

## **54 Fish Protection at Steam Electric Power Plants**

### **Program Overview**

#### **Program Description**

This program provides information, analytical tools, innovative mitigation technologies, and expert services to help environmental and power plant managers effectively manage water resources and protect aquatic communities in accordance with §316 of the Clean Water Act. The research assesses the effects of thermal power plant cooling system operation on fish and other aquatic life. Results support the development of effective intake and discharge protection approaches for workable operating permits at individual facilities. By improving the technical basis for regulatory, permitting, and operating decisions, this program serves the public interest in effective resource management while meeting an industrywide imperative to control costs, ensure or even exceed environmental compliance, and manage business risks.

#### **Industry Needs and Issues Addressed**

- Engineering, performance, and cost information for cooling water intake structure fish protection technologies to meet Clean Water Act §316(b) requirements
- Assessment methods and impact information related to managing thermal discharges to meet Clean Water Act §316(a) requirements
- Information on retrofit costs and economic, environmental, and electric system impacts of closed-cycle cooling systems
- Methods to support technology performance verification monitoring

#### **Impact**

- Program information informed revisions to Clean Water Act §316 (b) Phase II regulations, providing for a cost-effective, flexible rule that protects aquatic life.
- Products and services provide benefits comparable to the efforts of four or more full-time equivalent staff.
- Program results defray or avoid research costs that could range from hundreds of thousands to millions of dollars if funded independently.
- Program information reduces compliance costs, enhances permitting process, and identifies cost-effective management strategies.

#### **Key Accomplishments**

- Information on performance of intake fish protection technologies for U.S. Environmental Protection Agency (EPA) consideration in identifying Best Technology Available (BTA) for new (Phase I) and existing (Phase II) power plants, as required under §316 (b)
- Impingement mortality and entrainment sampling information in support of §316(b) rulemaking
- Technical resource documents on fish protection technology performance and costs
- Technical information on the impacts and environmental benefits of reducing impingement mortality and entrainment
- Technical workshops and symposia for technical information and cost-effective technology transfer

#### **Current Year Objectives**

- Continue the assessment of the cost, environmental, social, and economic impacts of a potential national retrofit of closed-cycle cooling systems to plants with once-through cooling operation
- Evaluate the performance of intake fish protection technologies for reducing impingement mortality and entrainment

- Identify the causes of episodic impingement events and develop fish health assessment criteria
- Develop fish thermal tolerance data to support technically defensible thermal discharge permit criteria
- Transfer information and application services via workshops, conferences, and consultations with members

**Industry Involvement**

- Estimated 2009 funding: \$3.6M

**Program Technical Lead**

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**Summary of Projects**

<b>Project Number</b>	<b>Project Title</b>	<b>Value</b>
P54.001	Environmental and Economic Effects of a Potential National Retrofit of Closed-Cycle Cooling Systems	In late 2007, in accordance with a court mandate, EPA initiated a reconsideration of closed-cycle cooling as BTA for existing facilities with once-through cooling as part of revising the remanded Phase II §316(b) Rule. The Electric Power Research Institute (EPRI) simultaneously began a research effort to inform this process; research will continue in accordance with EPA findings and a revised draft Rule, expected in early 2009.
P54.002	Biological Sampling and Fish Health Assessment Research	Research will focus on evaluating and developing sampling methods to assess the performance of intake fish protection technologies. Research will include the identification of biological criteria for classifying dead and moribund fish collected on intake screens and in entrainment samples.
P54.003	Fish Protection Technology Research	Research will focus on assessing the fish protection performance provided by technologies for reducing impingement mortality and entrainment at cooling water intake structures relative to national EPA standards. Research will be conducted in the laboratory and at field locations where pilot- or full-scale technologies have been deployed.
P54.004	Thermal Discharge Risk Analysis	Given the emergence of new thermal discharge issues, advances in science and technology, and loss of institutional memory, EPRI began in 2008 a multiyear project to create a resource document on assessment and management of issues related to Clean Water Act §316(a). The research focuses on identifying cost-effective strategies for controlling thermal releases to rivers, lakes, and estuaries and supporting §316(a) variance demonstrations.

