EPA Cooling Water Intake Symposium
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AN OVERVIEW OF FLOW REDUCTION TECHNOLOGIES

Presented by: Reed Super
Senior Attorney, Riverkeeper, Inc., Garrison, NY 10524
845-424-4149 rsuper@riverkeeper.org www.riverkeeper.org

Outline

- Why Reduce Flow?
- Flow Reduction Technologies
- Issues in Flow Reduction
- Cooling System/Flow/Impact Relationship
- Power Plant Examples and Illustrations

  -New Plant

  -Replacement Plant

  -Flow Reduction vs. AFB

  -Cooling Towers vs. Variable Speed Pumps

Why Reduce Flow?

- Drastic reductions in I+E (~95%)
- Guaranteed reductions (no reliability issues)
- Facilitates lower velocity and better screens
- Reduces or eliminates thermal impacts
- Allows use of municipal H_2O or effluent
- Allows siting away from wetlands, coasts

Flow Reduction Technologies

- Once-Through to Closed-Cycle Wet (96%)
- Closed-Cycle Wet to Dry Cooling (97-100%)
- Repowering (add Combustion Turbine) (33%)
- Variable Speed Pumps (% varies; note baseline)
- Changing Source Water (100%)
- Seasonal Outages (% varies)
- Combination of the Above

Issues in Flow Reduction

- Level of Reduction in Flow (and I+E)
- Relative Effectiveness
- Technical Feasibility
- Effect on Plant Efficiency (Energy Penalty)
- Cost to Plant Owner and Rate-Payer

Flow/Impingement Relationship

Great Lakes: $I = 1.7023V^{1.778}$

Pisces (2002) using data from Kelso (1979)

Other Fresh Water: $I = 6 \times 10^{-8}V^{3.1444}$

Pisces (2002)

Ocean and Estuary: $I = 0.1704V^{1.5943}$

Pisces (2002)

All Waters: $I = 0.4719V^{1.8699}$

Pisces (2002)

I is # of fish impinged/yr **V** is volume in cu/ft per sec

Flow/Entrainment Relationship

Fresh Water: $En = 2E + 07V^{0.1924}$

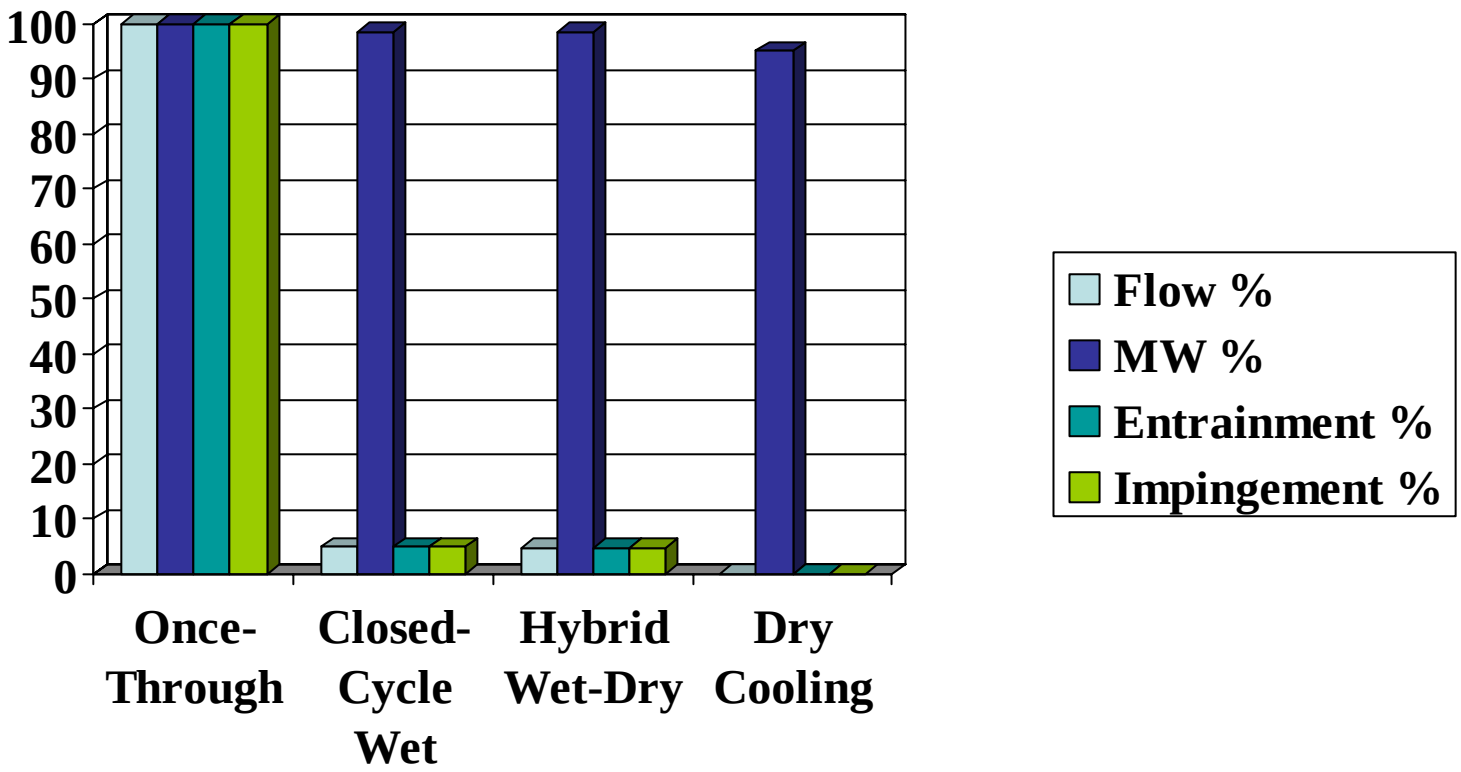
Pisces (2002)

