

**DRAFT DETERMINATION TO APPROVE MITIGATION MEASURES FOR THE WATER QUALITY CONTROL POLICY ON THE USE OF COASTAL AND ESTUARINE WATERS FOR POWER PLANT COOLING (ONCE-THROUGH COOLING POLICY):**

**DIABLO CANYON NUCLEAR POWER PLANT**

**Interim Mitigation Requirements**

The Once-Through Cooling (OTC) Policy requires owners or operators of existing power plants to implement measures to mitigate interim impingement and entrainment impacts resulting from their cooling water intake structures. The interim mitigation period commenced on October 1, 2015, and continues up to and until owners or operators achieve final compliance with the OTC Policy. Section 2.C(3) of the Policy provides the following requirements for demonstrating compliance with interim mitigation:

- (a) Demonstrate to the satisfaction of the State Water Resources Control Board (State Water Board) that the owner or operator is compensating for the interim impingement and entrainment impacts through existing mitigation efforts, including any projects that are required by state or federal permits as of October 1, 2010; or
- (b) Demonstrate to the State Water Board's satisfaction that the interim impacts are compensated for by the owner or operator by providing funding to the California Coastal Conservancy which will work with the California Ocean Protection Council to fund an appropriate mitigation project; or
- (c) Develop and implement a mitigation project for the facility, approved by the State Water Board, which will compensate for the interim impingement and entrainment impacts.
- (d) Use the habitat production foregone (HPF) method, or comparable alternate method approved by the State Water Board in order to determine the habitat and area, based on replacement of the annual entrainment, for funding a mitigation project.
- (e) The State Water Board's preference is that funding be provided to the California Coastal Conservancy, working with the California Ocean Protection Council, for mitigation projects directed toward increases in marine life associated with the state's Marine Protected Areas in the geographic region of the facility.

In an April 1, 2011 letter to the State Water Board, Pacific Gas and Electric Company (PG&E), proposed to comply with interim mitigation for its Diablo Canyon Nuclear Power Plant (Diablo Canyon Plant) by providing funding for mitigation projects directed toward increasing marine life in marine protected areas in the geographic region of the facility.

On August 18, 2015, the State Water Board adopted [Resolution No. 2015-0057](#) (2015 Resolution), delegating to its Executive Director the authority to approve proposed measures for power plant owners or operators to comply with interim mitigation on a case-by-case basis. The 2015 Resolution also includes procedures for calculating a mitigation payment for the power

plants that have selected the interim mitigation option of providing funding to the Coastal Conservancy for appropriate mitigation projects. As described in the 2015 Resolution and consistent with following the recommendations of the Expert Review Panel on minimizing and mitigating intake impacts from power plants and desalination facilities, the State Water Board calculated interim mitigation payments to equal the sum of three components: an entrainment payment, an impingement payment, and a management and monitoring payment.

### **Estimate of Interim Mitigation Payment for Diablo Canyon Plant**

#### **Entrainment Payment Calculation**

To calculate the interim mitigation payment to offset entrainment impacts, staff used a facility-specific fee calculated as the average cost of two separate, site-specific entrainment studies. PG&E proposed this option and staff agrees for the following reasons:

- PG&E has data available from two separate comprehensive entrainment assessments, and the approach and data from both studies have been reviewed by the Technical Workgroup (TWG), an independent technical advisory group. The TWG approved the study plan for the 2008-2009 study in May 2008.
- The results of the two studies are similar given the potential for large inter-annual variation in biological populations and differences in design of the two studies. This consistency is expected from the Empirical Transport Model (ETM) approach used in both studies, since the model relies on estimates of proportional loss to the source water that should be less subject to variation among years if the intake volume is constant.
- The Diablo Canyon Plant is the only plant where entrainment impacts are associated with rocky reef habitat and thus, using site-specific data to calculate the mitigation payment is reasonable as it is based directly on both the acreage and the type of habitat impacted.
- Using site-specific data from over three years increases the confidence in the estimated interim mitigation payment for the Diablo Canyon Plant.

#### Study 1 (1996-1999)

The default average entrainment cost was calculated to be \$4.60 per million gallons (MG) in 2015 dollars with a cost projection of one year to account for the time an applicable mitigation project would begin in 2016, one year after payment is collected. The 2015 Resolution describes the default cost developed in accordance with the expert review panel using data from the Diablo Canyon Plant and four other OTC plants as shown in Table 1. In all five power plant cases, the entrainment cost calculations utilized an ETM coupled with the use of Habitat of Production Foregone (HPF, sometimes called Area Production Foregone [APF]) to calculate the area of habitat that would need to be created or restored that replaces the production of marine organisms killed by entrainment.