## Project Descriptions

### P54.001 Environmental and Economic Effects of a Potential National Retrofit of Closed-Cycle Cooling Systems (067512)

#### Issue

Court action in 2007 remanded EPA's Phase II Rule under Clean Water Act §316(b) for a revised determination of Best Technology Available (BTA). Most importantly, the court required EPA to reevaluate closed-cycle cooling (CCC) as BTA. The court noted that EPA could consider in its reevaluation whether CCC costs could be reasonably borne by industry, what the potential impacts to energy production and efficiency might be, and any adverse environmental factors. In late 2007, EPA began its efforts to revise the Phase II Rule, and a draft for public review and comment is expected in late 2008 or early 2009. Up-to-date scientific and engineering information on the potential ramifications of a CCC systems retrofit is required to inform EPA's considerations and serve the public interest.

#### Description

This project provides EPA, the public, and industry with technical information on the economic and environmental consequences of a potential CCC systems retrofit to power plants with once-through cooling systems. This information will be provided to EPA via EPRI's technical comments on the draft Phase II Rule during the public comment period.

#### Value

- EPRI research informs the EPA rulemaking process with credible engineering and scientific information.
- EPRI research provides critical information on the overall costs, benefits, and impacts of a potential national retrofit of CCC on all power plants with once-through cooling. Such a retrofit could cost the industry from \$50 billion to \$100 billion or more and could impact overall plant efficiency and electric system reliability.
- EPRI research addresses the engineering, scientific, and permitting issues that will need to be addressed should EPA specify CCC as BTA.

#### How to Apply Results

Members can review EPRI's information on CCC to support their own preparation and submittal of comments on the draft Phase II Rule when it becomes available for public comment. Should EPA determine CCC as BTA, the engineering, scientific and permitting information resulting from this project can support member planning of future compliance efforts.

#### 2009 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Technical Comments on the EPA draft §316(b) Phase II Rule:</b> EPRI will prepare and submit technical comments on the EPA draft §316(b) Phase II Rule when the Rule becomes available for public comment, expected in late 2008 or early 2009.	6/30/2009	Assembled Package

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### Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<b>EPRI Technical Comment on Future EPA §316(b) Phase II Rule</b> <b>Actions:</b> Includes focused assessment projects on retrofit costs, environmental and social impacts, and energy efficiency impacts from a potential retrofit of CCC systems. The scope of this effort is dependent upon a number of future actions with unpredictable outcomes, including the U.S. Supreme Court's review of the 2007 Second Circuit Court decision on the initial Phase II Rule and the scope of EPA's revised draft Phase II Rule.	2010	Technical Update

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### **P54.002 Biological Sampling and Fish Health Assessment Research (100033)**

#### **Issue**

Compliance with Clean Water Act §316 regulations requires sampling of fish and shellfish in the aquatic environment in the vicinity of cooling water intakes and discharges, as well as off of intake structures and within power plant cooling water systems. Water body type (e.g., reservoir, estuary, river), power plant cooling system configuration and operation, and intake fish protection technology all present site-specific challenges to collecting representative sample data. The health of impinged and entrained fish can also further compromise the interpretation of sample results and fish protection technology performance.

#### **Description**

Building on its past work in impingement, entrainment, and fish population and community sampling and assessments, EPRI will continue to improve and develop technical resources to support member compliance with the provisions of the §316(a) and (b) regulations. Most importantly, EPRI's research efforts will be directed at the development of information to support preparation of site-specific verification monitoring plans, including research on the numbers of and reasons for dead and moribund fish and on biological criteria for identification.

