SECTION 2.0

Project Description

AES Southland Development, LLC (AES-SD) proposes to construct, own, and operate a new electrical generating plant in the City of Redondo Beach, Los Angeles County, California. The Redondo Beach Energy Project (RBEP) is a natural-gas-fired, combined-cycle, air-cooled electrical generating facility with a net generating capacity of 496 megawatts (MW)[1] and gross generating capacity of 511 MW, that will replace, and be constructed on the site of the AES Redondo Beach Generating Station, an existing and operating power plant in Redondo Beach, California. The project will consist of one 3-on-1 combined-cycle gas turbine power block with three natural-gas-fired 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 also include natural gas compressors, water treatment facilities, emergency services, and administration and maintenance buildings. The project will be constructed entirely within the existing approximately 50-acre Redondo Beach Generating Station site. The existing Redondo Beach Generating Station Units 1 through 8[2] and auxiliary boiler no. 17 will be demolished as part of the project.

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 onsite 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.

RBEP will use the existing natural gas, water, sewer, and high-voltage interconnections to the site; no offsite linear developments are necessary or proposed as part of the project. RBEP will continue the use of potable water for construction, operational process, and sanitary uses, but at substantially lower volumes than the existing Redondo Beach Generating Station has historically used. Potable water will continue to be provided by the California Water Service Company. The new generating units will employ air-cooled condensers and will eliminate the use of ocean water at the site. 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 sewer connection. The RBEP power block will connect to the existing onsite Southern California Edison (SCE) 230-kilovolt (kV) switchyard via a new onsite interconnection. See Section 3.0, Transmission System Engineering, for a discussion of the RBEP interconnection to the existing SCE 230-kV switchyard.

[1] The net generating capacity including auxiliary load is 496 MW, gross output as measured at the generator terminals is 511 MW, referenced to site ambient average temperature (SAAT) conditions of 63.3°F dry bulb and 58.5°F wet bulb temperature.

[2] Units 1, 2, 3, and 4 are currently retired. Units 5, 6, 7, 8 are currently in use. All eight units will be demolished as part of the project.

2.1 Generation Facility Description, Design, and Operation

The Redondo Beach Energy Project (RBEP) is a natural-gas-fired, combined-cycle, air-cooled electrical generating facility rated at a net generating capacity of 496 MW[3] and gross generating capacity of 511 MW. RBEP has been designed using commercially proven technology equipped with monitoring, protection, and safety systems to provide safe and reliable operation over a 30-year operating life. It will consist of one 3-on-1 combined-cycle gas turbine power block with three natural-gas-fired CTGs, three supplemental-fired HRSGs, and one STG.

The RBEP site encompasses approximately 50 acres and includes 16.8 acres of construction laydown and parking, 10.5 acres where the new aboveground equipment of RBEP will be constructed, a 2.2-acre existing switchyard, and the remaining 20 acres which encompass the footprint of the existing Redondo Beach Generating Station aboveground equipment (stacks, turbines, control buildings, etc.). For purposes of this analysis, and to orient the viewer, Figure 2.1-1 shows the relationship between the proposed RBEP equipment and the larger, existing Redondo Beach Generating Station area within which it would be located.

RBEP will include the following principal design elements:

- Three Mitsubishi Power Systems America (MPSA) 501D CTGs with a nominal rating of approximately 119 MW each.[4] The CTGs will be equipped with evaporative coolers on the inlet air system and dry low oxides of nitrogen (NO_x) combustors.
- One single-cylinder, single-flow, impulse, axial exhaust condensing STG rated at 151 MW.
- Three HRSGs of the horizontal gas flow, single-pressure, natural-circulation type. Each HRSG has a natural-gas-fired duct burner for supplemental firing in the HRSG inlet ductwork and an emission reduction system consisting of a selective catalytic reduction (SCR) unit in the outlet ductwork to control NO_x emissions and an oxidation catalyst to control carbon monoxide (CO) and volatile organic compounds (VOC) emissions
- One air-cooled condenser and one closed-loop cooling fin fan cooler.
- A 230-kV interconnection to the existing, onsite, SCE switchyard
- Direct connection to the existing, onsite, Southern California Gas Company (SoCalGas) 20-inch-diameter natural gas pipeline.
- Demolition of retired Units 1, 2, 3, and 4
- Demolition of operating Units 5, 6, 7, and 8 and auxiliary boiler no. 17
- Demolition of existing administrative buildings and ancillary facilities.
- Connection to existing onsite potable water line
- Connection to existing onsite sanitary pipeline and to the existing permitted ocean outfall[5]

2.1.1 Site Arrangement and Layout

Primary access to the RBEP site will be provided via an existing entrance off of North Harbor Drive, just south of the intersection of Herondo Street and North Harbor Drive. Figure 1.1-3 shows the facility site location, Figure 2.1-2 shows the general arrangement and layout of the facility, and Figures 2.1-3a through 2.1-3d show typical elevation views of the project.

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[3] The net generating capacity including auxiliary load is 496 MW, gross output as measured at the generator terminals is 511 MW, referenced to site ambient average temperature (SAAT) conditions of 63.3°F dry bulb and 58.5°F wet bulb temperature.

[4] Nominal CTG only output at SAAT conditions.

[5] Stormwater and process water from RBEP will be discharged through the existing ocean outfall and will meet ocean discharge standards.

Source:Department of Public Work's Water Resources Division(2004).
Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

0 500 1,000 Feet

Legend

- AES Redondo Beach Energy Project
- Laydown and Parking Areas
- Existing RBGS Aboveground Facilities
- Existing SCE Switchyard
- Proposed RBEP Aboveground Facilities
- City Boundary

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Figure 2.1-1
Project Site Layout –
Existing and Proposed Features.
AES Redondo Beach Energy Project
Redondo Beach, California

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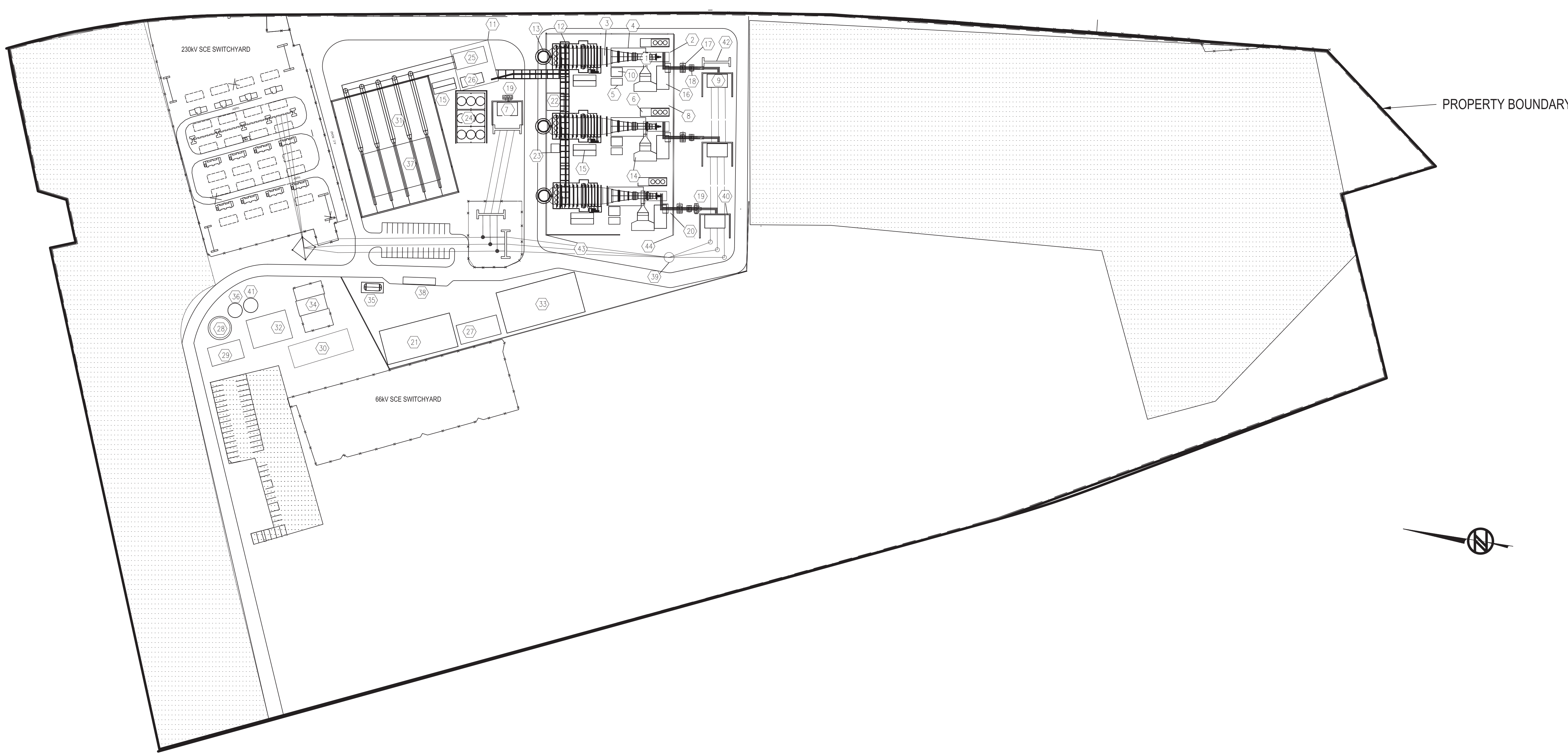
NO.	DESCRIPTION	DIMENSIONS	NO.	DESCRIPTION	DIMENSIONS	NO.	DESCRIPTION	DIMENSIONS
EQUIPMENT LIST			EQUIPMENT LIST			EQUIPMENT LIST		
1	COMBUSTION GAS TURBINE (CGT)	100'x32'x34'	16	SFC. ENCLOSURE	40'x21'x15'	31	ACC	209'x174'x83'
2	CGT GENERATOR ENCLOUSURE	16'x39'x34'	17	SFC. TRANSFORMER	11'x8'x10'	32	WATER TREATMENT BUILDING	70'x50'x19'
3	CGT/HRSG TRANSITION DUCT	14'x32'x31'	18	SEC. TRANSFORMER	11'x8'x10'	33	NEW CONTROL/ADMIN BUILDING	100'x72'x19'
4	CGT ENCLOSURE	61'x32'x25'	19	UNIT TRANSFORMER	9'x11'x9'	34	EXIST. HAZARDOUS MTRL. STORAGE	50' x 27'x 12'
5	FUEL GAS SKID	20' x 12'x15'	20	GENERATOR MAIN CIRCUIT BREAKER	10' x 12'	35	AMONIA TANK AND CONTAINMENT	18' x 38'x14'
6	CGT CONTROL/LUBE OIL SKID	50' x 14.5'x12'	21	FUEL GAS COMPRESSOR ENCLOSURE	125'x60'x25'	36	DI WATER TANK	28' DIA.x30'S.S.
7	STG STEP UP TRANSFORMER	35' x 23'x 15'	22	BOILER FEEDPUMP ENCLOSURE	30' x 30'x15'	37	RETENTION POND	100'X180'
8	TURBINE COOLING AIR SKID	10' x 8' x 24'	23	CEMS	15'x15'x10'	38	AMMONIA UNLOADING	56'X12'
9	CGT STEP UP TRANSFORMER	35' x 22'x15'	24	BOP FIN FAN COOLER	86'x48'x15'	39	TRANSMISSION POLE (TYP.)	80' - 135' TALL
10	CO2 F/F (LP TANK)	19'-6"x15'-6"	25	STEAM TURBINE GENERATOR	52' x 23'	40	TRANSFORMER WALL	53'x42'x30'
11	STG ENCLOSURE	77' x 73' x 40'	26	STG CONTROL/LUBEOIL SKID	38' x 17'	41	NEW SERVICE WATER TANK	28' DIA.x30'S.S.
12	HEAT RECOVERY STEAM GENERATOR	96'x45'x70'	27	FUEL GAS CONDITIONING SKID	71.5' x 34'	42	TRANSMISSION A-FRAME	75' TALL
13	STACK	18' DIA.	28	EXIST. SERVICE WTR. TNK 1	40' DIA.x48' S.S.	43	TURBINE HALL ENCLOSURE HRSG	349'x95'x83'-6"
14	CGT AIR INTAKE SYSTEM	40' x 38'	29	EXIST.FIRE WATER PUMP ENCLOSURE	58' x 32'x 18'	44	TURBINE HALL ENCLOSURE CGT	349'x126'x60'-6"
15	ELECTRICAL/CONTROL PACKAGE	20' x 40'X 15'	30	EXISTING GAS METERING STATION	106' x 38'			

FENCE

CONSTRUCTION PARKING AND LAYDOWN



PLOT LAYOUT

SCALE: 1/64"=1'-0"

Source: Power Engineers Collaborative, LLC, 10/31/2012.

FIGURE 2.1-2
General Arrangement
AES Redondo Beach Energy Project
Redondo Beach, California

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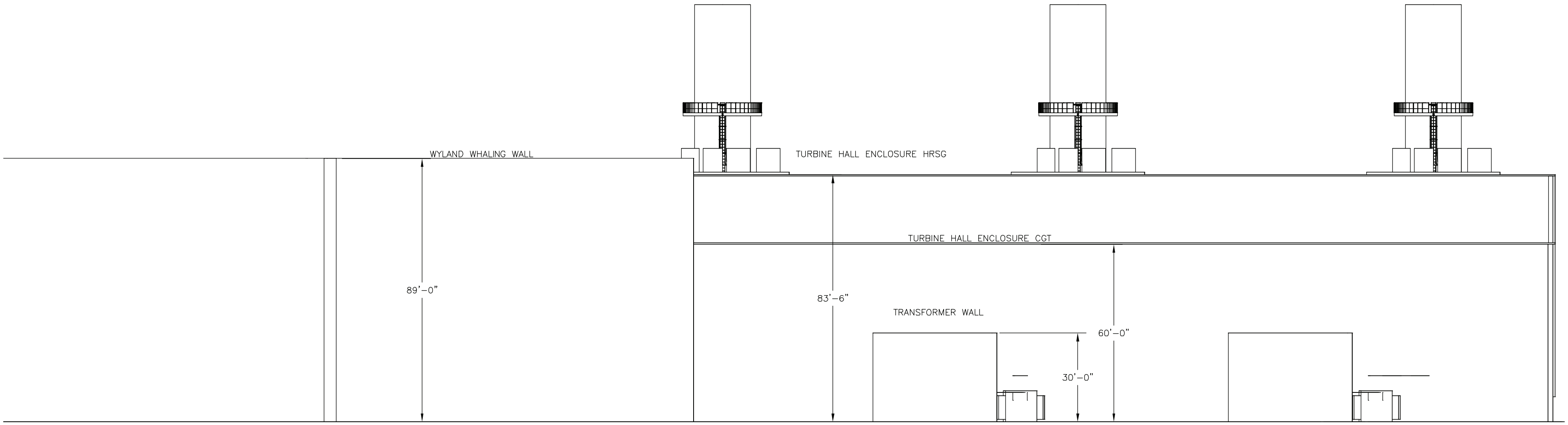

ELEVATION LOOKING NORTH D-D
SCALE: 1/16"=1'-0"

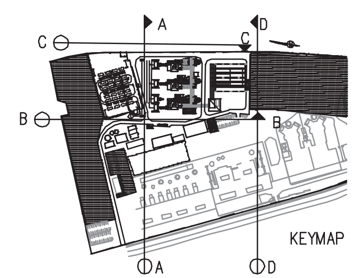

FIGURE 2.1-3a
Elevation Drawings
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 10/31/2012.

