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# Diablo Canyon

## Once Through Cooling



# Facilities Using OTC

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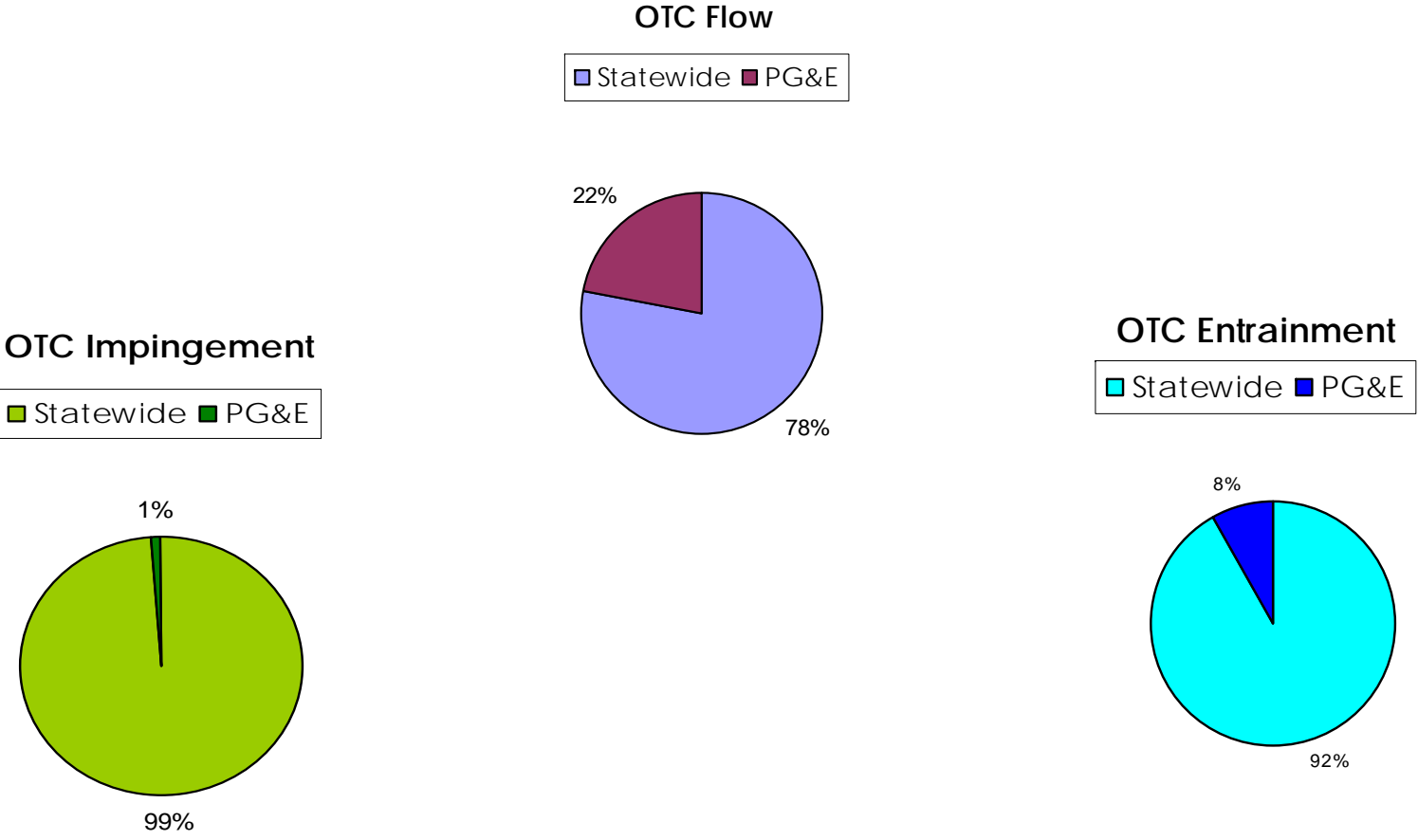
- **539 Power Plants Nationwide and 19 Plants in California**
- **California Facilities -**
  - 40% of generating capacity
  - 22% of generation
  - Baseload, Intermediate, and Peaking Resources
  - DCPD & SONGS
- **Nationwide - 38 Nuclear Plants Use OTC**
  - 61-Units (59% of Fleet)
  - 20-Units (19.5% of Fleet) Use Saltwater/Brackish-Water OTC.
- **No Other Closed-Cycle, Saltwater-Cooled Nuclear Plant in the World**

# Eliminating Once-Through Cooling

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- **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



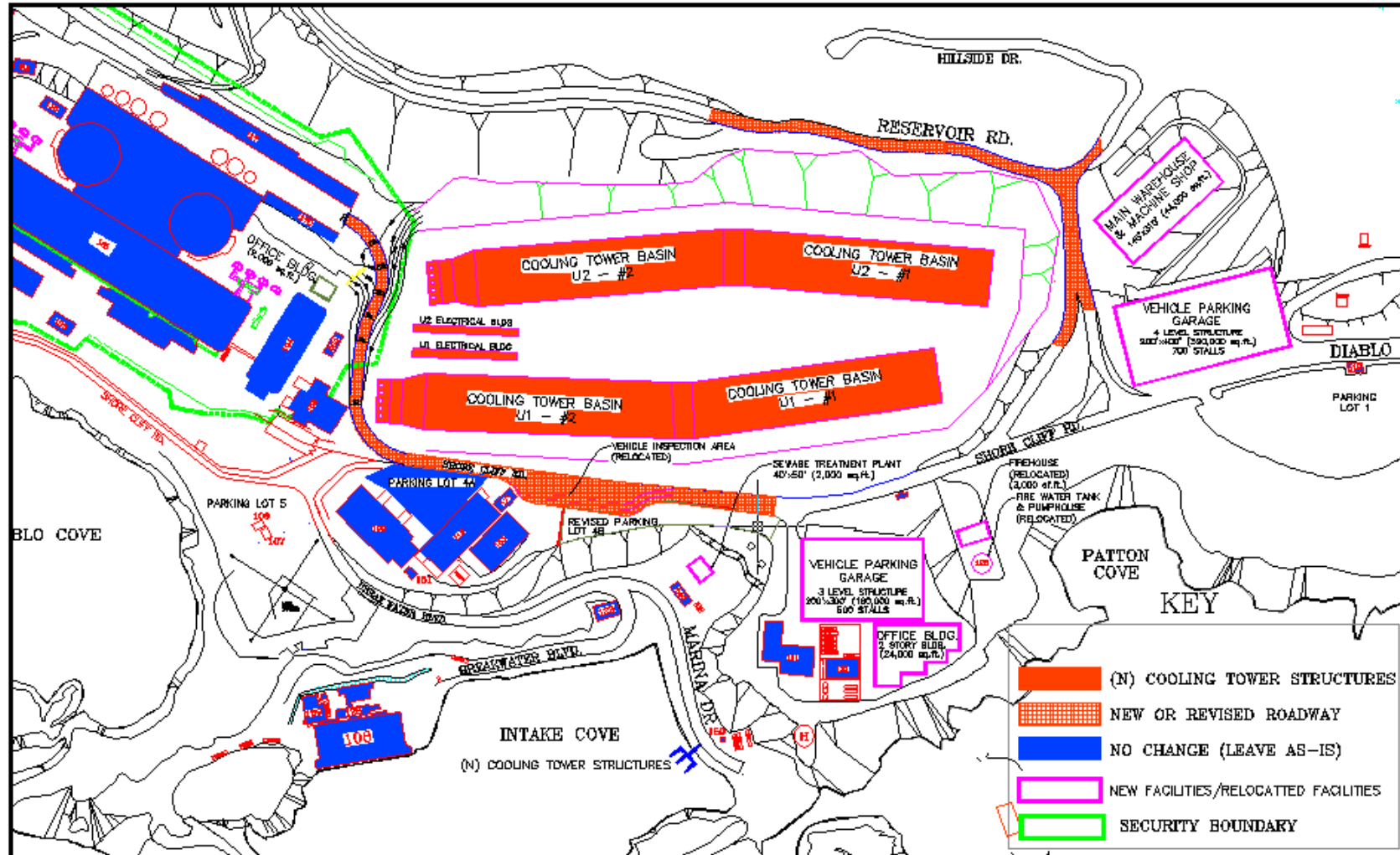
Data taken from SWRCB’s Substitute Environmental Document.

# Retrofit Feasibility - Conceptual Model

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# 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<sub>10</sub> 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

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- 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

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**\$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

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- **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

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- **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

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- **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<sub>10</sub> 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

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- **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

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- 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