
Diablo Canyon

Once Through Cooling



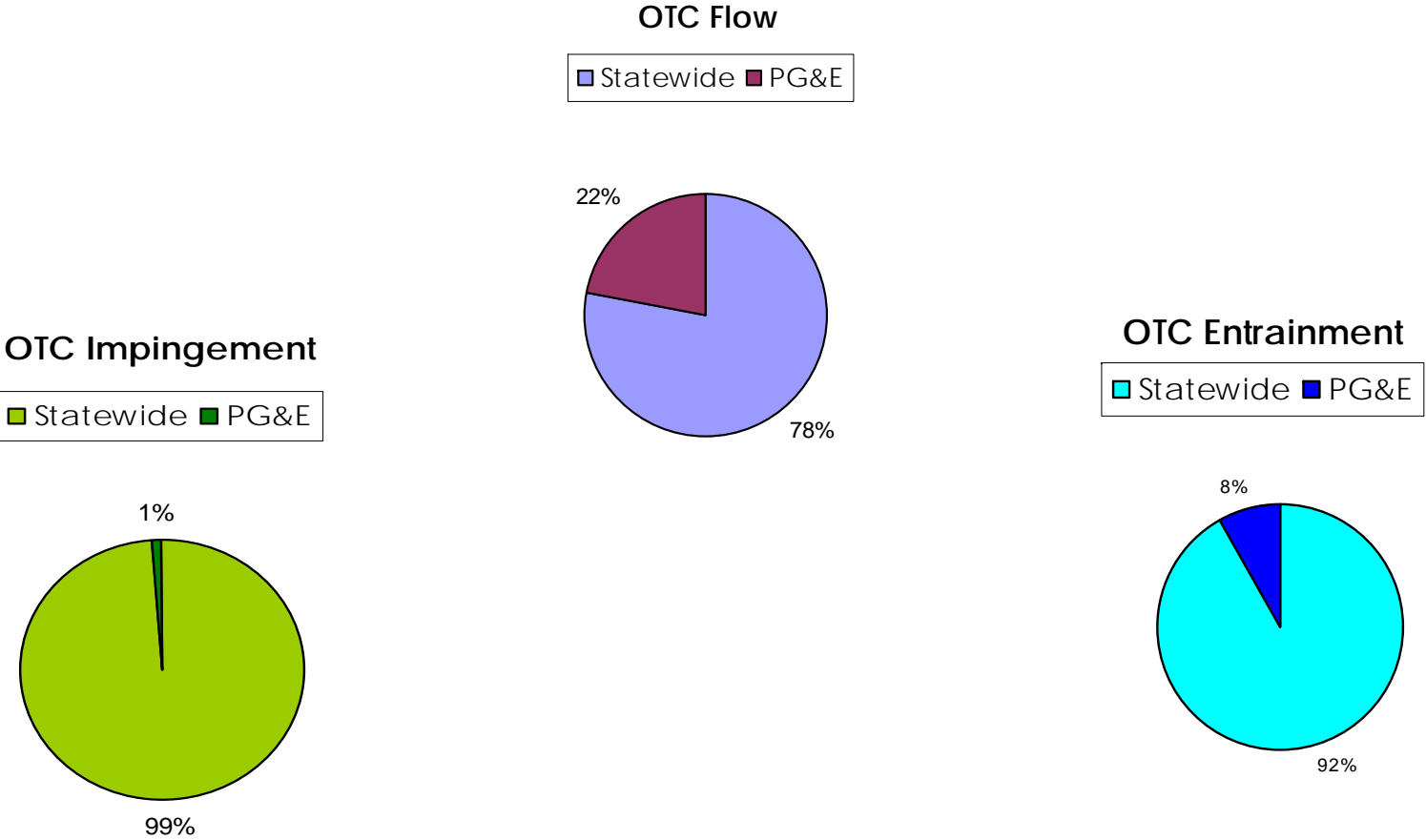
Facilities Using OTC

- **539 Power Plants Nationwide and 19 Plants in California**
- **California Facilities -**
 - 40% of generating capacity
 - 22% of generation
 - Baseload, Intermediate, and Peaking Resources
 - DCPD & 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

