Dynegy Moss Landing, LLC

State Water Resources Control Board
Once-Through Cooling Water Policy
Updated Implementation Plan
for the Moss Landing Power Plant

November 2014

Prepared for:

Dynegy Moss Landing, LLC
Moss Landing Power Plant
Moss Landing, California

Prepared by:

TENERA Environmental

141 Suburban Rd., Suite A2, San Luis Obispo, CA 93401
805.541.0310, FAX: 805.541.0421

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1.0 Introduction

On April 1, 2011, Dynegy Moss Landing, LLC submitted an Implementation Plan (2011 Implementation Plan) for the Moss Landing Power Plant (MLPP) in accordance with the California Statewide Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling (Policy), which was adopted on May 4, 2010 by the California State Water Resources Control Board (SWRCB) and became effective on October 1, 2010, as subsequently amended.

This updated Implementation Plan for the MLPP reflects the Settlement Agreement and Release (Settlement Agreement) executed on October 9, 2014 between the SWRCB and Dynegy Moss Landing, LLC, the owner and operator of the MLPP, regarding the Policy. A copy of the Settlement Agreement is attached as Attachment A. The Settlement Agreement requires Dynegy Moss Landing, LLC to submit an updated Implementation Plan for MLPP within 30 days after the execution of the Settlement Agreement. This updated Implementation Plan describes the compliance alternative for MLPP as presented in the Settlement Agreement and the general design, construction and operational measures that will be undertaken to implement the compliance alternative, and provides a schedule for implementing these measures as set forth in the Settlement Agreement.

1.1 Overview of California Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling[1]

The Policy provides for two alternatives for compliance with the required reductions in impingement mortality and entrainment (IM&E) at power plant cooling water intake structures.

Compliance under Track 1 requires the following:

- Reduction of the intake flow rate at each unit, at a minimum, to a level commensurate to a closed-cycle wet cooling system (minimum 93 percent intake flow rate reduction for each unit compared to the unit's design intake flow rate), and
- Through screen intake velocity must not exceed 0.5 foot per second (fps).

Installation of a closed-cycle dry cooling system meets the intent and minimum reduction requirements under Track 1.

If it can be demonstrated to the satisfaction of the SWRCB that compliance with Track 1 is not feasible, IM&E of marine life for the facility must be reduced on a unit-by-unit basis to a level comparable to that achievable under Track 1, using operational or structural controls, or both.

[1] This overview presents a summary of relevant Policy provisions and is intended only as a convenience for the reader.

For impingement mortality, Track 2 requires:

- For plants relying solely on reductions in velocity, monthly verification that through-screen intake velocities do not exceed 0.5 fps, or
- Monitored impingement mortality reductions of at least 90 percent of the reduction in impingement mortality required under Track 1 (i.e., at least 83.7 percent [90 percent of 93 percent]).

For entrainment, Track 2 requires:

- If relying solely on reductions in flow, by recording and reporting a minimum of 93 percent reduction in monthly flow as compared to the average actual flow for the corresponding months from 2000 to 2005, or
- Installation of control technologies (e.g., including, but not limited to, screens or re-location of intake structures), that, in whole or in part, would reduce entrainment at least 90 percent of the reduction required under Track 1 (i.e., at least 83.7 percent [90 percent of 93 percent]).

Technology-based improvements that are specifically designed to reduce impingement mortality and/or entrainment and were implemented prior to October 1, 2010 may be counted towards meeting Track 2 requirements.

The Policy also includes considerations for plants that installed more efficient combined-cycle units prior to October 1, 2010. For units such as MLPP Units 1 & 2, reductions in impingement mortality and entrainment resulting from the replacement of steam turbine units with combined-cycle units may be applied towards meeting the Track 2 requirements. The reductions would be based on the reduced intake flows, calculated as the difference between the maximum permitted flow for the entire plant prior to the installation of the combined-cycle units and the maximum permitted flow after installation of the units.

1.2 Summary of the Settlement Agreement[2]

The Settlement Agreement includes provisions addressing the MLPP's compliance track, final compliance date, interim and immediate requirements, compliance plan, baseline and technology studies and compliance monitoring. A copy of the Settlement Agreement is provided as Attachment A to this updated Implementation Plan. The following provides a summary of certain key terms of the Settlement Agreement as relevant to the MLPP Implementation Plan. Other terms of the Settlement Agreement are addressed in relevant sections of this updated Implementation Plan.

[2] This summary of the Settlement Agreement and discussion of the Settlement Agreement in subsequent sections of the updated Implementation Plan are intended only as a convenience for the reader. The terms and conditions of the Settlement Agreement control.

The Settlement Agreement provides that Track 1 at MLPP is not feasible, as defined in Policy section 5, and that MLPP may comply pursuant to Track 2 under Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii).[3]

In accordance with the Settlement Agreement, Track 2 compliance can be achieved by an 83.7% or greater reduction in impingement mortality and entrainment,[4] and the required Track 2 reductions may be achieved at MLPP by: (1) use of the prior flow reduction credit provided in Policy section 2.A.(2)(d), calculated and applied as described in Settlement Agreement paragraph 2.1.4,[5] to MLPP Units 1 & 2; (2) use of operational controls to further reduce flow; and (3) reductions in impingement mortality and entrainment through installation of technology controls, which can be calculated based on total numbers of fish larvae and other meroplankton.[6] The percent reductions in entrainment achieved by the technology controls may also be based on calculations of the numbers of fish larvae and other meroplankton of a specific age or size class that have been protected from the effects of entrainment for the species selected for analysis.[7] Further, compliance with the required Track 2 reductions can be computed, after application of the credit for MLPP Units 1 & 2, by combining the percent reduction from design flow achieved through flow control or operational measures with the reductions in impingement mortality and entrainment through the installation of technology controls, which can be calculated in accordance with Settlement Agreement paragraph 2.1.3.c.[8]

The Settlement Agreement provides that the SWRCB staff and Dynegy Moss Landing, LLC shall advocate to the SWRCB that it extend the final compliance date for all units at MLPP to December 31, 2020.[9] The final compliance date in the Policy has not yet been amended. For purposes of this updated Implementation Plan, it is assumed that the compliance date for all four MLPP units will be extended to December 31, 2020 through the process agreed to in the Settlement Agreement.

[3] Settlement Agreement paragraph 2.1.2.
[4] Settlement Agreement paragraph 2.1.3.b.
[5] Settlement Agreement paragraph 2.1.4 provides that MLPP shall receive a credit for the prior reduction of 224 million gallons per day ("MGD") achieved by the replacement of prior Units 1–5 with combined-cycle Units 1 & 2 as provided in Policy section 2.A.(2)(d). The entire 224 MGD will be credited towards compliance for MLPP Units 1 & 2, which may then achieve compliance with Track 2 by additional reductions in impingement mortality and entrainment to meet the required Track 2 reduction pursuant to Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii).
[6] Settlement Agreement paragraph 2.1.3.c.
[7] *Id.*
[8] Settlement Agreement paragraph 2.1.3.d.
[9] Settlement Agreement paragraph 2.1.5. Settlement Agreement paragraphs 2.3.1. and 2.3.2, respectively, provide that within three months of the Execution Date of the Settlement Agreement, the SWRCB staff shall propose a Policy amendment to change the final compliance date in Table 1, section 3.E of the Policy for all units at MLPP to December 31, 2020, and that the SWRCB shall take action on the Proposed Policy Amendment promptly, and in any event no later than within six months of the Execution Date.

1.3 Implementation Plan Organization

The 2011 Implementation Plan provided information and was organized based on the SWRCB's November 30, 2010 letter identifying seven requirements that must be included in an Implementation Plan.[10] The SWRCB's November 30, 2010 letter also requested information on how a facility would comply with the Immediate and Interim Requirements in section 2.C. of the Policy.

Much of the information in the 2011 Implementation Plan is also included in this updated Implementation Plan. This updated Implementation Plan also updates, as appropriate, that prior information, including incorporation of the terms of the Settlement Agreement, which in certain instances replace, in part or in whole, some of the information provided in the 2011 Implementation Plan. The seven required information elements identified in the SWRCB's November 30, 2010 letter and the corresponding location of the information in this updated Implementation Plan are provided in **Table 1-1**.[11] The Immediate and Interim Requirements in Section 2.C. of the Policy that were addressed in Section III of the 2011 Implementation Plan and are now addressed in Section 3.4 of this updated Implementation Plan.[12]

This updated Implementation Plan contains six sections and one attachment. Section 1.0 provides an Introduction. Section 2 describes the MLPP, the source water body and its aquatic resources, and previous MLPP IM&E studies. Section 3 presents the compliance alternative selected by MLPP and describes the general design, construction and operational measures that will be undertaken to implement the alternative. Section 4 provides a compliance schedule for implementing the measures to meet the final compliance date of December 31, 2020 to be established in accordance with the Settlement Agreement. Section 5 provides methods for determining compliance. Section 6 provides the literature cited in this Plan. A copy of the Settlement Agreement is provided as Attachment A.

This Implementation Plan and the information contained herein are subject to material change. As recognized by the SWRCB, if an implementation plan or associated information changes after submittal, the facility may submit amendments at a later date. This Implementation Plan reflects information currently available and known to Dynegy Moss Landing, LLC and provides as much detail as is reasonably possible about future activities that are contingent on and affected by numerous currently unknown factors. Dynegy Moss Landing, LLC expressly reserves the right

[10] Letter from Thomas Howard, Executive Director, SWRCB, to Daniel Thompson, Moss Landing Power Plant, re "Implementation Plans and Immediate and Interim Requirements for the Once-Through Cooling Water Policy", Nov. 30, 2010.

[11] In accordance with the SWRCB's November 30, 2010 letter, the 2011 Implementation Plan also included a new application to renew the NPDES permit for MLPP. Dynegy Moss Landing, LLC intends to modify that pending permit application to reflect the Settlement Agreement once the Policy amendment identified in Settlement Agreement paragraphs 2.3.1 and 2.3.2 has been acted upon by the SWRCB.

[12] To the extent the 2011 Implementation Plan and this updated Implementation Plan differ, this updated Implementation Plan controls.

to, and intends to, amend and/or supplement this Implementation Plan as relevant information develops and circumstances warrant.

Table 1-1. Information requested in the November 30, 2010 letter from the SWRCB for Implementation Plans and corresponding sections where that information is included in the 2011 Implementation Plan and this updated Implementation Plan.

Information required by SWRCB November 30, 2010 letter	Section in 2011 Implementation Plan	Corresponding Section in this Updated Implementation Plan
1. Identify the selected compliance alternative	Section II.1	Sections 3.1 and 3.2
2. Describe the general design, construction or operational measures for the selected alternative	Section II.2	Section 3.2
3. Provide a schedule for implementing the selected measures	Section II.3	Section 4.0
4. Identify the periods when generating power is infeasible and the measures taken to coordinate with the electrical system balancing authority	Section II.4	Section 3.3
5. Describe any plans for repowering	Sections II.1.B and II.5	Section 3.2 (incorporating by reference Sections II.1.B and II.5 of the 2011 Implementation Plan)
6. Identify the transmission configuration around the units	Section II.6	Section 3.6 (incorporating by reference Section II.6 of the 2011 Implementation Plan)
7. Provide and describe any prior studies that reflect current levels of impingement and entrainment	Section II.7	Section 2.4 and 2.5

2.0 MLPP Description and Background

This section of the updated Implementation Plan presents information on the MLPP, the environmental setting for the plant, and summaries of previous IM&E studies.

2.1 Location

MLPP is located on the eastern shoreline of Moss Landing Harbor (**Figure 2-1**). This medium sized harbor, which provides dock space for approximately 600 commercial and recreational vessels, is located about 110 miles south of San Francisco. Moss Landing Harbor is located roughly midway between Santa Cruz and Monterey, California and is open to Monterey Bay. MLPP is located in a relatively undeveloped area that includes industrial facilities, agricultural lands, sparse residences, recreational beaches, and tidal wetlands.

2.2 Power Plant Description

MLPP originally consisted of seven generating units. Units 1–5 were built in the early 1950s and were retired in 1995. Units 6 & 7 were built in the late 1960s and are still operating. Units 6 & 7 typically operate as peaking units that are generally dispatched to serve load only during the highest periods of power demand, such as hot summer and cold winter days.

In Spring 2002, two new high efficiency combined-cycle (CC) generating units (Units 1 & 2) began commercial operation. Units 1 & 2 each generate 510 megawatts (MW) while Units 6 & 7 each generate 755 MW (**Table 2-1**). At full design flows Units 1 & 2 use about 360 MGD and Units 6 & 7 use about 864 MGD of ocean water that is used for once-through cooling to remove excess heat from the power generation process. The total permitted flow for all four units through Discharge 002 as specified in Waste Discharge Requirements Order No. 00.041 in NPDES Permit No. CA0006254 issued October 27, 2000 is 1,226 MGD. This represents a reduction of 224 MGD from the combined flow through Discharge 001 and Discharge 002 of 1,450 MGD (560 and 890 MGD, respectively), which is the basis for the 224 MGD credit provided for in the Agreement (see Attachment A, paragraph 2.1.4).

MLPP has two separate intake structures in Moss Landing Harbor for withdrawal of cooling water (**Figure 2-2**). The Units 1–5 intake structure was upgraded and serves as the new combined-cycle Units 1 & 2 intake. The Units 1 & 2 intake structure is located at 36º 48’25” N. Latitude, 121º47’05” W. Longitude, and the Units 6 & 7 intake structure is located at 36º 48’17” N. Latitude, 121º47’04” W. Longitude. The Units 1 & 2 and Units 6 & 7 intake structures extend down to depths of 20 and 18 feet below mean lower low water (MLLW), respectively.

Two separate subsurface conduits carry the discharge from Units 6 & 7 to a submerged offshore discharge structure located in Monterey Bay about 2,400 feet from the plant, and approximately

600 feet offshore. The discharge from Units 1 & 2 is normally divided between the Unit 6 and Unit 7 discharge conduits, but can be directed in its entirety into either conduit.