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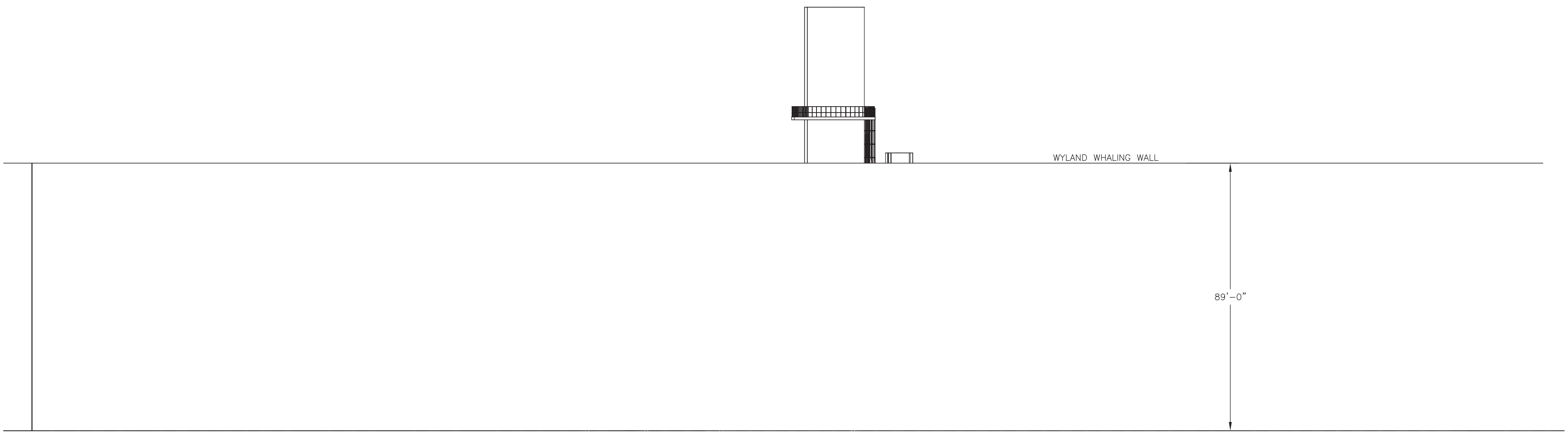

ELEVATION LOOKING EAST B-B
SCALE: 1/16"=1'-0"

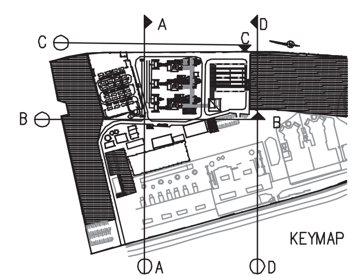

FIGURE 2.1-3b
Elevation Drawings
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 10/31/2012.

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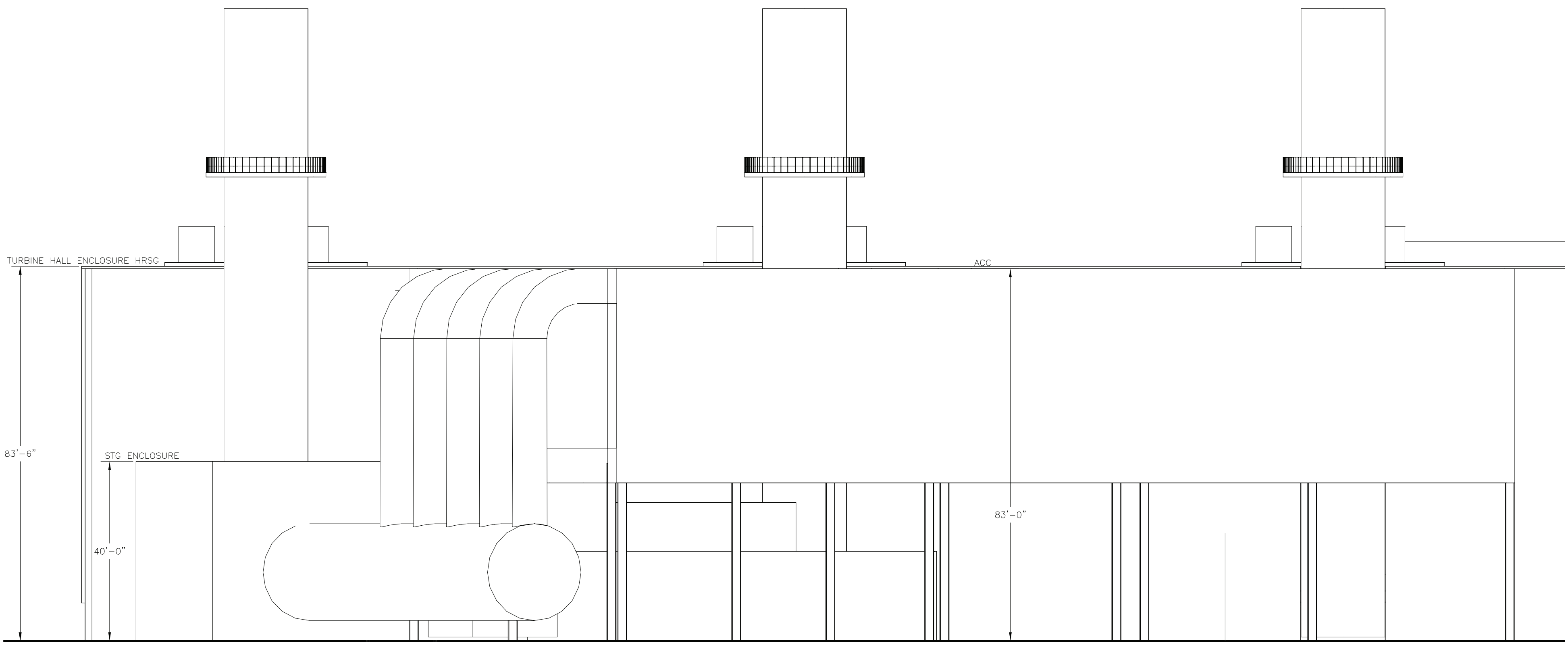

ELEVATION LOOKING SOUTH A-A
SCALE: 3/32"=1'-0"

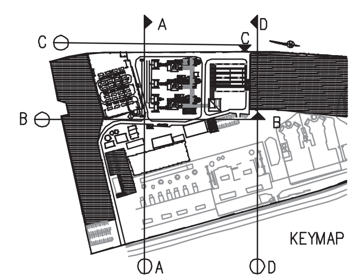

FIGURE 2.1-3c
Elevation Drawings
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 10/31/2012.

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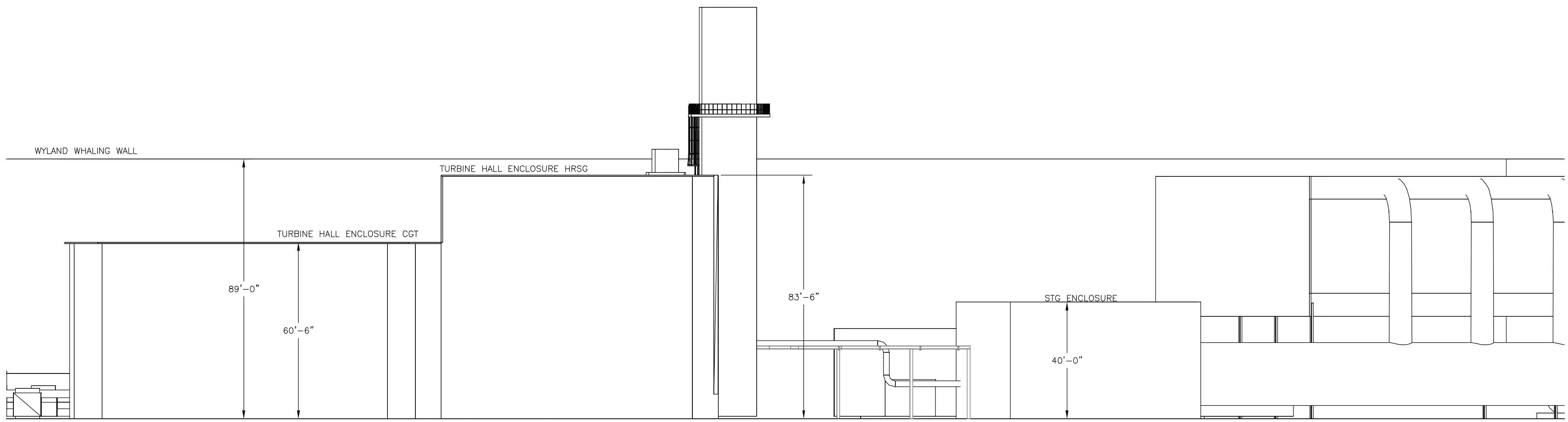

ELEVATION LOOKING WEST C-C
SCALE: 1/16"=1'-0"

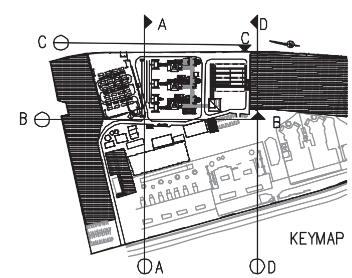

FIGURE 2.1-3d
Elevation Drawings
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 10/31/2012.

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The RBEP site is located within 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 a residential apartment block, King Harbor marina, and the Pacific Ocean.

The existing Redondo Beach Generating Station currently has four operating generating units (Units 5–8) and one auxiliary boiler (no. 17). The operating units as well as the retired Units 1–4, auxiliary boiler no. 17, and the main administrative building will be demolished as part of the project. The Redondo Beach Generating Station Units 1–4 and the main administrative building were originally constructed by SCE in the 1940s followed by Units 5 and 6 in the 1950s and Units 7 and 8 in the 1960s. The existing plant has various ancillary facilities, which will remain in use to support RBEP, including the existing SoCalGas natural gas pipeline interconnection, the existing permitted ocean outfall,[6] California Water Service Company potable water connection, and connection to the City of Redondo Beach sanitary sewer system.

The primary source of fire protection water for the project will be the same as for the existing generating station: it will be supplied via the existing connection to the California Water Service Company 8-inch potable water distribution system. The existing fire water distribution system, including two emergency electric-driven fire water pumps, and process water distribution and storage systems will be re-used to the greatest extent possible, but with some modifications to the onsite conveyance systems to accommodate the newly constructed facilities.

2.1.1.1 Pipelines

The project will not require offsite pipelines and will use the existing interconnections for natural gas, potable water, and sanitary wastewater.

2.1.1.1.1 Natural Gas Supply Pipeline

As discussed in Section 4.0, Natural Gas Supply, natural gas is delivered to the existing Redondo Beach Generating Station via an existing 20–inch-diameter line by SoCalGas to an existing onsite gas metering station.

The natural gas will flow from the existing SoCalGas metering station to a new gas pressure control station and gas scrubber/filtering equipment that will be constructed by the project owner as part of the project. Natural gas will then be distributed onsite to the combustion turbine fuel gas compressors and subsequently the combustion turbines and directly to the duct burners.

2.1.1.1.2 Potable Water Supply Pipeline

Potable water for the site is supplied from four separate pipeline interconnections with the California Water Service Company. Because RBEP’s water requirements are significantly less than the existing generating station’s current use, only one water line will be required to support the new project. The existing California Water Service Company pipeline that enters the north boundary of the site along Herondo Street, will supply the project.

2.1.1.1.3 Wastewater Discharge Pipeline

Sanitary wastewater will be discharged to an onsite City of Redondo Beach sewer main that bisects the site.

2.1.1.1.4 Plant Process Wastewater Pipeline and Stormwater Disposal

Plant process wastewater and site stormwater will be collected in an onsite retention basin and then discharged to the ocean outfall. The majority of the existing storm drains onsite will remain in place. New inlets and storm drains will be installed in the eastern portion of the site to convey rainwater to the new retention pond.

2.1.1.1.5 Fire Protection Water

Fire protection water will be provided by two sources: the primary source will be supplied via a connection to the existing potable water distribution system, the secondary source will be supplied from an existing 210,000-gallon onsite fire/service water storage tank, which will be reconfigured in accordance with National Fire Protection

[6] Stormwater and process water from RBEP will be discharged through the existing ocean outfall and will meet ocean discharge standards.

Association (NFPA) guidelines to provide 2 hours of protection for the onsite worst-case single fire. New onsite fire water piping and hydrants will be constructed at the facility.

2.1.2 Overview of Demolition Activities

Demolition of the Redondo Beach Generating Station will be ongoing beginning in first quarter 2016 and continuing at some level of activity through the RBEP construction period, with final demolition complete in fourth quarter 2020. The major equipment of retired Units 1–4 will be dismantled and removed in January 2016 through December 2016, prior to the start of construction of the new power block. In the first quarter 2019, demolition of Units 5–8, and auxiliary boiler no. 17 will begin while the new power block is in the final stages of construction and commissioning, and will be completed by the second quarter of 2020. The new power block will begin commercial operation in early third quarter of 2019. 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. Demolition activities will include the removal of existing office and warehouse buildings, auxiliary mechanical and electrical equipment associated with the Redondo Beach Generating Station units but does not include the removal of the Southern California Edison electric switchyards. Additional discussion regarding demolition is provided in Section 5.10, Socioeconomics, and Section 5.14, Waste Management.

2.1.3 Process Description

The RBEP power train will consist of the following equipment: three MPSA 501-D CTGs equipped with dry low-NO_x combustors and evaporative coolers; three HRSGs with natural-gas-fired duct burners; SCR for NO_x emission control, and oxidation catalyst equipment to control CO and VOC; one MPSA single casing, axial exhaust STG; one air-cooled condenser; and associated support equipment.

Each CTG will generate approximately 119 MW (gross) at SAAT conditions. The CTG exhaust gases of approximately 1100°F will be used to generate steam in the HRSGs. The HRSGs will employ a single-pressure design. Steam from the three HRSGs will be admitted to a single condensing STG. The STG will produce approximately 151 MW (gross) under these conditions. The project is expected to have an overall annual availability of more than 98 percent.

