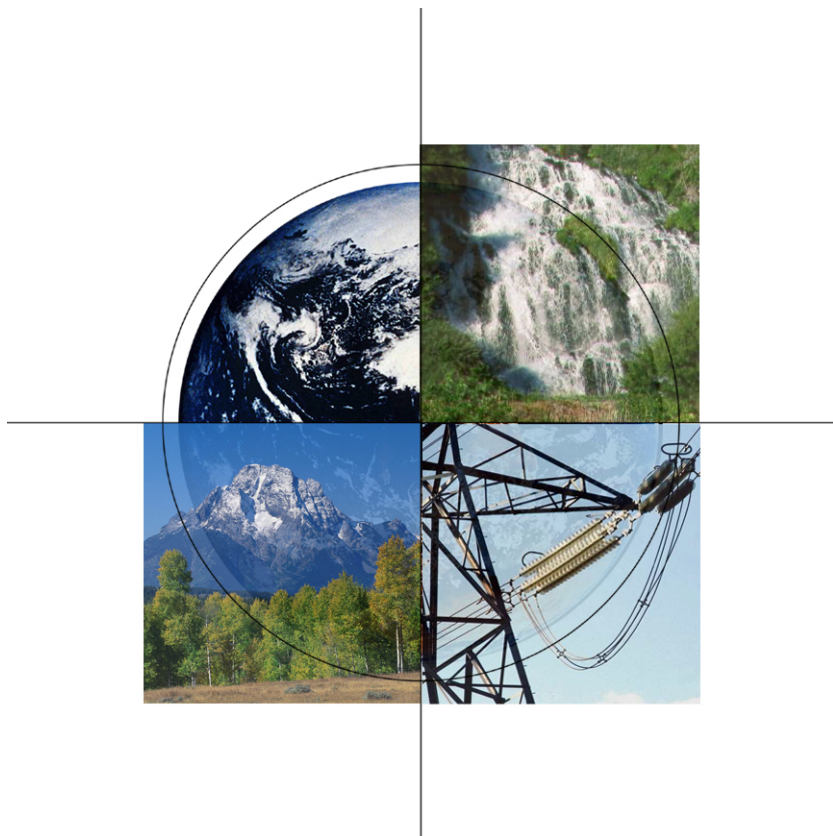


# Electric Utilities and Water: Emerging Issues and R&D Needs



## *9th Annual Industrial Wastes Technical and Regulatory Conference*

*April 13-16, 2003  
San Antonio, TX*

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U.S. Department of Energy/National Energy Technology Laboratory



# Presentation Outline



- **Who is NETL**
- **Background on energy & water**
- **Power plant & water issues**
- **Workshop results**
- **NETL's water-energy R&D program**



# National Energy Technology Laboratory



- **One of DOE's 17 national labs**
- **Government owned / operated**
- **Sites in:**
  - Pennsylvania
  - West Virginia
  - Oklahoma
  - Alaska
- **More than 1,100 federal and support contractor employees**



# What We Do

- Shape, fund, and manage extramural RD&D
- Conduct onsite research
- Support energy policy development



# Three Things Power Plants Require



**1) Access to transmission lines**



**2) Available fuel, e.g., coal or natural gas**



**3) Water**

# Water and Energy Inextricably Linked

- Each kilowatt-hour of electricity requires on average about 25 gallons of water to produce.
- Therefore, we may indirectly use as much water turning on lights and running appliances as we use in taking showers and watering lawns.

