

## Strategic Water Issues: TMDLs, Availability, Climate - Program 55

### Program Overview

#### Program Description

A growing population is increasing demand for electricity and water and putting pressure on the electric power industry to increase its water use efficiency and minimize overall water usage. In the future, water policy and regulations will be driven by watershed planning, water availability constraints on electric power generation, and implications of climate variation for power industry water use. The U.S. Environmental Protection Agency (EPA) is committed to a watershed-based approach to water resource management and protection, including Total Maximum Daily Loads (TMDLs), watershed-integrated National Pollutant Discharge Elimination System (NPDES) permitting, and water quality trading.

The Electric Power Research Institute's (EPRI's) Strategic Water Issues Program helps members, regulators, and other water resource stakeholders develop and implement cost-efficient, risk-based strategies for TMDL/watershed management, improved power plant water use efficiency, reduced power plant water demand, and management of impacts due to climate variability.

#### Research Value

This program prepares member companies to participate in evolving water policy development and to develop strategies for the future. Because water is a shared resource, the industry must understand the perspectives of all water resource stakeholders (government and nongovernment) and participate in stakeholder consensus decision making. This research helps power generators address

- watershed-driven water policy and regulations,
- a future where water use (including withdrawals, consumption, storage, and flow regulation) will be constrained by water availability,
- risk management associated with the implications of climate variability for water resource availability,
- TMDLs that incorporate atmospheric deposition,
- innovative technologies to increase water use efficiency and conservation (e.g., dry/hybrid cooling and degraded water use), and
- novel watershed-based approaches to reducing pollutant loads (e.g., water pollution trading).

#### Approach

The program delivers credible scientific information, practical guidance, proven decision-support tools, and technology assessments. Program information and results are disseminated through reports, papers, webcasts, issue briefs, and presentation materials. The program delivers

- efficient water resource management for maintenance and growth of electric power generation capacity;
- information for watershed and TMDL regulatory compliance and management decisions with respect to mercury, nitrogen, metals, heat, sediments, and acidity; and
- management and technology tools to improve power plant water use efficiency and reduce overall water use.

#### Accomplishments

Program research enables members to create watershed management plans, derive TMDLs, evaluate alternative loading allocations and implementation plans, design water quality trading programs, evaluate business strategies and advanced cooling technologies to address current and future water availability constraints, and address TMDLs where atmospheric deposition is involved. Facility-specific savings can range from tens of thousands to tens of millions of dollars. Program accomplishments include the following:

- The Electronic Watershed Assessment and Management Tool (eWAM), a comprehensive web-based information source for watershed management and TMDLs
- The Watershed Analysis Risk Management Framework (WARMF), a decision-support tool for watershed management and assessment and TMDL allocation and implementation
- Watershed TMDL case studies
- Engineering and economic analyses of advanced cooling technologies and use of nontraditional water sources
- Evaluation of best management practices for noncooling-water releases
- Management and assessment methodologies for energy/water sustainability
- Guidance on how to technically verify TMDLs
- Scientific/technical evaluation of the concept of regional TMDLs
- Evaluation of cross-pollutant trading practices

### Current Year Activities

Program R&D for 2010 will focus on addressing stormwater issues, clarifying implications of changes in the nation's water resources, and improving thermoelectric water use efficiency. Specific efforts will include

- evaluating implications of water resource changes and trends for power generation;
- addressing stormwater characterization, effluent limits, treatment, and reuse issues; and
- developing and demonstrating advanced cooling technologies for new and existing generation.

### Estimated 2010 Program Funding

\$1.2M

### Program Manager

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## Summary of Projects

Project Number	Project Title	Description
P55.001	TMDL/Watershed Issues	This project addresses complex scientific, technical, and economic issues concerning TMDLs, watershed management, atmospheric deposition effects, mercury and nitrogen discharges, stormwater runoff, and water quality trading.
P55.002	Water Availability	This project addresses the need to develop and evaluate new strategies for managing water resources to guarantee water availability to meet current and future electric power demand.
P55.003	Advanced Cooling	This project creates, develops, and demonstrates new technologies to increase thermoelectric power plant water use efficiency.

### P55.001 TMDL/Watershed Issues (101920)

#### Key Research Question

A principal strategic objective of EPA is to use a watershed approach through the implementation of TMDLs and watershed-integrated NPDES permits to achieve protection of water resources. This action creates a growing number of new, complex research needs. Research is needed to understand how to effectively manage stormwater runoff; apply water quality trading concepts to TMDL implementation plans; couple

watershed and air quality models to address TMDLs where atmospheric deposition is a major source of pollutants (e.g., nitrogen and mercury); derive, allocate, and implement complex TMDLs (e.g., thermal and PCBs); and increase value to members of EPRI's eWAM tool.

