

**STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION**

STAFF REPORT FOR REGULAR MEETING OF July 13, 2000

Prepared on June 6, 2000

ITEM NUMBER:

SUBJECT: Diablo Canyon Nuclear Power Plant, Resolution of Thermal Discharge and Entrainment/Impingement Impacts

Summary

Pacific Gas & Electric Company and the Regional Board have been discussing, for about two years, resolution of issues regarding receiving water impacts from the PG&E Diablo Canyon Power Plant cooling water system. Although the two parties disagree on the significance of marine resource effects from cooling water system operation, they have agreed on a proposed solution to resolve the issues. Staff believes that the proposed settlement terms discussed below constitute a fair resolution of the issues, avoids costly and protracted litigation, provides support for permit findings of protection of beneficial uses and best technology available, and provides permanent preservation of marine resources along a significant portion of the Central Coast.

Thermal Effects

Details of the thermal effects from the Regional Board's staff's perspective have been discussed at length in other documents, including the March 30 testimony written by staff and the Regional Board's consultants, and legal argument by staff counsel. In addition, PG&E's *Chapter 1—Changes in the Marine Environment Resulting from the Diablo Canyon Power Plant Discharge*, December 1997, describes the thermal impacts. PG&E's perspective has also been documented in their Chapter Two Thermal Effects report, as well as numerous documents and testimony presented during the Regional Board's hearing on thermal effects. These

documents are available for review at the Regional Board office.

The following is a very brief summary of the habitat affected by thermal discharge. A comprehensive description is included in other documents as noted above. The most significant and consistent biological effects caused by PG&E's Diablo Canyon thermal discharge occur mainly along the intertidal and shallow subtidal marine environment. The intertidal and shallow subtidal zone in Diablo Cove is the most heavily impacted, with major reductions in important species such as habitat forming algae and intertidal fish. The habitat affected is best measured as linear distance following the contours of the coastline. The linear distance affected in Diablo Cove is about 1.1 miles (1:24,000 USGS scale). Reduced biological effects are also detected to the north in Field's Cove intertidal zone, along an additional 0.73 miles. It should be noted that PG&E's Chapter 1 report and previous staff reports used a finer scale map (1:9,000 scale) to estimate affected distances. This scale is not available for the larger length of coastline, so the 1:24,000 scale USGS map is used here to allow comparison of the affected distance to the preserved distance preserved distance discussed later in this report. Attachment 1 is an aerial photograph of the power plant vicinity.

Regional Board staff contends that thermal effects exceed those anticipated by the State and Regional Board when the plant was permitted and so do not protect beneficial uses as required by the Thermal Plan. PG&E disagrees with the

Staff's position and contends that a balanced indigenous community of fish, shellfish and plants exist in Diablo Cove and beyond and that beneficial uses are therefore protected.

Entrainment/Impingement or 316(b) Studies

The purpose of the entrainment study at Diablo Canyon was to 1) estimate the number of larvae lost due to the power plant, 2) convert the loss to adult fish, and 3) estimate the proportion of larvae lost relative to the amount of larvae available in species-specific source water bodies. This information is necessary to determine if the plant's cooling-water intake structure reflects the best technology available as required by section 316(b) of the Clean Water Act. The data is used to determine whether the cooling water intake structure is causing an adverse environmental impact, and then if so, whether there is technology available to minimize any such impact. In determining the best technology available, the permit issuer should consider whether the cost is "wholly disproportionate" to the environmental benefit to be gained. If there is a wholly disproportionate determination regarding certain technologies and alternatives, less costly methods of mitigation may be substituted.

The entrainment study at Diablo Canyon was overseen by a technical workgroup that included independent consultants for the Regional Board (Dr. Greg Cailliet, MLML; Dr. Roger Nisbet, UCSB; Dr. Allan Stewart-Oaten, UCSB), a consultant for the League for Coastal Protection (Dr. Pete Raimondi, UCSC), and PG&E and its consultants from Tenera. The technical workgroup reviewed all aspects of the study, including sampling equipment, sampling periods, target species selection, larval identification, and analyses of the results via a process that continued for almost five years.

Entrainment Studies at Diablo Canyon began in October 1996, and continued through June 1999 (about 2 ½ years of sampling in front of the intake structure). Attachment 2 shows the intake structure and sampling locations. In addition to entrainment sampling in front of

the intake structure, the study included an offshore sampling program. The offshore sampling area consisted of a grid approximately nine miles long and 1½ miles wide, centered on the power plant as shown in Attachment 3. The offshore grid sampling began in June 1997, and continued through June 1999 (approximately two years of sampling). PG&E's final entrainment study (*Diablo Canyon Power Plant 316b Demonstration Study*) was submitted on March 1, 2000, and is available for review at the Regional Board office in San Luis Obispo, and at the PG&E Community Center. The Executive Summary from that report is attached.

