Diablo Canyon

Once Through Cooling
Facilities Using OTC

• 539 Power Plants Nationwide and 19 Plants in California

• California Facilities -
  – 40% of generating capacity
  – 22% of generation
  – Baseload, Intermediate, and Peaking Resources
  – DCPP & SONGS

• Nationwide - 38 Nuclear Plants Use OTC
  – 61-Units (59% of Fleet)
  – 20-Units (19.5% of Fleet) Use Saltwater/Brackish-Water OTC.

• No Other Closed-Cycle, Saltwater-Cooled Nuclear Plant in the World
Eliminating Once-Through Cooling

- **Diablo Canyon OTC**
  - Circulates 2.5 billion gallons of seawater per day
  - Technology options to minimize impacts
    - No effective modifications to existing system available
    - Alternative cooling systems assessed
  - **Dry Cooling - Infeasible (Space & Engineering Limits)**
    - Natural Draft Towers - Infeasible (Space & Seismic Issues)
    - Mechanical Draft Towers - Likely Infeasible (Adverse Impacts & Permitting)
Diablo Canyon – Percentage of flow vs. impact

Data taken from SWRCB’s Substitute Environmental Document.
Retrofit Feasibility - Conceptual Model
Retrofit Feasibility: Possible Cooling Tower Layout
Retrofit Feasibility: Adverse Environmental Impacts

• **GHG Emissions for Replacement Power**
  - 8-10 Million Metric Tons During 17-month Outage
  - 282,000 Metric Tons/Year Ongoing

• **Significant Visible Plumes**
  - Plumes 2/3 to 5 Miles in Length (50% of Winter 41% of Summer)
  - Visible From SLO 18% of the Year

• **Salt Drift 7,600 Tons/Year**
  - 15,200,000 Pounds Minimum of PM$_{10}$ Emissions

• **Fossil Fuel Combustion for Implementation**
  - Approximately 4.5 Million Gallons of Diesel

• **Thermal Discharge Limit Challenges—Diffuser Required**
  - Remaining 72 Million Gallon-Per-Day Discharge Will be Warmer, Saltier
Retrofit Feasibility: Engineering Challenges

• Plume Abatement Towers Are Infeasible

• Auxiliary Salt Water (ASW) & Service Cooling Water (SCW) Must Remain on OTC.
  – 43-mgd once-through cooling flow to existing discharge

• 2 20-Cell Back-to-Back Tower Sets per Unit (80-Cells Total)
  – 5 Circulating Water Pumps Per Unit Located @ Tower Basin/Pit
  – New Conduits Tie Into Old (Major Excavation Effort)
  – Main Condensers Replaced With Modular Welded Bundles

• Existing Intake Structure Maintained but Reconfigured

• Tower Blowdown to New Off-Shore Diffuser System
Retrofit Feasibility: Cost/Schedule Challenges

• Require 17-Month Dual Unit Outage
  – Necessity to Upgrade/Replace Main Condensers
  – Extensive Excavations West of Turbine Building

• Initial Costs (2008 Dollars)
  – Capital Project Costs $2,656,000,000
  – Replacement Power (Construction) $1,805,700,000
    @ $70MW - 1155MW/Hr * 24Hr * 517 Days * 2 Units * 0.9 Capacity Factor
    \[4.46\text{ Billion Dollars}\]

• Average Lost Capacity Post-Retrofit (“Derate”)
  – 56MW (23MW per Unit)

• Post Implementation Costs (2008 Dollars)
  – Decommissioning Fund Increase $66,400,000
  – Replacement Power Derated Capacity $36,200,000/year
  – Additional O&M $7,400,000/year
Diablo Canyon – Retrofit Cost Estimate