The heat balance for the project’s base load operation is shown in Figures 2.1-4a and 2.1-4b and is based on operation of new and clean units at SAAT conditions, with no evaporative cooling of the CTG inlet air or supplemental firing of the duct burner. The use of the evaporative coolers is not intended as power augmentation but will be employed to mitigate CTG degradation (ambient and mechanical) to maintain the facility at or near the nominal generating capacity. Heat balances for additional operating cases are presented in Appendix 2A. The predicted electrical output of the facility under these conditions is approximately 496 MW at a heat rate of approximately 7,387 British thermal units per kilowatt hour (Btu/kWh) on a lower heating value (LHV) basis. This corresponds with an efficiency of approximately 46 percent on a LHV basis.

The combustion turbines and associated equipment will include the use of best available control technology (BACT) to limit emissions of criteria pollutants and hazardous air pollutants. NO_x will be controlled to 2.0 parts per million by volume, dry basis (ppmvd), corrected to 15 percent oxygen through the use of dry low-NO_x combustors and SCR. An oxidation catalyst will also be used to control CO emissions to 2.0 ppmvd at 15 percent oxygen and VOCs emissions to 1.0 ppmvd at 15 percent oxygen. BACT for particulate matter (airborne matter with an equivalent aerodynamic diameter of less than 10 microns [PM_{10}] and 2.5 microns [$PM_{2.5}$]) and sulfur dioxide emissions will be the exclusive use of natural gas with a sulfur content not to exceed 0.75 grains per 100 dscf. Emissions of excess ammonia not used in the SCR process (ammonia slip) will be limited to 5.0 ppmvd at 15 percent oxygen.

Case 1

Case 1 Heat Balance Number 1a Three Combustion Turbines Operating at Maximum Heat Input without Evaporative Cooling
Site Average Annual Temperature (SAAT), Dry Bulb 63.3 F, Wet Bulb 58.5 F, Relative Humidity 75.2%

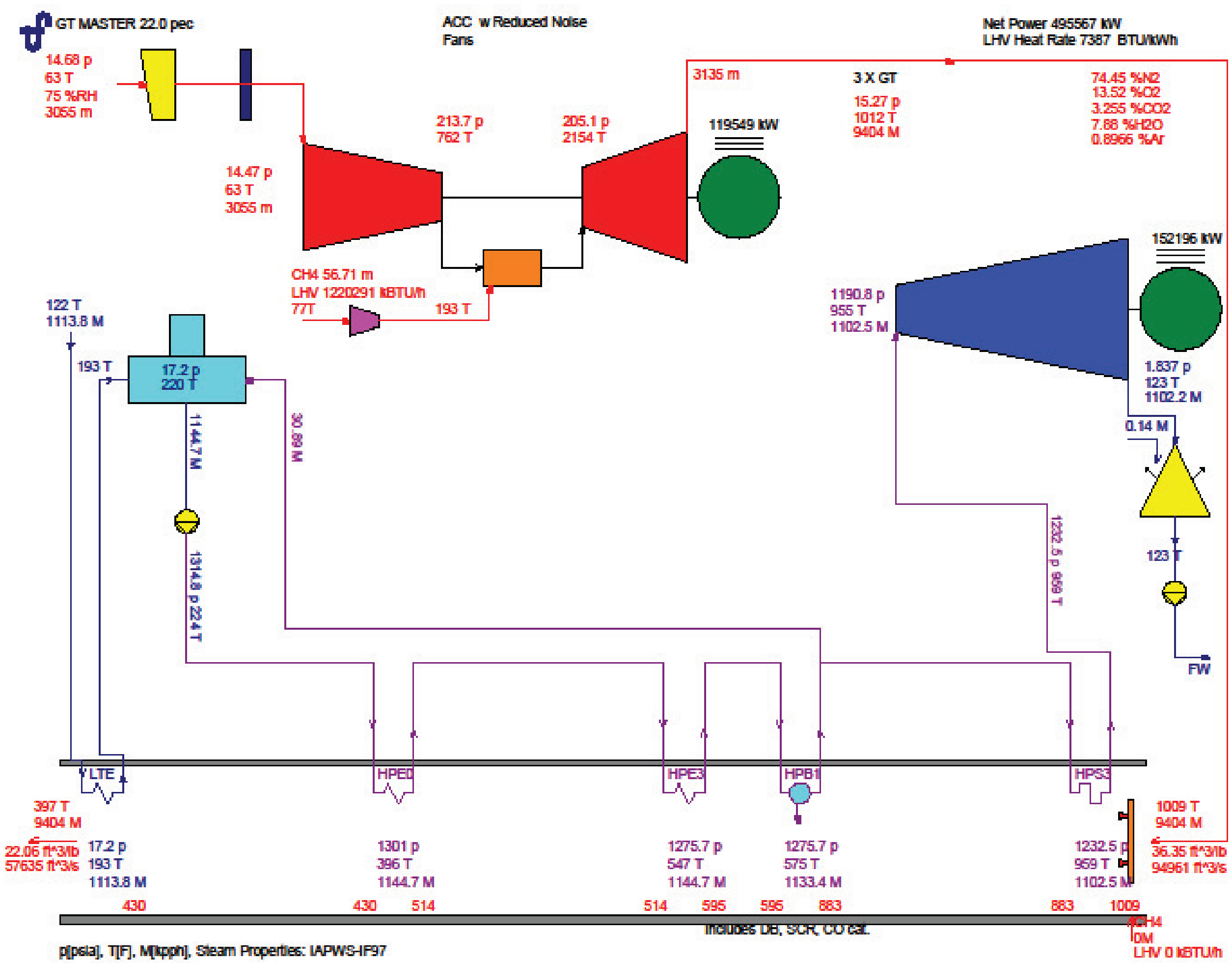

FIGURE 2.1-4a
Heat and Mass Balance Diagram - Case 1
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 11/02/2012.

Case 4

Case 4 Heat Balance Number 2a   Three Combustion Turbines Operating at Maximum Heat Input with Evaporative Cooling

Site Average Annual Temperature (SAAT), Dry Bulb 63.3 F, Wet Bulb 58.5 F, Relative Humidity 75.2%

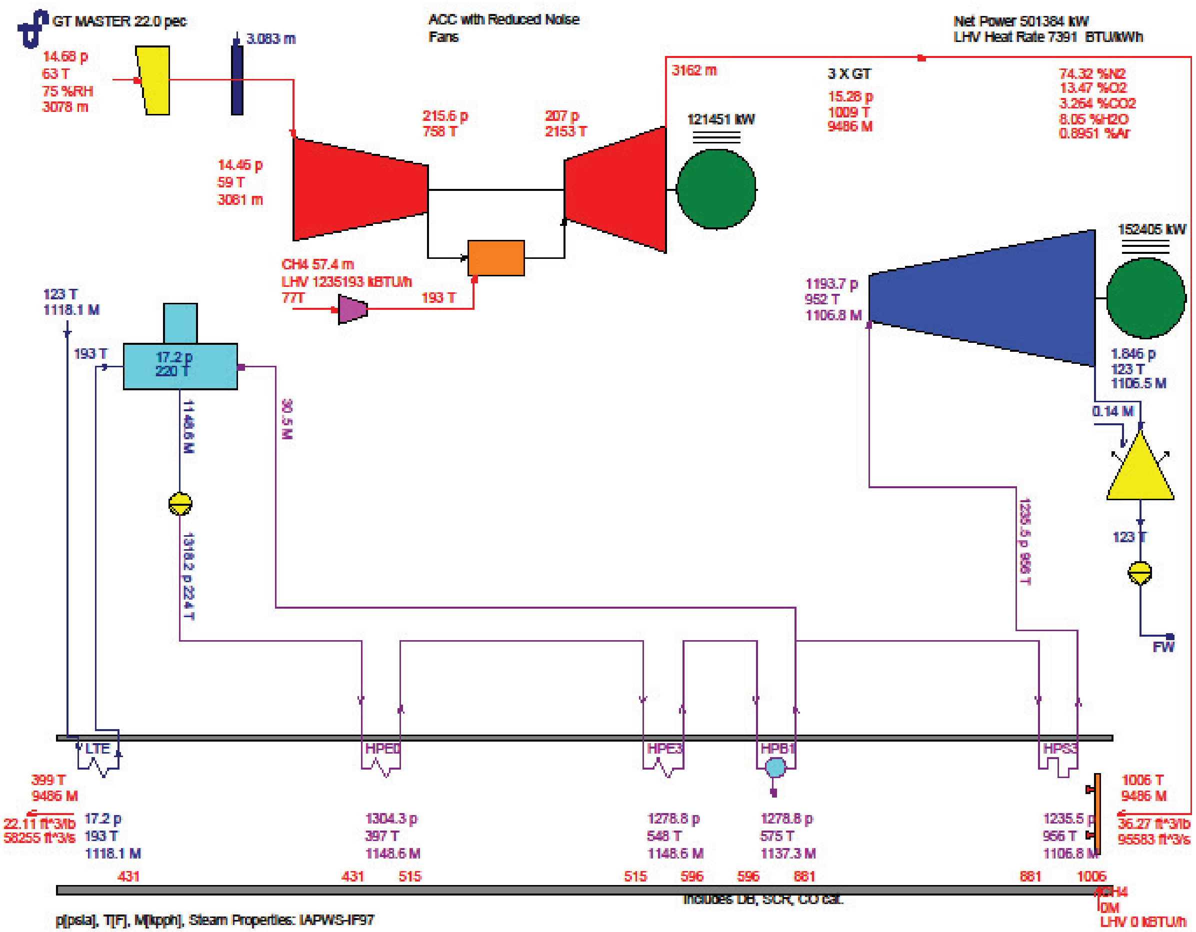

FIGURE 2.1-4b
Heat and Mass Balance Diagram - Case 4
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 11/02/2012.

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2.1.4 Combined-cycle Process

CTG combustion air will flow through the inlet air filters, evaporative inlet air coolers, and associated air inlet ductwork before being compressed in the CTG compressor section and then entering the CTG combustion sections. Natural gas will be mixed with the compressed air prior to being introduced to the combustion sections and ignited. The hot combustion gases will expand through the power turbine section of the CTGs, causing them to rotate and drive the electric generators and CTG compressors. The hot combustion gases will exit the turbine sections and enter the HRSGs. The HRSGs will heat water (feed water), converting it to superheated high-pressure steam. High-pressure steam will be delivered to the high-pressure inlet section of the steam turbine. The high-pressure steam is expanded as it passes through the STG and exits as low-pressure steam. The low-pressure steam enters the air-cooled condenser, which removes heat from the low-pressure steam (causing the steam to condense to water) and releases the heat to the ambient air. The condensed water, or condensate, will be returned to the HRSG feed water system for reuse.

2.1.5 Major Generating Facility Components

The major generating components will be housed in fully or partially enclosed buildings for safety purposes, the attenuation of noise, and to improve the aesthetic features of the project. The steam turbine generator will be fully enclosed in its own building while the CTGs and HRSGs will be housed in a separate, partially enclosed building. The west side of the CTG and HRSG building will be left open to facilitate air flow into the CTG air inlets and for the dissipation of heat from the CTG and HRSG. The following paragraphs describe the major components of the generating facility.

2.1.5.1 Combustion Turbine Generators

Thermal energy will be produced in the MPSA 501DA CTGs through the combustion of natural gas, which will be converted into mechanical energy required to drive the combustion turbine compressors and the remaining mechanical energy is then converted into electrical energy by the generators. Each CTG system will include supporting systems and associated auxiliary equipment.

The combustion turbine will drive a totally enclosed water-to-air-cooled (TEWAC) synchronous generator. Using a TEWAC, the closed cooling fluid cooler will reject the generator's heat load. The closed cooling fluid cooler's preliminary design accounts for the TEWAC's heat load.

The CTGs will be equipped with the following systems and components:

- Inlet air filters, inlet silencers, and evaporative coolers
- Metal turbine enclosure
- Lubrication oil system for the combustion turbine and the generator
- Dry low-NO_x combustion system
- Compressor wash system
- Fire detection and protection system (using carbon dioxide)
- Fuel gas system, including flow meter, strainer, and duplex filter
- Starter system
- Turbine controls
- TEWAC synchronous generators
- Generator controls, protection, excitation, power system stabilizer, and automatic generation control

2.1.5.2 Heat Recovery Steam Generators

The HRSGs will transfer heat from the exhaust gases of the CTGs to the feed water to produce high-pressure steam. The HRSGs will be single-pressure, natural circulation units equipped with inlet and outlet ductwork, insulation, lagging, and separate exhaust stacks.

Major heat transfer components of each HRSG will include the low temperature economizer (LTE)/feed water heater, high-pressure economizers, high-pressure evaporator, high-pressure drum, and high-pressure super heater sections. The LTE receives condensate from the condenser hot well via the condensate pumps. The LTE is the final heat transfer section to receive heat from the combustion gases before they are exhausted to the atmosphere.

Condensate is pumped through the LTE and into a deaerator. The feed water pumps remove feed water from the deaerator and pump it to the high pressure portions of the HRSG. The feed water passes through multiple high-pressure economizers, then to the high-pressure steam drum. The saturated water then flows from the steam drum to the inlet of the high-pressure evaporator where saturated steam is formed in the tubes through the transfer of heat energy from the CTG exhaust gas. The high-pressure-saturated liquid/vapor mixture is returned to the steam drum, where the saturated liquid/steam vapor mixture is separated by moisture separators. The saturated water is returned to the high-pressure evaporator while the steam passes to the high-pressure super heater inlet. High-pressure steam is produced in the high-pressure super heater through the transfer of heat energy from the CTG exhaust gas. The superheated high-pressure steam flows to the inlet of the STG. An attemperator will be provided upstream of the final high-pressure super heater for control of the steam temperature entering the STG.

The technology for RBEP will be configured and deployed as a multi-stage generating (MSG) asset designed to generate power across a wide range of capacity with superior and relatively constant thermal efficiency and maximum operating flexibility. The project will include multiple generators, often termed “embedded generating units,” whereby combinations of embedded generating units comprise the full operational capability for each power block, from minimum to maximum generating capacity. RBEP will have the ability to generate power from 120 MW (1-on-1 CCGT state) to 496 MW (3-on-1 CCGT state) while maintaining a relatively consistent heat rate. Because each individual CTG can only be operated through a 70 to 100 percent load range, the minimum and maximum output of each MSG state does not fully overlap, which results in a nominal dead band of generating capacity across the operating range of the power block (i.e., the power output of the 1-on-1 state at 100 percent load is lower than the 2-on-1 state at 70 percent load). Supplemental firing through the use of duct burners will be employed to minimize the dead band between states. One 507 MMBtu/hr higher heating value (HHV) natural-gas-fired duct burner will be installed in the inlet ductwork of each HRSG and will be used to increase the flue gas temperature entering the HRSG from 1100°F to a maximum of 1500°F. This increase in exhaust gas temperature will increase the high-pressure steam flow to the STG to provide additional generating capacity, effectively increasing output until another gas turbine can come on line, thus minimizing the dead band.