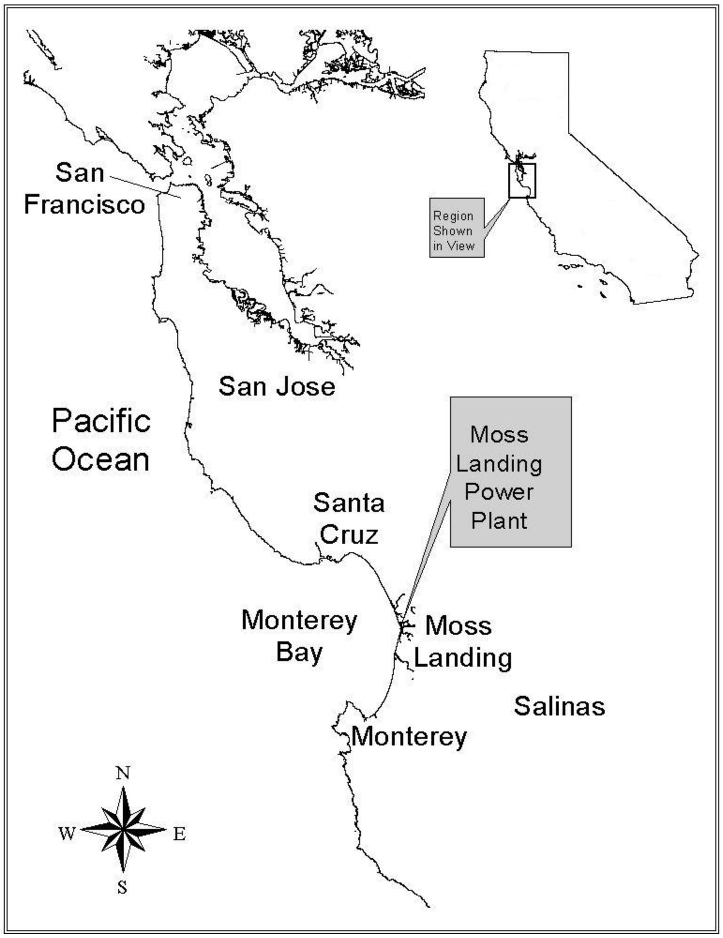

Figure 2-1. The location of the Moss Landing Power Plant.

Table 2-1. Electrical output (megawatts) and design cooling water flows (MGD and gpm) for the four operating units at Moss Landing Power Plant.

	Unit				
	1(1)	2(1)	6(2)	7(2)	Total
Design Capacity (MW)	510	510	754	755	**2,529**
Design Flow per Unit (MGD)	180	180	432	432	**1,224(3)**
Design Flow per Unit (gpm)	125,000	125,000	300,000	300,000	**850,000**

1. Units 1 & 2 each are equipped with 3 circulating water pumps.
2. Units 6 & 7 each are equipped with 2 circulating water pumps.

3. Maximum permitted flow for all units is 1,226 MGD (including industrial waste streams).

Source: NPDES Permit No. CA 0006254.

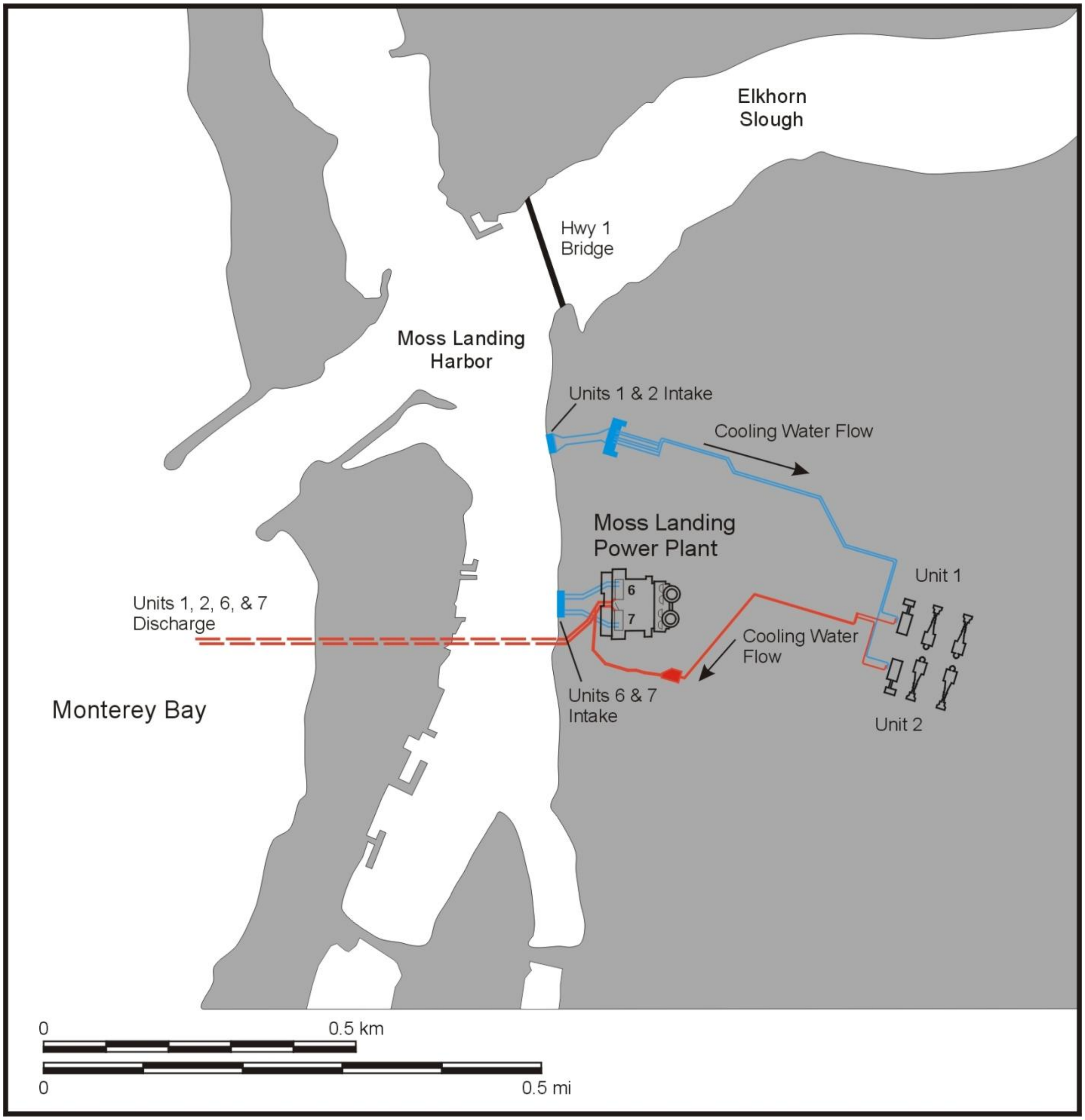

Figure 2-2. Map of Moss Landing Power Plant showing locations of both intake structures, cooling water conduits, and discharge structure.

2.2.1 Units 1 & 2

Units 1 & 2 are two 510 MW combined-cycle generating units that began commercial operation in Spring 2002. Each unit is cooled by three circulating water pumps (CWP) having a total combined flow of 180 MGD (125,000 gpm). Cooling water is drawn from Moss Landing Harbor, entering the system through an intake structure located on the east side of the Harbor, about 500 feet south of the entrance to Elkhorn Slough (**Figure 2-2**). The concrete intake structure was originally built to serve the plant's now retired Units 1–5 that were constructed in the 1950s. Units 1–5 were permanently retired in 1995, and the intake was later upgraded to meet the debris filtration needs of the new Units 1 & 2.

Water entering the system initially passes through a bank of bar racks (**Figure 2-3**). The bars are positioned with approximately 4 inch center-to-center spacing, which provides 3½-inch wide openings between bars. The bar racks extend from the deck of the intake structure, 9.6 feet above MLLW, down to the Harbor bottom at a depth of 20.1 feet below MLLW. Debris impinged on the bars is removed by an automated raking system and deposited in a receptacle for subsequent disposal in a landfill.

Located approximately 20 feet behind the bar racks are the traveling water screens (TWS) (**Figure 2-3**). The TWS remove most of the debris that is small enough to pass through the bar racks, but large enough to potentially clog the plant's condenser tubes. Each generating unit has a bank of three screens. Each of the screens is 10 feet wide and extends down to the floor of the intake structure, 20 feet below MLLW. When the TWS are in operation, cooling water passes through an upward rotating belt of stainless steel screen with an effective mesh size of 5/16 inch. The screen belt lifts debris out of the flow stream and carries it to the top of the TWS where a seawater screenwash system sprays the debris off the screen and onto a conveyor belt. The conveyor belt carries the debris to the same receptacle utilized by the bar rack rake system. The Units 1 & 2 TWS are inclined 35 degrees from vertical to increase their ability to retain debris. This also reduces the through-screen velocity by presenting a larger screen area to the flow than would be presented by a vertical TWS. The traveling screens are normally operated (rotated) every four hours for a period of 20 to 30 minutes. They can also be activated automatically during periods of high debris loading if the differential water height between the upstream and downstream sides of the TWS exceeds a predetermined value due to clogging of the stationary screen.

During the September 2011 survey (Tenera 2011a) when all six CWPs were operating at full flow, water velocity immediately in front of the Units 1 & 2 bar racks ranged from 0.39 to 0.42 feet per second (fps) among the six intake bays, and averaged 0.41 fps over the entire intake (**Table 2-2**).

Table 2-2. Water velocities measured[1] or estimated[2] at full circulating water pump flow for several locations throughout the Moss Landing Power Plant Units 1 & 2 intake structure.

Location	Water Velocities (fps)
Approach to bar racks	0.41[1]
Approach to screens	0.44[2]
Through screens	0.92[2]

1. Approach-to-bar-rack measurements made by Tenera during a survey conducted in September 2011.
2. Approach-to-screen and through-screen design water velocities estimates were based on calculations made by intake screen manufacturer (FPI August 2005).

The CWPs that supply cooling water to Units 1 & 2 are located approximately 300 feet downstream of the TWS (**Figure 2-3**). Each generating unit has three CWPs that provide a total cooling water flow of 180 MGD (125,000 gpm) to its steam condenser and other heat exchangers.

Each of the three CWPs discharges into individual 48-inch pipes which, after a run of about 200 feet, join together into a single 84-inch diameter pipe (**Figure 2-2**). The two 84-inch lines (one per unit) carry the cooling water a distance of about 2,000 feet to the Units 1 & 2 condensers. Upon exiting the condensers, the two discharge lines feed into a single 120-inch discharge pipe that runs about 1,400 feet to the disengaging basin. The disengaging basin is a concrete reservoir, open to the atmosphere, where turbulent mixing aerates the discharge flow and provides some cooling. The basin also acts as a vacuum breaker and prevents siphoning of the discharge flow. The discharge exits the disengaging basin via two discharge conduits that run about 600 feet to a point just west of the Units 6 & 7 turbine building where they join the Unit 6 and Unit 7 discharge lines. Stop logs can be inserted at the disengaging basin to direct the Units 1 & 2 discharge into either the Unit 6 or Unit 7 flow streams or, as is normally the case, they can be removed to allow the flow to be split between the two conduits. The two discharge conduits carry the combined discharge of all four generating units about 2,400 feet from the plant to the discharge structure located approximately 600 feet offshore in Monterey Bay.

2.2.2 Units 6 & 7

The Units 6 & 7 intake structure is located on the east shore of Moss Landing Harbor about 800 feet south of the Units 1 & 2 intake structure (**Figure 2-2**). The structure has many of the same features found at the Units 1 & 2 intake, bar racks and traveling water screens, but the layout is considerably different (**Figure 2-4**). The bar racks are located behind a vertical curtain wall that extends down to 3.3 feet below MLLW. The wall prevents large floating debris from being impinged on the bar racks. The spacing between bars is about 3 inches.

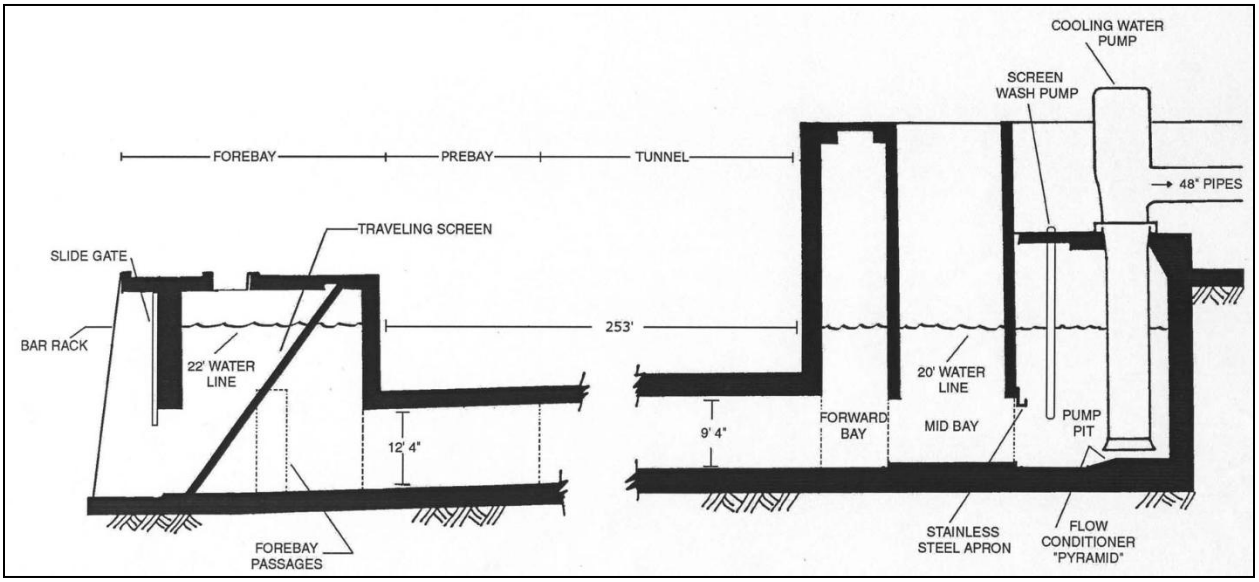

Figure 2-3. Cross-sectional diagram of the Units 1 & 2 intake structure and pump bays.