Ocean and Estuary: $En = 457475V^{1.1405}$

Pisces (2002)

En is # of fish entrained/yr **V** is volume in cu/ft per sec

Cooling Systems, Flow, and E+I



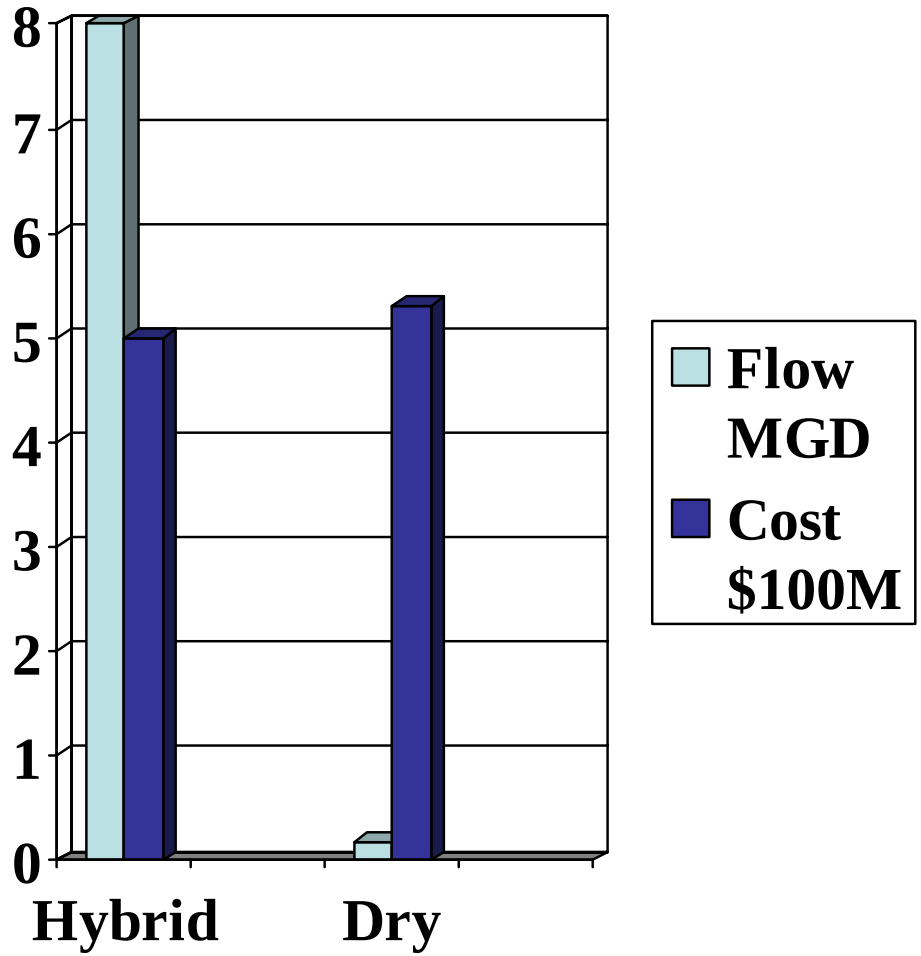
Flow Reduction at New Plant
Hybrid Cooling vs. Dry Cooling
(Athens, NY)