The HRSGs are designed to function with the maximum heat input of three combustion turbines operating at 100 percent load in new and clean condition. As the turbines age, an unrecoverable loss of efficiency of up to 5 percent will occur over time. This loss of efficiency and subsequent loss of heat input into the steam cycle can be recovered with supplemental firing. Limited supplemental firing, at less than the rated capacity of a single duct burner (approximately 100 MMBTU/hr), could be employed when three CTGs are operating at 100 percent output to make up for the lost generating capacity. Due to the steam cycle size, supplemental firing of the HRSGs at the full rated capacity of the duct burners could only be deployed when there are no more than two CTGs operating.

The HRSGs are equipped with two emission control systems located in the HRSG evaporator region. The first system is an oxidation catalyst to control CO and VOC emissions. The second is an SCR emission control system that uses 19 percent aqueous ammonia in the presence of a catalyst to reduce the NO_x concentration in the exhaust gases. Ammonia is injected into the exhaust gas stream through a grid of nozzles located upstream of the SCR catalyst module. The subsequent chemical reaction will reduce almost all of the NO_x to nitrogen and water leaving only 2.0 parts per million (ppm) of NO_x in the exhaust stream. Both catalysts begin removing their respective emissions at approximately 400°F.

2.1.5.3 Steam Turbine System

The steam turbine system will consist of a condensing steam turbine, gland steam system, lubricating oil system, hydraulic control system, and steam admission/induction valves. The steam turbine will be an MPSA single-casing, single-flow, impulse axial exhaust condensing turbine for outdoor installation.

The steam turbine will drive a TEWAC synchronous generator. The closed-loop cooling system design accounts for the TEWAC's heat load and will reject the generator's heat through the cooling fluid cooler. Steam from the HRSG high-pressure super heaters will enter the steam turbine through the inlet steam system. The steam will expand through the turbine blades, driving the generator. On exiting the turbine, the steam will flow into the air-cooled condenser. A bypass valve, vent, and noise attenuator will be installed on the main steam line to release steam to the atmosphere in the event of a system upset condition.

2.1.6 Major Electrical Equipment and Systems

The bulk of the electric power produced by RBEP will be transmitted to the electrical grid through the 230-kV generation tie line connecting the project to the existing onsite SCE switchyard (see Section 3.0, Transmission System Engineering, for a discussion of the RBEP interconnection to the existing SCE 230-kV switchyard). A small amount of electric power will be used onsite to power auxiliaries such as gas compressors, pumps and fans, control systems, and general facility loads including lighting, heating, and air conditioning. A station battery system also will be used to provide direct current (DC) voltage as backup power for control systems and other critical uses. Transmission and auxiliary uses are discussed in the following subsections.

2.1.6.1 Alternating Current (AC) Power—Transmission

Power will be generated by the three CTGs and the STG at 13.8-kV and stepped up by four fan-cooled generator step-up (GSU) transformers to 230-kV for transmission to the grid. Auxiliary power will be fed from the 13.8-kV bus through separate station unit service transformers, which will step the power down to 4.16 kV. Each CTG will have a 13.8-kV generator circuit breaker, located on the generator output, to isolate and synchronize the CTG to the grid during startup. Surge arresters will be provided at the high-voltage bushings to protect the transformers from surges on the 230-kV system caused by lightning strikes or other system disturbances. The transformers will be set on concrete pads within berms designed to contain the transformer oil in the event of a leak or spill. The high-voltage side of the GSU transformers will be connected to SCE switchyard circuit breakers and associated equipment with the SCE high voltage transmission system. Section 3.0, Transmission System Engineering, presents additional information regarding the electrical transmission system.

2.1.6.2 AC Power—Distribution to Auxiliaries

Auxiliary power for RBEP is supplied at 4.16-kV and 480 volts AC by a double-ended, 4.16-kV switchgear lineup and a double-ended, 480-volt load center substation arrangement. Two mineral-oil-filled, 13.8kV/4.16-kV station unit service transformers will supply primary power to the switchgear and then subsequently to large motor loads and to the 4.16 kV side of the 4.16-kV/480-volt, mineral oil-filled load center transformers. The high-voltage side of the station unit service transformers will be connected to a tap on the 13.8-kV isolated phase bus duct which connects the generator to the respective GSU transformer low voltage (secondary) winding. The 4.16-kV switchgear lineup will supply power to the large motor loads and to the load center transformers for 480-volt power distribution. The 4.16-kV switchgear will have vacuum interrupter circuit breakers for the main incoming feeds and for power distribution. The combustion turbine starting system and the generator excitation system will be powered through a respective transformer that will be connected through taps on the 13.8-kV isolated phase bus.

Each load center transformer will be mineral oil-filled and will supply 480-volt, three-phase power to the CTG and balance-of-plant 480-volt motor control centers (MCC).

The MCCs will provide power through feeder breakers to the various 480-volt motor loads, and other low-voltage plant loads, including 480-volt power distribution panels, and lower voltage lighting and distribution panel transformers. Power for the AC power supply (240-volt/120-volt) system will be provided by the 480-volt MCCs and 480-volt power panels. Dry-type transformers will transform 480-volt power to 240/120-volt power.

The fuel gas compressors will receive their power at 13.8 kV via a separate auxiliary connection that will be tied to the 13.8kV bus duct between the generator output breakers and the GSU low voltage connection.

2.1.6.3 Essential Services Bus

A 480-V AC bus will provide power to essential loads which will include but will not be limited to ventilation, critical lighting and a charger to the 125-volt DC power supply system.

2.1.6.4 125-volt DC Power Supply System

The 125-volt DC power supply system will consist of one battery bank, a battery charger, and one or more distribution panels. The panels will supply DC pumps, circuit breaker line power, and an uninterruptible power supply (UPS) system. The combined-cycle gas turbine DC buses will be connected with a tie breaker. Each CTG and the plant switchyard will be provided with its own separate battery systems, chargers, and panel boards.

Under normal operating conditions, the essential services buses provide 480-volt, three-phase AC power to the battery chargers and continuously charge the battery banks while supplying power to the DC loads.

Under abnormal or emergency conditions, when power from the essential services bus is unavailable, the batteries supply DC power to the DC system loads. Recharging of a discharged battery occurs whenever 480-volt power becomes available from the essential services bus. The rate of charge depends on the characteristics of the battery, battery charger, and the connected DC load during charging. The anticipated maximum recharge time will be 24 hours.

2.1.6.5 Uninterruptible Power Supply System

The combined-cycle gas turbine power block will have a critical service 120-volt AC, single-phase, 60-hertz bus. It will be powered with a UPS system to supply AC power to instrumentation and loads which will include, but not be limited to distributed control system (DCS) operator stations, DCS controllers, the continuous emissions monitoring system, and protection and safety systems.

A UPS inverter will supply 120-volt AC single-phase power to the UPS panel boards that supply critical AC loads. The UPS inverter will be fed from the station 125-volt DC power supply system and alternatively from the essential services bus trough a transformer. The UPS system will consist of one full-capacity inverter, a static transfer switch, a manual bypass switch, an alternate source transformer, and one or more panel boards.

The normal source of power to the system will be from the 125-volt DC power supply system through the inverter to the UPS panelboard. A solid-state static transfer switch will continuously monitor the inverter output and the alternate AC source. The transfer switch will automatically transfer essential AC loads without interruption from the inverter output to the alternate source upon loss of the inverter output.

2.1.6.6 Alternate Power Source

RBEP will use power from an existing onsite 66-kV source for construction and commissioning.

2.1.7 Fuel System

The CTGs will be designed to burn natural gas only. The natural gas requirement during full load operation at SAAT conditions is approximately 3,661 MMBtu/hr (LHV basis, total for three CTGs).

Natural gas will be delivered to the site via the existing SoCalGas, high-pressure natural gas line. The high-pressure natural gas pipeline is a 20-inch-diameter line that operates at a nominal 175 pounds per square inch gage (psig). At the plant site, the natural gas will flow through a flow-metering station, a gas pressure control station, gas compression equipment, and gas scrubber/filtering equipment prior to entering the CTGs. The 175 psig natural gas will also flow to the duct burner skid without requiring gas compression but it will require some level of scrubbing and filtration. The natural gas for the building heating systems will flow through the flow-metering station and gas pressure control station, but will not require compression, filtering, or heating.

2.1.8 Plant Cooling Systems

The steam turbine cycle heat rejection system will consist of an air-cooled condenser, which will eliminate the need for ocean water for power plant cooling, which is the method currently used at the existing Redondo Beach Generating Station. The heat rejection system will receive exhaust steam from the low-pressure section of the steam turbine and condense it to water (condensate) for reuse. The condenser will be designed to operate at a pressure of approximately 3 pounds per square inch (psi), absolute, during base load operation at summer design conditions of 76.8°F dry bulb and 67.6°F wet bulb. It will transfer approximately 997.2 MMBtu/hr to the ambient air as a result of condensing steam at these operating conditions.

Balance of plant systems will be cooled by a closed-loop fluid cooler utilizing water. CTG, STG, gas compressors and other balance-of-plant auxiliary equipment requiring cooling will be integrated into the closed cooling water loop.

2.1.9 Water Supply and Use

Figures 2.1-5a and 2.1-5b provide the water balances for RBEP representing two operating conditions. Figure 2.1-5a represents operation under site monthly maximum average ambient temperature (SMMAAT)[7] conditions with the CTGs at 100 percent load with CTG inlet air evaporative cooling operating. Figure 2.1-5b represents operation at site peak summer ambient temperature (SPSAT)[8] conditions with the CTGs operating at 100 percent load with CTG inlet evaporative cooling operating.

RBEP will use potable water provided by California Water Service Company for process and potable uses. The project will tie into the existing onsite 8-inch-diameter main along Herondo Street.

2.1.9.1 Water Requirements

The water requirements for the RBEP combined-cycle units while operating at the maximum daily and peak consumption rates (three CTGs at 100 percent load with inlet air evaporative cooling operating) were developed using the following two sets of temperature conditions:

- For the site SMMAAT conditions, the maximum average water use will be approximately 41.7 gallons per minute (gpm), and 52.5 acre-feet per year.
- For the SPSAT peak flow conditions, station maximum water use will be approximately 225.6 gpm.

The annual water requirements for RBEP, assuming it would operate continuously for the maximum permitted hours per year (6,835 hours per year) will be approximately 52.5 acre-feet per year, substantially less than the actual historical water consumption of the existing Redondo Beach Generating Station. Process and potable water demand for the existing Redondo Beach Generating Station has been supplied by California Water Service Company. Based on water volumes from 2008 through 2011, the Redondo Beach Generating Station has historically used approximately 190 gallons per minute and 306 acre-feet per year while operating at only 5 percent of its maximum capacity.

Plant makeup water will be fed directly from California Water Service Company through metering equipment into the existing 210,000-gallon service water tank no. 1, and into a new 100,000-gallon service water tank no. 3. Water from the service water tank no. 1 will be used for fire protection. Water from the new service water tank no. 3 will be used as plant service water, irrigation water, makeup to the combustion turbine inlet air evaporative coolers, and raw feed to the cycle makeup water treatment system. Service water tank no. 1 will provide approximately 2 hours of fire protection storage. Service water tank no. 3 will provide 40 hours of storage in the event of a disruption in the supply.

Table 2.1-1 lists the estimated daily and annual water use for RBEP operations.

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[7] This is the annual average of the median max daily temp, corresponding to 76.8°F dry bulb and 67.9°F wet bulb, and 62 percent relative humidity, which is where the station expects to need evaporative cooling on a regular basis.

[8] Maximum Summer (1 hour) conditions (106°F dry bulb and 66.7°F wet bulb, and 9.6 percent relative humidity)

TABLE 2.1-1
Estimated Daily and Annual Water Use for RBEP Operations

Water Use	Average Daily Use Rate (gpm)	Maximum Daily Use Rate (gpm)	Average Annual Use* (acre-feet per year)
Potable water	41.7	225.6	52.5

*Assumes 6,835 hours of operation.

2.1.9.2 Wastewater Requirements

The wastewater requirements for the RBEP combined-cycle units while operating at the maximum daily and peak consumption rate (three CTGs at 100 percent load with inlet air evaporative cooling operating) were developed using the following two sets of temperature conditions:

- For the SMMAAT conditions, discharge to the existing outfall will be approximately 11.2 gpm and 14.1 acre-feet per year.
- For the SPSAT conditions, discharge to the existing outfall will be approximately 71.3 gpm.

Maximum annual discharge volumes to the existing ocean outfall for the plant operating at the maximum permitted hours per year (6,835 hours per year) will be approximately 14.1 acre-feet per year (Table 2.1-2).

Sanitary wastewater discharge from RBEP will be to the existing sewer line that bisects the site and connects to the City of Redondo Beach sanitary sewer system. The existing City main flows by gravity to the City of Redondo Beach pump station along Herondo Street.

TABLE 2.1-2
Estimated Daily and Annual Wastewater Discharge for RBEP Operations

Wastewater Use	Average Daily Discharge Rate (gpm)	Maximum Daily Discharge Rate (gpm)	Average Annual Use* (acre-feet per year)
Wastewater to outfall	11.2	71.3	14.1

*Assumes 6,835 hours of operation at the average daily maximum temperature.

2.1.9.3 Water and Wastewater Treatment

Makeup water for the steam cycle will have contaminants removed (demineralized) by passing the service water through a reverse osmosis system followed by exchangeable mixed bed demineralizer bottles. The various water streams are:

- The reject water stream from the reverse osmosis system will be discharged to a holding tank for reuse on site. The unused portion will ultimately be discharged to the outfall. The re-used portion will flow to the service water tank for storage and reuse.
- The demineralized water will be sent to one 100,000 gallon storage tank. It will provide approximately 50 hours of storage at the average daily use rate shown in Table 2.2-1 conditions. Demineralized water is used for feedwater makeup for the steam cycle and for combustion turbine washwater.
- Feedwater makeup water will be deaerated and fed to the condensate receiver or the deaerator water storage tank.
- Blowdown (condensate removed from the HRSGs to reduce water contaminants) will be discharged to an atmospheric flash tank where the flash steam will be vented to atmosphere and the condensate will be cooled prior to transfer to a holding tank for reuse. The unused portion will ultimately be discharged to the outfall. The re-used portion will flow to the service water tank for storage and reuse.

