

## Consolidated Edison Company Uses EPRI Climate Policy Risk Assessment to Validate Business Model Under Future Greenhouse Gas Controls

Consolidated Edison Company of New York (Con Edison) wanted to examine its business model to determine its viability if national policies regulating greenhouse gases (GHG), including a price on carbon, were put in place. The company also wanted to assure its stakeholders—stockholders, customers, regulators and the environmental community—that it is committed to maintaining its status as an environmental leader in the utility industry. Con Edison was familiar with other EPRI climate policy risk analyses, but these projects had all been done for generation companies and Con Edison is primarily an electricity and natural gas distribution (“wires and pipes”) company. Con Edison asked EPRI to use its existing modeling framework to create a customized climate policy risk assessment, which would be the first for an energy distribution company. The assessment examined a wide range of carbon price scenarios, as well as sensitivity analyses on natural gas prices, and assessed the impact of those costs on both wholesale and retail electricity prices and customer demand response. The analysis concluded that even under high carbon price scenarios, elevating both the wholesale and retail price of electricity and where customers responded by conserving electricity, Con Edison’s business model was still robust and sustainable. The insights gained from this assessment can now be customized for other companies similar to Con Edison.

### A New Application for EPRI Climate Policy Risk Assessment

Con Edison operates one of the world’s largest energy delivery systems, supplying power to most of New York City and Westchester County. Its business includes providing natural gas service as well as owning and operating the world’s largest district steam service. Con Edison purchases most of the energy it distributes from a regional wholesale power market and only generates about 700 MW of electricity itself. The company was aware of EPRI and other industry presentations analyzing the effect that climate policy, in particular regulations on GHG emissions, would have on generating companies. Con Edison wanted to find out how its electricity and natural gas distribution business might be impacted and what long-range planning it should engage in to preserve the viability of its business model as well as its reputation as environmental stewards. Con Edison was recently ranked as the top utility in the Carbon Disclosure Project’s measurement of companies’ climate-change performance actions and was also cited by *Newsweek* magazine’s Green



Con Edison is the primary electricity supplier to New York City

### Challenge

As a company that primarily distributes—rather than generates—electricity, Con Edison needed to determine whether its existing business model would be sustainable and successful if greenhouse gases are regulated.

### Solution

EPRI customized existing analyses to examine a wide range of regulatory and economic scenarios that Con Edison might face if policies regulating greenhouse gases are enacted.

### Results and Benefits

EPRI’s assessment validated Con Edison’s business model as viable if national climate policies are put in place, enabling senior management to assure key internal and external stakeholders that Con Edison is poised to respond to potential climate legislation.

This was the first EPRI climate policy risk assessment for a “wires and pipes” company, resulting in new methodologies and insights that can be applied to similar companies.

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*“The immediate value of this project is that we’ve got an analysis prepared by a highly respected organization with an industry-wide perspective. We determined that our business model is robust even under a wide range of variables in carbon pricing.”*

~ William V. Slade,  
Project Specialist, Con Edison

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Rankings 2009 as one of the most environmentally friendly utilities in the United States.

Con Edison asked EPRI to use its existing modeling framework to create an analysis of the company's entire business and how it would be affected by climate policy, in particular a price on carbon. Paul Manning, Director Environmental Health and Safety, Con Edison, notes that Con Edison chose EPRI because, "They have an understanding of the industry. We knew the quality and we knew the players. If we'd gone elsewhere we probably would have had to start from scratch with somebody that wouldn't have been as familiar with the various inputs that would have to be gathered."

### EPRI's Climate Policy Risk Assessment Validates Con Edison's Business Model

EPRI began its analysis by focusing on the multi-state region from which Con Edison purchases wholesale electricity and how it would be impacted by carbon prices that varied from \$10-\$80/ton. The next step was to model how the potential changes in wholesale electricity prices would affect the retail prices that Con Edison charges its customers for natural gas and electricity. Finally, the assessment examined the demand response of Con Edison's customers and whether they might react to higher prices by conserving power. Possible retail price rate increases were compared to those typically approved by the state's public utility commission. Multiple scenarios were analyzed to ensure the assessment's conclusions were justifiable. To further strengthen the assessment, many organizations throughout Con Edison became involved in the project, including Environmental Health and Safety, Strategic Planning, Energy Supply, Gas Supply, Regulatory Affairs, Accounting, and Finance. Notes Manning, "That was critical for us. The buy-in and alignment we got internally as well as EPRI's ability to communicate how they were arriving at their conclusions ensured that the conclusions were supported."

The assessment concluded that climate policy would most likely have a modest impact on Con Edison's retail electric rates. Wholesale rate impacts were projected to be low due to slow load growth and aggressive energy efficiency and renewable portfolio standards requirements, resulting in low or modest increases in retail prices that would most likely be acceptable to the New York State Public Service Commission. Sensitivity analyses on the demand response of customers to higher rates showed only small reductions in retail electric and natural gas volumes even in extreme carbon price and elasticity scenarios.

The assessment results were presented to and accepted by Con Edison's senior management team in 2009. Con Edison can also use the assessment to demonstrate to investment and environmental organizations that its business model, future strategic planning and ongoing commitment to environmental stewardship are solid. Looking ahead, the assessment will also be a benchmark for Con Edison to review emerging legislative proposals and how its business might be impacted. Con Edison also is the recipient of a 2009 EPRI Technology Transfer Award for being a first demonstrator of this methodology for wires and pipes companies. Con Edison believes that EPRI's assessment can serve as a foundation for similar companies that might want to conduct comparable analyses. According to Manning, "This was a good application where EPRI had a process in place and the ability to apply it to a wires and pipes company. It was a good way for us to take advantage of our existing investment in EPRI and at the same time provide value to the utility industry."

### Related EPRI Products

Title	Product ID
EPRI Analysis Benefits Western Utilities by Examining Impacts of CO <sub>2</sub> Price on Western Power Markets, 2009	1018610
PRISM Analysis Benefits Oglethorpe Power Corporation: Shapes Response to a Carbon-Constrained Future, 2009	1018604

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## Duke Energy and EPRI Enhance Passive Treatment Method to Reduce Selenium Levels in Power Plant Wastewater

Marshall Steam Station of Duke Energy Carolinas, LLC needed to reduce the levels of selenium in the wastewater from a newly installed flue gas desulfurization (FGD) system. Duke previously built a constructed wetland treatment system (CWTS) at the station to treat wastewater, but internal treatment levels for selenium were not always met for FGD effluent within the station wastewater treatment system. EPRI recommended the addition of a vertical flow cell (VFC) pilot project. After some initial adjustments, the VFC reduced selenium at the internal outfall from the CWTS that would assure compliance with the new permitted limits and reduced already acceptable mercury levels even further. Duke project personnel recommended the addition of a full-scale VFC treatment system to the CWTS, using design parameters that were determined during the pilot study. Duke management selected this technology over several others for full implementation. By 2012, when compliance with new permit limits for selenium will be required, Duke expects to be fully compliant.

***“Applying VFC technology to FGD wastewater treatment had never been tried before. We knew this work was on the cutting edge, and that’s where EPRI stays, on the cutting edge.”***

*~ Ron Lewis, Senior Environmental Specialist, Water Management*

### Duke Taps EPRI’s Expertise in Passive Treatment Technologies

Passive treatment technologies use natural biogeochemical processes to treat wastewater and are potentially more environmentally and economically effective than other treatment methods. For more than a decade, EPRI has supported research and field applications of various passive treatment technologies—and Duke Energy has been a participant in and champion of this research since its inception.

Duke’s Marshall Steam Station is a coal-fired generating plant located on Lake Norman in Catawba County, North Carolina. In late 2006, Duke started operation of an FGD system and a CWTS at the station. Effluent from the FGD system contained elevated levels of several substances, with selenium being of specific concern for compliance. The CWTS proved effective at lowering mercury concentrations to acceptable levels. It also lowered selenium levels when the FGD system was installed; however, Duke’s newly issued permit included new limits for selenium (heretofore the permit only required monitoring), and the company’s environmental personnel knew that additional water treatment would be necessary for compliance.



