ISSUES AND ENVIRONMENTAL IMPACTS ASSOCIATED WITH
ONCE-THROUGH COOLING AT CALIFORNIA’S COASTAL POWER PLANTS

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MAJOR MARINE IMPACTS
-pollution (nutrients, toxins, sediment)
-over fishing & by catch
-habitat destruction
-invasive species
-ocean warming & sea level rise
-once-through cooling?
21 Power Plants

Permitted To Use ~ 17 Billion Gallons Per Day

Coast Sand/Rock (2)  5.12 BGD
Coast Sand/Harbor (6)  3.43 BGD
Bay/Estuary (13)        8.39 BGD
INTAKE
- Impingement
- Entrainment

DISCHARGE
- Thermal
Thermal Effects, Impingement and Entrainment

Heated water exits plant to ocean

Fish (and other organisms) entrained with water

Power Plant
Heating and turbulence kills small organisms and young life stages (eggs, larvae and spores)

Screens impinge larger organisms (>3/8 inch)

Impinged organisms die and are removed

(modified from Raimondi)
Test TV-9
Date: June 12, 1986
Time: 08:24 (daylight savings)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Discharge Temp °C</th>
<th>Cooling Water Flow (cfs)</th>
<th>Reactor Power (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22.3</td>
<td>2000</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>20.1</td>
<td>2000</td>
<td>71</td>
</tr>
</tbody>
</table>

Intake Temp °C: 11.3
Tide: (-.42)-.73 ft (MLLW)
Wind: 7.5 mph from 205° (true)
Offshore Currents: 47.9 ft/min, 118° true
Waves: (H13) .74 cm 9 sec from 274° true
Air Temperature: 13.0 °C
Thermal Impacts – *very site specific but can be large* - rock bottoms and enclosed waters

Before Discharge

[Image of before discharge scene]

After Discharge

[Image of after discharge scene]
Impingement – *very site specific but can be large*
= 8-30% of Sport Fishing Catch in Southern California
 (> 90% of this impingement by San Onofre)
ENTRAINMENT - THE OCEAN IS NOT LIMITLESS
COASTAL AND ESTUARINE WATERS ARE DISTINCT HABITATS
AND COMMUNITIES WITH LIMITED EXTENT
SEAWATER IS A COMMUNITY, NOT JUST SALTY WATER

\[ 1000 \text{ m}^3 \times 100,000 \approx 17 \text{ Billion Gallons} \]

\[ \sim 50 \text{ Million Marine & Estuarine Fish Entrained Per Day in CA} \]
ENTRAINMENT IMPACT ASSESSMENT

**Traditional:**
Sample at Intake

**Modern:**
Also Sample Source Water

**AEL & FH**
Use # of Larvae
Entrained to Estimate
# of Adult
Equivalents Killed &
cmpare to fishery catch.

**BUT** how about impacts
to other species?

1. Use Empirical Transport Model (ETM) to determine
   Proportional Mortality (PM) = proportion of larvae
   killed from entrainment that could be entrained (larvae
   in source population)
2. Determine area of source population
3. Determine average of 1. & 2. for species
   assessed (“target species”)
4. Average PM x Average Area = area equivalent
to 100% loss =
   HABITAT PRODUCTION FOREGONE (HPF)
   Representative of all species lost to entrainment

More direct determination of community impacts?
large areas + many species + natural variation
+ multiple impacts = presently impossible
Habitat Production Foregone
Hypothetical Example of a Power Plant in an Estuary
Assume Entrainment Study Found:
1. Average Proportional Mortality of Estuarine Species = 17%
2. Area of Estuary = 2000 Acres (= source water; same for all species)

THEN: The Habitat Required to Compensate for Larval Losses (= New Estuarine Habitat Needed to Produce The Number of Larvae Equivalent to Entrainment Losses)
\[ = (2000 \times 0.17) = 340 \text{ Acres} \]
POTENTIAL CUMULATIVE IMPACTS
SANTA MONICA BAY (% / 6 weeks)

CUMULATIVE = 13.1%
## ENTRAINMENT IMPACTS FOUND IN RECENT STUDIES

<table>
<thead>
<tr>
<th>Location</th>
<th>Original Study (1979-80)</th>
<th>Recent Study – Habitat Loss (1999-2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moss Landing</td>
<td>no adverse</td>
<td>1100 acres - estuary</td>
</tr>
<tr>
<td>Morro Bay</td>
<td>no adverse</td>
<td>230-760 acres - estuary</td>
</tr>
<tr>
<td>Huntington</td>
<td>no adverse</td>
<td>370-780 acres - sandy coast</td>
</tr>
<tr>
<td>Diablo Canyon</td>
<td>not reliable</td>
<td>300-600 acres - rocky reef</td>
</tr>
<tr>
<td>South Bay</td>
<td>no adverse</td>
<td>1000 acres - estuary</td>
</tr>
<tr>
<td>Potrero</td>
<td>no adverse</td>
<td>370-780 acres - estuary</td>
</tr>
</tbody>
</table>

### Projected Total Bay/Estuarine Habitat Production Foregone from Power Plants:

- 13 power plants, 8.39 BGD - 1.2 acres/MGD - $114,000/acre
- \(~10,000\) ACRES LOST \(\sim\) \$1.1 BILLION TO RESTORE
13 Coastal Power Plants Lack Recent Entrainment Impact Assessments
- Accuracy of Original Assessments Unknown
- Only Considered Impact on Fished Species
- No Cumulative Impact Assessments
- 25 Years Old = Out of Date

NEED:
- TO KNOW THESE IMPACTS, INDIVIDUAL & CUMULATIVE
- CONSISTENT APPROACHES & INTERPRETATIONS
- REVIEW BY UNBIASED EXPERTS

ASSESSMENT IS A SCIENCE ISSUE