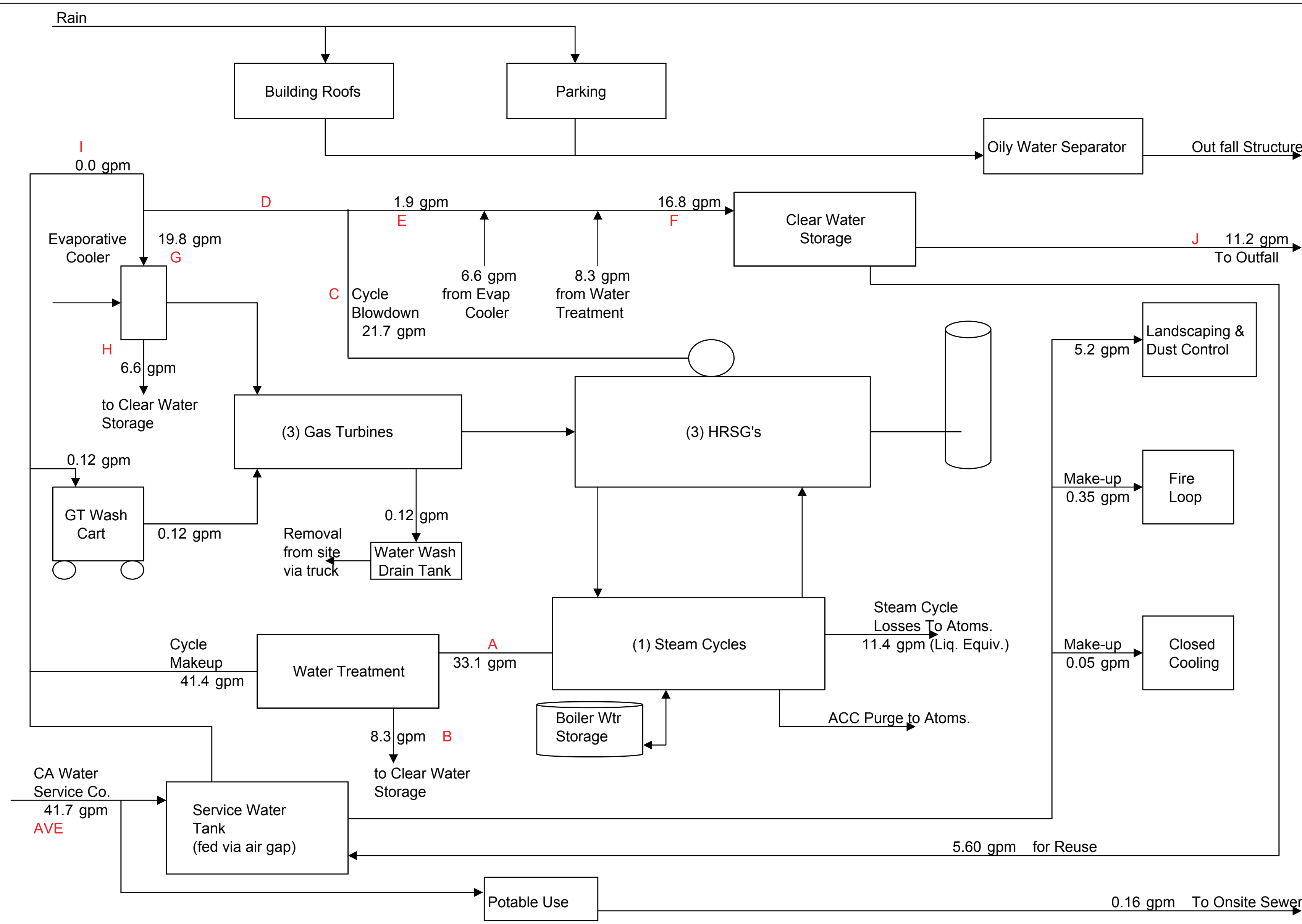

FIGURE 2.1-5a
SMMAAT Water Balance Diagram
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 02/23/2012.

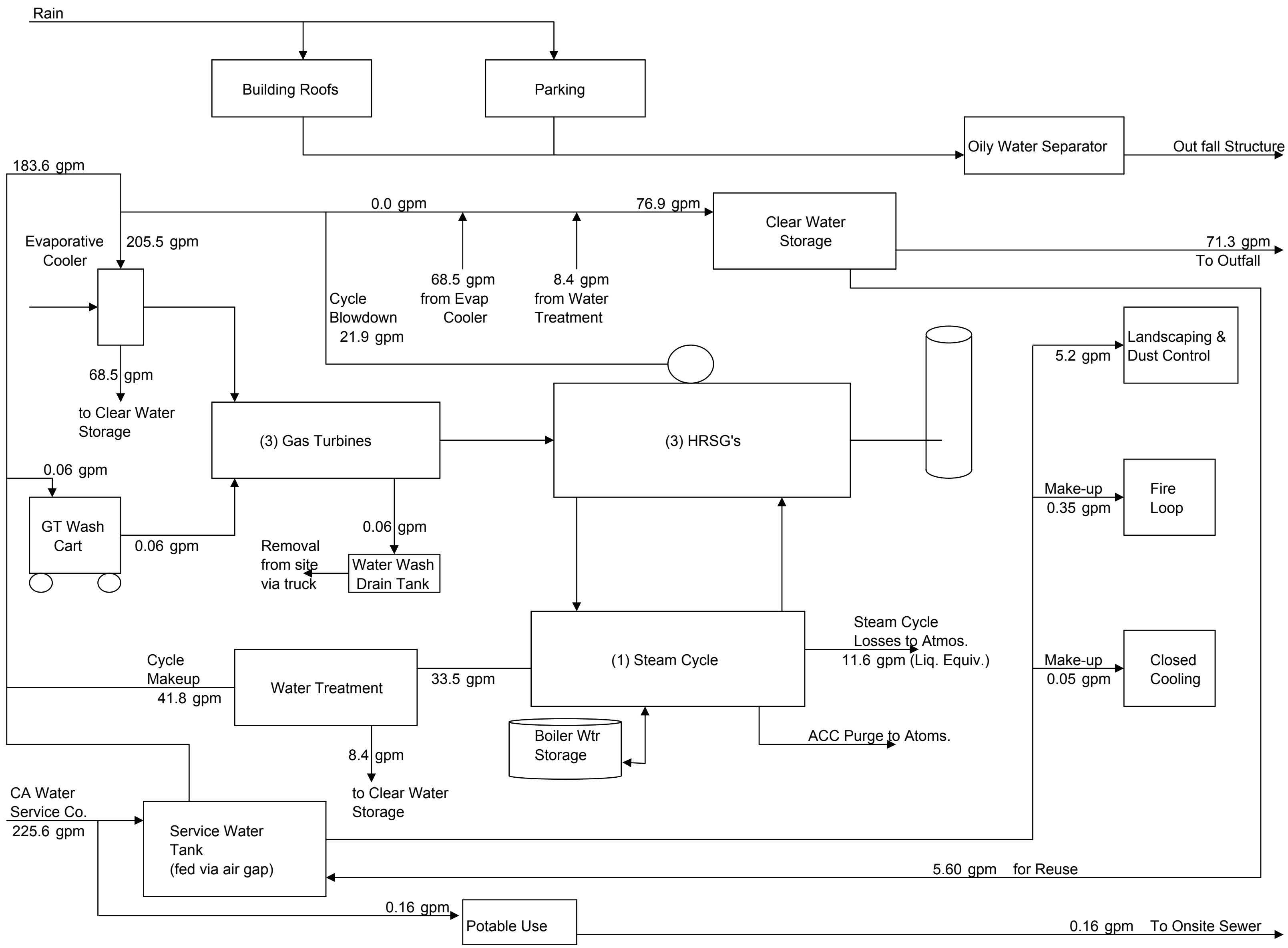

FIGURE 2.1-5b
SPSAT Water Balance Diagram
AES Redondo Beach Energy Project
Redondo Beach, California

Source: Power Engineers Collaborative, LLC, 02/23/2012.

- Wastewater from combustion turbine water washes will be collected in combustion turbine drain tanks and then trucked offsite for disposal. Service water will be used for makeup to the combustion turbine evaporative coolers, equipment washdown, and other miscellaneous plant uses.
- Blowdown from the combustion turbine evaporative coolers will be discharged to the plant process drain system and stored for reuse. The unused portion will ultimately be discharged to the outfall. The re-used portion will flow to the service water tank for storage and reuse.
- Stormwater from process areas that could potentially include oil or other lubricants will be directed to an oil/water separator for removal of accumulated oil that may result from equipment leakage or small spills and large particulate matter that may be present from equipment washdowns. The oil-free stormwater from the process areas and from the pavement areas will be collected in the retention basin and will be discharged to the existing ocean outfall. The residual oil-containing sludge will be collected via vacuum truck and disposed of as hazardous waste.

2.1.9.4 Air-cooled Condenser System

Exhaust steam from the STG will be condensed in an air-cooled condenser. The use of an air-cooled condenser will eliminate the significant water demand required for condensing STG exhaust steam in a conventional surface condenser/cooling tower arrangement. To condense steam in an air-cooled condenser large fans blow ambient air across finned tubes through which low-pressure steam flows. The low-pressure steam is cooled to a temperature at which point it is condensed back into water (condensate). It is collected in a receiver located under the air-cooled condenser. Condensate pumps will return the condensate from the receiver back to the HRSGs for reuse.

2.1.9.5 Closed-loop Cooling System

A closed-loop cooling system will provide cooling water for various plant equipment, such as the CTG and STG generator coolers, CTG and STG lubrication oil coolers, and boiler feedwater pumps. The primary means of heat rejection for this closed-loop system will be an air-cooled heat exchanger. The air-cooled heat exchanger will use large fans to blow ambient air across finned tubes through which the closed-loop cooling water will flow. The air-cooled heat exchanger will consume no water.

2.1.10 Emission Control and Monitoring

Air emissions from the combustion of natural gas in the CTGs and duct burners in the HRSGs will be controlled using state-of-the-art systems. To ensure that the systems perform correctly, continuous emission monitoring of stack exhaust flow rate, temperature, oxygen, NO_x and carbon monoxide will be performed as well as the natural gas heat input, generator output and ammonia injection rate into the pollution control system. Section 5.1, Air Quality, includes additional information on emission control and monitoring.

2.1.10.1 NO_x Emission Control

Selective catalytic reduction will be used to control NO_x concentrations in the exhaust gas emitted to the atmosphere to 2.0 ppmvd from the HRSG stacks. The SCR process will use 19 percent aqueous ammonia. Ammonia slip, or the concentration of unreacted ammonia in the exiting exhaust gas, will be limited to 5.0 ppmvd from the HRSG stacks. The SCR equipment will include a reactor chamber, catalyst modules, ammonia storage system, ammonia vaporization and injection system, and monitoring equipment and sensors. The project will install a new 19 percent aqueous ammonia delivery system, which consists of a single 12,000-gallon ammonia tank, a spill containment basin, and a refilling station with a spill containment basin and sump. The existing Redondo Beach Generating Station currently uses an ammonia delivery system that uses a 29 percent aqueous ammonia solution.

2.1.10.2 Carbon Monoxide and Volatile Organic Compounds

An oxidizing catalytic converter will be used to reduce the carbon monoxide concentration in the exhaust gas emitted to the atmosphere from the HRSG stacks to 2.0 ppmvd and VOCs to 1.0 ppmvd.

2.1.10.3 Particulate Emission Control

Particulate emissions (PM10 and PM 2.5) will be controlled through the use of best combustion practices and the sole use of inherently low sulfur natural gas fuel. The best available control technology for particulate emissions from combustion sources is the use of clean natural gas. In addition, particulate emissions from RBEP will be further limited by the use of a high-efficiency inlet air filtration system, which will remove particulates in the ambient air prior to entering the CTG processes. The dry low NOx combustors in the CTG further insure particulate emissions are limited to measurement detection limits by combusting natural gas as close to the stoichiometric air-fuel mixture point as possible.

2.1.10.4 Continuous Emission Monitoring

Continuous emission monitors will sample, analyze, and record fuel gas flow rate, NO_x and CO concentration levels, and percentage of oxygen in the exhaust gas from each of the six HRSG stacks. This system will generate reports of emission data in accordance with permit requirements and will send alarm signals to the plant supervisory control system when emissions approach or exceed pre-selected limits.

2.1.11 Waste Management

Waste management is the process whereby all wastes produced at RBEP are properly collected and disposed of. Wastes include process and sanitary wastewater, nonhazardous waste (liquid and solid), and hazardous waste (liquid and solid). Waste management is discussed in more detail in Section 5.14.

2.1.11.1 Stormwater Collection, Treatment, and Disposal

Stormwater that falls within process equipment containment areas will be collected and discharged to the existing Redondo Beach Generating Station process drain system, which consists of oil/water separation sumps and one retention basin. Stormwater that falls within the plant in pavement area and outside the process equipment containment areas will be routed to the retention basin. Stormwater that falls outside of the process containment and pavement areas will either percolate directly into the soil or drain over the surface into the retention basin to assist with the removal of suspended solids. The oil-free stormwater from the process areas and from the pavement areas collected in the retention basins will be discharged through the existing ocean outfall. The residual oil-containing sludge will be collected via vacuum truck and disposed of as hazardous waste. The water balance diagrams, Figures 2.1-5a and 2.1-5b, show the expected wastewater streams. Table 2.2-2 shows the flow rates for RBEP for the annual average and maximum conditions, respectively.

2.1.11.2 Plant Drains and Oil/Water Separator

General plant drains will collect containment area wash down, sample drains, and drainage from facility equipment drains. Water from these areas will be collected in a system of floor drains, hub drains, sumps, and piping and routed to the process drain collection system. Drains that potentially could contain oil or grease will first be routed through an oil/water separator. Wastewater streams that are unlikely to contain oil and grease, including CTG inlet air evaporative cooler blowdown, HRSG blowdown, blowdown from the auxiliary cooling system fin fan fluid cooler, and reverse osmosis reject will bypass the oil/water separator. Miscellaneous wastewaters, including those from combustion turbine water washes and from some water treatment membrane-based system’s cleaning operations, will be collected in holding tanks or sumps and will be trucked offsite for disposal at an approved wastewater disposal facility.

2.1.11.3 Sanitary Wastewater

Sanitary wastewater from sinks, toilets, showers, dishwashers, and other sanitary facilities will be discharged to the facility’s sanitary sewer collector system. Sanitary wastewater will be sent through the onsite sewer line, which extends to an existing sanitary sewer system/pump station located within Herondo Street. The water balance diagrams, Figures 2.1-5a and 2.1-5b, show the expected wastewater streams. Table 2.2-2 shows the flow rates for RBEP for the annual average and maximum conditions, respectively.