*A pilot-scale vertical flow cell was added to an existing constructed wetland wastewater treatment system at Duke Energy’s Marshall Steam Station.*

### Challenge

Duke needed to reduce the levels of selenium in the wastewater from a newly installed FGD system at its Marshall Steam Station power plant in North Carolina.

### Solution

Duke and EPRI initiated a research study to evaluate whether adding a vertical flow cell to its existing constructed wetland wastewater treatment system would lower wastewater selenium levels—the first study of VFC use in treating FGD wastewater.

### Results and Benefits

Results showed that selenium levels could be reduced by VFC treatment to assure compliance with new permitted limits. Results are also being used to revise EPRI’s PT2 passive treatment design model for use by other EPRI members.

Ron Lewis, Senior Environmental Specialist, Water Management at Duke, says, "We knew from research EPRI had done previously that VFCs had removed selenium from wastewater, but VFCs hadn't been used to specifically treat scrubber effluent. So we decided to do a pilot study as a collaborative research project with EPRI. We knew this work was on the cutting edge, and that's where EPRI stays, on the cutting edge. EPRI already had the expertise, knew the vendors and technology, and could give us objective reviews." The project was the first study to apply VFC technology for FGD wastewater treatment.

Project researchers used anoxic reduction processes described in EPRI's PT2 passive treatment design model to design a pilot-scale VFC. Then a VFC test cell was constructed to receive a portion of the wastewater discharge. The test cell consisted of a standard 2000-gallon tank from a commercial vendor, filled with 1 foot of clean gravel, a woven organic mesh fabric, and 4 feet of aged spent mushroom compost. The compost provided for a reducing environment as a result of bacterial activity, precipitating the selenium from the effluent. "We wanted to get 24-hour retention time in the cell. We went for the premium grade of compost," says Lewis, "but the flow rate got slower and slower. So we replaced the compost with fresh sterilized mushroom compost, which was more porous. After that we could control the flow rate as we wanted. In a new application like this, a pilot test is essential to determine the design requirements you'll need for a full-scale system."

"EPRI gave us a basic list of parameters to collect, so we didn't have to struggle to identify what we should specifically monitor. EPRI researchers also worked with our lab people (Margaret Galvin-Karr, Supervising Scientist for Trace Metals and Inorganic Chemistry, and Jay Perkins, Scientist, Analytical Laboratory Customer Support) on the analytical side, confirming that we were using the right methods. We also knew that other EPRI members had wastewater substances of interest so we added those to the list. That benefits the industry as a whole, and Duke in case we are asked about those substances."

### Successful Results Lead to Plans for a Full-Scale VFC System

The VFC performed well in treating the selenium to required levels regardless of fairly large changes in influent concentrations and different concentrations of selenium species. Selenium levels at the internal outfall from the wetland treatment system were well within levels for compliance with the new permitted limits. Then the project team did a comparison of system results and costs with those of two other possible treatment systems, and recommended to Duke management that a VFC system be added to the existing CWTS. Management agreed and

decided to install a full-scale VFC system at the station. A portion of the existing CWTS will be replaced with six VFCs with construction to be completed in summer 2011.

To date, VFCs have been considered essentially "black-box" treatment systems using empirical data, rather than known removal mechanisms, to determine design criteria. EPRI research is under way to address these knowledge gaps. Says Lewis, "Our results will also be used to revise and refine the PT2 model, so members can use it to give them a guideline for construction of a VFC wastewater treatment system. I'm already talking to EPRI researchers about what additional research to conduct once we go full-scale."

Lewis, Galvin-Karr, and Perkins received an EPRI 2009 Technology Transfer award for their commitment to widening Duke's use of passive treatment technologies, expanding industry understanding of how these technologies work best, and making this knowledge available industry-wide.

### Related EPRI Products

Title	Product ID
Vertical Flow Cell Pilot Study: Duke Energy, Marshall Steam Station, Spring 2010	1017959
Vertical Flow Wetland Pilot Study, 2008	1016811
Predictive Maintenance, Design, Construction, and Maintenance for Passive Treatment of Wastewaters and the PT2 Passive Treatment Planning Tool V1.0, 2002	1005352
Speciation of Trace Elements in Biological and Environmental Samples by X-ray Absorption Spectroscopy: The Role of Plants and Microbes in Remediation, 2001	1006507
The Springdale Project: Applying Constructed Wetland Treatment to Coal Combustion By-Product Leachate, 1998	TR-111473

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## EPRI Researches Alternative Condensible Particulate Matter Test Method to Help Wisconsin Public Service Measure Emissions



*Integrus Energy Group subsidiary Wisconsin Public Service's Weston 4 plant near Wausau, Wisconsin is an award winning power plant with advanced environmental control technologies.*

Wisconsin Public Service (WPS)'s new Weston 4 plant in Wisconsin uses advanced emissions control technologies. Although the plant was issued an air pollution control permit by the Wisconsin Department of Natural Resources (WDNR), WPS was required to conduct numerous particulate matter emissions tests to ensure compliance with state and federal regulations. The testing methods that the U.S. Environmental Protection Agency (EPA) required were known to produce results with a positive bias towards higher sulfate levels—resulting in higher condensable particulate matter (CPM) emissions—but no other method had been approved for conducting the tests. In response, WPS formed a working group to work with WDNR and other regulators on the issue, but the group was unable to convince regulators that the testing bias was a significant problem. EPRI quickly put together a project exploring an alternative method which underwent thorough laboratory testing, while EPA conducted similar tests. EPRI was able to quickly analyze and document the results of its testing, and this information was used to provide input to EPA's evaluation of the alternate test method. EPA and the WDNR gave permission for WPS to use the alternate test method at all of their Wisconsin facilities, saving the company the costs of retesting, retrofitting its plants, and incurring non-compliance penalties. WPS and other power companies now have a condensable particulate matter test method that will ensure greater accuracy as they strive to meet environmental goals.

### WPS Turns to EPRI to Evaluate Alternative CPM Test Method

In June 2008, WPS began commercial operation of its new Weston 4 power plant. Weston 4 is a state-of-the-art, 525-MW pulverized coal plant with numerous advanced environmental control technologies. Weston 4 was named 2008 Power Plant of the Year by Power Magazine, and was a Platts Global Energy Finalist for 2008 Construction Project of the Year. Although the plant had been issued an air pollution control permit by the WDNR, WPS was required to conduct numerous particulate matter emissions tests to ensure compliance with state and federal regulations. Test Method 202, required by EPA, produced a positive bias toward sulfate for sources emitting sulfur dioxide, resulting in inaccurate, increased levels of measured CPM. WPS wanted to ensure its test results would be as accurate as possible, so they formed a group to work with regulators on the issue and to investigate possible alternative test methods.

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***“It was remarkable how quickly EPRI was able to put the project together, facilitate a partnership with EPA and accomplish so much research.”***

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*~ Cindy Brandt  
Integrus Energy Group*

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### Challenge

Wisconsin Public Service needed to ensure that its new Weston 4 power plant would meet state and federal emissions regulations. But, current testing methods were known to produce inaccurate results for Condensable Particulate Matter (CPM), which could result in additional costs for retesting or non-compliance penalties.

### Solution

EPRI quickly initiated research and published the results on an alternative CPM test method that showed greater accuracy for measuring CPM emissions.

### Results and Benefits

- EPRI's research will help ensure more accurate CPM test results, benefiting all power companies that must perform particulate matter testing.
- The EPRI technical report on the alternative test method was published and entered into the EPA docket for public review, where it will help inform future regulations.
- Wisconsin DNR granted WPS permission to use the alternative test method for its particulate matter compliance testing at all of its Wisconsin facilities, including Weston 4, avoiding costly retesting, retrofits and noncompliance penalties.