Traveling water screens are located about 25 feet downstream of the bar racks. These are vertical traveling screens with 3/8-inch screen mesh. Each generating unit has four 10-foot wide TWS, two per CWP, that extend down to the floor of the intake structure (20 feet below MLLW). The screenwash system removes debris from the screens, and flushes it into a sluiceway that empties into a screenwash wet well. The screenwash discharge, less the impinged material, is returned to Monterey Bay by large-diameter screen refuse pumps that empty into the discharge conduits of Units 6 & 7. The impinged material that is retained in the wet well is periodically removed by a local refuse collection contractor and trucked to a sanitary landfill for disposal. Due to the limited operation of Units 6 & 7, the traveling screens are currently rotated and cleaned on an as-needed basis. They can also be activated automatically during periods of high debris loading if the differential water height between the upstream and downstream sides of the TWS exceeds a predetermined value due to clogging of the stationary screen. The screens can also be run continuously, as a precaution, when debris levels are high.

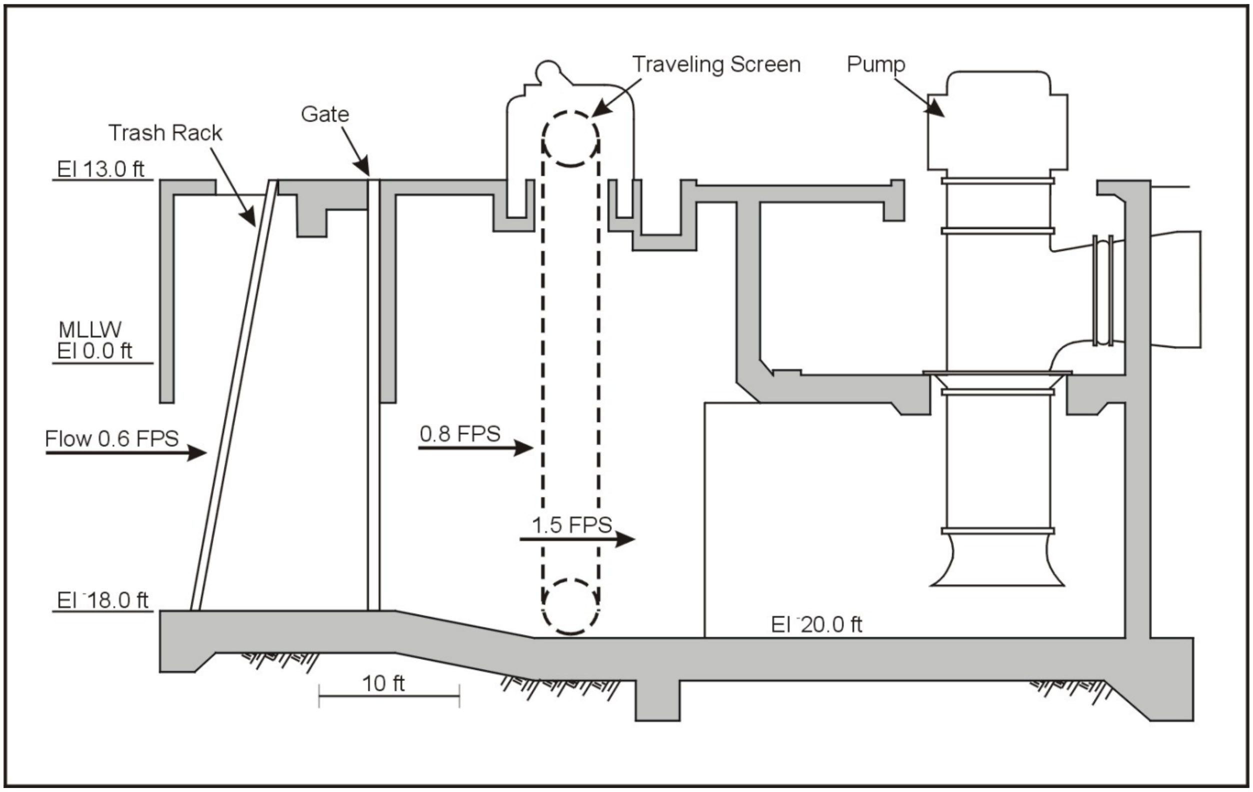

Figure 2-4. Cross-sectional diagram of the Units 6 & 7 intake structure.

During a September 2011 survey when all four CWPs were operating at full flow, water velocity immediately in front of the Units 6 & 7 bar racks ranged from 0.57 to 0.88 fps among the eight intake bays, and averaged 0.70 fps over the entire intake (Tenera 2011a). Water velocity at the TWS has not been measured in recent years but was calculated in the past to be 0.8 fps approaching the TWS and 1.5 fps through the screens (**Table 2-3**).

Table 2-3. Water velocities measured(1) or estimated(2) at full circulating water pump flow for several locations throughout the Moss Landing Power Plant Units 6 & 7 intake structure.

Location	Water Velocities (fps)
Approach to bar racks (average)	0.7(1)
Approach to screens	0.8(2)
Through screens	1.5(2)

1. Approach-to-bar-rack measurements made by Tenera during a survey conducted in September 2011.

2. Values reported in PG&E (1983). Pacific Gas and Electric Company. Moss Landing Power Plant Cooling Water Intake Structures 316(b) Demonstration.

Both generating units have two CWPs that each provide a nominal flow of 150,000 gpm (300,000 gpm [432 MGD] per unit). Unlike the Units 1 & 2 CWPs, the Units 6 & 7 pumps are located immediately behind the TWS (about 30 feet) and about 400 to 450 feet upstream of the Units 6 & 7 condensers. Each CWP discharges into its own conduit. Each conduit supplies cooling water to half of a generating unit's condenser. Upon exiting the condenser, the cooling water from both condenser halves flows into a common discharge conduit. The discharge from Unit 6 remains separate from that of Unit 7. The discharge flow from Units 1 & 2 joins the Units 6 & 7 discharge about 100 feet downstream of the condensers. The flow from Units 1 & 2 can be directed in its entirety into either the Unit 6 or Unit 7 conduit, but is normally split between the two. The two separate subsurface discharge conduits carry the flow from each unit to a submerged offshore discharge structure located in Monterey Bay 2,400 feet from the plant, and approximately 600 feet offshore.

2.2.3 Analysis of Recent Generation and Flow Data

The MLPP generation and average daily cooling water usage over the period 2009 through 2013 are shown in **Tables 2-4 and 2-5**. Annual generation is presented as a percentage of the design basis capabilities of each unit.

Table 2-4. Moss Landing Power Plant yearly generation capacity factor by unit for 2009–2013.

Unit Number	Yearly Generation Capacity Factor (percentage of design basis)					
	2009	2010	2011	2012	2013	Average
Unit 1	40.13	37.19	18.37	49.40	51.39	39.30
Unit 2	42.29	35.19	20.45	49.55	52.98	40.09
Units 1 & 2	41.21	36.19	19.41	49.48	52.19	39.70
Unit 6	3.44	1.05	1.06	4.69	4.06	2.86
Unit 7	7.21	3.07	2.90	4.19	1.71	3.82
Units 6 & 7	5.33	2.06	1.98	4.44	2.89	3.34

2.3 Source Water Body Description and Aquatic Biological Resources

The MLPP is situated at the intersection of three distinct marine geographic areas: Elkhorn Slough (tidal lagoon), Moss Landing Harbor, and Monterey Bay. Each of these areas has its own unique aquatic biological habitats. Distinct aquatic habitats present within the boundaries of Moss Landing Harbor and Elkhorn Slough include shallow open water, submerged aquatic vegetation, sand/mud/salt flats, fresh/salt/brackish marshes, rocky subtidal and intertidal. Distinct habitats present in Monterey Bay include sandy beach, rocky intertidal and subtidal and open water areas.

Table 2-5. Moss Landing Power Plant annual daily average circulating water flow in MGD for 2009–2013.

Unit Number	Design Flow (MGD)	Daily Average Circulating Water Flow (MGD)					
		2009	2010	2011	2012	2013	Average
Unit 1	180	117.56	105.29	62.25	124.31	127.19	107.32
Unit 2	180	117.95	103.12	69.46	123.33	126.76	108.12
Units 1 & 2	360	235.51	208.41	131.71	247.64	253.95	215.44
Unit 6	432	54.36	24.78	20.82	78.81	67.99	49.35
Unit 7	432	88.45	57.09	59.64	70.49	32.85	61.70
Units 6 & 7	864	142.81	81.87	80.46	149.30	100.84	111.06

2.3.1 Elkhorn Slough / Moss Landing Harbor

Elkhorn Slough is a narrow, shallow water embayment that extends 6.2 miles inland from the eastern margin of Monterey Bay. As it extends inland, it gradually narrows and decreases in depth. Tidal mud flats and pickleweed (*Salicornia* spp.) marsh extend the length of the slough. The drainage basin for Elkhorn Slough is small, only 226 square miles in area. The land near the slough is used primarily for agriculture. Shallow open water and lagoon habitats comprise the majority of aquatic habitat provided by the Elkhorn Slough and Moss Landing Harbor complex.

Several changes have occurred in the hydrology and channel geomorphology since the time of the PG&E entrainment and impingement studies in 1978–1980 (Malzone and Kvitek 1994, Oxman 1995, Lindquist 1998). In the mid 1980s several dikes and levees surrounding pasture lands were reopened to tidal flow. These changes increased the surface wetlands by 48 percent and the tidal volume by 43 percent (Malzone and Kvitek 1994). The increased volume of water exchanged with the tides has increased both the rate of erosion and the velocity of the tidal currents (Philip Williams and Associates 1992, cited in Lindquist 1998, Malzone and Kvitek 1994). Recent studies of the effects of this erosion on the ecology of the slough (Lindquist 1998) and studies of the prey availability for harbor seals (Oxman 1995) provide updated information on the species composition of adult fishes in the slough. Yoklavich et al. (2002) discuss data collected from numerous studies (past and present) on fish assemblages found in Elkhorn Slough habitats and surrounding marine waters.

The varied marine and estuarine habitats within Elkhorn Slough provide habitat for at least 97 species of fish (representing 40 families) (Yoklavich et al. 1992, 2002). Most (76) of these species are marine species from Monterey Bay. Fish species utilizing the slough were divided by Yoklavich et al. (2002) into several groups. Immigrant marine species typically use the slough for spawning or as a nursery ground. These species include the northern anchovy *Engraulis mordax*, Pacific herring *Clupea pallasi*, and cabezon *Scorpaenichthys marmoratus*. Numerous species of flatfish including the speckled sanddab *Citharichthys stigmaeus*, English sole *Parophrys vetulus*, sand sole *Psettichthys melanostictus*, starry flounder *Platichthys stellatus*, California halibut *Paralichthys californicus*, and several species of turbot are also considered immigrant marine species. Fish species considered permanent residents include the Pacific staghorn sculpin *Leptocottus armatus*, black surfperch *Embiotoca jacksoni*, striped mullet *Mugil cephalus*, bay pipefish *Syngnathus leptorhynchus*, and five species of gobies. Partial residents, or species that live or reproduce in the slough but migrate to the ocean during certain seasons or life stages, include the jacksmelt *Atherinopsis californiensis*, shiner surfperch *Cymatogaster aggregata* and white surfperch *Phanerodon furcatus*, leopard shark *Triakis semifasciata*, and bat ray *Myliobatis californica*. Species primarily associated with freshwater include the American shad *Alosa sapidissima* and threadfin shad *Dorosoma petenense*, mosquitofish *Gambusia affinis*, prickly sculpin *Cottus asper*, threespine stickleback *Gasterosteus aculeatus*, and striped bass *Morone saxatilis*. Few non-native species have been noted (yellowfin goby *Acanthogobius flavimanus*, mosquitofish, American shad, and striped bass).

In 1991, otter trawls were conducted as part of a study of fish availability as prey items for harbor seals (Oxman 1995). Otter trawls were conducted monthly for a year (1991) in Elkhorn Slough in an effort to establish seasonal trends of fish availability and distribution. The trawls were taken at the same three stations (Bridge, Dairies, and Kirby Park) sampled by Nybakken et al. (1977) and reported by Yoklavich et al. (1992) in the main channel of the slough. Eighty-three daytime otter trawls captured 1,955 fish representing 41 species. The 29 nighttime trawls at two stations (Dairies and Bridge) resulted in the collection of 1,461 fishes representing 39 species. The lower numbers caught during the day may have been a result of fishes avoiding the net.

More than 90 percent of the fishes taken in the daytime and nighttime trawls were represented by 11 species. These fishes included shiner surfperch, English sole, Pacific staghorn sculpin, California tonguefish *Symphurus articauda*, speckled sanddab, white surfperch, cabezon, black surfperch, and lingcod *Ophidion elongatus*. Pipefish *Syngnathus* spp. were caught during the daytime trawls and brown rockfish *Sebastes auriculatus* were caught at night.

Oxman (1995) reported that overall there was a slight change in the 1991 diurnal fish assemblage from that reported by Yoklavich et al. (1992) during 1974–1976. These changes included a decrease in the mean number of fish per tow, species diversity decrease at the Bridge and Dairies stations, and species diversity increases at Kirby Park. Species absent from the 1991 daytime trawls that were present in 1974–1980 trawls included topsmelt *Atherinops affinis*, jacksmelt, Pacific herring, threadfin shad, sand sole, blue rockfish *Sebastes mystinus*, queenfish *Seriphus politus*, and night smelt *Spirinchus starksi*. Several species were less abundant. English sole, cabezon, lingcod, and California tonguefish increased in relative abundance and density.