Table 1 Calculation of default entrainment cost adopted in the State Water Boards Resolution No. 2015-0057.

Facility	Intake Volume (MGD)	APF (Acres)	Mitigation Type	Cost Estimate	Cost per Annual Intake (MG)	Notes	Years Between Assessment and 2015	Cost Escalator	Total Escalator	2016 Cost per MG	Estimated Half Life of the Project (Years)	Prorated 2016 Cost per MG	Estimated Cost at Time of Projection per MG	Estimated Annual Cost at Time of Projection per MG
Moss Landing Power Plant	360	840	Wetland	\$15,100,000	\$115	Based on max larval duration, dollars in year 2000	15	3.00%	\$1.56	\$179.04	30	\$179.04	\$184.41	\$6.15
Morro Bay Power Plant	371	760	Wetland	\$13,661,905	\$101	Based on max larval duration, dollars in year 2001	14	3.00%	\$1.51	\$152.60	30	\$152.60	\$157.18	\$5.24
Poseidon	304	37	Wetland	\$11,100,000	\$100	Based on max larval duration, dollars in year 2009 and cost per acre =300K (SONGS cost)	6	3.00%	\$1.19	\$119.45	30	\$119.45	\$123.03	\$4.10
Huntington Beach Generating Station	126.5	66	Wetland	\$4,927,560	\$107	Based on max larval duration, dollars in year 2009 and cost per acre =74.66K (from Davis et al report and final permit (acres))	6	3.00%	\$1.19	\$127.43	30	\$127.43	\$131.25	\$4.38
Diablo Canyon Nuclear Power Plant	2670	543	Rocky Reef	\$67,875,000	\$70	Based on 125K per acre (SONGS) in 2006	9	3.00%	\$1.305	\$90.87	30	\$90.87	\$93.60	\$3.12
Average								3.00%				\$133.88	\$137.89	\$4.60

Table 1 shows the calculation of the default entrainment cost adopted in Resolution No. 2015-0057. For the calculation, the following parameters are set: a cost escalator of 3%, the estimated life of a project is 30 years, the estimated period of continued operation is 30 years, the projection is one year, and the assessment percentage is 10.00%.

The Diablo Canyon Plant was the only facility related to rocky reef habitat, while all the other four OTC plants related to wetland habitat. The Diablo Canyon Plant data used in the calculation of the \$4.60/MG default average entrainment cost were from an intake assessment study conducted from 1996 to 1999.

The site-specific cost for the Diablo Canyon Plant from the 1996-1999 study was calculated to be \$3.12/MG in 2015 dollars<sup>1</sup>. Staff adjusted the amount for 2016 dollars and projected for funding to be used by 2017. The cost is calculated to be \$3.21/MG as shown in Table 2.

*Table 2 Study 1 Based Cost Projection for 2015-2016 Interim Mitigation Period*

HPF (acres)	2006 Cost based on \$125,000 per acre	Cost per MG per year	Years between Assessment and 2016	Cost Escalator	Cost Escalator Factor	Cost in 2016 dollars	Cost at time of Projection (2017)	Mitigation Years	Annual Mitigation Cost
543	\$67,875,000	\$70.00	10	3.00%	1.34	\$93.60	96.41	30	\$3.21

Table 2 is based on the table in Appendix 1 of Resolution No. 2015-0057 and the results from study 1, modified for Diablo Canyon Plant's 2015-2016 interim mitigation payment period, including a cost escalation of 3.00% to account for inflation. For the calculation, the following parameters are set: the estimated life of a project is 30 years, the estimated period of continued operation is 30 years, the projection is one year, and the assessment percentage is 10.00%.

### Study 2 (2008-2009)

PG&E conducted an additional study and collected data in 2008 and 2009. The update was developed in coordination with the Diablo Canyon Plant's TWG, which included staff from PG&E and their consultants, Tenera Environmental Inc., Dr. Peter VonLangen from the Central Coast Regional Water Quality Control Board, and Drs. Gregor Cailliet, Michael Foster, John Largier, and Peter Raimondi. Entrainment data were collected, ETM estimates were developed, and these results were used to determine the area of HPF. PG&E submitted the details of the 2008-2009 study in a technical memorandum prepared by Tenera Environmental, dated November 14, 2016<sup>2</sup>.

