plants; and (2) assess the technical feasibility and economics of advanced dry cooling concepts for thermoelectric power plants. As part of this work, EDF will conduct an assessment of advanced cooling systems based on ammonia refrigeration cycles and the EDF binary ammonia cycle.
- To conduct wind tunnel and numerical modeling of air flow around air-cooled condensers (ACC) and through ACC fans, and to assess mitigation measures to reduce the impacts of high winds on ACC performance.

Results of this project will provide the basis for design of new power plants with advanced dry or alternative cooling systems. For more information, contact Chuck McGowin, (650) 855-2445, cmcgowin@epri.com.

Paper on WARMF for Development of Mercury TMDLs for Drainage Lakes Accepted

Chen, C.W., J.W. Herr, and R.A. Goldstein. "Model calculations of total maximum daily loads of mercury for drainage lakes." Scheduled for publication in the *Journal of the American Water Resources Association*, August 2008. The WARMF watershed model was enhanced to simulate the transport and fate of mercury and to calculate the fish mercury concentrations (FMCs) attained by fish through the food web. The model was applied to the Western Lake Superior Basin in Minnesota, which has many peat lands and lakes. Simulated flow and mercury concentration data for several stream stations were comparable to available data. The model was used to perform mercury TMDL calculations for two contrasting drainage lakes (Wild Rice Lake and Whiteface Reservoir). Under the 1989–2004 base condition, the average simulated FMC of four-year-old walleye was 0.31 µg/g for Whiteface Reservoir and 0.15 µg/g for Wild Rice Lake. The FMC criterion in Minnesota is 0.2 µg/g; Wild Rice Lake already meets this criterion, but Whiteface Reservoir does not. The model showed that a 65% reduction in atmospheric mercury deposition would not, by itself, allow Whiteface Reservoir to meet the criterion within 15 years. Additional best management practices would be needed to reduce 50% of the watershed input. For more information, contact Robert Goldstein, (650) 855-2593, rogoldst@epri.com.

AWWARF Workshop Addresses Water Utility Planning for Climate Change

The American Water Works Association Research Foundation (AWWARF), which sponsors collaborative research for the water utility sector, held a workshop on Jan. 8–9 on the topic of research planning for climate change. EPRI's Bob Goldstein served on the workshop's water resources group, which selected eight projects as top priorities in the development of a strategic research plan for the Foundation. Goldstein noted that a speaker from an Australian utility stated that every major urban area in Australia is either building or planning to build desalination plants for production of fresh water. For more information, contact Robert Goldstein, (650) 855-2593, rogoldst@epri.com.

Goldstein Appointed to Advisory Board of Issues in Ecology

Bob Goldstein has been appointed to a three-year term on the advisory board of *Issues in Ecology*, a publication of the Ecological Society of America that uses commonly understood language to report the consensus of a panel of scientific experts on issues related to the environment. His role will be to review proposals for possible publication, evaluate author teams to ensure scientific breadth and balance of each issue, create topic ideas, and periodically serve as guest editor. For more information, contact Robert Goldstein, (650) 855-2593, rogoldst@epri.com.

Program 56: Effluent Guidelines and Water Quality Management

Report Published on Metallic Iron Cementation for Selenium Removal From FGD Wastewaters

Program on Technology Innovation: Selenium Removal from FGD Wastewaters Using Metallic Iron

Cementation (1016191). Some new FGD wastewaters may have selenium (Se) discharge levels high enough to require water treatment. Selenium can be present in several chemical forms, including selenite, selenate, and other unknown Se compounds. Only the selenite appears to be effectively captured using traditional iron coprecipitation. The primary objective of the study described in this report was to demonstrate application of metallic iron cementation to removal of Se from FGD wastewaters. The report provides background on selenium aqueous chemistry, metallic iron cementation technology, and the study's experimental approach. These laboratory feasibility studies indicated that the metallic iron cementation approach is promising for treating selenium from FGD waters, including the more difficult selenate species. Additional studies are warranted in the laboratory as well as in a field pilot operating on a slipstream of FGD wastewater. In addition, further evaluation of mercury removal performance—with the goal of determining the mercury removal mechanism—is recommended. For more information, contact Paul Chu, (650) 855-2812, pchu@epri.com.