PROPOSED

- Hybrid Cooling
- 4.53-8 MGD

APPROVED / BUILT

- Dry Cooling
- 0.18 MGD



Flow Reduction at Replacement Plant (Morro Bay, CA)

Existing 1954 plant:1000 MW, gas, 707 (387) MGD

ONCE-THROUGH

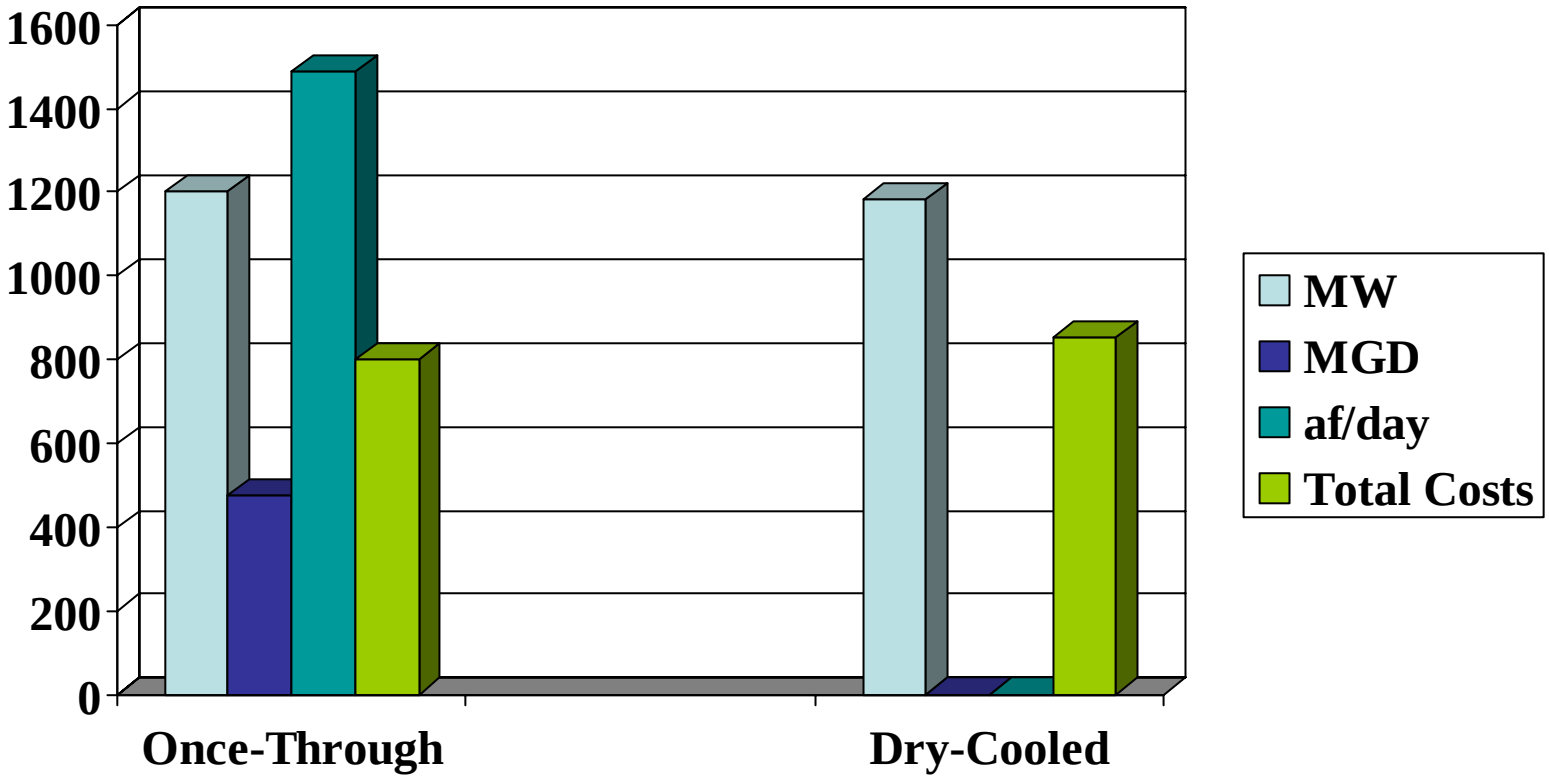
- 1200 MW
- 475 MGD
- 1489 af/day (62%)
- CMR 17-33% 20-37%
- Cost: $800M