The study used three methods to analyze the data: 1) Empirical Transport Model, or ETM; 2) Fecundity hindcasting, or FH; and 3) Adult Equivalent Loss, or AEL. Each of these methods has advantages and disadvantages as described in PG&E's final report. The ETM approach estimates the proportion of larvae lost relative to the amount of larvae available in a given source water body. The FH and AEL approaches convert larvae to adults using life history information for each species.

The major limiting factor with each of these approaches, and most fishery impact assessments, is our lack of knowledge about species life histories (such as larval stage duration, longevity, fecundity, mortality at various larval stages, etc.). The lack of available life history information for specific species requires us to make assumptions to fill in the gaps. Nevertheless, the entrainment study conducted at Diablo Canyon is one of the most comprehensive such studies ever done. The intake sampling program provides a good estimate of the amount of larvae entrained for the target species. The offshore grid sampling also provides a good estimate of the amount of larvae available in source water bodies. The target species (fish and crabs) were selected by the technical workgroup after reviewing the entrainment data. Species were selected based on a list of criteria, such as abundance in samples, threatened or endangered status, etc., as described in the final report (page 4-1).

The results of the analyses (amounts entrained and equivalent adults lost) are shown in Table 1. The results show that larvae from offshore (deeper water) species, including sport and commercial species, are not entrained in significant amounts. This makes sense because the intake structure is located at the shoreline. The offshore species include sand

dabs, CA halibut, rockfish, white croaker, Pacific sardine, and northern anchovy. However, larvae from near-shore (shallow water) species are entrained in significantly higher numbers. The nearshore species include smoothhead sculpin, monkeyface prickleback, clinid kelpfishes, snubnose sculpin, and blackeye goby.

Table 1: Estimated losses due to entrainment at Diablo Canyon. PG&E 2000.

	FH (adults lost)	AEL (adults lost)	ETM¹ (proportion of larva lost)
Pacific sardine	3,170 – 8,460/yr	2,600 – 7,000/yr	No calculation ²
Northern anchovy	16,000 – 45,000/yr	43,000 – 120,000/yr	No calculation
Blue Rockfish	20 – 43/yr	164 – 353/yr	0.9 - 2% of source water body
KGB Rockfishes	497/yr - 617/yr	905 – 1,120/yr	1- 2% of source water body
Painted greenling	No calculation ³	No calculation	3 - 5 % of source water body
Smoothhead sculpin	No calculation	No calculation	10 - 15% of source water body
Snubnose sculpin	No calculation	No calculation	10 - 20% of source water body
Cabazon	No calculation	No calculation	1 - 2 % of source water body
White croaker	5,000 – 7,000/yr	14,700 – 21,600/yr	0.2 - 2 % of source water body
Monkeyface prickleback	No calculation	No calculation	11- 16% of source water body
Clinid kelpfishes	No calculation	No calculation	29 - 32% of source water body
Blackeye goby	10,300 – 12,000/yr	64,100 – 75,200/yr	17- 19% of source water body
Sand dabs	92 – 426/yr	511 – 1,450/yr	0.5 - 5% of source water body
CA Halibut	No calculation	No calculation	0.08 - 12% of source water body
Brown rock crab	91,000 – 117,000/yr	182,000 – 234,000/yr	0.01% of source water body
Slender crab	8,950 – 27,300/yr	17,900 – 54,600/yr	1% of source water body

¹Percentages based on mean larval duration and along-shore currents for nearshore species. Offshore species percentages based on mean larval duration and along-shore plus offshore currents.

²ETM Calculations not possible due to large variation in sampling abundance.

³FH and AEL calculations not possible for species with little or no life history information.

These results show that number of equivalent adults lost due to entrainment of larvae for offshore species is relatively small. Northern anchovies were the highest (up to 120,000 adults lost per year). However, this represents a very small fraction of the commercial landing for this species. The number of adults lost equates to about two metric tons, with a value of approximately \$576. The value of Pacific sardines lost to the commercial fishery is about \$700. The commercial loss to the rockfish fishery is approximately \$1,200/year. The dollar value of the other harvested species in terms of commercial landings is similar.