Supplemental Project: Evaluating Technologies for Treatment of Mercury and Selenium in FGD Water Blowdown

“Mercury and Selenium FGD Water Blowdown Treatment” (1016128). Many FGD systems include a water blowdown stream (chloride purge stream). Vapor-phase trace elements captured in the FGD system may be discharged via this blowdown stream. As trace metal limits on power plants become more common and more stringent, options to treat and remove mercury, selenium, and other trace elements from FGD waters may be necessary. This supplemental project will evaluate promising technologies for treatment of the FGD chloride purge stream, specifically the mercury and selenium constituents. The goals for 2008 are to select the most promising technologies based on currently available results. EPRI proposes that a number of technologies for mercury and selenium removal be considered for evaluation, including metallic iron and other iron-based reagents, biological treatment systems, and passive constructed wetlands, as well as optimization of existing organosulfide and iron coprecipitation systems. Much of this evaluation will be conducted in a series of pilot evaluations at several power plant sites, including We Energies Pleasant Prairie Power Plant, a PRB-fired facility, as well as several bituminous-fired facilities. The cost of participation is \$100,000 per company. Companies funding at least one EPRI Environment program may use TC funds for up to 50% of the total cost. For more information, contact Paul Chu, (650) 855-2812, pchu@epri.com.

Program 58: Hydropower Environmental Issues

EPRI-Funded Research Results in Successful Artificial Spawning of American Eels

For the first time in North America, American eels have been artificially spawned in the laboratory, and eel larvae have hatched. This feat has never before been accomplished for American eels, and only once before for Japanese and European eels. American eels normally spawn in the middle of the Atlantic Ocean after a very long journey that is part of their sexual maturation. EPRI-funded researchers at the University of Massachusetts–Dartmouth fertilized American eel eggs taken from artificially stimulated females in the laboratory, produced dividing embryos, and observed a few of the resulting eggs hatch. The potential benefits of this accomplishment are substantial:

- Future hatchery operations could allow elimination of natural commercial fishing for eels, thereby relieving mortality pressure.
- Spawning stock could be provided for restoration of the species in estuarine and freshwater watersheds.
- Chemical contaminant experiments could be performed directly on eel larvae rather than on surrogates, without affecting existing eel stocks.

Researchers intend to repeat the procedure with modifications to enhance fertilization rates and survival of embryos and larvae. For more information, contact Doug Dixon, (804) 642-1025, ddixon@epri.com.

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

Report Helps Companies Choose Optimal Transmission Pole Materials

[Assessment of Treated Wood and Alternate Materials for Utility Poles](#) (1014064). This technical report provides the latest information on utility poles made from southern pine treated with various preservatives, from other woods, and from alternate materials that may offer in-service and environmental advantages. Since power distribution companies replace a million treated wood poles each year, they need the best poles for their service territories. Thus, EPRI and the Utility Solid Waste Activities Group prepared this report (as well as 2004 and 2005 versions) to help their members make decisions about purchasing and managing distribution poles. According to the present report, the most common wood pole preservatives—creosote, pentachlorophenol, chromated copper arsenate, and copper naphthenate (with a shorter track record)—work well with southern pine and have known properties, ready availability, and reasonable cost. However, potential or perceived environmental impacts of these preservatives may be disadvantageous. Alternate preservatives, such as ammoniacal copper zinc arsenate, ammoniacal/alkaline copper quaternary compound, and copper azole, lack an industrial track record and may be more expensive. Other pole materials include steel, fiberglass-reinforced composite, spun-cast concrete, plastic, and woods such as American chestnut and topical hardwoods that require few or no preservatives. Although they look attractive, these choices cost more, are less available, lack performance records, and have uncertain ecological impacts. For more information, contact Mary McLearn, (650) 855-2487, mmclearn@epri.com.