DRY-COOLED

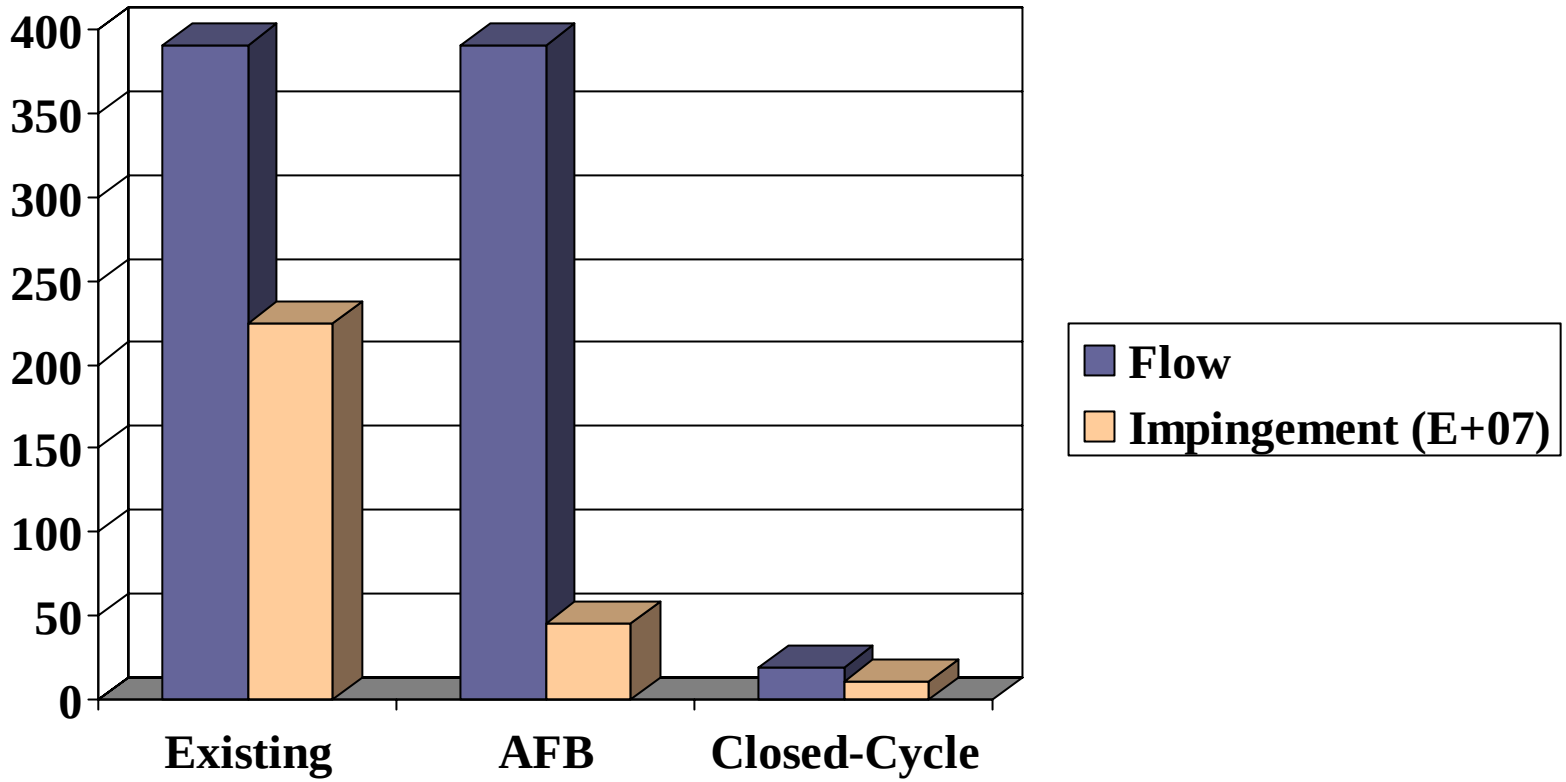
- 1200 MW
- 0 MGD (muni source)
- 0 af/day (0%)
- CMR 0%
- Cost: $852M
- Energy Penalty: 1.5%