WPS asked Naomi Goodman, a Senior Project Manager in EPRI's Power Plant Toxics Characterization program, for assistance. EPRI was already participating in an EPA stakeholder group formed to provide input into the development and testing of a procedure designated Other Test Method 28 (OTM-28), a modification to EPA's existing Method 202 for measuring CPM. OTM-28 replaces the first two water-filled impingers of Method 202 with dry impingers in an ice bath. Initial tests demonstrated that the new method substantially reduced the formation of sulfate, and OTM-28 was published by EPA in the Federal Register for public comment in March 2009. Goodman quickly initiated a research project, funded by WPS and several other companies, to evaluate OTM-28 under rigorous test conditions. According to Goodman, "EPRI believed this approach needed to be tested more thoroughly in the lab and the test results showed that OTM-28 was less likely to overestimate CPM emissions because it minimized the conversion of sulfur dioxide to sulfuric acid."

**EPRI Research Provides an Alternative CPM Test Method and Informs the Regulatory Process**

The results of EPRI's laboratory tests on OTM-28 and other alternative CPM test methods were provided to EPA, and also published in an EPRI technical report in September 2009. The information will assist power plant permitting staff in evaluating air permit monitoring requirements, developing sampling and analysis plans, and evaluating CPM test results. In addition, EPRI's research results were important factors in

WDNR's decision to allow WPS to utilize OTM-28 when conducting its particulate matter testing at all facilities. Cindy Brandt, a Senior Environmental Consultant at Integryns, notes, "Getting the DNR to approve the use of the dry impinger method for all of our sources gives us a greater compliance margin because our measurements are that much more accurate." WPS is the recipient of an EPRI Technology Transfer Award for its role in collaborating with EPRI, EPA, and other stakeholders to help test OTM-28 and communicate the test results. They are grateful to Goodman and EPRI for their rapid response in establishing the project. Says Brandt, "We were really impressed at how smoothly and quickly EPRI was able to address such a detailed technical issue, especially one that required so much testing and measurement data." In addition to providing WPS with a solution to its immediate problem, EPRI has once again rigorously evaluated a test method and gotten the research results into the regulatory, scientific and public arenas. The CPM test results will help inform the regulatory process, strengthen the scientific validity of OTM-28, and provide a valuable tool to any power company or manufacturer to accurately test its CPM emissions.

**Related EPRI Products**

Title	Product ID
<i>Evaluation of Alternative Condensible Particulate Matter Measurement Methods, 2009</i>	1017976

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## EPRI and Minnesota Power Conduct Innovative Study of Water Fluctuation Effects on Mercury in Reservoirs

During the relicensing process for its St. Louis River hydroelectric project, Minnesota Power (MP) agreed to initiate research into whether the daily and seasonal fluctuations in reservoir water levels supplying the project had any effect on the creation or mobilization of methylmercury within the reservoirs. With agreement from the two other major stakeholders—the Minnesota Pollution Control Agency (MPCA) and the Fond du Lac Band of Lake Superior Chippewa—MP requested that EPRI manage a collaborative study. It was the first integrated laboratory and field study to test the hypothesis that methylmercury creation and mobilization were associated with reservoir fluctuation. “It was believed by the resource agency and tribal regulators that fluctuating water levels in storage reservoirs could enhance bacterial activity in connected wetlands, thereby increasing mercury methylation and mobilization. This experiment demonstrated the relationship between water fluctuations and methylmercury isn’t nearly so simple,” said MP’s Kurt Anderson, Environmental Compliance Specialist. Instead, the results showed that the chemistry and mobilization of mercury are much more complex than the hypothesis indicated. Understanding these processes requires a comprehensive analysis of many factors operating throughout the surrounding watershed—analyses in which EPRI has extensive experience and proven tools. MP is now well positioned to consider this study’s results with regulators, supported by EPRI’s recognized scientific credibility and confidence of EPRI’s ability to help extend the research to a wider watershed scale if necessary.

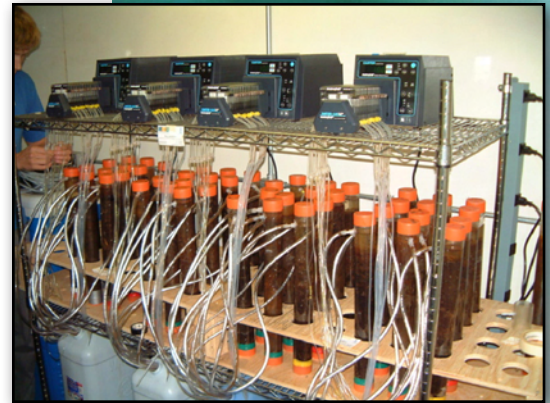
***“This experiment demonstrated the relationship between water fluctuations and methylmercury is far more complex than originally thought.”***

***~ Kurt Anderson, Environmental Compliance Specialist***

### Minnesota Power Asks EPRI to Examine Reservoir Fluctuation Effects

MP operates 11 hydroelectric power stations in northern and central Minnesota. Its St. Louis River hydroelectric project near Duluth has a history stretching back to 1905, when construction began on the first of four hydroelectric units on the river. The five headwater storage reservoirs that currently feed the St. Louis River project are subject to seasonal water level fluctuations to provide for winter generation. During lower flow months, a sixth peaking reservoir is also used to meet day-to-day energy needs with a daily drawdown and refill cycle over a 24 hour period. In the headwater storage reservoirs, a slow but steady seasonal drawdown is used to provide generation from freeze up in November until the spring thaw in April.

During the federal relicensing process for the St. Louis River project, which began in 1993, new research results from Canadian studies began to appear, showing that newly formed reservoirs for hydro projects were associated with increased mercury levels in reservoir fish tissues. As a



*EPRI and Minnesota Power conducted a first-of-its-kind integrated laboratory and field study on the impacts of reservoir water level fluctuation on methylmercury production and mobilization.*

### Challenge

To meet hydropower facility relicensing requirements, Minnesota Power needed to research whether fluctuations in reservoir water levels affect the creation and mobilization of mercury within a reservoir.

### Solution

Minnesota Power asked EPRI to manage this study based on EPRI’s past experience in mercury research and its knowledge of the environmental, utility and regulatory arenas.

### Results and Benefits

Results did not demonstrate a simple relationship between water level fluctuation and mercury chemistry and mobilization, but rather revealed the complexities of the process and provided data for Minnesota Power’s continued discussions with regulators and further research.

result, the issue of mercury and its possible sources became part of regulatory considerations for the St. Louis River project relicensing. The MPCA and the Fond du Lac Band expressed concern that, although the project's headwater reservoirs were not new, fluctuating water levels in existing reservoirs might affect levels of mercury in fish tissues in ways similar to new reservoir construction. Several mercury scientists hypothesized that such fluctuations might increase biological activity of sulfate-reducing bacteria, or SRB, which in turn could increase mercury methylation rates in near-shore sediments in the reservoirs. Additionally, the flux of water between these wetlands and the reservoirs was thought to increase mobilization of methylmercury into the water column. However, no research had been conducted to examine this hypothesis. As part of its relicensing agreement, MP agreed to undertake research on this topic.

MP suggested that EPRI manage the study, citing EPRI's record of research in the western Lake Superior watershed in northern Minnesota on mercury biogeochemical cycling. With agreement from MPCA and the Fond du Lac Band, MP and EPRI undertook the study as a collaborative project. EPRI's research management experience was of immediate value. Lowell Neudahl, Senior Environmental Compliance Specialist, commented, "I can't say enough about how [EPRI's] Bob Goldstein helped with the contract negotiations between EPRI and the contractor that did the work."

With extensive help from Neudahl and Anderson, the contractor chose two reservoirs and a natural lake within the watershed for collection of field samples: Boulder Lake, an annual drawdown reservoir; Thomson Reservoir, a peaking reservoir; and Alden Lake as a control. The field work for the study established total mercury and methylmercury levels at the three sites. The laboratory research addressed three issues:

- Effects of water-level fluctuation on methylmercury production in the wetland soils
- Mobilization of total mercury and methylmercury from the wetland soils to the reservoirs' water column
- Effects of winter drawdown on methylmercury production in wetland sediments along the shores.