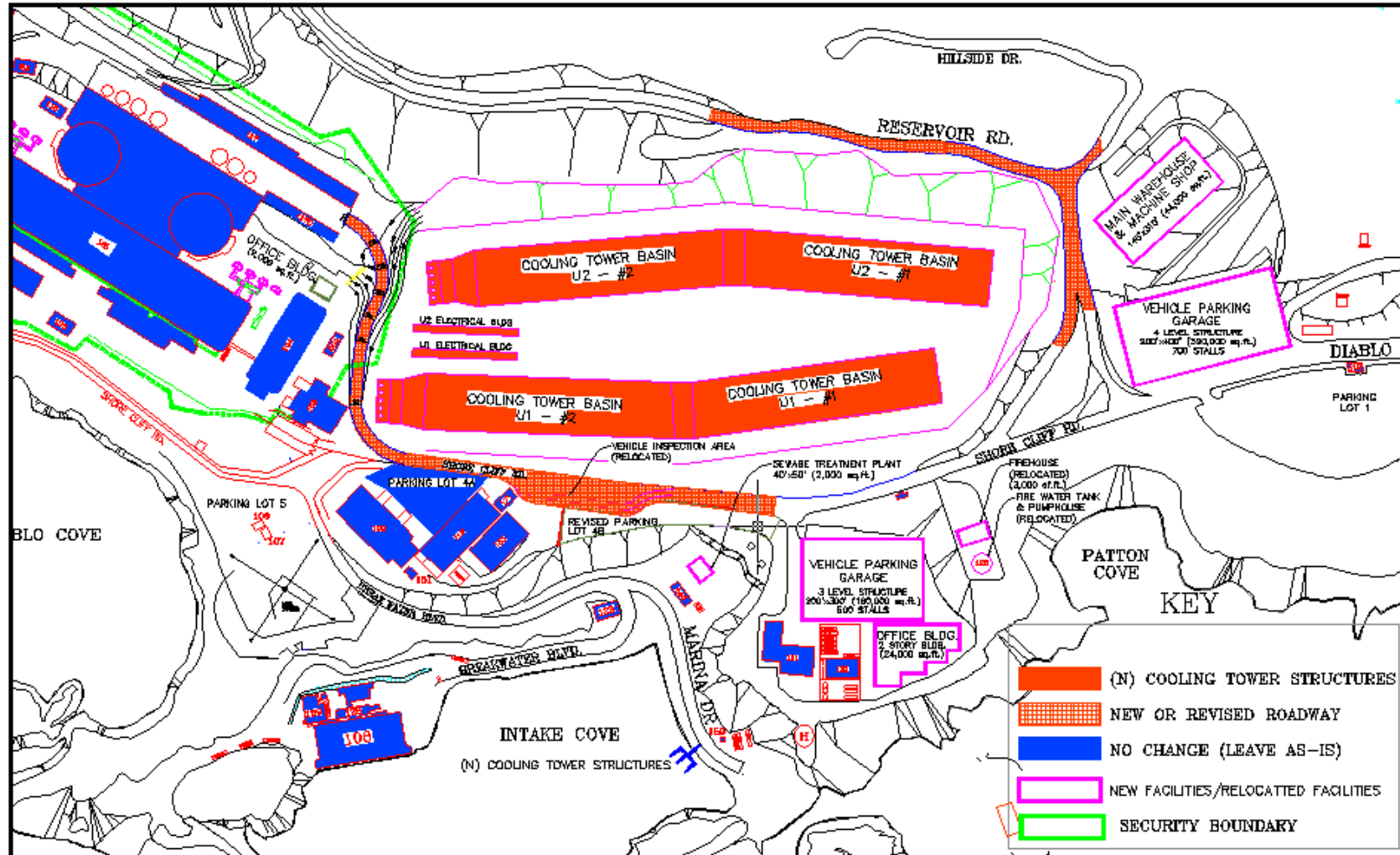


Data taken from SWRCB’s Substitute Environmental Document.

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 PM₁₀ 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 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

In Millions by Category of Work:

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

\$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-Fahrenheit
- **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 PM₁₀ 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