# Water-Energy Issues

- **Regulatory**
  - Clean Water Act
    - §316 (b) – Cooling Water Intake Structures
    - TMDL Program
  - Safe Drinking Water Act
  - Resource Conservation & Recovery Act
- **Population shifts to water-challenged regions**
- **Economic growth – increase demand for both water and electricity**
  - **State and regional issues**
  - **Native American rights**
  - **Climate change**
    - Short-term impacts, drought
    - Long-term effects



# Power Plant Water Issues in Recent News



- **Company Ends Fight for Power Generator on NJ-NY Border**
  - *The Record, NJ, September 2002*
- **EPA Orders Mass. Power Plant to Reduce Water Withdrawals**
  - *Providence Journal, RI, July 2002*
- **Georgia Power Loses Bid to Draw Water from Chattahooche**
  - *Miami Herald, February 2002*

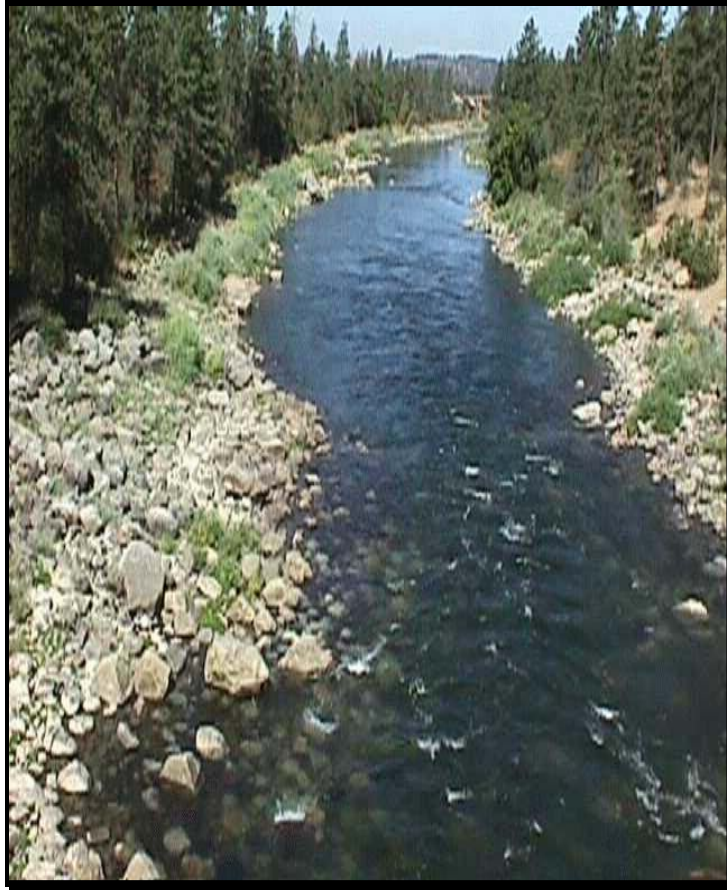


# Power Plant Water Issues in Recent News

- **Duke Power Warns Towns in Charlotte, N.C., Area to Cut Water Use**
  - *The Charlotte Observer, NC, August 2002*
- **Water at Pueblo, Colorado, Power Plant Slows to Trickle**
  - *The Pueblo Chieftain, CO, August 2002*
- **Official: Plants Would Use Too Much Water**
  - *The Idaho Statesman, July 2002*



# “Official: Plants Would Use Too Much Water”



***Spokane River***

- Two large power plants proposed for Washington-Idaho border
- 17 million gallons of water/day from Spokane-Rathdrum Prairie Aquifer
- Local concerns that withdrawal would impact Spokane River

Source: Idaho Statesman, July 19, 2002

# Power Plant Fresh Water Use

- **Thermoelectric power plants are second largest user of fresh water in the United States**
- **Use about 132 billion gallons per day**