2.1.11.4 Solid Wastes

RBEP will produce maintenance and plant wastes typical of power generation operations. Generation plant wastes include oily rags, broken and rusted metal and machine parts, defective or broken electrical materials, empty containers, and other refuse generated by workers. Solid wastes will be trucked offsite for recycling or disposal (see Section 5.14).

2.1.11.5 Hazardous Wastes

Several methods will be used to properly manage and dispose of operational hazardous wastes generated by RBEP. Waste lubricating oil will be recovered and recycled by a waste oil recycling contractor. Spent lubrication oil filters will be disposed of in a Class I landfill. Spent SCR and oxidation catalysts will be recycled by the supplier or disposed of in accordance with regulatory requirements. Workers will be trained to handle hazardous wastes generated at the site.

Chemical cleaning wastes will consist of alkaline and acid cleaning solutions used during pre-operational chemical cleaning and in turbine wash waters. These wastes, which are subject to high metal concentrations, will be temporarily stored onsite in portable tanks or sumps, and disposed of offsite in accordance with applicable regulatory requirements.

2.1.12 Management of Hazardous Materials

A variety of chemicals will be stored and used during RBEP construction and operation. The storage, handling, and use of all chemicals will be conducted in accordance with applicable laws, ordinances, regulations, and standards (LORS). Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals will be stored in storage tanks, and most other chemicals will be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills. Concrete containment pits and drain piping design will allow a full-tank capacity spill without overflowing the containment area. For multiple tanks located within the same containment area, the capacity of the largest single tank will determine the volume of the containment area and drain piping. Containment areas subject to rainfall will be provided additional containment volume sufficient to contain the rainfall from a 25-year, 24-hour storm event. Drain piping for reactive chemicals will be trapped and isolated from other drains to eliminate noxious or toxic vapors.

Safety showers and eyewashes will be provided adjacent to, or in the vicinity of, chemical storage and use areas. Plant personnel will use approved personal protective equipment during chemical spill containment and cleanup activities. Personnel will be properly trained in the handling of these chemicals and instructed in the procedures to follow in case of a chemical spill or accidental release. Adequate supplies of absorbent material will be stored onsite for spill cleanup.

The ammonia tank containment structure will be designed and installed to specifically limit the amount of ammonia vapor involved in the event of a tank failure.

A list of the chemicals anticipated to be used at RBEP and their storage locations is provided in Section 5.5, Hazardous Materials Handling. The list identifies each chemical by type, intended use, and estimated quantity to be stored onsite.

2.1.13 Fire Protection

The existing fire protection system will be modified for RBEP to meet all LORS while reusing existing equipment to the maximum extent possible. The system design will protect personnel and limit property loss and plant downtime in the event of a fire. The primary source of fire protection water will be supplied via a connection to the existing potable water distribution system. A new onsite fire water loop and hydrants will be constructed at the facility; however, no new offsite linears will be needed for fire protection

The secondary source of fire protection water will be supplied from an existing 210,000 gallon onsite fire/service water storage tank, which will be reconfigured in accordance with NFPA guidelines to provide 2 hours of protection for the onsite worst-case single fire.

Two electric fire pumps, connected to two independent power feeds from SCE distribution system, will be provided to pump water from the onsite storage tank. Fire protection water from the potable connection and onsite fire/service water storage tank will be provided to a dedicated underground fire loop piping system. Fixed fire suppression systems will be installed at determined fire risk areas. Sprinkler systems also will be installed in the administration/maintenance building as required by NFPA and local code requirements. The CTG units will be protected by a carbon dioxide fire protection system. Hand-held fire extinguishers of the appropriate size and rating will be located in accordance with NFPA 10 throughout the facility.

Section 5.5, Hazardous Materials Handling, includes additional information on fire and explosion risk, and Section 5.10, Socioeconomics, provides information on local fire protection capability.

2.1.14 Plant Auxiliaries

The following systems will support, protect, and control the generating facility.

2.1.14.1 Lighting

RBEP will be operational (though not necessarily generating power) 24 hours per day, 7 days per week and would require night lighting for safety and security. The lighting system will provide illumination for operation under normal conditions, for safety under emergency conditions, and for manual operations during a power outage. The system will also provide 120-volt convenience outlets for portable lamps and tools.

To reduce offsite lighting impacts, lighting for RBEP will be restricted to areas required for safety and operation. Exterior lights will be hooded and will be directed onsite to minimize glare and light spill off of the site. Low-pressure sodium lamps and fixtures of a non-glare type will be specified. In addition, switched lighting circuits will be provided for areas where lighting is not required for normal operation or safety to allow these areas to remain dark at most times and to minimize the amount of lighting potentially visible offsite.

2.1.14.2 Grounding

The electrical system is susceptible to ground faults, lightning, and switching surges that result in high voltage that constitutes a hazard to personnel and electrical equipment. The station grounding system provides an adequate path to permit the dissipation of current created by these events.

The station grounding grid will be designed for adequate capacity to dissipate the ground fault current from the ground grid under the most severe conditions in areas of high ground fault current concentration. The grid spacing will maintain safe voltage gradients. Bare conductors will be installed below grade in a grid pattern. Each junction of the grid will be bonded together by an exothermic weld. Ground resistivity readings will be used to determine the necessary numbers of ground rods and grid spacing to ensure safe step and touch potentials under severe fault conditions. Grounding conductors will be brought from the ground grid to connect to building steel and non-energized metallic parts of electrical equipment.

2.1.14.3 Distributed Control System

The DCS is integrated with the CTG controls and also provides modulating control, digital control, monitoring, and indicating functions for the plant power block systems.

The DCS will provide the following functions:

- Integrated control of the CTGs coordinating the STG, HRSGs, and other systems
- Control the balance-of-plant systems in response to plant demands
- Monitor controlled plant equipment and process parameters and deliver this information to plant operators
- Provide control displays (printed logs, LCD video monitors) for signals generated within the system or received from the input/output equipment
- Provide consolidated plant process status information through displays presented in a timely and meaningful manner

- Provide alarms for out-of-limit parameters or parameter trends, display on alarm video monitor(s), and record on an alarm log printer
- Provide storage and retrieval of historical data

The DCS will be a redundant microprocessor-based system and will consist of the following major components:

- Operator consoles with display video monitors
- Input/output cabinets
- Historical data unit
- Printers
- Data links to the CTG and STG control systems

The DCS will have a functionally distributed architecture allowing integration of balance-of-plant equipment that may be controlled locally via a programmable logic controller. The DCS will interface with the STG control systems to provide remote control capabilities, as well as data acquisition, annunciation, and historical storage of turbine and generator operating information. The system will be designed with sufficient redundancy to preclude a single device failure from significantly affecting overall plant control and operation. This also will allow critical control and safety systems to have redundancy of controls and a UPS. As part of the quality control program, daily operator logs will be available for review to determine the status of the operating equipment.

2.1.14.4 Cathodic Protection

The cathodic protection system will be designed to control the electrochemical corrosion of designated metal piping buried in the soil. Depending on the corrosion potential and the site soils, either passive or impressed current cathodic protection may be provided.

2.1.14.5 Service Air

The service air system will supply compressed air to hose connections for general plant use. Service air headers will be routed to hose connections located at various points throughout the facility. The instrument air system will provide the source of air for the service air system. Each service air header will include a backpressure regulating valve to maintain a minimum instrument air system pressure, regardless of service air use. For purposes of reliability, the power block will have two 100-percent-capacity air compressors. The service air and instrument air system will feed from the same compressors.

2.1.14.6 Instrument Air

The instrument air system will provide dry air to pneumatic operators and devices. An instrument air header will be routed to locations within the facility equipment areas and within the water treatment facility where pneumatic operators and devices will be located.

2.1.15 Interconnection to the Electrical Grid

Each of the three CTGs and the STG will be connected to separate two-winding, three-phase, GSU transformers. The GSU’s will connect to an existing single-circuit overhead transmission line via a new single circuit overhead transmission line (combination of new and existing). The existing overhead line connects to the existing SCE 230-kV switchyard. The SCE switchyard will contain 230-kV circuit breaker and air break disconnect switches to interconnect the new RBEP units to the SCE 230-kV transmission system. Refer to Section 3.0, Transmission System Engineering, for additional information on the switchyards and generation tie line.

2.2 Project Construction

Construction of the generating facility, from final engineering design and planning to commercial operation date, is expected to take place from the first quarter of 2017 into the fourth quarter of 2019 (approximately 36 months total). Actual onsite construction and demolition from site preparation to completion of all mechanical, electrical, and balance of plant equipment and demolition of Redondo Beach Generating Station facilities is expected to take approximately 60 months. Major milestones are listed in Table 2.2-1.

TABLE 2.2-1
RBEP Schedule Major Milestones

Activity	Date
Begin dismantling and removal of retired Units 1–4	First quarter 2016
Removal of equipment from retired Units 1–4 complete	Fourth quarter 2016
Begin construction of power block	First quarter 2017
Begin demolition of existing Units 5–8, auxiliary boiler no. 17	First quarter 2019
Startup and test	First and Second quarter 2019
Commercial operations	Third quarter 2019
Construction of control room and relocation of Wyland Whaling Wall	Third and Fourth quarter 2019
Demolition complete	Fourth quarter 2020

As noted in Table 2.2-1, demolition (as described in Section 2.4) of the existing Redondo Beach Generating Station will occur throughout the construction period of the RBEP.

2.2.1 Construction Schedule and Workforce

The construction plan is based on a single shift composed of a 10-hour workday, Monday through Friday, and an 8-hour shift on Saturdays. Overtime and additional shift work may be used to maintain or enhance the construction schedule. Construction will most typically take place between the hours of 7 a.m. and 6 p.m., Monday through Friday, and 9 a.m. and 5 p.m. on Saturday; however, additional hours may be necessary to maintain schedule or to complete critical construction activities (for example, pouring concrete at night during hot weather, working around time-critical shutdowns and constraints). During the commissioning and startup phase of each of the power blocks, the schedule will be based on a single shift, 10 hour/ 6 day work week; however, during this time, some activities may continue 24 hours per day, 7 days per week.

There will be an average and peak workforce of approximately 149 and 338, respectively, of construction and demolition craft people, supervisory, support, and construction management personnel on site during construction and demolition. Appendix 5.10B provides the projected construction craft manpower by month.

2.2.2 Construction Plans

An Engineer-Procurement-Construction (EPC) contractor will be selected for the engineering, procurement, and construction of the facility. Subcontractors will be selected by the general contractor for specialty work as needed.

2.2.2.1 Mobilization

The EPC contractor will mobilize after full notice to proceed. Initial site work will include site grading and stormwater control. A rock aggregate will be used for temporary roads, laydown, work areas, and onsite construction parking areas.

2.2.2.2 Construction Office Facilities

The existing Redondo Beach Generating Station administration building will be used as shared offices for construction staff as well as construction offices for owner, contractor, and subcontractor personnel.

Parking for construction workers will be provided onsite. Figure 2.1-1 identifies the construction parking areas. These areas will provide adequate parking space for construction personnel as well as visitors during construction.

2.2.2.3 Construction Laydown and Storage

In addition to field office siting, areas within the site will be used for offloading and laydown and for storage of materials, equipment and vehicles. Construction laydown areas will be within existing site boundaries. These areas include the parking lot and the open areas formerly occupied by the fuel storage tanks on the southeast end of the site as shown in Figure 2.1-1. Construction access will be generally from Herondo Street. Large or heavy equipment, such as the turbines, generators, GSU transformers, and HRSG modules will be delivered to site by heavy haul truck/trailer following specific requirements of any permits that are required.

Figure 2.1-1 identifies the areas onsite that have been reserved for laydown, storage, and parking. Approximately 17 acres have been allocated onsite.

2.2.2.4 Emergency Facilities

Emergency services will be coordinated with the local fire department and hospitals. An urgent care facility will be contacted to arrange for non-emergency physician referrals. First aid kits will be provided around the site and will be regularly maintained. At least one person trained in first aid will be part of the construction crew. In addition, all foremen and supervisors will be given first aid training and will be trained in the use of a portable automatic external defibrillator.

Fire extinguishers will be located throughout the site at strategic locations at all times during construction.

2.2.2.5 Construction Utilities

During construction, existing, onsite utility lines will be used for the construction offices, laydown area, and the project site.

Temporary construction power will be obtained from SCE. Area lighting will be provided and strategically located for safety and security.

Construction water will be potable water from the California Water Service Company. Average daily use of potable water is expected to be approximately 18,000 gallons. During the 60-day commissioning period, when activities such as hydrostatic testing, cleaning, and flushing and steam blows of the HRSGs and steam cycles will be conducted, average water usage is estimated at 24,000 gallons per day with a maximum daily use of 130,000 gallons. Hydrostatic test water and cleaning water will be tested and disposed in accordance with applicable LORS.

Portable toilets will be provided onsite.

2.2.2.6 Site Services

The following site services will be provided by the EPC contractor:

- Environmental health and safety training
- Site security
- Site first aid
- Construction testing (e.g., nondestructive examination, hydrostatic testing)
- Fire protection including extinguisher maintenance
- Furnishing and servicing of sanitary facilities
- Trash collection and disposal
- Disposal of hazardous materials and waste in accordance with local, state, and federal regulations

2.2.2.7 Construction Materials and Equipment

Construction equipment will be at the project site from shortly after an EPC contractor is selected through commissioning and startup of the plant. The type of equipment onsite will coincide with the erection work being performed. Appendix 2B lists the construction equipment anticipated to be on the project site.

Materials such as concrete, pipe, wire and cable, fuels, reinforcing steel, and small tools and consumables will be delivered to the site by truck. Some of the heavy equipment items will be transported by rail. Rail deliveries will be offloaded in the Long Beach area and transported by truck to the site. Appendix 2C shows the anticipated number of construction truck deliveries to the project site. Truck deliveries of construction materials and equipment will generally occur on weekdays between 6:00 a.m. and 6:00 p.m.

2.2.2.8 Construction Noise

Typically, noisy construction will be scheduled to occur between 7:00 a.m. and 6:00 p.m. Monday through Friday, and 9:00 a.m. and 5:00 p.m. on Saturdays. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities (for example, pouring concrete at night during hot weather, working around time-critical shutdowns and constraints). During some construction periods and during the startup phase of the project, some activities will continue 24 hours per day, 7 days per week. Because RBEP construction will be completed while the existing Redondo Beach Generating Station is still in operation, the public will be partly shielded from noise, visual, and dust impacts resulting from project construction activities. See Section 5.7, Noise, for a discussion and analysis of construction and demolition noise.