However, the results also show that the amount of larvae lost for nearshore species is relatively high. These non-harvested near shore species have no direct dollar value in terms of commercial fisheries, but are important in an ecological sense. For several nearshore species (sculpins, kelpfish, blackeye goby, monkeyface prickleback), the amount of larvae taken by the power plant is large relative to the amount available in the source water body. The source water bodies (alongshore) were specific to each sample survey. For each sample survey period, larval duration periods were determined for each

species. Then, using specific data for tracking water movement collected prior to the sampling survey period, the range of upcoast and downcoast movement was calculated. This was done by taking the maximum upcoast and downcoast current vectors measured during each survey period and adding them together to obtain an estimate of the total alongshore movement. These measurements were greatly influenced by larval duration and meteorologic effects such as wind.

The ETM values above represent the amount of larvae taken by the power plant relative to the amount estimated to be in the source water bodies for each species. As shown in Table 1, the relative amounts of larvae taken by the power plant are between 1% and 32% for near-shore species. In addition, other data indicate potential population declines in two species of near-shore fish in the vicinity of the power plant (snubnose sculpins and clinid kelpfish). PG&E conducted plankton tows in front of the intake structure from 1990 to 1998. These data show a decline in the amount of snubnose sculpin and kelpfish larvae in the vicinity of the power plant, indicating a potential decline in this species local population. In addition, results of the thermal discharge monitoring study show large declines in intertidal fish populations in Diablo Cove and Field's Cove. These declines are likely due to the thermal discharge, but entrainment of larvae through the intake structure may contribute to this decline. Since several of the ETM values for nearshore species are relatively high (up to 32% for clinid kelpfishes), and related monitoring data indicate potential population declines, staff believes that the intake system causes an adverse impact on nearshore species.

PG&E disagrees with staff's position. PG&E concludes that given the low entrainment estimates for offshore species, the conservative nature of the higher nearshore estimates, and the limited nature of the population trend data, the entrainment data do not indicate any adverse environmental impact.

In addition to entrainment of larvae by the intake system, adult fish are also impinged on travelling screens in front of the intake structure. The travelling screens are designed to remove debris before it enters the cooling water system. Adult fish can become trapped, or impinged, in the debris. PG&E conducted an impingement study during 1985 and 1986. The results of that study show that very few adult fish are actually impinged on the travelling screens. This is due to the low velocity of the water as it passes through the travelling screens. The water velocity is slow enough (1 ft/sec) so that even small fish can actually inhabit the intake structure and swim onto and off of the travelling screens. Divers have observed several species inhabiting the intake structure area. The study showed that a total of 262 fish were impinged at Diablo Canyon during the study year (April 1985 through March 1986). The technical workgroup concluded that this represents an insignificant impact.

Alternative Technologies

Physical modifications could be done to reduce the adverse impacts on nearshore fish populations due to entrainment of larvae. PG&E's final report discusses these alternatives in detail. Some of these alternatives are briefly mentioned here:

Offshore Intake Structure: The intake structure could be moved offshore, similar to the offshore intake structure at Southern CA Edison's San Onofre Nuclear Power Plant. This may increase the adverse effects on offshore species, and may not reduce the effects on nearshore species. There would also be major impacts due to the massive construction project.

Off-stream Cooling: The major drawbacks with off-stream cooling are costs, which can be hundreds of millions of dollars, and other potential environmental impacts. Also, there are no salt water cooling towers for facilities as large as Diablo Canyon so the technology is not proven. Extremely costly alternatives would also likely result in protracted litigation.

Fine Mesh Screens: Fine mesh screens could be installed in front of the intake structure to eliminate entrainment of larvae. However, larvae are then impinged on the fine mesh screens, with possibly little overall net benefit because some species would still experience high mortality rates.

Variable Speed Pumps: The use of variable speed pumps can reduce the amount of water used for cooling purposes. However, Diablo Canyon operates at 100% base load, so the use of variable speed pumps would only result in a 10% reduction in flow volume.

Offshore Discharge: PG&E could install an offshore discharge to eliminate the thermal impacts on the nearshore environment. This alternative would likely cost in the hundred million dollar range, and would cause environmental impacts due to construction.

Additional information on alternatives is provided in PG&E's Entrainment Report.

Resolution

It's important to note that without a negotiated solution, the options for enhanced environmental protection become extremely limited, and all parties would be assured of a very protracted and costly legal battle, the outcome of which is not certain. PG&E and the Regional Board have worked extensively toward a long-term resource protection solution. This tentative agreement will resolve issues surrounding Diablo Canyon's ocean cooling water discharge permit. Such a solution is a positive outcome in terms of resource protection and enhancement, and far superior to the alternative of litigation.