Oxman (1995) stated that there was a significant change in fish assemblages at the Bridge and Dairies stations since the 1974–1980 otter trawls. Several species were absent and many were caught in less abundance in the 1991 tows. English sole, lingcod, and California tonguefish increased in relative abundance and density.

Lindquist (1998) collected fishes by otter trawl to provide information on their feeding habits from four stations in Elkhorn Slough from May 1996 to May 1997. He analyzed 11 species of fish from nine families. The species were yellowfin goby, topsmelt, speckled sanddab, arrow goby *Clevelandia ios*, Pacific herring, shiner surfperch, northern anchovy, Pacific staghorn sculpin, white surfperch, English sole, and California tonguefish. These species accounted for 96 percent of the total abundance from the otter trawls. Of those species all but yellowfin goby and California tonguefish were dominant fishes during studies conducted in Elkhorn Slough in the 1970s (Lindquist 1998).

Yoklavich et al. (2002) discussed several distinct habitat types which have been sampled within the slough. Different sampling methods were used for each habitat type (otter trawl, beach seine, and channel nets). The most abundant and diverse family of fishes within the slough and surrounding coastal waters are the embiotocids or surfperches. Shiner surfperch was the most common species found throughout the habitats studied and the Pacific staghorn sculpin was the most abundant species in upper slough areas. Several large elasmobranchs are also relatively common within the slough (bat ray, shovelnose guitarfish *Rhinobatos productus*, gray smoothhound *Mustelus californicus*, and leopard shark (Yoklavich et al. 2002, San Filippo 1994).

Yoklavich (2002) concluded that in general, fish assemblages present in Elkhorn Slough in the 1990s were characterized by decreased abundance at most sample sites as well as less diversity than in the past. Within the last 20 years a homogenization of fish assemblages appears to have occurred between the lower main channel and tidal channels. These changes coincided with the continued erosion and scouring of smaller channels to the point that they are now similar (in habitat type) to the main channel (Malzone and Kvitek 1994).

The most abundantly collected fishes from studies reported in Nybakken et al. (1977), Yoklavich et al. (1991), from PG&E impingement studies in 1978–80 (PG&E 1983), and from Lindquist (1998) generally have remained the same. Northern anchovy, shiner surfperch, and Pacific herring were some of the most abundantly collected fishes from all three of these studies. Topsmelt was the only species collected in high numbers in impingement samples that was not collected during the other two studies. Oxman's (1995) studies in 1991 however, showed greater differences in species composition when compared to the other studies with the exception of the presence of shiner surfperch. This species was collected in high numbers in the slough during all studies. Fishes that were not collected in Oxman's study but were present in high numbers in all other studies were northern anchovy and Pacific herring. Both of these missing species were again collected in high numbers in Lindquist's 1996–1997 studies.

2.3.2 Monterey Bay

Monterey Bay, California's largest open-coast embayment, is formed by the extent of shoreline between Santa Cruz and Monterey and by the offshore depths of the Monterey Submarine Canyon. The opening of the bay is 23 miles across and 10 miles wide. Four main tributaries, the

Pajaro River, Elkhorn Slough, the Salinas River, and the San Lorenzo River flow into the bay. The bay's immense supply of cold, nutrient-rich, ocean water is exchanged tidally with the Elkhorn Slough and harbor located midway along the bay shoreline at the head of the canyon.

Monterey Bay lies within the boundaries of the Monterey Bay National Marine Sanctuary (MBNMS). The MBNMS extends from 7 miles north of the Golden Gate Bridge to Cambria Rock in northern San Luis Obispo County. The sanctuary contains about 400 statute miles of coastline and extends an average of 30 miles offshore. Its total area is 5,322 square miles. The MBNMS was officially established in 1992 by the authority of the Secretary of Commerce under the 1972 Marine Protection, Research and Sanctuaries Act. The MBNMS is one of fourteen marine sanctuaries in the United States under the jurisdiction of the National Oceanic Atmospheric Association (NOAA) of the U.S. Department of Commerce.

Monterey Bay is characterized by a gently sloping shelf cut by a system of submarine canyons, the largest of which is the Monterey Submarine Canyon. The head of this canyon is located off of the entrance to Moss Landing Harbor. The depth of the canyon ranges from 60 feet to 2,800 feet. The canyon is 650 feet wide at the head and approximately 7.5 miles wide at the mouth of Monterey Bay.

Monterey Bay's sandy beach habitat extends in nearly a continuous reach of approximately 20 miles from Santa Cruz to Monterey, encompassing the Moss Landing area. Beach habitat in the area of Moss Landing is exposed to high-energy waves from the northwest. Large quantities of sand are annually transported on and off the beach shoreline by strong waves and longshore currents. The continuously changing nature of this habitat favors mobile invertebrate and fish species that adjust quickly to the depletion and accretion of sediments. Relatively few species are able to adjust to this habitat.

The marine resources of Monterey Bay support a variety of commercial fisheries (Starr et al., 1998). Many of the fisheries are very dynamic. Landings are driven by the demands of the market, the abundance of the target species, and attempts by the regulators to reduce harvest. As new markets are found for species that were previously unmarketable or of low value, annual landings of those species can increase rapidly. Landings from other fisheries decline as fishermen fill the demands of the new markets. Regulation of fish harvest, entry into a fishery, gear usage, and season length can have a pronounced effect on landings. Fisheries also decline and expand with the cycles of abundance and scarcity of the targeted species. Long-term over-exploitation of many fish stocks along the Pacific Coast has decreased the abundance of adult fishes and recently led to more restrictive regulation of harvest levels. Some regulations were made because of concerns regarding declines in populations. Declines in landings often follow regulatory efforts and may not directly reflect species abundance. Because of the complexity of the forces driving fish harvest in the Monterey Bay area, generalizations about fish abundance based on landing data must be made carefully.

Fishes and invertebrates are harvested from the Monterey area using a variety of fishing methods. A majority of the fishes landed in Monterey ports between 1975 and 1998 were taken with purse seine and trawl nets. Purse seining is used to harvest pelagic species such as market squid *Loligo opalescens*, Pacific sardine *Sardinops sagax,* northern anchovy, and both Pacific mackerel *Scomber japonicus* and jack mackerel *Trachurus symmetricus*. Commercial trawlers in the area target a variety of demersal fish species, or groundfish. Set gillnets have traditionally been used to harvest California halibut, rockfish *Sebastes* spp., white croaker *Genyonemus lineatus*, and a variety of sharks. Commercial fishermen use trolling gear to harvest salmon and albacore during the seasons when they are abundant in the area. Hook- and line- gear has traditionally been used to harvest rockfish and lingcod over rocky reefs near the canyon. Set longlines, which are now prohibited in nearshore waters (within 1 mile), are used in the Monterey canyon area to take sablefish *Anoplopoma fimbria* and grenadier (Family Macrouridae). Fish traps and “stick gear” are used in the recently established live rockfish fishery. Traps are also used to take rock crabs *Cancer* spp. and Dungeness crab *Metacarcinus magister*.

2.4 Previous Impingement and Entrainment Studies

2.4.1 1978–1980 Cooling Water Intake Structures 316(b) Demonstration

In response to the requirements of Section 316(b) of the Clean Water Act, PG&E conducted an intensive study in 1978–1980 of the entrainment and impingement of fishes and macroinvertebrates resulting from the operation of the MLPP cooling water system (PG&E 1983).

2.4.1.1 Entrainment

The objective of the PG&E entrainment abundance and survival studies at MLPP was to estimate the number and taxa of organisms exposed to the plant’s cooling water system, and to determine if organisms survived contact with the Plant’s cooling water system. The entrainment abundance and survival studies focused on the early life stages of fishes (ichthyoplankton) and selected macroinvertebrates (amphipods, shrimps, and crabs). The species composition, length (for ichthyoplankton), and the seasonal and diel patterns of entrainment were also determined.

The numbers of ichthyoplankton and macroinvertebrates entrained were estimated by sampling a portion of the cooling water flow for a period of 24 hours once a month for 16 months (November 20, 1978–March 13, 1980) and once per week for 12 months (March 29, 1979–March 17, 1980) at Units 6 & 7, and then multiplying the densities of ichthyoplankton and macroinvertebrates observed by the volumes of cooling water withdrawn by the Plant. Entrainment sampling was conducted from three levels (top, middle and bottom) in a Units 1–5 bar rack intake forebay and from two levels (middle and bottom) in a Unit 6 intake bar rack forebay. When Unit 6 was removed from service for repairs (December 21, 1979 through February 1980, sampling was conducted from a Unit 7 bar rack forebay.

The most abundant fish larvae and juveniles entrained were northern anchovy, silversides Atherinopsidae, gobies Gobiidae, smelts Osmeridae, Pacific staghorn sculpin, white croaker, longjaw mudsucker *Gillichthys mirabilis*, and Pacific herring. These species accounted for 94 percent of the fish collected. The larval and juvenile fish susceptible to entrainment were typically small; most species had mean lengths < 10 mm (0.4 inch). Fish larvae and juveniles were collected throughout the year, with greatest density (expressed as the number or organisms per cubic meter of cooling water) in winter and spring (> 7.8/m^3) and lowest density in summer (typically < 1/m^3). Fish eggs were also collected year round, with greatest density occurring during the summer and fall (> 40/m^3). A majority (70 percent) of the eggs, larvae, and juvenile fish collected were entrained at night. The fish species collected during the entrainment study are common and widely distributed along the Pacific Coast; their planktonic life stages (i.e., eggs and larvae) are widely distributed by tidal and ocean currents (PG&E 1983).

Several species of invertebrates were collected. These species comprised mostly the amphipods, *Jassa falcata* and *Corophium* spp., and the larvae of several noncommercial crabs: Pinnotheridae, *Pachygrapsus crassipes* and *Hemigrapsus oregonensis*. Macroinvertebrates were collected throughout the year with greatest densities (greater than 20/m^3 for many species) occurring during the spring and summer. No diel distribution patterns were recorded for invertebrates with the exception of the crab larvae (*Cancer* spp.) which were collected primarily (58 percent) between 0600 and 0900 hours. The macroinvertebrates collected during the entrainment study are common and widely distributed along the Pacific Coast.

2.4.1.2 Impingement

Impingement studies were conducted in 1978–1980 and the results were presented in the Moss Landing Power Plant Cooling Water Intake Structures 316(b) Demonstration (PG&E 1983).

Northern anchovy was the most abundant fish species collected in the impingement studies, constituting 44 percent of the fish collected at Units 1–5 and 76 percent at Units 6 & 7. Northern anchovy, shiner perch, topsmelt, and Pacific herring together accounted for 83 percent of the 327,415 fish collected in impingement studies. Impinged fish ranged in length from a 0.4-inch jacksmelt to a 60-inch bat ray; the overall average length was 4 inches. The impingement of fishes was highest during the summer and fall, with peaks exceeding 10,000 fish per day at each intake on five sampling days during August, September, and October. Approximately 80 percent of the fishes collected were impinged at night. These species are abundant in the Monterey Bay area and common in bays and coastal waters along the Pacific Coast.

A majority (62 percent) of the 36,830 macroinvertebrates collected was impinged at the Units 1–5 intake. Brown rock crab *Romaleon antennarium*, red rock crab *Cancer productus*, and yellow crab *Metacarcinus anthonyi* constituted 37 percent of the number of macroinvertebrates impinged at Units 1–5 and 9 percent at Units 6 & 7. Shrimps of the genus *Crangon* constituted

19 percent of the macroinvertebrates collected at Units 1–5 and 31percent at Units 6 & 7. Impingement of macroinvertebrates was highest during the early summer and in winter, with the highest peak (6,165 individuals on one sampling date, all units combined) in January. Approximately 60 percent of the macroinvertebrates collected were impinged at night.

The overall rate of impingement (standardized for differences in cooling water flow) for both fish and macroinvertebrates was higher at the Units 1–5 intake than at the Units 6 & 7 intake by a factor of 1.6 for fish and 3.3 for macroinvertebrates (PG&E 1983).

2.4.2 1999–2000 Cooling Water Intake Assessment Entrainment Study

The field studies and data analyses for the proposed modernization project followed a Study Plan developed in coordination with a Technical Working Group (TWG) established under the auspices of the Central Coast Regional Water Quality Control Board (Tenera 1999).

2.4.2.1 Methods

Entrainment sampling began March 2, 1999 and continued through February 24, 2000 immediately offshore of the Units 1 & 2 and Units 6 & 7 intake structures. Samples were collected once per week during the peak larval fish season (November through June) and every other week during the off-peak period. Samples were collected by towing a bongo frame with two 2.3 ft diameter openings and equipped with two 335 µm mesh plankton nets and codends. Samples were collected over a continuous 24-hour period; each period was divided into six, 4-hour sampling cycles. Two tows were conducted during each cycle. The bongo nets were lowered as close to the bottom as possible. Once the nets were at the correct depth, the boat was moved forward and the nets retrieved at an oblique angle (winch cable at a 45° angle). Each net mouth was fitted with a calibrated flowmeter to record the water volume filtered (Tenera 2000).

During laboratory processing all larval fishes and the megalopal stage of selected crab species were removed from the samples. European green crab *Carcinus maenas* megalops were searched for and removed from the samples. Larval fishes and targeted crab species megalops were identified to the lowest taxonomic level practicable and the lifestages of larval fishes were identified and recorded on the data sheet. Lengths of larval bay goby and longjaw mudsucker were obtained using a computer imaging system and image analysis software.

Entrainment effects were assessed using three independent models and assuming 100 percent design flows for circulating water and screenwash pumps. Two of the models, Fecundity Hindcasting (FH) and Adult Equivalent Loss (AEL), used species' life history information to estimate the potential numbers of adults represented by the entrainment losses. The third approach, Empirical Transport Modeling (ETM), compared entrainment larval concentrations to source water larval concentrations to calculate the effects of larval removal on the standing stock of larvae in Monterey Bay and Elkhorn Slough.

2.4.2.2 Results

Eight taxa of larval fishes comprised 95 percent of the total of the 66 taxa collected in entrainment samples (**Figure 2-5**) (Tenera 2000). The taxa, listed in decreasing order of abundance, were: unidentified gobies Gobiidae (53.2 percent), bay goby *Lepidogobius lepidus* (30.4 percent), blackeye goby *Rhinogobius nicholsi* (3.0 percent), Pacific staghorn sculpin (2.2 percent), white croaker (2.1 percent), blennies *Hypsoblennius* spp. (1.9 percent), longjaw mudsucker (1.2 percent), and Pacific herring (0.9 percent). Of the 95 percent, nearly 88 percent were represented by members of one Family—Gobiidae. This Family included the unidentified gobies, bay goby, blackeye goby, and longjaw mudsucker. Only three species of fish (Pacific herring, white croaker, and Pacific staghorn sculpin), had some commercial or recreational value, and individually represented 5 percent of the eight taxa or species.

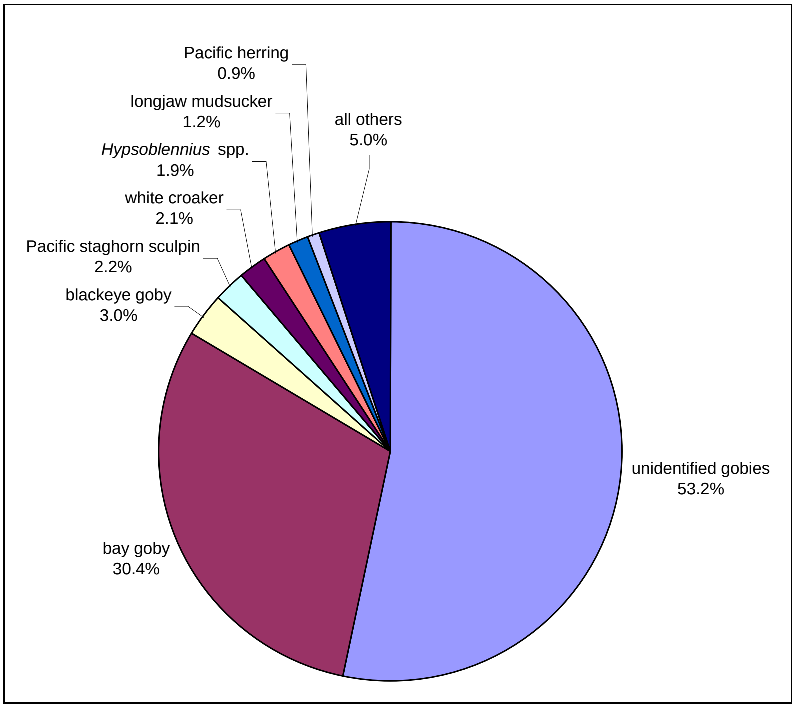

Figure 2-5. Percent composition of the most abundant larval fish taxa collected in entrainment surveys at the Moss Landing Power Plant: March 1999 through February 2000.

Low numbers (<365 individuals) of cancer crab megalops were collected in the year-long study at MLPP. Six species of cancer crab megalops were collected in entrainment surveys. Hairy rock crab comprised 29.3 percent of the total number of entrained Cancer megalops followed by yellow crab (19.6 percent), brown rock crab (19.0 percent), Dungeness crab (14.7 percent), red rock crab (9.8 percent), and slender rock crab (7.1 percent). European green crab megalops (3 individuals) were collected in only two (April 15 and April 22, 1999) entrainment surveys.

2.4.3 2005–2006 Impingement Studies

2.4.3.1 Methods

Impingement collections began on November 6, 2005 (Tenera 2007). Surveys at Units 1 & 2 were conducted over a 24-hour period once per week for the period of one year. Impingement sampling at the Units 6 & 7 occurred only if one or both of those units were scheduled to operate during any given week during the study period. Each sampling period was divided into four 6-

hour cycles. Before each weekly sampling effort, all of the screens and the bar racks (if possible) were cleaned of all impinged debris and organisms. The sluiceways and collection baskets were cleaned before the start of each sampling effort.

Samples were collected by rotating and rinsing the impinged material from the Units 1 & 2 and Units 6 & 7 (if operating) screens into collection baskets. The screens remain stationary for a period of approximately 5.5 hours then they were rotated and washed for 30 minutes. The impinged material from the traveling screens was rinsed into the collection baskets associated with each set of screens. The debris and organisms rinsed from each set of traveling screens was kept separate and processed according to the procedures presented below. Material removed by the Units 1 &2 bar rack rakes was also collected and processed. The operating status of each circulating water pump during the 6-hour cycle was recorded on the data sheet.

All fishes, decapod crabs, shrimps and prawns, cephalopod molluscs, and echinoderms collected at the end of each 6-hour cycle were identified, counted, weighed and measured. Any mutilated organisms were identified to the lowest taxonomic level possible, but their lengths were not recorded. If field personnel were unable to identify an organism, it was preserved for identification in the laboratory. The presence of other species such as jellyfish and colonial species such as bryozoans were recorded on the data sheets (Tenera 2007).

2.4.3.2 Results

Units 1 & 2

A total of 8,560 fishes were collected from the Units 1 & 2 traveling screens and bar racks; 8,527 from the traveling screens and 33 from the bar racks (Tenera 2007). Sixty-three fish taxa were collected from Units 1 & 2 traveling screens and 12 fish taxa collected from the Units 1 & 2 bar racks.

Eight taxa or species comprised 91.1 percent of the total number of fishes impinged at the Units 1 & 2 traveling screens (**Figure 2-6a**). Silversides were the most abundantly impinged fish taxa (n=2,651), comprising 31.1 percent of the total number of fishes impinged. Members of the silverside family included topsmelt, jacksmelt, California grunion *Leuresthes tenuis*, and individuals that could not be identified below the family level. Plainfin midshipman *Porichthys notatus* was the second most abundantly impinged fish comprising 15.9 percent of the total number of fishes impinged at the Units 1 & 2 traveling screens followed by pipefishes (11.4 percent), northern anchovy (9.6 percent), sanddabs *Citharichthys* spp. (9.3 percent), arrow goby (8.1 percent), threespine stickleback *Gastererosteus aculeatus* (3.1 percent), and bay goby (2.5 percent). Sanddabs included speckled sanddab and sanddabs that could not be identified to species.

The total weight of fishes impinged on the traveling screens and bar racks was 89 lb and 8 lb, respectively. Thirteen taxa or species comprised 84.4 percent of the total biomass impinged at the Units 1 & 2 traveling screens (**Figure 2-6b**). Silversides accounted for the highest biomass (33.3 percent), followed by northern anchovy (9.9 percent), Pacific staghorn sculpin (7.8

percent), plainfin midshipman (6.4 percent), cabezon (6.0 percent), Pacific electric ray *Torpedo californica* (5.6 percent), pipefishes (4.3 percent), bay goby (3.0 percent), starry flounder (2.2 percent), sanddabs (2.2 percent), California tonguefish (2.0 percent), and arrow goby (1.9 percent). On two occasions, large individual fish contributed to greater than 1 percent of the total biomass collected on the Units 1 & 2 traveling screens: green sturgeon *Acipenser medirostris* (1.9 percent), ratfish *Hydrolagus colliei* (1.5 percent).

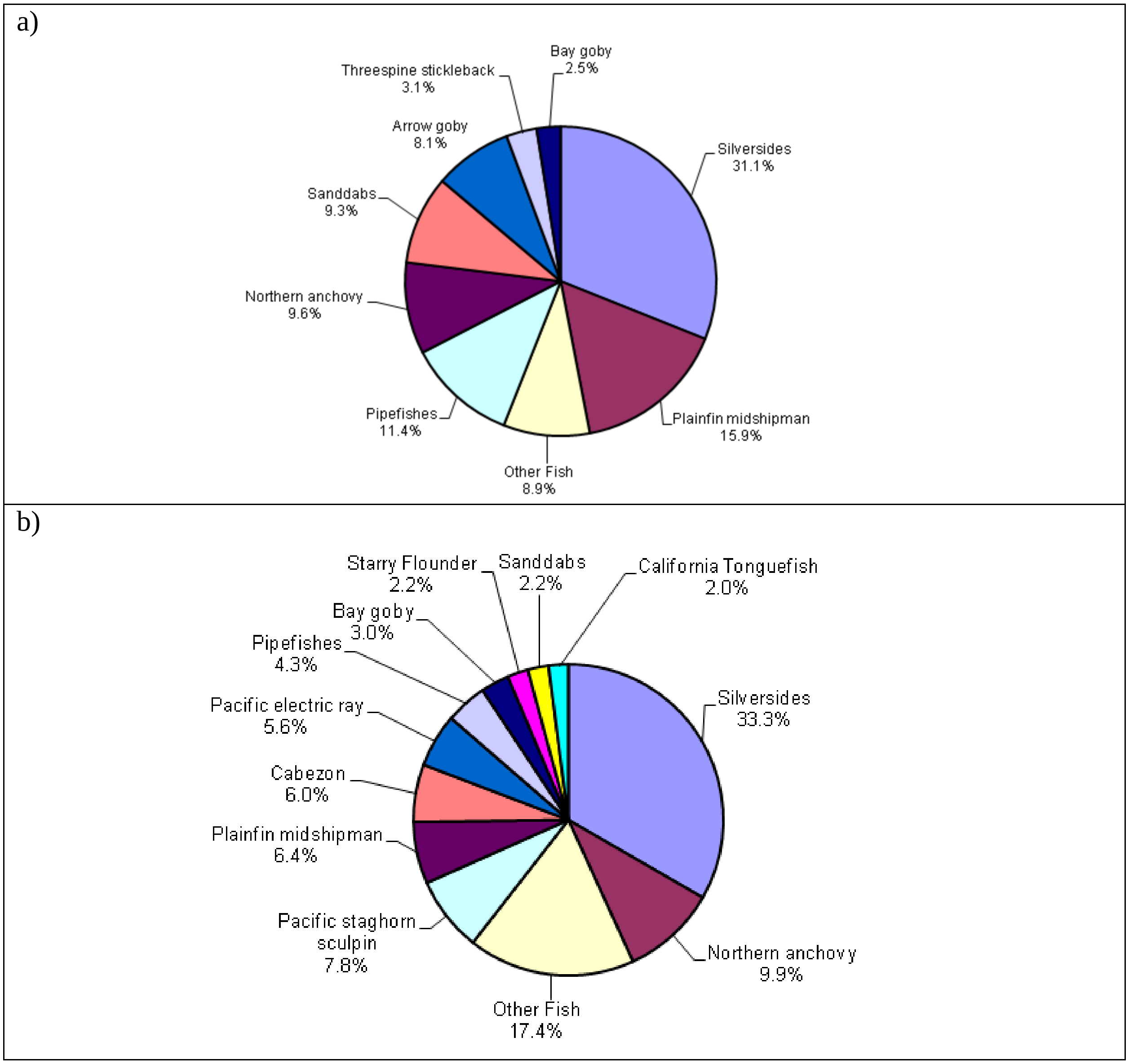

Figure 2-6. Percent composition of the most abundant fishes by a) count and b) weight in impingement surveys at the Moss Landing Power Plant Unit 1 & 2 intake: November 2006 through November 2007.

One species that is now afforded protection under the Endangered Species Act was collected at the Units 1 & 2 intake during the year-long impingement study. The southern distinct population segment (DPS) of the North American green sturgeon was listed by the National Marine Fisheries Service (NMFS) as a threatened species on July 7, 2006. The green sturgeon (21.5 inch standard length) was collected during the January 4, 2006 survey before the species was listed.

One Chinook salmon *Oncorhynchus tshawytscha* (4.8 inch SL) was collected during the August 16, 2006 survey. This specimen was examined by NMFS in Santa Cruz and it was determined that it was a hatchery-raised fish that was released in Moss Landing Harbor as part of a re-stocking program.

Units 6 & 7

A total of 20,720 fishes were collected from the Units 6 & 7 traveling screens (Tenera 2007). Fifty-three fish taxa were collected from Units 6 & 7 traveling screens. Five taxa or species comprised 90.8 percent of the total number of fishes impinged at Units 6 & 7 (**Figure 2-7a**). Northern anchovy were the most abundantly impinged fish taxa (n=16,462), comprising 79.4 percent of the total number of fishes impinged at the Units 6 & 7 intake. Silversides were the second most abundant fish impinged, comprising 5.5 percent of the total number of fishes impinged. Members of the silverside family impinged at the Units 6 & 7 intake included topsmelt, jacksmelt, and individuals that could not be identified below the family level. Sanddabs comprised 2.4 percent of the total number of fishes impinged, followed by shiner surfperch (1.8 percent), and Pacific staghorn sculpin (1.7 percent).

Nine taxa or species comprised 90.1 percent of the total biomass impinged at the Units 6 & 7 traveling screens (**Figure 2-7b**). Northern anchovy accounted for the highest biomass (53.8 percent), followed by thornback *Platyrhinoides triseriata* (9.4 percent), Pacific electric ray (7.0 percent), silversides (5.6 percent), sablefish (4.3 percent, n=5), Pacific staghorn sculpin (3.3 percent), plainfin midshipman (2.5 percent), sanddabs (2.3 percent), and English sole (1.9 percent).

Five Chinook salmon were collected at the Units 6 & 7 intake during the 2005–2006 impingement study. Two were collected during the July 6, 2006 survey (both fish measured 3.5 inch SL), one was collected during the July 12, 2006 survey (3.9 inch SL), and two were collected during the August 2, 2006 survey (4.4 inch SL). These specimens were also examined by NMFS in Santa Cruz and it was determined that they, like the specimen impinged at Units 1 & 2, were hatchery-raised fish that were released in Moss Landing Harbor as part of a re-stocking program.

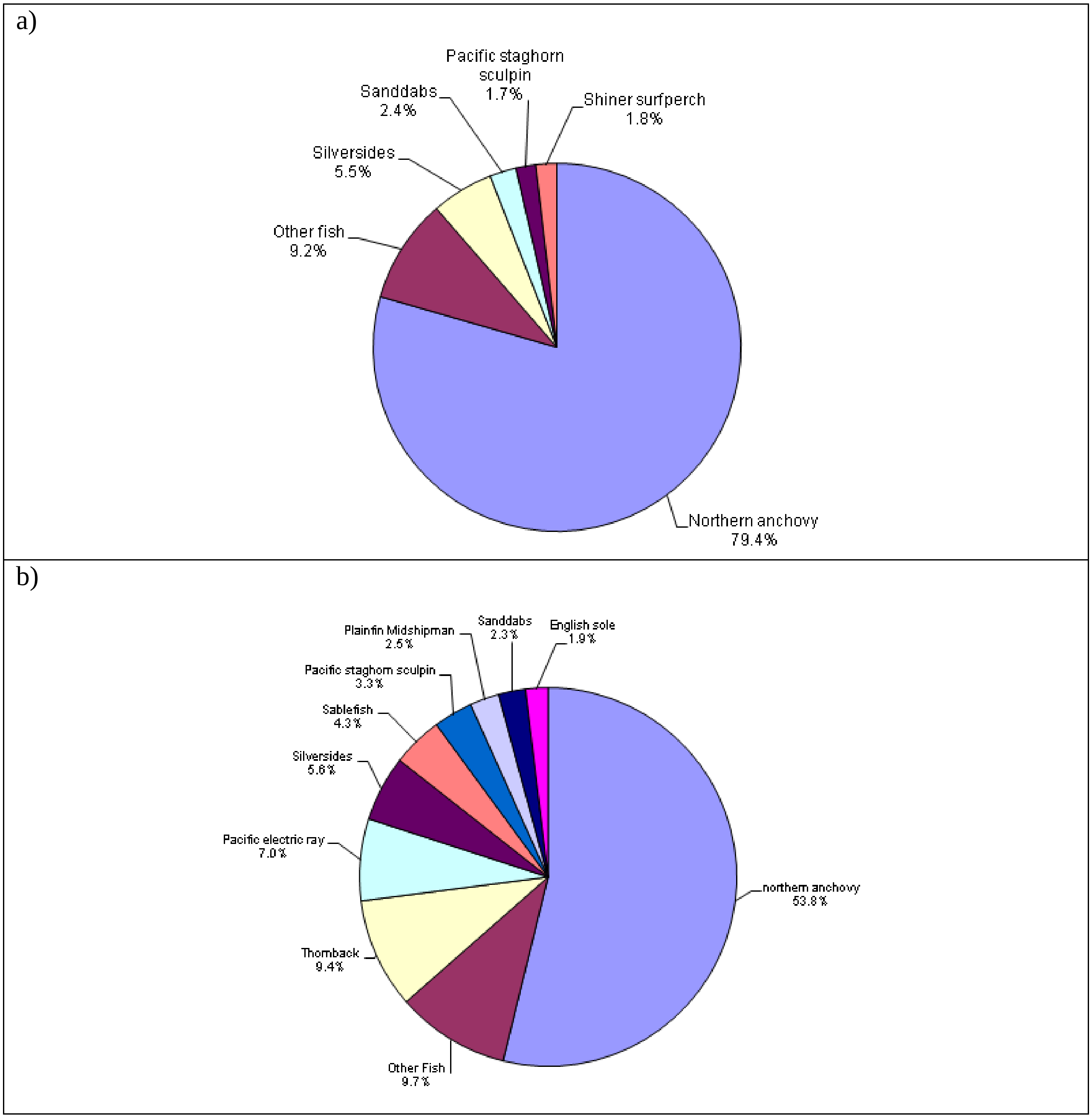

Figure 2-7. Percent composition of the most abundant fishes by a) count and b) weight in impingement surveys at the Moss Landing Power Plant Unit 6 & 7 intake: November 2006 through November 2007.

2.5 Relevance of Previous Impingement and Entrainment Studies

The Moss Landing Power Plant Modernization Project 316(b) Resource Assessment (April 2000) (MLPP 316(b) Resource Assessment)[13] and Moss Landing Power Plant Units 1&2 and Units 6&7 Impingement Study Data Report (March 2007) (MLPP Impingement Study)[14] accurately reflect current impingement and entrainment impacts of the existing MLPP intakes.

The MLPP 316(b) Resource Assessment report contains the study plan, description of field and analytical methods, detailed results, and evaluation of alternative intake technologies. This study, as well as the more recent MLPP Impingement Study, was designed in a collaborative effort by scientists representing Federal and State resource and regulatory agencies and academic institutions. The Technical Working Group (TWG) scientists routinely attended meetings for the specific purpose of designing sampling plans that would accurately describe the species composition, abundance and behavior of larval fishes and shellfishes that were entrained and also found living in the facility's source water and at risk to entrainment. The statistical design of the studies also took into account the need to identify spatial and seasonal variation in these populations, particularly as might be influenced by oceanographic conditions during the course of the study. A rigorous quality assurance and control program exercised throughout the study audited the field, laboratory, and analytical methods employed during the studies.[15] Study results were routinely shared with TWG members to enable real-time review and opportunity for study plan modification. This adaptive management process facilitated the high degree of accuracy achieved in both collection and analysis of the study's entrainment and impingement data.

The entrainment study design adopted by the TWG scientists employed a method of assessing entrainment impacts that essentially eliminated traditional statistical concerns of interannual variation in larval abundance. The sampling and analytical methodology, as recognized by its acronym "ETM" (Empirical Transport Model) and described in a CEC publication,[16] has been widely applied throughout the State by Regional Water Quality Control Boards, the CEC, the

[13] Moss Landing Power Plant Modernization Project, 316(b) Resource Assessment (April 28, 2000), prepared for Duke Energy Moss Landing LLC by Tenera Environmental Inc.

[14] Moss Landing Power Plant Units 1&2 and Units 6&7 Impingement Study Data Report (March 2007), prepared for Moss Landing Power Plant by Tenera Environmental Inc. These impingement data replaced the impingement data in the MLPP 316(b) Resource Assessment that were collected during the 1979-1980 MLPP 316(b) study and had been used to estimate the rate of impingement until the new Units 1 and 2 intake could be constructed and impingement studied. In addition, the new impingement data replaced/reanalyzed impingement at Units 6 and 7, which had not been studied since the 1979-1980 MLPP 316(b) Study.

[15] A laboratory quality control (QC) program for all levels of laboratory sorting and taxonomic identification was applied to all samples. The QC program also incorporated the use of outside taxonomic experts to provide taxonomic QC and resolve taxonomic uncertainties.

[16] Steinbeck, J., J. Hedgepeth, P. Raimondi, G. Cailliet, and D. Mayer. Assessing Power Plant Cooling Water Intake System Entrainment Impacts, California Energy Commission Consultant Report, CEC-700-2007-010 (2007). The authors of this peer-reviewed paper were also members of the MLPP TWG, along with other agency scientists.

California Department of Fish and Game, the California Coastal Commission, and other State and Federal resource and regulatory agencies to assess entrainment impacts. The steady oversight of the TWG scientists throughout the course of the MLPP 316(b) Resource Assessment from study design to final report along with the project's Quality Control program assured the assessment's outcome of thorough, accurate, and purposeful findings.

The species composition of larval fish collected in the MLPP 316(b) Resource Assessment entrainment samples was mostly Harbor and slough species. The larval fishes found in the Harbor and surrounding habitat are dominated by three species of gobies that occupy mud burrows throughout the Harbor and slough's extensive intertidal and subtidal areas of shallow, soft-bottom habitat. These same species of gobies are ubiquitous in their distribution and occur in large numbers in most California bays, lagoons, and sloughs. There have not been any substantial changes in the available habitat type in Moss Landing Harbor and Elkhorn Slough since the 316(b) Resource Assessment study in 2000. As a result, the larval species composition would not be expected to have changed and the entrainment results from the study remain valid at the present time.

The absence of any substantial change in the habitats in Moss Landing Harbor and Elkhorn Slough would also indicate that the same adult and juvenile fishes collected during the MLPP Impingement Study less than ten years ago would still be valid and representative at the present time due to their recent date of collection and reporting.

In short, prior impingement and entrainment studies at Moss Landing accurately reflect current impingement and entrainment impacts of the existing cooling water intakes and Dynegy Moss Landing, LLC plans, subject to the SWRCB's approval, to use these prior studies to provide 12 months of the 36 months of baseline impingement and entrainment data.

3.0 Compliance Strategy

This section of the updated Implementation Plan identifies the compliance alternative selected for MLPP and describes the general design, construction and operational measures that will be undertaken to implement the alternative. A schedule for implementing those measures, as established in the Settlement Agreement, is also provided. In addition, compliance with the immediate and interim requirements under Policy section 2.C are addressed.

3.1 Track 1 is Not Feasible at MLPP

As determined by the SWRCB and set forth in the Settlement Agreement, Track 1 compliance is not feasible at MLPP.[17] Section II.1.A. of the 2011 Implementation Plan describes in detail why compliance with Track 1 is not feasible at MLPP.

3.2 Track 2 Compliance

The Settlement Agreement (paragraph 2.1.3.) provides details on the compliance approach for MLPP under the Track 2 provisions identified in section 2.A.(2) of the Policy. As presented below, the proposed approach for Units 1 & 2 differs from Units 6 & 7, recognizing the unique nature of the recently constructed combined-cycle units and the separate intakes for the two pairs of units (**Figure 2-2**).

As set forth in paragraph 2.1.7.a. of the Settlement Agreement, Dynegy Moss Landing, LLC will conduct baseline studies pursuant to Policy sections 4.A.(1) and 4.B.(1) at MLPP and, no later than six months after completion of the baseline studies, shall submit a Baseline Study Report to the SWRCB for approval which shall provide: (1) results of the baseline studies for impingement and entrainment; (2) the representative species, including sensitive species, proposed to be used to determine compliance; and (3) the measured densities of the representative species by seasonal and diel periods.[18] Following approval of the Baseline Study Report, these data will be used with data on plant cooling water flows to implement a program ("Compliance Tracking Tool") to track and demonstrate compliance with the required reductions in the Policy and the Settlement Agreement.[19]

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[17] See Settlement Agreement paragraph 2.1.2.–Infeasibility Demonstration. The Policy (Section 5) defines "not feasible" to mean "cannot be accomplished because of space constraints or the inability to obtain necessary permits due to public safety considerations, unacceptable environmental impact, local ordinances, regulations, etc. Cost is not a factor to be considered when determining feasibility under Track 1."

[18] Dynegy Moss Landing, LLC will seek SWRCB approval of study designs for baseline studies as needed. Settlement Agreement paragraph 2.1.7.a.

[19] *Id.*

The baseline studies will include a total of 36 months of data. As described above in Section 2.5, Dynegy Moss Landing, LLC plans to use, subject to the SWRCB's approval, previous data on entrainment and impingement as 12 of the required 36 months, and new studies which will provide the additional 24 months of data. The new studies will be designed to be compatible with the previous studies and the sampling locations for determining compliance for both Units 1 & 2 and Units 6 & 7 will be consistent with the following: (1) entrainment may be measured at one location for the two MLPP intake structures, which are separated by approximately 800 feet, to estimate source water concentrations of fish larvae and other meroplankton during the baseline studies, and (2) the impingement monitoring for the baseline studies will occur at both intakes due to the differences in the design of the two intake structures. These and other details of the baseline studies will be described in the study design proposal to be submitted to the SWRCB (see Settlement Agreement, paragraph 2.1.3.e.).

3.2.1 Units 1 & 2

Dynegy Moss Landing, LLC will comply with the Policy using Track 2 under Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii), including application of the prior flow reduction credit provided in Policy section 2.A.(2)(d). In accordance with the Policy and the Settlement Agreement,[20] Track 2 compliance will be achieved by an 83.7% or greater reduction in impingement mortality and entrainment, pursuant to Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii).

The required Track 2 reduction in impingement mortality and entrainment may be achieved by the following:

1. Use of the prior flow reduction credit provided in Policy section 2.A.(2)(d). This credit will be applied solely to Units 1 and 2 as described below;
2. Use of operational controls to further reduce flow; and
3. Reductions in impingement mortality and entrainment through installation of technology controls.

3.2.1.1 Existing Control Measures

MLPP Units 1 & 2 currently utilize the following impingement and entrainment control measures:

- 5/16-inch mesh inclined traveling water screens;
- initial bar racks with approximately 4 inch center-to-center spacing, which provide 3½ inch wide openings between bars;
- a relocated intake structure that shortened the intake tunnel from 300 feet to approximately 20 feet; and

[20] See Settlement Agreement–Track 2 Compliance, paragraph 2.1.3.b.

- operating practices for the circulating water pumps that minimize operation time of the pumps.

3.2.1.2 Flow Reduction Credit

Based on Policy section 2.A.(2)(d) and Settlement Agreement paragraph 2.1.4., the MLPP received a credit of 224 MGD by the replacement of prior Units 1–5 with combined-cycle Units 1 & 2. The 224 MGD credit is based on the reduction in permitted flow for the entire plant achieved through the replacement of Units 1–5. As described in Section 2.2 above, the total permitted flow for the four existing MLPP units through Discharge 002 is 1,226 MGD. This represents a reduction of 224 MGD from the combined flow through Discharge 001 and Discharge 002 of 1,450 MGD (560 and 890 MGD, respectively).

The entire 224 MGD will be credited towards compliance for Moss Landing Units 1 & 2 and subtracted from the combined actual flow for those units when calculating the levels of flow and associated levels of impingement and entrainment used in demonstrating compliance.

3.2.1.3 Track 2 Compliance Strategy

Compliance under Track 2 will be achieved by an 83.7% or greater reduction in impingement mortality and entrainment, pursuant to Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii) and Settlement Agreement paragraph 2.1.3.b. The reductions will be computed by combining the 224 MGD credit provided in Policy section 2.A.(2)(d) and Settlement Agreement paragraph 2.1.4., with the percent reduction achieved through flow control or operational measures and reductions in impingement mortality and entrainment resulting from the installation of technology controls. The percent reduction in entrainment achieved by the technology controls will be calculated based on total numbers of fish larvae and other meroplankton,[21] or calculated numbers of fish larvae and other meroplankton of a specific age or size class that have been protected from the effects of entrainment for the species selected for analysis.

The 224 MGD credit will be applied by calculating baseline levels of impingement mortality and entrainment from the data collected during previous studies at the plant and from additional data collected during the baseline studies. The impingement and entrainment rates (# and weight per cubic meter) for Units 1 & 2 measured at the sampling locations will be used to calculate annual impingement and entrainment estimates based on the design flow for Units 1 & 2 (**Table 2-1**). These estimates will provide the baseline for determining compliance. Compliance will be determined by comparing the baseline estimates with impingement and entrainment estimates calculated using actual daily flow volumes minus the 224 MGD credit. Since the entrainment and impingement survey periods through the year do not include the same number of days the adjustment for the 224 MGD credit would be applied by calculating the daily entrainment or impingement estimate based on a flow of 224 MGD and subtracting that from the daily estimate

[21] The term "fish larvae and other meroplankton" means ichthyoplankton and meroplankton as identified in the Policy at section 2.A.2.b.ii.

calculated using the actual flow. The reduction is then calculated as the ratio of the total reduction to the baseline and is converted to a percentage by multiplying by 100 as follows:

$$Percentage\ Reduction = \frac{\sum_{i=1}^{365}(Daily\ Estimate\ for\ Actual\ Flow - Daily\ Estimate\ at\ 224\ MGD)}{\sum_{i=1}^{365} Baseline\ \ Daily\ Estimate\ at\ 360\ MGD} \cdot 100.$$

Additional credit for flow reduction based on operational controls would be calculated using the same approach using the reduced daily flow volumes achieved through the controls in calculating the impingement and entrainment estimates and then applying the ratio of the total reduction to the baseline.

In accordance with the Settlement Agreement, the compliance strategy for Units 1 & 2 also includes operational measures to reduce flow. Specifically, by December, 31, 2016, Dynegy Moss Landing, LLC will install and operate variable speed drive controls on the circulating water pumps serving MLPP Units 1 & 2. In addition, Dynegy Moss Landing, LLC has implemented operational control measures to reduce flow, as required within 30 days after execution of the Agreement. These operational control measures include operating procedures concerning the circulating pumps to reduce pump usage during startup and shutdown.

Compliance with the required Track 2 reductions will be monitored using a Compliance Tracking System that will integrate data on impingement and entrainment with data on intake volumes to estimate the levels of impingement and entrainment. The estimates of impingement and entrainment will be compared with baseline estimates calculated using previous design flows of 360 MGD to determine the percentage reductions as shown in the above equation. The Compliance Tracking System will be used to adjust operations, as needed, to ensure compliance, including adjusting operations relative to seasonal and diel variation in larval concentrations in the source waters of the MLPP.

Reductions through the installation of technological controls would be added to the reductions achieved through the flow credit and operational controls. The calculations described above provide the flexibility to allow the additional reductions to be calculated as numbers or a percentage depending on the technology and data produced to verify the performance of the system. The technologies that will be evaluated for Units 1 and 2 have yet to be determined. Options that will be considered for evaluation are identified in Section 3.3 below.

3.2.2 Units 6 & 7

In accordance with the Settlement Agreement, Dynegy Moss Landing, LLC will comply at Units 6 & 7 under the Track 2 provisions detailed in section 2.A.(2) of the Policy no later than December 31, 2020 or cease operation of such unit(s) until such time as compliance is achieved as specified in Policy section 2.B.(2) and Settlement Agreement paragraph 2.1.6.g.[22]

[22] See supra note 9 and accompanying text concerning Settlement Agreement paragraph 2.1.5.

3.2.2.1 Existing Control Measures

MLPP Units 6 & 7 currently utilize the following impingement and entrainment control measures:

- 3/8 inch mesh vertical traveling water screens;
- initial bar racks with spacing between the bars at 3⅝ inches; and
- operating practices for the circulating water pumps that minimize operation time of the pumps.

3.2.2.2 Track 2 Compliance Strategy

To meet the impingement standards in section 2.A.(2)(a) of the Policy at MLPP Units 6 & 7, impingement mortality must be reduced by at least 83.7 percent from baseline levels (i.e. at least 90 percent of the reduction in impingement mortality required under Track 1) by implementing operational and/or technological measures (section 2.A.(2)(a)(ii)). To meet the entrainment standards specified in the Policy, entrainment must be reduced from baseline levels by at least 83.7 percent pursuant to section 2.A.(2)(b)(ii) (i.e., at least 90 percent of the reduction in entrainment required under Track 1) by implementing one or more control technologies in conjunction with reductions in circulating water flows.

The results of the biological baseline studies for MLPP will provide a foundation for assessing potential implementation of additional operational and/or control technologies for Units 6 & 7. Dynegy Moss Landing, LLC intends to continue to investigate and evaluate the viability of various impingement and entrainment control measures, independently and in combination with one another, that may enable Units 6 and/or 7 to meet Track 2 requirements. The technology control measures currently under consideration for Units 6 & 7 are discussed in Section 3.3 below.

The evaluation of control measures for Units 6 & 7 may involve performing pilot studies and/or support studies of certain impingement/entrainment technologies and/or control measures, where appropriate. Such pilot studies generally would be aimed at identifying the potential biological performance of selected technologies. The support studies would provide data necessary for thorough evaluation of the potential biological performance of the technologies or potential operations and maintenance issues with the technologies. Before a final decision is made to pursue any particular control measures at Units 6 and/or 7, additional site-specific engineering or other evaluations may be needed. The control measures that Dynegy Moss Landing, LLC may ultimately select for either Unit 6 or Unit 7 may not be the same for the other unit.

At the appropriate time, Dynegy Moss Landing, LLC will submit an updated Implementation Plan for Units 6 & 7. In the event Units 6 and/or 7 cannot comply with the Track 2 requirements by December 31, 2020, Dynegy Moss Landing, LLC will cease operation of such unit(s) by that date until compliance is achieved. As provided in Settlement Agreement paragraph 2.1.6.h. Dynegy Moss Landing reserves the right to repower MLPP.

In accordance with the Settlement Agreement, the compliance strategy for Units 6 & 7 includes operational measures to reduce flow. Specifically, Dynegy Moss Landing, LLC has implemented operational control measures to reduce flow, as required within 30 days after execution of the Settlement Agreement. Operational control measures include operating procedures concerning the circulating pumps to reduce pump usage during startup and shutdown. Further, the Compliance Tracking System will be used to adjust operations, as needed, to ensure compliance. For example, additional operational control measures involving operations relative to seasonal and diel variation in larval concentrations in the source waters of the MLPP will be studied, as described above for Units 1 & 2 in Section 3.2.1.3 (see also Section 3.3.1.2 below).

3.3 Technology Options and Investigative Studies Under Consideration

The potential technologies and investigative studies that are being considered are described below. Other options not included below may also be considered.[23]

Because Dynegy Moss Landing, LLC has not yet made a final decision regarding which technologies it will pursue to achieve compliance under Track 2, it is not possible at this time to identify with certainty the time period, if any, when generating unit outages, if any, will need to be taken to install the selected control measure(s). Once Dynegy Moss Landing, LLC decides which impingement and entrainment control measure(s) will be pursued, an amended Implementation Plan will be submitted to identify more definitively the time periods, if any, when generating unit outages will be taken. Dynegy Moss Landing, LLC will submit and coordinate all necessary scheduled generating unit outages with the California Independent System Operator (CAISO) in accordance with the outage coordination requirements set forth in the CAISO tariff, to which Moss Landing is bound through its Participating Generator Agreement with the CAISO.

3.3.1.1 Units 1 & 2

In accordance with the Settlement Agreement paragraph 2.1.6.f., Dynegy Moss Landing, LLC must install supplemental control technology at MLPP Units 1 and 2 by December 31, 2020 to complement the operational control measures and achieve Track 2 compliance pursuant to Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii). Given that Units 1 & 2 are anticipated to meet the minimum 83.7% reduction in entrainment and impingement requirement through the use of operational controls following installation of variable speed drives on the circulating water pumps and the 224 MGD credit, the technologies identified for evaluation at the Units 1 & 2 intake structure will likely involve modification of the existing screens and/or the intake

[23] For example, based on preliminarily analysis, Dynegy Moss Landing, LLC does not currently intend to study dual flow (double entry-single exit) screens as a potential control measure for meeting Track 2 at Units 6 & 7, but we may revisit this compliance option again in the future.

structure to reduce through-screen intake velocity to less than 0.5 feet per second and/or installation of a fish return system to increase the survival of the small numbers of organisms impinged at the intake.

3.3.1.2 Units 6 & 7

The Track 2 compliance strategy for Units 6 & 7 include evaluation (and, as appropriate and necessary, implementation) of further operational measures to reduce flow, including various operational scenarios for reducing entrainment that are optimized around seasonal and diel variation in larval concentrations in the source waters of the MLPP. The scope of this work would primarily involve the development of an entrainment data modeling tool that can be used to evaluate varying operational scenarios involving different technological control measures. This would allow for calculations of estimated entrainment based on various reductions in intake water flow on a monthly or daily basis. The modeling data may also have applicability to impingement compliance strategies. The modeling would also allow for the evaluation of the effectiveness of variable speed drive pumps at further reducing impingement and entrainment. MLPP is currently testing and evaluating this modeling program.

In addition to operational measures, different technologies that may be evaluated for Units 6 & 7 are described in the following sections.

3.3.1.2.1 Wedgewire Screen Modules or Barrier Curtain

The effects of impingement and entrainment at the Units 6 & 7 intake could be reduced through the use of wedgewire intake modules or a vertical curtain of wedgewire material surrounding the intake. Wedgewire screening with a 1- or 2-mm (0.04 or 0.08 inch) slot dimension and a large surface area would reduce the intake through-screen velocity to less than 0.5 fps, providing compliance for impingement under Track 2, and greatly reducing the effects of entrainment by screening out all but the smallest larvae from the cooling water flow. Pilot studies on the effectiveness of wedgewire screens to reduce entrainment and impingement were conducted for the cities of Santa Cruz and Soquel and at the West Basin Municipal Water District (WBMWD) pilot desalination facility in Santa Monica Bay. These studies also investigated debris clogging, biofouling rates, and corrosion of the test screens. Results of these studies will be evaluated to see if they can be applied to the site conditions that exist at MLPP.

3.3.1.2.2 Hydrodynamic Studies of Wedgewire Screen Intakes

These hydrodynamic studies would provide data and information to assess the effectiveness of different wedgewire screen intake designs. The results of these studies would supplement previous modeling work performed for the WBMWD desalination project. As currently envisioned, the studies would be conducted during a period that allows for data collection over a range of tide and sea conditions and would include an evaluation of the entrainment reduction efficiency of the screens as a function of sweeping flows.

Dynegy Moss Landing, LLC has already conducted preliminary studies within Moss Landing Harbor that have assessed and quantified currents in the vicinity of both the MLPP Units 6 & 7 and Units 1 & 2 intake structures. Acoustic Doppler Current Profilers (ADCPs) were deployed in front of the two intakes for a period of three months from December 2010 to March 2011 (Tenera 2011b). The ADCP's provided data on water movement with Moss Landing Harbor due to currents, tides, watershed inputs, and the operation of the MLPP once through cooling systems. This information will be used in the assessment of any new potential intake design including the use of wedgewire modules or barrier curtains.

3.3.1.2.3 Wedgewire Screen Module Orientation and Hydrodynamic Effects

This study would evaluate the entrainment reduction performance effects of changing the orientation/direction of wedgewire screens in relation to prevailing currents and water flow patterns. Data gathered during the study will be useful in the evaluation and potential design of intake technology at MLPP.

3.3.1.2.4 Fine Mesh Traveling Screens

This study would evaluate the efficacy of fine mesh traveling screens in minimizing mortality due to impingement and entrainment of organisms of different sizes and life stages. As currently envisioned, the first phase of the study would involve flume trials of fine mesh screen impingement that would also assess return system mortality. The second phase would involve the trial installation of an actual fine mesh traveling screen to provide data regarding the reduction of larval mortality. Fine mesh traveling screens would need to incorporate a fish return system described in the following section.

3.3.1.2.5 Fish Return System

A fish return system could be designed to reduce the impingement mortality of fishes impinged by the existing traveling screen system or as part of a redesigned system utilizing fine mesh screens and fish handling system to help reduce mortality. The system would need to be integrated with the traveling screen system to reduce the amount of time that fishes are impinged against the screens. This would require that the existing screens be rotated continuously, be retrofitted with baskets to hold fishes washed off the screens and a two-stage spray system that incorporates a gentle spray to remove fishes from the screens and a high pressure spray to wash debris from the screens.

The installation of a fish return system would require a thorough engineering evaluation to determine the feasibility of the system, and then biological studies to determine the survival of any fishes passing through the system. This would include an evaluation of the fishes collected during the impingement sampling in 2006–2007. A large percentage of the fishes collected at the Units 6 & 7 intake were northern anchovy, which would be expected to have low survival following impingement. In the recently adopted 316(b) regulations, northern anchovy would be classified as a "fragile" species.[24] As such, the MLPP would not be required to include northern

[24] Environmental Protection Agency 40 CFR Parts 122 and 125 National Pollutant Discharge Elimination System—Final Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities; Final Rule. Federal Register / Vol. 79, No. 158. August 15, 2014.

anchovy in determining compliance with the levels of impingement mortality required in the new federal 316(b) regulations. Unless California adopted the same approach for determining impingement survival, it is unlikely that a fish return system would result in acceptable levels of survival due to the potential for large numbers of fragile species which would not be expected to survive impingement.

3.3.1.2.6 Cooling Water Intake Structure Fish Survival Assessment

Larval mortality as a result of passage through once-through cooling water systems is less than 100 percent for some species, and survival may actually be high for some organisms. This may be especially true for facilities, like MLPP, that do not have offshore intakes with long conduits, since predation by filter feeding biofouling organisms (primarily barnacles and mussels) in long conduits can be a significant source of larval mortality. MLPP has an effective biofouling control program that includes heat treatment of Units 6 & 7 and the use of foul-release coatings on the Units 1 & 2 intake conduits. The coatings greatly reduce or eliminate biofouling settlement and growth by maintaining clean cooling water conduits. MLPP has already greatly reduced the likelihood of entrainment mortality by predation. The potential for even low levels of survival during passage through the system may help MLPP achieve compliance with Track 2.

As currently envisioned, this assessment would involve laboratory tests of factors that contribute to entrainment mortality (e.g., pressure and temperature changes, physical impacts and turbulence, macrofouling predation) to provide guidance on the feasibility of pursuing subsequent site-specific field studies of through-plant survival that consider the unique characteristics of the MLPP cooling water system.

3.3.1.2.7 Deep Water Nearshore Intake

Dynegy Moss Landing, LLC participated in a 12-month long study to investigate the potential for a nearshore deepwater intake to reduce the effects of impingement and entrainment. MLPP is uniquely located in close proximity to the Monterey Submarine Canyon, in which a deepwater intake (-100 ft) could be constructed without the need for a prohibitively long intake conduit. The results of the study showed that larval concentrations at the depth of approximately 100 ft (30.5 m) were significantly reduced from larval concentration in shallower water above 60 ft (18.3 m). The concentrations at both depths were less than the concentrations of larvae inside Moss Landing Harbor where the current intake is located. The location of a deepwater intake in the vicinity of the Monterey Submarine Canyon benefitted from both the effects of reduced larval densities at depth and the transport of cold water up out of the canyon that was also shown to have very low densities of fish larvae. The reduction in entrainment may also reduce the settlement of biofouling organisms within the system and further reduce entrainment mortality due to predation. Addition evaluation of this option may be considered.

3.3.2 Technology Verification Studies

As specified in the Settlement Agreement at paragraphs 2.1.7.c.i–iii, Dynegy Moss Landing, LLC will evaluate technology control(s) to be installed at MLPP by conducting a pilot study after completion of baseline studies and evaluation of the results of baseline studies and operational controls. More specifically:

- MLPP will seek SWRCB approval of the pilot study designs as needed.
- After completion of the pilot study, Dynegy Moss Landing, LLC will report the results to the SWRCB including: (1) specific details of the planned technology(ies) to be installed; (2) the representative site-specific species, including sensitive species, identified in the Baseline Study Report that will be used in determining compliance with Track 2 impingement mortality and entrainment reductions; and (3) an estimate of the supplemental reductions in impingement mortality and/or entrainment through installation of technology control(s), which can be calculated based on total numbers of fishes and other meroplankton. For entrainment, the percent reduction in entrainment achieved by the technology controls may also be based on calculations of the numbers of fishes and other meroplankton of a specific age or size class that have been protected from the effects of entrainment for the species selected for analysis.
- Upon installation of technology control(s), Dynegy Moss Landing, LLC will verify that the technology(ies) performs as expected.

As specified in the Settlement Agreement, Dynegy Moss Landing, LLC will use a modeling approach for evaluating the effectiveness of any screening technologies used in complying with Track 2 of the Policy. The approach is similar to models developed for evaluating IM&E losses (Horst 1975, Goodyear 1978, Dixon 1999) that were used extensively by USEPA in analyses for the 316(b) Phase II rulemaking (USEPA 2004, EPA-821-R-02-003). EAM is a useful approach for evaluating IM&E losses because it accounts for the multiple ages and life stages of fishes potentially impacted and standardizes the losses to numbers of equivalent adults at a specific age or life stage. The model recognizes that natural mortality rates vary for different age and life stages and uses these age and life stage specific mortality rates to estimate the number of fishes at a different age that would have been expected to survive in the absence of the power plant losses.

As a direct consequence of the processes of natural mortality, later stage fish larvae have a much higher probability of reaching adulthood than earlier life stages. For example, the number of adult equivalents resulting from an EAM for 1,000, 30-day old larvae will be much greater than the equivalent adults from 1,000, 3-day old larvae. Accounting for the different mortality rates for the age and life stages of larvae is especially important for evaluating the effectiveness of any screening technology because of the need to balance screening efficiency with the potential for survival. While a small mesh size down to 0.02 inch will screen out large numbers of small, very young larvae, very few of these larvae will survive to become reproductive adults due to the high natural mortality rates experienced by these earliest life stages. The greatest population benefit from intake screens will result from using screen sizes that minimize the entrainment of older (larger) larvae and juveniles that have a higher likelihood of becoming reproductive adults.

3.4 Immediate and Interim Requirements in Section 2.C of the Policy

The section addresses the requirements in section 2.C. of the Policy and the related information requirements identified in the SWRCB's November 30, 2010 letter.

3.4.1 Immediate Requirements

3.4.1.1 Large Organism Exclusion Devices

Section 2.C.(1) of the Policy requires that no later than October 1, 2011, an existing power plant with an offshore intake shall install large organism exclusion devices having a distance between exclusion bars of no greater than nine inches, or install other exclusion devices, deemed equivalent by the SWRCB.

This requirement is not applicable at MLPP, which does not have an offshore intake. The intake structures for Units 1 and 2 and Units 6 and 7 are located at the east shoreline in Moss Landing Harbor.[25]

3.4.1.2 Restricting Intake Flows During Non-Operational Periods

Section 2.C.(2) of the Policy requires that no later than October 1, 2011, the owner or operator of an existing power plant unit that is not directly engaging in power-generating activities, or critical system maintenance, shall cease intake flows, unless the owner or operator demonstrates to the SWRCB that a reduced minimum flow is necessary for operations.

As provided in paragraph 2.1.7.f. of the Settlement Agreement, the SWRCB recognizes that it may be necessary to continue intake flows at MLPP even when not directly engaging in power-generating activities or critical system maintenance for short time periods while performing baseline, pilot, and/or verification studies. The Settlement Agreement (paragraph 2.1.7.f.) further provides that Dynegy Moss Landing, LLC shall include proposed testing schedules in the development of baseline, pilot and technology study plans and coordinate the study designs with the SWRCB with the goal of minimizing the impacts on the biological community from the effects of the studies. Upon SWRCB confirmation of the relevant study, Dynegy Moss Landing, LLC shall be deemed to have demonstrated to the SWRCB that a reduced minimum flow is necessary for operations pursuant to Policy section 2.C.(2). For additional information regarding

[25] The onshore intake structure for Units 1 and 2 has initial bar racks with approximately 4 inch center-to-center spacing (which provides 3½ inch wide openings between bars) that exclude, among other things, large organisms. Similarly, the onshore intake structure for Units 6 and 7 has initial bar racks with spacing between the bars at 3⅝ inches that exclude, among other things, large organisms.

intake flows during non-operational periods, see Section III.2 of the 2011 Implementation Plan, which is incorporated herein by reference.[26]

3.4.2 Interim Mitigation

As determined by the SWRCB in the Settlement Agreement (paragraph 2.1.1), the prior seven million dollar ($7,000,000.00) contribution to the Elkhorn Slough Foundation satisfies the requirements under Policy section 2.C.(3)(a) from October 1, 2015 through the December 31, 2020 final compliance date for all MLPP units.

3.5 Submittals

As provided in paragraph 2.1.6.c. of the Settlement Agreement, Dynegy Moss Landing, LLC will provide the SWRCB with an annual update on the status of measures to reduce IM&E and report the status of any studies undertaken in the previous calendar year to determine compliance options to meet Track 2.

In addition, as provided in paragraph 2.1.6.e. of the Settlement Agreement, Dynegy Moss Landing, LLC will submit, from time to time, study designs, results, and other information regarding compliance approaches and progress related to the Policy, including but not limited to the Baseline Study Design, Baseline Study Report, pilot study designs and technology verification reports. Whenever Dynegy Moss Landing, LLC submits information to the SWRCB and requests the SWRCB's confirmation or approval, the SWRCB will respond promptly with an approval or an explanation for disapproval, including any additional information needs, but in any event no later than sixty (60) days after receipt of the update. In the event the SWRCB requests additional information or other amendment, the SWRCB shall provide a decision not later than thirty (30) days after receipt of the information or amendment. These deadlines may be extended by mutual agreement. The provisions of this paragraph 2.1.6.e of the Settlement Agreement pertain only to Dynegy Moss Landing, LLC's compliance with the Policy, and do not impose obligations on the SWRCB unrelated to Dynegy's compliance with the Policy.

3.6 Transmission Issues

See Section II.6 of the 2011 Implementation Plan, incorporated herein by reference.[27]

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[26] Typical planned maintenance outages at MLPP identified in Section III.2.B.ii of the 2011 Implementation Plan also include 30-day outages every four years per unit.

[27] The CAISO's 2013/2014 statewide conceptual transmission plan and information on the CAISO's 2014-2015 Regional Transmission Planning Process can be found at http://www.caiso.com/planning/Pages/TransmissionPlanning/Default.aspx. The CAISO's 2014-2015 preliminary reliability assessment study results are available at http://www.caiso.com/planning/Pages/TransmissionPlanning/2014-2015TransmissionPlanningProcess.aspx.

4.0 Compliance Schedule

In accordance with paragraphs 2.1.5 and 2.3 of the Settlement Agreement, the SWRCB has agreed to propose an amendment to the Policy which would extend the compliance deadline for all four units at Moss Landing from December 31, 2017 to December 31, 2020. The SWRCB will initiate the public rulemaking process associated with the proposed amendment within three months of execution of the Settlement Agreement and take final action on the proposal within six months.

The Settlement Agreement contains a compliance schedule plan for MLPP (see paragraph 2.1.6.a.–g.). The schedule requires Dynegy Moss Landing, LLC to perform the following:

- within 30 days after execution of the Settlement Agreement (i.e., by November 8, 2014), submit an update to the MLPP Implementation Plan (this document);
- within 30 days after execution of the Settlement Agreement (i.e., by November 8, 2014), implement operational control measures to reduce flow;
- beginning in 2015 by March 1 of each year, provide an annual update to the SWRCB on the status of measures to reduce IM&E and report the status of any studies undertaken in the previous calendar year to determine compliance options to meet Track 2;
- install variable speed drive controls on the CWPs for Units 1 & 2 by December 31, 2016;
- beginning December 31, 2016 through the final compliance date of December 31, 2020, achieve 83.7% or greater reduction at MLPP in impingement mortality and entrainment from design flow using flow control and operational measures;[28]
- by the final compliance date of December 31, 2020, install supplemental control technology at Units 1 & 2 to complement the operational control measures and achieve compliance pursuant to Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii); and
- by the final compliance date of December 31, 2020 achieve compliance with Policy sections 2.A.(2)(a)(ii) and 2.A.(2)(b)(ii) at Units 6 & 7 or cease operations of such unit(s) until such time as compliance is achieved subject to Policy section 2.B.(2).

In addition, the Settlement Agreement requires Dynegy Moss Landing, LLC to conduct and submit to the SWRCB baseline studies pursuant to the Policy and evaluate technology controls by conducting a pilot study after completion of the baseline studies (see paragraph 2.1.7). A Baseline Study Report must be submitted to the SWRCB no later than six months after completion of the studies.

[28] In accordance with Settlement Agreement paragraph 2.1.6.e., percentage reductions in impingement mortality and entrainment achieved through flow control will be directly proportional to reductions in flow relative to design flow and for purposes of the provision, compliance will be determined as an annual average over the period December 31, 2016 to December 31, 2020.

5.0 Compliance Determination

For MLPP Moss Units 1 & 2, the baseline annual loss shall be calculated using estimates of density from the baseline studies multiplied by the design flow for Units 1-5 and assuming a mortality rate of 100%. For MLPP Moss Units 6 & 7, the same calculation will be made using the design flow for those units. The actual annual loss following implementation of operational and other measures shall be calculated as the baseline density adjusted for any applied technology multiplied by the actual plant flow and assuming an entrainment mortality of 100% and impingement mortality as adjusted by any applied technology (such as a fish return system).

After the Track 2 controls are implemented and after the December 31, 2020 final compliance date, Policy sections 4.A.(2) and 4.B.(2) specify the need for another study to confirm Track 2 compliance. For MLPP, as established in the Settlement Agreement (see paragraph 2.1.7.d.), the following provisions will satisfy the requirements of Policy sections 4.A.(2) and 4.B.(2):

i. Compliance shall be monitored utilizing a Compliance Tracking System that relies on: (1) data on the densities of representative site-specific species as approved in the Baseline Study Report, which will allow the calculation of the percent reduction in impingement mortality and entrainment; (2) actual records of cooling water flow; and (3) technology performance as verified in paragraph 2.1.7.c.iii of the Settlement Agreement.

ii. Compliance shall be determined based on the average annual reduction calculated across each NPDES permit term.

These provisions do not affect responsibilities at the end of each NPDES permit term under Policy sections 4.A.(3) and 4.B.(3).

6.0 Literature Cited

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Attachments

A – Settlement Agreement and Release regarding Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling between State Water Resources Control Board and Dynegy, dated October 9, 2014

Attachment A: Settlement Agreement and Release