### Results Show Complexity of Methylmercury Creation and Mobilization Processes

Results from extensive laboratory analyses did not support the simple hypothesis that increased water-level fluctuation increases methylmercury formation or mobilization. Results were in fact mixed, showing that

aquatic chemistry and mercury mobilization are much more complex than could be accounted for by the study design. However, the study laid the groundwork and clarified the possibilities for further research that could address the issue more thoroughly—for example, the role of wetland types, drawdown duration, and fluctuation frequency in methylmercury production and mobilization. MP can now use this information to continue discussions with its regulators and satisfy additional research or relicensing needs.

Bob Goldstein observed, "This was a highly original study, looking at things that hadn't been looked at before. It combined studies of microorganisms with chemical studies, and it built a good foundation for future research in this area. Lowell and Kurt were very active participants throughout the project, both to meet MP's needs and to help out other utilities facing similar issues. EPRI is pleased to recognize their genuine commitment to the industry with a 2009 Technology Transfer award."

Said Anderson, "Having someone like Bob who understands our perspective from a power generation standpoint has been really valuable. He understands the issues; he's knowledgeable about environmental concerns and also about what we'd have to do as a company if we were restricted on our water management. If we are required by our regulators to continue this research, EPRI's expertise will be very helpful in stepping it up to more of a risk-based, watershed-wide analysis."

### Related EPRI Products

Title	Product ID
Applicability of Regional Total Maximum Daily Loads (TMDLs) for Atmospheric Deposition of Contaminants: Mercury and Nitrogen, 2009	1015581
TMDL Technical Evaluation Framework, 2009	1015580
Enhancement of Watershed Analysis Risk Management Framework (WARMF) for Mercury Watershed Management and Total Maximum Daily Loads (TMDLs), 2006	1005470

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## EPRI, National Grid Collaboration Advances Electric and Magnetic Fields Science

The issue of whether electric and magnetic fields (EMF) from transmission lines and electrical equipment are associated with health effects has been the subject of hundreds of studies for more than 35 years. National Grid operates the electricity transmission system for the whole of England and Wales and transmission and distribution systems in the northeastern United States, and has devoted considerable resources to studying EMF and working with regulatory and public stakeholders to address their concerns. Two of National Grid's most critical investments in understanding the EMF issue are its staff of dedicated researchers and its long-standing membership in EPRI's EMF program. EPRI membership provides National Grid with opportunities to collaborate with other EMF researchers, inform preparation of standards and regulations in the United States and Europe, strengthen the scientific body of knowledge about EMF and sustain an ongoing dialogue with its customers and the public to address EMF concerns.

### Understanding and Communicating EMF Science is Critical to National Grid

EMF is produced by many sources, including electricity power lines and substations, electrical wiring and equipment. The question of whether EMF associated with the electricity transmission and distribution systems and with residential use affects human health has been studied for decades by scientists around the world, and has also been discussed extensively in the media and other public forums. As the demand for electricity capacity and reliability increases, power lines and other electrical equipment are added or upgraded, and companies need to address the EMF issue with regulators, customers, and other stakeholders.

***“EPRI has the only program that addresses the whole breadth of the EMF issue with high-quality, well-managed, research.”***

***- David Renew, EMF Scientific Advisor, National Grid***

As one of the world's largest investor-owned utilities and the largest electricity transmission company in the U.K., National Grid has developed and maintained a robust program of research on, and communication about, the possible association between EMF and human health. National Grid has a team of three scientists who focus on the spectrum of EMF subjects—including occupational, regulatory and standards issues—as well as participating in a wide variety of EMF scientific research activities. Although its investment in EMF helps address compliance issues and reduce risk and liability, National Grid also is committed to its customers and the communities it serves. National Grid proactively addresses EMF concerns through a public EMF website and regular communication with customers, the public and other stakeholders. Another key component of its EMF management strategy is a long-standing, active participation in EPRI's EMF program.



*National Grid is one of the world's largest investor owned utilities and provides electricity to most of the U.K.*

### Challenge

As the owner of the electricity transmission network in the United Kingdom and transmission and distribution systems in the northeastern United States, National Grid looks to collaborate on EMF research, advance EMF science and keep an open dialogue about EMF health concerns with customers, regulators and the public.

### Solution

National Grid has relied on and actively participated in EPRI's EMF program for more than a decade, collaborating with EPRI on many projects and peer-reviewed studies.

### Results and Benefits

National Grid has used EPRI's research results to inform the writing of international standards set by CENELEC (the European Committee for Electrotechnical Standardization).

EPRI, National Grid and another European utility cosponsored an international conference that advanced the science around EMF exposure guidelines.

An EPRI study on field exposures for U.K. electrical workers helped support a National Grid regulatory safety case.

## EPRI Membership Helps National Grid Contribute to and Communicate EMF Scientific Knowledge

EPRI has been studying the EMF issue for more than 35 years and is one of the only organizations that perform long-term, multidisciplinary EMF research. EPRI's program also includes an external, blue-ribbon scientific advisory committee that provides guidance for the program's research activities. National Grid has been a member of EPRI's EMF program since the 1990s, and during that time has actively led or participated in several important research efforts. National Grid collaborated with EPRI and another large European utility to cosponsor an international workshop on "EMF Exposure Guidelines Science," which introduced important new concepts to inform exposure guidelines, and also resulted in publication of a special issue of *Health Physics*, the journal of the Health Physics Society. National Grid recently co-managed a groundbreaking study with the U.K.'s Health Protection Agency to compute the absorption rate of radio-frequency exposures in the near field of an antenna. National Grid also worked with EPRI on numerous published studies, which contribute to the ever-increasing body of scientific knowledge about EMF. John Swanson, one of National Grid's EMF Scientific Advisors, believes its EPRI membership helps National Grid stay connected with its peers and the advancing body of EMF science throughout the world. He notes that if National Grid didn't belong to EPRI, "we wouldn't have the kind of direct access to the global program that EPRI gives us. EPRI is pretty well the only broad EMF research program left in the world today."

To help communicate information about EMF to its customers and the public, National Grid also maintains a public EMF page on its corporate website containing useful information about the EMF issue as well as links to other sites, including EPRI's. National Grid also uses its research in working with European standards bodies such as CENELEC (the European Committee for Electrotechnical Standardization) to help establish EMF exposure limits. According to Hayley Tripp, a National Grid EMF Scientist, "We depend on the independent research that EPRI has done and use that to contribute towards standards preparation. Review bodies know that EPRI research is high quality and that it's adding to the body of EMF science."

In recognition of its strong and ongoing collaboration with EPRI, National Grid is the recipient of an EPRI Technology Transfer Award for its active role in helping to develop and shape the EMF program. The Award also states that National Grid's EMF work aligns directly with its company objectives to take a leadership role on safety and the environment. EPRI Senior Technical Executive Robert Kavet recognizes the value of EPRI's

collaboration with National Grid. "It's important for EPRI to have such active members in the program who can bring ideas back to us. They give us an extra layer of oversight." David Renew, an EMF Scientific Advisor with National Grid, summarizes EPRI's and National Grid's collaborative efforts by saying, "The kind of research that EPRI has done and our contribution to it is important. I think it has made a significant difference to the development of the issue and how it's managed in the electricity industry."