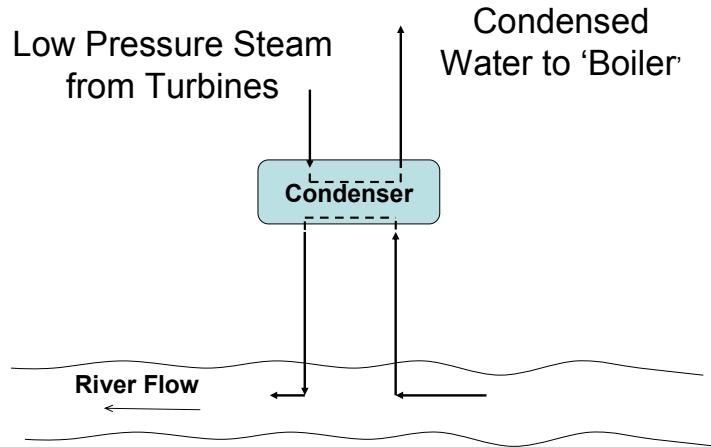
***Power Plant Cooling Towers***

Source: USGS Circular 1200, 1998

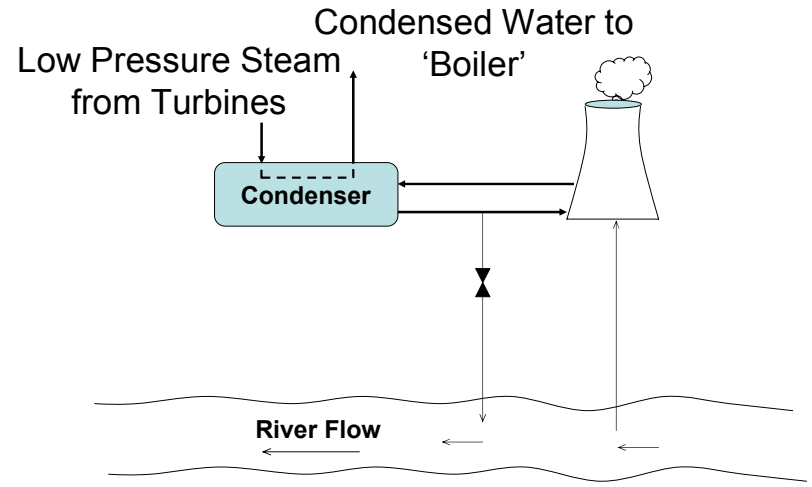


# Wet Cooling Systems

## Once-Through Cooling System



## Recirculating Cooling System



# Use vs. Consumption of Water



*Youghegany River,  
SW Pennsylvania*

- **Once-through cooling systems can use as much as 30 times more water than closed (re-circulating) systems**
- **Closed systems consume about 10 times more water than once-through systems**
- **A 500 MW power plant consumes about 9 million gallons of water per day, equivalent to 17 Olympic-sized pools**

# Water Regulations Affecting Power Plants

- **Clean Water Act § 316(b) – Cooling Water Intake Structure Regulations**
  - Require new and existing power plants to prevent adverse environmental impacts to aquatic organisms, i.e., prevent entrainment and impingement
    - Install closed (re-circulating cooling systems)
    - Install new intake structure technology



# EPA Orders Massachusetts Power Plant to Reduce Water Withdrawals

- **PG&E's Brayton Point Station's once-through cooling system has reportedly led to collapse of Mt. Hope Bay fishery**
- **EPA requires PG&E to reduce current water withdrawal from 1 billion gpd to 60 million gpd**
  - PG&E estimates a cost \$254 million to install cooling tower



*Mt. Hope Bay*

# Atmospheric Deposition Can Impact Water Quality

- Emissions from power plants such as sulfur dioxide (SO<sub>2</sub>), nitrogen oxide (NO<sub>x</sub>), and mercury can impact water quality
- A “non-point” source