Flow Reduction at Replacement Plant

Once-Through vs. Dry Cooling (Morro Bay, CA)



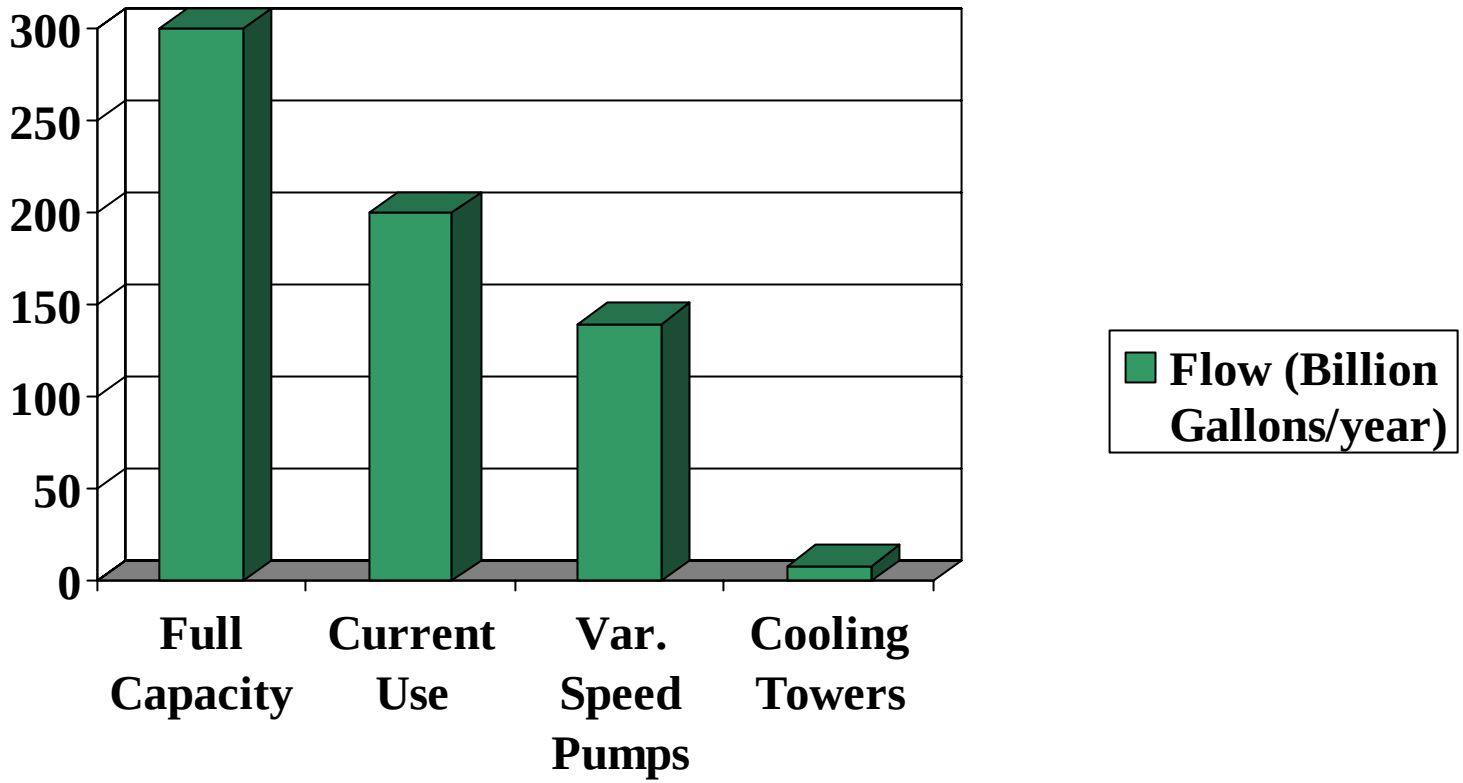
Comparison of Technology Types
Flow Reduction vs. Barrier Filters
An Illustration



Comparison of Flow Reduction Methods

Variable Speed Pumps vs. Cooling Towers

An Illustration (Current Use as Baseline)



A Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms