

## DOCKETED

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## SECTION 2.0

# Project Description

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AES Southland Development, LLC (AES-SLD) proposes to construct, own, and operate the Alamitos Energy Center (AEC)—a natural-gas-fired, air-cooled, combined-cycle, electrical generating facility in Long Beach, Los Angeles County, California. The proposed AEC will have a net generating capacity of 1,936 megawatts (MW) and gross generating capacity of 1,995 MW.<sup>1</sup> The AEC will replace and be constructed on the site of the existing Alamitos Generating Station.

The AEC will consist of four 3-on-1 combined-cycle gas turbine power blocks with twelve natural-gas-fired combustion turbine generators (CTG), twelve heat recovery steam generators (HRSG), four steam turbine generators (STG), four air-cooled condensers, and related ancillary equipment. The AEC will use air-cooled condensers for cooling, completely eliminating the existing ocean water once-through-cooling system. The AEC will use potable water provided by the City of Long Beach Water Department (LBWD) for construction, operational process, and sanitary uses but at substantially lower volumes than the existing Alamitos Generating Station has historically used. This water will be supplied through existing onsite potable water lines.

The AEC will interconnect to the existing Southern California Edison (SCE) 230-kilovolt (kV) switchyard adjacent to the north side of the property. Natural gas will be supplied to the AEC via the existing offsite 30-inch-diameter pipeline owned and operated by Southern California Gas Company (SoCalGas) that currently serves the Alamitos Generating Station. Existing water treatment facilities, emergency services, and administration and maintenance buildings will be reused for the AEC. The AEC will require relocation of the natural gas metering facilities and construction of a new natural gas compressor building within the existing Alamitos Generating Station site footprint. Stormwater will be discharged to two retention basins and then ultimately to the San Gabriel River via existing stormwater outfalls.

The AEC will include a new 1,000-foot process/sanitary wastewater pipeline to the first point of interconnection with the existing LBWD sewer system and will eliminate the current practice of treatment and discharge of process/sanitary wastewater to the San Gabriel River. The project may also require upgrading approximately 4,000 feet of the existing offsite LBWD sewer line downstream of the first point of interconnection, therefore, this possible offsite improvement to the LBWD system is also analyzed in this AFC. The total length of the new pipeline (1,000 feet) and the upgraded pipeline (4,000 feet) is approximately 5,000 feet.

To provide fast-starting and stopping, flexible generating resources, the AEC will be configured and deployed as a multi-stage generating (MSG) facility. The MSG configuration will allow the AEC to generate power across a wide and flexible operating range. The AEC can 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). As California's intermittent renewable energy portfolio continues to grow, operating in either load following or partial shutdown mode will become necessary to maintain electrical grid reliability, thus placing an increased importance upon the rapid startup, high turndown, steep ramp rate, and superior heat rate of the MSG configuration employed at the AEC.

By using proven combined-cycle technology, the AEC can also run as a baseload facility, if needed, providing greater reliability to meet resource adequacy needs for the southern California electrical system. As an in-basin generating asset, the AEC will provide local generating capacity, voltage support, and reactive power that are essential for transmission system reliability. The AEC will be able to provide system stability by

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<sup>1</sup> Referenced to site ambient average temperature conditions of 65.3 degrees Fahrenheit (°F) dry bulb and 62.7°F wet bulb temperature without evaporative cooler operation.

providing reactive power, voltage support, frequency stability, and rotating mass in the heart of the critical Western Los Angeles local reliability area. By being in the load center, the AEC also helps to avoid potential transmission line overloads and can provide reliable local energy supplies when electricity from more distant generating resources is unavailable.

The AEC's combustion turbines and associated equipment will include the use of best available control technology to limit emissions of criteria pollutants and hazardous air pollutants. By being able to deliver flexible operating characteristics across a wide range of generating capacity, at a relatively consistent and superior heat rate, the AEC will help lower the overall greenhouse gas emissions resulting from electrical generation in southern California and allow for smoother integration of intermittent renewable resources.

Existing Alamitos Generating Station Units 1–6 are currently in operation. All six operating units and retired Unit 7 will be demolished as part of the proposed project. Construction and demolition activities at the project site are anticipated to last 139 months, from first quarter 2016 until third quarter 2027. The project will commence with the demolition of retired Unit 7 and other ancillary structures to make room for the construction of AEC Blocks 1 and 2. The demolition of Unit 7 will commence in the first quarter of 2016. The construction of Block 1 is scheduled to commence in the third quarter of 2016 and construction of Block 2 is scheduled to commence in the fourth quarter of 2016. The demolition of existing Units 5 and 6 will make space for the construction of AEC Block 3. AEC Block 3 construction is scheduled to commence in the first quarter of 2020 and will be completed in the second quarter of 2022. The demolition of existing Units 3 and 4 will make space for the construction of AEC Block 4. AEC Block 4 construction is scheduled to commence in the second quarter of 2023 and will be completed in the fourth quarter of 2025. The demolition of remaining existing units is scheduled to commence in the third quarter of 2025.