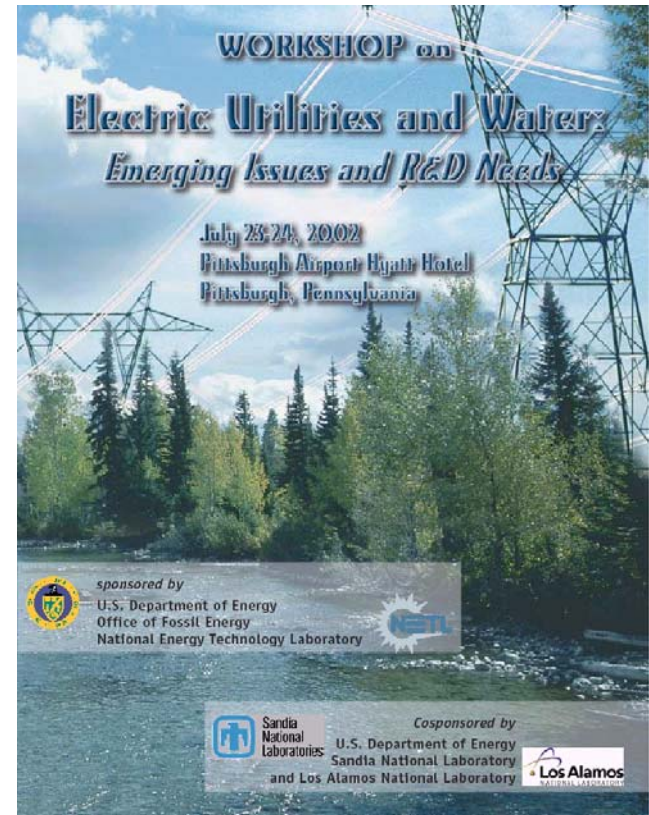


*Mercury Wet Deposition Monitoring Station in Southwestern PA*



# Workshop on Electric Utilities and Water

- July 2002 two-day workshop addressing emerging water/energy R&D needs
- Meeting of government, electric utility and coal industry, academia, EPRI, and regulatory representatives



# Key Issues Identified at Workshop

- **Advanced cooling systems**

- cost effectiveness
- reliability
- efficiency

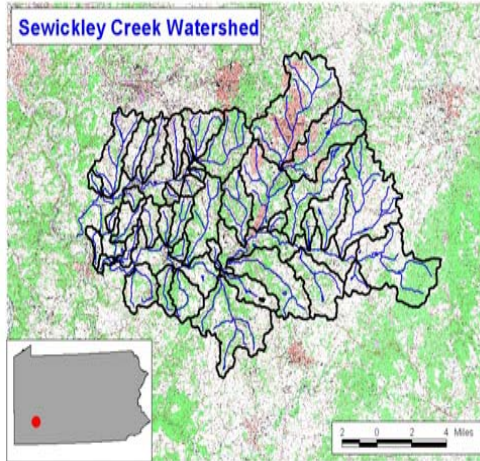


- **Alternative (non-traditional) water sources**

characterization of source:

- availability
- suitability
- long-term water quality variability

# Key Issues Identified at Workshop



- **Regulatory issues**
  - 316(b) regulations
  - future regulatory uncertainty
  - trading program and water credits
  - impact of non-point source and atmospheric deposition on water quality

- **R&D Needs and Opportunities**

- systems studies profiling water demands, alternative sources, and cooling requirements
- treatment technologies for trace level contaminants
- better watershed characterization technologies

