

EPA Cooling Water Intake Symposium  
Washington, DC May 6-7, 2003

# RETROFIT OF CLOSED-CYCLE COOLING TOWERS

John Torgan, Narragansett Baykeeper  
Save the Bay®-People for Narragansett Bay

Reed Super, Senior Attorney  
Riverkeeper, Inc.

# Closed-Cycle Cooling at New Plants

- 100% of combined-cycle plants built in the last 20 years have a closed-cycle recirculating cooling system.
- 88% of the coal-fired facilities built in the last 10 years have closed-cycle cooling.

Source: U.S. EPA (66 Fed. Reg. at 28,855)

# Closed-Cycle Retrofits

- Palisades 821 MW nuclear (MI) 1974
- Pittsburg (Unit 7) 751 MW gas (CA) 1976
- Jefferies 346 MW coal (SC) 1985
- Canadys 490 MW coal (SC) 1972, 1992
- Wateree 772 MW coal (SC) 2003+
- Yates 1250 MW coal (GA) 2004 (proj)
- McDonough 520 MW coal (GA) 2008 (proj)
- Brayton Point 1500 MW coal/oil (MA/RI)

# Yates Plant

## Chattahoochee River

- Mechanical-draft counter flow cooling twrs
- 40 cells: 5 units, 8 cells each
- Length: 1000 ft
- Allows Routing to Different Cells
- 96% Flow Reduction (600 to 22 MGD)
- No Construction Outages
- Cost \$75-87M

# Yates Plant

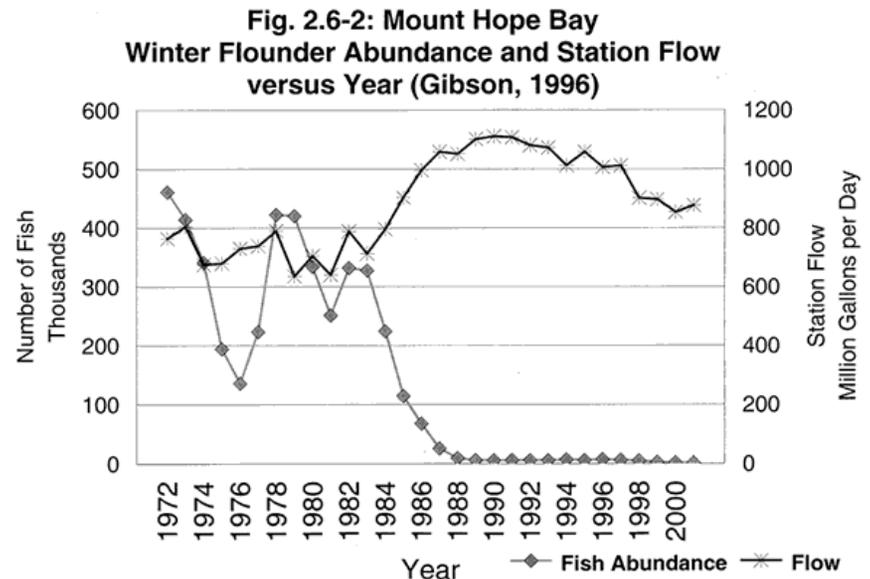
## Chattahoochee River

- 7 Units, 1250 MW total, coal-fired
  - Units 1-5, 1950s, 550 MW, once-through cooling
  - Units 6-7, 1970s, 700 MW, closed-cycle cooling
- Depowers Units 1-5 to 300 MW
  - b/c thermal discharge, DO, fish kills
- Retrofitting Units 1-5

# Brayton Point Station

## -Aquatic Impacts of Once-Through Cooling-

- Thermal discharge 95° F
- Entrainment, including:
  - 251M winter flounder
  - 11.8M bay anchovy
  - 375M windowpane
  - 3.5 billion tautog
- 87% decline in finfish populations



# Brayton Point Station

## -Cooling Tower Retrofit Options-

- Closed-Cycle Unit-Specific - Unit 3 (654 MGD)
- Enhanced Multi-Mode system (650 MGD)
- C/C Unit-Specific - Units 1 or 2&3 (350 MGD)
- C/C Unit-Specific - all 4 Units (with by-pass capability) (56 MGD)

# Brayton Point Station

## - Cooling Tower Retrofit Options Specs-

**[Current Plant: Once-Through, 4 Units = 1.4 BGD]**

### Enhanced Multi-Mode

- Mechanical Draft
- 20-cells, from canal
- Not associated w/ units
- 650 MGD (33%)
- Allow bypass

### Unit-Specific Option

- Mechanical Draft
- All 4 units
- 56 MGD (96%)
- By-Pass Capability  
(6,847 MGY)

# Mechanical Draft Unit-Specific Cooling Towers

## **-Summary of Aquatic Benefits-**

- Reduce thermal discharge by 99%  
(97 trillion to 0.8 trillion BTUs/yr)
- Reduce Max temperature from 95° F to 85° F
- Reduce water withdrawals by 96%  
(1.4 BGD to 56 MGD)
- Reduce losses to fishery (E+I) by 94%  
(e.g., 251M to 15M flounder larvae/yr)

