STATE OF CALIFORNIA — THE RESOURCES AGENCY GRAY DAVIS, *Governor*

CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

January 8, 2002

REQUEST FOR REVIEW OF THE ENERGY COMMISSION STAFF'S DRAFT POWER PLANT COOLING OPTIONS REPORT (APPENDIX TO THE BIOLOGICAL RESOURCES FINAL STAFF ASSESSMENT PART III) FOR THE MORRO BAY POWER PLANT PROJECT

Enclosed is a copy of the Energy Commission staff's draft cooling options analysis for the Morro Bay Power Plant project. The final version will be included as an appendix to the staff's biological resources section of the Final Staff Assessment (FSA) Part III which is expected to be issued in late January, 2002.

We request that you review the enclosed draft analysis and provide any written comments to Kae C. Lewis, the Energy Commission's Project Manager, by February 15, 2002. While there may be insufficient time to incorporate responses into the final version, staff will use the comments to prepare for evidentiary hearings concerning biological resources.

Purpose of Analysis

The proposed once-through cooling system for the Morro Bay Power Plant (MBPP) project would use large quantities of seawater, pulling cooled water from Morro Bay and returning almost all of the water, warmed, to Estero Bay. This analysis of power plant cooling options at MBPP was undertaken for two reasons. First, in the Energy Commission's certification process, staff has identified potential adverse impacts to aquatic biological resources that would result from the proposed use of once-through cooling. This report explores the technology options for MBPP cooling that could mitigate these impacts.

Second, in addition to Energy Commission certification, the MBPP requires a National Pollutant Discharge Elimination System (NPDES) permit from the Central Coast Regional Water Quality Control Board (CCRWQCB). CCRWQCB requested that the Energy Commission perform a site-specific CEQA analysis of feasible technology options to mitigate aquatic biological impacts that they could review prior to taking action on the project's permit. This report will support both the Energy Commission's impact analysis under CEQA and the CCRWQCB's consideration of the project's compliance with the NPDES regulations (federal Clean Water Act).

This draft analyzes the potential impacts of three cooling technologies: dry cooling, hybrid (wet/dry) cooling, and an aquatic filter barrier (AFB) systems. The dry cooling system utilizes air-cooled condensers (ACCs) to cool turbine exhaust, and the hybrid system (also called a parallel condensing wet/dry system) would use reclaimed water for cooling and as well as ACCs. A 100% wet cooling system is not considered because sufficient qualities of reclaimed water are not available in Morro Bay.

Summary of Conclusions

The impacts of MBPP cooling technologies that are of primary concern are those that may occur in the following disciplines: air quality, noise, power plant efficiency, cultural resources, visual resources, and land use. For the first two disciplines (air quality and noise), impacts were found to be potentially significant, however, they could be fully mitigated if the appropriate measures are taken. For power plant efficiency, the impacts were found to be less than significant.

Staff identified three disciplines where potential impacts from dry and hybrid cooling technologies or the AFB could be significant: cultural resources, visual resources, and land use. In *cultural resources*, the implementation of dry or hybrid cooling could potentially affect a site that is both an archaeological resource and a registered Native American sacred site. Staff believes that it is feasible to mitigate the impact to archaeological resources, but does not know if it is feasible to mitigate the potential impact to traditional cultural values. In *visual resources,* visual impacts of both the dry cooling and the hybrid cooling alternatives are found to be significant when viewed from several viewpoints, but impacts are mitigable. The impacts of the vapor plume from the hybrid cooling towers would be significant if plume abatement systems were not implemented, but this is considered feasible. The AFB alternative causes significant adverse impacts that are not mitigable. In *land use* the dry and hybrid cooling alternatives would create land use incompatibility impacts stemming from inconsistencies with adopted land use designations and zoning. In addition, the significant adverse visual impacts identified for the AFB would create significant adverse land use impacts.

Further Information

If you want information on how to participate in the Energy Commission's review of the project, please contact Ms. Roberta Mendonca, the Energy Commission's Public Adviser, at (916) 654-4489 (toll free in California at (800) 822-6228), or by email at pao@energy.state.ca.us. Technical or project schedule questions should be directed to Kae C. Lewis, Siting Project Manager, in the Systems Assessment and Facility Siting Division, at (916) 654-4167, or by email at klewis@energy.state.ca.us. A copy of the report, the status of the project, copies of notices and other relevant documents are also available on the Energy Commission's Internet web page at **www.energy.ca.gov/sitingcases/morrobay**. News media inquiries should be directed to Assistant Executive Director, Claudia Chandler, at (916) 654-4989.

Sincerely,

PAUL RICHINS, JR.
Energy Facilities Licensing Manager

Enclosure

Draft

APPENDIX A

MORRO BAY POWER PLANT
COOLING OPTIONS REPORT

Draft January 7, 2002

Appendix to the Biological Resources Section of the
Morro Bay Power Plant Final Staff Assessment (FSA) Part III

APPENDIX A TO BIOLOGICAL RESOURCES FSA
MORRO BAY POWER PLANT COOLING OPTIONS

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APPENDIX A TO BIOLOGICAL RESOURCES FSA
MORRO BAY POWER PLANT COOLING OPTIONS REPORT

Susan V. Lee and James Henneforth

1. INTRODUCTION

PURPOSE OF REPORT

The proposed once-through cooling system for the Morro Bay Power Plant (MBPP) would use large quantities of seawater. This cool water is drawn from Morro Bay and returned at higher temperatures, to Estero Bay. This analysis of cooling options at MBPP was undertaken for two reasons. First, this Final Staff Assessment (FSA) for the Morro Bay Power Plant (MBPP) Modernization Project (00-AFC-12) identifies significant impacts to aquatic biological resources that would result from the proposed use of once-through cooling. Second, the Central Coast Regional Water Quality Control Board (CCRWQCB) has not yet defined the results of their 316(b) assessment (the cooling water intake assessment) in order to determine what is the Best Technology Availability (BTA) for the proposed project. Options being considered by the Energy Commission and CCRWQCB staff include dry cooling, hybrid cooling, an aquatic filter barrier, and habitat enhancement. Therefore, this report will support both the Energy Commission's impact analysis under CEQA and the CCRWQCB's need to evaluate feasible cooling options. Habitat enhancement information is not included in this appendix, but is provided separately (Appendix B to the Biological Resources FSA Section).

This analysis considers the use of three technologies: a dry cooling system, a hybrid (wet/dry) cooling system, and an aquatic filter barrier (AFB) used with once-through cooling. The dry cooling system utilizes air-cooled condensers (ACCs) to cool turbine exhaust, and the hybrid system (also called a parallel condensing wet/dry system) uses water for cooling and as well as ACCs. A 100% wet cooling system is not considered because sufficient reclaimed water is not available from the Morro Bay-Cayucos Wastewater Treatment Plant and other fresh water sources are also inadequate. The AFB is proposed by the applicant as a means of reducing entrainment and impingement impacts associated with once-through cooling.

REPORT CONTENTS

This report includes six chapters that include the information shown below.

1. Introduction

Chapter 1 describes the purpose of the report, the cooling options reviewed and other report contents, the roles of the Energy Commission and the CCRWQCB, and a brief description of the aquatic biology impacts of concern.

2. Background on Cooling Options

Chapter 2 provides an overview of the cooling technologies considered in this report: (dry cooling, hybrid cooling and the AFB). It describes the basic technologies and how they work, where the technologies are currently used, and the advantages and disadvantages of each.

3. Conceptual Design of Cooling Options for Morro Bay Power Plant

Chapter 3 presents specific designs for cooling options to replace or enhance the once-through cooling system proposed by the project. This Chapter presents two locations for the dry cooling system, two locations for the hybrid cooling system, and two configurations for the AFB.

4. Environmental Analysis of Cooling Options

Chapter 4 analyzes the environmental effects of the cooling options and the alternative locations for each of the technical issue areas that would be substantially affected (e.g., air quality, aquatic biology, visual, etc.).

5. Engineering Analysis of Cooling Options

Chapter 5 includes the engineering analyses for power plant reliability and efficiency, facility design, and geology and paleontology.

6. Conclusion: Comparison of Cooling Options

Chapter 6 presents overall conclusions about the environmental and engineering effects of the cooling options and the AFB. This chapter also provides a summary table that compares the effects of the three major cooling options for each environmental and engineering issue areas.

ROLES OF THE ENERGY COMMISSION AND THE REGIONAL WATER QUALITY CONTROL BOARD

The Energy Commission is the Lead Agency for the review of the proposed MBPP Modernization Project under CEQA. This review is known as the Application for Certification (AFC) process. As part of the AFC process, the Energy Commission evaluates the potential environmental impacts of the proposed project and considers feasible mitigation for significant impacts. The Warren-Alquist Act, the Energy Commission's enabling legislation, also requires an assessment of compliance with laws, ordinances, regulations, and standards (LORS). In addition to certification from the Energy Commission, the MBPP requires a National Pollutant Discharge Elimination System (NPDES) Permit from the CCRWQCB (this permit must be renewed for MBPP every five years). The CCRWQCB has requested that in its AFC process for the modernized MBPP, the Energy Commission provide an independent, site-specific, CEQA analysis of the potentially feasible cooling alternatives and mitigation measures to the proposed once-through cooling system (Briggs, 2001). This information will be used by the CCRWQCB as they develop their draft NPDES Permit. As requested by the CCRWQCB, this report analyzes dry cooling and hybrid cooling options, as well as the option of using an aquatic filter barrier (AFB) with the once-through cooling system. The CCRWQCB also requested information on habitat enhancement as another method of mitigating aquatic biological impacts.

AQUATIC BIOLOGY IMPACTS OF CONCERN

The primary operational components associated with once-through cooling that have the potential to cause significant adverse impacts to biological resources are the intake and discharge of large volumes of seawater. Once-through cooling may impact aquatic organisms by entrainment, impingement, and thermal discharge. The Technical Working Group (TWG) (described in the Biological Resources Section of the FSA) has carefully analyzed the 316(a) and 316(b) studies required under the Clean Water Act, and for CEQA analysis, and has determined that there will be significant impacts to the Morro Bay/Estuary ecosystem.

Impingement of aquatic organisms results during cooling water intake as organisms are pulled into contact with intake screens, and are held there by the velocity of the water being pumped through the cooling system. Unless the organisms are able to escape, they perish. **Entrainment** occurs when small aquatic organisms (fish eggs, larvae, etc.) are carried on a destructive passage through the intake screens (screen mesh size is usually 5/16 or 3/8 of an inch) and on through the remainder of the cooling system. It is generally assumed that a high percentage of entrained species are lost. **Thermal discharge** (i.e., release of heated water used for cooling) may also have adverse effects on aquatic species.

Entrainment may cause significant damage to the Morro Bay/Estuary ecosystem by sustaining fish larvae and egg losses and thus increase entropy (loss or waste of useful energy that would otherwise be used in ecosystem productivity) and decrease biomass in the ecosystem. Because these effects are considered significant, the FSA recommends mitigation that could include: (1) Eliminate once-through cooling and use a different cooling technology; (2) Use of the AFB to reduce entrainment, plus mitigation for remaining losses; and (3) Mitigation of the losses from the once-through cooling system by enhancing habitat and reducing ongoing degradation within the estuary and watershed. To varying degrees, impacts from impingement and thermal discharge would also be reduced by these mitigation options.

2 BACKGROUND ON COOLING OPTIONS

2.0 POWER PLANT OPERATION AND COOLING

The new units at the MBPP will replace currently operating Units 1-2 (326 MW, 1950's technology) and Units 3-4 (676 MW, 1960's technology) with two state-of-the-art 600 MW natural gas-fueled combined cycle units. The proposed MBPP units will be capable of producing 1,200 MW. Each new unit will consist of two gas-fired turbines and one steam turbine.

The combined cycle units are expected to use a maximum of 475 million gallons per day (mgd) of seawater for once-through cooling. The cooling water intake is proposed to remain at its existing location on Morro Bay. The cooling water would continue to be discharged to Estero Bay (Pacific Ocean) through a canal outfall entering Estero Bay, along the north side of Morro Rock.

Thermal power plants convert fuels (such as natural gas) to electrical power and waste heat. In combustion turbines, or Brayton cycles, almost all the waste heat is rejected in the exhaust gases. In steam turbines, or Rankine cycles, waste heat is rejected in the flue gases and in the condenser/cooling system. Operation of the cooling system for steam turbines serves three purposes: (1) condensing steam into water to allow pumping of a liquid instead of compressing a gas to raise the feedback to the boiler to high pressures; (2) recycling of the water back to the boiler to optimize water use; and (3) minimizing the steam turbine exhaust temperature to maximize the output of the steam turbine. The temperature of the heat sink and the heat transfer efficiency of the cooling system affect the overall plant performance. In the case of the MBPP, the proposed cooling medium (or heat sink) is estuarine water.

Combined cycle plants require less cooling than traditional fossil or nuclear steam power plants because only part of the electricity is generated from the steam cycle. In the case of the MBPP application, about 520 MW would be produced by the steam cycles. The combustion (gas) turbine parts of the combined cycle plant would not need water for cooling.

Historically, power plants were built along the coast to make use of seawater for cooling. Because of its low capital and operating costs and potential for high power plant operating performance (i.e., lower temperature heat sink), and therefore, greater profit, once-through cooling is still favored for old coastal power plants. In once-through cooling, water is drawn from a local source (i.e., the ocean), passed through the condenser tubes, and returned to the ocean at a higher temperature. Although large volumes of water are required, once-through cooling does not consume water; it uses the water briefly and returns the water at an elevated temperature. Steam is condensed in a shell-and-tube condenser.

The environmental impacts of once-through cooling include impingement and entrainment of aquatic organisms and raised temperature of the cooling water when it is returned to the receiving water (thermal discharge). Because there have long been concerns about the impacts of once-through cooling and this cooling technology is dependent on an open water source, power plant designers have developed other cooling systems to replace once-through cooling. This chapter describes the three cooling technologies that can be used to replace once-through cooling: dry cooling, wet cooling, and hybrid cooling systems. For each of the cooling technologies, this chapter provides general background information, conceptual design information, and discusses possible environmental effects of the cooling technologies for the project site. In addition, this chapter describes the Aquatic Filter Barrier that the Applicant proposes be used with once-through cooling to reduce entrainment and impingement impacts.

2.1 DRY COOLING

Description of the Process and Equipment Required

There are two types of dry cooling systems: direct dry cooling and the lesser used indirect dry cooling. In both systems, fans blow air over a radiator system to remove heat from the system via convective heat transfer (instead of once-through cooling or evaporative heat transfer). In the direct dry cooling system, also known as an air-cooled condenser (ACC), steam from the steam turbine exhausts directly to a manifold radiator system that rejects heat to the atmosphere, condensing the steam inside the radiator. This is shown in Figure 1 (at the end of this section). Direct dry cooling is analyzed in this report.

Indirect dry cooling uses a secondary working fluid (in a closed cycle with no fluid loss) to help remove the heat from the steam. The secondary working fluid extracts heat from the surface condenser and is transported to a radiator system that is dry cooled (fans blow air through the radiator to remove heat from the working fluid). Because indirect dry cooling is not very common and does not appear to have any strategic advantages at the MBPP, it will not be further analyzed in this report.

Historic, Current, and Proposed Use of Dry Cooling

Dry cooling was first used in 1938 for a vacuum steam turbine installed in a power plant in Germany (Guyer, 1991). By 1971, 14 power plants worldwide had been equipped with condensers with direct dry cooling. The largest installation at that time was a roof-mounted unit for a 160 MW power plant in Utrillas, Spain. By 1991, dry cooling was being used at approximately 40 power plants worldwide with generating capacities greater than 100 MW. Since that time, use of dry cooling has also increased significantly around the world and in the United States (Guyer, 1991; EPA, 2001; Maulbetsch, 2001).

The largest dry-cooled system in the world today is the Matimba plant in South Africa, which began operating in 1991. It represented a major scale-up of dry-cooled technology, using direct dry cooling for six 660 MW units, totaling 3,960 MW.

The Sutter Power Plant, one of the newest power plants in California (coming on-line in the summer of 2001) was constructed as a dry-cooled facility. This plant was constructed by Calpine Corporation and is a 540 MW, natural gas-fired, combined cycle facility. The combined cycle design consists of two combustion turbine generators (CTGs), two heat recovery steam generators (HRSGs) with duct burners, and a steam turbine generator (STG). The Sutter Power Plant uses a 100% dry cooling design that will reduce groundwater use by over 95% from the original proposal of 3,000 gallons per minute (gpm) to a revised annual average of less than 140 gpm. The five percent of the water that is used represents the make-up for the steam cycle, which is not used for cooling. The dry cooled plant is a zero effluent discharge facility and does not discharge any process fluids.

The Energy Commission also permitted a 240 MW co-generation facility with dry cooling in Crockett in 1996. The Crockett Co-Generation Plant uses 12 fans to cool the steam output from the 80 MW steam turbine. Energy Commission staff visited the facility in June 2000 and found the dry cooling to be operating as expected, with no major problems. Reliant Energy has also proposed a new dry-cooled facility, the 500 MW Colusa Power Project. This project is currently undergoing environmental review by the Energy Commission.

Dry cooling is also becoming a common technology for power plants in Nevada. Currently, the El Dorado Energy Project is the only operational air-cooled power plant facility in the State of Nevada. This 480 MW combined cycle facility is located in Boulder City. Two other combined cycle air-cooled power plants are currently under construction in Nevada: the Duke Energy 1,200 MW Moapa Energy Facility (approximately 20 miles northeast of Las Vegas in Apex Industrial Park) and the 575 MW Big Horn Power Plant (in Primm, southwest of Las Vegas). In addition, there are four combined cycle air-cooled power plants proposed to be constructed in Nevada. These facilities include: Apex Generating Station (1,100 MW), Arrow Canyon (575 MW), and Silver Hawk (570 MW) facilities at the Apex Industrial Park, and the Copper Mountain Power Facility (600 MW) in Boulder City.

Energy Commission staff researching the use of dry cooling have seen that the use of dry cooling technology is expanding rapidly, and the sizes of the plants are also increasing. It is estimated that there are over 2,500 MW of U.S. power generated using dry cooling, and approximately 15 to 20 GW worldwide.

Photos 1 and 2 (at the end of this section following the figures) provide examples of dry cooling installations.

Advantages and Disadvantages of Dry Cooling

Dry cooling is the best choice of cooling technologies for a steam power plant to conserve water and minimize wastewater. However, this technology can raise environmental and economic issues, depending on the location and specific situation (these are reviewed for the MBPP site specifically in Chapter 4 of this report). The following is a general list of the advantages and disadvantages of dry cooling.

Advantages of Dry Cooling Systems

- Dry cooling is not water dependent so plant location is not tied to a water source. It has essentially no water intake or water discharge requirements.
- Dry cooling minimizes the use of water treatment chemicals.
- Dry cooling minimizes the generation of liquid and solid wastes.
- Dry cooling does not generate visible plumes that are commonly associated with wet cooling towers.
- Dry cooling eliminates impacts to aquatic biological resources.
- Dry cooling reduces the number of permits and potential permit delays.
- Dry cooling eliminates the need for disturbance of wetland/aquatic substrate habitat.

Disadvantages of Dry Cooling Systems

- Dry cooling requires air-cooled condensers that could have negative visual effects.
- Compared to once-through cooling, dry cooling requires the disturbance of several acres of additional upland areas for the air-cooled condensers.
- Dry cooling can have noise impacts that are greater than once-through or wet cooling systems because of the number of fans and the considerably greater total airflow rate. New quieter fans and other mitigation measures are available to reduce these impacts.

- Using dry cooling, the power plant steam cycle efficiency and output can be slightly reduced, depending on site conditions and seasonal variations in ambient conditions. Also, extra power is needed to operate the cooling fans.
- Capital costs for building air-cooled condensers are generally higher than capital costs for once-through cooling.

2.2 WET COOLING

Description of the Process and Equipment Required

Wet cooling systems use about 5% of the water used by once-through cooling systems. The water removes waste heat from the system through the cooling towers, and the water is recirculated. In wet cooling systems, process heat is removed by evaporation each time the water is cycled through the system. Figure 2 shows how a typical wet cooling system operates (see end of this section).

The cooling system must be replenished with "make-up water" to replace water "lost" (or consumed by) to evaporation, blowdown[1], and drift. The cooling system takes advantage of evaporation to remove heat, but cooling system water is consumed through evaporation. Evaporation causes the concentration of impurities. Blowdown volumes are dependent on the quality of the make-up water and the system specifications regarding the impurities that are in the make-up water. Other methods of conserving water can be used, such as reverse osmosis (RO). Photo 3 (see end of this section following the figures) shows two mechanical draft cooling towers.

Current Uses of Wet Cooling

Wet cooling is one of the most common technologies in the world for the removal of waste heat, including many applications at power plants. Wet cooling towers used by U.S. industries remove heat from approximately 500 billion gallons per day (Burger, 1994).

Advantages and Disadvantages of Wet Cooling

The following is a general list of the advantages and disadvantages of wet cooling.

Advantages of Wet Cooling Systems

- Wet cooling uses only about 5% of the water required for a once-through cooling system.
- Once a wet cooling system is filled, the only water withdrawn from the environment is makeup water to replace water lost to evaporation, blowdown and drift.
- Wet cooling removes heat by the evaporation of a small fraction of the recirculating water.

[1] Blowdown is the bleeding off of a small percentage of the total flow, so that the new more pure make-up water balances impurities. In this way, the water quality in the system stays within specifications.

- Wet cooling can reach "wet bulb[2]" temperatures, which are generally lower than "dry bulb[3]" temperatures, thus improving cooling efficiency in comparison to dry cooling systems.
- Wet cooling can use recycled water from wastewater treatment plants, thereby avoiding the use of fresh water.

Disadvantages of Wet Cooling Systems

- Wet cooling requires a dependable source of water.
- Although more efficient than dry cooling, the power plant steam cycle efficiency and output can be slightly reduced with wet cooling systems when compared to once-through cooling systems, depending on site conditions and seasonal variations in ambient conditions.
- Wet cooling requires water treatment and monitoring to control concentrations of impurities.
- Wet cooling can produce water vapor plumes that have negative aesthetic effects.
- Capital and maintenance costs for wet cooling systems are generally higher than these costs for a once-through cooling system.

2.3 HYBRID (WET/DRY) COOLING

Description of the Process and Equipment Required

Hybrid cooling systems combine wet and dry cooling technologies. These systems reduce cooling water quantities by 95% or more from that needed for once-through cooling. The two primary hybrid systems are water conservation and plume abatement designs. These hybrid systems can vary depending upon the unique situation and objectives (Burns, 2000).

Water conservation designs reduce water usage for plant heat rejection. Water is primarily used during the hottest periods of the year to reduce the large losses in steam cycle capacity and plant efficiency that occur with all-dry systems. The hybrid water conservation systems can limit water use to only 2% to 5% of that required for all-wet systems while achieving substantial efficiency and capacity advantages during the peak load periods of hot weather. If more water is available, it can be used to further increase plant efficiency.

Another water conservation hybrid approach is Spray-Enhanced Dry Cooling. In these systems, the exhaust steam is pre-cooled with spray before it reaches the air-cooled condenser. This system uses 25% of the water used for all-wet cooling, but reduces the capacity loss that occurs with all-dry cooling (Maulbetsch, 2001).

[2] Wet bulb temperature account for the relative humidity in the air (the largest differences between wet and dry bulb temperatures would occur in very dry conditions).

[3] Dry bulb temperature is the temperature is the temperature as indicated by an ordinary thermometer, without accounting for humidity in the air.

The most common type of hybrid system is the hybrid plume abatement system. Plume abatement towers are very similar to all-wet systems, but they also add a small amount of dry cooling to dry out the tower exhaust plume during cold, high-humidity days when the plumes would be very visible. Figure 3 (see end of this section) shows the similarities between wet towers and hybrid plume abatement towers. On an annual basis, the hybrid plume abatement towers can use from 95% to 99% of the water quantity used in conventional wet cooling system. The goal of the plume abatement towers is to achieve high plant efficiency similar to the wet towers, but with reduced plumes.

Figure 4 (see end of this section) shows a parallel condensing cooling system where the steam turbine exhaust steam is condensed simultaneously in both a standard steam surface condenser (SSC) and in an air-cooled direct condenser (ACC). This is a water conservation design. This configuration is used for site designs that are described in Chapter 3 of this Appendix (see also Plates 5 through 8). In a parallel condensing cooling system, the amount of steam condensed in each tower depends on the overall heat rejection load, availability of makeup water and ambient conditions. During operation, the condensing pressures in both the SSC and ACC constantly equilibrate due to self-adjustment of steam flows entering each device. As ambient conditions, load conditions, and heat rejection capability of each device vary over time, the steam flow to each will automatically adjust without any active components being required on the steam side (Duke, 2001a).