#### **Value**

- Supports strategic and cost-effective §316(a) and (b) compliance planning
- Provides credible technical information to EPA in its efforts to revise the scope of the §316(b) Phase II Rule in light of the Second Circuit Court's 2007 decision
- Defrays or avoids research costs that could exceed half a million dollars or more if funded individually

#### **How to Apply Results**

The information developed in this program will be used by power plant environmental affairs and compliance staff and by federal and state §316 permit writers when developing permit compliance and monitoring plans. Clients will read reports and disseminate information to community water resource stakeholders and government agencies. EPRI staff will provide company-specific compliance support through supplemental projects.

**2009 Products**

Product Title & Description	Planned Completion Date	Product Type
<b>Health Assessment of Impinged Fish:</b> This report will present results of a three-year effort on the health factors that cause fish to impinge on intake screens and the criteria that can be used to identify fish that are already moribund or dead on arrival at the intake.	12/31/2009	Technical Update
<b>Impingement and Entrainment Sampling: A National Review:</b> This report will summarize results of EPRI's gathering of impingement and entrainment data collected via a nationwide questionnaire implemented in 2008. Results will be presented by, for example, water body type, species, region, and cooling water intake configuration.	6/30/2009	Technical Update

**Future Year Products**

Product Title & Description	Planned Completion Date	Product Type
<b>Verification Monitoring Technical Resource Document:</b> Final procedures and technical information for verifying the performance of fish protection technologies will be included in this final report.	2010	Technical Report
<b>Health Assessment of Impinged Fish:</b> Final criteria for identifying dead and moribund fish, larvae, and eggs in impingement and entrainment samples; frequency of occurrence; and possible reasons for the condition will be presented in this final technical report.	2010	Technical Report

**P54.003 Fish Protection Technology Research (SP0473)**

**Issue**

Identification of cost-effective fish protection technologies for installation at cooling water intake structures to control impingement and entrainment of fish and shellfish is a primary goal of industry in seeking to comply with Clean Water Act §316(b) Phase I and Phase II rules. This need is even more critical following a 2007 Second Circuit Court decision that voided other compliance options (e.g., restoration and cost-benefit analysis). EPA is expected to issue a revised Phase II Rule in late 2008 or early 2009, and this Rule may require implementation of impingement and, in some cases, entrainment control technologies, each with required levels of performance.

**Description**

Various screen systems (coarse- and fine-mesh rotary screens, band screens, modified Ristroph screens, and wedge-wire screens), vacuum pump systems, and behavioral deterrent systems will be evaluated for performance relative to the revised EPA 316(b) Phase II impingement and entrainment reduction standards; technology design, construction, O&M requirements, and costs will also be addressed in the evaluation.

**Value**

- Cost-effective §316(b) compliance planning
- Development and submittal of sound technical information to EPA to inform the agency's efforts to revise the scope of the §316(b) Phase II Rule in light of 2007 Circuit Court decisions
- Defrayed or avoided technology research costs that could exceed half a million dollars or more if funded individually

**How to Apply Results**

The information developed in this program will be used by power plant environmental affairs and compliance staff and by federal and state §316 permit writers when developing permit compliance and monitoring plans. Clients will read reports and attend EPRI scheduled workshops and symposia to better understand the results and then disseminate information to community water resource stakeholders and government agencies. EPRI staff will provide company-specific compliance support through supplemental projects.

**2009 Products**

Product Title & Description	Planned Completion Date	Product Type
<b>316(b) Fish Protection Website:</b> This website provides a synthesis of §316(b) information collected or developed by EPRI for use by members in addressing permit negotiation and compliance needs. Included is a review of all fish protection technologies (physical and behavioral), including costs for retrofit and for operation and maintenance.	12/31/2009	Technical Resource
<b>Conference/Workshop on 316(b) and Other Water Use Impacts and Fish Protection Issues:</b> Conferences and/or workshops will explore research and information needs related to regulations, guidance, and compliance, including the latest developments in baseline and compliance assessments, intake fish protection technologies, and Best Technology Available requirements.	12/31/2009	Workshop, Training, or Conference