<table>
<thead>
<tr>
<th>In Millions by Category of Work:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$325 Site Work – excavation, retaining walls</td>
</tr>
<tr>
<td>$316 Demolition, replacement of buildings, roads, parking</td>
</tr>
<tr>
<td>$298 Recirculating water/make-up water pumps, tunnels</td>
</tr>
<tr>
<td>$269 Permitting, engineering, project management, security</td>
</tr>
<tr>
<td>$242 Cooling Towers</td>
</tr>
<tr>
<td>$199 Electrical systems, process/instrumentation, utility relocation</td>
</tr>
<tr>
<td>$189 Worker transportation, commute wages, parking</td>
</tr>
<tr>
<td>$131 Upgrades – condensers, sewage treatment, SCW</td>
</tr>
<tr>
<td>$56 Blowdown water treatment, mixing station, diffuser</td>
</tr>
<tr>
<td>$50 Plant shutdown and start-up</td>
</tr>
</tbody>
</table>

$2,075 Total Direct Costs

$614 Project Indirect Costs and Contingency

$2,689 Total Capital Costs

$1,800 Replacement Power (at $70 MWh)

$4,500 TOTAL PROJECT COSTS
Retrofit Feasibility: Nuclear Safety Challenges

• ASW Must Remain on OTC
  – Infeasible to Retrofit to CCC due to Elevated Inlet Temperatures as High as 83-Farenheit

• Turbine Building Flooding
  – Elevated System Configuration, Correctable But Costly

• Salt Deposition on Transmission System
  – Significant Arcing Risk, Loss of Power
  – Several Levels of Redundant Backup, But Tripping is NRC Concern

• ASW System Interruption During Implementation

• ISFSI Haul Road Rerouting
Retrofit Feasibility: Permitting Challenges

• NPDES Permit for New/Altered Discharge(s)
  – Reconfigured Remaining Discharge and Offshore Diffuser

• Army Corp of Engineers CWA Section 404 Permit
  – Discharge, Diffuser and Intake Construction

• New State Lands Commission (SLC) Lease
  – Required for Diffuser Installation

• Air Emissions Permit-To-Operate (APCD PTO)
  – Necessary Credits Not Currently Available

• Coastal Development Permit (CDP)
  – Significant Level of On-Site Construction [more?]
Retrofit Feasibility: Adverse Environmental Impacts

- **Significant Visible Plumes**
  - Plumes 2/3 to 5 Miles in Length (50% of Winter 41% of Summer)
  - Visible From SLO 18% of the Year

- **Salt Drift 7,600 Tons/Year**
  - 15,200,000 Pounds Minimum of PM$_{10}$ Emissions

- **GHG Emissions for Replacement Power**
  - 12-15 Million Tons During Shut Down
  - 282,000 Tons/Year Ongoing

- **Fossil Fuel Combustion for Implementation**
  - Approximately 4.5 Million Gallons of Diesel

- **Thermal Discharge Limit Challenges**
Mitigation at Diablo Canyon

• Original Construction Began Prior to Implementation of the Coastal Act

• Subsequent Projects Have Included Significant Mitigation
  – Training Building
    • Creation of the Pecho Coast Trail
      – 7 mile docent-led public bluff top trail
  – Independent Spent Fuel Storage Installation
    • Creation of the Pt. Buchon Trail on the North Ranch
      – 3.5 mile public bluff top trail
  – Steam Generator Replacement
    • Preservation of 1200 acres on the South Ranch
    • Additional Public Access Enhancements on the Pecho Coast Trail
    • Elimination of Water Use From Diablo Creek
Tentative Settlement with Central Coast Board

• Settlement Reached in 2000 Resolved All Issues Involving OTC – Both Thermal and Impingement/Entrainment
• Board Approved Settlement in March 2003, Signed by Parties in June 2003
• Settlement Included:
  – 2013 Acre Conservation Easement Along 5.7 miles of Coastline, BMPs on Additional 547 Acres and $200K Oversight Fund
  – $4.0 Million Fund for Environmental Projects
  – $1.5 Million Fund for CCAMP
  – $350K for CDF&G Abalone Restoration Project
  – $150K for Bio-lab Facility Oversight and Additional Funds for Upkeep
• At July 2003 Permit Renewal Hearing, Board Requested Additional Information on Mitigation Options and Did Not Renew the Permit