It is important to understand, though, that any agreement will not be final until after there is public comment and subsequent adoption by the Regional Board. There are many details to be worked out with other parties, but this report provides a few more specifics of the proposed agreement. The major components of the proposed agreement including the following elements:

1. With appropriate agency approval, land consisting of watersheds draining to the coastline from Fields Cove north of the Diablo plant to Montana de Oro State Park will be preserved. A conservation easement will be the vehicle to ensure that preservation will be achieved in perpetuity. Existing uses of the property will be defined and allowed to continue (in general, cattle grazing controlled by best management practices and existing structures). In addition, other lands inland from these coastal watersheds (that are owned by PG&E) will be protected through Best Management Practices by PG&E for as long as PG&E operates the plant or holds the property, whichever is longer. Attachment 4 is a map showing the area of preservation. The boundaries are approximate, due to the need for a property survey, particularly regarding the exact location of the southeastern boundary. The linear distance of preserved coastline (following the contour of the coastline) is approximately 5.7 miles.
2. PG&E will provide \$4 million for projects to protect marine resources in the vicinity. Specific criteria to ensure project proposals target marine resource enhancement and protection will be included in the settlement agreement. The projects will be selected by the Regional Board after soliciting proposals from agencies and the public. The Regional Board will only consider approval of proposals after receiving comments on the proposals from agencies and the public, including PG&E.
3. PG&E will make its BioLab facilities available for ten years for marine research to educational organizations, providing \$100,000 in initial operating money, as well as up to \$5,000 annually, for water and electricity during this period.
4. PG&E will contribute \$350,000 for black abalone restoration by Department of Fish and Game, that will consist of artificial culture and out-planting of black abalone in the area. The project aims to strengthen

the ability of the stock to withstand the combined effects of disease and marine pollutants. This project concept has been reviewed by many of the foremost abalone experts in the State, and involves artificial culture Withering Syndrome-resistant black abalone from the area in a hatchery situation. In order to maximize abalone survival in the field, survivors of Withering Syndrome that are more resistant to this disease will be used as brood stock. Offspring will be out-planted in suitable rocky intertidal habitat. To improve survival after out-planting, the abalone will be out-planted at five years of age. After out-planting, monitoring will be conducted for five years to document success in the establishment and recruitment of black abalone. The expected survival rate is 75%.

5. PG&E will eliminate the fish passage blockage on lower Coon Creek, in the northern portion of the conservation easement. This work is estimated to cost approximately \$50,000.
6. Based on this settlement, PG&E's monitoring program will be reduced to reflect resolution of these issues, and PG&E will contribute \$100,000 per year for the next ten years to the Central Coast Ambient Monitoring Program. If the plant is still operating after ten years, PG&E will continue to participate in the program in an amount proportional to other dischargers with respect to issues other than thermal and entrainment effects.
7. The settlement will resolve issues regarding entrainment/impingement and the thermal discharge for the Diablo Plant over its operating life subject to compliance with thermal effluent limitations and other conditions to be negotiated.
8. The agreement will include a narrow provision to protect the settlement against possible future changes in the law, regulations, and permit conditions that may be inconsistent with the terms of this

settlement. This is a standard provision for agreements of this nature.

A public meeting will be scheduled for July 13, at 3:00 p.m., in the Regional Board conference room to receive public input. The Board will also consider written comments submitted by June 30, 2000. In addition, staff is planning a site visit to allow interested parties an opportunity to view the coastal area proposed for preservation. Additional information regarding the site visit will be provided in the near future. Those attending the workshop on July 13 may highlight or emphasize certain aspects of their written comments in brief statements to the Board.

CONCLUSION

The foundation of this resolution is permanent habitat preservation. While staff contends the thermal discharge is affecting approximately 1.8 miles of linear coastline habitat (and some of that habitat was predicted to be affected when the plant was permitted), the length of coastline habitat preserved by this settlement is approximately 5.7 miles. The larger length of coastal preservation provides an appropriate buffer of environmental protection considering both entrainment and thermal effects. While technologies exist for modifying the intake and outfall structures, the costs for such modifications are extremely high. While the Board has not made a determination that these costs are wholly disproportional to the environmental benefits to be derived, in the context of settlement it is reasonable to look at less costly alternatives that achieve similar benefits without the need for a formal cost/benefit determination. Staff believes the proposed resolution is the best overall alternative from an environmental perspective because it provides permanent habitat preservation, as well as other significant marine resource enhancements.

Attachments:

1. Aerial photo of Diablo Canyon Power Plant
2. Schematic showing the intake structure location and sampling stations (entrainment/impingement study)

3. Schematic of PG&E's offshore sampling grid (entrainment study)
4. Map showing the proposed area of preservation
5. PG&E's Entrainment Report Executive Summary