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

EPRI-GTC Transmission Line Siting Methodology Applied in Kentucky

[Kentucky Transmission Line Siting Methodology](#) (1016198). This technical report describes the application of a standardized methodology for siting overhead electric transmission lines to corridor selection in Kentucky. The methodology, developed by EPRI and Georgia Transmission Corporation and first applied in Georgia, facilitates quantitative consideration of stakeholder input in the route selection process, making it more transparent and credible. The EPRI-GTC methodology will be increasingly useful as demand for new high-voltage transmission lines grows amid public controversy and greater regulatory scrutiny. To calibrate the methodology to local concerns, Kentucky stakeholders with wide-ranging interests met at a February 2006 workshop in Lexington. They assessed the relative suitability and importance of criteria that could be used to develop new transmission line corridors in the state. Subsequent tests using preferred criteria showed that the methodology was valid for siting overhead transmission lines in Kentucky. This report, as well as the 2006 report [EPRI-GTC Overhead Electric Transmission Line Siting Methodology](#) (1013080), are available free of charge. 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

Resource Paper Presents Elements of Written Technical Communication

[Written Technical Communication: A Primer](#) (1014949). This *resource paper* presents the elements of written technical communication. A practical knowledge of these elements will help ensure effective communication of professional information of all kinds, from memos and correspondence to research reports. The paper covers the preparation, organization, writing, and revision of technical documents and includes sections on page design and graphics. Although the paper uses examples from EMF science, technical writing skills are applicable to any area of science or technology. For more information, contact Gail Lundell, (650) 855-7956, glundell@epri.com.

EMF Workstation 2007 Released

[EMF Workstation 2007](#) (1014012). EMF Workstation 2007 is a powerful tool for evaluating electromagnetic fields and audible noise associated with electric power installations. Workstation users can model electric and magnetic fields around equipment, construct 2- and 3-D representations of equipment and magnetic fields, and analyze audible noise characteristics. They can also consult the software for answers to frequently asked

questions about magnetic fields. EMF Workstation 2007 includes EMF Expert as well as the power line calculator, and replaces all prior versions of EMF Workstation and EMF Modeler. The software operates on a Windows 2000 or XP platform. For more information, contact Mike Silva, (650) 855-2815, msilva@contractor.epri.com.

Use of Specific Absorption Rate Modeling to Assess Compliance With RF Exposure Limits

Use of SAR Modeling for RF Exposure Limit Compliance (1014950). Under Technology Innovation (TI) funding, the Radio-Frequency (RF) Safety program contracted with the Health Protection Agency in the United Kingdom to analyze the patterns of RF energy deposition in the human body under various conditions. Variables included field uniformity, proximity to the source, and frequency. A major aim of this study was to assess whether there could be conditions under which exposure limits, such as those specified by the Federal Communications Commission (FCC), were exceeded. This new *resource paper* consolidates the findings published in two previous technical reports (1013312 and 1014048) on a new dosimetric basis for RF exposure compliance assessment. The key findings are:

- Exposures in the far field (away from an antenna) to RF fields at the exposure limits (referred to in guidelines as the “reference levels”) specified by the FCC adequately maintain the dose to tissue at a level below the FCC’s dose limits (referred to in guidelines as the “basic restriction”).
- In the near field (within about one wavelength of an antenna), basic restrictions may be slightly exceeded, depending on frequency and antenna location relative to the body. These exceedances are not expected to result in significant tissue heating because of the margins of safety incorporated into the exposure limits.
- Whether in the near or far field, measurements to assess compliance can be carried out in a straightforward manner.

As a result of this research, workers in proximity to RF emitters have improved tools with which to assess their RF environment, protecting against the possibility of overexposure. Furthermore, safety and industrial hygiene personnel can understand the principles of a valid RF environmental survey near and far away from RF antennas. For more information, contact Mike Silva, (650) 855-2815, msilva@contractor.epri.com.