### Approach

The approach is to create decision-support frameworks, water resource knowledge bases, and advanced technology evaluations to develop innovative watershed management plans, derive TMDLs, analyze alternative TMDL loading allocations and implementation plans, evaluate watershed-integrated NPDES permits, design water quality trading programs, and assess/manage atmospheric deposition effects. Facility-specific savings can range from tens of thousands to tens of millions of dollars. This project is closely integrated with the supplementary project on water quality trading.

### Impact

- Technically sound and economically efficient watershed, TMDL, and NPDES regulatory compliance and management decisions
- Facility-specific savings ranging from tens of thousands to tens of millions of dollars.
- Potential reduction of costs, estimated to be approximately \$17 billion industrywide, associated with the current TMDL rule

### How to Apply Results

Power company environment staff will consult the EPRI eWAM tool and EPRI technical reports to derive more environmentally effective and cost-efficient TMDLs and watershed management plans through application of innovative technologies and strategies, including water quality trading. Information and data will be used by power company environment and generation staff, power company strategic planners, key watershed stakeholders, regulatory agencies, and the public. In addition, EPRI will facilitate broader use and awareness of the results by conducting webcasts; briefing key stakeholders, including EPA and state agencies; developing materials for the trade press/media; and continuing service on various government, academic, industry, and professional organization advisory panels.

### 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Stormwater Characterization, Effluent Limits, Treatment and Reuse - Year One:</b> This is the first year of a project to determine how members can manage stormwater to reduce discharge compliance issues and can use stormwater to meet cooling and other water demands within the plant.	12/31/10	Technical Resource

### Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<b>Stormwater Characterization, Effluent Limits, Treatment and Reuse - Year Two:</b> This is the second and concluding year of a project to determine how members can manage stormwater to reduce discharge compliance issues and can use stormwater to meet cooling and other water demands within the plant.	12/31/11	Technical Report
<b>Water Quality Trading Case Study Design - Year One:</b> This is the first year of a study to evaluate water quality trading in a watershed whose environmental, economic, and social characteristics contrast with those of the Ohio River Basin, where EPRI has already performed a case study.	12/31/11	Technical Resource

Product Title & Description	Planned Completion Date	Product Type
<b>Water Quality Trading Case Study Design - Year Two:</b> This is the second and concluding year of a study to evaluate water quality trading in a watershed whose environmental, economic, and social characteristics contrast with those of the Ohio River Basin, where EPRI has already performed a case study.	12/31/12	Technical Report
<b>Air-Water Model Coupling Review - Year One:</b> This is the first year of an evaluation of proposals by government agencies and other groups to combine air and watershed models in order to assess and manage atmospheric emissions impacts on near- and far-field watersheds. Specific attention will focus on government-related 319(g) proposals.	12/31/12	Technical Resource

## P55.002 Water Availability (058353)

### Key Research Question

Rapidly growing demand for clean, fresh water, coupled with the need to protect and enhance the environment, have made many areas of the United States vulnerable to water shortages. If society's dependence on reliable supplies of electricity, as well as on freshwater availability, continues to rise without regard for the potential conflicts these two demands can create, sustainability of national economic growth and electricity supply may be severely challenged. At a minimum, the conflicts could cause shortages in current supplies of electricity and could have direct impacts on power system planning and expansion. Unlike longer-term environmental concerns such as climate change, where long lead times allow for the development of coping strategies with evolving scientific and technical innovations, water and energy shortages can occur relatively suddenly and can have adverse impacts on local and regional economies. To address this critical issue, research needs include decision-support management tools for watershed and power plant water use, development of water resource knowledge bases, and evaluations of water-saving technologies and watershed management strategies.

### Approach

This project evaluates and creates planning strategies to address current and future water availability constraints on electric power generation. The project provides data, information, and tools to analyze and project water demand and supply within watersheds and regions under multiple future scenarios, including population and economic growth, land use change, new-technology development, and climate variability. The research also analyzes alternative management plans, including siting and design of new generation and retrofits of existing plants, for increased water use efficiency and minimization of water use.

### Impact

- Develops cost-effective business strategies to address current and future water availability limitations
- Provides strategies for increased water use efficiency, water conservation, and cost savings
- Leverages government-funded research

### How to Apply Results

Power company environment, generation, and planning staff will extract information from project reports, papers, issue briefs, and presentation material. This information will also be disseminated to community water resource stakeholders and government agencies. Members will use results to support decision making with respect to meeting community and government pressures to increase water use efficiency and reduce water use in both existing and new plants. Members will use results to guide design and siting of new generation. In addition, EPRI will facilitate broader use and awareness of the results by presenting webcasts; briefing key stakeholders, including EPA and state agencies; developing materials for the trade press/media; and continuing service on various government, academic, and professional organization advisory panels.