Construction of the AEC will require the use of onsite laydown areas (approximately 8 acres dispersed throughout the existing site) and an approximately 10-acre laydown area located adjacent to the existing site. The adjacent 10-acre laydown area will be shared with another project being developed by the Applicant (Huntington Beach Energy Project [HBEP] 12-AFC-02). Due to the timing for commencement of construction for these two projects, the adjacent laydown area will already be in use for equipment storage before AEC construction begins.

## 2.1 Generation Facility Description, Design, and Operation

The AEC is a natural-gas-fired, combined-cycle, air-cooled electrical generating facility rated at a net generating capacity of 1,936 MW<sup>2</sup> and gross generating capacity of 1,995 MW. The AEC has been designed using commercially proven technology equipped with environmental monitoring, protection, and safety systems to provide safe and reliable operation over an expected 30-year operating life.

The AEC site encompasses approximately 63 acres, including 8 acres of onsite construction laydown and parking, and an approximately 10-acre offsite laydown area adjacent to the southern boundary of the AEC site (Figure 2.1-1). Figure 2.1-2 shows the proposed AEC equipment general arrangement.

The AEC will include the following principal design elements:

- Twelve Mitsubishi Power Systems America (MPSA) 501DA CTGs with a nominal rating of approximately 119 MW each.<sup>3</sup> The CTGs will be equipped with evaporative coolers on the inlet air system and dry low oxides of nitrogen (NO<sub>x</sub>) combustors.
- Four single-cylinder, single-flow, impulse, axial exhaust condensing STGs with a nominal rating of approximately 143 MW each.

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<sup>2</sup> The net generating capacity accounting for auxiliary load is 1,936 MW, gross output as measured at the generator terminals is 1,995 MW, referenced to SAAT conditions of 65.3°F dry bulb and 62.7°F wet bulb temperature without evaporative cooler operation.

<sup>3</sup> Nominal CTG only output at SAAT conditions.

- Twelve HRSGs of the horizontal gas flow, single-pressure, natural-circulation type. Each HRSG will be equipped with a selective catalytic reduction (SCR) unit in the outlet ductwork for the control of NO<sub>x</sub> emissions and an oxidation catalyst to control carbon monoxide (CO) and volatile organic compound (VOC) emissions.
- Four air-cooled condensers and four closed-loop cooling fin fan coolers.
- Four 230-kV interconnections to the existing SCE switchyard, which is adjacent to the site.
- Direct connection to an existing SoCalGas 30-inch-diameter natural gas pipeline.
- Demolition of Alamos Generating Station Units 1–6 and retired Alamos Generating Station Unit 7 on the schedule described above.
- Demolition of ancillary facilities and selected existing warehouses.
- Connection to existing onsite potable water lines.
- Recontouring of two existing retention basins and the existing outfalls to the San Gabriel River.<sup>4</sup>
- A new 1,000-linear foot process/sanitary wastewater pipeline to the first point of interconnection with the existing LBWD sewer system at the east end of East Vista Street in Long Beach.
- A possible upgrading of the existing offsite sewer line just downstream of the first point of interconnection with the existing LBWD sewer system.

### 2.1.1 Site Arrangement and Layout

Primary access to the project site will be provided via an existing entrance off of North Studebaker Road, just north of the intersection of Westminster Avenue and North Studebaker Road. Figure 2.1-1 shows the facility site plan, Figure 2.1.2 shows the general arrangement and layout of the facility, and Figures 2.1-3.a through 2.1-3.d show typical elevation views of the project.

The project site is bounded to the north by the SCE switchyard and State Route 22 (East 7th Street); to the east by the San Gabriel River and, beyond that, the Los Angeles Department of Water and Power Haynes Generating Station; to the south by the Plains West Coast Terminals petroleum storage facility and undeveloped property; and to the west by the Alamos canal, the former fuel oil tank farm for the Alamos Generating Station (now owned by a third party), Alamos Generating Station inlets, and residences west of the canal.