National Academy of Sciences Report Identifies Research Needed on RF Health Effects

Barnes FS, Gandhi OP, Hietanen M, Kheifets LI, Mathes R, McCormick DL, and Veyret B. *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication Devices*. The National Academies Press. Washington, DC. 2008, 78 p. This report from the National Research Council of the National Academy of Sciences identifies research that should be conducted on potential health effects of wireless devices emitting RF fields. Recommendations in the report are based on discussions and expert opinions offered during a three-day workshop held in August 2007. While present research evaluates the health effects of short-term high exposures to RF fields in adults, studies of long-term low exposures are lacking, as are studies of children who will incur lifetime exposures by using wireless devices such as cell phones, laptop computers, and hand-held text messaging systems. Specifically, the report recommends assessments of RF exposure effects that include:

- a prospective study of adults in the general population and a retrospective study of workers with relatively high occupational exposures,
- human laboratory studies of brain electrical activity and performance on cognitive tasks,
- studies of children and pregnant women that include childhood cancer and brain cancer endpoints,
- RF dosimetry at the tissue and cellular level, and
- characterization of fields emitted by multi-element base station antennas and resultant exposures to those nearby.

The committee preparing the report did not evaluate potential health effects or state how research needs should be met. The report was sponsored by the U.S. Food and Drug Administration, the agency responsible for prioritizing possible future work. Dr. Gabor Mezei of EPRI was a reviewer of the report. For more information, contact Gabor Mezei, (650) 855-8908, gmezei@epri.com.

Program 62: Occupational Health and Safety

Eighth Annual Occupational Health and Safety Report Published

Occupational Health and Safety Annual Report 2007 (1014041). This technical report presents trends in illness and injury for electrical industry workers, based on information collected for EPRI's Occupational Health and Safety Database (OHSD) program. The OHSD currently integrates 12 years (1995–2006) of personnel, injury, and claims data from 16 companies into a single data system; additional historical data were added this year. The database helps users identify high-risk occupations or work environments, quantify lost time and cost, adopt benchmark standards for monitoring worker health, and evaluate the effectiveness of prevention programs. This report describes the types of information collected for the database and the analytical methods and statistical procedures used to evaluate injury rates and severity of risk. Demographic and occupational profiles of electrical workers are discussed, and overall trends in injury and illness for the group are reported by company, nature of injuries, and body regions affected. This year's report provides an in-depth analysis of injury occurrence by days of the week and months of the year, injuries sustained during motor vehicle accidents, and injuries occurring among workers at generating stations. For more information, contact Gabor Mezei, (650) 855-8908, gmezei@epri.com.

EPRI Expands Ergonomics Handbook Series

EPRI has published an ergonomics handbook for electricians, the fourth in a series begun in 2001, and is developing a fifth handbook for operations and maintenance (O&M) workers, to be published in 2008. Ergonomics handbooks are based on systematic investigation of tasks performed by workers in fossil-fueled electric power plants and in the T&D parts of a company's operations. The handbooks recommend interventions for those tasks that will decrease the risk of musculoskeletal disorders (MSDs) like low-back, shoulder, and wrist injuries. Interventions—such as new or modified tools and equipment or changes in work methods—prevent or minimize costly work-related injuries. Each handbook presents information in nontechnical language, illustrated with simple line drawings of procedures for each task. Power companies can use these handbooks as guides for their occupational health and safety programs.

- *EPRI Ergonomics Handbook for the Electric Power Industry: Ergonomic Interventions for Electrical Workers in Fossil-Fueled Power Plants* (1014042). Research supporting the development of this handbook included field evaluations and the creation of an ergonomics process for electricians at We Energies, where workers and supervisors received training to sustain improved work practices. Biomechanical instruments and software models were used in the laboratory to quantify aspects of 16 electrical tasks posing medium to high MSD risk. With ergonomic intervention, six of these tasks could be made safer for less than \$500 in new equipment. For example, laboratory tests showed that a pistol-grip screwdriver could double the torque that an electrician exerts, compared to a conventional straight-handle screwdriver.
- *EPRI Ergonomics Handbook for the Electric Power Industry: Ergonomic Interventions for Plant Operators and Mechanics in Fossil-Fueled Generating Stations—Progress Report* (1014084). This technical update describes progress in developing an ergonomics handbook for power plant operators and mechanics. It focuses on interventions for three tasks: coupling uneven railroad cars, cleaning condenser tubes, and manually tightening and loosening large nuts and bolts. Workers at We Energies brainstormed task improvements and tested possible changes in work practices, resulting in recommended ergonomic interventions. Research also included a detailed laboratory study of the effects of operating hand wheel valves on the activity of trunk and shoulder muscles. The final handbook will include ergonomic evaluations of 16 O&M tasks.

