SECTION 6.0

Alternatives

This section discusses alternatives to the Redondo Beach Energy Project (RBEP) as proposed in this Application for Certification (AFC). The alternatives analyzed include the "no project" alternative, technology alternatives, water supply alternatives, and wastewater disposal alternatives. These alternatives are discussed in relation to the environmental, public policy, and business considerations involved in developing the project. The primary objective of RBEP is to supply environmentally responsible, cost-effective, operationally flexible, and efficient electrical generating capacity in southern California.

This section evaluates reasonable alternatives to RBEP that could feasibly attain most of the project objectives and reduce or eliminate any significant effects of the project.

6.1 Project Objectives

The key objective of RBEP is to provide up to 496 megawatts (MW) of environmentally responsible, cost-effective, operationally flexible, and efficient generating capacity to the Los Angeles Basin Local Reliability Area in general, and specifically to the western Los Angeles Basin sub-area.[1] The project will provide local capacity for reliability needs, serve peak southern California energy demand, and provide controllable generation to allow the integration of the ever-increasing contribution of variable renewable energy into the electrical grid. The project will displace older and less efficient generation in southern California, and has been designed to start and stop very quickly and frequently and be able to quickly ramp up and down through a wide range of electrical output. As more renewable electrical resources are brought on line as a result of electric utilities meeting California's Renewable Portfolio Standard, projects strategically located within load centers and designed for fast starts and ramp-up/ramp-down capability, such as RBEP, will be critical in supporting local electrical reliability and grid stability.

Consistent with the Energy Action Plan, as drafted by the California Energy Commission (CEC) and the California Public Utilities Commission, RBEP will assist in meeting the state's goal of ensuring that electric energy in the state is "adequate, affordable, technologically advanced, and environmentally sound." It will also assist in meeting greenhouse gas reduction targets under the Global Warming Solutions Act of 2006 (AB-32), and will help utilities integrate renewable energy into their systems as required under the state's RPS. RBEP will also provide needed electric generation capacity with improved efficiency and operational flexibility to help meet southern California's long-term electricity needs and Clean Air objectives. The California Independent System Operator (CAISO) has identified a need for new power generation facilities in the western sub-area of the Los Angeles Basin Local Reliability Area to replace the ocean water once-through-cooling (OTC) plants that are expected to retire as a result of the California State Water Resources Control Board's (SWRCB) *Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling* (OTC Policy) (CAISO, 2012a; SWRCB, 2010). The results from CAISO's year 2021 long-term Local Capacity Requirement study estimates that between 2,370 and 3,741 MW[2] of replacement OTC generation is required in the Los Angeles Basin to meet the future needs of the area. The requirement for new generation in light of OTC retirements in the Los Angeles Basin, along with other long-term transmission planning assumptions, is also confirmed in CAISO's Once-Through Cooling and AB-1318 Study Results presented on December 8, 2011 (CAISO, 2011). CAISO also notes that many of the OTC facilities are in locations critical to local electrical reliability and repowered or replacement generating capacity with characteristics that support renewable integration in these same locations would provide both local capacity for reliability and essential grid support for a future with ever increasing amounts of variable renewable energy, thereby reducing the number of total megawatts required compared to new generation developed elsewhere (CAISO, 2012b).

[1] As defined by the CAISO's "Local Capacity Technical Study Overview and Results" report dated April 17, 2012.

[2] This range of OTC replacement capacity corresponds to the CAISO "Trajectory" planning scenario, which has been defined as the most likely planning scenario.

The project objectives also include using qualifying technology under the South Coast Air Quality Management District's (SCAQMD) Rule 1304(a)(2) that allows for the replacement of older, less efficient electric utility steam boilers with specific new generation technologies on a megawatt to megawatt basis (that is, the replacement megawatts are equal or less than the megawatts from the electric utility steam boilers). The Rule 1304(a)(2) requires the electric utility steam boiler be replaced with one of several specific technologies, including the combined-cycle configuration used in the RBEP design.

RBEP was designed to address the local capacity requirements within the Los Angeles Basin with the following objectives:

- Provide the most efficient, reliable, and predictable generating capacity available by using combined-cycle, natural-gas-fired combustion turbine technology to replace the OTC generation, support the local capacity requirements of southern California's western Los Angeles Basin Local Reliability Area and be consistent with SCAQMD Rule 1304(a)(2).
- Develop a 496-MW project that provides efficient operational flexibility with rapid-start and steep ramping capability to allow for the efficient integration of renewable energy sources into the California electrical grid.
- Serve southern California energy demand with efficient and competitively priced electrical generation.
- Develop on a brownfield site of sufficient size and reuse existing offsite electrical, water, wastewater, natural gas infrastructure and land to minimize terrestrial resource impacts.
- Site the project to serve the western Los Angeles Basin load center without constructing new transmission facilities.
- Assist in developing increased local generation projects, thus reducing dependence on imported power and associated transmission infrastructure.
- Ensure potential environmental impacts can be avoided, eliminated, or mitigated to less-than-significant levels.

Locating the project on an existing power plant site avoids the need to construct new linear offsite facilities, including gas and water supply lines, discharge lines, and transmission interconnections. This reduces potential offsite environmental impacts, and the cost of construction. The proposed RBEP site meets all project siting objectives.

Additionally, as demonstrated by the analyses contained in this AFC, the project will not result in any significant environmental impacts. Therefore, as detailed in the following sections, there are no alternatives that would be preferred over the project as proposed.

6.2 Project Overview

RBEP is a 496-MW[3] natural-gas-fired power plant, consisting of one 3-on-1 combined-cycle gas turbine power block. The power block includes three combustion turbine generators (CTG), three supplemental-fired heat recovery steam generators (HRSG), one steam turbine generator (STG), an air-cooled condenser, and related ancillary equipment. RBEP will be constructed entirely within the existing approximately 50-acre Redondo Beach Generating Station site in Redondo Beach, California. The project will use the existing onsite potable water, natural gas, stormwater, process wastewater, and sanitary pipelines and electrical transmission facilities. No offsite linear developments are proposed as part of the project.

RBEP will use potable water, provided by the California Water Service Company, for construction water and for operational process and sanitary uses. During RBEP operation, stormwater and process wastewater will be discharged to a retention basin and then ultimately to the Pacific Ocean via an existing permitted outfall. Sanitary wastewater will be conveyed to the Los Angeles County Sanitation District via the existing City of Redondo Beach

[3] Referenced to site ambient average temperature (SAAT) conditions of 63.3°F dry bulb and 58.5°F wet bulb temperature.

sewer connection. A new onsite 230–kilovolt (kV) transmission interconnection will connect the RBEP power block to the existing onsite Southern California Edison (SCE) 230-kV switchyard.

Construction and demolition activities at the project site are anticipated to last 60 months, from January 2016 until December 2020. The first activities to occur on site will be the dismantling and partial removal of existing Units 1–4. The major generating equipment including steam turbines, generators, boilers, and duct work will be removed, leaving the administration building and western portion of the building that houses Units 1–4 intact. These buildings will be left standing temporarily to provide screening between the construction site of the new power block and Harbor Drive. Construction of the new power block will begin in the first quarter of 2017 and continue through to the end of the second quarter 2019, when it will be ready for commercial operation. Although operational, construction will continue through 2019 including construction of the new control building and the relocation of the Wyland Whaling Wall. The existing Units 5–8 and auxiliary boiler no. 17 will remain in service until the second quarter of 2018. Units 5–8 and auxiliary boiler no. 17 will be demolished starting the first quarter of 2019 through the fourth quarter of 2020. During the demolition and removal of Units 5–8, the Wyland Whaling Wall will be dismantled and moved to a new location directly in front of the new power block. Finally, the remaining buildings and structures left standing will be demolished and removed by the end of 2020.

All laydown and construction parking areas will be located within the existing Redondo Beach Generating Station fence line, as shown in Figure 2.1-1. Approximately 17 acres onsite will be used for construction laydown and parking. All construction equipment and supplies will be trucked directly to the site.

6.3 Alternatives Analysis Regulatory Requirements

The Energy Facilities Siting Regulations (Title 20, California Code of Regulations [CCR], Appendix B) guidelines titled *Information Requirements for an Application* require:

> A discussion of the range of reasonable alternatives to the project, including the no project alternative…which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and an evaluation of the comparative merits of the alternatives.

The regulations also require:

> A discussion of the applicant's site selection criteria, any alternative sites considered for the project and the reasons why the applicant chose the proposed site.

Additionally, the California Environmental Quality Act's Guidelines for Implementation, Title 14 CCR Section 15126.6(a), requires an evaluation of project alternatives based on the comparative merits of "a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project." The analysis must also address the "no project" alternative (14 CCR Section 15126.6 (e)). The Guidelines further state that the range of alternatives is governed by the "rule of reason," which requires consideration only of those alternatives necessary to permit a reasoned choice and to foster informed decision making and public participation (14 CCR Section 15126.6 (f) (3)).

6.4 The No Project Alternative

The no project alternative is a scenario where no new project is undertaken. Existing conditions and infrastructure would remain in place and continue to operate or cease operations. Under the no project alternative, the existing Redondo Beach Generating Station would still need to comply with the SWRCB's OTC policy, by either replacing the present ocean water OTC system with a closed-loop cooling system; employing other engineered solutions to reduce impingement and entrainment of marine life through the OTC system; or ceasing operations.

The existing plant could be retrofitted with a closed-loop cooling system, which would not use ocean water. Such a system would consist of a cooling tower utilizing wet cooling technology or a dry cooling system. Wet cooling technology would employ massive cooling towers that would take up all of the free space at the current site.

Because 100 percent of the power generated from the existing plant is from steam, as opposed to only one-third from the proposed project, and the existing plant is more than twice the generating capacity of the proposed project, the cooling requirements of the existing Redondo Beach Generating Station are significantly greater than what is required for RBEP. Additionally, a wet cooling system would have a visible plume and require substantial fresh water to operate. Because the availability of Title 22 Reclaimed water is limited in the South Bay area, cooling tower water requirements would have to be met with potable fresh water.

A dry cooling system would employ an air-cooled condenser, which would have to be large enough to meet the cooling demand of the existing steam generator units. An air-cooled condenser large enough for the existing plant is not feasible on the limited land available at the existing Redondo Beach Generating Station. A replacement closed-loop cooling system, using either wet or dry cooling technology was rejected as a feasible option at the Redondo Beach Generating Station because these options would either place a significant demand on local water supplies, result in a larger industrial site, cause local visibility issues, or would not be possible on the limited land available at the Redondo Beach Generating Station. In addition, a closed-loop cooling system would extend the life of an antiquated, less efficient and much less flexible generating resource.

Other engineered solutions for the ocean water intake include technology and systems that have not yet been demonstrated beyond the conceptual or pilot project scale. There has been some progress made with certain efforts to limit the impacts from impingement and entrainment into intake systems on rivers; however, offshore ocean intake solutions are still very much in the research and development stages. For this reason, a retrofit of the ocean water cooling intakes at Redondo Beach Generating Station was rejected as a possible option.

Based on CAISO's 2021 projection of the need for OTC replacement generation, decommissioning existing OTC facilities such as the Redondo Beach Generating Station units without adequate replacement generation would create reliability concerns. The no project alternative would not be preferable because of the need for economical, reliable, and environmentally sound generation resources in the region. In summary, the no project alternative would not satisfactorily meet the specified project objectives and, thus, was rejected in favor of the proposed RBEP.

6.5 Power Plant Site Alternatives

Because RBEP will be located within the boundaries of an existing power plant property (the Redondo Beach Generating Station) with operating power plant units, a discussion of site alternatives is not included in this AFC. Public Resources Code 25540.6 [b] reads, in part:

> (b) The commission may also accept an application for a non-cogeneration project at an existing industrial site without requiring a discussion of site alternatives if the commission finds that the project has a strong relationship to the existing industrial site and that it is therefore reasonable not to analyze alternative sites for the project.

RBEP will have a strong relationship to the existing industrial site. The new facilities will provide the same service in the same location as the existing facilities, utilizing the existing high-voltage electric transmission interconnection point, water pipelines and high-pressure, high-volume natural gas pipeline that serve the existing facilities. The land use designation of the site is consistent with power plant development.

No suitable alternative sites have been identified in the RBEP area, which consists of densely developed residential neighborhoods and commercial and public facilities, with little suitable open land. Therefore, because RBEP will have a strong relationship to the existing industrial site and will provide needed electric reliability service in a densely populated load pocket, and because no suitable and available alternative sites have been identified for RBEP, no alternate sites are analyzed in this AFC, and only the proposed site for RBEP is discussed below. Furthermore, if a suitable brownfield site were identified, it is unlikely that that such a site would provide the necessary infrastructure available at the proposed site. Therefore, an alternative site will likely not reduce or avoid any impacts posed at the RBEP site, which as the analysis in this AFC shows are already below significant levels, but may likely result in greater impacts than present with development of the proposed site.

6.5.1 Proposed Project Site

The proposed site for RBEP is located within the existing approximately 50-acre Redondo Beach Generating Station site located near the intersection of North Harbor Drive and Herondo Street, in Redondo Beach, California (see Figure 1.1-3). The project site is located in the city of Redondo Beach; however, the northern boundary of the plant is adjacent to the city of Hermosa Beach. The project site is bounded to the north by residential areas, to the east by a storage facility and office buildings, to the south by mixed use residential and commercial areas, and to the west by King Harbor marina and the Pacific Ocean. The existing site consists of four operating natural-gas-fired electric utility steam generating units (Units 5–8), four decommissioned units (Units 1–4) and auxiliary boiler no. 17, all located on the western border of the property closest to the ocean. To the south and east of the operating units are the former sites of five large tanks formerly used to store supplies of fuel oil prior to the elimination of fuel oil use at the Redondo Beach Generating Station. The new facilities would be developed on the two northernmost former tank sites. The existing Redondo Beach Generating Station is designated and zoned as Public/Generating Plant (P-GP), which allows construction and operation of "public utility facilities," including "any gas treatment plant, reservoir, tank or other storage facility, water treatment plant, well, reservoir, tank or other storage facility, electric generating plant, distribution or transmission substation, telephone switching or other communications plant, earth station or other receiving or transmission facility, any storage yard for public utility equipment or vehicles and any parking lot for parking vehicles or automobiles to serve a public utility." The term "public utility" is further defined to include every gas, electrical, telephone and water corporation for which a Certificate of Public Convenience and Necessity has been issued by the California Public Utility Commission (City of Redondo Beach, 2011).

The site meets all of the project's objectives and would have no significant, unmitigated, environmental impacts. The RBEP site:

- Is located adjacent to an adequately sized natural gas supply pipeline
- Is located adjacent to an existing high-voltage switchyard
- Is located near the centers of electrical demand within the western Los Angeles Basin Local Reliability Area for maximum efficiency and system benefit
- Minimizes construction impacts on existing residences and businesses
- Has feasible mitigation of potential environmental impacts

6.5.2 Summary and Comparison

Based on the following site selection criteria, it is clear that the siting of a power plant is feasible at the proposed site. Following is a summary of site selection factors:

- **Site control feasible –** Site control has been achieved at the RBEP site; the facility will be located within the boundaries of the existing Redondo Beach Generating Station.
- **Located on a brownfield site –** The new RBEP facilities will be located within an existing industrial facility, which limits potential terrestrial impacts. The existing Redondo Beach Generating Station Units 1–8 and ancillary facilities will be demolished as part of the project and the land cleaned of potential industrial contamination to the satisfaction of the California Department of Toxic Substances Control.
- **Location near electrical transmission facilities –** The RBEP site is already served by high-voltage transmission lines connecting the facility to the electrical transmission grid through the existing SCE 230-kV switchyard located within the boundaries of the existing Redondo Beach Generating Station site.
- **Location near ample natural gas supply –** The existing Redondo Beach Generating Station is presently served by an adequately sized, 20-inch-diameter natural gas pipeline owned by the Southern California Gas Company.

- **Land appropriately zoned –** The site is designated and zoned Public/Generating Plant by the City of Redondo Beach General Plan and zoning code, which allows construction and operation of major utility projects, including power plants and substations/switchyards.
- **Parcel or adjoining parcels of sufficient size for the site –** The RBEP site is adequately sized to allow for both the project site and construction.
- **Location near the centers of electrical demand –** The site is located in western Los Angeles County, where electrical demand is high because of dense development of residential, commercial, and industrial facilities, and construction of new transmission line projects to import power into the region is difficult because of the lack of open space. In addition, because of the residential, commercial, and industrial density in the region, there is also the lack of space for a development of a new power generating facility of the size of RBEP.
- **Minimizes impacts on local residents and businesses –** The RBEP site is located at an existing industrial site that has continuously been operated as a power plant for more than 50 years. With the demolition of the existing Units 1–8 and placement of RBEP on the eastern edge of the existing Redondo Beach Generating Station site, noise and visual impacts at the site would be similar or lower than what is already part of the baseline environment.
- **Mitigation of potential impacts is feasible –** As documented in this AFC, mitigation of potentially significant environmental impacts from RBEP to less than significant is feasible.

When taking into account all factors above, the RBEP site meets all project objectives. The RBEP site has a known adjacent supply of natural gas and water with an existing electrical transmission interconnection onsite. The RBEP site is zoned appropriately for power plant uses and would be located on an existing power plant site, but have a net reduced footprint. Further, the RBEP site meets the project's objectives without resulting in any adverse environmental impacts.

6.6 Alternative Project Design Features

This section addresses alternatives to some of the RBEP design features, such as the locations of the natural gas supply pipeline, electrical transmission interconnection, and water supply pipeline.

6.6.1 Alternative Natural Gas Supply Pipeline Routes

RBEP will connect to the existing natural gas pipeline; therefore, no other alternatives were analyzed.

6.6.2 Electrical Transmission System Alternatives

RBEP will connect to the existing onsite electric switchyard, which connects the existing facilities to the SCE electrical system; therefore, no other alternatives were analyzed.

6.6.3 Water Supply Alternatives

RBEP will use air-cooled condensers (dry cooling) rather than the OTC ocean water system used for the existing Redondo Beach Generating Station. An air-cooled plant typically uses less than 7 percent the total water use of a comparable wet-cooled plant. Fresh water demand at RBEP will be limited to onsite potable water use, makeup water for the new generating units' steam cycle, and for cooling of the air intake into the CTG. RBEP is expected to use 52.5 acre-feet per year (AFY)[4] of potable water on average for power plant cooling and process water, fire protection and potable uses. The water will be provided by the California Water Service Company through its Rancho Dominguez District, which supplies all of the City of Redondo Beach's potable water needs using a mix of groundwater pumped from the West Coast Groundwater Basin[5] and purchased surface water that is imported by

[4] The annual water requirements for RBEP operating at a 76 percent annual capacity factor (6,665 hours per year) will be approximately 51.2 AFY, substantially less than the actual historical water consumption of the existing Redondo Beach Generating Station.

[5] The West Coast Groundwater Basin underlies 160 square miles in the southwestern part of the Los Angeles Coastal Plain in Los Angeles County. The basin extends southwesterly along the coast from the Newport-Inglewood Uplift to Santa Monica Bay. It provides groundwater to 11 cities and to unincorporated

the Metropolitan Water District of Southern California (MWD) from the Colorado River or the State Water Project. Water use would vary from approximately 42 gallons per minute (gpm) to 226 gpm, depending on ambient temperature and humidity. Total potable water demand would never exceed more than 52.5 AFY, which is the equivalent to the use of about 203 average four-person families in the U.S., based on average per capita use of 84,387 gallons per year per family (Rockaway, 2011) but would provide electricity for more than 1 million homes. Furthermore, this annual water use is approximately 77 percent lower than historical use by the existing Redondo Beach Generating Station units of 306 AFY (2004 to 2011).[6]

Potential water supply sources for the RBEP include:

- Ocean water from the Pacific Ocean
- Secondary treated wastewater from the City of Los Angeles Hyperion Treatment Plant (HTP) approximately 5.6 miles to the north of the RBEP site adjacent to the Los Angeles International Airport
- Secondary treated wastewater from the Sanitation Districts of Los Angeles County's Joint Water Pollution Control Plant[7] (JWPCP) in the city of Carson, approximately 7 miles southeast of the RBEP site
- Recycled water from the West Basin Municipal Water District (WBMWD), which purchases secondary treated water from the HTP and treats it to recycled water standards at its Edward C. Little Water Recycling Facility in El Segundo, immediately to the east of the HTP.

Potable water, as well as secondary treatment or recycled water, would need to be further treated at the power plant site to meet water quality requirements for use within the plant. Ocean water could be used as makeup water for a saltwater cooling system, or could be desalinated to be used as fresh water. Use of ocean water in an ocean water cooling tower system is discussed in Section 6.7.2, Power Plant Cooling Alternatives.

Regional sources of secondary treated wastewater include the HTP and the JWPCP. The HTP treats up to 350 million gallons per day of wastewater generated in Los Angeles and surrounding communities, and discharges about 91 percent of the treated effluent into the ocean. The WBMWD purchases the remaining 9 percent for treatment to tertiary standards at the Edward C. Little's Water Recycling Facility (WBMWD, 2011). Using secondary treated reclaimed water from the HTP would require construction of a pipeline from the RBEP site to the HTP, located just south of the Los Angeles International Airport. The pipeline would likely be located under city streets, requiring construction of approximately 5.6 miles of new pipeline.

Using secondary treated reclaimed water from the JWPCP would require construction of an approximately 7.8-mile-long pipeline from the RBEP site to the JWPCP site located in the city of Carson. The JWPCP does not currently produce secondary treated wastewater for reuse, but rather discharges its effluent through a series of outfalls into the Pacific Ocean. This is because the JWPCP is designed to accept the effluent from 10 other treatment plants operating at higher elevations that is considered too salty for use as reclaimed water. Use of treated wastewater from the JWPCP would require additional treatment to meet tertiary treatment influent standards, in addition to construction of a pipeline of at least 7 miles in length through a heavily urban area.

Use of secondary treated wastewater from either the JWPCP or the HTP would require construction of a treatment facility either at the treatment facilities or at the RBEP site to further treat the wastewater to the standards required for power plant use, as well as storage facilities to ensure sufficient treated water is on hand at all times, and an approximately 5.6- to 7.8-mile-long pipeline connecting the two facilities. Construction and

areas of Los Angeles County. Its average annual production is roughly 52,000 AFY, which accounts for 20 percent of total retail demands. The basin was adjudicated in 1961, placing a limit on the allowable annual extraction of groundwater per water rights holder to prevent ocean water intrusion and an unhealthy groundwater level. The California Department of Water Resources serves as Watermaster to account for all water rights and groundwater extraction amounts per year.

[6] See Section 2.2.9.1, Water Requirements, of this AFC.

[7] The City of Redondo Beach participates in the Sanitation Districts of Los Angeles wastewater treatment system as part of the South Beach Cities District, along with the cities of Palos Verdes Estates, Manhattan Beach, and Hermosa Beach. All sewage produced within the city of Redondo Beach is pumped via a main sewer trunk line to the JWPCP for treatment. The sewage is treated to secondary treatment standards, with the effluent discharged into the Los Angeles River and into the Pacific Ocean.

operation of the tertiary treatment facility and the connecting pipeline would create their own environmental impacts, including those associated with disposal of the waste products created during the treatment process. Cost of constructing the additional treatment facilities is estimated at $1.5 million to $2 million, and cost of constructing the pipeline is estimated at $1 million to $1.6 million, assuming a suitable right-of-way could be obtained. Both the treatment and conveyance estimates were made for planning and comparison purposes only, based on known costs of conventional mono-media sand filtration and sodium hypochlorite disinfection, as well as typical urban water pipeline engineering, permitting, procurement, and construction costs. The estimates did not include detailed investigations of permitting, exact locations of treatment facilities, interference with existing utilities, nor jurisdictional agreements for the preliminary pipeline routes. Therefore, considering cost and availability, secondary treated wastewater from the JWPCP or the HTP is not a viable source of makeup water for RBEP.

Using recycled water from the WBMWD would require connection to the Edward C. Little Water Recycling Facility's recycled water pipeline system. The WBMWD has two main recycled water pipelines that serve the city of Redondo Beach, one of which provides irrigation water for landscaping at the King Harbor Yacht Club adjacent to the Redondo Beach Generating Station site. The California Water Service Company purchases approximately 5,000 AFY of recycled water from the WBMWD and distributes it throughout its Rancho Dominguez District (California Water Service Company, 2011). The WBMWD and California Water Service Company both have expressed goals of using greater amounts of recycled water to meet their customers' fresh water needs. However, according to the WBMWD, due to ongoing water quality issues, despite improvements made as recently as 2010, the HTP has not been able to produce secondary treated wastewater to the standards needed as influent into the recycled water facility at sufficient volumes to meet full demand (WBMWD, 2011). Therefore, the HTP cannot be considered a reliable water source for either secondary treated water or for recycled water through the Edward C. Little Water Recycling Facility, even for the relatively small amount of fresh water needed for RBEP.

Desalinated water is also a possible source of freshwater for RBEP. The WBMWD has announced its intention to provide up to 10 percent of its customers' drinking water needs with desalinated ocean water by the year 2020. The WBMWD currently operates the West Basin Ocean-Water Desalination Demonstration Facility located adjacent to RBEP. The project produces up to 550,000 gallons per day (616 AFY) for research purposes. The WBMWD has not announced any plans for constructing any desalination facilities as part of its 10 percent goal, though it has released a study concluding that water produced by a desalination plant in Redondo Beach would use significantly more energy than any other source of water available to the WBMWD. There is no guarantee a desalination plant would be built in time for RBEP use, or at all. Therefore, use of desalinated water as an augmentation of regular potable water sources is not preferred due not only to water supply reliability reasons, but cost issues as well. Desalination plants also present challenging environmental issues, not the least of which are the impacts associated with pumping of ocean water into the plant, which is the same impact that prompted the SWRCB's recent policy regulating use of ocean water in the Redondo Beach Generating Station OTC system.

Use of the California Water Service Company's potable water system is both economically feasible and environmentally superior when compared to other options. Potable water is available onsite in sufficient quantities to supply all freshwater needs, and avoids the need to construct pipelines or additional treatment facilities for the use of secondary treated wastewater. The company's Rancho Dominguez District includes the Palos Verdes Peninsula, Hawthorne Carson, Hermosa Beach and Redondo Beach (served through the Hermosa/Redondo District), and portions of Compton, Harbor City, Long Beach, Los Angeles, and Torrance. As a separate district within the Rancho Dominguez District, the Hermosa/Redondo District (herein referred to as the "Hermosa/Redondo unit" to avoid confusion with the larger Rancho Dominguez District) serves the cities of Redondo Beach and Hermosa Beach, and about 5 percent of the city of Hawthorne. The unit serves a population of about 94,070 people in the Hermosa/Redondo area through 212 miles of distribution pipeline, 17 storage tanks, four MWD connections, and two active wells. It currently serves about 26,000 customers in the Hermosa/Redondo unit, which is projected to gradually increase to about 30,000 customers as area population increases to about 113,200 people by 2040.

California Water Service Company is currently capable of pumping about 2,510 gpm on average from two active wells in the Central Groundwater Basin area. A third well has been abandoned due to saline contamination. The company can also obtain up to 26,930 gpm from its four connections to the MWD system. In general, about 10 percent of its freshwater needs came from groundwater, with the remaining 90 percent purchased from the WBMWD, which is one of 27 member agencies of the MWD. However, groundwater pumping has varied over the past 30 years, from as low as zero in 1993 and 1996, to a high of more than 3,000 acre-feet in 2003. Total available freshwater supply to the Company's Hermosa/Redondo unit averaged 14,450 AFY from 2006–2010, which was down significantly from the average of 16,022 AFY from 2001-2005. The decrease is attributed to aggressive conservation program implementation due to drought conditions in 2007–09, an economic downturn resulting in less consumption beginning in 2009, and subsequent wet seasons in 2009 and 2010.

Total available supply to the Hermosa/Redondo Beach unit was approximately 18,800 acre-feet in 2010, based on an allocation of up to 16,800 acre-feet from the WBMWD and up to 2,000 acre-feet of groundwater; actual use was 12,516 acre-feet, leaving a surplus availability of approximately 4,284 acre-feet in that year. Demand[8] is projected to be 14,506 AFY in 2015, and then increase to about 14,519 AFY in 2020; 14,912 AFY in 2025; 15,315 AFY in 2030; 15,728 AFY in 2035; and 16,152 AFY in 2040. Use of groundwater is expected to increase significantly during the planning period, to about 3,500 AFY in 2015–2019, and to about 4,070 AFY in 2020–2040 as new wells are drilled to reach the adjudicated limit of 4,070 AFY that the company has the rights to pump. Both the WBMWD and California Water Service Company project that they will have sufficient supply to meet demand over the planning period to 2040, even during periods of multi-year droughts (California Water Service Company, 2011; WBMWD, 2011).

At a projected maximum use of 52.5 AFY, fresh water use at RBEP would amount to less than 0.5 percent of total projected freshwater deliveries in the Hermosa/Redondo unit in 2015, and less than 10 percent of the lowest projected available surplus of water supply in the same district in multiple dry years. These estimates do not reflect RBEP's overall net reduction in water consumption over the historical water use by Redondo Beach Generation Station's operation. Service through California Water Service Company's water system would require no new construction of facilities to meet the increase in demand. Therefore, because other sources would create additional environmental impacts and be more costly, use of the potable water system is the preferred source of water for RBEP.

6.7 Technology Alternatives

The RBEP configuration was selected from a wide array of technology alternatives. These include generation technology alternatives, fuel technology alternatives, combustion turbine alternatives, storage alternatives, and nitrogen oxide (NO_x) control alternatives.

6.7.1 Generation Technology Alternatives

Selection of the power generation technology focused on those technologies that can utilize the natural gas readily available from the existing gas pipeline system, and meet the requirements of SCAQMD's Rule 1304(a)(2), which limits the generation technology options for the replacement of existing utility steam boilers to either combined-cycle technology or other use of advanced turbine technology, or a renewable energy resource while continuing to meet the project's objectives. Following is a discussion of the suitability of such technologies for application to the RBEP that were rejected for failing to meet RBEP's project objectives.

6.7.1.1 Conventional Boiler and Steam Turbine

This technology burns fuel in the furnace of a conventional boiler to create steam. The steam is used to drive an STG, and the steam is then condensed and returned to the boiler. This technology that can achieve thermal efficiencies up to approximately 36 percent when utilizing natural gas, although efficiencies are somewhat higher when utilizing oil or coal. Several conventional boiler/steam turbine technologies were reviewed but rejected

[8] Including losses along supply pipelines, which total approximately 2,000 AFY according to the WBMWD.

because of regulatory prohibitions or public acceptance. Specifically, the technologies rejected were nuclear and municipal solid waste generation.

Because of this technology's low efficiency and large space requirement, and because it would not meet the requirements of SCAQMD Rule 1304(a)(2), conventional boiler and steam turbine technology was eliminated from consideration.

6.7.1.2 Simple-cycle Combustion Turbine

Aero-derivative turbine-generator units are able to achieve thermal efficiencies up to approximately 38 percent. A simple-cycle combustion turbine has a quick startup capability and comparable capital cost to that of a combined-cycle, and is appropriate for peaking applications. However, simple-cycle combustion turbines have lower thermal efficiency and emit more air pollutants per kilowatt hour (kWh). Because of this relatively low efficiency, and because only one manufacturer and one model of aero-derivative gas turbine generator currently meet the requirements of SCAQMD Rule 1304(a)(2), simple-cycle combustion turbine technology was eliminated from consideration.

6.7.1.3 Kalina Combined-cycle

This technology is similar to the conventional combined-cycle, except a mixture of ammonia and water is used in place of pure water in the steam cycle. The Kalina cycle could potentially increase combined-cycle thermal efficiencies by several percentage points. This technology is still in the development phase and has not been commercially demonstrated; therefore, it was eliminated from consideration.

6.7.1.4 Internal Combustion Engines

Internal combustion engine designs are also available for small peaking power plant configurations. These are based on the design for large marine diesel engines, fitted to burn natural gas. Advantages of internal combustion engines are that they use very little water for cooling because they use a closed-loop coolant system with radiators and fans; provide quick-start capability (online at full power in 10 minutes); and are responsive to load-following needs because they are deployed in small units (for example, 10 to 14 engines in one power plant) that can be started up and shut down at will. Disadvantages of this design include higher emissions than comparable combustion turbine technology. Additionally, an internal combustion engine installation is generally deployed at less than 150 MW and so would not meet the project objective to generate 496 MW of power and was eliminated from consideration.

6.7.2 Power Plant Cooling Alternatives

Wet cooling technology was evaluated for RBEP as an alternative to the use of an air-cooled condenser system, using either freshwater or ocean water as the water makeup source. With a wet-cooled plant, water is pumped through a condenser, where it is exposed to pipes carrying steam from the steam turbine. The steam condenses to water and is recycled through the HRSG. Heated water cycling through the condenser is then pumped to a cooling tower, where large fans draw air through the heated water droplets, cooling the water, which is cycled back to the condenser, with evaporative losses of approximately 5 percent.

Wet cooling using fresh or potable water is discouraged by SWRCB and CEC policy. Wet cooling using recycled water is acceptable under state policy, but the choice of this cooling method depends on the availability of a supply of tertiary treated recycled water consistent with state law. Such recycled water is not currently available at the RBEP site. As discussed above (see Section 6.6.3), tertiary treated water is available near the RBEP site, but not in sufficient quantities to supply project needs. Secondary treated water is available at the HTP or JWPCP facilities and could be used as a possible source of cooling water makeup, though doing so would require construction of a 5.6- to 7.8-mile-long pipeline and additional facilities to treat the wastewater to the tertiary standards required for power plant use. Wet cooling using ocean water in the cooling towers is another possibility, though this method would require taking suction off of an ocean intake structure for makeup supplies, which would create project-related environmental impacts. Maintenance and operating costs for a cooling tower system using ocean water are also significantly higher than for systems using freshwater. The use of ocean water

as cooling tower makeup water typically imposes a 4 to 8 percent performance penalty and a 35 to 50 percent cost penalty in comparison to freshwater towers of comparable cooling capability (Maulbetsch and DiFilippo, 2010).

The major drawback of wet cooling is that it takes large amounts of water to cool a large, combined-cycle power plant: approximately 16 times as much as a dry-cooled design. Therefore, because of the uncertainty in obtaining reliable and cost-effective water supply in sufficient quantities to allow use of wet cooling, RBEP has been designed as a dry-cooled plant using an air-cooled condenser. No other technologies are currently available that are capable of adequately cooling the RBEP.

6.7.3 Fuel Technology Alternatives

Technologies based on fuels other than natural gas were eliminated from consideration because they do not meet the RBEP's objective of utilizing natural gas available from the existing gas piping system. Additional factors rendering alternative fuel technologies unsuitable for use at RBEP are as follows:

- No geothermal or hydroelectric resources exist in Los Angeles County.
- Biomass fuels such as wood waste are not locally available in sufficient quantities to make them a practical alternative fuel, and RBEP site space is limited.
- The RBEP site does not experience sufficient wind resources to make a wind project feasible at the site. Additionally, wind technologies are not flexible and dispatchable resources because of their variable nature. Also, RBEP space is limited and these technologies require large expanses of land, and a wind power installation would not be compatible with surrounding land uses. For example, it would be possible to install a single 2 MW wind turbine at the site considering the site size, orientation, and setback requirements. The wind resources available at the Redondo Beach site are categorized as a 3 Tier global ranking of 9 percent. Eighty percent of all wind energy projects built have a ranking of 65 percent or better. Because wind resources are insufficient, and only a single 2 MW wind turbine could be installed at the site, wind energy was rejected as a viable energy alternative.
- Utility-scale solar technologies need to be sited in an area with high solar radiation[9] and require very large amounts of land (up to 10 acres per megawatt). Los Angeles County is not a viable location for concentrating solar technologies or utility-scale photovoltaic power plants because it lacks the large and open expanses of land necessary and is not a strong solar energy resource area. These resources are also available only during the daytime and have reduced availability on cloudy days. Approximately 7 MW of photovoltaic panels could be installed at the Redondo Beach site considering the specific site orientation and setback requirements. The solar resource available at the site is also limited, considering the marine layer and fog, which is common in the area. Only 15,300 MWh/year of electrical could be generated with photovoltaic panels, as compared to the over 3.3 GWhrs that could be available from RBEP.

The availability of the natural gas resource provided by Southern California Gas Company and the environmental and operational advantages of natural gas technologies make natural gas the logical choice for the RBEP.

6.7.4 NO_x Control Alternatives

To minimize NO_x emissions from RBEP, the CTGs will be equipped with dry low NO_x combustors and selective catalytic reduction (SCR) using 19 percent aqueous ammonia as the reducing agent. The following combustion turbine NO_x control alternatives were considered:

- Steam injection (capable of 25 parts per million [ppm] NO_x)
- Water injection (capable of 25 ppm NO_x)
- Dry low NO_x combustors (capable of 9 to 25 ppm NO_x)

[9] Measured in terms of kWh per square meter of land. See the National Renewable Energy Laboratory for additional information about solar energy and maps of solar resource distribution (http://www.nrel.gov/solar/). The project area solar radiation is rated at approximately 5 to 5.25 kWh per square meter. Utility-scale solar energy plants are not currently being proposed for areas with solar radiation at levels this low.

Dry low NO_x combustors were selected because these allow for lower NO_x emission rate from the combustion turbine over either water or steam (wet) injection. Furthermore, dry low NO_x combustors result in a slight improvement in thermal efficiency over wet injection NO_x control alternatives, and will reduce RBEP's water consumption.

Two post-combustion NO_x control alternatives were considered:

- SCR
- $SCONO_x$

SCR is a proven technology and is commonly used in combustion turbine electrical generating applications. Ammonia is injected into the exhaust gas upstream of a catalyst. The ammonia reacts with NO_x in the presence of the catalyst to form nitrogen and water.

$SCONO_x$ consists of an oxidation catalyst, which oxidizes carbon monoxide to carbon dioxide and nitric oxide to nitrogen dioxide. The nitrogen dioxide is adsorbed onto the catalyst, and the catalyst is periodically regenerated.

The level of emission control effectiveness between the $SCONO_x$ and SCR technologies is approximately equivalent. However, the $SCONO_x$ technology does not use ammonia to reduce air emissions. The CEC recently summarized in the U.S. Environmental Protection Agency's opinion (CEC, 2007) "that $SCONO_x$ is no more effective for reducing air quality impacts than selective catalytic reduction…, and it also found $SCONO_x$ to be significantly more expensive and arguably less reliable, particularly for larger facilities." Therefore, $SCONO_x$ was not considered for use at RBEP.

The following reducing agent alternatives were considered for use with the SCR system:

- Anhydrous ammonia
- Aqueous ammonia
- Urea conversion

Anhydrous ammonia is used in many combustion turbine facilities for NO_x control, but is more hazardous than diluted forms of ammonia. Aqueous ammonia (an ammonia-water solution) is proposed for RBEP because of its safety characteristics.

Urea conversion technology uses solid urea (prill) in a reactor with steam to convert the urea to aqueous ammonia, which is typically stored in a tank for use by the SCR system during upsets in the process and plant start up activities. Although the urea conversion technology has been employed for power plants for a number of years, it only eliminates the need to truck aqueous ammonia to the site, because onsite ammonia storage is always included in the system design. Furthermore, the urea conversion process has a higher energy demand over an aqueous ammonia system as a result of consuming steam as part of the process. Finally, the urea process has proven to have poor reliability and slow response times, and it produces an inconsistent concentration of ammonia. The RBEP power block is designed to be fast-start and fast-ramp units, which require precise control of ammonia concentrations for emissions control. Therefore, urea conversion was considered and rejected.

6.7.5 Energy Storage

Energy storage options currently available include electrochemical energy storage, thermal energy storage, hydrogen production, and mechanical energy storage. Electrochemical storage includes several types of batteries and capacitors, which meet specific needs and requirements in certain applications. However, at this time, these devices have not been deployed at a scale that would effectively substitute the 496 MW of generating capacity of this project and further current electric load serving entities have been unwilling to contract long-term power purchase agreements apart from specific direction of the PUC.

Thermal energy storage generally is limited to heat energy storage from solar thermal applications for later use, such as steam for power production during evening hours, or for water or building heating purposes, and therefore would not meet the RBEP objectives. Hydrogen production involves "storing" energy by using inexpensive or surplus energy (that is, off-peak energy from all sources, or surges of windpower during the night) to create hydrogen through hydrolysis, and then use the hydrogen to create energy for other purposes, including

on-peak generation, as well as transportation purposes. However, hydrogen production has not yet been demonstrated as a cost-effective alternative to generation services that RBEP would provide.

Compressed air technology also stores energy by using inexpensive or surplus electrical energy to operate compressors that store high-pressure air for later release through an air-powered turbine, while flywheel technology uses off-peak power to accelerate large rotors (flywheels) to very high speeds, and then use the energy stored as angular momentum to spin a generator during on-peak power periods. While promising, compressed air and flywheel technology have not yet been demonstrated to be cost-effective methods for storing energy on a large scale.

The only utility-scale energy storage technology currently in use in California is pumped-storage hydroelectricity, in which energy is stored by pumping water from a lower reservoir to a higher reservoir when inexpensive or surplus energy is available, and then released through a turbine-generator when additional generating capacity and energy is needed. These projects require two reservoirs at significantly different elevations, plus a pumping/generating station and connecting penstock, and therefore have very specific siting requirements not generally found in the population centers of the greater Los Angeles Basin (CEC, 2011). Because of the very limited ability to site cost-effective energy storage facilities that are able to provide reliable electric power services to the Western Los Angeles Basin, energy storage technologies were considered but rejected for RBEP.

6.7.6 Waste Discharge Alternatives

RBEP will discharge process wastewaters through the existing Redondo Beach Generating Station's ocean outfall, consistent with the way process wastewater is discharged currently from the Redondo Beach Generating Station. Similar to the existing Redondo Beach Generating Station, stormwater from RBEP will be captured in onsite stormwater retention basins, processed through an oil/water separator as necessary, then discharged through the existing Redondo Beach Generating Station's ocean outfall. AES Southland Development, LLC, staff met with the staff of the California Regional Quality Control Board–Santa Ana Region on May 23, 2012, to discuss the discharge of RBEP process wastewater and the continued discharge of stormwater from RBEP through the existing Redondo Beach Generating Station's ocean outfall (see Appendix 5.15B for the RWQCB Meeting Summary notes). At this meeting, the RWQCB staff representative concurred with the approach for the continuation of discharging the wastewater and stormwater from RBEP through the existing outfall, providing the project obtains a new National Pollutant Discharge Elimination System permit and the discharge meets all ocean standards. RBEP will be designed to meet the current requirements of Los Angeles County for stormwater drainage design and discharge (see Section 5.15, Water Resources).

The alternative discharge method for process wastewater would be to construct a zero liquid discharge (ZLD) system in which concentrators and crystallizers are used to evaporate process wastewater and to remove the residual salts and other contaminants such that little or no water is discharged, and residual salt is trucked as a "salt cake" byproduct to a landfill. The CEC, as stated in the 2003 Integrated Energy Policy Report (IEPR), has encouraged power plant developers to incorporate ZLD facilities into their power plant designs as a way of reducing discharges and maintaining the quality of state waters. The 2003 IEPR states:

> Additionally, as a way to reduce the use of fresh water and to avoid discharges in keeping with the Board's policy, the Energy Commission will require zero-liquid discharge technologies unless such technologies are shown to be "environmentally undesirable" or "economically unsound."

The use of a ZLD design was considered for RBEP and was eliminated from consideration for the following reasons:

- It is not necessary to use a ZLD system to control wastewater discharge in a plant using dry cooling because discharge volumes using dry cooling are relatively small, approximately one-sixteenth those of a wet-cooled plant.
- ZLD systems are technologically complex and expensive to construct, operate, and maintain, adding to the project's capital cost and reducing its return on investment.

- ZLD systems have been found to be relatively unreliable, often resulting in plant outages that affect operating ability, the availability of power, and grid reliability.

To summarize, using ZLD for a dry-cooled plant of this nature would not support the RBEP objectives of providing easily dispatchable, reliable, and economically viable power to the California grid. The initial construction, operations and maintenance costs of a ZLD system, and the associated lost production costs, would be out of proportion to the environmental benefits of eliminating the low volume of wastewater expected to be generated by RBEP. The use of a ZLD system would be economically unfeasible and would offer little or no environmental benefit.

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