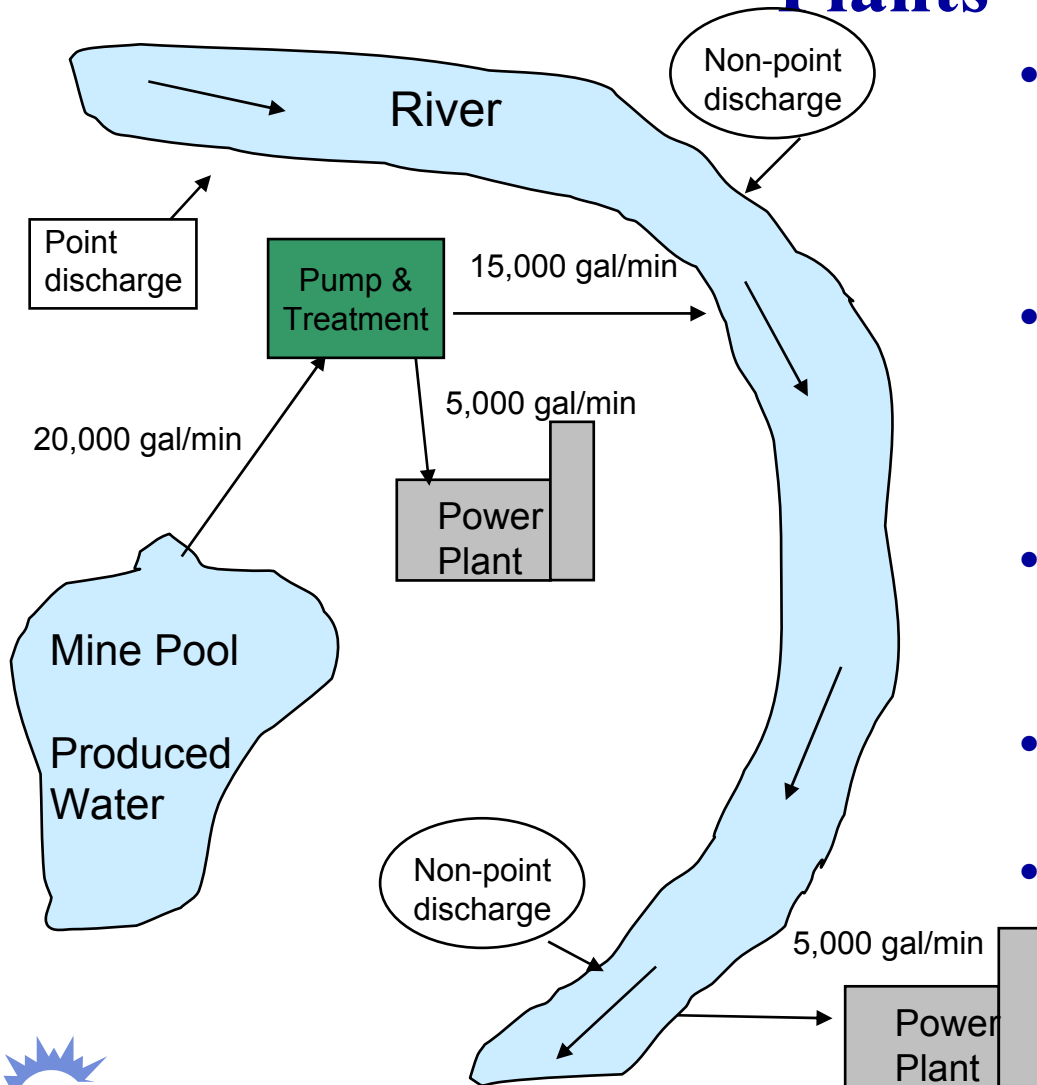


# “Innovative Water Management Technologies and Concepts for Coal-Fired Electric Utility Boilers”

- **Targeted competitive solicitation closed February 14, 2003**
- **Four topic areas:**
  - Non-Traditional Sources of Process and Cooling Water
  - Innovative Cooling Technology
  - Advanced Cooling Water Intake Technology
  - Advanced Pollutant Measurement and Treatment Technology



# Using Non-Traditional Waters for Power Plants



- Provide cooling makeup water for adjacent and downstream power plants
- Provide water to river during low flow to benefit in-stream use and biological systems
- Dilute unregulated point and non-point pollution discharges
- Control mine flooding
- Improve quality of mine pool/CBM produce waters

# Coal Drying to Reduce Water Consumed in Pulverized Coal Power Plants



***Great River Energy's Coal Creek Station, North Dakota***

- Lehigh University & Great River Energy collaboration
- Low-temperature drying of subbituminous and lignite coals through recovery of low grade waste heat
- Previous work demonstrates coal drying can reduce cooling tower makeup water requirements by 5%-7%
- Examining fluidized and fixed bed drier designs

# NETL's Water & Electric Utilities R&D Program



- Innovative water management concepts and technologies
- Regulatory and policy analysis
- Atmospheric transport and deposition of pollutants (e.g., mercury)
- Mine land reclamation and water quality improvements
- Water-quality trading



**“Whiskey is for drinking;  
water is for fighting.”**

**– Mark Twain**

*To learn more about NETL’s water-energy  
R&D activities, please visit us at:*

**[WWW.NETL.DOE.GOV/COALPOWER/ENVIRONMENT](http://WWW.NETL.DOE.GOV/COALPOWER/ENVIRONMENT)**