Current Use of Hybrid Cooling

Plume abatement wet/dry towers have been used since the 1970s with proven reliability. The parallel condensing cooling systems (with both a wet tower and a dry cooling tower) have been used since at least since the late 1980s. GEA Power Cooling Systems is one vendor that provides a parallel condensing system called the PAC Parallel Condensing System. This system combines reliable wet cooling and dry cooling tower technologies.

Advantages and Disadvantages of Hybrid Cooling

The following is a general list of the advantages and disadvantages of parallel condensing hybrid cooling.

Advantages of Parallel Condensing Hybrid Cooling Systems

- Water conservation hybrid systems use only 20% to 80% of the water consumed by wet towers, which already use only 5% of the water used by once-through systems.
- Once a parallel condensing hybrid cooling system is filled, the only water withdrawn from the environment is makeup water to replace water lost to evaporation, blowdown and drift. Water loss is less than the water loss from all-wet cooling systems.
- Parallel condensing hybrid cooling can reach “wet bulb” temperatures in the wet portion of the system. These wet bulb temperatures are generally lower than “dry bulb” temperatures, thus improving cooling efficiency in comparison to an all-dry cooling systems.

- Because of the lowered water requirements, parallel condensing hybrid cooling systems can avoid the use of seawater when available fresh or recycled water may not be sufficient to meet the demands from an all-wet cooling system.

Disadvantages of Parallel Condensing Hybrid Cooling Systems

- Parallel condensing hybrid cooling requires a dependable source of water.
- Although more efficient than dry cooling, the parallel condensing hybrid cooling system would not be as efficient at once-through or wet cooling.
- Parallel condensing hybrid cooling systems requires water treatment and monitoring to control concentrations of impurities.
- The wet cooling side of the hybrid system can produce water vapor plumes that may have negative aesthetic effects.
- Capital and maintenance costs for parallel condensing hybrid systems are generally higher than once-through or wet systems.
- Parallel condensing hybrid cooling systems require air-cooled condensers and wet cooling towers that could have negative visual effects.
- Compared to once-through cooling, parallel condensing hybrid cooling systems require the disturbance of several acres of additional upland areas.
- Parallel condensing hybrid cooling systems can have noise impacts that are greater than once-through or wet cooling systems because of the increased number of fans and greater total airflow associated with the air cooled condensers. New quieter fans and other mitigation measures are available to reduce these impacts.

2.4 AQUATIC FILTER BARRIER

Description of the Process and Equipment Required

An Aquatic Filter Barrier (AFB) is a fine-mesh fabric with a large surface area that can be deployed in front of a water intake at a power plant. Velocities of water passing through the AFB are extremely low, thereby reducing biological losses to marine life from entrainment and impingement. A new version of the AFB technology has been developed by Gunderboom Inc.'s Marine/Aquatic Life Exclusion System (MLES). The MLES is a patented full-water-depth filter curtain comprised of treated polypropylene/ polyester fabric suspended by flotation billets on the water's surface and secured in place with anchoring systems (Gunderboom, 2001).

The only power plant where the AFB has been used at a "full-scale" level is the Lovett Generating Station along the Hudson River in New York. Difficulties have occurred at that location, including tearing, overtopping, and plugging/clogging. A spokesman for Gunderboom was contacted for a status update on the use of Gunderboom AFB technology at electric power facilities. Lovett Generating Station on the Hudson River in New York is currently the only operating power generating facility using the technology. Gunderboom AFB technology has been in place for approximately 3 years for one of the two intakes at the Lovett Station and the technology has recently been installed around the second intake. The Gunderboom AFB system has been under development since

1995 when the first version was installed at the Lovett Generating Station on the Hudson River in New York.

This report will refer to the MLES as the Gunderboom Aquatic Filter Barrier, or generically as the AFB. Some sources indicate that Gunderboom AFB systems have withstood a diverse range of aquatic conditions, including water level fluctuations in excess of 12 feet per day, waves at least 5-6 feet, and currents of 3-4 knots (CSG, 2001). Other information is more pessimistic about this experimental technology.

Gunderboom AFB systems consist of a custom designed curtain suspended from the water surface to the bottom, surrounding an intake so that all water going into the intake must pass through the filter material. The filter fabric is made of a strong polyethylene or polypropylene fiber and is non-woven. The fabric perforation diameter of the AFB is selected and customized to provide for exclusion of the smallest targeted planktonic organism, usually fish eggs. Larger perforation sizes allow for increased flow, reducing required fabric area and thereby, reducing the cost of the system. Therefore, perforation diameter is one of the factors considered on a case-by-case design basis (CSG, 2001). Depending on the specific design of the AFB, velocities through the AFB range from less than 0.01 feet per second (fps) to approximately 0.05 fps. This low velocity makes it possible for virtually all large organisms to swim away from the AFB during operations and theoretically, most small, motile organisms, including small fish and larvae, will also be able to swim away from the barrier fabric. Theoretically, larvae or fish eggs drawn onto the fabric would experience little pressure from the water being drawn through the fabric. To prevent overtopping, tearing, or biofouling, the Gunderboom AFB uses a computerized “air burst” system to periodically shake material by releasing air bubbles through the curtain system to dislodge sediment buildup and release any biotic materials back into the water column (CSG, 2001).

The Gunderboom AFB fits under the U.S. Environmental Protection Agency’s (USEPA) definition of a “passive screen technology,” in that the system is essentially a large, fine-meshed screen through which all water must pass before entering the once-through cooling intake system (CSG, 2001). Early versions of the AFB performed poorly, requiring considerable maintenance and repair (Tetra Tech, 2001).

Duke Energy has proposed the use of an AFB system for the once-through cooling system at the MBPP. This proposed system is described in Chapter 3 and its potential impacts are evaluated in Chapters 4 and 5. Tetra Tech, Inc., at the request of the Central Coast Regional Water Quality Control Board, was asked to assess the feasibility and likely effectiveness of the AFB system proposed by Duke (Tetra Tech, 2001). The assessment found that AFB was a promising technology, however, experience in using this technology specifically to reduce impingement and entrainment at cooling water intake structures is very limited, especially under the generally severe environmental conditions found in Morro Bay. The Tetra Tech assessment does not find that the existing performance data support a designation for the AFB as a proven Best Technology Available (BTA). Tetra Tech concluded that application of the AFB at Morro Bay would require, at minimum, a pilot test and intensive maintenance optimization during the initial years of operation.

The Gunderboom AFB is also proposed for use at Mirant's existing Contra Costa Power Plant (in California), in an experiment to see if the AFB will reduce significant entrainment and impingement impacts and withstand the conditions in the San Joaquin River/delta San Francisco Bay/estuary interface area. This installation will provide information on AFB effectiveness and durability after 5-10 years.

Gunderboom is currently designing aquatic filter systems for three other power generating facilities: Haverstraw, New York; Contra Costa, California (as described above); and Staten Island, New York. In addition to these systems, Gunderboom is currently talking to eight potential clients, including Duke Energy at Morro Bay, about installing the Gunderboom AFB systems at their power generating facilities (Dreyer, 2001).

Advantages and Disadvantages of the Aquatic Filter Barrier

The following is a general list of the advantages and disadvantages of the Gunderboom AFB.

Advantages of the Aquatic Filter Barrier

- Theoretically, the AFB could significantly reduce impingement and entrainment.
- The AFB would allow the continued use of once-through cooling, which allows for the highest power plant efficiencies (as compared to wet, dry, or hybrid cooling systems).

Disadvantages of the Aquatic Filter Barrier

- The AFB will exclude benthic habitat and potential exclusion of shoreline habitat
- The AFB could interfere with marine navigation and other water related activities.
- The AFB is an experimental system that may not be effective in reducing impingement and entrainment.
- The permitting process for the AFB in Morro Bay, if possible, could be time consuming and delay the construction and operation of the modernized MBPP.

PLACEHOLDER FIGURE 1

DIAGRAM OF DIRECT DRY COOLING SYSTEM

PLACEHOLDER FIGURE 2

WET COOLING SYSTEM WITH SURFACE CONDENSER AND MECHANICAL DRAFT COOLING TOWER.

PLACEHOLDER FIGURE 3

COMPARISON DRAWINGS OF A WET TOWER AND A HYBRID PLUME ABATEMENT TOWER.

PLACEHOLDER FIGURE 4

Parallel condensing cooling system, simult. SSC/ACC

COMPARISON DRAWINGS OF A WET TOWER AND A HYBRID PLUME ABATEMENT TOWER.

OR:

DUKE ENERGY MORRO BAY, LLC DRAWING SHOWING POSSIBLE LOCATION OF HYBRID COOLING SYSTEM AT MORRO BAY. THE SYSTEM WOULD HAVE 40 COOLING FANS AND 8 COOLING TOWERS.

PLACEHOLDER PHOTO 1

MID-DISTANCE VIEW OF DRY COOLING SYSTEM AT THE SUTTER POWER PLANT.

PLACEHOLDER PHOTO 2

CLOSE-UP VIEW OF THE DRY COOLING SYSTEM AT THE SUTTER POWER PROJECT.

PLACEHOLDER PHOTO 3

CLOSE-UP VIEW OF MECHANICAL DRAFT COOLING TOWERS.

3 DESIGN OF COOLING OPTIONS FOR THE MORRO BAY POWER PLANT

3. 1 DESCRIPTION OF PROPOSED PROJECT

The Morro Bay Power Plant (MBPP) Modernization Project is proposed to be a combined cycle electric generating plant consisting of two units each comprised of two General Electric Frame 7F combustion turbines (CTGs) and one steam turbine generator (STG). The combustion turbines would draw in air through a compressor section and add natural gas for combustion. The resulting hot gases would expand through a power section of the CTGs and drive electric generators. The hot exhaust gases are then passed through two heat recovery steam generators (HRSGs) to produce steam that is directed to a single STG driving an additional electric generator. After expansion through the STGs, the now low-pressure steam must be condensed back to water to be pumped again through the HRSGs.

As a source of cooling medium for the condenser, the Applicant has proposed to use the once-through cooling system of the existing Units 1-4 for the proposed MBPP Modernization Project. The once-through cooling system consists of drawing water from Morro Bay Harbor through a shoreline intake structure, passing it through the power plant surface condensers to cool the steam discharged by the steam turbine portions of the plant, and then discharging the heated water to Estero Bay via the existing shoreline discharge located near the northern base of Morro Rock. The existing cooling water pumps would be replaced with new pumps, and the cooling water pipes that now deliver water to the existing units would be rerouted to the new units. The timing of this work would allow the continued operation of Units 1-4 until the proposed units are fully operational.

In considering cooling options, staff finds insufficient fresh water supply in the Morro Bay area for an all wet cooling option at this time. Staff also finds fresh water use for cooling to be an unreasonable use of fresh water, consistent with SWC Section 13550 et seq. Therefore, staff has analyzed dry cooling, hybrid cooling, and the AFB. The water for the hybrid cooling system will come from the nearby Morro Bay-Cayucos Wastewater Treatment Plant (MBCWTP). There is a limited supply of wastewater from this plant, and the hybrid cooling option has been sized to maximize use of this available water.

Section 3.2 describes cooling technologies studied in this report. Section 3.3 describes the design of a dry cooling system, Section 3.4 describes the hybrid system, and Section 3.5 describes the Aquatic Filter Barrier (AFB). Chapters 4 and 5 of this report present an analysis of the environmental and engineering impacts of these cooling technologies.

3.2 COOLING OPTIONS CONSIDERED

As a result of the significant biological impacts that will occur from the use of a once-through cooling design, the Energy Commission has reviewed several optional cooling technologies. These optional technologies would not require the use of water from Morro Bay Estuary for power plant cooling. The two types of cooling technologies considered in this report are:

1. A dry or air-cooled condenser (ACC) that transfers the heat from the steam turbine exhaust directly to the atmosphere, therefore neither drawing cooling water from the Morro Bay/Estuary nor discharging heated water to Estero Bay.

2. A parallel condensing hybrid cooling tower system using treated reclaimed water. This system would use both dry and wet cooling tower technologies to cool the plant STG exhaust. The use of reclaimed water would eliminate the need to draw water from the Morro Bay/Estuary for cooling, and then return heated to Estero Bay. After use, the reclaimed water would be returned to the water treatment.

A third cooling technology was also considered and rejected: a straight wet cooling system. Due to the limited volume of makeup water available in the Morro Bay area from the water treatment plant, and the extent of a visible vapor plume from this type of tower, this alternative was not further evaluated.

This report also analyzes the used of an aquatic filter barrier (AFB) with once-through cooling.

3.3 DRY COOLING

Design Criteria

In order to compare the performance and impacts of a dry or air-cooled condenser (ACC) with that of the once-through system, the operating conditions at a common design point must be established. The design and operation of an ACC is highly dependent upon the ambient conditions at a specific site. Therefore, design criteria that are based on expected site conditions have been established upon which to base the conceptual design. These values were discussed with the Applicant and agreed to for this conceptual analysis. While these values reflect conditions on an average day, the performance of the combined cycle will be reduced when higher temperatures occur. During periods of very high ambient temperatures (which occur periodically, but seldom), operation of the steam portion of the plant could be restricted or curtailed. A final design and optimization for these criteria will be necessary if the dry cooling technology were selected.

Table 1 below shows the criteria used for the design of the ACC.

Table 1
Morro Bay Power Plant Dry Cooling Tower Design Criteria

Parameter	**Design Point**
Site Elevation	23 feet
Dry Bulb Temperature	64°F
Wet Bulb Temperature	58°F
Relative Humidity	70%
Steam Flowrate	1,097,000 lb/hr
Steam Turbine Exhaust Temp	124°F
Enthalpy[4]	1103.8 Btu/lb
Backpressure	3.87 in. Hg

Size, Configuration, and Layout

The size of the ACC is a function of the heat load from the steam turbine generator and the ambient conditions. The ACC is comprised of tube bundles with fins attached to the tubes to enhance heat transfer to the air. These bundles are grouped together and mounted in an A-frame configuration on a steel support structure. These A-frame tube bundles are lined up into rows or bays. The steam is ducted directly from the steam turbine exhaust to the ACC where it enters in a parallel flow into the tubes across the top of the bays. Air is blown from below across the finned tube bundles by a series of large fans. The fans are located beneath the A-frame tube bundles with each fan considered as a module. To accommodate the large mass of air required for cooling the steam, the A-frame tube bundles are elevated on top of an open structure. As the steam passes down through the tube bundles, it is condensed. The condensate drains by gravity flow into a tank and is then pumped back to the HRSG. Since the steam is exhausted directly from the steam turbine generator after it has expanded through the turbine, it is at a very low pressure and thus a large volume. This condition limits the distance that the ACC can be located from the steam turbine generator due to the drop in pressure that results during the transport of the steam; it should be taken into consideration when configuring the plant layout.

At the Morro Bay site for the ACC, the preliminary design configuration using the design criteria stated above resulted in the following design parameters.

- No. of bays 4
- No. of fans per bay 5
- No. of fan modules 20
- Fan diameter 32 feet
- Height to top of steam duct 99 feet
- Main steam duct diameter 19 feet

[4] Enthalpy is the heat content of the working fluid; it is used to determine the amount of work that can be produced in the process.

The results of these design parameters would require two ACCs, each with a plot area of 206 feet (in length) by 165 feet (in width) by 99 feet high. Other rectangular shapes could also be used.

Two locations for the ACC are presented. In Dry Cooling Alternative One, the ACCs would be located immediately south of the proposed new steam generator turbines. In Dry Cooling Alternative Two, the ACC would be located northeast of the new units, across Willow Camp Creek (see Plates 1 through 4).

Dry Cooling Alternative One is located directly south of the proposed location of the steam turbine generators, which would minimize the length of the steam pipe. This location is between the new proposed units and the existing units. The plot plan and elevation for this configuration are shown on Plates 1 and 2, respectively. Considering the current plant arrangement, this location for the ACC is feasible operationally and can physically fit into the space available. Since this location extends toward the existing units, the potential exists that the ACCs would be located above the cooling water tunnels serving the existing plant. Based on Figure 2-17 of the AFC, it is believed that the tunnels may be sufficiently separated from the new units so that carefully designed ACCs could avoid the tunnels. However, if Dry Cooling Alternative One were selected and the tunnels could not be avoided, the tunnels would be taken out of service during the construction of the new ACCs. This would require the early shutdown of Units 1-4 and the corresponding loss of electrical production, as well as the loss of revenue to the Applicant. This area was initially proposed by the Applicant to serve as the laydown and staging area for construction of the project. More recently, the Applicant has proposed both off-site laydown and parking areas.

A second location for the ACCs was evaluated (shown on Plates 3 and 4). This location, Dry Cooling Alternative Two, is northeast of the new units across Willow Camp Creek. To minimize the length of the steam duct between the STGs and ACCs, the layout of the new units has been reconfigured but with all four CTGs and HRSGs in a line with their axis in the north-northwest direction and the STGs both similarly aligned northeast of the CTGs and HRSGs.

The following information on heat balance, auxiliary loads, and efficiency of the dry cooling option is relevant to either alternative.

Heat Balance

The amount of power that the steam turbine can produce is directly related to its exhaust pressure. Simply stated, the higher the temperature and pressure of the steam entering the steam turbine generator, the more energy or potential for work it contains. Correspondingly, the lower the temperature and pressure of the steam exhausted into the condenser, the greater the amount of energy extracted from it to produce electricity. Therefore, the colder the cooling source for the condenser, the greater the potential output of the steam turbine generator. When using the ACC, the ambient dry bulb temperature of the atmosphere directly controls the condensing temperature. Because the ACC cannot bring the temperature of the steam to match that of the ambient dry bulb, there is always a difference between the turbine exhaust temperature and the outside temperature. This difference is called the initial temperature difference or ITD. Generally, the ITD will be on the order of 50°F. Thus for the ambient temperature of

64°F, the steam turbine exhaust temperature would be 114°F. For purposes of this analysis, an ambient temperature of 74°F has been assumed to reflect a more extreme ambient condition.

The following is an example using an ambient temperature of 74°F. A STG turbine operating with an ACC at an ambient air temperature of 74°Fwould result in a backpressure of 3.87 inches of mercury (in. Hg). This would compare to the backpressure, using once-through cooling of approximately 1.4 in. Hg. Since the colder cooling water condensing source translates to a greater output for the STG, it is estimated that using the ACC will result in a reduction of output from the STG of approximately 5 MW per unit or 10 MW for the entire plant. This degradation reflects an estimate of an average loss that is conservative compared to an annual average site temperature. However, the losses would be greater when the temperatures at the site are greater than 74°F. Also, as the ambient dry bulb temperature increases, the output of the STG decreases due to the increased turbine backpressure. If the turbine backpressure becomes too great, the steam turbine operation must be curtailed. It is estimated that when using a standard design steam turbine, the ambient dry bulb temperature at which this would occur is around 95°F (an infrequent occurrence in Morro Bay). If the ambient dry bulb temperature decreases, the output of the STG increases due to the decreased turbine backpressure. The average dry bulb temperature for the MBPP is 64°F, which results in smaller production losses than for this 74°F example.

Auxiliary Loads

The ACC requires electricity to operate the 20 fans used to circulate air over the cooling tube bundles. Each fan has a diameter of 32 feet and is driven by a 200 horsepower motor. The total power required to operate the fans is 3,512 kW per unit or 7,024 kW for the entire plant. This, however, is somewhat offset by the fact that the ACC does not require cooling water pumps for cooling water circulation. Based on the Applicant's proposed design, there would be four pumps used to provide the cooling water to each unit, although only three of the pumps would normally be operated when the duct burners are out of service. It is estimated that these three pumps will require approximately 900 kW each (900 kW x 3 pumps = 2700 kW). Thus, the net increase in auxiliary power requirements for the ACC case is approximately 812 kW per unit (3512 kW – 2700 kW) or 1.6 MW for the entire plant.

Efficiency

Two factors cause a reduction in plant output when using an ACC system as compared with a once-through cooling system. First, higher condenser backpressure will cause a loss of power generated by the steam turbine. Second, auxiliary loads to operate the fans also require power. The measure of power plant efficiency is the comparison of the amount of fuel required to generate a kilowatt-hour (kWh) of electricity. For the once-through case, the plant will burn approximately 300,000 pounds per hour of natural gas per unit at the chosen design point without duct firing.[5] The net plant heat rate would be approximately 6,900 Btu/kWh.

[5] The fuel use is measured in British thermal units or Btus; therefore, the units used to portray the efficiency (heat rate) of a power plant are Btus per kWh. This is identified as the plant heat rate.

Assuming equivalent fuel consumption for the ACC option, the heat rate of the plant would increase, reflecting a decrease in efficiency due to lower net plant output. This lower output is caused by the combination of reduced steam turbine generator output due to the higher condenser backpressure and the slightly increased auxiliary loads (over once-through cooling pumps) due to the requirement of the ACC fans. Thus, the new plant heat rate would be approximately 6,981 Btu/kWh, or an increase of approximately 1.2%.

The Applicant has indicated that the net power output from the plant would be reduced by 102 MW (compared to about 12 MW estimated herein by the staff). However, the Applicant provided no breakdown to indicate how much of this was due to loss of efficiency of the steam turbines and how much was due to additional auxiliary loads. Further, the Applicant did not state the specific site conditions used to determine the plant output. As described above, ACC operation during high ambient temperatures results in additional losses of power, so assumptions of unrealistically high ambient temperatures could have created the higher Applicant estimates than the staff calculations.

The Central Coast Regional Water Quality Control Board (CCRWQCB) hired Tetra Tech, Inc. to review the feasibility and cost estimates for specific alternatives for minimizing adverse impacts from cooling water intake at the MBPP. Tetra Tech has submitted a revised draft report dated December 31, 2001 presenting their findings. For operation at 67 percent maximum load (804 MW), Tetra Tech estimated that the energy “penalty“ from dry cooling would average 1.61 percent of capacity or about 12.9 MW. These values are much lower than the Applicant’s estimate of more than 100 MW lost due to dry cooling.

Cost

An estimate of the capital cost for the ACC option has been developed using budget level estimates from an ACC supplier. These estimates were based on the design criteria in Table 1. If the system were to be designed to reflect more stringent ambient conditions, the costs could increase; however, such a determination would be made on a complete optimization of the plant performance including a cost/benefit assessment. The costs provided by the ACC supplier include: equipment engineering, materials, tube bundles, support structures, fans and accessories, motors, steam distribution headers, condensate collection tank, steam jet ejectors, and delivery to the site. Additional capital costs to complete the system include: unloading and handling of equipment and materials, erection labor and supervision, painting, engineering/design interface, steam duct supply and installation from the STGs to the ACC, and equipment to perform the erection services. The total capital cost estimate for the ACC option for both units is $46,852,620. Table 2 gives a breakdown of these costs.

Table 2
Capital Cost Estimate: Dry Cooling Technology

Item	Cost Estimate
Suppliers Equipment	$25,680,000
Owner Supplied Equipment & Materials	$1,920,000
Installation	$6,556,920
Indirects and Fees	$12,695,700
Total Cost	$46,852,620

When compared to the cost of the proposed once-through cooling system, the ACC costs would be offset by a reduction of expenditures for the purchase and installation of new cooling water pumps, refurbishing of the traveling screens, and rerouting of the cooling water piping. Staff has estimated the costs assuming the new pumps would be installed in the same location as the existing cooling water pumps, and that the cooling water piping material would be 96 inch diameter AWWA C-300 reinforced concrete cylindrical pipe installed underground and routed as shown on AFC Figures 1-4. The estimated cost associated with the modifications to the proposed once-through cooling system is approximately $9.9 million. Therefore, the differential capital cost for the dry cooling option would be an increase of approximately $37 million. The breakdown of these cost are shown in the following Table 3:

Table 3
Capital Cost Estimate: Once-Through Cooling

Equipment	$3,300,000
Materials	$1,800,000
Installation	$2,400,000
Indirects and Fees	$2,400,000
Total Cost	$9,900,000

The Applicant presented estimated costs for the ACC option in its “Evaluation of Alternate Intake Technologies – Air Cooled Condensers” dated August 9, 2001. Section 2.4 of that report states that, “two direct cooled condensers for the new CC units including supporting systems is about $120 million more than the proposed once-through cooling water system.” This value is very high in comparison to staff’s estimate because the Applicant includes the estimated capital cost needed to build additional power plants to replace the amount of electrical power that the Applicant estimates would be lost due to the operation of the ACC. If these costs are removed from the Applicant’s estimate, their estimate for the ACC appears to be $39 million greater than for the proposed once-through cooling design. This is very similar to staff’s $37 million estimate.

Tetra Tech estimated that the total cost of the ACC would be $41.4 million. The report indicated that the ACC was designed for ambient conditions of 64°F dry bulb and a thermal duty of 325 MW.

Routine operation and maintenance costs for the ACC are minimal. Since the system is completely closed, there is no chemical treatment required. There is routine maintenance required for the fans, motors, and gearboxes. The finned tubes may need periodic cleaning and touchup. Repainting of the equipment and structure would be performed periodically. Estimates for the operation and maintenance of the ACC range from $100,000 to $300,000 per year. Operation and maintenance costs for once-through cooling would include chemicals, pump operation, screen maintenance, and periodic dredging, so costs could be comparable to those of the ACC.

3.4 HYBRID (WET/DRY) COOLING

Design Criteria

The design and operation of the hybrid cooling option is also highly dependent upon the ambient conditions at the specific site. Therefore, design criteria consistent with those established for the dry cooling option have been applied to develop a conceptual design. These criteria are not intended to form the basis of final design, but are presented for comparative analysis only. If the hybrid cooling technology were selected, further optimization for these criteria would be necessary.

Table 4 shows the criteria used per unit for the analysis of the hybrid cooling option.

Table 4
Hybrid Cooling Tower Design Criteria

Parameter	Design Point
Site Elevation	23 feet
Dry Bulb Temperature	64°F
Wet Bulb Temperature	58°F
Relative Humidity	70%
Steam Flowrate	1,097,000 lb/hr
Makeup Water	600 gpm
Cooling Water Flowrate	25,000 gpm

Using the above criteria, a single design point was selected that reflected the site conditions considered to be reasonable for purposes of this analysis. The design point used assumed the following conditions:

- Steam flow 1,097,000 pound per hour
- Steam quality 98.9%
- Cold water temperature 70°F
- Hot water temperature 90°F
- Turbine backpressure 3.87 in. Hg

Water Supply

The use of fresh water for power plant cooling is considered an unreasonable use of fresh water (SWC Section 35550 et seq. and State of California Constitution Article X, Section 2). The SWRCB Policy 75-58 favors other sources of water to the use of fresh inland water, including a preference for ocean water. However, staff determined that using Morro Bay/Estuary water would result in significant biological resource impacts (see Biological Resources Section of the FSA). Therefore, options to once-through cooling and fresh water use for cooling water are analyzed.

This analysis of a hybrid cooling option has been included to determine whether it is possible to use available water supplies other than ocean/estuarine water or freshwater. The water supply would be reclaimed wastewater from the nearby Morro Bay-Cayucos Wastewater Treatment Plant. The MBCWTP is designed to treat 2.06 million gallons per day (mgd) in average dry weather, and as much as 6.60 mgd during peak wet weather flow. Currently, the MBCWTP treats wastewater to a secondary level prior to discharge to Estero Bay. Secondary effluent is not suitable for use in the cooling tower without filtration and disinfection to meet California Code Regulations Title 22 standards for turbidity and coliform content. Therefore, additional water treatment would be required before use in the cooling tower. Based on the design of the MBCWTP, it is assumed that about 1,200 gpm of makeup water would be available for use in a hybrid cooling system for the MBPP. There is a limited amount of reclaimed water available from the MBCWTP, and the MBPP hybrid cooling system technology has been designed to maximize the use of the water available from this source.

The hybrid cooling option would consist of both a wet cooling tower and a dry or air-cooled condenser (ACC). This concept is described as a parallel condensing system. It is designed so that exhaust coming off the steam turbine generators is split into two streams. One stream flows to a surface condenser while the other is directed to an ACC. The condensed steam produced in the surface condenser and the ACC is collected and then pumped back to the HRSGs.

As water is passed over the wet tower, some of it would evaporate and require replacement. Additionally, due to evaporation losses, the remaining water would increase in mineral content. The minerals would deposit on the tower and reduce its effectiveness. To avoid this, water would be discharged or blown down and replaced with treated reclaimed water. Also, some water would be lost as a mist that is carried up as a result of the airflow through the tower. This mist is called drift. Drift eliminators would reduce the loss to 0.0005% of the cooling water flow. The addition of treated reclaimed water would replace the losses.

The MBCWTP is located approximately 0.4 mile north of the MBPP. Use of a hybrid cooling system would require the construction of a new delivery pipeline and a return pipeline (see Figure 5). The return line would transport the cooling tower blowdown back to the MBCWTP for treatment. There are two potential routes for these pipelines. One route would be directly south from the plant along Embarcadero Road, and a second route would exit the MBCWTP to the east and then turn south through Lila Keiser Park and onto the MBPP site. Since the pipelines would be underground, land disturbances would be temporary during the construction period. Both routes would have to cross under Morro Creek.

Subject to agreement with MBCWTP, additional treatment facilities (required for treatment of secondary effluent prior to use for cooling) could be located either at the wastewater treatment plant or at the project site. It is estimated that the additional water treatment facilities would require 1 to 1.5 acres of land. The additional treatment of the secondary effluent would employ physical and chemical methods to produce water suitable for use in the cooling tower. The reclaimed water pre-treatment system would use microfiltration equipment as the central technology. The microfiltration process would significantly lower the turbidity and total suspended solids (TSS) levels in the water. In a microfilter, the water is pressurized and forced through micropores removing many forms of TSS, virus, and bacteria typically found in secondary treated effluent. In addition to solids, dissolved phosphorus is removed from the secondary effluent water in the microfiltration process. Removal of phosphates is performed as a means of limiting microbiological activity in the cooling tower makeup water. Phosphate removal is achieved by injection of alum upstream of the microfilter to precipitate aluminum phosphate solids. The microfiltration membranes then remove these solids. Sulfuric acid is also added to promote the efficiency of the precipitation process. The microfiltration equipment is backwashed on a regular basis to clean the membranes. The backwash water would be combined with the cooling tower blowdown and returned to the MBCWTP.

Size, Configuration, and Layout

The size of the hybrid cooling system is a function of the heat load, the ambient conditions at the site, and the amount of available makeup water. Both the ACC and the wet cooling towers have been sized using site conditions that reflect normal conditions at the Morro Bay site. The ACC towers would consist of 12 fans 32 feet in diameter that would force air up through the ACC. Using these site conditions results in ACCs for each unit that are approximately 260 feet long x 87 feet wide, and approximately 30 feet high to the fan deck and 82 feet to the top of the steam header. The wet cooling towers are 84 feet long x 42 feet wide, and approximately 57 feet high per tower. The wet cooling tower uses two 32-foot diameter fans.

As with the dry cooling technology, the most logical location for the hybrid system is to have the dry potion of the system directly south of the proposed project with the wet towers located on either side of the ACC to the east and west. This layout is Hybrid Cooling Alternative One, shown on Plates 5 and 6. Hybrid Cooling Alternative Two,as with the ACC alternative, is located northeast of the new units, and is shown on Plates 7 and 8.

Heat Balance

Although the hybrid cooling system has a wet portion included in the design that takes advantage of evaporation, the limited amount of makeup water available from MBCWTP restricts its ability to have a significant effect on the plant performance. Thus, the output of the facility in this case would be expected to be similar to that of the dry cooling option. Therefore, the steam turbine backpressure would be expected to be 3.87 inches Hg, with the resulting difference in output being approximately 10 MW less than for the proposed MBPP. This degradation reflects an estimate of an average loss that is conservative compared to an annual average site temperature. However, the losses would be greater when the temperatures at the site increase.

Auxiliary Loads

As with the ACC design, the hybrid cooling system also requires power to operate the 12 fans used to circulate air through the ACCs, as well as the two fans for the wet cooling towers. Each fan has a diameter of 32 feet and is driven by a 200 horsepower motor. All together the total power required to operate the fans is approximately 4,200 kW (4.2 MW). During periods of low ambient temperatures it may be possible to eliminate the wet cooling portion of the hybrid cooling system potentially saving an additional 600 kW auxiliary power.

Both the wet cooling tower and the once-through system require circulating water pumps. The pumping loads for the once-through system are estimated to be approximately 5.4 MW while that of the hybrid system are approximately 1 MW. This results in once-through cooling auxiliary loads of approximately 5.4 MW, and hybrid auxiliary load of 4.2 MW plus 1 MW for a total of 5.2 MW. There would also be some additional power use for the pumps used to deliver the makeup wastewater and return the plant blowdown to MBCWTP. Therefore, the auxiliary power requirements for the once-through system and the hybrid system are almost equal.

Efficiency

The lower plant output when using the hybrid cooling system would result in reduced efficiency of the overall cycle when compared to the once-through design. This lower output would be caused by reduced steam turbine generator output of about 10 MW for both units (5 MW per unit) due to the higher condenser backpressures. Using this value, new plant heat rate would be approximately 6,970 Btu/kWh or an increase of approximately 1%.

In Section 6 of the Applicant's 316(b) Resource Assessment, it is estimated that the steam turbine output using hybrid cooling would decrease by approximately 100 MW for the total plant. Since no breakdown or design criteria were provided for this estimate, it is difficult to determine the reasons for the difference between the staff estimate and that of the Applicant.

Cost

The capital cost estimate for the hybrid cooling technology has been developed using budget level estimates from the equipment supplier. These estimates were based on the design criteria presented in Table 3. If the system were to be designed to reflect more or less stringent ambient conditions, the costs could increase or decrease. However, such a determination would be made on a complete optimization of the plant performance including a cost/benefit assessment. The cost of materials and services provided by the equipment supplier includes: engineering for the equipment supplied, materials, tube bundles, support structures, fans and accessories, motors, steam distribution headers, condensate collection tank, steam jet ejectors, drift eliminators, cooling tower fill materials, and delivery to the site. Additional capital costs to complete the system include: unloading and handling of equipment and materials, site work, foundations, circulating water pumps, erection labor and supervision, painting, engineering/design interface, steam duct supply and installation from the STGs to the ACC, erection equipment, and the tertiary water treatment equipment. The total capital cost estimate for the hybrid cooling options for both units is $40,404,000. Table 5 gives a breakdown of these costs.

Table 5
Capital Cost Estimate: Hybrid Cooling Technology

Item	Cost Estimate
Suppliers Equipment	$19,000,000
Tertiary Water Treatment Plant	$3,000,000
Owner Supplied Equipment & Materials	$4,560,000
Installation	$3,782,000
Indirects and Fees	$10,062,000
Total Cost	$40,404,000

When compared to the cost of the proposed once-through cooling system, the hybrid cooling technology cost would be offset by a reduction of expenditures for upgrading the proposed once-through system, as defined in Section 3.3 above. The estimated cost associated with the modifications to the existing cooling water system is approximately $9.9 million. Therefore, the differential capital cost for the hybrid cooling technology would be an increase of approximately $30.6 million.

The Applicant estimated costs for a hybrid parallel condensing system in its 316(b) Resource Assessment. Section 6 of that report indicates that the total installed cost for hybrid parallel system would be approximately $27 million. Since no breakdown of this cost was provided, it cannot be determined why it differs from staff’s estimate of $40.4 million.

Plume Abatement. Operation of the hybrid system allows for the flexibility to control the visible vapor plume from the cooling towers during periods of cooler weather and high humidity. This is accomplished by shutting down or reducing the flow of water to the wet cooling tower. Since the ACC performs more efficiently during these cooler periods, plant performance often is not greatly impacted. The amount of time that these conditions exist could be high in a coastal location such as Morro Bay. If such periods are excessive, it is possible that the wet cooling portion of the hybrid system could employ a plume-abated design. The additional cost to provide this modification would be considered an optimization to the design and therefore has not been addressed here.

Operation and Maintenance. Routine operation and maintenance costs for the hybrid cooling system are minimal. Since the ACC system is completely closed, there is no chemical treatment required. There is routine maintenance required for the fans, motors, and gearboxes. The finned tubes may need periodic cleaning and touchup. Repainting will be needed periodically. The wet cooling tower would require chemical treatment as well as routine maintenance of fans and pumps. Estimates for the operation and maintenance of the hybrid cooling system range from $400,000 to $500,000 per year.

3.5 AQUATIC FILTER BARRIER

The Applicant has proposed the use of the Aquatic Filter Barrier (AFB) in Morro Bay to reduce entrainment and impingement impacts of once-through cooling. Figure 5 (see end of this section) shows the approximate location of the AFB proposed by the Applicant. Two possible cross-sections are illustrated in this figure: one is a minimal design and one includes boat mooring locations. The potential impacts of the AFB are evaluated in Chapters 4 and 5 of this appendix.

One of the major constraints of the AFB at the MBPP site is the installation space in front of the project's Cooling Water Intake System (CWIS), which is an active recreation area. This is a concern identified by the Applicant, USACE, U.S. Coast Guard, and the City of Morro Bay. Tidal flows in the channel in front of the CWIS appear to provide appropriate flushing flows required to sweep particles along the surface of the AFB, but sediment may build up around the AFB, requiring frequent dredging.

Based on the size range of entrained larvae at the existing facility and required intake flows, the AFB for MBPP would require approximately 33,000 square feet of barrier. The MBPP AFB might have a length of approximately 2,000 feet assuming an average depth of 15 feet in an installation area in front of the intake (Duke, 2000a). The final design of the AFB would require information from a number of studies and field tests of the site's characteristics such as (Duke, 2000a):

- Detailed plant site mapping;
- Nearshore Bathymetry;
- Geotech data for anchoring;
- Data for currents;
- Suspended solids levels;
- Debris transport data;
- Wind and wave data, including fetch;
- Tidal current and elevation changes;
- Benthic infauna, epifauna and nearshore fisheries usage of the area;
- Target organisms for exclusion, life stages, location in water column, size, seasonality; and
- Permitting, navigational and local planning issues.

Cost estimates for installation of Gunderboom AFBs at power plant sites range from $4 to $6 million, which would not include the cost of multi-purpose design elements (wharves, piers, boat ramps, boardwalks, etc.) that would be unique to Morro Bay's environmental setting. Annual operation and maintenance cost at the MBPP is estimated to be around $300,000 to $500,000 and includes operation of the air burst cleaning operation, and repairing and replacement of the AFB materials over the vendor estimated 10-year life span. The actual cost would depend to a large extent on the final design of the AFB.

Permitting Requirements

The installation and use of the AFB would require the permits listed below in Table 6. Staff estimates the time needed to obtain these permits at one to three years. The U.S. Army Corps of Engineers (USACE) would play a major role in permitting the AFB. At a meeting on August 29, 2001, the USACE stated that any impacts to the navigation channel may prevent them from permitting the AFB. The U.S. Coast Guard has similar concerns for channel access and speed of response to emergencies and would provide input to the USACE and the City of Morro Bay.

Table 6
Permits Required for Installation of Gunderboom AFB in Morro Bay

Permitting Agency	Permit Required for AFB
U.S. Army Corps of Engineers	Individual Project Permit 401 Permit: Dredging and Fill 404 Permit: Discharge Section 10 Permit: Navigable Waters Section 7 Consultation with USFWS Essential Fish Habitat Consultation with NMFS
U.S. Fish and Wildlife Service	Section 7 Consultation
National Marine Fisheries Service	1. Essential Fish Habitat Consultation for Impacts to Eelgrass 2. Possible Section 7 for Impacts to Steelhead Trout
California Coastal Commission	Determination of Consistency with Coastal Act
Regional Water Quality Control Board	401 Certification of Project Incorporate into NDPDES Permit
California Department of Fish and Game	Potential Permit if Aquaculture Leases Exist
City of Morro Bay (Including the Harbor Master)	Lease Required (Other City Permits are Included in Certification Process Through CEC)
U.S. Coast Guard	No Permit; Consult with U.S. Army Corps of Engineers and City Strong Concern for Impacts to Navigation Channel, Human Safety, and Emergency Response

PLATE 1 [PLACEHOLDER]

DRY COOLING ALTERNATIVE ONE, PRELIMINARY SITE PLAN

PLATE 2 [PLACEHOLDER]

DRY COOLING ALTERNATIVE ONE, ELEVATION

PLATE 3 [PLACEHOLDER]

DRY COOLING ALTERNATIVE TWO, PRELIMINARY SITE PLAN

PLATE 4 [PLACEHOLDER]

Dry Cooling Alternative Two, Elevation

PLATE 5 [PLACEHOLDER]

HYBRID COOLING ALTERNATIVE ONE, PRELIMINARY SITE PLAN

PLATE 6 [PLACEHOLDER]

HYBRID COOLING ALTERNATIVE ONE, ELEVATION

PLATE 7 [PLACEHOLDER]

HYBRID COOLING ALTERNATIVE TWO, PRELIMINARY SITE PLAN

PLATE 8 [PLACEHOLDER]

HYBRID COOLING ALTERNATIVE TWO, ELEVATION

PLACEHOLDER FIGURE 5

MAP OF PIPELINE ROUTES FOR RECLAIMED WATER (HYBRID COOLING)

PLACEHOLDER FIGURE 6

PROPOSED LOCATION OF GUNDERBOOM AFB...

4 ENVIRONMENTAL ANALYSIS OF COOLING OPTIONS

4. 1 AIR QUALITY

Matt Layton

Introduction

Potential air pollutant emissions and impacts from project-related air emissions are associated with both facility construction and operation. Construction emissions of concern are diesel exhaust and fugitive dust, while operational impacts include particulate matter (PM10 and PM2.5) and the combustion air pollutants. The potential air pollutant emissions include combustion by-products, fugitive dust, and cooling tower drift. This section identifies the potential air pollutant emissions and air quality impacts of using air-cooled or hybrid cooling tower systems, or adding an aquatic filter barrier (AFB) to the proposed combined cycle Morro Bay Power Plant (MBPP) in lieu of the once-through cooled configuration. These emissions and impacts are compared to each other and to the existing MBPP steam boilers, Units 1-4.

Air Emissions and Impacts – Existing Morro Units 1 - 4

If the existing units were not replaced with the proposed combined cycle units, the units would be subject to District Rule 429 to reduce NOx emissions during operation. Installation of the Selective Catalytic Reduction (SCR) systems necessary to comply with District Rule 429 would result in construction emissions. Alternatively, the existing units' capacity factors could be significantly reduced to comply with the rule's daily NOx emissions caps rather than the rule's concentration limits, thereby avoiding any SCR construction air emissions and reducing the other combustion air pollutant emissions from the existing units.

While the SCR construction emissions have not be modeled, it is likely that construction PM10 emissions would contribute to existing violations of the State 24-hour PM10 standard. With implementation of District construction mitigation, staff does not believe that this contribution would be significant. Operationally, District Rule 429 will reduce NOx emissions from the existing units and potentially reduce the other criteria air pollutant emissions.

Prior to December 31, 2000, Units 1 and 2 were limited to 150 parts per million (ppm) NOx, and Units 3 and 4 to 56 ppm NOx, both limits being for natural gas. As of December 31, 2000, Units 3 and 4 were required to maintain at maximum 10 ppm NOx for natural gas; or, all four units were limited to 3.5 tons NOx (in total) per day. Staff believes that the owners of Units 1-4 have opted to meet the daily cap and have not installed the emissions controls on Units 3 and 4 to stay within the 10 ppm NOx limit. By December 31, 2002, Units 1-4 will be limited to 2.5 tons NOx (in total) per day. If Units 1-4 were to remain in operation after December 31, 2002, staff understands that all four units would require some type of SCR in order to meet the daily NOx cap of 2.5 tons; hence the likelihood of construction emissions if the existing units were to remain in operation.

Air Emissions and Impacts of Dry Cooling

Emissions from the construction of the air-cooled condenser (ACC) would be different than from the construction of the proposed once-through cooling system. Additional sections of the project site would be disturbed for the cooling towers, and the laydown area(s) may have to be increased to store and/or prepare the air-cooled radiator components prior to installation. Grading and construction equipment would be required to prepare the site and install the ACC system. The additional soil disturbance and equipment activity would result in increased fugitive dust and vehicle exhaust emissions.

Air impact modeling for construction of the proposed project calculated project contributions to existing violations of the State 24-hour PM10 standard. The increased construction activity for a dry cooling system would increase the project's contribution to local PM10 levels relative to the proposed project, increasing the short-term and potentially unavoidable construction air impacts. With the implementation of the District and staff proposed construction mitigation, staff believes that this contribution would be less than significant.

No additional emissions would be created by the dry cooling system itself, but the operation of the system could change the impact of the PM10 and PM2.5 emissions that are created by the project. As the air is moved over the coils, PM10 and PM2.5 (dust/dirt) from the ground surface would be resuspended in the atmosphere. Since these PM emissions would not be "new" emissions, and average emission rates vary seasonally and significantly, evaluating those impacts and mitigating them, if necessary, would be difficult.

The Applicant has argued that the power plant performance penalties associated with ACCs, compared to the proposed once-through cooled project, would result in additional air pollutant emissions from additional fuel firing. The performance penalties include increased heat rates and parasitic loads. However, these potential increases in air emissions at the project are highly speculative since California has a competitive electricity market. The proposed project will operate as a merchant plant. The owner is not under contractual obligations to provide 100% of the proposed capacity in the immediate region. Furthermore, the project owner could choose to generate the "lost" capacity at another company plant, or buy capacity on the open market throughout the western system rather then generating it at the Morro Bay project.

The displaced capacity could be from an emissionless hydro or nuclear plant, from a coal plant in Wyoming, or from numerous plants throughout the western region. Therefore, the emission changes due to power plant performance degradation resulting from the dry cooling technology cannot be tied to the proposed project. Furthermore, if the Applicant opted to fire more fuel at Morro Bay to overcome reduced capacity due to ACCs, offsets would have to be provided for most permitted emission increases, and the increases would need to be modeled for potential impacts. Therefore, impacts would be less than significant with the operation of a dry cooling (ACC) system.

Air Emissions and Impacts of Hybrid Cooling

Construction of a hybrid cooling system would likely produce both diesel and fugitive dust emissions similar to those associated with constructing the dry cooling option. There would also be additional fugitive dust and diesel exhaust impacts, compared to the proposed project or the ACC system, from constructing the pipeline used to bring cooling water to the site. Air impact modeling for construction of the proposed project calculated project contributions to existing violations to the State 24-hour PM10 standard. The increased construction activity for a hybrid cooling system would increase the project's contribution to local PM10 levels relative to the proposed project, increasing the short-term and potentially unavoidable construction air impacts. With the implementation of the District and staff proposed construction mitigation, staff does not believe that this contribution would be significant.

During operation of a hybrid cooling system, there would be PM emissions from the cooling tower drift. The amount of PM is proportional to the amount of dry to wet cooling in a hybrid or plume abatement system and the amount of drift and the total dissolved solids (TDS) in the circulating water. For the proposed hybrid cooling system with a circulating water flow rate of 25,000 gallons per minute (gpm) and a drift of 0.0006%, the gpm of drift and lbs/hr of PM10 emissions can be calculated. Assuming TDS of 3,000 ppm, the PM10 from the hybrid cooling system is estimated at 0.99 tons per year.

The annual PM10 emissions from a hybrid cooling tower will be small, but can vary with drift eliminator efficiency, make-up water TDS, allowable tower TDS, and size of the wet system. The PM10 emissions from cooling tower drift would cause less than significant impacts, as the emissions would be fully mitigated by emission reduction credits. As with the ACC system, any potential or actual power plant performance penalties compared to the proposed project will not result in air emissions that must be tied to the project. Potential air emissions increases at Morro Bay will be modeled for impacts and mitigated or offset, as appropriate. Therefore, impacts would be less than significant with the operation of a hybrid cooling system.

Air Emissions and Impacts of the Aquatic Filter Barrier

The initial deployment of an aquatic filter barrier (AFB) would result in construction emissions different from the construction of the proposed once-through cooling system. The laydown area(s) may need to be increased to store and/or prepare the AFB components prior to installation. Construction equipment and vessels would be required to prepare the land and sea anchor sites. The additional soil disturbance and equipment activity would result in increased fugitive dust and vehicle exhaust emissions relative to the proposed project.

Staff used air impact modeling for construction of the proposed project to calculate project contributions to existing violations of the State 24-hour PM10 standard. The increased construction activity for an AFB system would increase the project's contribution to local PM10 levels relative to the proposed project, increasing the short-term and potentially unavoidable construction air impacts. With the implementation of the District and staff proposed construction mitigation, staff does not believe that this contribution would be significant.

Depending on the aquatic species and their hatching cycles, the AFB may be deployed and/or retrieved one or more times annually. The deployment, retrieval, and any maintenance activities would result in equipment, vessel, and onshore activities, as well as increased combustion and fugitive dust emissions. Because these activities would occur annually, they would need to be permitted as part of the project and mitigated, where appropriate.

Most AFBs require air sparging[1] to minimize entrainment and/or remove entrained materials. The air compressors necessary to operate the sparging system would increase the parasitic loads of the project, affecting the project heat rate and capacity. As with the dry cooling and hybrid cooling systems, any potential or actual power plant performance penalties compared to the proposed project would not result in air emissions that must be tied to the project. Potential air emissions increases at Morro Bay would be modeled for impacts and mitigated or offset, as appropriate. Therefore, there would not be any significant air emissions impacts with the operation of an AFB system at Morro Bay.

Mitigation

Construction

The implementation of the District and staff Conditions of Certification regarding construction emissions would address and mitigate to a less than significant level any potential impacts from increases in emissions from the construction of either of the cooling technologies, or the AFB.

Operation

Any potential air emissions increases at Morro Bay would be modeled for impacts and mitigated or offset, as appropriate.

Conclusion for Air Quality

Staff believes that the construction of the proposed project, the cooling technologies, or the AFB described above would increase criteria air pollutant emissions compared to the existing project. The potential emission increases could increase the short-term and unavoidable impacts due to construction. However, staff and the District have proposed Conditions of Certification that will minimize emissions, and mitigate the impacts to a less than significant level. Furthermore, if PM10 violations are measured, construction activities will be modified to reduce emissions sufficiently to ensure that standards are not violated.

Any potential or actual power plant performance penalties associated with the cooling technologies or the AFB described above, as compared to the existing or proposed project, would not result in air emissions that must be tied to the project. In addition, any air emissions increases at Morro Bay would be modeled for impacts and mitigated or offset, as appropriate. Therefore, air emission impacts would be less than significant with the operation of either of the cooling system technologies, or the AFB.

[1] Air sparging uses bursts of air from below the AFB to shake off impinged materials.

4.2 BIOLOGICAL RESOURCES

Andrea Erichsen, Richard Anderson, and Michael Foster

Introduction

The Applicant proposes to modernize the existing MBPP while continuing to use once-through cooling. The existing once-through cooling at the MBPP relies upon the intake of water from Morro Bay and discharge of the same water into Estero Bay. The ecological impacts of once-through cooling in Morro Bay are discussed in detail in the **Biological Resources** section of the FSA (see also Tenera, 2001). These adverse impacts are the basis for requiring this evaluation of mitigation strategies using alternative cooling technologies.

There are three adverse biological impacts associated with once-through cooling at MBPP:

- The entrainment of fish and invertebrate larvae,
- The impingement of fish and invertebrates, and
- The thermal alteration of intertidal marine communities.

Additional information on impacts may be found in the FSA section on Biological Resources. This Appendix evaluates the biological impacts of three cooling technologies: dry cooling, hybrid cooling, and use of the aquatic filter barrier (AFB) with once-through cooling.

Biological Impacts of Dry Cooling

The major advantage of dry cooling is that it would eliminate the adverse impacts of entrainment, impingement, and thermal discharge, because it would not require use of ocean/estuary water for power plant cooling.

The air-cooled condensers (ACCs) could be placed in two alternative locations on the MBPP site (Plates 1 and 3). In each location, the two ACCs would be 206 feet long x 165 feet wide x 100 feet high. Altogether, the ACCs will occupy an area 206 feet x 330 feet x 100 feet (a total area of approximately 1.56 acres).

Dry Cooling Alternative One positions the ACCs south of the proposed location of the modernized power plant, on what is currently a parking lot. The use of this site would not create biological impacts.

Dry Cooling Alternative Two positions the ACCs northeast of the proposed location of the modernized power plant, which may be re-oriented to maximize space use. This alternative places the ACCs in an area currently used to dump seaweed captured on the once-through cooling system screens and proposed as a parking area during new power plant construction. This site is bordered on two sides by an Environmental Sensitive Habitat Area (ESHA) of riparian woodland.

Marine Impacts

Use of Dry Cooling Alternative One or Two would eliminate the identified adverse impacts of entrainment, impingement, and thermal discharge.

Terrestrial Impacts

Terrestrial impacts would not occur if Dry Cooling Alternative One were selected. Dry Cooling Alternative Two (Plate 3) would place the ACCs in a more sensitive habitat area of the MBPP site. Two ACCs would result in the permanent loss of approximately 1.5 acres of land, in an area that is currently being used to dump seaweed and other debris cleaned off of the once-through cooling intake structure. Dry Cooling Alternative Two would be bordered on two sides by an ESHA. The ESHA is riparian woodland, which supports diverse wildlife. While endangered and threatened species have not been detected there and are not expected to be directly or indirectly impacted, impacts to ESHAs should be minimized with implementation of appropriate mitigation (e.g., prevention of contamination and sedimentation in the streams).

The ESHA is adjacent to Morro Creek, which is an evolutionary significant unit (ESU) and designated as critical habitat. There are numerous species of special concern, including fully protected species (see Table 5), which nest, roost, hunt in, or migrate through the riparian habitat of Morro and Willow Camp Creeks. In surveys conducted in early 2001, several fish “which may have been steelhead” were found, so the Biological Assessment prepared for the MBPP project assumes that steelhead trout are present.

The benefits of dry cooling are significant and desirable. Terrestrial biological resources impacts are not expected to be significant at either site with implementation of appropriate and feasible mitigation, similar to that defined in the Conditions of Certification (see **Biological Resources** section of this FSA). Standard mitigation would include requirements such as development of stormwater pollution prevention plans, buffer zones around sensitive areas, and compensation for lost sensitive habitat.

Biological Impacts of Hybrid Cooling

Hybrid cooling systems combine wet and dry cooling technologies. The proposed design uses all available recycled water for the wet component of the cooling system. As with dry cooling, the once-through cooling facilities would cease operation completely.

The designs of the hybrid cooling alternatives are presented in Plates 5 through 9. Hybrid cooling includes components of dry cooling as well as wet cooling towers.

Hybrid Cooling Alternative One positions the hybrid cooling system south of the currently proposed power plant modification. Total permanent acreage required would be approximately 1.2 acres. This area is currently paved and used as a parking lot. Thus, no terrestrial biological impacts are expected. Standard mitigation would include requirements such as development of stormwater pollution prevention plans, buffer zones around sensitive areas, and pollution prevention measures.

Hybrid Cooling Alternative Two positions the hybrid cooling system northeast of the currently proposed power plant modification. Total permanent acreage required would be approximately 1.2 acres. As with Dry Cooling Alternative Two, this facility design places the dry (ACC) and wet cooling towers adjacent to an ESHA. This ESHA is proposed to be used as a temporary parking lot during construction and is currently used as a dumping site for seaweed and other debris removed from the once-through cooling intake structure screens. In general, impacts to ESHAs should be minimized; however, if it is necessary to use this alternative to avoid significant impacts in other technical areas, proper mitigation for impacts to the ESHA would be required. The ESHA that could be impacted by Hybrid Cooling Alternative Two is riparian woodland, which could support special status wildlife. Endangered and threatened species have not been detected there and are not expected to be directly or indirectly impacted. Mitigation requirements would be similar to those for Dry Cooling Alternative Two.

Marine Impacts

The adverse impacts to marine biota would be eliminated with the use of hybrid cooling.

Terrestrial Impacts

No terrestrial impacts would result from installation of the hybrid cooling system at Hybrid Cooling Alternative One. If Hybrid Cooling Alternative Two were selected, analysis and mitigation of impacts to the ESHA would be required.

Both hybrid designs would require the installation of a water pipeline that would be installed underground and run north of the MBPP site to the Morro Bay-Cayucos Wastewater Treatment Plant. The pipeline would be constructed within city streets and possibly through ESHAs, such as Morro Creek. These additional construction impacts need to be considered along with impacts of the cooling structures themselves.

Based upon the current biological analysis of the MBPP site, it is expected that any potential impacts could be mitigated to less than significant levels. The installation of the water pipeline will require a CDFG streambed alteration agreement and a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (USACE).

The biological resources benefits of implementing a hybrid cooling system are significant. The hybrid cooling system would eliminate marine impacts and would not create any significant or unmitigable terrestrial impacts. The use of reclaimed freshwater is encouraged for water conservation reasons and would not create significant biological impacts.

Biological Impacts of the Aquatic Filter Barrier

The Applicant has proposed two AFB designs: one with a single set of pilings, and a second with pilings on either side of the submerged AFB that could also be used as a boat dock (see Figure 5 in Chapter 3 of this Appendix).

Marine Impacts

The AFB would enclose a portion of the water column from the floor of the Bay to the surface. This would result in a direct loss of aquatic habitat, some of which may be sensitive habitat. Specifically, in Morro Bay there may be loss of Essential Fish Habitat (EFH). Both of the Applicant's proposed designs are similar in shape and size.

The indirect impacts of the AFB may be significant. The design incorporating the boat dock would result in indirect impacts such as increased water pollution, habitat disturbance, and general increases in human activity in the area around the AFB, which as proposed is close to or within essential fish habitat. The marine biological impacts of the AFB would need to be studied thoroughly and mitigated as necessary in consultation with NMFS and USFWS (as well as USACE and other permitting agencies).

The AFB would also result in habitat loss because it will enclose an area of the water column and cut it off from the rest of the bay. The benthic (bottom) habitat will also be isolated from the rest of the bay and considered to be lost. The AFB would potentially eliminate eelgrass and other important fish habitat in Morro Bay, and this habitat loss would need to be mitigated within Morro Bay.

Unforeseen impacts may result if the AFB fails due to technical reasons, weather, or other damage (e.g., from boat traffic). The impacts may be unintentional entrainment and impingement, or damage to habitats in the bay (e.g., if the AFB were carried away in a storm). The development of a comprehensive AFB mitigation, implementation, monitoring, and maintenance plan would be required and the administration of this plan would have to be adaptively managed due to the experimental nature of the technology in the coastal marine environment. Experimental actions such as the AFB in a state and federal estuary are considered to be exceptionally risky, and receiving agency approval may not be feasible.

Terrestrial Impacts

Neither of the proposed AFB designs will result in significant direct or indirect terrestrial impacts.

Effectiveness of the AFB in Reducing Biological Impacts

The U.S. Environmental Protection Agency considers the AFB to be a promising passive screen technology for minimizing impingement and entrainment. However, there are few published, peer-reviewed or rigorously tested scientific data to support its effectiveness and durability, particularly in a coastal marine environment (Riverkeeper, Inc., 2001; Huddleston, 2001). There is still significant disagreement among scientists about the AFB and its implementation as the best technology available (BTA) for mitigating biological resources impacts.

Scientific studies of the biological effectiveness of the AFB in reducing larval entrainment have been attempted since 1994 (Huddleston, 2001; LMS, 2000). The main test site where the bulk of AFB information was generated is the Lovett Generating Station on the Hudson River, NY. In 1994, the first AFB was installed there to prevent entrainment and impingement of anadromous fish that spawn in the Hudson River. Several studies were conducted testing the amount of reduction in impingement with the AFB, as well as any mortality to larvae through impingement on the AFB screen (Radle, 2001). Larger organisms were able to swim against the intake velocity easily, and small organisms and larvae were reportedly able to swim away or were freed by the AFB's air burst system, which is designed to remove sediment and other debris from the AFB.

According to the reported studies on the AFB in Lovett, there are several major types of problems associated with the AFB, many of which may be fixed over time, through trial and error (LMS, 2000). The 80-90% efficacy rate of the AFB in reducing entrainment is debatable, and there are numerous problems documented with its failure rate and maintenance (Bell, 2001; Henderson, 2001; Huddleston, 2001; Radle, 2001). Huddleston chronicles the many issues with AFB installation, operation, and maintenance. As a member of the American Fisheries Association and Society of Wetlands Ecologists, Dr. Huddleston has testified that the AFB is decidedly *not* a proven technology and cannot be relied upon as a component of BTA to mitigate for adverse impacts of entrainment.

Some of the problems encountered with the AFB between 1994 and 1997 include: strap failure less than 24 hours after deployment; anchoring failure less than 24 hours after deployment; tearing of the AFB screen less than 5 days after installation; over-topping of the AFB due to sediment accretion (less than a week after installation); deterioration of the AFB due to flexing under tidal action; small holes in the AFB caused by chafing of air hoses, valves, and support lines; and extensive algal growth (even after development of the air-burst system) (Bell, 2001; Henderson, 2001; Huddleston, 2001).

The air-burst system itself has been evaluated with contrasting results, and several experts including Bell (2001, p.3) and Henderson (2001, p.4) testified that the air-burst system inadequately controlled biotic growth and sediment accumulation. For example, Dr. Henderson's testimony states, "After 29 days, the fabric exposed to moving water and air-burst cleaning was found to have an even greater reduction in flow than the corresponding static test panels" (Henderson, 2001, p.4). In some instances, the flow was stopped altogether. Henderson (2001, p.5) concludes that "the permeability after 29 days exposure was greatly reduced under all conditions and was reduced by greater than 96% in the case of the panels that were subjected to air-burst cleaning."

These results raise serious concerns for deployment of the AFB in Morro Bay, a high energy, coastal, tidal environment surrounded by kelp and eelgrass habitats, as well as a boat marina. Indeed, biofouling may cause failure of the entire system. Often, tears and other structural damage cannot be repaired without removing the AFB from the water, and depending on the time of year, removal may be impractical (Henderson, 2001). Repairs often require at least 2 weeks to be completed. While repairs are being made, the MBPP's intake would again be entraining and impinging biota, or the power plant would be required to shut down until repair is completed.

There are basic issues regarding the scientific design and validity of studies conducted. Some presented contrasting results on larval survival and mortality (including the controls), which cannot be explained (Radle, 2001, p.9). Generally, when controls fail unexpectedly, the results for the entire experiment should be rendered invalid. There are also many questions about the length of time that it takes larvae to die, if impinged on the AFB. There is little evidence that the larvae are impinged, but the data are not conclusive (Radle, 2001, p.8). In addition, the conditions of the studies were not matched to the natural environment (larvae were not fed), and lacked appropriate control groups, adequate sample sizes, and replication of the experiment.

In Morro Bay, the natural environment is much more dynamic than the Hudson River in terms of tides, currents, storm events, salt water, and potential debris (including nearby private and commercial boats). Successful use has been achieved in waves up to five feet; however, the likelihood of the AFB surviving a storm or high tide event over the course of 20 years is low. Thus, in a coastal environment like Morro Bay, this technology would likely require a high level of maintenance. If the AFB were destroyed in a storm, a back-up mitigation plan would need to be implemented in a timely fashion. Testing and monitoring would also require multiple years to complete. Thus, the AFB is not proven to be effective and would require extensive and intensive monitoring of its effectiveness and durability (Henderson, 2001; Huddleston, 2001; Algert, 2001).

The City of Morro Bay has expressed concern regarding the AFB's impacts to safe boat traffic, public access to the beach in the area, biofouling, maintenance, and visual impacts (Algert, 2001; Fore, 2001).

Biological resources staff considers the AFB to be an experimental technology, and unacceptable for use in state and Federally-designated estuary. Thus, biological resources staff does not consider the AFB to be effective enough to constitute a feasible option for mitigation of biological impacts to Morro Bay.

Conclusion for Biological Resources

Dry and hybrid cooling technologies have similar benefits to biological resources and similar impacts to terrestrial resources (although hybrid cooling would have additional offsite impacts due to construction of the water pipeline). The adverse impacts would be less than significant or mitigable to less than significant levels for both dry and hybrid cooling, and both technologies are preferred over once-through cooling, with or without the AFB.

The AFB may not be a feasible technology for mitigating significant adverse marine impacts, and it will result in the loss of habitat within its boundary. Losses of marine habitats, particularly EFH, would need to be mitigated. There would be no terrestrial impacts associated with the AFB. Lastly, AFB permitting is estimated to take one to three years. While the AFB may potentially reduce impacts from entrainment and impingement, its use is considered experimental and there are no guarantees that any benefits will result or that they will be permanent. Therefore, dry cooling and hybrid cooling Alternative One and then Alternative Two are preferred over the AFB and once-through cooling or once-through cooling as proposed.

4.3 CULTURAL RESOURCES

Dorothy Torres and Gary Reinoehl

Introduction

Cultural resources include archaeological resources or resources within the built environment 45 years or older and areas of cultural importance to a community within American society. The Morro Bay area is particularly sensitive for archaeological resources, and there are three recorded significant sites, eligible for the California Register of Historic Resources (CRHR), within the boundaries of the existing plant. The more ground disturbance caused by this project, the more potential there is for discovering archaeological resources. Mitigation to reduce adverse impacts below a level of significance is available, but this can potentially result in expensive time-consuming data recovery.

Two of the three archaeological sites within the project area have been registered with the Native American Heritage Commission (NAHC) as Salinan sacred sites. Morro

Rock has been identified by both the Salinan and Chumash Native American groups as a sacred site and is an historical resource eligible for inclusion in the CRHR. In addition, a concerned Native American has raised questions regarding potential noise impacts to Native American religious experience at Morro Rock. The sacred sites within the project area have not been evaluated for their value as traditional cultural resources in accordance with the CRHR criteria.

Information provided in Chapters 2 and 3 of this appendix describing dry cooling and hybrid cooling technologies indicates that either of these options would result in additional ground disturbance and potentially more impacts to cultural resources than the once-through cooling that is currently proposed. Two of the alternative site plan variations would impact an existing archaeological site. Moreover, noise levels at Morro Rock would be raised 2 to 3 dBA for either dry cooling or hybrid cooling. This increase would not result in a significant impact to Morro Rock

To determine whether the aquatic filter barrier (Gunderboom) would impact cultural resources, additional information is necessary because surveys have not been conducted for the affected offshore areas. If additional sites were encountered either before or during construction, mitigation measures would need to be implemented.

Cultural Resources Impacts of Dry Cooling

The ground disturbance necessary for the supports for the ACC units will be 1.6 acres for Dry Cooling Alternative One, and 1.8 acres for Dry Cooling Alternative Two. There are several archaeological sites very near the proposed project, and three sites within the boundaries of the existing plant. It is possible that once the structures and asphalt of portions of the existing plant are removed, additional cultural resources will be discovered. If Dry Cooling Alternative One is selected and archaeological sites are discovered under the existing plant, data recovery would be necessary and may be the only feasible option. This should reduce any impacts to a level that is less than significant.

The proposed site plan for Dry Cooling Alternative Two would locate the ACCs northeast of the proposed project. This would impact an archaeological site that is also a registered Native American sacred site. Use of this location would cause a significant adverse impact to a significant and perhaps extensive archaeological site. Testing and data recovery would be required to mitigate the impact to less than significant levels. Analysis and curation of collected artifacts would be necessary. Some archaeological reports indicate the possibility of deeply buried sub-surface components in this area. Data recovery would be sufficient to mitigate archaeological values of the site; however, the Native American Heritage Commission (NAHC) considers the only acceptable mitigation for a sacred site to be avoidance. If the sacred site were determined eligible to the CRHR based on traditional cultural values, the project impact would be significant and unmitigable. If it were not, staff would consider the project's impact on the traditional cultural values to be less than significant.
Dry or hybrid cooling would require an additional laydown area. Cultural resource assessments would need to be completed for the new laydown and parking areas, and, if resources were discovered, mitigation would need to be devised. Mitigation could potentially include testing, data recovery, analysis, and curation.

The FSA cultural resources section addresses the concern of noise because a member of the Native American community raised the question of noise from the plant interfering with the quality of religious experience on Morro Rock. Since Morro Rock has been identified as a sacred site by both Salinan and Chumash Native American groups, it is necessary to consider potential impacts to this sacred site. In the FSA, staff found that the proposed plant, using once-through cooling, would be quieter than the existing plant. In the AFC (pp. 6.12-57), the Applicant indicates that the proposed plant will have noise levels that are approximately 18 dBA lower than the existing plant. According to the Noise Section of this analysis, use of dry cooling would increase the ambient noise level by approximately 3 dBA. This would not be a significant noise increase and would not constitute a significant impact to Native American religious experience at Morro Rock.

Cultural Resources Impacts of Hybrid Cooling

In addition to increased ground disturbance caused by the cooling apparatus, hybrid cooling would require construction of a water pipeline from the treatment plant to the MBPP. Since the entire Morro Bay area is sensitive for cultural resources, the potential for impacts to archaeological resources increases with this option. Although the pipeline would be installed in a city street and these areas are already disturbed, the infrastructure in many cities was built before environmental laws were in place. As a result, when there is additional ground disturbance, archaeological deposits may be discovered.

Hybrid Cooling Alternative One would locate the air-cooled condensers (ACCs) and cooling towers to the south of the proposed plant. This location (where there is currently a parking lot) has the potential to impact undiscovered archaeological resources. Use of this location would cause additional ground disturbance and might impact undiscovered archaeological resources that would need to be mitigated. It is likely that the necessary mitigation would involve testing, evaluation, data recovery, analysis, and curation of collected artifacts.

Hybrid Cooling Alternative Two would locate the ACCs and cooling towers to the northeast of the proposed project. As described for Dry Cooling Alternative Two, use of this location would cause a significant adverse impact to a significant archaeological site. Data recovery in the area of the identified site that would be impacted by the condensers would be required to mitigate the significant impact. Analysis and curation of collected artifacts would occur. This is an important and perhaps extensive archaeological site. Some archaeological reports indicate the possibility of deeply buried sub-surface components in this area. There is a potential for mitigation for impacts to this site to be very time-consuming and expensive. This archaeological site is also registered with the NAHC as a Native American sacred site. Unlike the archaeological site, the sacred site has not been evaluated in accordance with CRHR criteria for its value as a traditional cultural resource. According to the NAHC, the only acceptable mitigation for a sacred site is avoidance. If the sacred site were determined eligible to the CRHR based on traditional cultural values, the project impact would be significant and unmitigable. If it were not, staff would consider the project's impact on the traditional cultural values to be less than significant. It appears, in terms of cultural resources, that this alternative has the potential to have significant impacts for cultural resources.

ACCs would also be a part of hybrid cooling and similar to dry cooling, the ambient noise level at Morro Rock would be approximately 2 dBA higher than the current ambient noise levels. There would not be a significant noise impact to Native American religious experience at Morro Rock.

Cultural Resources Impacts of Aquatic Filter Barrier

If the aquatic filter barrier (AFB) were used, the harbor would need to be investigated for its prior uses and associated cultural resources. If pilings or anchors were placed in the harbor floor, geotechnical work would need to be completed to ensure cultural resources are not impacted. If additional land elements (wharves, piers, boat ramps, boardwalks, etc.) are added, areas not previously surveyed for cultural resources may need to be surveyed to determine the location of archaeological sites. If archaeological sites were discovered, it would be necessary to evaluate them and determine mitigation if they are to be impacted by the AFB. The harbor has been dredged several times in recent history, making it unlikely that artifacts close to the surface still remain.

Conclusion for Cultural Resources

From a cultural resources stand point, once-through cooling as originally proposed by the Applicant would have the least impacts. Of the cooling options considered in this report, once-through cooling with the AFB is the option with the least impacts. Dry Cooling Alternative One has the potential to impact undiscovered resources, but it is expected that these impacts could be successfully mitigated to less than significant levels. As identified in the Noise Section of this appendix, mitigation measures for noise impacts appear to be effective for both dry cooling options and will not result in a significant impact at Morro Rock.

The hybrid cooling alternatives would also have the most potential to disturb previously undiscovered resources due to the required construction of a water pipeline. Implementation of Dry Cooling Alternative Two and Hybrid Cooling Alternative Two would require mitigation for impacts to a significant archaeological resource. They would also cause a significant unmitigable impact to a Native American sacred site, if the sacred site were determined eligible to the CRHR based on traditional cultural values. If it were not, staff would consider the project's impact on the traditional cultural values to be less than significant. Noise levels for hybrid cooling would be slightly lower than dry cooling, but there would be a 2 dBA level increase over ambient noise levels. This increase would not constitute a significant impact.

Hybrid Cooling Alternative Two would cause the most impacts to both previously identified and potential resources. Significant impacts similar to those of Dry Cooling Alternative Two and Hybrid Cooling Alternative Two have the potential to occur with the currently proposed cooling method, however avoidance appears feasible as a mitigation measure. Avoidance may not be feasible for construction of the larger structures associated with alternative cooling systems.

4.4 HAZARDOUS MATERIALS MANAGEMENT, WORKER SAFETY, AND FIRE PROTECTION

Alvin J. Greenberg, Ph.D. and Rick Tyler

Introduction

As possible alternatives to the once-through cooling system proposed for the Morro Bay Power Plant (MBPP), the Regional Water Quality Control Board has requested information regarding impacts of dry and hybrid cooling technologies.

Hazardous Materials Impacts of Dry Cooling

Dry cooling would not use the large volumes of water used in once-through cooling systems, in turn reducing the volume of chemicals (e.g., sodium hypochlorite) needed to control algae growth within the system (particularly in the condenser tubes). Thus, hazardous materials usage would decrease. However, the larger volume of piping (including seals, flanges, and valves) could result in oxygen entry into the system and therefore would require an increase use in oxygen scavengers to prevent corrosion and scaling. The MBPP project is proposing to use aqueous hydrazine, an acutely toxic hazardous material, as an oxygen scavenger. Staff has recommended the use of a non-toxic alternative, carbohydrazide. If the Applicant were to select this chemical, or if the Energy Commission requires its use, the overall use of hazardous materials with dry cooling would be the same or less than as with both the current and proposed once-through cooling.

Hazardous Materials Impacts of Hybrid Cooling

Both hybrid cooling alternatives would use larger volumes of water than the dry cooling options, but less than once-through cooling. Therefore, the amount of hazardous materials and the risk of accidental release for hybrid cooling would be somewhat less than with once-through or dry cooling.

Hazardous Materials Impacts of the Aquatic Filter Barrier

Construction and placement of an AFB with once-through cooling would not be expected to create any risk of exposure to hazardous materials even if fabrication were conducted on-site.

Worker Safety and Fire Protection

The risk to workers and the impacts on fire protection would not change significantly with any of the cooling technologies. This is mostly due to the generic nature of worker and fire protection required at a power plant licensed by the Energy Commission.

Conclusion for Hazardous Materials Management, Worker Safety, and Fire Protection

Staff does not consider the impacts from the four cooling technologies discussed to be significantly different, since rather minor differences in hazardous materials use would exist with any of the options. Because both the Applicant and staff have proposed mitigation measures or Conditions of Certification, the overall risk due to hazardous materials is approximately the same for all proposed cooling methods technologies, and is insignificant. Staff concludes that the impacts to workers and fire protection are also similar with all cooling options.

4.5 LAND USE

Sue Walker and Mark Hamblin

Introduction

The evaluation of cooling technologies for the MBPP for the land use technical area is primarily focused on two issues: (1) consistency with applicable land use plans, ordinances, and policies; and, (2) compatibility with existing and planned land uses.

Laws, Ordinances, Regulations, and Standards

The Federal Rivers and Harbor Act and Clean Water Act require regulatory review and approval of any action that proposes to locate a structure, or excavate or discharge dredged or filled material into "Waters of the United States." Under these Acts, the quality of Waters of the United States must be protected from significant degradation and protected from unreasonable alteration or obstruction.

The Gunderboom Aquatic Filter Barrier (AFB) would be located within the harbor, which is considered a navigable water of the United States. The primary jurisdictional authority over navigable waters of the United States is the U.S. Army Corps of Engineers (USACE). Under its jurisdictional authority, the AFB would require a Section 401 Permit (dredging or fill), as well as a Section 10 Permit (navigation). The principal criterion used for approving these permits is the probable impacts of a proposed action in light of its intended use. Benefits and detriments are balanced by considering effects on such issues as conservation, economics, navigation, water quality, and the needs and welfare of the public. In processing the above-referenced permits, the USACE would coordinate with the U.S. Environmental Protection Agency, the Regional Water Quality Control Board, National Marine Fisheries Service, California Coastal Commission, and U.S. Coast Guard.

Applicable State laws, ordinances, regulations, and standards (LORS) for implementation of either a dry cooling or hybrid cooling engineering system, as well as the AFB, would include the California Coastal Act of 1976 (Public Resources Code § 30000 et seq.), the Warren-Alquist Act (Public Resources Code § 25500 et seq.), the Subdivision Map Act (Public Resources Code § 66410 – 66499.58), and State Tide and Submerged Land Leasing (Public Resources Code § 6701 – 6706). Please refer to the **Land Use** section of the FSA for summaries of these laws, ordinances, regulations, and standards.

Applicable local laws, ordinances, regulations, and standards for implementation of either a dry cooling or hybrid cooling engineering system, as well as the AFB, would include the City of Morro Bay General Plan, City of Morro Bay Coastal Land Use Plan, City of Morro Bay Zoning Ordinance, City of Morro Bay Waterfront Master Plan, and City of Morro Bay Flood Damage Prevention Ordinance (No. 477). Although it is not currently a legally binding agreement, the City and Duke Energy Draft Agreement to Lease and Agreement Regarding Power Plant Modernization (Draft Agreement to Lease) would also be affected by implementation of either an alternative cooling system or placement and use of the AFB. Please refer to the **Land Use** section of this FSA for summaries of these laws, ordinances, regulations, and standards.

Land Use Impacts of Dry Cooling

In regard to land use, the impacts of both dry cooling alternatives in comparison to the existing facility would primarily include: (1) increased noise; (2) increased acreage; (3)

facility size and bulk; and, (4) abandonment and demolition of the existing seawater intake structure and outfall area.

Dry Cooling Alternative One

Under Dry Cooling Alternative One, the array of air-cooled condensers (ACCs) would be placed on the southeast portion of the 14-acre footprint of the proposed facility (project site). The increased acreage needed for Dry Cooling Alternative One could be accommodated within the existing MBPP property boundaries, and would not encroach into the site’s Environmentally Sensitive Habitat Area (ESHA).

Dry Cooling Alternative One introduces a new structure (the ACCs), which would have visual effects on surrounding land uses, particularly from views south of the site where the existing plant is currently less visible. However, visual impacts are mitigable to less than significant levels. Please refer to the **Visual Resources** section of this Appendix for information regarding potential impacts and mitigation.

Noise from the ACCs would create long-term impacts to surrounding land uses that would be greater than the existing facility, but the noise impacts are mitigable to a less than significant level. Please refer to **Noise** section in this Appendix for detail regarding these impacts and available mitigation.

From the land use perspective, Dry Cooling Alternative One may not be consistent with the MBPP property’s existing land use designations and zoning (see discussion on consistency below).

Abandonment and demolition of the seawater intake structure and outfall area may create beneficial impacts to surrounding land uses if these project features were restored and/or re-developed in a manner that is compatible with existing and planned development, as well as with the City’s Coastal Land Use Plan and adopted portions of its Waterfront Master Plan.

Dry Cooling Alternative Two

Under Dry Cooling Alternative Two, the array of ACCs would be placed along the north side of the project site. This location also introduces a new main part of the facility as a result of the installation of the array of ACCs. In this case, the ACCs would be set back further within the property in comparison to the configuration of Dry Cooling Alternative One. The area required for installation of this alternative could be accommodated within the site’s existing property boundaries.

Dry Cooling Alternative Two would create visual impacts due to the bulk of the facility associated with the array of ACCs. However, this bulk would be set back further within the property in comparison to the configuration of Dry Cooling Alternative One, and visual impacts are considered to be mitigable to less than significant levels. Please refer to the **Visual Resources** section of this Appendix for potential impacts and mitigation.

Under Dry Cooling Alternative Two, the operation of the array of ACCs would exceed the noise standards of the Morro Bay Noise Element at certain sensitive receptors and therefore requires mitigation to achieve compliance with LORS. The long-term increase in noise would result in significant adverse impacts to surrounding land uses that would require additional mitigation (use of low or super low noise fans); this mitigation is feasible and would reduce impacts to less than significant levels. Please refer to the **Noise** section in this Appendix for detail regarding noise impacts and mitigation.

The array of ACCs at this location would also be located closer to the ESH designated land use area, and may potentially impact it. The noise levels associated with the ACCs may affect biological resources; refer to the **Biological Resources** section of this Appendix for further discussion. The City has several objectives, policies, and programs in its General Plan and Coastal Land Use Plan, as well as development standards in its zoning ordinance that address ESHAs. If construction and operation of Dry Cooling Alternative Two were conducted in a manner that fully adheres to these objectives, policies, programs and zoning ordinances, no significant adverse impacts to land use would occur.

From the land use perspective, Dry Cooling Alternative Two may not be consistent with the MBPP property's existing land use designations and zoning (see discussion on consistency below).

As with Dry Cooling Alternative One, abandonment and demolition of the seawater intake structure and outfall area may create beneficial impacts to surrounding land uses if these project features were restored and/or re-developed in a manner that is compatible with existing and planned development, as well as with the City's Coastal Land Use Plan and adopted portions of its Waterfront Master Plan.

Land Use Impacts of Hybrid Cooling

The physical impacts of the two hybrid cooling alternatives would be essentially the same as those described above for the dry cooling alternatives. They include: (1) noise; (2) increased acreage; (3) facility bulk and visual impact; and, (4) abandonment and demolition of the existing seawater intake structure and outfall area.

The hybrid cooling alternatives would require similar amounts of acreage to accommodate the ACCs and the wet cooling towers. This acreage is available within the boundaries of the existing site. In Hybrid Cooling Alternative One, the array of cooling equipment would be placed on the southeast portion of the project site, similar to Dry Cooling Alternative One. The acreage for the hybrid cooling system is available within the boundaries of the existing property.

The configuration for Hybrid Cooling Alternative Two would be located immediately adjacent to an ESH designated land use area, similar to Dry Cooling Alternative Two. Please refer to the **Biological Resources** section of this Appendix for additional information regarding potential impacts and mitigation for this area.

Visual impacts on surrounding land uses for both hybrid cooling alternatives are considered to be greater than for the dry cooling alternatives due to frequent presence of a vapor plume if plume abatement is not implemented; however, plume abatement is considered to be feasible mitigation. Please refer to the **Visual Resources** section of this Appendix for discussion of impacts and mitigation.

Noise impacts to surrounding land uses and sensitive receptors would be considered potentially significant but feasible mitigation is available for both Hybrid Cooling Alternative One and Alternative Two. Please refer to the **Noise** section of this Appendix for additional information regarding impacts and mitigation.

Under Hybrid Cooling Alternative Two, the cooling system would be located closer to the ESH designated land use area. The noise levels associated with the hybrid cooling system may potentially affect biological resources. Refer to the **Biological Resources** section of this appendix for further discussion.

The hybrid cooling alternatives additionally include construction of a pipeline for cooling water that would connect the facility to the Morro Bay-Cayucos Wastewater Treatment Plant. This pipeline would be constructed within city streets and a portion of the site's ESH. Construction of the pipeline would increase public and surrounding land use nuisances. However, due to the temporary nature of construction, these impacts are not considered to generate a significant affect to land use. Also, if appropriately designed and mitigated, construction and operation of the pipeline should not significantly affect the site's ESH. Please refer to the **Biological Resources** section of this Appendix for additional information regarding the ESH.

From the land use perspective, the Hybrid Cooling Alternatives may not be consistent with the MBPP property's existing land use designations and zoning; see discussion in the following section.

Impacts associated with abandonment, demolition, and ultimately, re-development or restoration of the seawater intake structure and outfall area would be the same as for the dry cooling alternatives, and may result in beneficial impacts.

Consistency with Plans, Ordinances, and Policies

The key regulatory issue associated with both dry and hybrid cooling alternatives is that the MBPP may no longer be a coastal-dependent use. Under the City's Land Use Map, which serves as the combined map for the General Plan and Coastal Land Use Plan, the property as a whole is designated Coastal Development Industrial with Planned Development zone, and Interim Uses overlays. The project also has an Environmentally Sensitive Habitat general plan land use designation. It is currently zoned M-2, Coastal-Dependent Industrial district, with Planned Development zone and Interim Uses overlays. The project also has an Environmentally Sensitive Habitat (ESH) zone designation on it.

The term Coastal Development Industrial is not defined in the General Plan, Coastal Land Use Plan, or City Zoning Ordinance; it appears in the legend of the Land Use Map only. However, Coastal-Dependent Industrial is defined in all of the City's land use planning documents. For the purposes of its land use planning documents, counsel for the City has determined that Coastal-Dependent Industrial and Coastal Development Industrial are synonymous (Sheppard et al., 2001). The City's Coastal Land Use Plan defines the land use of the property as "Coastal-Dependent Industrial." Chapter II, page 23 of the Coastal Land Use defines this term as:

"Coastal-Dependent Industrial Land Use: This land use specifically relates to those industrial land uses which are given priority by the Coastal Act of 1976 for location adjacent to the coastline. Examples of uses in this designation are thermal power plants, seawater intake structures, discharge structures, tanker support facilities, and other similar uses which must be located on or adjacent to the sea in order to function. The Morro Bay wastewater treatment facilities are protected in their present location since an important operational element, the outfall line, is coastal-dependent."

Under both dry cooling alternatives, the facility would be inconsistent with the site's existing local land use designations and zoning, as it would not need to be located on or adjacent to the sea in order to function. This would be a significant land use effect unless the City amended its General Plan, Coastal Land Use Plan, and Zoning Ordinance.

The City, in a resolution passed by City Council on August 27, 2001 (City Resolution No. 57-01), established that: (1) it would not support a cooling alternative that either creates additional impacts or exacerbates identified impacts associated with the proposed project; (2) some types of cooling alternatives may not be considered coastal-dependent uses, and that these uses may jeopardize consistency with the City's adopted zoning and land use designations; and, (3) the analysis of impacts for cooling alternatives should be based upon the site's existing conditions (City of Morro Bay, 2001).

Staff does not know whether the City would find that either cooling option would increase or exacerbate impacts, but if it should do so, the current City Council would not likely approve changes to the site's General Plan and Coastal Land Use Plan land use designations or its zoning (Fuz, 2001).

The California Coastal Commission could allow a non-coastal dependent use at the site. In addition, Coastal Act § 30515 provides a mechanism for the Applicant to request the Coastal Commission to amend the City's Coastal Land Use Plan to change the site's land use designation if the City opted not to change it. However, the Coastal Commission does not have the authority to amend the City's General Plan or Zoning Ordinances.

Notwithstanding this inconsistency, the Energy Commission could approve the power plant at this location by virtue of the authority granted it in the Warren-Alquist Act. Section 25525 states:

"The commission shall not certify any facility contained in the application when it finds pursuant to subdivision (d) of Section 25523, that the facility does not conform with any applicable state, local, or regional standards, ordinances, or laws, <u>unless the commission determines that such facility is required for public convenience and necessity and that there are not more prudent and feasible means of achieving such public convenience and necessity.</u> In making this determination, the commission shall consider the entire record of the proceeding, including, but not limited to, impacts of the facility on the environment, consumer benefits, and electric system reliability" (Underline added).

It is noted that if once-through cooling were not used in the existing or proposed facility, the existing Outfall Agreement would not be necessary. As a result, Public Resources Code § 6701 – 6706 (State Tide and Submerged Lands Leasing) would no longer apply to either the existing or proposed project.

Abandonment and redevelopment of the facility's existing seawater intake structure would be subject to consistency with the City's Coastal Land Use Plan, and the design and architectural standards of adopted Chapter 5 of the City's Waterfront Master Plan. Abandonment of the outfall area would also require consistency with applicable regulations of the Federal Harbors and Rivers Act and Clean Water Act. No inconsistencies with these regulations are anticipated.

Other applicable laws, ordinances, regulations, and standards associated with both dry cooling alternatives would be essentially the same as for the proposed project (see the **Land Use** section of the FSA). Implementation of the applicable Conditions of Certification found in the **Land Use** section of the FSA would ensure consistency with these requirements.

The additional cooling towers necessary for both dry cooling alternatives would lengthen project construction, as well as the nuisances and inconveniences associated with it (i.e., new pipeline construction, etc.). However, given the breadth of the project's overall construction schedule (23 months), the additional construction time needed for the additional towers is not considered to raise new issues not evaluated in the FSA.

Land Use Impacts of the Aquatic Filter Barrier

Construction and operation of the Aquatic Filter Barrier (AFB) would impact recreational activities within and adjacent to Morro Bay Harbor. Recreational boating, fishing, diving, and related activities within the AFB area would be restricted on a long-term basis, and could result in significant impacts. Additionally, offshore access to the far north end of the main channel of the harbor and its shoreline would be limited, which may conflict with the California Coastal Commission's interpretation of the Coastal Act's requirements for public coastal access. This hindrance to access may result in significant impacts requiring mitigation, such as the identification and dedication of additional public easements for coastal access. Staff cannot conclude whether or not such mitigation would reduce potential land use impacts to a less than significant level without more detailed design plans.

Construction and operation of the AFB would also have a direct impact on routine harbor activities and boat/vessel movement, as well as with such activities as the periodic dredging of the harbor by the USACE, and some types of maritime emergency response activities conducted by the U.S. Coast Guard. These impacts could be significant if not appropriately factored into the AFB's design. In addition, it has been noted by the U.S. Coast Guard that construction and maintenance of the AFB may result in accidental spills of hazardous materials such as oil or hydraulics fluids, and that contingency plans must be in place to respond to such potential incidents (U.S. Coast Guard, 2001). Development and appropriate implementation, as necessary, of an Emergency Response Plan and/or Hazardous Materials Spill Contingency Plan may resolve this issue.

While construction of either one or two sets of pilings may have a significant visual impact on surrounding land uses (as described in the **Visual Resources** section of this appendix), the design standards and aesthetic goals and objectives of the City's Coastal Land Use Plan and adopted portions of the Waterfront Master Plan may still be able to be met, avoiding land use policy conflicts impacts. If the pilings were designed such to allow vessels to dock, a beneficial impact could occur. Public use of the pilings would be contingent upon either: (1) the Applicant's willingness to allow public use; or, (2) requiring public use as a condition of certification. Either voluntary or conditioned public use of the pilings would require consideration of property damage and liability, as well as public safety. Consequently, although staff does not anticipate a conflict with local land use and coastal policy if such design criteria can be met, a significant, physical impact to land use recreation, harbor operation and coastal access would still be anticipated to occur.

In addition, it is noted that the AFB would require a lease agreement with the City under the City's authority to permit uses within State tide and submerged lands.

Conclusion for Land Use

From a land use perspective, the impacts associated with the dry cooling and hybrid cooling alternatives could be considered significant if the construction of these options creates inconsistencies with adopted local land use designations and zoning. However, the Energy Commission does have the authority to approve a proposed project which will create a local land use inconsistency, provided it finds that the project is required for public convenience and necessity and that there are not more prudent and feasible means of achieving such public convenience and necessity. (Pub. Resources Code, section 25525). Implementation of the project as proposed (with once-through cooling) would have fewer obtrusive effects on land use than would be caused by the project with the cooling alternatives.

Implementation of the AFB may affect harbor activities. These impacts include physical limitations on water-related recreational activities, limitations on the harbor's routine working operations, potential conflicts/limitations on the harbor's special operations (e.g., emergency response and dredging). Staff cannot conclude whether or not these impacts may be significant after mitigation without review of more detailed design, construction, and operational plans.

4. 6 NOISE

Jim Buntin

Introduction

The use of either dry or hybrid cooling systems will introduce additional noise sources to the overall plant design, consisting of fans, motors, gearboxes, and, in the hybrid system, cascading water. The most significant noise sources are the fans, which are located relatively high on the system structures. The wet cooling tower fans (part of the hybrid cooling system) may be lower than the dry cooling system fans, the lower portions of which may be 90 feet above the ground. Motors and gearboxes are typically located near ground level, and may be shielded by other components of the system. The sides of the wet cooling tower structure may significantly shield noise from cascading water.

The array of structures for both types of systems may provide shielding of some units for receptors, depending on the receptor position. That is, one of the cooling towers or radiator units may block line of sight to some or all of the others, which would reduce the noise received from the shielded units. For receptors parallel to the array, each unit would contribute noise to the total noise exposure, with little or no shielding.

Any type of combined cycle power plant will introduce the possibility of high start-up noise levels due to the need to bypass HRSG-produced high-pressure steam to the condenser until it is of adequate quantity and quality to send to the steam turbine. For dry cooling systems, the high-pressure start-up steam would be ducted into the manifolds leading to the air-cooled condensers. Silencers or other acoustical treatment may be required in the steam lines to ensure that noise due to the steam bypass during start-up does not exceed acceptable levels.

Noise level data used for this analysis were obtained for a base case and two options from GEA, a supplier of cooling equipment for power plants and similar industrial installations. The actual noise emissions of a given cooling system installation may vary from these values, depending upon final system configuration, but the values presented here are expected to be reasonably representative of typical installations.

CEQA requires that significant environmental impacts be identified, and that such impacts be eliminated or mitigated to the extent feasible. The CEQA Guidelines (Cal. Code of Regulations, Title 14, § 15000 et seq., Appendix G, § XI) explain that a significant effect from noise may exist if a project would result in:

"a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.

"b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels.

"c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.

"d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project…."

The Energy Commission staff, in applying Item c) above to the analysis of this and other projects, has concluded that a potential for a significant noise impact exists where the noise of the project plus the background exceeds the background by 5 dBA L_{90} or more at the nearest noise sensitive receptor.

Noise Impacts of Dry Cooling

Dry Cooling Alternative One

In Dry Cooling Alternative One, the array of air-cooled condensers would be placed on the southeast portion of the project site. Forty fan units are proposed as Option 1 (the "base case" in this analysis). Two noise-reducing options were provided by GEA, which may be considered as potential noise mitigation measures. The reference noise levels and operational assumptions are presented in Table 7.

Table 7
Cooling Fan Installation Operational Assumptions
Dry Cooling Alternatives

Option	No. of Fans	Motor Ratings	Sound Level, dBA at 400 feet	Layout	Relative Cost
1 (Base Case)	20X2	200 HP	66	165'x206'X2	--
2	25X2	150 HP	60	192'x192'X2	+10%
3	30X2	100 HP	52	224'x188'X2	+30%

Given the assumptions listed above, the noise levels due to the fan installations at the nearest receptors were predicted, based upon hemispherical spreading. The predicted noise levels at the nearest affected receptors are given in Table 8.

Table 8
Predicted Cooling Fan Noise Levels
Dry Cooling Alternative One

Receptor	Distance, feet	Sound Level, dBA			
		Option 1 (Base Case)	Option 2	Option 3	Ambient
Residences to southeast	1,800	56	47	39	43
Morro Rock	3,000	48	42	34	48

The predicted values indicate that, in the base case (Option 1), the fan noise levels would exceed the noise standards of the Morro Bay Noise Element at the nearest residences. The fan noise levels at the nearest residences would also exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether additional analysis is required to assess whether project noise results in a significant noise impact. At Morro Rock, the predicted fan noise levels in Option 1 would be equal to the ambient noise level, which would result in a cumulative noise level 3 dBA higher than the ambient noise level. This would not be considered a significant increase in noise levels, though the fans would constitute a new and noticeable noise source.

Noise mitigation would be required to achieve compliance with the LORS, and may be required to ensure that a substantial increase in ambient noise levels does not occur. Noise mitigation Option 3 would likely be required to achieve these objectives.

Dry Cooling Alternative Two

In Dry Cooling Alternative Two, the array of air-cooled condensers would be placed on the north side of the project site. As in Dry Cooling Alternative One, 40 fan units are proposed. Noise levels assumed for this alternative are the same as given by Table 7.

Given the assumptions listed above, the noise levels due to the fan installations at the nearest receptors were predicted, based upon hemispherical spreading. The predicted noise levels at the nearest affected receptors are given by Table 9.

Table 9
Predicted Cooling Fan Noise Levels
Dry Cooling Alternative Two

Receptor	Distance, feet	Sound Level, dBA			
		Option 1 (Base Case)	Option 2	Option 3	Ambient
Residences to southeast	2,100	52	46	38	43
Baseball Fields	200	72	66	58	45
High School	800	60	54	46	45
Houses east of Highway 1	800	60	54	46	43
Morro Rock	3,300	48	42	34	48

The predicted values indicate that, in the base case (Option 1), the fan noise levels would exceed the noise standards of the Morro Bay Noise Element at the nearest residences. The fan noise levels at the nearest residences would also exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether additional analysis is required to assess whether project noise results in a significant noise impact.

At the baseball fields, the predicted fan noise levels in Option 1 would exceed the noise standards of the Morro Bay Noise Element. At the high school, the predicted fan noise levels in Option 1 would be generally consistent with the Morro Bay Noise Element, assuming that the noise levels inside the classrooms would be no more than 45 dBA during school hours. In both of these cases, the fan noise levels would exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether additional analysis is required to assess whether project noise results in a significant noise impact.

At Morro Rock, the predicted fan noise levels in Option 1 would be equal to the ambient noise level, which would result in a cumulative noise level 3 dBA higher than the ambient noise level. This would not be considered a significant increase in noise levels, though the fans would constitute a new and noticeable noise source.

Noise mitigation would be required to achieve compliance with the LORS, and may be required to ensure that a substantial increase in ambient noise levels does not occur. Noise mitigation Option 3 would be required to achieve these objectives at all receptors, except for the houses east of Highway 1. At those receptors, additional noise mitigation would likely be required.

Additional Noise Mitigation

Another method of reducing fan noise is to use a type of fan that is designed to minimize noise. These fans are called “low noise” and “super low noise” fans. These fans are in service in about 12 power plants in the U.S. and more plants overseas. When using these fans, the noise from the fan itself is generally lower than that of the motor and gearbox. For wet cooling towers the noise of the falling water may be louder than the fan. General comparisons to conventional cooling tower fans show the super low noise fans are about 15 dBA quieter than conventional fans. These fans use slightly more horsepower because they are less efficient, and they cost from 2.5 to 3 times more than conventional fans (the list price for a 32 foot diameter low noise fan is about $45, 000 compared to about $14,000 for the same size conventional fan). Therefore, the installation of super low noise fans is considered to be feasible, and their use would result in noise impacts being less than significant at all sensitive receptor locations.

Noise due to motors and gearboxes can be significantly reduced by enclosing or lagging the units. These measures are also expected to be feasible.

Conclusion for Dry Cooling

The predicted noise levels associated with the dry cooling alternatives are significant in terms of both LORS compliance and the threshold that staff uses to determine whether additional assessment of changes in ambient noise levels is required. For Alternative One, feasible mitigation measures (modified configuration of conventional fans) for the nearest sensitive receptors are expected to reduce the identified noise impacts to a level that is insignificant. For Alternative Two, low or super-low noise fans would likely be required in order to reduce impacts to less than significant levels.

Noise Impacts of Hybrid Cooling

Hybrid Cooling Alternative One

In Hybrid Cooling Alternative One, the array of cooling equipment for the hybrid cooling system would also be placed on the southeast portion of the project site. Twenty-four (24) fan units are proposed, along with four (4) wet cooling towers in the “Base Case”. Staff developed working assumptions for this alternative using the data provided by GEA, adjusting for the use of 24 fans. Similarly, staff estimated the effects of noise-reducing options to be the same as expected for the dry cooling alternatives. The reference noise levels and operational assumptions are presented in Table 10.

Table 10
Cooling Fan Installation Operational Assumptions
Hybrid Cooling System

Option	No. of Fans	Motor Ratings	Sound Level, dBA at 400 feet	Layout	Relative Cost
1 (Base Case)	24	200 HP	64	N/A	--
2	30	150 HP	58	N/A	+10%
3	36	100 HP	50	N/A	+30%

Given the assumptions listed above, the noise levels due to the fan installations at the nearest receptors were predicted, based upon hemispherical spreading. The predicted noise levels at the nearest affected receptors are given by Table 11.

Table 11
Predicted Cooling Fan Noise Levels
Hybrid Cooling Alternative One

Receptor	Distance, feet	Sound Level, dBA			
		Option 1 (Base Case)	Option 2	Option 3	Ambient
Residences to southeast	1,700	54	45	37	43
Morro Rock	3,000	46	40	32	48

The predicted values indicate that, in the base case (Option 1), the fan noise levels would exceed the noise standards of the Morro Bay Noise Element at the nearest residences. The fan noise levels at the nearest residences would also exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether additional analysis is required to assess whether project noise results in a significant noise impact. At Morro Rock, the predicted fan noise levels in Option 1 would be lower than the ambient noise level, and would result in a cumulative noise level 2 dBA higher than the ambient noise level. This would not be considered a significant increase in noise levels, though the fans would constitute a new and noticeable noise source.

Noise mitigation would be required to achieve compliance with the LORS, and may be required to ensure that no substantial increase in ambient noise levels would occur. For Option 2, the cumulative noise level (45 dBA + 43 dBA=47 dBA) would exceed the LORS. Noise mitigation Option 3, modified configuration of the fans, would likely be required to achieve the objectives.

Hybrid Cooling Alternative Two

In Hybrid Cooling Alternative Two, the array of air-cooled condensers and cooling towers would be placed on the north side of the project site. As in Hybrid Cooling Alternative One, twenty-four fan units are proposed, along with four (4) wet cooling towers. The noise levels assumed for this alternative are the same as given by Table 7.

Given the assumptions listed above, the noise levels due to the fan installations at the nearest receptors were predicted, based upon hemispherical spreading. The predicted noise levels at the nearest affected receptors are given by Table 12.

Table 12
Predicted Cooling Fan Noise Levels
Hybrid Cooling Alternative Two

Receptor	Distance, feet	Sound Level, dBA			
		Option 1	Option 2	Option 3	Ambient
Residences to southeast	2,000	50	44	36	43
Baseball Fields	200	70	64	56	45
High School	800	58	52	44	45
Houses east of Highway 1	800	58	52	44	43
Morro Rock	3,300	46	40	32	48

The predicted values indicate that, in the base case (Option 1), the fan noise levels would exceed the noise standards of the Morro Bay Noise Element at the nearest residences. The fan noise levels at the nearest residences would also exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether additional analysis is required to assess whether project noise results in a significant noise impact.

At the baseball fields, the predicted fan noise levels in Option 1 would exceed the noise standards of the Morro Bay Noise Element. At the high school, the predicted fan noise levels in Option 1 would be generally consistent with the Morro Bay Noise Element, assuming that the noise levels inside the classrooms would be no more than 45 dBA during school hours. In both of these cases, the fan noise levels (using conventional fans) would exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether additional analysis is required to assess whether project noise results in a significant noise impact.

At Morro Rock, the predicted fan noise levels in Option 1 would be below the ambient noise level, which would result in a cumulative noise level 2 dBA higher than the ambient noise level. This would not be considered a significant increase in noise levels, though the fans would constitute a new and noticeable noise source.

Noise mitigation would be required to achieve compliance with the LORS, and may be required to ensure that no substantial change in ambient noise levels would occur. Noise mitigation Option 3 would likely be required to achieve these objectives at all receptors, except for the houses east of Highway 1. At those receptors, additional noise mitigation would likely be required.

Additional Noise Mitigation

No additional mitigation (beyond the fan configuration defined in Table 11 above) would be required for Hybrid Cooling Alternative One. For Hybrid Cooling Alternative Two, low or super low noise fans, as described above under Dry Cooling, would likely be required in order to reduce noise impacts at all sensitive receptor locations to less than significant levels.

Noise due to motors and gearboxes can be significantly reduced by enclosing or lagging the units. These measures are expected to be feasible.

Conclusion for Hybrid Cooling

The predicted noise levels associated with the hybrid cooling alternatives are significant in terms of both LORS compliance and the threshold that staff uses to determine whether additional assessment of changes in ambient noise levels is required. Feasible mitigation measures for the nearest sensitive receptors for Alternative One are expected to reduce the identified noise impacts to a level that is insignificant. For Alternative Two, additional noise mitigation measures would likely be required (low or super-low noise fans) to reduce noise impacts.

Noise Impacts of the AFB

It appears that the AFB would involve no significant noise sources that were not addressed in the AFC. That is, any pumps and construction measures required for its operation would probably be the same as, or similar to, those required at the power plant site for once-through cooling. These noise sources were included in the AFC noise level predictions, and any necessary mitigation measures were addressed by the original acoustical design of the project.

Construction Noise

Of the three cooling options, the AFB would have the fewest potential construction noise impacts, as the construction would occur away from the most sensitive receptors. The most significant variable introduced by installation of fans and/or cooling towers would be the potential increase in the amount of time required for construction, or potential changes in the hours during which construction would occur. The allowable noise levels for construction activities would not be different for any of the alternatives.

Conclusion for Noise

Of the three cooling options, the AFB would have the fewest potential noise impacts, as the only significant noise sources would be pumps and motors, which are relatively quiet as compared to the remainder of the equipment comprising the power plant. The noise impacts of the AFB are expected to be the same as for once-through cooling.

The dry cooling option would produce the highest unabated noise levels, as there would be more fans than in the hybrid system, and the baseline noise levels of the fans are higher than those of the hybrid cooling towers. Therefore noise mitigation methods for dry cooling would have to be more effective or more extensive than for the hybrid system. Feasible mitigation measures are available for both sites: for Dry Cooling Alternative One, alternative fan configuration probably would be required, and for Dry Cooling Alternative Two, low or super-low noise fans would probably need to be installed.

The hybrid cooling option would produce noise levels slightly lower than for the dry cooling system. Therefore noise mitigation requirements for the hybrid cooling system could be less demanding than for the dry cooling system. Feasible mitigation measures are available for both alternative locations, and would be the same as those described for dry cooling.

4.7 PUBLIC HEALTH

Obed Odoemelam, Ph.D.

Introduction

This section evaluates the health risks from operating the proposed project using three different cooling technologies: dry cooling, hybrid cooling, and once-through cooling with an aquatic filter barrier (AFB). It then compares such risks with the baseline risk from the existing Units 1-4 currently operated using once-through cooling. The potential impacts that are addressed in this section are the cancer and non-cancer impacts from exposure to the project's non-criteria, pollutants (or air toxics) for which there are no specific air quality standards. Such pollutants may originate from a project's combustion turbines, cooling structures, or equipment to be used for construction. The methods for assessing the cancer and non-cancer health impacts of such pollutants are presented in the **Public Health** section of this FSA. Since staff considers the risk of cancer as the most sensitive measure of the potential for health hazards from specific sources of environmental pollutants, the relative impacts of these cooling technologies are assessed in terms of their respective cancer risk levels. The potential impacts of the companion criteria pollutants (for which there are specific air quality standards) are addressed in the **Air Quality** section in terms of compliance with the applicable standards.

The toxic pollutants of concern in this analysis would result from both construction and operation. Construction emissions include diesel exhaust and dust-related PM10 on which there are adsorbed air toxics. Pollutants from operations include combustion by-products and air toxics from cooling tower drift.

Since the present once-through cooling system is operated as a closed system, it does not allow for human exposure to the potentially toxic additives usually added to the cooling water to prevent biofouling and system corrosion. Therefore, the once-through cooling technology does not significantly contribute to the risk from present facility operations. The risk is related instead to emissions from the existing boilers, the diesel fire pump engines, and diesel emergency generator that will continue to be used for the proposed project. The existing project risk estimate is 1.4 in a million as noted on page 6.2-68 of the AFC. Staff does not consider this risk level as suggesting a significant cancer risk.

Public Health Impacts of Dry Cooling

As noted in the **Air Quality** section, the additional construction activities from erecting a dry cooling structure would increase the dust-related PM10 emissions. PM10 impacts are of concern in this public health analysis because health effects can result from the interaction of the toxic pollutants that might be adsorbed to the PM10. Such adsorption would be associated with specific soil contamination that must be remediated before beginning construction.

Dry Cooling Alternative One would be located just south of the existing tank farm. Therefore, pre-construction soil sampling surveys should be conducted at this location, as well as the areas beneath the structures to be demolished as part of the proposed project. The Conditions of Certification in the **Waste Management** section of the FSA for the proposed construction activities would be adequate to ensure the appropriate pre-construction mitigation. These conditions specifically require preparation and implementation of a site mitigation plan that would ensure removal of all soil contaminants before starting construction.

The toxic health risks from diesel equipment emissions would be minimized through implementation of the Conditions of Certification in the **Air Quality** section, which would also apply to construction of any cooling structures that might be used for the project.

The last dry cooling-related toxic impacts of potential significance would be the emission increases from increased generation that might be considered necessary to counteract the loss in generation efficiency. Since such loss can easily be replaced at other generating facilities (as noted in the **Air Quality** section), staff does not consider the potential loss in efficiency as a significant factor in the assessment of dry cooling-related health risks. Therefore, dry cooling would be incapable of meaningfully increasing the 1.5 in a million cancer risk specified in the FSA for the proposed project. Staff regards the suggested cancer risk as less than significant.

Public Health Impacts of Hybrid Cooling

Construction of a hybrid cooling system would generate similar diesel and dust emissions associated with construction of a dry cooling system. As with dry cooling, implementation of staff-proposed mitigation requirements would be adequate to reduce the cancer and non-cancer risks of concern. The Conditions of Certification are specified in the **Air Quality** and **Waste Management** sections of the FSA.

The other hybrid cooling-related impacts of potential concern would result from exposure to any toxic water constituents that would be emitted in the wet cooling phase. Such constituent emissions do not occur with once-through cooling. Health impacts from such emissions would mainly depend on the quality of the utilized water. For any such application, using water that has been purified to maintain its toxic constituents below applicable drinking water standards would prevent the health impacts of concern. Staff typically finds the risk from conventional cooling towers to be at less than significant levels. If reclaimed water from MBCWTP were to be utilized for this project, tertiary treatment would be required to maintain these pollutants at the desired levels. Using an effective drift eliminating system would minimize the potentially impacted area. An efficiency of 0.0005% is presently achievable for such systems. Staff considers such hybrid cooling-related water use as incapable of adding significantly to the 1.5 in a million cancer risk calculated for the project as currently proposed with once-through cooling. It would similarly be incapable of significantly increasing the 1.4 in a million associated with existing operations.

Public Health Impacts of the Aquatic Filter Barrier

Any use of an aquatic filter barrier (AFB) at the proposed facility would only affect the aquatic species in the water to be used and would not generate any emissions of health significance. Therefore, such use would not increase the 1.5 in a million cancer risk from the project as proposed. Any air toxics emissions from deployment, retrieval, or maintenance activities would be minimized through compliance with the staff proposed mitigation measures specified with respect to dust generation and diesel exhaust involved.

Conclusions for Public Health

Since the proposed once-through cooling system is a closed system that does not expose plant workers or area residents to any constituents of the utilized seawater, its continued use in the proposed modernization project would not introduce any cooling-related health risk to the project area. The use of dry cooling would also prevent exposure to these water constituents, thereby avoiding a potentially significant health risk from facility cooling. The use of hybrid cooling could theoretically introduce a cooling-related risk to the area. However, the requirement for water purification would be adequate to reduce any such health risks to less than significant levels. Compliance with Air District-mandated mitigation measures would be adequate to reduce all construction-related air toxics emissions to less than significant levels. Staff concludes that the air-cooled and hybrid cooling alternatives could each be erected and operated in ways that would pose a less than significant public health risk.

4.8 SOCIOECONOMIC RESOURCES

Michael Fajans and Amanda Stennick

Introduction

The modernization of a power plant could have socioeconomic impacts due to modifications in the plants' need for water, land, or public services, and revenues to public agencies, could have either adverse or beneficial socioeconomic impacts. Dry or hybrid cooling technologies, by virtue of their potential impacts on noise and visual conditions, could have impacts on public finance or surrounding neighborhoods and businesses that are different from once-through cooling.

Socioeconomics Impacts of Dry Cooling

Neither of the dry cooling alternatives would have significant impacts on employment or housing demand in Morro Bay. There would not be a corresponding impact upon demand for schools. As with other plant designs, direct fiscal impacts on the community would be positive because new plants generate more tax revenue. Dry cooling would not require a new outfall agreement, and thus would generate $250,000 less revenue to the City annually than anticipated from the outfall lease required for once-through cooling. As described in the Visual Resources section of this appendix, visual impacts of the dry cooling structures are potentially significant, but can be mitigated to less than significant levels, so there would be no adverse neighborhood consequences compared to once-through cooling. Increased noise levels would result if the dry cooling system was installed without mitigation, but feasible mitigation is available for both sites.

Socioeconomics Impacts of Hybrid Cooling

The hybrid cooling alternatives would not have significant impacts on employment or housing demand in Morro Bay. There would not be a corresponding impact upon demand for schools. As with other plant designs, direct fiscal impacts on the community would be positive because new plants generate more tax revenue. Elimination of the outfall would reduce City revenues compared to once-through cooling, as described above. If potential noise impacts and visual impacts (hybrid cooling without plume abatement) are not mitigated, hybrid cooling would have adverse neighborhood consequences compared to once-through cooling. However, noise and visual mitigation is available and feasible (see discussion in the **Noise** section of this appendix). Increased visual impacts could make Morro Bay a less attractive tourism destination, which would have adverse impacts on Morro Bay tax revenues, and indirectly on the number of jobs in the tourism industry.

Construction of a new pipeline to the Morro Bay-Cayucos Wastewater Treatment Plant, just north of the power plant site, would mitigate potential impacts on domestic water supply that could result without the connection, but would have temporary construction impacts on city streets, affecting provision of public services for a short time. Through coordination with other agencies and public information, the construction impacts would be reduced to less than significant levels.

Socioeconomics Impacts of the Aquatic Filter Barrier

Use of the AFB with once-through cooling would not have significant impacts on employment or housing demand in Morro Bay, and thus not on schools either. As with other plant designs, fiscal impacts on the community would be positive because of higher power plant property values than for the existing plant. The **Visual Resources** section identifies a significant visual impact for the AFB; this could have adverse secondary socioeconomic impacts on the community, potentially affecting tourism. The AFB cooling technology would not have differential socioeconomic impacts from the once-through cooling option (see **Socioeconomics** section of this FSA).

Conclusion for Socioeconomics

Any of the cooling options would have positive short-term employment impacts, and would likely generate positive fiscal benefits to the City. Because of the elimination of the outfall and associated municipal revenue, the fiscal benefits of dry cooling and hybrid cooling would be somewhat less than those associated with once-through cooling or the use of the AFB.

4.9 TRAFFIC AND TRANSPORTATION

Jim Fore

Introduction

The development of alternate cooling options for the Morro Bay Power Plant (MBPP) would result in some traffic impacts not associated with either the existing environment or with the Applicant's original proposal. A dry cooling system for the MBPP would result in increased truck traffic for the delivery of structural steel and other materials and supplies. The hybrid cooling system that is considered could result in an increase in truck traffic and would also require the construction of a water pipeline to the Morro Bay-Cayucos Wastewater Treatment Plant located north of the MBPP site. The AFB would increase truck traffic to the Morro Bay harbor, as equipment and supplies would need to be transferred to barges for the construction and installation of the AFB. The construction activity in the bay along with the placement of the AFB could impact marine traffic.

Traffic and Transportation Impacts of Dry Cooling

The construction of a dry cooling system at either of the two possible sites would result in additional truck traffic for the delivery of material, equipment, and supplies. This would be expected to occur over a relatively short period of time and construction schedules could be planned such that peak truck traffic would not increase during construction. Impacts would be less than significant.

Traffic and Transportation Impacts of Hybrid Cooling

The construction of a hybrid cooling system at either of the two possible sites could result in additional truck traffic for the delivery of material, equipment, and supplies. This cooling option also requires the construction of a water pipeline to be placed in city streets. This would require the development of a traffic control plan for the construction activity that would take place in city streets. If proper construction and safety procedures are followed for working in city streets, it should be possible to carry out this construction activity with minimum impact on the community, and impacts would be less than significant.

Traffic and Transportation Impacts of the Aquatic Filter Barrier

Morro Bay is approximately four miles long and 1.75 miles wide at its maximum width. Portions of the bay are not suitable for the passage of commercial vessels because of sand spit and seaweed beds, resulting in restriction of marine traffic to a fairly narrow portion of the bay.

The main channel of the bay must be dredged every couple of years in order to maintain its depth for safe passage by marine traffic. Morro Bay area marine traffic consists of commercial fishing vessels (up to 300 vessels during certain fishing seasons), tour boats, and recreational boats. Harbor and U.S. Coast Guard vessels are also stationed at the harbor.

The main channel for the bay is along the north shoreline where the filter is to be located. This could be a problem as boats enter and exit the harbor. After entering the bay, this channel runs parallel to the north shoreline and then makes a fairly sharp turn to the south in the vicinity of the existing water intake structure for the power plant.

The proposed AFB has the potential to create the following problems for marine traffic:

- The north shoreline has an access area for recreational boaters. Access to the bay could be somewhat restricted by the location of the filter. The filter would also reduce access to the north shoreline for the tour boats operating in the bay.
- The filter location appears to be very close to the main channel for boats entering and leaving the bay. Marine traffic leaving the bay travel along the shoreline, then in the vicinity of the power plant intake, these boats make a left turn to exit the bay. Traffic coming into the bay travel through a fairly narrow entrance channel of approximately 50 feet. They then travel along the north shoreline approximately 250 to 300 feet offshore and make a fairly sharp right turn in the vicinity of the power plant intake to get to a dock and mooring location.
- The location of the filter is also of some concern for the vessels of both the City of Morro Bay Harbor Department and the U.S. Coast Guard. When they are called out for a rescue mission, their vessels would be traveling at high speeds. The placement of the filter near the main shipping channel could create a hazard.
- If barges and vessels used for the construction of the circulating cooling water supply system must anchor or moor in a manner other than to an existing approved dock or pier, they could create a safety hazard to shipping traffic.

- Construction of the filter would require that the City of Morro Bay Harbor Department and the U.S. Coast Guard be involved in the development of a marine traffic plan for both the construction and operation of the AFB. They would also need to be consulted on determining the location of the AFB in the bay to minimize marine traffic problems.

During construction of the AFB, truck trips to and from Morro Bay harbor would be required. This would be for the delivery of materials, equipment, and supplies to be transferred to barges for the construction of the offshore structure to support the AFB. This impact could be handled with the development of a traffic control plan as noted in the Traffic and Transportation Section of the FSA. This plan would include but not be limited to; identifying truck routes, scheduling deliveries during off peak traffic hours, use of signing, lighting and other traffic control devices to ensure public safety. These control measures would be needed to minimize overall traffic congestion impacts on harbor operations, tourism, and other commercial activities.

Conclusion for Traffic and Transportation

The truck traffic associated with the construction activities for the dry cooling alternatives would not result in a significant impact on traffic assuming the Applicant follows the mitigation measures and Conditions of Certification set forth in the **Traffic and Transportation** Section of the FSA.

For the hybrid cooling alternatives, the impact on traffic should not be significant assuming the Applicant follows normal safety and construction procedures for working in city streets.

The placement of the AFB in Morro Bay would increase truck traffic to the harbor and create some marine traffic concerns during its construction and operation. These concerns would need to be mitigated. Staff believes that the concerns associated with the construction and operation of the AFB can be mitigated to less than significant levels with the development of a marine traffic control plan. This plan would need to be developed in consultation with the City of Morro Bay and the U.S. Coast Guard.

The increase in harbor truck traffic would be mitigated through delivery schedules arranged to avoid the peak traffic periods for the community. Similarly, peak traffic periods at the harbor, such as during the tourist season, would be avoided through off-peak time delivery schedules.

4.10 VISUAL RESOURCES

Michael Clayton

Introduction

This section presents a visual analysis of the various cooling options compared to a baseline established by the existing Morro Bay Power Plant. Implementation of any of the cooling alternatives would also include the visual benefit of removal of the existing power plant and its regionally prominent stacks.

The primary issue of concern with respect to visual resources is the introduction of additional visible structures and plumes into the power plant and harbor landscape.

Specifically, with the dry cooling option, the two air-cooled condensers (ACCs) would be visible as a single, large, elevated, geometric structure that could appear quite massive from foreground viewing distances depending on viewing location (for the remainder of this analysis the two side-by-side ACC structures will be referred to as a single ACC structure since its appearance would be that of a single geometric box structure). The hybrid cooling alternatives would have a smaller (paired) ACC structure than for the dry cooling option, but would include two additional cooling towers with the potential to generate visually dominant plumes. In either case, the cooling structures would exhibit an industrial visual character similar to that of other existing and proposed structures at the site.

The Gunderboom Aquatic Filter Barrier (AFB) system would be installed in Morro Bay north of the T-Pier and would extend up to 2,000 feet toward the mouth of the harbor. The AFB would have the appearance of a narrow floating dock, anchored to mooring piles. The AFB could have two possible configurations. The occurrence of significant visual impacts would depend primarily on the extent to which the new structures introduce additional visual contrast, dominate views, or cause additional view blockage of higher quality landscape features such as Morro Bay waters, the sand spit or ocean, the hills to the east of the site, or sky.

The following assessment of visual impacts is based on an analysis conducted from six representative key observation points (KOPs). The reader is referred to Figure 7 (see end of this sub-section) for the location of the KOPs.

Visual Impacts of Dry Cooling

Dry Cooling Alternative One

Under Dry Cooling Alternative One, the ACC would be located immediately south of the proposed power plant. The ACC would appear as a large elevated box-like structure (330 feet long x 206 feet wide x 100 feet high). Figures 8, 9, and 10 (see end of this sub-section) present visual simulations of a different dry cooling design than analyzed here, but the simulations are instructive in terms of the character and approximate location of the ACC structure. The simulations represent views from KOP 8 (Morro Rock), KOP 14 (Sunset Plateau), and KOP 15 (Harbor Front Tract) respectively. The ACC shown in the simulations is slightly more than twice as long as the design evaluated here. Also, the simulations do not show the removal of the water intake structure, which would occur under the dry cooling alternatives.
Table 13 summarizes Dry Cooling Alternative One's visual impacts by KOP. As shown in the table, compared to existing views, an increase in visual contrast, project dominance, and view blockage caused by project structures, would be experienced at three of the six representative viewing areas (KOP 5 - Morro Strand State Beach, KOP 6 - Morro Dunes Trailer Park and Resort Campground, and KOP 7 - Morro Creek at Embarcadero Road). The resulting visual impact on these three viewing locations would be adverse and significant.

Table 13
Dry Cooling Alternative One: Summary of Visual Impacts

KOP	Location	Description of Impact Before Mitigation
KOP 5	Morro Strand State Beach	**Adverse and Significant.** The new power plant and dry cooling structures would be located closer to KOP 5 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to KOP 5. The air-cooled condenser (ACC) would be partially screened by the proposed Heat Recovery Steam Generator (HRSG) structures, Gas Turbine Generator (GTG) air inlets and enclosures, and Steam Turbine Generator (STG) structures. The portion of the ACC that would be visible would appear similar in character to the other power plant structures.
KOP 6	Morro Dunes Trailer Park and Resort Campground	**Adverse and Significant.** The new power plant and dry cooling structures would be located closer to KOP 6 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the trailer park. The ACC would be minimally visible from KOP 6 due to the screening provided by the proposed project structures.
KOP 7	Morro Creek at Embarcadero Road	**Adverse and Significant.** The new power plant and dry cooling structures would be located closer to KOP 7 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the KOP 7. The ACC would be partially screened by, and appear similar in character to, other proposed structures.
KOP 8	Morro Rock	**Beneficial**. Compared to the existing power plant, the proposed facilities would be smaller in scale though more industrial in appearance due to metallic surface color and texture and complexity of form. Overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Dry Cooling Alternative One.
KOP 14	Sunset Plateau	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance due to metallic surface color and texture and complexity of form. The structure locations would encroach on sightlines to Morro Rock, the harbor, sand spit, and ocean. However, overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Dry Cooling Alternative One.
KOP 15	Harbor Front Tract	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance. View blockage of Morro Rock by structures would be eliminated though the location of the new HRSGs in relation to Morro Rock could result in occasional view blockage of Morro Rock by HRSG plume drift. Visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Dry Cooling Alternative One.

From KOP 8 (Morro Rock), KOP 14 (Sunset Plateau), and KOP 15 (Harbor Front Tract), the resulting visual impact would be beneficial because of the reduction in visual contrast, structural dominance, and view blockage that would be experienced by replacing the existing power plant with Dry Cooling Alternative One.

With full and effective implementation of staff-proposed Visual Resources Mitigation Measures 1, 2, and 3 (through Conditions of Certification VIS-1 through VIS-3, respectively), the significant visual impacts that would occur at KOPs 5, 6, and 7 would be reduced to levels that would be less than significant. However, these less than significant impacts would be greater than the impacts created by the proposed project.

Dry Cooling Alternative Two

Under Dry Cooling Alternative Two, the proposed power plant facilities (HRSGs, GTGs, and STGs) would be re-oriented in an east-west configuration on the site. The ACC would be located immediately to the northeast of the power generation facilities. The ACC would have the same dimensions as for Dry Cooling Alternative One.

Table 14 summarizes Dry Cooling Alternative Two's visual impacts by KOP. As shown in the table, compared to the existing views, the resulting visual impacts from Dry Cooling Alternative Two would be similar to Dry Cooling Alternative One. An increase in visual contrast, project dominance, and view blockage caused by the project structures would be experienced at three of the six representative viewing areas (KOPs 5, 6, and 7). The resulting visual impact on these three viewing locations would be adverse and significant. Also, under this alternative, the ACC would be prominently visible from Lila Kaiser Park (located just north of Morro Creek), resulting in an adverse and significant visual impact.

Table 14
Dry Cooling Alternative Two: Summary of Visual Impacts

KOP	Location	Description of Impact Before Mitigation
KOP 5	Morro Strand State Beach	**Adverse and Significant**. The new power plant and dry cooling structures would be located closer to KOP 5 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to KOP 5. Also, with this alternative, the HRSGs, GTGs, and STGs would be re-orientated on the site in a linear east-to-west configuration with the ACC situated to the northeast of the power generation facilities. This configuration would result in greater visibility of the power plant structures to Morro Strand State Beach since there would be less opportunity to screen facilities with other facilities.
KOP 6	Morro Dunes Trailer Park and Resort Campground	**Adverse and Significant**. The new power plant and dry cooling structures would be located closer to KOP 6 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the trailer park. With the re-configuration of the power plant facilities and addition of the ACC on the northeast side of the site, the project would be substantially more visible from the trailer park and structural visual contrast would be increased. The project would dominate views to the south and would cause a significant increase in the blockage of sky.
KOP 7	Morro Creek at Embarcadero Road	**Adverse and Significant**. The new power plant and dry cooling structures would be located closer to KOP 7 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the KOP 7. With the re-configuration of the power generation facilities and addition of the ACC on the northeast side of the site, the ACC and eastern-most structures would be partially screened by other project structures. However, with re-configuration of the proposed project structures, additional sight lines to the PG&E switchyard would be opened up, increasing visual exposure to this complex industrial facility.
KOP 8	Morro Rock	**Beneficial**. Compared to the existing power plant, the proposed facilities would be smaller in scale though more industrial in appearance due to metallic surface color and texture and complexity of form. Overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Dry Cooling Alternative Two. Also, The ACC (located to the northeast of the HRSG facilities) would be substantially screened from view by other structures.
KOP 14	Sunset Plateau	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance. The structure locations would encroach on sightlines to Morro Rock, the harbor, sand spit, and ocean. However, overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Dry Cooling Alternative Two.
KOP 15	Harbor Front Tract	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance due to metallic surface color and texture and complexity of form. View blockage of Morro Rock by structures would be eliminated though the location of the new HRSGs in relation to Morro Rock could result in the occasional blockage of views of Morro Rock by HRSG plume drift. Overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Dry Cooling Alternative Two.

From KOPs 8, 14, and 15, the resulting visual impact would be beneficial because of the reduction in visual contrast, structural dominance, and view blockage that would be experienced by replacing the existing power plant with Dry Cooling Alternative Two.

With full and effective implementation of staff-proposed Visual Resources Mitigation Measures 1, 2, and 3 (through Conditions of Certification VIS-1 through VIS-3, respectively), the significant visual impacts that would occur at KOPs 5, 6, and 7 would be reduced to levels that would be less than significant. Also, it would be recommended that additional trees be planted along the southern perimeter of Lila Kaiser Park in order to screen views of the ACC from the park and reduce the associated visual impact to a level that is not significant. However, these less than significant visual impacts would be greater than the impacts created by the proposed project, which would avoid the additional project visibility, structural contrast, and view blockage of higher quality landscape features (coastal hills, harbor, sand spit, dunes, ocean, and sky) that would be caused by the east-west orientation of project facilities and the addition of the ACC under Dry Cooling Alternative Two.

Specifically, the in-line configuration of project facilities and addition of the ACC under Dry Cooling Alternative Two would result in an increase in project visibility (and visual contrast and view blockage) from KOPs 5, 6, 8, 14, and 15 because the "in-line" orientation of the structures would result in less screening of proposed structures by other proposed structures. A decrease in visibility would be experienced from KOP 7 because the in-line orientation would result in slightly more screening of project structures by other project structures. However, in this case additional sight lines to the PG&E switchyard would be opened up, increasing the visual exposure to this complex, industrial facility.

Visual Impacts of Hybrid Cooling

Hybrid Cooling Alternative One

Under Hybrid Cooling Alternative One, an ACC and two conventional cooling towers would be located immediately south of the proposed power plant. The ACC would appear as a relatively large, elevated box-like structure (330 feet long x 206 feet wide x 82 feet high). Each cooling tower would appear rectilinear in shape and would be 84 feet long x 42 feet wide x 57 feet high. Table 15 summarizes the visual impacts of the power plant facilities by KOP.

Table 15
Hybrid Cooling Alternative One: Summary of Visual Impacts
(Not Including Vapor Plume Analysis)

KOP	Location	Description of Impact Before Mitigation
KOP 5	Morro Strand State Beach	**Adverse and Significant**. The new power plant and dry cooling structures would be located closer to KOP 5 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to KOP 5. The air-cooled condenser (ACC) and eastern-most cooling tower would be almost completely screened by the proposed Heat Recovery Steam Generator (HRSG) structures, Gas Turbine Generator (GTG) air inlets and enclosures, and Steam Turbine Generator (STG) structures. The western-most cooling tower would be partially visible above the sound wall. The visible portions of the ACC and cooling towers would appear similar in character to the other power plant structures.
KOP 6	Morro Dunes Trailer Park and Resort Campground	**Adverse and Significant**. The new power plant and dry cooling structures would be located closer to KOP 6 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the trailer park. The ACC and cooling towers would not be visible from the trailer park due to screening provided by other project structures and existing vegetation.
KOP 7	Morro Creek at Embarcadero Road	**Adverse and Significant**. The new power plant and dry cooling structures would be located closer to KOP 7 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the KOP 7. The eastern-most cooling tower and a portion of the ACC would be partially screened by other proposed structures.
KOP 8	Morro Rock	**Beneficial**. Compared to the existing power plant, the proposed facilities would be smaller in scale though more industrial in appearance due to metallic surface color and texture and complexity of form. Overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Hybrid Cooling Alternative One. The eastern-most cooling tower would be partially screened from view.
KOP 14	Sunset Plateau	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance. The structure locations would encroach on sightlines to Morro Rock, the harbor, sand spit, and ocean. However, overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Hybrid Cooling Alternative One.
KOP 15	Harbor Front Tract	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance. View blockage of Morro Rock by structures would be eliminated though the location of the new HRSGs in relation to Morro Rock could result in occasional view blockage of Morro Rock by HRSG plume drift. Visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Hybrid Cooling Alternative One.

As shown in the table, compared to existing views, the resulting visual impacts from Hybrid Cooling Alternative One structures would be similar to Dry Cooling Alternative One. An increase in visual contrast, project dominance, and view blockage caused by the project structures would be experienced at three of the six representative viewing areas (KOP 5 - Morro Strand State Beach, KOP 6 - Morro Dunes Trailer Park and

Resort Campground, and KOP 7 - Morro Creek at Embarcadero Road). The resulting visual impact on these three viewing locations would be adverse and significant.

From KOP 8 (Morro Rock), KOP 14 (Sunset Plateau), and KOP 15 (Harbor Front Tract), the resulting visual impact would be beneficial because of the reduction in visual contrast, structural dominance, and view blockage that would be experienced by replacing the existing power plant with Hybrid Cooling Alternative One (assuming plume abated wet cooling towers).

This alternative would also require the construction of a new pipeline within city streets to bring cooling water to the site from the Morro Bay-Cayucos Wastewater Treatment Plant, just north of the power plant site. Although additional visual impacts would result from construction of the pipeline, these impacts would be temporary and minimally visible to the public, and there would be no lasting visual evidence of the pipeline's presence. Therefore, the visual impacts associated with pipeline construction would not be significant.

Based on a plume modeling analysis conducted by staff, the use of conventional cooling towers at this location would result in the formation of substantial steam plumes approximately 92% of daylight hours. The 10% frequency plume during daylight hours would be approximately 718 feet long x 645 feet high x 126 feet wide. These plumes would be visually dominant and would cause significant view blockage. The resulting visual impact would be adverse and significant.

With full and effective implementation of staff-proposed Visual Resources Mitigation Measures 1, 2, and 3 (through Conditions of Certification VIS-1 through VIS-3), the significant visual impacts (from structure visibility) that would occur at KOPs 5, 6, and 7 would be reduced to levels that would be less than significant. In order to mitigate the significant visual impact that would result from plume formation, it is recommended that only plume abated wet cooling towers be considered. Based on the available meteorological data, a design point of 38^{o}F and 80% relative humidity should reduce the daytime plume frequency during hours with high visibility to zero. However, additional plume analysis should be performed when and if a plume abated cooling tower is proposed for this project site.

Although Hybrid Cooling Alternative One, properly mitigated, would not create any significant adverse impacts, it would have greater impacts than the proposed project because the proposed project would result in less structural contrast and view blockage of higher quality landscape features (coastal hills, harbor, sand spit, dunes, ocean, and sky) when viewed from the surrounding areas.

Hybrid Cooling Alternative Two

Under Hybrid Cooling Alternative Two, the power plant facilities would be re-oriented in an east-west configuration on the site and the ACC and cooling towers would be located immediately to the northeast of the HRSGs. The ACC and cooling towers would have the same dimensions as for Hybrid Cooling Alternative One. Table 16 (below) summarizes Hybrid Cooling Alternative Two's visual impacts by KOP.

Table 16
Hybrid Cooling Alternative Two: Summary of Visual Impacts (Not Including Vapor Plume Analysis)

KOP	Location	Description of Impact Before Mitigation
KOP 5	Morro Strand State Beach	**Adverse and Significant**. The new power plant and hybrid cooling structures would be located closer to KOP 5 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to KOP 5. Also, with this alternative, the HRSGs, GTGs, and STGs would be re-orientated on the site in a linear east-to-west configuration with the ACC and cooling towers situated to the northeast of the power generation facilities. This configuration would result in greater visibility of the power plant structures to Morro Strand State Beach since there would be less opportunity to screen facilities with other facilities.
KOP 6	Morro Dunes Trailer Park and Resort Campground	**Adverse and Significant**. The new power plant and hybrid cooling structures would be located closer to KOP 6 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the trailer park. With the re-configuration of the power plant facilities and addition of the ACC and cooling towers on the northeast side of the site, the project would be substantially more visible from the trailer park and structural visual contrast would be increased. The project would dominate views to the south and would cause a significant increase in the blockage of sky.
KOP 7	Morro Creek at Embarcadero Road	**Adverse and Significant**. The new power plant and hybrid cooling structures would be located closer to KOP 7 than the existing power plant that is being replaced. As a result, the apparent scale of the new facilities would be similar to that of the existing plant. However, the new facilities would have a much stronger industrial character due to greater structural complexity and highly metallic coloration and texture. There would also be a noticeable increase in visible light at night due to the closer proximity of the facilities to the KOP 7. With the re-configuration of the power generation facilities and addition of the ACC and cooling towers on the northeast side of the site, the ACC and eastern-most structures would be partially screened by other project structures. However, with re-configuration of the proposed project structures, additional sight lines to the PG&E switchyard would be opened up, increasing visual exposure to this complex industrial facility.
KOP 8	Morro Rock	**Beneficial**. Compared to the existing power plant, the proposed facilities would be smaller in scale though more industrial in appearance due to metallic surface color and texture and complexity of form. Overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Hybrid Cooling Alternative Two. Also, the ACC and cooling towers (located to the northeast of the HRSG facilities) would be partially screened from view by other structures.
KOP 14	Sunset Plateau	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance. The structure locations would encroach on sightlines to Morro Rock, the harbor, sand spit, and ocean. However, overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Hybrid Cooling Alternative Two.
KOP 15	Harbor Front Tract	**Beneficial**. The proposed facilities would be smaller in scale though more industrial in appearance. View blockage of Morro Rock by structures would be eliminated though the location of the new HRSGs in relation to Morro Rock could result in occasional blockage of views of Morro Rock by HRSG plume drift. Overall visual contrast, structural dominance, and view blockage would all be reduced by replacing the existing power plant with Hybrid Cooling Alternative Two.

As shown in the table, compared to existing views, the resulting visual impacts from the Hybrid Cooling Alternative Two structures would be similar to Dry Cooling Alternative Two. An increase in visual contrast, project dominance, and view blockage caused by the project structures would be experienced at three of the six representative viewing areas (KOPs 5, 6, and KOP 7). The resulting visual impact on these three viewing locations would be adverse and significant. Also, under this alternative, the ACC would be visible from Lila Kaiser Park (located just north of Morro Creek), resulting in an adverse and significant visual impact.

From KOPs 8, 14, and 15, the resulting visual impact would be beneficial because of the reduction in visual contrast, structural dominance, and view blockage that would be achieved by replacing the existing power plant with Hybrid Cooling Alternative Two (assuming plume abated wet cooling towers).

This alternative would also require the construction of a new pipeline within city streets to bring cooling water to the site from the Morro Bay-Cayucos Wastewater Treatment Plant, just north of the power plant site. Although additional visual impacts would result from construction of the pipeline, these impacts would be temporary, minimally visible to the public, and there would be no lasting visual evidence of the pipeline's presence. Therefore, the visual impacts associated with pipeline construction would not be significant.

As discussed above for Hybrid Cooling Alternative One, the plume modeling analysis conducted by staff determined that vapor plumes from the conventional cooling towers would form approximately 92% of daylight hours. The 10% frequency plume during those daylight hours would be approximately 718 feet long x 645 feet high x 126 feet wide. These plumes would be visually dominant and would cause significant view blockage. The resulting visual impact would be adverse and significant.

With full and effective implementation of staff-proposed Visual Resources Mitigation Measures 1, 2, and 3 (through Conditions of Certification VIS-1 through VIS-3, respectively), the significant visual impacts (from structure visibility) that would occur at KOPs 5, 6, and 7 would be reduced to levels that would be less than significant. Also, it is recommended that additional trees be planted along the southern perimeter of Lila Kaiser Park in order to screen views of the ACC from the park and reduce the associated visual impact to a level that is not significant. In order to mitigate the significant visual impact that would result from plume formation, it is recommended that only plume abated wet cooling towers be considered. Based on the available meteorological data, a design point of 38^{o}F and 80% relative humidity should reduce the daytime plume frequency during hours with high visibility to zero. However, additional plume analysis should be performed when and if a plume abated cooling tower is proposed for this project site.

Although Hybrid Cooling Alternative Two, properly mitigated, would not create any significant adverse impacts, it would have greater impacts than the proposed project because the proposed project would result in less structural contrast and view blockage of higher quality landscape features (coastal hills, harbor, sand spit, dunes, ocean, and sky) when viewed from the surrounding areas.

Visual Impacts of the Aquatic Filter Barrier

The AFB system would be installed in Morro Bay north of the T-Pier and would extend up to 2,000 feet toward the mouth of the harbor (see Figure 9, end of this sub-section). The AFB would have the appearance of a narrow floating dock, anchored to mooring piles and could have two possible configurations – one with one set of mooring piles and a second option with two sets of pilings that would allow for boat mooring.

In either case, from most viewpoints the AFB would not appear out of character in the harbor environment. From the north T-Pier, the commercial waterfront area, and boats in the harbor, the AFB, if visible, would appear consistent with other harbor features including moorings, boats, docks, and piles. From these locations, the resulting visual impact would not be significant. However, from the northern portion of The Embarcadero and Coleman Drive, the Gunderboom mooring piles would partially obscure open views across the harbor waters to the rolling form of the sand spit. The resulting visual contrast and view blockage would cause an adverse and significant visual impact. Therefore, it is recommended that the mooring piles be kept to a minimum height. The residual visual impact of the AFB, though reduced with shorter piles, would still be significant.

Conclusion for Visual Resources

Staff concludes that from most viewing areas of the existing power plant and proposed project site, the proposed project and dry cooling alternatives would result in an overall long-term improvement in visual quality through the removal of the existing power plant and its regionally dominant stacks. However, the Hybrid Cooling Alternatives have the potential to cause significant visual impacts (due to view blockage and degradation of visual quality) associated with the formation of prominent and persistent plumes from the wet cooling towers. Therefore, staff is recommending that only plume abated wet cooling towers be considered under the Hybrid Cooling Alternatives.

The cooling alternatives have the potential to cause long-term significant adverse visual impacts to Morro Strand State Beach and the Morro Dunes Trailer Park and Resort Campground. These long-term operational impacts would result from the project's contrasting appearance and foreground visibility. However, with proper implementation of the Applicant's proposed mitigation measures as augmented by staff's proposed mitigation measures and Conditions of Certification, and the use of plume abated wet cooling towers under the hybrid cooling options, the impacts of the cooling alternatives would be reduced to levels that would not be significant.

The cooling alternatives also have the potential to cause nighttime lighting impacts when viewed from the elevated perspectives of the Sunset Plateau and Harbor Front Tract residential areas. The significance of the potential lighting impacts cannot be determined at this time because the project is lacking a detailed lighting plan. However, effective implementation of staff's proposed mitigation measures and Conditions of Certification would reduce the long-term significant adverse visual impacts and any potential nighttime lighting impacts to levels that are not significant.

The proposed project is preferred over Dry Cooling Alternatives One and Two because the ACC and/or re-configured power generation facilities would result in greater visual contrast and view blockage, and in some cases greater project dominance. Even with effective mitigation of the significant visual impacts associated with the dry cooling alternatives, the residual impacts, though not significant, would still be greater than the residual impacts of the proposed project.

The proposed project is also preferred over the hybrid cooling alternatives because the ACC and cooling tower structures would result in greater visual contrast and view blockage. Also, the vapor plumes associated with the hybrid cooling alternatives would cause adverse and significant visual impacts (due to view blockage and degradation of visual quality) if not abated. Even with effective mitigation of the significant visual impacts associated with the hybrid cooling alternatives, the residual impacts, though not significant, would still be greater than the residual impacts of the proposed project.

It should also be noted that the elimination of the water intake building under the various cooling options would not fully compensate for the visual impact of the ACC and cooling towers. The ACC would appear larger and more industrial than the intake building and the ACC and cooling towers would introduce more visual contrast and view blockage compared to the intake building. The greater visual contrast and view blockage associated with the ACC and cooling towers would be particularly noticeable from Morro Rock, Coleman Drive, and the harbor. Also, from most of the KOPs evaluated (5, 6, 7, 14, and 15), the intake building would either be less visible than the ACC or not visible at all.

With respect to site configuration, Dry Cooling and Hybrid Cooling Alternatives One are preferred over Dry Cooling and Hybrid Cooling Alternatives Two because the in-line configuration of facilities and increased structural visibility, visual contrast, and view blockage associated with the Alternative Two site configuration would result in greater residual visual impacts compared to the Alternative One site configuration. This conclusion assumes the implementation of plume abated cooling towers for the Hybrid Cooling Alternatives. Therefore, the ranking of the proposed project and alternatives from most preferred to least preferred is as follows:

- Proposed Project
- Dry Cooling Alternative One
- Hybrid Cooling Alternative One (assuming plume abated cooling towers)
- Dry Cooling Alternative Two
- Hybrid Cooling Alternative Two (assuming plume abated cooling towers)
- Existing Morro Bay Power Plant

If plume abated cooling towers are not proposed, then the hybrid cooling alternatives become least preferred overall because of the significant visual impacts associated with conventional cooling tower vapor plume formation. Furthermore, if plume abated cooling towers are not proposed under the hybrid cooling alternatives, the existing Morro Bay Power Plant would be preferred over the hybrid cooling alternatives.

The AFB alternative is not preferred because of the residual degradation of visual quality that would be experienced from a portion of The Embarcadero and Coleman Drive even with a reduction in pile heights.

PLACEHOLDER FIGURE 7

MORRO BAY POWER PROJECT – KOP LOCATIONS

PLACEHOLDER FIGURE 8

KOP 8 PROJECT W/ AIR CONDENSERS & 20'...

PLACEHOLDER FIGURE 9

KOP 14 PROJECT W/ AIR CONDENSERS & 20'...

PLACEHOLDER FIGURE 10

KOP 15 PROJECT W/ AIR CONDENSERS & 20'...

4.11 WASTE MANAGEMENT

Alvin Greenberg, Ph.D.

Introduction

This section evaluates the waste management impacts of dry cooling and hybrid cooling technologies for the MBPP project. The technical area of waste management encompasses both hazardous and non-hazardous wastes that are generated during facility construction and operation. Construction wastes include those associated with site preparation, such as contaminated soil from excavating activities, in addition to those generated during actual facility construction. Once-through cooling does not generate any wastes during operation.

Waste Management Impacts of Dry Cooling

Wastes generated during construction of the air-cooled condenser (ACC) would consist of relatively minor amounts of hazardous and non-hazardous wastes such as: excess paint, packing materials, concrete, lumber, spent solvent, and clean-up materials. The amount of soil that would need to be excavated would depend on the final design chosen, but may not be significant if the ACC were built on pilings. Classification of the excavated material would take place after it is stockpiled. It would then be sampled and analyzed to determine on-site reuse or off-site disposal options in accordance with the final Site Mitigation and Implementation Plan. Dry cooling would not generate any wastes during operation.

Waste Management Impacts of Hybrid Cooling

Construction of either of the hybrid cooling alternatives would generate types of wastes similar to those from the other cooling technologies. The amount of soil from excavation activities could be larger, since pilings would not likely be used for the wet cooling towers. Instead, a basin would be constructed that would be placed on the ground, with some excavation required. There could be minor amounts of additional waste generated from construction of a pipeline used to bring cooling water to the MBPP site from the Morro Bay-Cayucos Water Treatment Plant, located about 1 mile to the north.

During operation of a wet cooling tower, relatively minor amounts of sludge collects in the basin of the cooling tower and would require removal every few years. The sludge would require testing to determine its classification as hazardous or non-hazardous.

Waste Management Impacts of the Aquatic Filter Barrier

Construction and placement of the aquatic filter barrier (AFB) would not be expected to generate any wastes unless fabrication was conducted on-site, in which case, only minor non-hazardous wastes consisting mostly of debris would be generated. No soil excavation activities would be expected.

Conclusion for Waste Management

Staff does not consider the waste management impacts from the cooling technologies to be significantly different, since rather minor amounts of wastes would be generated from any of the technologies. All impacts are less than significant. Although once-through and dry cooling do not generate any operational wastes, the hybrid cooling option also does not generate any significant amounts from operation. The types of construction wastes generated would be similar for the dry cooling and hybrid cooling technologies. Minimal to no waste would be generated during construction of the AFB.

4.12 SOIL AND WATER RESOURCES

Joe Crea, Dominique Brocard, Jim Henneforth, Jim Thurber, and Mike Krolak

Introduction

This section analyzes potential impacts on soil and water resources from the construction and operation of two cooling systems that could be used in place of once-through cooling: (1) dry cooling, and (2) hybrid cooling. The analysis focuses on the potential for induced erosion and sedimentation and adverse impacts to water quality and supply resulting from the construction of these alternative cooling technologies. This section also analyzes potential impacts on soil and water resources resulting from the installation and maintenance of the Aquatic Filter Barrier (AFB).

Soil and Water Impacts of Dry Cooling

Dry Cooling Alternative One

The air-cooled condensers (ACCs) used for Dry Cooling Alternative One would encompass approximately 1.6 acres. The ACCs would be located between the proposed power block and the existing Peregrine Building.

Earthmoving activities would primarily be limited to the construction of the ACCs. Accelerated wind- and water-induced erosion could result from such earthmoving activities, which in turn could ultimately result in increased sediment loads within nearby receiving waters. However, impacts related to erosion and sedimentation would be less than significant due to compliance with requirements of the Clean Water Act. The earthmoving required for Dry Cooling Alternative One would be included as part of the overall National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharge from construction activities. As required within the permit, the Applicant would be required to develop a Stormwater Pollution Prevention Plan (SWPPP) that identifies Best Management Practices (BMPs) used to properly manage the quantity and quality of stormwater with regard to erosion and sedimentation. Examples of BMPs are: the use of sediment barriers, limiting the amount of exposed area, conveyance channels, sediment traps, and stormwater control devices.

Project excavation could disturb potentially contaminated soils and/or groundwater. Refer to the **Soil and Water** and **Waste Management** sections of the FSA for discussions on contaminated soils and groundwater that specify appropriate mitigation measures and Conditions of Certification to ensure impacts are less than significant.

Dry Cooling Alternative Two

The ACCs used for Dry Cooling Alternative Two would encompass approximately 1.8 acres. The ACCs would be located north of the proposed MBPP, abutting the northern bank of Willow Camp Creek.

The ACC location may potentially lie within a floodplain and would need to be elevated and/or bermed for flood protection and/or prevention purposes. Earthmoving activities for this alternative would be greater than Dry Cooling Alternative One in order to construct a berm for the ACCs. However, impacts related to flooding would be less than significant because the Applicant would need to comply with Federal Emergency Management Agency and the City of Morro Bay's flood permits. Erosion and sediment impacts would be comparable to Dry Cooling Alternative One; however, more stringent BMPs would be required due to the ACCs' proximity to Morro Creek and Willow Camp Creek. Earthen berms constructed to direct sediment-laden runoff to a sediment trap, coupled with limiting exposed areas and upstream runoff, are examples of highly effective erosion and sediment control BMPs. Examples of stormwater BMPs include water quality devices such as oil skimmers and extensive water quality monitoring to ensure that potential water-borne pollutants are contained on-site.

Excavation activities may encounter potentially contaminated soils and/or groundwater; therefore, proper handling and disposal procedures may be required. Refer to the **Soil and Water** and **Waste Management** sections of the FSA for discussions on contaminated soils and groundwater and appropriate mitigation measures and Conditions of Certification to ensure that impacts are less than significant.

Soil and Water Impacts of Hybrid Cooling

Hybrid Cooling Alternative One

The hybrid cooling option would entail two 2-celled cooling towers, air-cooled condensers (ACCs), and water supply and discharge pipelines. Total ground disturbance for this hybrid cooling option would be about 1.3 acres.

In order to provide cooling water for the MBPP project from the Morro Bay-Cayucos Wastewater Treatment Plant (MBCWTP), water pipelines and an additional wastewater treatment facility would be required. Approximately 1.5 acres of land would be disturbed to accommodate the additional treatment facility. The pipelines, which would extend approximately 0.4 miles from the MBPP to the MBCWTP, would be installed underground along two potential routes. Whichever route is chosen, the pipelines would have to cross Morro Creek.

Because a SWPPP would be required, impacts related to erosion and sediment control and stormwater runoff would be less than significant. Refer to the previous impact analyses for a more detailed discussion and for examples of BMPs. Boring under Morro Creek could cause a "frac-out"[2] and potentially release suspended contaminated sediments into the channel. However, impacts would be less than significant with the implementation of a suitable Frac-Out Contingency Plan. If trenching across the Creek were selected, appropriate BMPs (through coordination with the U.S. Army Corps of Engineers) would ensure that impacts related to erosion and sedimentation would be less than significant.

Excavation activities may disturb potentially contaminated soils and/or groundwater; therefore, proper handling and disposal procedures may be necessary. Refer to the

[2] A "frac-out' can occur during boring (horizontal drilling) below a creek or river when drilling fluids under pressure find their way into subsurface fractures, potentially resulting in contamination of the surface water.

Soil and Water and **Waste Management** sections of the FSA for discussions on contaminated soils and groundwater, and appropriate mitigation measures and Conditions of Certification to ensure less than significant impacts.

Hybrid Cooling Alternative Two

The ACCs and cooling towers used for Hybrid Cooling Alternative Two would disturb a total of about 1.5 acres of on-site land.

The ACC and cooling towers may potentially lie within a floodplain and would need to be elevated and/or bermed for flood protection and/or prevention purposes. Therefore, earthmoving activities for this alternative would be greater than Hybrid Cooling Alternative One due to the need to construct a berm for the cooling structures. However, impacts related to flooding would be less than significant because the Applicant would be required to comply with the Federal Emergency Management Agency and the City of Morro Bay's flood permits. In addition, water supply/wastewater discharge pipelines would have to cross Willow Camp Creek and Morro Creek. Erosion and sediment impacts would be comparable to Hybrid Cooling Alternative One; however, more stringent BMPs would be required due to the proximity of the hybrid cooling structures to Morro Creek and Willow Camp Creek. Refer to the Dry Cooling Alternative Two discussion for examples of BMPs.

Excavation activities could encounter potentially contaminated soils and/or groundwater; therefore, proper handling and disposal procedures would be necessary. Refer to the **Soil and Water** and **Waste Management** sections of the FSA for discussions on contaminated soils and groundwater and appropriate mitigation measures and Conditions of Certification to ensure impacts are less than significant.

Soil and Water Impacts of the Aquatic Filter Barrier

The Aquatic Filter Barrier (AFB) would require the installation of single pilings or a pair of pilings to keep the filter barrier in place. During construction of the AFB, there would be a potential for bay sediment to become suspended. Also, during maintenance activities a burst of air would be directed into the mesh barrier to clear it of debris. This activity would also cause sediment and other particles to become suspended. The sedimentation impact would be short-lived and with proper BMPs would be considered a less than significant impact. Cofferdams and aquatic silt curtains would be examples of BMPs to be used during construction.

Conclusion for Soil and Water Resources

The once-through cooling process would require minor earth disturbance activities that would occur as a result of the tie-in pipelines for the proposed MBPP to the existing lines. Erosion and sedimentation impacts would be less than significant because there is feasible mitigation that would be included as part of the NPDES permit requirements for stormwater discharge from construction activities.

Dry Cooling Alternative One would be limited to on-site earthmoving activities and the ACCs would encompass approximately 1.6 acres. Dry Cooling Alternative Two would require additional earthmoving if the existing location is determined to be likely to encounter flooding. Hybrid Cooling Alternative One would require both on-site and off-site earthmoving activities as well as boring under, or trenching through, Morro Creek. Hybrid Cooling Alternative Two would require additional earthmoving to create a berm in order to prevent potential flooding. Hybrid Cooling Alternative Two would also require both on-site and off-site earthmoving activities as well as boring under, and trenching through, Morro Creek and Willow Camp Creek. Because earthmoving activities related to Dry Cooling Alternative One would be limited to the MBPP site, this option would have fewer impacts than Dry Cooling Alternative Two and both Hybrid Cooling Alternatives One and Two.

The AFB would only be used with once-through cooling. No land-based erosion and sedimentation would occur as a result of the AFB installation and operation, since the AFB would be installed within the bay. Sedimentation could occur during the construction and maintenance of the AFB, but appropriate BMPs would make impacts associated with this activity less than significant. Dry Cooling Alternative One would create the fewest erosion and sedimentation impacts, although all of the alternatives would have impacts that are less than significant for soil and water resources.

5 ENGINEERING ANALYSIS OF COOLING OPTIONS

5.1 FACILITY DESIGN

Brian Payne

Facility Design encompasses the civil, structural, mechanical, and electrical engineering design of the project. The purpose of the Facility Design analysis is to, among other things, provide reasonable assurance that the project can be designed and constructed in accordance with all applicable LORS and in a manner that assures public health and safety. Conditions of Certification have been established that will ensure that the proposed power plant is designed and constructed in compliance with applicable LORS.

Introduction

Three cooling options are evaluated for the MBPP: a dry cooling system, a hybrid cooling system, and use of the Aquatic Filter Barrier (AFB). Each of the cooling system alternatives would require the construction of some fixed facilities (e.g., foundations, structures, mechanical systems, electrical systems, control systems, etc.). The Conditions of Certification for the proposed project (as defined in the **Facility Design** section of this FSA) cover the design and construction of these types of fixed facilities. The structural and mechanical aspects of a Gunderboom AFB would also be covered by the proposed Conditions of Certification.

Facility Design Impacts of Dry Cooling

The dry cooling system would require the construction of some fixed facilities (e.g., foundations, structures, mechanical systems, electrical systems, control systems, etc.). The proposed Conditions of Certification cover the design and construction of these types of fixed facilities. If the dry cooling system is selected, Table 1 in the **Facility Design** section of this FSA will need to be revised accordingly.

Facility Design Impacts of Hybrid Cooling

The hybrid cooling system alternative would also require the construction of some fixed facilities (e.g., foundations, structures, mechanical systems, electrical systems, control systems, etc.). The Conditions of Certification for the proposed project cover the design and construction of these types of fixed facilities. If the hybrid cooling system is selected, Table 1 in the **Facility Design** section of this FSA will need to be revised accordingly.

Facility Design Impacts of the Aquatic Filter Barrier

The aquatic filter barrier (AFB) would require the construction of some mechanical and structural components. The Conditions of Certification for the proposed project cover the design and construction of these types of fixed facilities. If an AFB is selected, Table 1 in the **Facility Design** section of this FSA will need to be revised accordingly.

Conclusion for Facility Design

The proposed Conditions of Certification adequately address the engineering concerns associated with all three cooling system options. If an alternative cooling system is selected, Table 1, included in the **Facility Design** FSA section, will need to be revised.

This table lists the major structures and equipment associated with the facility. The proposed Conditions of Certification require the Applicant to submit pertinent design documents for these major structures and equipment to the Chief Building Official (CBO). The CBO would then verify that the designs and construction are in accordance with applicable LORS.

5.2 GEOLOGY AND PALEONTOLOGY

Neal Mace

Introduction

The structures for Dry Cooling Alternative One and Hybrid Cooling Alternative One would be located to the south of the existing tank farm, between the proposed combined cycle combustion turbine facility and the existing power plant. The structures for Dry Cooling Alternative Two and Hybrid Cooling Alternative Two would be located northeast of the existing tank farm on the opposite side of Willow Camp Creek. The Gunderboom AFB is a passive screen technology that would be located in front of the cooling water intake system in Morro Bay Harbor, immediately west of the Power Plant.

Geology and Paleontology Impacts of Dry Cooling

The Morro Bay Power Plant facility is located on a low-lying coastal terrace at the northern end of Morro Bay. The terrace is underlain by bedrock of the Franciscan Formation at elevations of -50 to -80 feet (mean sea level datum) beneath the proposed project site. Morro Rock is located approximately 2,000 feet west of the site. The structures for the dry cooling alternatives would overlie dune sand, estuarine deposits, and hydraulic fill, which blanket the coastal terrace. Borings completed by Hushmand Associates (2000a) in the immediate vicinity of Dry Cooling Alternative One indicate that the structures for this alternative would be underlain by loose-to-medium dense silty sand with local estuarine deposits. Site-specific geotechnical data for location of Dry Cooling Alternative Two is not available, but sub-surface conditions are expected to be similar to conditions encountered near the location of Dry Cooling Alternative One.

Faulting and Seismicity

No active or potentially active faults are known to cross the power plant footprint or the harbor area and no indications of surface faulting were observed at the power plant site during the site visit. Therefore, the potential of surface rupture on a fault beneath the proposed footprints of the dry cooling alternatives is considered to be very low.

The ground shaking impacts of the dry cooling alternatives are also identical. The Applicant calculated a peak ground acceleration at the Morro Bay Power Plant site of 0.33g associated with a magnitude 6.8 earthquake on the Los Osos fault (DUKE, 2000a), located 8 kilometers south of the plant site. The Applicant’s geotechnical consultant, Hushmand Associates (2000a), also performed the probabilistic analysis, using the Abrahamson-Silva (1997), Campbell (1997), and Sadigh (1997) attenuation relationships to calculate peak ground accelerations at the Morro Bay Power Plant site of 0.30g for the Design Basis Earthquake and 0.39g for the Upper Bound Earthquake. These events are defined by the 1997 UBC as having probabilities of exceedance of 10% in 50 years (for the Design Basis Earthquake) and 10% in 100 years (for the Upper Bound Earthquake). These values are consistent with the California Division of Mines and Geology (CDMG) Map Sheet 48, which predicts a peak ground acceleration with a 10% chance of exceedance in 50 years of between 0.3g and 0.4g for the project area.

Liquefaction and Expansive Soils

During the preliminary geotechnical investigation for the proposed MBPP Modernization Project the depth to groundwater beneath the site generally varied from approximately four feet below existing grade to 14 feet below existing grade (Hushmand Associates, 2000a). The combination of saturated sand and silty sand of varying density beneath the locations for the dry cooling structures and the potential for a moderately high peak ground accelerations at the site points to a potential for liquefaction. Hushmand Associates (2000a) concluded that localized liquefaction in unconsolidated sand layers could result in several inches of settlement. As a result, their report recommends the use of pile foundations for “relatively heavy structures” (Hushmand Associates, 2000a).

The potential for liquefaction induced lateral spreading within the soils beneath most of the proposed dry cooling structure locations is considered low because of the low surface gradients at the project site and the heterogeneous nature of the liquefiable soils.

Potentially expansive clays occur at depths of 15 to 70 feet beneath the site (Hushmand, 2000a) and may also occur in Morro Bay Harbor. However, at these depths, the estuarine deposits do not undergo the changes in moisture content required to produce expansion. As a result, the potential for damage to the project facilities from expansive soils is expected to be low.

Tsunami

Tsunamis occurred in the Morro Bay area in 1878, 1946, 1953, 1960, and 1964, resulting in localized damage to piers, wharves, and buoys in Morro Bay Harbor (DUKE, 2000a). The ground surface elevation at the proposed dry cooling alternative sites is above the maximum run up attributed to these historic tsunamis. Therefore, the potential for damage to the dry cooling structures from a tsunami is expected to be low.

Slope Failures

Since the dry cooling alternatives are located on a coastal terrace that has a slope of between 1% and 2%, the potential for slope failures is considered to be low.

Geological and Paleontological Resources

No significant sand and gravel resources of the quality required to produce Portland cement concrete have been identified in the project area (DUKE, 2001b) and no other significant mineralogical resources are known to exist in the project area.
The paleontological assessment included both an archival record search from the University of California, Berkeley, Museum of Paleontology and a field survey of the project site on February 1, 1999 (Govean, 1999). The paleontological assessment concluded that the sediments beneath the power plant site are geologically very young and the proposed project site footprint was highly disturbed during the construction of the original MBPP. Therefore, both the proposed project and the proposed dry cooling alternatives are believed to have a low paleontologic sensitivity.

Geology and Paleontology Impacts of Hybrid Cooling

The hybrid cooling alternatives are generally located within the same footprints as the dry cooling alternatives. Therefore, the geologic and paleontologic impacts of the hybrid cooling alternatives are essentially identical to the geologic and paleontologic impacts of the dry cooling alternatives, described above.

Geology and Paleontology Impacts of Aquatic Filter Barrier

The AFB would likely be supported by piles driven into the estuarine deposits in Morro Bay Harbor.

Faulting and Seismicity

No active or potentially active faults are known to cross the harbor area. Therefore, the potential of surface rupture on a fault beneath the AFB is considered to be very low. The ground shaking impacts of the cooling alternatives and the AFB system are also identical. In addition, liquefiable soils are also likely to be present in Morro Bay Harbor where the AFB would be located.

The only seismic hazard that is significantly greater for the AFB than for the existing plant or the proposed project and the dry and hybrid cooling alternatives is the threat of a tsunami. A tsunami would potentially damage the AFB in the harbor.

Geological and Paleontological Resources

The sediments in the harbor are also very young and would only be disturbed by pile driving activities. As a result the AFB is also expect to have a low paleontologic sensitivity.

Conclusion for Geology and Paleontology

The Applicant will likely be able to comply with applicable LORS for any of the cooling alternatives. No significant geologic or paleontologic resources have been identified in the project area. The significant geologic hazards associated with the proposed cooling alternatives are strong ground shaking and liquefaction potential. The potential impacts of these seismic hazards on the cooling alternatives are expected to be nearly identical to their potential impacts on both the existing power plant and the proposed project. The AFB would also be at risk from a tsunami. The LORS require preparation of an Engineering Geology Report that addresses these issues and provides design recommendations to mitigate any potential impacts associated with liquefaction and strong ground shaking.

The cooling alternatives should have no adverse impact with respect to geologic hazards or geological and paleontological resources if project construction complies with the LORS requirements outlined in the Conditions of Certification for Geology and Paleontology.

5. 3 POWER PLANT RELIABILITY AND EFFICIENCY

Steve Baker

Introduction

If the cooling system of a combined cycle power plant such as Morro Bay fails to operate, or operates at a level of effectiveness lower than intended, the plant's power output may be curtailed (reduced), or the plant may be forced to shut down entirely. Additionally, the plant's fuel efficiency would be adversely impacted by any degradation of cooling system effectiveness.

Reliability Impacts of Dry Cooling

Once-through ocean water cooling provides a reliable source of nearly constant temperature cooling water that ensures optimum power plant operation year-round. While severe storms could cause the system to become clogged with sand or marine life such as kelp, degrading cooling system performance, this would be a very rare occurrence.

Dry cooling relies on the dry bulb temperature of the ambient air to provide the needed cooling effect. In hot climates, extremely hot days may degrade cooling system performance, causing partial curtailment of power output or, in the worst case, total shutdown of the power plant. In the marine climate of Morro Bay, however, it is highly unlikely that such extremely hot days will occur. Significant adverse impacts on plant reliability from use of dry cooling are therefore unlikely.

Dry Cooling Alternatives One and Two would produce identical effects from a reliability standpoint.

Efficiency Impacts of Dry Cooling

Once-through ocean water cooling maximizes power plant fuel efficiency by providing a continuous source of effective cooling for the plant's steam condensers.

Dry cooling will typically provide less effective cooling of the condensers, reducing the efficiency of the steam cycle portion of the power plant, and thus the overall fuel efficiency of the facility. Since only about one-third of the power from a combined cycle power plant is produced by the steam cycle, however, this negative impact on fuel efficiency is diluted. An analysis of the Sutter Power Project (97-AFC-2) showed that annual average fuel efficiency would be reduced 1.5% compared to a wet cooling system. A similar reduction in efficiency could be expected for the Morro Bay Power Plant (MBPP). Energy Commission staff concluded that the reduction in water consumption and wastewater production justified the use of dry cooling at Sutter. The benefits under consideration for the MBPP Project include elimination of entrainment, impingement, and thermal effects.

Dry Cooling Alternatives One and Two would produce identical effects from an efficiency standpoint.

Reliability Impacts of Hybrid Cooling

A hybrid cooling system can be expected to yield reliability at least as great as a dry cooling system, and probably greater, due to the inherent redundancy of the combination of dry and wet (or dry and once-through) systems. Significant adverse impacts on plant reliability from use of hybrid cooling are therefore unlikely. Hybrid Cooling Alternatives One and Two would produce identical effects from a reliability standpoint.

Efficiency Impacts of Hybrid Cooling

A hybrid cooling system can be expected to provide cooling more effectively than a dry cooling system, especially on the very hot days when dry cooling system performance would show the most degradation. While still less effective on an annual average basis than once-through ocean water cooling, a hybrid system would reduce the loss of power plant fuel efficiency to less than the 1.5% reduction that might be expected with a dry cooling system. Incorporation of a hybrid cooling system would thus present less of an adverse impact on fuel consumption than dry cooling, but would still likely be less efficient than once-through cooling.

Hybrid Cooling Alternatives One and Two would produce identical effects from an efficiency standpoint.

Reliability and Efficiency Impacts of the Aquatic Filter Barrier

Neither reliability nor efficiency of the power plant should be significantly affected by incorporation of the AFB.

Conclusion for Reliability

Once-through ocean water cooling is the most reliable method for cooling the MBPP Project. Dry cooling, hybrid cooling, and the AFB may exhibit slight adverse impacts on plant reliability, but it is not expected that these impacts would be significant.

Conclusion for Efficiency

Once-through ocean water cooling should yield maximum fuel efficiency. Dry cooling will likely provide a reduction of fuel efficiency up to 1.5%; a hybrid cooling system would likewise reduce fuel efficiency, but to a lesser degree. The AFB should have no significant impact on fuel efficiency.

6 CONCLUSION: COMPARISON OF COOLING OPTIONS

Chapters 4 and 5 of this Appendix describe the potential impacts of dry cooling and hybrid cooling facilities (each in two possible locations), and the Aquatic Filter Barrier (AFB) to serve the Morro Bay Modernization Project. These cooling facilities would replace (or modify, in the case of the AFB) the proposed use of once-through cooling. This study was undertaken because of potential significant impacts of once-through cooling to aquatic biological resources, and to satisfy the request of the CCRWQCB for site-specific CEQA analysis of impacts of proposed cooling alternatives.

The environmental and engineering disciplines can be divided into two groups: those with the potential for significant impacts that would be difficult to mitigate, and those with little to no potential for significant impacts (either because impacts are negligible, or because impacts that are identified can be reduced to an insignificant level through application of readily available mitigation measures). Technical areas in which impacts would be less than significant for all three types of cooling (some with implementation of mitigation or conditions of certification) are the following:

- Air quality
- Hazardous materials
- Worker safety and fire protection
- Noise
- Public health
- Traffic and transportation
- Soil and water resources
- Geology and paleontology
- Biological resources (terrestrial)
- Waste management
- Power plant reliability and efficiency

Staff notes that the Applicant has indicated that it would disagree with both the nature of staff's analysis and our conclusions for three of these technical areas: air quality, noise, and power plant efficiency. Staff has addressed the Applicant's concerns in the text of the analysis; conclusions are summarized below:

- **Air Quality:** Emissions for dry and hybrid cooling would be greater than those for once-through cooling, but impacts are found to be less than significant because offsets are required for all emissions. Particulate emissions would be slightly greater with both dry and hybrid cooling because in dry cooling, fans would re-suspend particulate matter in the area, and hybrid cooling creates minor particulate emissions associated with cooling tower drift. This conclusion in air quality leads to a similar conclusion in the public health analysis that impacts of dry and hybrid cooling would also be less than significant.
- **Noise:** Noise from dry and hybrid cooling would create significant impacts if the proposed designs (as defined in Chapter 3) were used. However, for both Dry Cooling and Hybrid Cooling Alternatives One and Two, design or technology options are presented in which fan configuration or type is modified and noise levels are reduced to less than significant levels. Mitigation requirements would be less extensive for the hybrid cooling alternatives than the dry cooling alternatives, because these systems include fewer fans. The AFB would not create significant noise impacts.
- **Power Plant Efficiency:** As described in Chapters 2 and 3, power plants cooled by dry and hybrid cooling technologies are less efficient than those using once-through cooling, so power generation is slightly reduced using these technologies. Also, additional electricity is required to operate the cooling fans, so net power generation is reduced for that reason as well. The reductions in efficiency are found to be small (1% for both dry and hybrid cooling), and they are determined not to cause significant adverse impacts on the availability of fuel or to cause wasteful or inefficient energy consumption.

Staff identified three technical areas where potential impacts from dry and hybrid cooling technologies or the AFB could be significant: cultural resources, visual resources, and land use. The conclusions of these analyses are described below.

- **Cultural Resources:** Implementation of Dry Cooling Alternative Two and Hybrid Cooling Alternative Two would affect a site that is both an archaeological resource and a registered Native American sacred site. Staff believes that it is feasible to mitigate the impact to archaeological resources, but does not know if it is feasible to mitigate the potential impact to traditional cultural values. To make that determination, staff would need to ascertain whether the site is also eligible for the California Register of Historic Resources based on its traditional cultural values. If the site were determined to be eligible based on its traditional cultural values, the project impact would be significant and unmitigable. If the site were not determined eligible, staff would consider the project's impact on the traditional cultural values represented by the site to be less than significant and the only mitigation required would be that for the archaeological resources associated with the site.

- **Visual Resources:** The visual impacts of each cooling option are evaluated from key viewpoints surrounding the Morro Bay site. Visual impacts of both the dry cooling and the hybrid cooling alternatives are found to be significant when viewed from several viewpoints, but impacts are mitigable. The impacts of the vapor plume from the hybrid cooling towers would be significant if plume abatement systems were not implemented, but plume abatement is considered to be feasible. The AFB alternative causes significant adverse impacts because of the degradation of visual quality that would be experienced from a portion of The Embarcadero and Coleman Drive. These impacts are not mitigable.
- **Land Use:** The dry and hybrid cooling alternatives (at either site) would create land use incompatibility impacts stemming from inconsistencies with adopted land use designations and zoning. In addition, the significant adverse visual impacts have been identified for the AFB would create significant adverse land impacts as well.

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