The technical memorandum identified similarities and differences between the 1996-1999 study and the 2008-2009 study, as summarized below.

- 1) The source water sampling design for the 2008-2009 study was similar to other recent studies, but was not as spatially extensive as the sampling grid design used in the 1996–1999 Study. The source water sampling was done monthly in both studies and included six of the original 64 source water stations from the 1996–1999 study. These six stations

<sup>1</sup> PG&E has stated this cost should be the starting point for determining the Diablo Canyon Plant's entrainment mitigation payment. However, PG&E pointed out in its submittal that after reevaluation of data from the 1996-1999 Study, the HPF estimate should have been 593 acres instead of 543 acres. PG&E determined this after averaging the HPF estimate areas that ranged from 120 to 401 hectares in a 2005 Independent Scientists' Report, resulting in an average of 240 hectares, which equates to 593 acres. After further investigation of the 2005 Independent Scientists' Report and the calculation of the estimate, it was determined that the data PG&E had evaluated was from a preliminary draft of the 2005 Independent Scientists' Report and in fact the initial value of 543 was correct based on the revised 2005 Independent Scientists' Report, and therefore the annual mitigation cost of \$3.12/MG was appropriate.

<sup>2</sup> Technical Memorandum from John Steinbeck, Tenera Environmental, to Mr. Jearl Strickland, Mr. Mark Krausse, and Mr. Bryan Cunningham, PG&E (April 26, 2017).

[https://www.waterboards.ca.gov/water\\_issues/programs/ocean/cwa316/powerplants/diablo\\_canyon/docs/revised\\_tenera\\_memo.pdf](https://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/powerplants/diablo_canyon/docs/revised_tenera_memo.pdf)

were positioned along a transect heading straight offshore from the entrainment sampling locations inside the Diablo Canyon Plant's intake cove.

- 2) Instead of using acoustic Doppler current profiler (ADCP) instruments as in the 1996-1999 Study for the estimation of the source water for the ETM analysis, high frequency radar instruments (CODAR) data were used. The CODAR data were used instead because of its availability over a large area of the central coast around the Diablo Canyon Plant, and because it provided a much larger spatial coverage of ocean current data than the ADCPs. CODAR was not authorized for use in assessing mitigation for desalination projects subject to the Ocean Plan. However, the use of CODAR is appropriate in this study and in the determination of interim mitigation payments for Diablo Canyon Power Plant, because the results are averaged with those using ADCP and yielded similar acreage of HPF. CODAR may not be an appropriate mitigation assessment tool for other mitigation projects subject to different regulatory requirements.
- 3) There were several uncertainties in the 1996-1999 study. The source water estimates used in the ETM were directly related to the resolution provided by the ADCP data on ocean currents. Additionally, the HPF estimates used to estimate the areas of nearshore rocky reef habitat were based on aerial photograph surveys of kelp beds. The 2008-2009 Study reduced some of these uncertainties. In addition to the greater resolution provided by the CODAR data, the habitat estimates in the 2008-2009 Study used more recent data on bottom habitats collected from GIS data from the Seafloor Mapping Lab at the California State University at Monterey Bay (CSUMB). These data were collected along much of the central California coast as part of the California Department of Fish and Wildlife (CDFW) initiative to develop a network of marine protected areas. The better estimates of coastal currents and habitat used in this study greatly improve on the estimates of HPF provided from the 1996-1999 Study.
- 4) The HPF calculations from the 1996-1999 Study were based on estimates of surface kelp cover with a multiplier to approximate the total area of subtidal rocky reef. The HPF estimates provided in the 2008–2009 Study were calculated using a more detailed approach that included multiple data sources and adjustments based on the depth distribution of the adults of the seven taxa evaluated.
- 5) The estimates of nearshore rocky reef used in the 2008–2009 Study combined data on the surface kelp canopy from CDFW with data on habitat from nearshore multi-beam surveys conducted by the CSUMB habitat mapping group. Habitat maps for each of the taxa showed that the CSUMB hard substrate extends into water deeper than the kelp, which tends to be very close to shore. This is one of the factors associated with the increase in the HPF estimate of 690 acres based on the ETM estimates calculated from the entrainment data collected during the 2008–2009 Study from the estimate of 543 acres from the 1996–1999 Study.