The existing Alamos Generating Station currently has six operating generating units (Units 1–6) that will be retired, decommissioned, and demolished as part of the project. The existing plant has various ancillary facilities that will be used to support the AEC, such as the administration, maintenance, and certain warehouse buildings; existing SoCalGas natural gas pipeline; LBWD potable water connections; and the existing SCE switchyard. Other existing infrastructure at the Alamos Generating Station, such as the fire water distribution, including two emergency electric driven fire water pumps and process water distribution and storage systems, will be re-used to the greatest extent possible.

#### 2.1.1.1 Pipelines

The AEC will rely on existing natural gas, potable water, and process water supply lines, with the exception of a new, 1,000-foot-long process/sanitary wastewater pipeline to the first point of interconnection with the existing LBWD sewer system and possible upgrading of an additional 4,000 linear feet of the LBWD sewer system just downstream of the first point of interconnection to the LBWD sewer system.

<sup>4</sup> Stormwater will be discharged through the existing outfall and will meet applicable effluent discharge standards.

#### **2.1.1.1.1 Natural Gas Supply Pipeline**

Natural gas will be supplied to the AEC via the two existing 30-inch-diameter pipelines that currently serve the Alamitos Generating Station. No new offsite natural gas supply pipelines will be necessary for the project. The existing natural gas pipelines are owned and operated by SoCalGas. The pipelines operate at a nominal pressure of 165 pounds per square inch, and enter the existing Alamitos Generating Station site at two points onsite. At the northeast corner of the facility near the existing 230-kV switchyard, one pipeline runs parallel to the San Gabriel River to serve existing Units 5 and 6, and a second pipeline enters the site near the vehicle entrance along Studebaker Road to serve existing Units 1 through 4. The existing gas metering station and ancillary equipment will be demolished and a new gas metering station will be constructed on the northeast corner of the facility. The natural gas will flow into the new gas metering station and then 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.

#### **2.1.1.1.2 Potable Water Supply Pipeline**

Potable water for the site is supplied from three separate existing LBWD pipeline interconnections. Because the AEC's combined-cycle technology requires much less water than the existing Alamitos Generating Station's boiler systems, the AEC's water requirements are significantly less than the existing generating station's current use. All of the existing connections will be used to support the AEC. No new offsite potable water supply pipelines will be required for the project.

#### **2.1.1.1.3 Plant Process and Sanitary Wastewater Pipeline**

The project's only offsite linear is an offsite pipeline for discharge of plant process and sanitary wastewater to the Sanitation Districts of Los Angeles County via the LBWD sewer system. A new 1,000-foot-long, 6-inch-diameter pipeline will connect the AEC to the existing LBWD sewer system (Figure 2.1-1). The new, offsite pipeline will commence at the west side of the site near the intersection of Studebaker Road and the northern intake channel. The pipeline will cross under Studebaker Road then turn south to the intersection with Loynes Drive. The pipeline will then turn west and will cross over the Los Cerritos Channel (affixed to the bridge). After crossing the channel, the pipeline will turn north on East Vista Street to connect into the existing system in the residential subdivision.

The extent of any potential upgrades to the existing LBWD sewer pipeline downstream of the first point of interconnection is being analyzed by the LBWD. The LBWD will ultimately determine the scope and conduct of any such upgrades. To ensure a comprehensive review of potential project impacts, a capacity upgrade to an existing approximately 4,000-foot-long existing sewer pipeline downstream of the first point of interconnection with the existing LBWD system (starting at eastern end of East Vista Street and ending at an existing interconnection tee along East Pacific Coast Highway) is included in the environmental analysis of the project (see Figure 2.1-1). While it is still to be determined if any or all of this existing 4,000-foot section of LBWD sewer pipeline downstream of the first point of interconnection maybe upgraded, out of an abundance of caution the potential impacts of upgrading the entire existing 4,000-foot section are analyzed in this AFC. It is anticipated that for both the new construction and for any upgrades, an average 10-foot-wide construction corridor will be necessary.

#### **2.1.1.1.4 Stormwater Disposal**

Site stormwater will continue to be collected in two onsite retention basins and then discharged to the existing San Gabriel River outfalls serving these existing retention basins.