### Related EPRI Products

Title	Product ID
Program on Technology Innovation: Analyses of International T&D Systems with the Contact Voltage Modeler (CVM) Program, 2006	1013310
Renew DC, Glover ID. 2002. Basic restrictions in EMF exposure guidelines.	<i>Health Physics</i> , September 2002, Volume 83, Issue 3
Sheppard AR, Kavet R, Renew DC. 2002. Exposure guidelines for low-frequency electric and magnetic fields: report from the Brussels workshop.	<i>Health Physics</i> , September 2002, Volume 83, Issue 3
Swanson J. 2002. A transmission utility's experience of applying EMF exposure standards.	<i>Health Physics</i> , September 2002, Volume 83, Issue 3
Dawson TW, Caputa K, Stuchly MA. 2002. Magnetic field exposures for UK live-line workers.	<i>Physics in Medicine and Biology</i> , April 7, 2002, Volume 47, Number 7
Gabriel C, Peyman A, Grant EH. 2009. Electrical conductivity of tissue at frequencies below 1 MHz.	<i>Physics in Medicine and Biology</i> , August 21, 2009, Volume 54, Number 16

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## PNM Resources Avoids Substation Retrofit Costs Through Oil Spill Risk Evaluation

In 2008, PNM Resources assembled a Spill Prevention, Control and Countermeasures (SPCC) team to assess the risk of an oil spill at one of its substations or switching stations reaching surface waters. An earlier risk assessment recommended costly containment retrofits at about half of the company's stations in New Mexico. The company used EPRI's Mineral Oil Spill Evaluation System (MOSES) software tool to reevaluate the potential risks of an oil spill reaching water. The data provided by MOSES and the subsequent SPCC plans developed by PNM Resources demonstrated that fewer than 30% of its New Mexico stations required containment retrofits, which saved more than \$800,000 in retrofit costs. With PNM Resources' membership in the EPRI research program, this equates to an 80:1 cost-benefit ratio. In addition, by using MOSES to evaluate its recently-acquired stations in Texas, the company was able to get an accurate picture of where containment retrofits were needed. The SPCC evaluations using MOSES ensure that PNM Resources will be able to comply with both current and future SPCC rules, as well as helping address corporate sustainability and environmental goals.

### PNM Resources Uses EPRI's MOSES to Update SPCC Plans

PNM Resources is an energy holding company that provides electricity to nearly 900,000 customers in New Mexico and Texas. Like many energy companies, PNM Resources must comply with SPCC regulations designed to prevent oil discharges from reaching navigable waters or adjoining shorelines. The SPCC Rule requires companies to have plans in place that describe the equipment, workforce, procedures, and training to prevent, control and provide adequate countermeasures to a discharge of oil at one of its facilities.

In 2005, PNM Resources revised SPCC plans for all of its New Mexico facilities. These plans recommended containment retrofits at more than half its substations and switching stations. The recommendation assumed that any station where oil could leave the property should have a containment feature. Since PNM Resources' New Mexico stations are located in arid regions

where there are few bodies of water and very little rainfall, the company wanted to reevaluate the assessment to determine if so many containment retrofits really were needed. In 2008, the company assembled an SPCC team to address this issue, but the team needed a better methodology to re-assess the risk that oil from one of its facilities could reach water. In addition, the company had recently acquired additional stations in Texas that had to be evaluated. PNM Resources also faced a compliance deadline for the SPCC Rule, which was being reviewed and amended by the U.S. Environmental Protection Agency.

***“MOSES was really important to our approach. It gave us a way to measure, compare and rank our substations, saving our company nearly \$1 million in retrofit costs.”***

***~ John Acklen, PNM Resources***



PNM Resources used an EPRI software tool for spill prevention, control and countermeasures evaluations of possible oil spills at substations and switching stations in New Mexico and Texas.

### Challenge

PNM Resources needed to more accurately evaluate the risk of substation oil spills reaching surface water before committing to significant containment retrofit expenditures.

### Solution

PNM Resources used EPRI's MOSES tool and expertise to develop an integrated program to thoroughly evaluate these risks.

### Results and Benefits

PNM Resources' integrated risk evaluation program resulted in a replicable approach that removed much of the bias in evaluating risk across a variety of physiographic and climatic zones.

Using MOSES saved PNM Resources more than \$800,000 from avoided containment retrofits in New Mexico and ensured compliance with SPCC regulations.

This project underscores PNM Resources' commitment to the environment and to sustainable business practices.

John Acklen, the manager of the SPCC project, turned to EPRI for guidance. He recalls, "We thought of EPRI right away. We started looking at MOSES and realized that this was a way to really evaluate the potential for oil reaching water. That's what this tool is all about." The MOSES-MP software tool provides an easy-to-use method for predicting the likelihood of mineral oil spills from substations reaching groundwater or nearby surface water, how much oil will infiltrate the ground beneath electrical equipment, and soil saturation profiles at user-specified times. The program also creates a draft SPCC plan that automatically incorporates site characteristics and simulation results into an editable text file that can be customized to include utility-specific information.

PNM Resources used MOSES to evaluate all of its stations in New Mexico and Texas. By conducting field investigations at these facilities, and then using that data to populate MOSES, the SPCC team was able to accurately predict the likelihood of oil spills reaching water. Notes Ted McCarty, an SPCC team member who worked on evaluating the Texas stations, "MOSES took the guesswork out of it by giving us definitive and quantitative information that we could use as a guide."

### MOSES Helps Avoid Costly Retrofits, Comply with SPCC Regulations and Meet Environmental and Sustainability Goals

After revising the SPCC evaluations with MOSES, PNM Resources concluded that containment retrofits at 28 of 96 New Mexico stations were warranted. Compared with the 2005 SPCC plans, this new evaluation saved the company more than \$800,000. As a member of EPRI's research program, PNM Resources realized an 80:1 cost-benefit ratio from using MOSES. The company also used MOSES to evaluate 127 stations owned by its subsidiary, Texas-New Mexico Power. These stations are located in a variety of areas, from arid desert to the Gulf Coast, so some stations have a greater likelihood of oil spills reaching water. MOSES helped assess the risks at these stations and develop the necessary SPCC plans. PNM Resources is developing multi-facility plans to be posted on the company website. Each plan will contain information about the SPCC rules, facility-specific information, and results of the MOSES analyses.

PNM Resources is receiving an EPRI Technology Transfer Award for its innovative use of MOSES in arid climates such as New Mexico. The award recognizes the large team of people from throughout the organization who contributed to developing the SPCC plans and underscores the value of membership in this research program. In addition to developing accurate facility plans that will help comply with the SPCC rule, PNM Resources also made progress toward sustainability goals, which are an important part of the company's business. According to Acklen, "Taking action to actively deal with threats to the environment is part of being a sustainable utility." Mary McLearn, the EPRI Senior Project Manager and MOSES expert adds, "I've spent time working with PNM on various issues. The company has a real commitment to doing things right and improving its environmental performance." In addition, PNM's SPCC project and its use of MOSES can provide valuable information to other utilities facing similar issues.

### Related EPRI Products

Title	Product ID
MOSES Leak Tool 1.0 (2007)	1014055
Oil Fires in Electrical Equipment (2006)	1012601
Templates for Spill Prevention, Control, and Countermeasure Plans (2004)	1009430
Training Materials for Spill Prevention, Control and Countermeasure Plans (2004)	1009467
Spill Prevention, Control, and Countermeasure (SPCC) Design Options (2004)	1009468
MOSES-MP Helps Central Hudson Gas & Electric Assure Environmental Protection at Substations at Reduced Cost, 2003	1007393
Innovation in Storm Water and Oil Spill Control Techniques for Substations (2002)	1007508
Mineral Oil Spill Evaluation System - Multi Phase Code, Version 3.0 (2002)	1006479

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## Tri-State Develops Greenhouse Gas Management Roadmap through EPRI R&D

As part of its ongoing comprehensive risk identification and analysis strategy, Tri-State Generation and Transmission Association (Tri-State) initiated an enterprise-wide effort to assess its ability to manage the risks associated with potential greenhouse gas emissions constraints. The result of these efforts was a Greenhouse Gas Management Roadmap that serves as an internal planning tool and was communicated to policymakers, its member cooperatives, and numerous other stakeholders. One of Tri-State's most significant findings from the Roadmap project was how fully engaged it is with EPRI throughout the organization and how crucial its full participation in EPRI's R&D portfolio will continue to be in helping identify its potential for short- and long-term emissions management. Tri-State now has an effective, flexible planning tool to help shape future efforts and communicate progress to internal and external stakeholders.

