

# PROJECT facts

Innovations for  
Existing Plants

01/2009

U.S. DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY



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## USE OF TREATED MUNICIPAL WASTEWATER AS POWER PLANT COOLING SYSTEM MAKEUP WATER: TERTIARY TREATMENT VERSUS EXPANDED CHEMICAL REGIMEN FOR RECIRCULATING WATER QUALITY MANAGEMENT: PROMIS/PROJECT No.: DE-NT0006550

## Background

This project builds upon a current study sponsored by the U.S. Department of Energy (DE-FC26-06NT42722), entitled, "Reuse of Treated Internal or External Wastewaters in the Cooling Systems of Coal-Based Thermoelectric Power Plants," which examines the characteristics and relative availability of these waters in the context of reuse in power plant cooling systems.

The evaluation of availability of the three impaired waters investigated in DE-FC26-06NT42722 showed that treated municipal wastewater is the most common and widespread source in the United States. Data analysis revealed that 81 percent of power plants proposed for construction by the Energy Information Administration (EIA) would have sufficient cooling water supply from 1-2 publicly owned treatment works (POTW) within a 10-mile radius, while 97 percent of the proposed power plants would be able to meet their cooling water needs with 1-2 POTWs within 25 miles of these plants. Thus, municipal wastewater will be the impaired water source most likely to be locally available in sufficient and reliable quantities for power plants.

Results from DE-FC26-06NT42722, while not yet complete, indicate that it is feasible to use secondary treated municipal wastewater as cooling system makeup. The biodegradable organic matter, ammonia-nitrogen, and phosphorus in the treated wastewater pose challenges with respect to enhanced biofouling, corrosion, and scaling, although current research is demonstrating that these problems can be controlled through aggressive chemical management. It is currently unclear whether tertiary treatment of municipal waste water prior to its re-use can be a cost-effective option to aggressive chemical management of the bulk cooling water volume.



## **PARTNERS**

Carnegie Mellon University

## **Description**

The project will further examine the feasibility of using treated municipal wastewater as cooling system makeup water by conducting experimental studies and economic and social analyses. The experimental studies will use novel bench-scale recirculating cooling water systems, as well as novel small-scale pilot cooling towers designed and constructed in DE-FC26-06NT42722, to evaluate the effects of different levels of additional treatment of secondary treated municipal wastewater on the potential for corrosion, scaling, and biofouling in the cooling system. In addition, the chemical treatments needed to control corrosion, scaling, and biofouling for the municipal wastewater treated to different levels will be investigated.

The data obtained from the experimental program will be supplemented with information gained from power plants where municipal wastewater is already used as makeup water for cooling. This information will be used as the basis for life cycle cost analyses of tertiary treatment of municipal wastewater prior to use in power plant cooling systems versus the use of less-treated wastewater plus aggressive in-plant chemical measures for controlling cooling water corrosion, scaling, and biofouling.

## **Primary Project Goal**

The primary goal of this project is to evaluate the benefits and costs of implementing tertiary treatment of municipal wastewater prior to using it in recirculating cooling systems at power plants versus an expanded chemical regimen for managing the quality of the entire cooling water volume with municipal wastewater as part of the makeup.

## **Objectives**

Specific project objectives include:

- Determine the benefits and costs of subjecting secondary treated municipal wastewater to additional treatment (to remove ammonia by nitrification, biological oxygen demand [BOD] by Granular Activated Carbon [GAC] adsorption or microfiltration, and particles by filtration) prior to use as cooling water makeup.
- Determine different chemical treatment regimens required to manage cooling water quality for different levels of tertiary treatment ranging from no tertiary treatment to inclusion of nitrification, organic compound removal by adsorption, and filtration.

- Perform comparative life cycle cost analyses for different levels of tertiary treatment versus the corresponding chemical treatment regimens.
- Determine the critical economic, technical, and social factors that need to be considered in a comparative evaluation of tertiary treatment of makeup water versus cooling water chemistry control by chemical treatment (e.g., future changes in freshwater availability and cost, value of treated wastewater in the future, or social support for water reuse efforts).



*Secondary Treated Municipal Wastewater*

## Benefits

Knowledge gained about the nature and degree of chemical treatment required for management of cooling water chemistry will be used to estimate capital and operating costs for each makeup water quality studied in the experimental testing. The total capital and operating cost of managing cooling water chemistry for several tertiary treatment scenarios will be estimated, as well as the costs of the associated chemical treatment for cooling water chemistry management if the tertiary treatment were not employed. Findings will be examined to assess the lowest cost treatment scenario among those studied, and also the most important tradeoffs in terms of additional chemical management avoided for tertiary treatment.

## PERIOD OF PERFORMANCE

10/01/08 to 06/30/12

## COST

**Total Project Value**  
\$941,293

**DOE/Non-DOE Share**  
\$740,551 / \$200,742

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**Planned Activities**

In the first phase of the project, detailed information about the use of treated municipal wastewater at several power plants where such water is in use as cooling system makeup water will be collected and evaluated; plans will also be made for the field studies at the Franklin Township Municipal Sanitation Authority (FTMSA) wastewater treatment facility. The second phase of the project includes the performance of laboratory studies, followed by related field studies with pilot-scale cooling towers at the FTMSA site to assess the benefits of tertiary treatment of the wastewater in reducing chemical treatment required for cooling water quality management. Initial studies for life cycle cost analyses will also be performed. Finally, life cycle cost analyses will be performed, including capital and operating costs, for the implementation of varying levels of tertiary treatment of municipal wastewater prior to use as makeup water for cooling systems. An assessment of the technical and social factors that need to be considered in a comparative evaluation of tertiary treatment of makeup water versus cooling water quality control by chemical treatment will also be conducted.