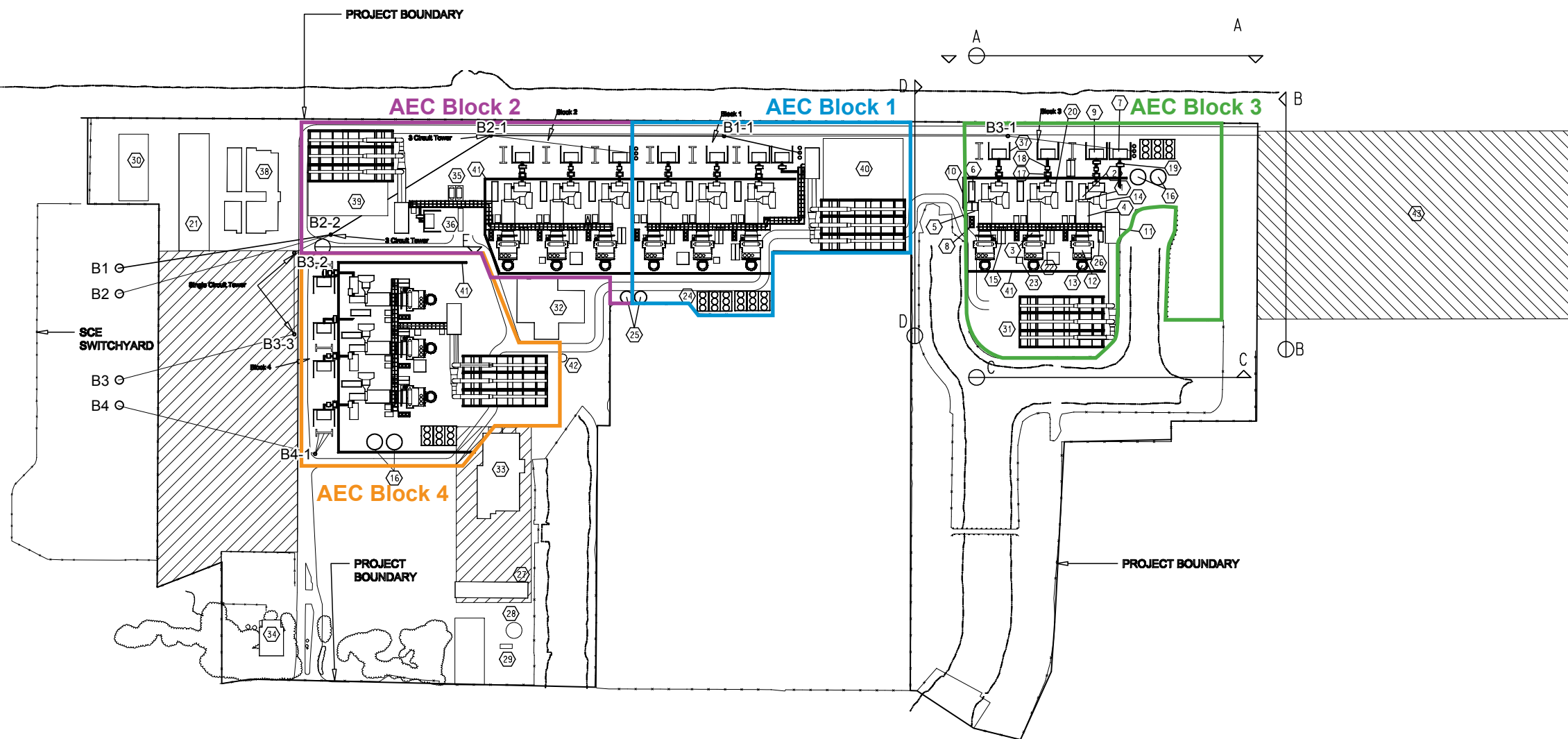


**Legend**

- Project Boundary
  - Parking/Laydown Construction Area
  - Proposed New Process/  
Sanitary Wastewater Pipeline to First Point of Interconnection
  - Upgraded Sewer Pipeline
- 0                      1,000                      2,000  
 Feet