Previous EPRI Ergonomics Handbooks for the Electric Power Industry include: *Overhead Distribution Line Workers Interventions* (1005199); *Ergonomic Interventions for Manhole, Vault and Conduit Applications* (1005430); and *Ergonomic Interventions for Direct Buried Cable Applications* (1005574). For more information, contact Gabor Mezei, (650) 855-8908, gmezei@epri.com.

The Energy Independence and Security Act of 2007

On Dec. 19, 2007, President Bush signed into law H.R. 6, the Energy Independence and Security Act of 2007. One of the key issues for EPRI was the bill language authorizing funding for large-scale demonstrations of CO₂ capture and storage. The initial language in H.R. 6 for both capture and storage demonstrations was very limiting and not consistent with the CoalFleet RD&D plans. EPRI staff provided details of the capture and storage demonstrations needed to deliver a full portfolio of advanced coal with CO₂ capture and storage technologies by the year 2025 by meeting with Senate and House staff and by testifying before House and Senate Committees. Following these discussions, the final language in H.R. 6 for large-scale storage and capture demos is consistent with EPRI's RD&D plans. The UltraGen and CO₂ capture and storage projects EPRI is pursuing in coordination with the Southern States Energy Board would potentially qualify for federal funding. For large CO₂ storage demonstrations, the bill authorizes \$240 million per year from 2008-2012. For CO₂ capture demonstrations, \$200 million per year from 2009-2013 is authorized. If the non-federal matching funds are added to the federal amounts in the bill, the total for CO₂ capture and storage demos is \$688 million per year for 5 years. This is consistent with if not in excess of the CoalFleet recommendation for RD&D of \$830 million/year for both advanced coal technology and CCS.

EPRI Meeting With EPA on Closed-Cycle Cooling Research Projects

On January 8, 2008, EPRI (David Bailey, Doug Dixon, John Novak), EPRI contractors, and key advisors to EPRI's closed-cycle cooling project met with the EPA 316(b) regulatory development team. The meeting covered the following items: EPRI's Closed-Cycle Cooling Retrofit Cost Estimation Spreadsheet and Adverse Impact Quantification Methodology; EPRI plans for providing information by May 1, 2008 to inform the proposed Phase II rulemaking; and EPRI's Impingement and Entrainment Database. EPRI also asked EPA for suggestions for new areas of EPRI fish protection research.

EPRI Presentation at Resources for the Future

On January 16, Richard Richels was the speaker at the RFF First Wednesday Seminar on "How Much to Stabilize our Climate?: A Review of Recent Estimates". A recent study by the U.S. Climate Change Science Program updated scenarios of greenhouse gas emissions and concentrations. Three modeling teams (from the Massachusetts Institute of Technology, the Pacific Northwest National Laboratory, and Stanford and the Electric Power Research Institute) used integrated assessment models to compare alternative reference case scenarios. Richard Richels presented the study results and their implications for future emissions, the energy system, and the economy if CO₂ concentrations are stabilized at different levels. The audience included Congressional staff, government officials, representatives from trade associations, industry, environmental groups, the media and others. A video of Richard's presentation can be seen [here](#).

EPRI Cited by White House on Coal Technology R&D

On January 25, EPRI was mentioned in a Press Briefing by Council on Environmental Quality Chairman Jim Connaughton and Under Secretary of State for Democracy and Global Affairs Paula Dobriansky on the Second Major Economies Meeting. Jim Connaughton included the following in his response to a question on coal R&D, ".....By way of background though, for everyone around the room, in the course of the last two years, there's been a very intensive effort with MIT, a group at MIT, a group at the Electric Power Research Institute, and then some of the international sort of technical development bodies, to frame up what they think it will take for us to accelerate the effort to prove the concept of lower-carbon coal technology."