### **Tri-State Uses EPRI Information and Tools to Assess Its Ability to Manage the Risks of Potential Greenhouse Gas Emission Controls**

Tri-State is a not-for-profit wholesale power supplier owned by 44 member distribution cooperatives operating in Colorado, New Mexico, Nebraska and Wyoming. Three states and one regional group have initiatives associated with potential climate change policy, and potential federal legislation or regulations could place a cost on greenhouse gas emissions. The organization decided to develop an enterprise-wide plan to assess its ability to manage the risks associated with possible constraints on its greenhouse gas emissions across its multi-state system. The effort involved almost every organization within Tri-State, according to Lee Boughey, senior manager, communications and public affairs, who says "We developed a comprehensive Roadmap that identified our technology strategies and compiled all the different initiatives, assessments and studies into one plan." Tri-State drew heavily on information and tools developed by EPRI to help shape its Roadmap. It used EPRI's PRISM analysis, which assesses how the electricity sector can reduce greenhouse gases, as well as a site-specific greenhouse gas emissions inventory that EPRI completed in 2007. Tri-State also based the Roadmap on many EPRI projects with which it is involved, including carbon capture and sequestration and renewables technologies.

In June 2009, Tri-State announced completion of its Greenhouse Gas Management Roadmap. Tri-State stated that its success in meeting emission reduction goals will be heavily dependent on developing cost-effective energy and environmental technologies, and that this effort was a vital part of its resource planning strategy. In addition,

***"Our full partnership with EPRI is critical to our future success."***

*~ Barbara Walz, Vice President, Environmental*



*At its Escalante Station, Tri-State is testing steam augmentation using concentrated solar power as greenhouse gas emissions reduction technology.*

### **Challenge**

Tri-State needs to manage the risks it could face from potential constraints on greenhouse gas emissions while continuing to cost-effectively and reliably meet the energy requirements of its member distribution cooperatives.

### **Solution**

Tri-State developed a comprehensive, enterprise-wide Greenhouse Gas Management Roadmap to help shape its approach to resource planning, assessments and analysis.

### **Results and Benefits**

- Tri-State's Roadmap relies heavily on its full participation in EPRI's R&D portfolio, which provides synergistic information and tools that Tri-State will use to assess and implement its strategy.
- The efforts involved in producing the Roadmap validate how effectively Tri-State uses its investment in EPRI, as demonstrated by receipt of an EPRI Technology Transfer Award.
- Tri-State will use its Roadmap to communicate its strategy to both internal and external stakeholders.

Tri-State noted that it submitted the Roadmap to state policymakers, its member cooperatives and other external stakeholders. Tri-State believes the Roadmap displays a commitment to address greenhouse gas management while continuing to provide reliable and affordable electricity to its members through multi-faceted R&D and engagement with state and federal agencies. "Continued pursuit of Roadmap actions and achievement of milestones will help us analyze our potential options for future resources," said Boughey. "And the roadmap is an important tool to communicate to policymakers and the public the challenges to address greenhouse gas emissions, the need for technology investment, and how Tri-State is taking meaningful steps to develop the technologies that we could need in the future."

### Roadmap Demonstrates Full Engagement with EPRI as Crucial Business Strategy Component

The goals laid out in the Roadmap are wide-ranging, including clean coal, carbon capture and storage and renewables technologies, generation and transmission efficiencies, demand-side management and research, and development and demonstration initiatives. One of the key conclusions is that Tri-State's investment in EPRI's entire R&D portfolio has and will continue to provide a foundation for most of the objectives identified in the Roadmap. Notes Barbara Walz, Vice President, Environmental, "The end result of this project was a realization that a large portion of what we're doing regarding GHG management throughout the company relies heavily on EPRI R&D and tools, as well as our implementation of EPRI products." Full participation in EPRI allows Tri-State to take advantage of the synergies between EPRI's broad array of collaborative RD&D programs, as well as providing access to all of EPRI's

research results and products. In addition, Tri-State has an internal committee that regularly reviews EPRI's entire portfolio of programs and projects to ensure that Tri-State is getting maximum value from its investment.

In recognition of how the Roadmap reflects successful collaboration with EPRI, Tri-State is the recipient of an EPRI Technology Transfer Award for its leadership in education and information exchange of technology and research results. EPRI's Tom Wilson, who has worked closely with Tri-State on many climate change projects, notes, "I think it's a wonderful example of how a company took the initiative to use EPRI information. We have so much information here that it's sometimes overwhelming. We're really impressed with how they were able to pull this together and communicate their strategy." Tri-State believes its Roadmap is a living document that will evolve over time, and that the success of the Roadmap's objectives is strongly tied to EPRI. According to Walz, "Through the EPRI research program we can participate and have access to cutting-edge information on energy technology and greenhouse gas management. While we created the Roadmap internally, the EPRI portfolio is an enabler for us to be able to do much of the work. EPRI is an invaluable partner in helping us achieve our mission."

### Related EPRI Products

Title	Product ID
<i>Prism/MERGE Analyses 2009 Update</i>	1019563
Understanding the Impact of Climate Policy on Electric Company Compliance and Investment Decisions	1015635

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## EPRI and TVA Provide Critical Scientific Input to Air Quality Standards for NO<sub>x</sub> and SO<sub>x</sub>

In 2008, the U.S. Environmental Protection Agency (EPA) released its Risk and Exposure Assessment (REA) of the secondary National Ambient Air Quality Standards (NAAQS) for NO<sub>x</sub> and SO<sub>x</sub>. EPA solicited public comments prior to its determination on whether to revise current standards. These secondary standards, which deal with public welfare issues such as the health of ecosystems, had not been reviewed in over a decade. EPRI formed a team of experts to review the science and methods employed by EPA in the REA document. TVA, who had retained in-house expertise in ecosystem science and atmospheric deposition impacts, collaborated with EPRI to develop formal comments on the REA. Working with experts from other utilities and EPRI, TVA took the lead in performing a detailed examination of the REA. Using research published by EPRI and others in the last two decades, the team developed a comprehensive white paper which became the foundation for the comments EPRI submitted to EPA. These comments addressed several key issues that require additional data and research and will help ensure that the review of secondary standards is informed by accurate and reliable scientific information.

***“EPRI’s twenty years of atmospheric modeling and deposition research has been critical to developing the data that ecosystem modelers use in a variety of applications in both air and water quality.”***

~ *Suzanne Fisher, Environmental Scientist, TVA*

### **EPRI, TVA and Other Utilities Convene an Industry Working Group**

EPA is considering whether to revise its secondary NAAQS for NO<sub>x</sub> and SO<sub>x</sub>, with proposed rulemaking scheduled for July, 2011. At issue is whether the current standard protects the public welfare from any adverse effects from ambient air pollution. Public welfare in this case refers to the effects on ecosystems, including soils, water, crops and vegetation, wildlife, weather, visibility and climate, and damage to property. When EPA released its REA document in 2008, it solicited public comments prior to beginning its policy assessment period in mid-2009. The conclusions reached in the REA relied heavily on regional ecosystem models based on ecological indicators and deposition thresholds to assign secondary NO<sub>x</sub> and SO<sub>x</sub> NAAQS for welfare effects.

EPRI and several utilities felt that the REA would benefit from more detailed analyses on the atmospheric deposition of NO<sub>x</sub> and SO<sub>x</sub>. Since the NAAQS had for many years focused on the primary standard, which protects human health, it was necessary to identify someone with expertise in the ecological issues who could perform a thorough scientific review and analysis of the REA. EPRI approached Suzanne Fisher, an environmental scientist at TVA, about performing the analysis. According to EPRI senior project manager, Eladio Knipping, “TVA had the



*In July 2009 EPRI submitted formal comments to EPA on the Risk and Exposure Assessment of the NAAQS for NO<sub>x</sub> and SO<sub>x</sub>.*

### **Challenge**

EPA issued a notice for public comments on the agency’s Risk and Exposure Assessment for secondary National Ambient Air Quality Standards for NO<sub>x</sub> and SO<sub>x</sub>.

### **Solution**

EPRI convened a team of air quality experts from member utilities to examine and comment on the science behind EPA’s Risk and Exposure Assessment of the Secondary SO<sub>x</sub> and NO<sub>x</sub> National Ambient Air Quality Standards. TVA led the development of a white paper that provided the basis for comments submitted by EPRI to EPA critiquing the proposed standards.

### **Results and Benefits**

The comments EPRI provided to EPA applied two decades of work by EPRI and other researchers, as well as significant air quality and ecological expertise. This effort helps ensure that the review of secondary standards for NO<sub>x</sub> and SO<sub>x</sub> is informed by sound science.

foresight to maintain in-house knowledge to address these issues.” EPRI also approached air quality experts at other utilities—including Southern Company, American Electric Power and We Energies—and asked these companies to join EPRI and TVA in a working group to review Fisher’s analysis.

### **Working Group Quickly Prepares Analyses and Submits Comments to EPA**

In the first half of 2009, Fisher examined the methodology employed in the REA and prepared a white paper summarizing her analysis. The working group reviewed the white paper and used it as the basis for comments EPRI was preparing for EPA. In July, 2009 EPRI submitted formal comments to EPA that incorporated the expertise of EPRI, TVA, and the working group’s air quality experts. The comments focused on two main issues: that ecosystem model assumptions were not applicable to the entire case study region or the entire United States, and that other environmental factors existed across the case study regions and the United States that determine how an ecosystem responds to atmospheric deposition loading of nitrogen and sulfur.

The ecosystem models used in the REA use assumptions that are inadequate to determine levels of protection within the case study regions let alone over the entire United States. These include the steady state approximation and other model assumptions that are too simple to adequately capture inherently complex processes. Moreover, a variety of physical, biological, and meteorological factors exist within the United States that influence how a water body or ecosystem may respond to deposition of nitrogen and sulfur from both the standpoint of acidity and nutrient enrichment. These influences are highly variable; accordingly, so is the ecosystem response. As a result of oversimplification, the REA does not address the influence that fire, windstorms, insect invasion, groundwater depletion, drought, or past land use may have

on acidity and nutrient cycling in an ecosystem. According to Fisher, her analysis relied heavily on past EPRI research. She notes that “EPRI has a rich history of research evaluating the relationship between deposition and surface water acidity and forest health. I reference these studies all the time.”

This project represents a successful collaboration between EPRI and its member utilities, using more than twenty years of EPRI research results as well as current scientific data. By convening a working group of air quality experts and collaborating with them in reviewing and refining the analysis, EPRI, TVA, and the other utilities helped ensure that EPA has the best scientific information available to help inform its regulatory decision-making. In addition, Suzanne Fisher of TVA is the recipient of an EPRI Technology Transfer Award for her work on this project. “Having someone like Suzanne who had kept abreast of the issues was extremely valuable. It was impressive that the review was done in such a short time frame to the satisfaction of a very exacting expert working group,” says Knipping. Fisher was also impressed with EPRI contributions to the project, noting that “EPRI brought a lot of value to this effort from its expertise, its internal working knowledge, and its involvement with past hands-on research.”

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## EPRI, We Energies Test Technologies to Reduce Mercury and Selenium in Wastewater

In response to a permit condition authorizing discharges associated with a new flue gas desulfurization (FGD) system at its Pleasant Prairie Power Plant, We Energies was asked to investigate the efficacy and cost-effectiveness of advanced wastewater treatment technologies that might be capable of lowering mercury levels from the FGD discharge. We Energies knew that reducing levels of mercury, selenium, and other contaminants in FGD wastewater was also of interest to other companies within the electricity sector. The company turned to EPRI to organize a multi-company collaborative effort to test several technologies. EPRI identified a number of possibilities and then worked with the project's 10 participating companies to choose the most promising technologies for short-term feasibility tests. Three of the tests conducted at the Pleasant Prairie plant showed favorable results—two for mercury level reductions and one for selenium level reductions. We Energies is confident that the project's scientifically sound results will serve as a baseline for further R&D and that the research has brought the industry closer to effective solutions.

### **We Energies Engages EPRI on a Multi-Company Research Project**

Flue gas desulfurization (FGD) systems can remove up to 99% of sulfur dioxide emissions from the flue gas of coal-fueled power plants. However, in addition to removing the target substance SO<sub>2</sub>, there are a number of other substances, including metals that are transferred to the circulating limestone slurry in the FGD system. To control the water chemistry of the circulating limestone slurry, the FGD system has a discharge (often referred to as "FGD blowdown") that is routed to a wastewater treatment facility. The FGD system wastewater may contain mercury, selenium and other trace elements. To protect aquatic species, the wastewater will require treatment before it is discharged into lakes and rivers.

*"EPRI has the expertise and ability to coordinate multiple power companies as well as technology developers to collaborate and share resources. EPRI lends credibility to the results; they're well respected by the regulators and throughout the industry."*

*- Elizabeth Hellman, Principal Environmental Engineer, We Energies*

Although there are no federal limits on mercury and selenium for the electricity industry, the U.S. Environmental Protection Agency plans to revise its water discharge limits (effluent guidelines) for power plants, and the revisions may include such limits. Many states already regulate selenium and mercury discharges through water quality standards. For example, states bordering the Great Lakes and the Ohio River have set goals for mercury of between 1.3 and 12 parts per trillion (ppt). To date, however, no one has demonstrated a technology that can reliably reduce concentrations to these levels.



*Pilot feasibility testing of selenium and mercury removal. We Energies and other power companies are looking at technological solutions to reducing contaminants in FGD wastewater.*

### **Challenge**

We Energies needed to identify and evaluate technologies that offered potential to reduce mercury and selenium levels in FGD wastewater to very low levels.

### **Solution**

We Energies approached EPRI to develop a collaborative project involving a number of power companies to perform feasibility tests on the most promising technologies for mercury and selenium reductions.

### **Results and Benefits**

The project provided accurate, credible data on the state of several potentially effective technologies, data that will be useful in discussions with regulators and for future technology development.

One of the first EPRI members to face these issues directly was We Energies that commenced operation of an FGD system at its Pleasant Prairie Power Plant in Wisconsin in 2006. As part of the permit to install the FGD system, the Wisconsin Department of Natural Resources (DNR), requested that We Energies examine the effectiveness of technologies available for further reducing its mercury discharges. Realizing that these issues face the entire industry, and knowing that EPRI's reputation as an independent, unbiased evaluator would lend credibility to the results, the Company requested EPRI's help in setting up a collaborative, multi-company study. The study eventually involved 10 member companies under EPRI leadership.

The project's technical approach was to survey and identify technologies that showed promise, conduct laboratory feasibility studies to screen technologies that could potentially achieve the target mercury and/or selenium objectives, and then conduct pilot feasibility tests to further evaluate the most promising technologies. Because FGD wastewater characteristics can vary widely depending on the source water, coal type, and plant operations, another purpose was to examine the results of different technologies applied to different wastewaters. The feasibility tests were limited in scope and duration, but EPRI researchers felt that the tests could show which technologies were worthy of further evaluation and that test results could provide data to support continued research on more technologies.

### Feasibility Testing Provides Baseline for Future Research

The EPRI staff searched the professional and vendor literature to identify technologies with the potential for effectively removing mercury and/or selenium in FGD wastewater. They then worked with participating companies to select candidate technologies for feasibility testing. As laboratory studies began, EPRI developed project plans that described the important characteristics of FGD wastewater and suggested standard treatment and analytical methods. The plans were designed to make the test results as comparable as possible. After laboratory bench tests were complete, EPRI worked with the vendors and utility staff to set up on-site tests using water directly from the FGD systems. We Energies conducted four feasibility tests at Pleasant Prairie. Three had promising results:

- **Mercury removal by microfiltration combined with adsorbent media.** Measured mercury levels were generally less than 100 ppt, with only several data points near 12 ppt.
- **Mercury removal by iron and sulfide additives with microfiltration.** Reduced filtered mercury to an average of about 90 ppt.

- **Selenium removal by iron cementation.** Demonstrated that a significant decrease in levels of selenium—including selenate, the form that is hardest to remove—was possible, best performance was about 160 parts per billion, which did not achieve the goal of 50 parts per billion.

Although none of these technologies could reliably lower mercury levels significantly below the level of the existing treatment technology at Pleasant Prairie, several indicated promise. We Energies continues to hold discussions with DNR, and is confident that it can demonstrate that the project has conducted scientifically valid tests. The company also used some aspects of the experimental technologies to fine-tune its existing wastewater treatment systems and improve performance.

EPRI manager Paul Chu says, "We Energies was instrumental in championing the project; it brought in other companies so the project could test various potentially effective new technologies." EPRI awarded five We Energies staff a 2009 Technology Transfer Award for their leadership in this project. "These results will be instrumental in determining how best to focus future research aimed at developing cost-effective advanced treatment technologies for mercury and selenium reduction" according to Elizabeth Hellman, Principal Environmental Engineer, We Energies.

### Related EPRI Products

Title	Product ID
Mercury Removal from FGD Water with Microfiltration Combined with SAMMS Adsorbent Media, 2009	1020576
Selenium Removal by Iron Cementation from a Coal-Fired Power Plant Flue Gas Desulfurization Wastewater in a Continuous Flow System—a Pilot Study, 2009	1017956
Laboratory and Pilot Evaluation of Iron and Sulfide Additives with Microfiltration for Mercury Water Treatment, 2009	1016813

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## EPRI and its Members Inform Regulatory Process on Sustainable Management of Coal Combustion Products

On December 22, 2008, an ash pond dike at the Tennessee Valley Authority's Kingston power plant failed, releasing more than five million cubic yards of coal ash onto surrounding land and into the Emory River. Reacting to the Kingston dike failure, the U.S. EPA announced that by the end of 2009 it would be reconsidering the classification of coal combustion products (CCPs) under the Resource Conservation and Recovery Act (RCRA), including a possible hazardous waste classification. All companies that burn coal to generate electricity must either dispose of the CCPs, store them or utilize them for beneficial use. Fly ash, the primary by-product from burning coal, has been successfully used as a substitute for cement in concrete, as well as having other uses in construction. FGD gypsum, derived from flue gas desulfurization systems, is widely used to manufacture wallboard and related products. A hazardous waste designation would significantly impact how companies managed their CCPs.

### EPRI and Several Members Rapidly Respond to Inform Potential New Regulations on Coal Combustion Products

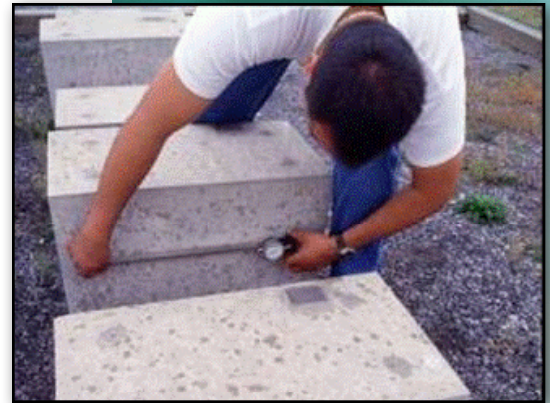
EPRI and its members wanted to ensure that rigorous, credible science would form the foundation of any revised regulations, but the tight regulatory time line demanded that they act quickly. EPRI has two programs addressing CCPs, one focusing on environmental issues and the other on CCP use. In early 2009, the advisory committees from each of the programs decided to join forces on a series of EPRI projects to compile historical and current technical information about CCP disposal and use and to communicate the information through a variety of forums. The participants worked hard to secure funding for the project from their companies, as well as providing much of the information for the case study examples and materials properties comparisons. The projects included comparing CCPs to other materials and quantifying the benefits of CCP use, as well as assessing the risks and reviewing the damage cases associated with CCPs. According to Mike Horvath of First Energy, "There was a large amount of important research that had been conducted over the years. We counted on EPRI to quickly pull it all together in a way that made sense."

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***"We had a short period of time to bring together a comprehensive set of data that was rigorous and credible. EPRI made that happen."***

*~ Lamar Larrimore, Principal Research Engineer, Southern Company Services*

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*Fly ash and other by-products from burning coal for electricity can be used to make concrete stronger, more durable and easier to work with.*

### Challenge

Following the failure of an ash pond dike in December, 2008, U.S. EPA announced it would revisit the classification of CCPs by the end of 2009, including a possible hazardous waste designation that could restrict how companies use and manage CCPs.

### Solution

EPRI quickly developed a series of projects to compile technical information about CCPs and communicate it to members, U.S. EPA and other government bodies.

### Results and Benefits

The technical information was developed and delivered in time to inform the regulatory process.

The project results were communicated through testimony and briefings to Congress, U.S. EPA, the Office of Management and Budget, the Department of Energy and other government bodies, and also through publication of numerous EPRI reports and technical briefs and a new CCP web site on EPRI.com.

## Project Results Quickly Documented and Communicated Through Many Different Forums

The projects were launched and completed in less than six months; the wide dissemination of the technical results was also a crucial part of the effort. Beginning in October of 2009, EPRI Senior Project Manager Ken Ladwig had meetings with U.S. EPA, the Office of Management and Budget, and the Department of Energy, as well as providing written and oral testimony to the House Energy and Commerce Committee to present and discuss the projects' results. The results were also used to prepare a series of EPRI technical reports and technical briefs. In addition, a new EPRI web site was developed that focuses on CCP management and research.

The key individuals that participated in this project are receiving an EPRI Technology Transfer Award for helping to inform the regulatory process by providing information about sustainable CCP management. The companies being recognized are Southern Company, American Electric Power (AEP), First Energy, Entergy, Progress Energy, Headwaters Resources and Boral Material Technologies. According to Ladwig, "The entire team was very active in identifying the need, formulating the research plan, putting together the necessary funding, and communicating the information." The participating members are also appreciative of the leadership that EPRI provided in pulling the project together. Bruce Boggs of Headwaters Resources observed, "The project was a unique blend of expertise, data, and personnel that was well organized and managed by EPRI."

The project also resulted in opportunities for planning future research, according to some of the participants:

- "This project is also helping to light the way to the future by identifying critical engineering and scientific investigations that we need to pursue." David Morris, Southern Company
- Lots of information was generated, compiled and effectively communicated, and this work provides stepping stones for filling more gaps in the future and managing unforeseen regulatory and public issues." Don Lierman, Entergy
- "EPRI has been excellent at anticipating the questions we're going to need to answer in five or ten years. They initiate projects, collect the data, draw conclusions on a scientific basis and publish the results so that the information is available when we need it." Tom Webb, AEP

EPRI and its members have helped ensure that the regulatory process on CCPs is being informed with high-quality, scientifically sound information, and that this information was communicated widely and effectively.

## Related Publications

Title	Product ID
An Evaluation of Potentially Exposed Populations in the Vicinity of Coal Combustion Waste Storage Units and Associated Cancer Risk, 2010	1020558
Screening Analysis of Financial and Electric Generating Capacity Impacts from Regulating Coal Combustion Products as Hazardous Waste, 2010	1020557
Comparison of the Chemical Characteristics of Coal Combustion Products to Other Common Materials, 2010	1020556
Evaluation of Coal Combustion Product Damage Cases, 2010	1020553
Quantifying the Benefits of Using Coal Combustion Products in Sustainable Construction, 2010	1020552
Is Coal Ash Toxic?, 2009	1020204
Human Health Risks from Mercury in Concrete and Wallboard Containing Coal Combustion Products, 2009	1019023
Coal Ash: Characteristics, Management and Environmental Issues, 2009	1019022

**For more information**, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com)

## CONTACTS

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