Based on data collected and analyzed for the 2008-2009 study, the total average HPF estimate of subtidal rocky reef habitat is calculated to be 690 acres. Table 3 shows the estimates of HPF for

nearshore rocky reef fish larvae based on nearshore ETM estimate of proportional mortality and rocky reef habitat within the source water areas extrapolated from CODAR data. For the taxa with depth limits deeper than 61 meters (200 ft), the offshore extrapolated estimates of proportional mortality were used in the calculations.

Table 3 Calculated average HPF estimate of nearshore rocky reef habitat necessary to compensate for the losses of larvae due to entrainment at the Diablo Canyon Plant<sup>3</sup>.

Taxon	Common Name	Average alongshore distance (km) used in extrapolated source water	CODAR ETM P <sub>M</sub> (%)	Depth (m) used in determining source water habitat	Estimate of subtidal rocky reef HPF (ha [acres])
Cottidae	unid. sculpins	30.7	38.6	91.4	1,331 (3,289)
Artedius spp.	smoothhead sculpins	24.9	20.6	15.0	125 (309)
Orthonopias triacis	snubnose sculpin	20.6	19.8	30.5	251 (621)
S. marmoratus	cabezon	8.4	8.6	91.4	70 (172)
Sebastes spp. V_	KGB rockfish complex	9.1	12.6	86.0	104 (257)
Sebastes spp. V	blue rockfish complex	7.2	5.2	91.4	44 (109)
Rhinogobiops nicholsi	blackeye goby	4.8	18.5	76.2	30 (74)
				<b>Average HPF =</b>	<b>279.3 (690)</b>

Using the 690-acre HPF in the calculation of the entrainment cost, and following the assessment of cost per MG of water described in Appendix 1 of the 2015 Resolution, the result for Study 2 is a cost of \$4.08 per MG as shown in Table 4.

Table 4 Study 2 Based Cost Projection for 2015-2016 Interim Mitigation Period

HPF (acres)	2006 Cost based on \$125,000 per acre	Cost per MG per year	Years between Assessment and 2016	Cost Escalator	Cost Escalator Factor	Cost in 2016 dollars	Cost at time of Projection (2017)	Mitigation Years	Annual Mitigation Cost
690	\$86,250,000	\$88.50	10	3.00%	1.34	\$118.94	122.51	30	\$4.08

Table 4 is based on the table in Appendix 1 of Resolution No. 2015-0057 and the results from study 2, modified for Diablo Canyon Plant’s 2015-2016 interim mitigation payment period, including a cost escalation of 3.00% to account for inflation. For the calculation, the following parameters are set: the estimated life of a project is 30 years, the estimated period of continued operation is 30 years, the projection is one year, and the assessment percentage is 10.00%.

### Entrainment Cost Adjustment

The entrainment costs for the 1996-1999 study (\$3.21/MG) and the 2008-2009 study (\$4.08/MG) were calculated using an estimated cost of reef construction in 2006 of \$125,000 per acre. On August 23, 2017, Peter Raimondi submitted a Technical Memorandum<sup>4</sup> to the State Water Board which included adjusted entrainment cost estimates to reflect the current cost for reef construction and eliminated the need for a 3% cost escalator for the 2015-2016 interim mitigation period. This adjustment uses current estimates for reef construction project costing included in

<sup>3</sup> Pacific Gas and Electric Company Diablo Canyon Power Plant Cooling Water Entrainment Study: July 2008 – June 2009. Tenera Environmental. November 29, 2016. Table ES-4 at page ES-10 < [https://www.waterboards.ca.gov/water\\_issues/programs/ocean/cwa316/powerplants/diablo\\_canyon/docs/diablocanyon\\_imf16.pdf](https://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/powerplants/diablo_canyon/docs/diablocanyon_imf16.pdf)>

<sup>4</sup> Technical Memorandum from Peter Raimondi, University of California at Santa Cruz (August 23, 2017). < [https://www.waterboards.ca.gov/water\\_issues/programs/ocean/cwa316/powerplants/diablo\\_canyon/docs/techmemo\\_raimondi.pdf](https://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/powerplants/diablo_canyon/docs/techmemo_raimondi.pdf)>

Southern California Edison’s submittal to the California Public Utilities Commission and uses a methodology consistent with that used by the Expert Review Panel in calculating the default average entrainment cost. For this adjustment, the estimated cost for construction of an artificial reef includes the following components:

1. Rock Cost – The rock cost is estimated at \$40/ton and \$5/ton to transport the rocks from the Catalina Island quarry to the Wheeler North reef (95km). The distance to Diablo Canyon Plant is 367km. The \$5/ton estimate for transport is partially based on the loading cost and does not include a cost factor based on the transportation distance; therefore, the overall cost of transportation was increased by 10 percent to account for the additional transportation distance to Diablo Canyon Plant.
2. Reef Design – The reef design for Diablo Canyon Plant is based on a low relief medium density design of 1500 tons per acre.
3. Construction Costs – The construction costs are based on recent projects and is estimated at \$45/ton.
4. Fixed Costs – The fixed costs include \$1,200,000 for environmental analysis and permitting, \$1,600,000 for engineering and construction management support, \$750,000 for mobilization and demobilization, and \$444,000 for labor, totaling \$3,994,000.
5. Contingency – The contingency is set at 10% of the direct costs.

The entrainment cost for the two studies was adjusted using the following equation:

$$= \frac{\text{Entrainment Cost} \times ((\text{Reef Size} \times \text{Reef Design} \times (\text{Rock Costs} + \text{Construction Cost})) + \text{Fixed Fosts}) \times \text{Contingency} \times \text{Additional Transportation Cost}}{\text{Maximum Design Flow at Diablo Canyon Plant (MG)}}$$

Using this equation and HPF results from the two studies, the entrainment costs are adjusted to \$3.44/MG for the 1996-1999 study and \$4.32/MG for the 2008-2009 study. These results are reflective of current reef mitigation project costs and therefore will be used in calculating the site-specific entrainment cost for Diablo Canyon Plant.

#### Entrainment Payment Calculation

The average adjusted entrainment cost is calculated to be \$3.88/MG as the average of the two studies with adjusted entrainment costs associated with updated reef construction estimates, as shown below:

$$(\$3.44/\text{MG} + \$4.32/\text{MG})/2 = \$3.88/\text{MG}$$

To determine the intake flow volume, staff used the maximum intake volume for the interim mitigation period of October 1, 2015, to September 30, 2016, of 827,196 MG. To estimate the entrainment fee, staff multiplied the intake volume by the average cost of entrainment calculated based on the two site-specific studies.

$$827,196 \text{ MG} \times \$3.88/\text{MG} = \$ 3,209,520.48$$

### Impingement Payment Calculation

Staff calculated the impingement payment using the average value provided by PG&E from impingement data included in the OTC Policy Substitute Environmental Document of 710 pounds, and the average indirect economic value of the fisheries as determined in the Expert Review Panel final report (\$0.80 per pound).

Therefore, the impingement calculation is as follows:

$$\$0.80/\text{pound} \times 710 \text{ pounds} = \$568$$

### Management Payment Calculation

Staff calculated the management and monitoring fee by taking twenty percent of the sum of the entrainment and impingement fees.

$$0.20 \times (\$3,209,520.48 + \$568) = \$642,017.70$$

### **State Water Board's Draft Determination for Diablo Canyon Plant**

The State Water Board has determined that a site-specific entrainment cost, calculated as the average cost from the two studies, is appropriate because: (1) Diablo Canyon Plant is the only plant where entrainment impacts are associated with rocky reef habitat, (2) PG&E has data available from two separate, comprehensive entrainment assessments, (3) the results of the two studies are relatively consistent given the significant inter-annual variability, and (4) using site-specific data from over three years increases the confidence in the estimated interim mitigation payment for Diablo Canyon Plant. Furthermore, adjusting the entrainment cost using current reef mitigation project cost estimates increases the confidence that the estimated interim mitigation payment is compensatory. However, this is a case-specific approval and this determination is not intended to set a precedent that CODAR is an appropriate mitigation assessment tool for other mitigation projects considered by the State Water Board.

The sum of the amounts for entrainment, impingement, and management and monitoring equals approximately \$3.85 million dollars for the interim mitigation fee for PG&E Diablo Canyon Plant. PG&E shall be required to pay the amount of \$3,852,106.18 to fulfill the interim mitigation obligation for its Diablo Canyon Plant for the operating period of October 1, 2015, to September 30, 2016.

$$\$3,209,520.48 + \$568 + \$642,017.70 = \$3,852,106.18$$