EPRI Input to National Academies Project

The National Academies have a major project underway called '[America's Energy Future](#)' to assess the timing, performance, and impacts of emerging energy technologies for the Nation. On Jan. 28 and 29, the National Academies' Fossil Energy subcommittee held a workshop in Washington D.C. to investigate the status of technologies for transforming carbon sources such as coal, natural gas, and biomass into products including electricity, diesel, gasoline, and methanol. EPRI was invited to participate in the workshop to provide its perspectives on future trends in fossil electricity generation technologies. John Novak participated in the workshop and gave a slide presentation on Advanced Coal and CO₂ Capture and Storage for Electricity

Generation. His talk addressed the role of advanced coal and CCS in a carbon constrained future, the challenges to be overcome, the RD&D needs, and the payoff of having the option of coal with CCS as an option to address climate change.

Report on EPRI Participation at the Climate Meetings in Bali, Indonesia

Background: EPRI participated in a panel discussion on CO₂ capture and storage (CCS) held at the 13th meeting of the Conference of Parties to the UN Framework Convention on Climate Change in Bali, Indonesia in December. The agreement to participate was made in May, when Bryan Hannegan and John Novak participated in the 26th meeting of the Subsidiary Bodies to the UN Framework Convention on Climate Change, part of the series of ongoing international discussions regarding greenhouse gases and climate change, in Bonn, Germany. The Bonn meetings provided an excellent opportunity to present EPRI's analysis on electric technologies in a carbon-constrained future to a global audience. During a meeting with business and industry representatives, the importance of CCS as an emissions reduction option was discussed. It was pointed out that many of the delegates from countries involved in the negotiations do not understand the concept of CCS and its importance. It was agreed that there was a need for education and for demonstrating CCS as a mitigation option. In response to a request from representatives of the oil and gas industry, EPRI committed to participation in a panel discussion on CCS in Bali.

Panel Discussion on CCS in Bali: The title of the panel discussion held in Bali on Monday, December 10 was "Business Perspectives on CO₂ Capture and Geological Storage (CCS): Enabling Widespread Application." The panel featured representatives from the coal, oil and gas, and electricity sectors and representatives from the European Union, IEA, and the IPCC. John Novak was the electricity sector representative on the panel. The meeting attracted a capacity audience of more than 70 attendees. J. Novak's presentation included slides from the PRISM and MERGE analyses and from CoalFleet™ for Tomorrow. The event highlighted EPRI's research on the crucial role of CCS and on the need for RD&D. The agenda for the panel discussion and copies of the slide presentations can be found at <http://www.ipeca.org/bali-ccs/index.php>.

Contacts with Conference Participants: In addition to participation in the CCS panel discussion, during the Climate Conference J. Novak held meetings with international participants to brief them on the results of the PRISM/MERGE analysis, on the global PRISM/MERGE proposal, and on UltraGen and other critical RD&D. J. Novak also met with delegates from a number of countries, the European Union, the UNFCCC Executive Secretary, the World Business Council for Sustainable Development President, and others. Additionally, J. Novak met with representatives from EPRI member companies - Eskom, Eon UK, EdF, ENEL, and Rio Tinto. On the national level, J. Novak made contact with U.S.- based participants, including Hill staff, U.S. government officials, World Bank, World Resources Institute, NRDC, Industrial Union Council, and RFF, providing the opportunity for follow up meetings in Washington. There was widespread interest in a global PRISM/MERGE analysis.

Environment Sector Supplemental Projects

Air Quality

Program 42: Air Toxics Health and Risk Assessment

- [Measurement of Mercury Chemistry in Power Plant Plumes: An Intensive Field Study](#)
- "Global Pollutant Challenge." For more information, contact Leonard Levin, (650) 855-7929, llevin@epri.com.
- [Health Research to Inform the Revision of the Arsenic Cancer Potency Factor](#)
- "MercSyn—The Mercury Synoptics Experiment." For more information, contact Leonard Levin, (650) 855-7929, llevin@epri.com.
- [Mercury Experiment to Assess Atmospheric Loading in Canada and the United States \(METAALICUS\): Phase II, Evaluating the Effects of Loadings](#)