## 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<p><b>Implications of Water Resource Changes and Trends on Power Generation - Year Two:</b> This is the second and final year of a study to evaluate the implications of changes and trends in U.S. water resources for current and future power generation. The study will consider empirically determined trends in water flows, lake levels, snowpack accumulation and melt, water quality, aquatic biota, land use, water resource management, and precipitation and air temperature patterns.</p>	12/31/10	Technical Report

## Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<p><b>New Plant Siting - Year One:</b> This is the first year of a study to develop a decision support methodology for siting new power plants. The methodology will consider water demands of different generation technologies, advanced cooling technologies, nontraditional water sources, in-plant water reuse, watershed/regional hydrology, water demands of competing water resource stakeholders, and community water sharing strategies. The methodology can also be used by existing power plants considering retrofits to increase water use efficiency and reduce overall freshwater demand.</p>	12/31/11	Technical Resource
<p><b>New Plant Siting - Year Two:</b> This is the second and final year of a study to develop a decision support methodology for siting new power plants. The methodology will consider water demands of different generation technologies, advanced cooling technologies, nontraditional water sources, in-plant water reuse, watershed/regional hydrology, water demands of competing water resource stakeholders, and community water sharing strategies. The methodology can also be used by existing power plants considering retrofits to increase water use efficiency and reduce overall freshwater demand.</p>	12/31/12	Technical Report

## P55.003 Advanced Cooling (063345)

### Key Research Question

Thermoelectric power plants need sufficient water supplies to meet generation demands. Most of the water used by thermoelectric power plants is either withdrawn for once-through cooling or consumed by wet-cooling towers. Siting of new power plants is critically dependent upon access to sufficient water for cooling and other plant processes. Geographical areas vulnerable to water availability shortages and water-induced constraints on electric power generation are not limited to the arid and semiarid West and Southwest but occur throughout the United States. This vulnerability will increase over the next quarter-century as a result of greater demands for fresh water and electric power associated with population growth. Climate variability and growing concerns about environmental protection may exacerbate the situation. Power companies will experience growing pressure to increase their water use efficiency and decrease their overall use of water. Existing technologies for significantly reducing water consumption have major energy and dollar costs. There is a need to create and test new technologies to increase power plant water use efficiency.

### Approach

By creating new knowledge bases and developing and testing new technologies, this project enhances compliance processes, controls O&M costs, reduces construction costs, expedites permitting, and assesses innovative, breakthrough technologies to increase water use efficiency and reduce overall water use by power

plants. It provides guidelines, tools, demonstrations, and information for use and optimization of advanced cooling strategies and technologies to meet water conservation requirements of permits, regulations, and policies. The project also reduces costs and heat-rate penalties associated with advanced cooling technologies, provides methods of water treatment to enhance use of degraded water sources, and addresses siting and construction of new plants and retrofitting of existing plants. This project is closely integrated with the supplemental project on advanced cooling technologies.

### Impact

- Reduces impacts of wet and dry cooling on power plant performance and O&M costs
- Expedites permitting by providing guidelines, tools, and information for the use and optimization of advanced cooling strategies to meet water conservation requirements
- Develops and demonstrates innovative water-conserving technologies for use at thermoelectric power plants

### How to Apply Results

Power company environmental and generation staff will apply project results to evaluate alternative wet- and dry-cooling technologies to reduce water consumption for cooling, and hence vulnerability to future water shortages. Pilot and demonstration studies will be conducted with cooperating members. U.S. Department of Energy and vendor cost sharing will be solicited. Workshops and webcasts will be held to foster communication of results to members, vendors, and government agencies.

### 2010 Products

Product Title & Description	Planned Completion Date	Product Type
<p><b>Advanced Cooling Technologies for New and Existing Generation - Year 1:</b> This is the first year of an effort to complement the advanced cooling supplemental project. The goal is to selectively support projects from which the broader program membership would benefit. The individual activities to be funded by the program would be chosen by program members after reviewing the status of the supplemental project. Possible activities could include mitigation of wind effects for air-cooled condensers; performance and application of vapor recapture from wet cooling towers; and conceptual design, performance, and economic evaluation of bottoming cycles.</p>	12/31/10	Technical Resource

### Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<p><b>Advanced Cooling Technologies for Thermoelectric Generation - Year 2:</b> This is the second and final year of studies and analyses conducted to complement the advanced cooling supplemental project. The topics to be included in the report will be chosen by program members after reviewing the status of the projects being funded within the supplemental project. Possible topics that could be covered include mitigation of wind effects for air-cooled condensers; performance and application of vapor recapture from wet cooling towers; and conceptual design, performance, and economic evaluation of bottoming cycles.</p>	12/31/11	Technical Report
<p><b>Advanced Cooling Synthesis Report:</b> EPRI will develop a web-based resource providing clients with all of the current information on use, optimization, and operational and maintenance issues related to the use of advanced cooling and water conservation techniques. This document will provide clients with the latest information in design, case studies, new technologies, guidance, and cost-benefit analysis support.</p>	12/31/12	Technical Resource