2.2.2.9 Construction Lighting

Lighting will be required to facilitate RBEP night construction and commissioning activities. Construction lighting will, to the extent feasible and consistent with worker safety codes, be directed toward the center of the construction site and shielded to prevent light from straying offsite. Task-specific construction/commissioning lighting will be used to the extent practical while complying with worker safety regulations. Typically, construction will be scheduled to occur between 7:00 a.m. and 6:00 p.m. Monday through Friday, and 9:00 a.m. and 5:00 p.m. on Saturdays. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities (for example, pouring concrete at night during hot weather, working around time-critical shutdowns and constraints). During some construction periods and during the commissioning/startup phase of the project, some activities will continue 24 hours per day, 7 days per week. During periods when nighttime construction/commissioning activities take place, illumination that meets state and federal worker safety regulations will be required. To the extent possible, the nighttime construction/commissioning lighting will be erected pointing toward the center of the site where activities are occurring and will be shielded. Task-specific lighting will be used to the extent practical while complying with worker safety regulations. Despite these measures, there may be limited times during the construction/commissioning period when the project site may appear as a brightly lit area as seen in close views and from distant hillside residential areas.

2.3 Demolition Activities

Existing Redondo Beach Generating Station generation facilities and support structures will be demolished. Demolition will begin in first quarter 2016, and will be on going at some level of activity throughout the RBEP construction period, with final demolition complete in fourth quarter 2020. Retired Units 1–4 will be dismantled and removed in 2016 leaving only the administration and generator buildings left standing temporarily to provide a screen between the construction site and Harbor Drive. Demolition of the remaining Units 5–8 and auxiliary boiler no. 17 will occur in 2019–2020 with all structures removed by the end of 2020. The demolition of the Redondo Beach Generating Station facilities will be performed to preserve the ability to recycle as much of the plant equipment as feasible. Demolition will remove plant equipment down to their foundations. Existing office and warehouse buildings and auxiliary mechanical and electrical equipment associated with the existing units will also be removed.

2.3.1 Demolition Manpower

A typical crew size has been assumed; however, manpower loads will vary depending on the specific activities being performed. Various skill sets will be required for equipment operation, truck driving, asbestos and lead abatement, dismantling of structures, health and safety monitoring, sampling, and general housekeeping. There will be an average and peak workforce of approximately 149 and 338, respectively, of construction and demolition craft people, supervisory, support, and construction management personnel on site during construction and demolition. Professional labor for the demolition will include project management, construction management, planning and permitting specialists, health and safety specialist, quality assurance / quality control engineers, project controls engineers, accounting and procurement specialists, and administrative specialists. See Appendix 5.10B for the manpower requirements for demolition.

2.3.2 Demolition Equipment

The following types of equipment is will be used for the demolition of the Redondo Beach Generating Station facilities. Actual equipment may vary depending on the selected demolition contractor.

- 35- and 75 -ton rubber tire cranes
- Excavators with shear attachments
- Backhoes
- Paving breaker attachments for the excavators or backhoes
- Front-end loaders
- 10-wheeled dump trucks for transporting materials
- Truck tractor driven end-dumps for transporting wastes to appropriate disposal facilities
- Fork lifts
- Compactors
- Bulldozers
- Various support vehicles such water trucks (dust control), fueling/service vehicles, and pickup trucks

During peak activities at the site, it is likely that a maximum of 28 tractor-trailer units will be leaving the site each day, to transport waste and debris offsite for disposal. See Appendix 2B for a list of the equipment requirements for demolition.

2.3.3 Demolition Schedule

Table 2.2-1 lists the RBEP major milestones, including demolition start dates.

It is anticipated that demolition activities will be conducted during a normal 10-hour workday, Monday through Friday, and an 8-hour shift on Saturdays, using a single shift. Demolition will typically take place between the hours of 7 a.m. and 6 p.m., Monday through Friday, and 9 a.m. and 5 p.m. on Saturday. However during critical activities, it may be necessary to work longer shifts and additional days. These additional hours can be managed by crew rotations to minimize overtime costs.

2.4 Facility Operation

RBEP will be capable of being dispatched throughout the year and will have annual availability 98.4 percent. It will be possible for plant availability to exceed 99 percent for a given 12-month period.

RBEP will employ a staff of 21 to operate the facility. Staff will include power plant operators, supervisors, administrative personnel, mechanics, and electricians (Table 2.4-1). Operational staff will work in three rotating shifts with administrative and supervisory staff working 8-hour shifts, 5 days a week. The facility will be capable of operating 24 hours per day, 7 days per week.

TABLE 2.4-1
Operating Employees

Classification	Number
Plant Manager	1
Operations Leader	1
Maintenance Leader	1
Environmental Engineer	1
Power Plant Operators	10
Control Specialists	5
Mechanic	1
Administration	1
Total	**21**

RBEP is designed as an MSG, to serve both peak and intermediate loads with the added capabilities of rapid startup, significant turndown capability (ability to turn down to a low load), and fast ramp rates, (30 percent per minute when operating above minimum gas turbine turndown capacity). RBEP is expected to have an annual capacity factor between 15 and 25 percent. Because RBEP will be dispatched as an as-needed generating asset for meeting peak energy demands, load following service or local area reliability needs, the plant could be operated at any of its generating states (1-on-1, 2-on-1 or 3-on-1 combined-cycle state) at any given time. It is expected the operating profile of RBEP will see the facility dispatched at intermediate (2-on-1) and minimum loads (1-on-1) more often than at full load (3-on-1), which makes the design of the RBEP MSG assets the best available technology in terms of thermal efficiency, greenhouse gas emissions, and criteria pollutant emissions. The actual capacity factor in any month or year will depend on weather-related customer demand, load growth, hydroelectric/renewable energy supplies, generating unit retirements and replacements, the level of generating unit and transmission outages, and other factors. The actual RBEP operational profile will depend on electrical grid needs at the time and dispatch decisions made by the California Independent System Operator (CAISO) and the offtaker or load-serving entity contracted with the project owner to buy and distribute the power generated.

The facility could be operated in one or all of the following modes:

- **Maximum or Base Load (3-on-1 state, gas turbines at 100 percent load)**. The facility would be operated at maximum continuous output for as many hours per year as dispatched by the load serving entity or offtaker, or CAISO.
- **Load Following (1-on-1, 2-on-1 or 3-on-1 state as needed)**. The facility would be available at contractual load but operated at less than maximum available output at low load times of the day. The output of each unit would therefore be adjusted periodically, either by schedule or automatic generation control, to meet whatever load requested by the offtaker or necessary by CAISO.
- **Partial Shutdown or Intermediate Load (1-on-1 or 2-on-1 state)**. One or two of the CTGs/HRSGs would be shut down and the other(s) would be operating at full load or in load following mode. If the shutdown unit is not undergoing maintenance, it will in most cases be available to the offtaker and CAISO as non-spinning reserve. This mode of operation can be expected to occur during average- to low-load hours (off-peak hours, weekends).
- **Full Shutdown**. This would occur when required as dictated by electrical system needs, economic conditions, equipment malfunction, fuel supply interruption, transmission line disconnect, or scheduled maintenance of equipment common to all units.

As California's renewable energy portfolio continues to grow, operating in either load following or partial shutdown mode will become more and more common, thus placing an increased importance upon the rapid startup, high turndown, steep ramp rate, and superior heat rate of the MSGs employed at RBEP. By being able to deliver flexible operating characteristics across a wide range of generating capacity, at a relatively consistent and superior heat rate, RBEP will help lower the overall greenhouse gas emissions resulting from electrical generation in southern California.

In the unlikely event of a situation that causes a longer-term cessation of operations, security of the facilities will be maintained on a 24-hour basis, and the California Energy Commission (CEC) will be notified. Depending on the length of shutdown, a contingency plan for the temporary cessation of operations may be implemented. Such a contingency plan will be in conformance with all applicable LORS and protection of public health, safety, and the environment. The plan, depending on the expected duration of the shutdown, could include the draining of all chemicals from storage tanks and other equipment and the safe shutdown of all equipment. All wastes will be disposed of according to applicable LORS. If the cessation of operations becomes permanent, the plant will be decommissioned (see Section 2.8, Facility Closure).

2.5 Engineering

In accordance with CEC regulations, this section, together with the engineering appendixes and Section 4.0, Natural Gas Supply, presents information concerning RBEP design and engineering. The LORS applicable to the engineering are provided, along with a list of agencies that have jurisdiction, the contact persons within those agencies, and a list of the permits that will be required.

Descriptions of the design criteria are included in Appendix 2D for this Application for Certification (AFC):

- Civil Engineering Design Criteria
- Structural Engineering Design Criteria
- Mechanical Engineering Design Criteria
- Electrical Engineering Design Criteria
- Control Engineering Design Criteria
- Chemical Engineering Design Criteria
- Geological and Foundation Engineering Design Criteria

Design and engineering information and data for the following systems are found in the following subsections of this AFC:

- **Power Generation**—See Section 2.1.4, Combined-cycle Process; Section 2.1.5.1, Combustion Turbine Generators; and Section 2.1.5.3, Steam Turbine System. Also see Appendix 2D and Sections 2.1.5 through 2.1.15, which describe the various plant auxiliaries.
- **Heat Dissipation**—See Appendix 2D.
- **Cooling Water Supply System**—See Section 2.1.9, Water Supply and Use.
- **Air Emission Control System**—See Section 2.1.10, Emission Control and Monitoring, and Section 5.1, Air Quality.
- **Waste Disposal System**—See Section 2.1.11, Waste Management, and Section 5.14, Waste Management.
- **Noise Abatement System**—See Section 5.7, Noise.
- **Switchyards/Transformer Systems**—See Section 2.1.6, Major Electrical Equipment and Systems; Section 2.1.14.2, Grounding; Section 2.1.6.1, AC Power—Transmission; Section 2.1.15, Interconnection to Electrical Grid; Section 3.0, Transmission System Engineering; and Appendix 2D.

2.5.1 Facility Safety Design

RBEP will be designed to maximize safe operation. Potential hazards that could affect the facility include earthquake, flood, and fire. Facility operators will be trained in safe operation, maintenance, and emergency response procedures to minimize the risk of personal injury and damage to the plant.

2.5.2 Natural Hazards

The principal natural hazards associated with the RBEP site are earthquakes, floods, and tsunami. The site is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion in the project area is considered significant during the design life of the proposed structures. Structures will be designed to meet the seismic requirements of California Code of Regulations Title 24 and the California Building Code. Section 5.4, Geologic Hazards and Resources, discusses the geological hazards of the area and site. This section includes a review of potential geologic hazards, seismic ground motions, and the potential for soil liquefaction caused by ground shaking. Appendix 2D includes the structural seismic design criteria for the buildings and equipment.

According to the Federal Emergency Management Agency (see Section 5.15), the site is not within the 100-year floodplain. Section 5.15, Water Resources, includes additional information on the potential for flooding.

2.5.3 Emergency Systems and Safety Precautions

This section discusses the fire protection systems, emergency medical services, and safety precautions to be used by project personnel. Section 5.10, Socioeconomics, includes additional information on area medical services, and Section 5.16, Worker Safety, includes additional information on safety for workers. Appendix 2D contains the design practices and codes applicable to safety design for the project. Compliance with these requirements will minimize project effects on public and employee safety.

2.5.3.1 Fire Protection Systems

The project will rely on onsite fire protection systems and local fire protection services. The fire protection systems are designed to protect personnel and limit property loss and plant downtime from fire or explosion. The project will have the following fire protection systems.

Carbon Dioxide and Dry Chemical Fire Protection Systems. These systems protect the CTGs and certain accessory equipment compartments from fire. The system will have fire detection sensors in all protected compartments. Actuating one sensor will provide a high-temperature alarm on the CTG control panel. Actuating a second sensor will trip the CTG, turn off ventilation, close ventilation openings, and automatically release the gas and chemical agents. The gas and chemical agents will be discharged at a design concentration adequate to extinguish the fire.

Sprinkler and Deluge Systems. These systems protect STG equipment, buildings, and large transformers and specific electrical equipment rooms. The STG pedestal area will be protected by an automatic dry pipe sprinkler system. The STG lubrication oil reservoir will be protected by dry pilot sprinklers, and the STG bearing areas will be protected with pre-action sprinkler systems. Buildings will generally be protected by automatic wet-type sprinkler systems. Large transformers (GSU and auxiliary transformers) will be protected by automatic water spray (deluge) systems. Electrical equipment and battery rooms will be protected with pre-action sprinkler systems.

Fire Hydrants/Hose Stations. This system will supplement the plant’s fixed fire suppression systems. Water will be supplied from the plant fire water system.

Fire Extinguisher. The plant administrative/control/warehouse/maintenance building, water treatment building, and other structures will be equipped with portable fire extinguishers as required by the local fire department.

Local Fire Protection Services. In the event of a major fire, the plant personnel will be able to call upon the Redondo Beach Fire Department for assistance. The Hazardous Materials Business Plan (see Section 5.5, Hazardous Materials Handling) for the plant will include all information necessary to allow firefighting and other emergency response agencies to plan and implement safe responses to fires, spills, and other emergencies.

2.5.3.2 Personnel Safety Program

RBEP will operate in compliance with federal and state occupational safety and health program requirements. Compliance with these programs will minimize project effects on employee safety. These programs are described in Section 5.16, Worker Health and Safety.

2.6 Facility Reliability

This section discusses the expected facility availability, equipment redundancy, fuel availability, water availability, and project quality control measures.

2.6.1 Facility Availability

RBEP will be designed to operate between about 23 and 100 percent of base load to support dispatch service in response to customer demands for electricity. RBEP will be designed for an operating life of 30 years. Reliability and availability projections are based on this operating life. Operation and maintenance procedures will be consistent with industry standard practices to maintain the useful life status of plant components.

The percent of time that the power plant is projected to be operated is defined as the “service factor.” The service factor considers the amount of time that a unit is operating and generating power, whether at full or partial load.

The projected service factor for the power plant, which considers projected percent of time of operation, differs from the equivalent availability factor (EAF), which considers the projected percent of energy production capacity achievable.

The EAF may be defined as a weighted average of the percent of full energy production capacity achievable. The projected equivalent availability factor for RBEP is estimated to be approximately 97 percent. The EAF differs from the "availability of a unit," which is the percent of time that a unit is available for operation, whether at full load, partial load, or standby.

2.6.2 Redundancy of Critical Components

The following subsections identify equipment redundancy as it applies to RBEP availability. Specifically, redundancy in the combined-cycle power block and in the balance-of-plant systems that serve it is described. RBEP will be served by the following balance-of-plant systems: fuel supply system, DCS, boiler feedwater system, condensate system, demineralized water system, power cycle makeup and storage, steam condensing system, closed-cycle cooling water system, and compressed air system. Major equipment redundancy is summarized in Table 2.6-1.

TABLE 2.6-1
Major Equipment Redundancy

Description	Number Per Block	Note
Combined-cycle CTGs and HRSGs	3 – 33% trains	Steam turbine bypass system allows both CTG/HRSG trains to operate at base load with the steam turbine out of service during start up and shutdown events.
Natural-gas-fired duct burners	3 – One per HRSG	Two duct burners are needed to provide part load operation to minimize MSG dead bands between stages. Duct burners will not be used for augmenting maximum power output.
STG	1 – 100%	See note above pertaining to CTGs and HRSGs
HRSG feedwater pumps	3 – 50% per block	—
Condensate pumps	3 – 50%	—
Air-cooled condenser	1 – 100%	Condenser must be in operation for plant to operate, however, it will include approximately 25 cells; thus there is a level of redundancy in fans, gearboxes, and motors.
Auxiliary cooling water pumps	2 – 100%	—
Close cooling fluid cooler (auxiliary cooling water)	1 – 100%	—
Air Compressors	2 – 100%	—
Fuel gas compressors per block	2 – 100%	Two gas compressors with 100% capacity. Gas compressors are expected to operate at 50% capacity.
Reverse osmosis units	1 – 100%	—
DI bottle polishers	100% spare capacity	Mixed Bed – bottles to be generated off site —
Condensate polishers	2 X 100%	Mixed Bed – bottles to be generated off site

2.6.2.1 Combined-cycle Power Block

Three CTG/HRSG power generation trains will operate in parallel within the combined-cycle power block. Each train will be powered by a CTG. Each CTG will provide approximately 20 to 34 percent of the total combined-cycle power block output (assuming three trains operating). The heat input from the exhaust gas from each CTG will be used in the steam generation system to produce steam. Thermal energy in the steam from the steam generation system will be converted to mechanical energy and then to electrical energy in the STG subsystem. The expanded steam from the STG will be condensed and recycled to the feedwater system. Power from the STG subsystem will contribute approximately 33 to 44 percent of the total unfired combined-cycle power block output (assuming three CTG/HRSG trains operating). Major equipment redundancies are listed in Table 2.6-1.

2.6.2.2 CTG Subsystems

The CTG subsystems will include the combustion turbine, inlet air filtration, cooling/heating system, turbine and generator lubrication oil systems, starting system, fuel system, generator and excitation systems, and turbine control and instrumentation. The combustion turbine will produce thermal energy through the combustion of natural gas. The thermal energy will be converted into mechanical energy through rotation of the combustion turbine, which drives the compressor and generator. Exhaust gas from the combustion turbine will be used to produce steam in the associated HRSG. The generator excitation system will be a solid-state static system. Combustion turbine control and instrumentation will cover the turbine governing system, the protective system, and the sequence logic.

2.6.2.3 Heat Recovery Steam Generator Subsystems

The steam generation system will consist of the HRSG and blowdown systems. The HRSG system will provide for the transfer of heat from the exhaust gas of a combustion turbine for the production of steam. This heat transfer will produce steam at the pressures and temperatures required by the steam turbine. The HRSG system will consist of ductwork, heat transfer sections, an SCR system, and an oxidation catalyst module, as well as safety and auto relief valves and processing of continuous and intermittent blowdown drains.

2.6.2.4 Steam Turbine Generator Subsystems

The steam turbine will convert the thermal energy to mechanical energy to drive the STG shaft to make electrical energy in the generator. The basic subsystems will include the steam turbine and auxiliary systems, turbine and generator lubrication oil systems, generator/exciter system, and turbine control and instrumentation.

2.6.2.5 Plant Distributed Control System

The DCS will be a redundant microprocessor-based system and will have a functionally distributed architecture comprising a group of similar redundant processing units; these units will be linked to a group of operator consoles and an engineer work station by redundant data highways. Each processor will be programmed to perform specific dedicated tasks for control information, data acquisition, annunciation, and historical purposes. Because they will be redundant, no single processor failure can cause or prevent a unit trip.

The DCS will interface with the control systems furnished by the STG, HRSG, fuel gas compressors to provide remote control capabilities, as well as data acquisition, annunciation, and historical storage of turbine and generator operating information.

The system will be designed with enough redundancy to preclude a single device failure from significantly affecting overall plant control and operation. Consideration will be given to the action performed by the control and safety devices in the event of control circuit failure. Controls and controlled devices will move to the safest operating condition upon failure.

Plant operation will be controlled from the operator panel in any control cubicle (3) for each CTG. The operator panel will consist of individual, cross-connected CRT/keyboard consoles and one engineering workstation. Each CRT/keyboard console will be an independent electronic package so that failure of a single package will not disable more than one CRT/keyboard. The engineering workstation will allow the control system operator interface to be revised by authorized personnel.

2.6.2.6 Heat Recovery Steam Generator Feedwater System

The HRSG feedwater system will transfer feedwater from the deaerator to the HRSGs. The system will consist of three, 50-percent-capacity pumps for supplying the power block. Each pump will be multistage, horizontal, and motor-driven and will include regulating control valves, minimum flow recirculation control, and other associated pipes and valves. The low-pressure system will receive feedwater directly from the low-pressure economizer using the pressure supplied by the condensate pumps.

2.6.2.7 Condensate System

The condensate system will provide a flow path from the condensate receiver to the HRSG low-pressure economizers. The condensate system will include three, 50-percent-capacity, multistage, vertical, motor-driven condensate pumps.

2.6.2.8 Power Cycle Makeup Water Treatment System

The cycle makeup will include two, 100-percent-capacity trains of two-pass reverse osmosis equipment followed by offsite-regenerated mixed bed demineralizer bottles. Sufficient bottle rack space will be provided to accommodate 200 percent of the required capacity of mixed bed demineralizer bottles or skids.

2.6.2.9 Power Cycle Makeup and Storage

The power cycle makeup and storage subsystem provides demineralized water storage and pumping capabilities to supply high purity water for system cycle makeup, CTG water wash, and chemical cleaning operations. The major components of the system are a single demineralized water storage tank and two 100-percent-capacity, horizontal, centrifugal, cycle makeup water pumps.

2.6.2.10 Compressed Air System

The compressed air system will be designed to supply service and instrument air for the facility. Dry, oil-free instrument air will be provided for pneumatic operators and devices throughout the plant. Compressed service air will be provided to appropriate areas of the plant as utility stations consisting of a ball valve and quick disconnect fittings.

The instrument air system will be given demand priority over the service air system. A backpressure control valve will cut off the air supply to the service air header so as to maintain the minimum required instrument air pressure.

Two, 100-percent-capacity, oil-free, rotary screw package air compressors will supply compressed air to the service and instrument air systems. Two, 100-percent-capacity, heat-less desiccant air dyers will be provided to dry the service and instrument air.

2.6.3 Fuel Availability

Fuel will be delivered via an existing SoCalGas 20-inch-diameter low-pressure gas pipeline. SoCalGas has confirmed that its system has enough capacity to supply RBEP at this location. A will serve letter from SoCalGas is included in Appendix 2E.

2.6.4 Water Availability

RBEP will use, on average, 52.5 acre-feet per year of potable water provided by the California Water Service Company for power plant process water, fire protection, and potable uses.

The availability of water to meet the needs of RBEP is discussed in more detail in Section 5.15, Water Resources. A will-serve letter from the California Water Service Company is included in Appendix 2E.

2.6.5 Sewer and Wastewater Treatment Availability

RBEP will discharge a maximum of 5.6 million gallons per year of wastewater, consisting of process and sanitary wastewater. Sanitary wastewater will be discharged to the public sewer system and process water will be discharged to the existing, permitted outfall.

The availability of wastewater collection and treatment capacity to meet RBEP's needs is discussed in more detail in Section 5.15, Water Resources. A will-serve letter from the City of Redondo Beach for connection to the City sewer lines is included in Appendix 2E.

2.6.6 Project Quality Control

The RBEP quality control program is summarized in this subsection. The objective of the quality control program is to ensure that all systems and components have the appropriate quality measures applied, whether during design, procurement, fabrication, construction, or operation. The goal of the quality control program is to achieve the desired levels of safety, reliability, availability, operability, constructability, and maintainability for generating electricity.

The required quality assurance for a system is obtained by applying controls to various activities, according to the activity being performed. For example, the appropriate controls for design work are checking and review, and the appropriate controls for manufacturing and construction are inspection and testing. Appropriate controls will be applied to each of the various activities for the project.

2.6.6.1 Project Stages

For quality assurance planning purposes, the project activities have been divided into the following stages that apply to specific periods during the project:

- **Conceptual Design Criteria.** Activities such as definition of requirements and engineering analyses.
- **Detail Design.** Activities such as the preparation of calculations, drawings, and lists needed to describe, illustrate, or define systems, structures, or components.
- **Procurement Specification Preparation.** Activities necessary to compile and document the contractual, technical, and quality provisions for procurement specifications for plant systems, components, or services.
- **Manufacturer's Control and Surveillance.** Activities necessary to ensure that the manufacturers conform to the provisions of the procurement specifications.
- **Manufacturer Data Review.** Activities required to review manufacturers' drawings, data, instructions, procedures, plans, and other documents to ensure coordination of plant systems and components, and conformance to procurement specifications.
- **Receipt Inspection.** Inspection and review of product at the time of delivery to the construction site.
- **Construction/Installation.** Inspection and review of storage, installation, cleaning, and initial testing of systems or components at the facility.
- **System/Component Testing.** Actual operation of generating facility components in a system in a controlled manner to ensure that the performance of systems and components conform to specified requirements.
- **Plant Operation.** As the project progresses, the design, procurement, fabrication, erection, and checkout of each generating facility system will progress through the stages defined above.

2.6.6.2 Quality Control Records

The following quality control records will be maintained for review and reference:

- Project instructions manual
- Design calculations
- Project design manual
- Quality assurance audit reports
- Conformance to construction records drawings
- Procurement specifications (contract issue and change orders)
- Purchase orders and change orders
- Project correspondence

For procured component purchase orders, a list of qualified suppliers and subcontractors will be developed. Before contracts are awarded, the subcontractors' capabilities will be evaluated. The evaluation will consider suppliers' and subcontractors' personnel, production capability, past performance, and quality assurance program.

During construction, field activities are accomplished during the last four stages of the project: receipt inspection, construction/installation, system/component testing, and plant operations. The construction contractor will be contractually responsible for performing the work in accordance with the quality requirements specified by the contract.

The subcontractors' quality compliance will be surveyed through inspections, audits, and administration of independent testing contracts.

A plant operation and maintenance program, typical of a project this size, will be implemented by RBEP to control operation and maintenance quality. A specific program for this project will be defined and implemented during initial plant startup.

2.7 Thermal Efficiency

The maximum gross thermal efficiency that can be expected from the configuration specified for RBEP is approximately 46 percent on a LHV basis. This level of efficiency is achieved when the facility is operated at either a partial load in a 2-on-1 configuration or at full load in 3-on-1 configuration. Other types of operations, particularly those at less than full gas turbine output, will result in slightly lower efficiencies. However the RBEP design achieves a very high level of efficiency across a wide range of generating capacity. The basis of RBEP operations will be system dispatch within California's power generation and transmission system. It is expected that RBEP will be primarily operated in load-following service.

Plant fuel consumption will depend on the operating profile of the power plant. It is estimated that the range of fuel consumed by the power plant will be from a minimum of near zero Btus per hour to a maximum of approximately 3,948 MMBtu/hr (LHV basis) at minimum ambient conditions.

RBEP's net annual electrical production cannot be accurately forecasted at this time because of uncertainties in the system load dispatching model and the associated uncertainties in load forecasts. However, because of the efficiency of the plant, with operating characteristics as described above, it is expected to have a plant capacity factor between 15 and 25 percent. The maximum annual generation possible from the facility is estimated to be approximately 3,335 gigawatt hours per year (based on an annual average facility base load MW rating of 496 MW, 98.4 percent availability and 6,835 hours per year).

2.8 Facility Closure

Facility closure can be temporary or permanent. Temporary closure is defined as a shutdown for a period exceeding the time required for normal maintenance, including closure for overhaul or replacement of the combustion turbines. Causes for temporary closure include a disruption in the supply of natural gas or damage to the plant from earthquake, fire, storm, or other natural acts. Permanent closure is defined as a cessation in operations with no intent to restart operations because of plant age, damage to the plant beyond repair, economic conditions, or other reasons. The following sections discuss temporary and permanent facility closure.

2.8.1 Temporary Closure

For a temporary facility closure, where there is no release of hazardous materials, security of the facilities will be maintained on a 24-hour basis, and the CEC and other responsible agencies will be notified. Depending on the length of shutdown necessary, a contingency plan for the temporary cessation of operations will be implemented. The contingency plan will be conducted to ensure conformance with all applicable LORS and the protection of public health, safety, and the environment. The plan, depending on the expected duration of the shutdown, may include the draining of all chemicals from storage tanks and other equipment and the safe shutdown of all equipment. All wastes will be disposed of according to applicable LORS, as discussed in Section 5.14.

Where the temporary closure includes damage to the facility, and there is a release or threatened release of regulated substances or other hazardous materials into the environment, procedures will be followed as set forth in a Risk Management Plan and a Hazardous Materials Business Plan to be developed as described in Section 5.5. Procedures will include methods to control releases, notification of applicable authorities and the public, emergency response, and training for plant personnel in responding to and controlling releases of hazardous materials. Once the immediate problem is solved, and the regulated substance/hazardous material release is contained and cleaned up, temporary closure will proceed as described above for a closure where there is no release of hazardous materials.

2.8.2 Permanent Closure

The planned life of the generation facility is 30 years. However, if the generation facility were still economically viable, it could be operated longer. It is also possible that the facility could become economically noncompetitive in less than 30 years, forcing early decommissioning. Whenever the facility is permanently closed, the closure procedure will follow a plan that will be developed as described below.

The removal of the facility from service, or decommissioning, may range from “mothballing” to the removal of all equipment and appurtenant facilities, depending on conditions at the time. Because the conditions that would affect the decommissioning decision are largely unknown at this time, these conditions would be presented to the CEC when more information is available and the timing for decommissioning is more imminent.

To ensure that public health and safety and the environment are protected during decommissioning, a decommissioning plan would be submitted to the CEC for approval prior to decommissioning. The plan would address the following:

- Proposed decommissioning activities for the facility and all appurtenant facilities constructed as part of the facility
- Conformance of the proposed decommissioning activities to all applicable LORS and local/regional plans
- Activities necessary to restore the site if the plan requires removal of all equipment and appurtenant facilities
- Decommissioning alternatives other than complete restoration
- Associated costs of the proposed decommissioning and the source of funds to pay for the decommissioning

In general, the decommissioning plan for the facility will attempt to maximize the recycling of all facility components. If possible, unused chemicals will be sold back to the suppliers or other purchasers or users. All equipment containing chemicals will be drained and shut down to ensure public health and safety and to protect the environment. All nonhazardous wastes will be collected and disposed of in appropriate landfills or waste collection facilities. All hazardous wastes will be disposed of according to all applicable LORS. The site will be secured 24 hours per day during decommissioning activities.