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

- Secondary Particulate Health Effects Research (SPHERES): Exploring the Influence of SO₂, NO_x and Acids on the Chemistry and Health Effects of PM-2.5
- Regional PM Characterization to Enable Source-Receptor Modeling: Data Collection

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

- Secondary Particulate Health Effects Research (SPHERES): Exploring the Influence of SO₂, NO_x and Acids on the Chemistry and Health Effects of PM-2.5
- Integrated Chamber and Panel Study (ICAPS)
- Tri-City Concentrated Ambient Particle Study (Tri-City CAPS)
- Children's Air Pollution Asthma Study: Part of the ARIES Program
- Detroit Cardiovascular Health Study
- Health Effects of Air Pollution and Particulate Matter Components: Texas ARIES
- Reanalysis of Key PM-Health Dataset
- Toxicological Evaluation of Realistic Emissions of Source Aerosols (TERESA)

Global Climate Change

Program 102: Global Climate Policy Costs and Benefits

- Developing GHG Emissions Offsets by Reducing Nitrous Oxide (N₂O) Emissions in Agricultural Crop Production
- Enhanced Assessment of Costs and Benefits of Climate Policy Proposals

Program 103: Greenhouse Gas Reduction Options

- Collaborative Analysis of CO₂ Policy Impacts on Western Power Markets
- CO₂ Capture and Storage Pilot Demonstrations 1.7-MW Chilled-Ammonia Pilot
- Corporate Climate Change Policy Risk Assessment
- Greenhouse Gas Risk Assessment
- Developing GHG Emissions Offsets by Reducing Nitrous Oxide (N₂O) Emissions in Agricultural Crop Production
- Enhanced Assessment of Costs and Benefits of Climate Policy Proposals

Land and Groundwater Issues

Program 49: Coal Combustion Products—Environmental Issues

- 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

- “Assessment of Downwind Exposure from Remediation of Former MGP Sites.” For more information, contact Jim Lingle, (414) 355-5559, jlingle@epri.com.
- *In Situ* Thermal Stabilization of Coal Tar
- MGP Odor Measurement, Prediction and Control
- Multi-Criteria Decision Analysis Model for Brownfields Development

Program 59: PISCES—Plant Multimedia Toxics Characterization

- LARK-TRIPP User's Group 2008
- Mercury Characterization & Control Interest Group (MerCCIG)

Water and Ecosystems

Program 53: Water Quality Criteria Development and Assessment

- Health Research to Inform the Revision of the Arsenic Cancer Potency Factor
- Scientific Evaluation of Arsenic Water Quality Criteria: Speciation and Bioaccumulation Issues
- Mercury Experiment to Assess Atmospheric Loading in Canada and the United States (METAALICUS): Phase II, Evaluating the Effects of Loadings
- Development of Site-Specific Water Quality Criteria

Program 54: Fish Protection at Steam Electric Power Plants

- Best Management Practices for Preventing Cooling Water Intake Blockage
- Environmental and Economic Effects of a Potential National Retrofit of Closed-Cycle Cooling Systems
- Full Range of 316(b) Phase II Compliance Support

Program 55: Watershed and Water Resource Management

- 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

- Mercury and Selenium FGD Water Blowdown Treatment
- Water Utilization in Cooling Systems: Recycling, Re-use, and Dry Cooling
- Biogeochemical Management of Ash Pond Sediments

Program 58: Hydropower Environmental Issues

- Development & Deployment of an Environmentally Enhanced Hydroelectric Turbine

T&D Environmental Issues

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

- In Situ Fixation and Sequestration of Metallic Contaminants
- Bioavailability of Arsenic in Contaminated Soils
- Remanufacturing Out-of-Service Treated Wood Poles
- Field Investigation of Changes to PCB Spills

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

- “Ergonomics Assessment of Vegetation Management.” For more information, contact Gabor Mezei (650) 855-8908, gmezei@epri.com.
- Occupational Health and Safety Trends Database: Customized Analysis

Upcoming Events

Environment Sector

Environment Sector and Area Council Advisory Meetings

Sept. 15–18, Baltimore, MD. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

Air Quality

Society of Toxicology Annual Meeting and ToxExpo

Mar. 16–20, Seattle, WA. Contact: Annette Rohr, (650) 855-2765, arohr@epri.com. More information is available at the [meeting website](#).