**Future Year Products**

Product Title & Description	Planned Completion Date	Product Type
<b>Intake Impingement Reduction Technology Evaluation:</b> EPRI will evaluate coarse-mesh rotary screens, band screens, modified Ristroph screens, wedge-wire screens, vacuum pump systems, and behavioral deterrent systems for performance relative to EPA's 316(b) Phase II impingement reduction standard, as well as for technology design, construction, O&M requirements, and costs.	2010	Technical Report
<b>Intake Entrainment Reduction Technology Evaluation:</b> EPRI will evaluate fine-mesh rotary screens, band screens, modified Ristroph screens, wedge-wire screens, vacuum pump systems, and aquatic filter barriers for performance relative to EPA's 316(b) Phase II entrainment reduction standard, as well as for technology design, construction, O&M requirements, and costs.	2010	Technical Report

## P54.004 Thermal Discharge Risk Analysis (102877)

### Issue

As a result of recent extended droughts in many areas of the country, increased societal demands for water withdrawals, continued concern about the protection of aquatic biota, and growing demand for more electric power, there is renewed interest in the management and consequences of thermal discharges. In the fall of 2007, the EPRI-organized Second Thermal Ecology and Regulation Workshop was held at Tri-State Generation's headquarters. The workshop drew about 120 domestic and international participants. Key topics of discussion included the convergence of thermal discharge issues with other issues such as §316(b), total maximum daily loads (TMDLs), effluent guidelines, water availability, and climate change; the need to reconcile field and laboratory observations of fish response; interactions of thermal discharges with other pollutants; and responses of macroinvertebrates.

### Description

This project will provide research and information transfer that will improve the ability to cost-effectively obtain thermal discharge permits and comply with thermal discharge regulations. Research will focus on resolving discrepancies in the observed behavior of fish under laboratory and field conditions. Information transfer will involve holding EPRI's Thermal Ecology Conferences, successfully begun in 2003 and 2007, on a regular four-year cycle.

### Value

- Reduces compliance costs
- Enhances the permitting process
- Identifies cost-effective management strategies
- Offers potential savings to individual facilities ranging from tens of thousands to millions of dollars based on site conditions

### How to Apply Results

The information developed in this program will be used by power plant environmental affairs and compliance staff and by federal and state §316 permit writers when developing permit compliance and monitoring plans. Members will read reports and disseminate information to community water resource stakeholders and government agencies. EPRI staff will provide company-specific compliance support through supplemental projects.

### 2009 Products

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Product Title & Description	Planned Completion Date	Product Type
<b>Methodology to Understand Fish Field Response – Year 1:</b> Often fish are observed in the field in locations where, based on laboratory experiments on thermal tolerance, they would not be expected. Laboratory research funded by EPRI indicates that recovery processes may be the cause. In this study, fish will be tracked in the field to see how their behavior may enhance recovery processes.	12/31/2009	Technical Update

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**Future Year Products**

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Product Title & Description	Planned Completion Date	Product Type
<b>Methodology to Understand Fish Field Response – Year 2:</b> The second year of field experimentation will be conducted to understand how fish behavior may mediate response to a thermal plume.	2010	Technical Report
<b>Third Thermal Ecology and Regulation Workshop</b> An outcome of the Second Thermal Ecology and Regulation Workshop was that participants strongly recommended that the workshop be continued on a regular basis. A steering committee of members and experts in the field will be created to plan the Third Workshop, to be held in 2011.	2011	Workshop, Training, or Conference
<b>Thermal TMDLs:</b> A review of thermal TMDLs will be conducted with special emphasis on implications for licensing of thermal discharges. Consideration will be given to interactions between thermal discharges and other TMDL issues of concern, such as dissolved oxygen and nutrients.	2012	Technical Report

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