## Reduction of Flow and Heat -Comparison of Options-

<u>Operating Scenario</u>	<u>Flow Rate (MGD)</u>	<u>Annual Heat Load Discharge (TBTU)</u>
Current	1452	97
Closed-Cycle Unit 3	654	22.9
Enhanced Multi-Mode (20-cell cooling tower)	650 (annual) 750(summer)/ 600 (winter)	28
Closed-Cycle (Units 1 or 2 & 3)	350	14
Closed-Cycle Entire Station (Units 1, 2, 3 and 4)	56	0.8

# Brayton Point Station

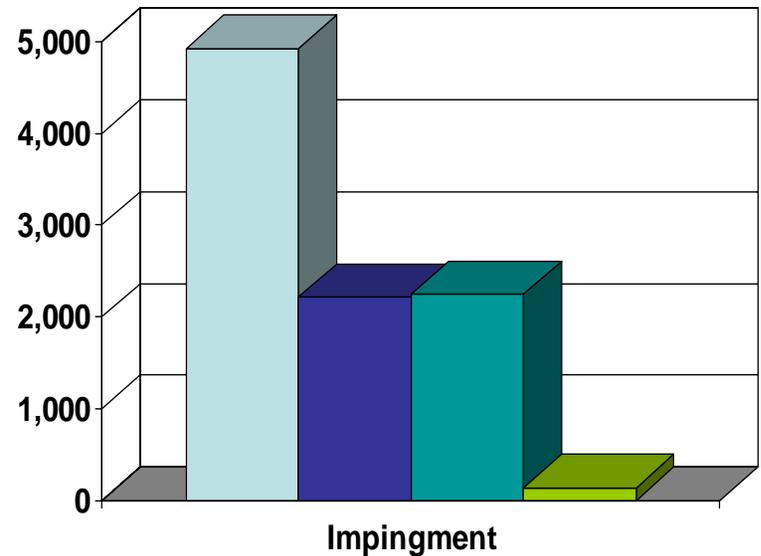
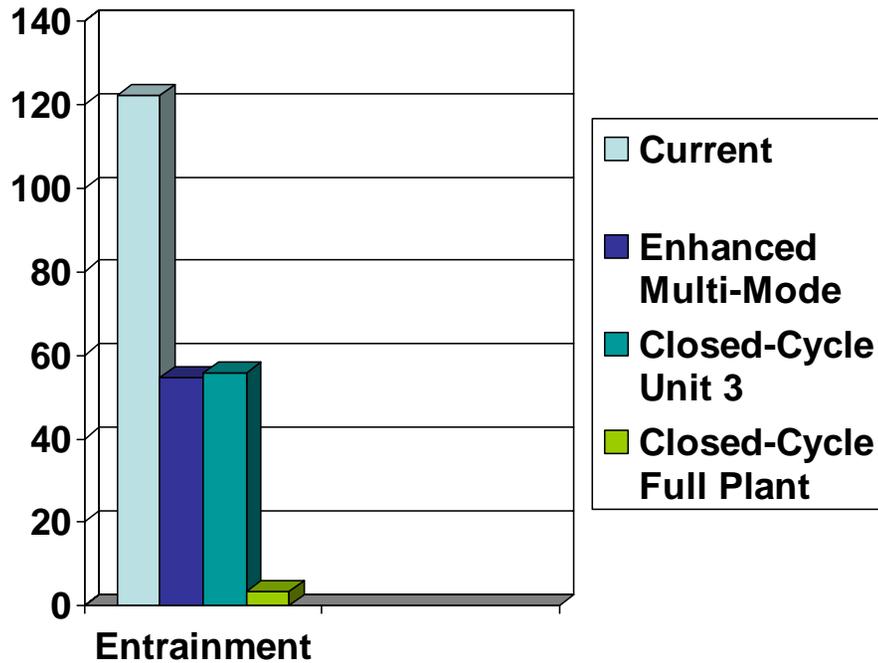
## Total Annual Production Foregone in Pounds

<u>Tech Option</u>	<u>Impinge</u>	<u>Entrain</u>
Current	4,926	121,968,640
Enhanced Multi-Mode	2,211	54,741,834
Closed-Cycle Unit 3	2,246	55,617,704
Closed-Cycle Full Plant	134	3,312,155

# Brayton Point Station

## Total Annual Production Foregone in Pounds

Millions



## Annual Efficiency Losses (“Energy Penalty”)

- Units 1, 2, 3: 0.29%    Unit 4: 0.09%  
(100% capacity factor)
- Units 1, 2, 3: 0.75%    Unit 4: 0.18%  
(100% capacity factor)

Current Capacity Factor (1, 2, 3): 80%

Source: SAIC Report (March 15, 2002)

# Annual Cost

## EPA/Abt Estimate (11.8% Disc. Rate)

Technology Option	20 years	30 years
<u>Closed-Cycle 4 Units ( 0% plume abate)</u>		
Total After-Tax Cash Flow Cost, PV:	\$68.385 M	\$67.975 M
Annual Equivalent Cost:	\$9.041 M	\$8.314 M
<u>Closed-Cycle 4 Units (100% plume abate)</u>		
Total After-Tax Cash Flow Cost, PV:	\$83.269 M	\$85.803 M
Annual Equivalent Cost:	\$11.009 M	\$10.494 M

## Increased Cost to Rate-Payer

**-from production costs and reduced generation-**

•  
Long-term increase in electric rates  
for the average household  
(500 kWh per month consumer):

\$0.03-\$0.13 per month