Aerosol and Atmospheric Optics: Visual Air Quality and Radiation

Apr. 28-May 2, Moab, UT. Contact: Naresh Kumar, (650) 855-2990, nkumar@epri.com

American Thoracic Society International Conference

May 16–21, Toronto, Canada. Contact: Annette Rohr, (650) 855-2765, arohr@epri.com. More information is available at the [conference website](#).

Environment Sector and Area Council Advisory Meetings

Sept. 15–18, Baltimore, MD. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

9th International Conference on Mercury as a Global Pollutant

June 7–12, 2009, Guiyang, China. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com.

Global Climate Change

Carbon Forum America

Feb. 26–27, San Francisco, CA. Contact: Adam Diamant, (510) 260-9105, adiamant@epri.com. More information is available at the [event website](#).

EPRI Annual Research Seminar

May 21–22, Washington, DC. Contact: Ana Montes, (650) 855-2165, amontes@epri.com.

Environment Sector and Area Council Advisory Meetings

Sept. 15–18, Baltimore, MD. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

Land and Groundwater Issues

MGP 2008

Mar. 4–6, Dresden, Germany. Contact: Andrew Coleman, (650) 855-2249, acoleman@epri.com or James Lingle, (414) 355-5559, jlingle@epri.com. More information is available at the [event website](#).

LARK-TRIPP Training Workshop

Mar. 11–12, Charlotte, NC. Contact: Naomi Goodman, (650) 855-2193, ngoodman@epri.com.

The Eighteenth Annual AEHS Meeting and West Coast Conference on Soils, Sediments, and Water

Mar. 10–13, San Diego, CA. Contact: Jim Lingle, (414) 355-5559, jlingle@epri.com. The conference is presented by the Association for Environmental Health and Sciences (AEHS). More information is available at the [event website](#).

6th International Conference on Remediation of Chlorinated and Recalcitrant Compounds

May 19–22, Monterey, CA. Contact: Andrew Coleman, (650) 855-2249, acoleman@epri.com. More information is available at the [event website](#).

Environment Sector and Area Council Advisory Meetings

Sept. 15–18, Baltimore, MD. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

9th International Conference on Mercury as a Global Pollutant

June 7–12, 2009, Guiyang, China. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com.

Water and Ecosystems

Water and Ecosystems Summer Advisory Council Meeting

June 24–25, Jackson Hole, WY. Contact: Kent Zammit, (805) 481-7349, kezammit@epri.com.

Environment Sector and Area Council Advisory Meetings

Sept. 15–18, Baltimore, MD. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

9th International Conference on Mercury as a Global Pollutant

June 7–12, 2009, Guiyang, China. Contact: Leonard Levin, (650) 855-7929, llevin@epri.com.

T&D Environmental Issues

The Bioelectromagnetics Society 30th Annual Meeting

June 8–12, San Diego, CA. Contact: Rob Kavet, (650) 855-1061, rkavet@epri.com. More information is available at the [event website](#).

2008 EMF Scientific Advisory Committee Meeting

June 17–18, Dallas, TX. Contact: Rob Kavet, (650) 855-1061, rkavet@epri.com. More information is available at the [event website](#).

Environment Sector and Area Council Advisory Meetings

Sept. 15–18, Baltimore, MD. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

12th International Congress of the International Radiation Protection Association

Oct. 19–24, Buenos Aires, Argentina. Contact: Rob Kavet, (650) 855-1061, rkavet@epri.com. More information is available at the [event website](#).

ICNIRP International Non-Ionizing Radiation Workshop

Oct. 22–23, Buenos Aires, Argentina. Contact: Rob Kavet, (650) 855-1061, rkavet@epri.com.

Occupational Health & Safety

Environment Sector and Area Council Advisory Meetings

Sept. 15–18, Baltimore, MD. Contact: Adina Kozuh, (650) 855-2991, akozuh@epri.com.

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