**FIGURE 2.1-1**  
**Site Location Map**  
 Alamitos Energy Center  
 Long Beach, California



EQUIPMENT LIST		
NO.	DESCRIPTION	DIMENSIONS LxWxH
1	COMBUSTION GAS TURBINE (CGT) AND GENERATOR	100' x 32' x 34'
2	CGT GENERATOR ENCLOSURE	39' x 16' x 34'
3	CGT/HRSG TRANSITION DUCT	14' x 32' x 31'
4	CGT ENCLOSURE	61' x 32' x 25'
5	FUEL GAS SKID	20' x 12' x 20'
6	CGT CONTROL/LUBE OIL SKID	50' x 14.5' x 20'
7	STG STEP UP TRANSFORMER	35' x 23' x 15'
8	TURBINE COOLING AIR SKID	31' x 12' x 21'
9	CGT STEP UP TRANSFORMER	35' x 23' x 15'
10	CO2 F/F (LP TANK)	15' x 20' x 15'
11	STG ENCLOSURE	76' x 35' x 51'
12	HEAT RECOVERY STEAM GENERATOR	77' x 44' x 92'
13	STACK	18' DIA.
14	CGT AIR INTAKE SYSTEM	40' x 17' x 38'
15	CONTROL/ELECTRICAL PACKAGE (TYP)	40' x 20' x 15'
16	EXIST. WATER TANK (TYP REUSE)	DIA 38'-6" x 44'
17	SFC. TRANSFORMER	11' x 8' x 10'
18	SEC. TRANSFORMER	11' x 8' x 10'
19	UNIT TRANSFORMER	9' x 11' x 9'
20	GENERATOR MAIN CIRCUIT BREAKER	10' x 12' x 24'
21	FUEL GAS COMPRESSOR/CONDITIONING	288' x 75' x 25'
22	BOILER FEEDPUMP ENCLOSURE	30' x 30' x 15'
23	CEMS	15' x 15' x 10'
24	BOP FIN FAN COOLER	86' x 48' x 15'
25	WATER TANK (TYP)	30' DIA. x 30'
26	STG CONTROL/LUBEDIL SKID	27' x 12' x 10'
27	EXISTING CAR PORT (REUSE)	180' x 38' x 10'
28	EXIST. SERVICE WTR. TANK (REUSE)	40' DIA. x 48' S.S.
29	EXIST. FIRE WATER PUMP SKID (REUSE)	30' x 11'
30	RELOCATED GAS METERING STATION	165' x 73'
31	ACC	209' x 127' x 104'
32	CONTROL/WATER TREATMENT (REUSE EXIST. BLDG.)	167' x 153' x 24'
33	MAINT. WAREHOUSE BUILDING (REUSE EXIST. BLDG.)	211' x 104' x 16'
34	EXIST. SCHOOLHOUSE (REMAIN)	89' x 60' x 13'
35	AMMONIA TANK AND CONTAINMENT	36' x 38' x 14'
36	AMMONIA UNLOADING	56' x 12'
37	TRANSFORMER WALL	53' x 42' x 30'
38	EXIST. ADMIN BUILDING (REUSE)	204' x 126' x 18'
39	RESHAPED NORTH RETENTION BASIN	197' x 170'
40	RESHAPED SOUTH RETENTION BASIN	224' x 197'
41	SOUND WALL	55' TALL
42	CLEAR WATER STORAGE TANK	20' x 20' H
43	LAYDOWN AREA FOR HBEP	

- FENCE
- ▨ CONSTRUCTION LAYDOWN & STAGING
- WATER LINE
- ▨ LAYDOWN AREA FOR HBEP

**GENERAL ARRANGEMENT**  
SCALE: N.T.S

Source: Power Engineers Collaborative, LLC, 12/10/2013.

FIGURE 2.1-2  
General Arrangement  
Alamos Energy Center  
Long Beach, California

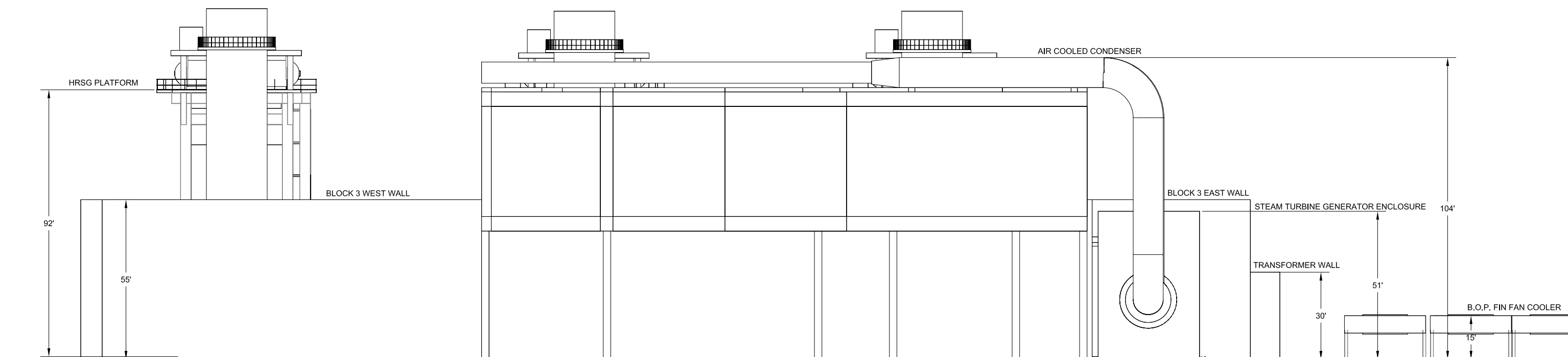


FIGURE 2.1-3a  
**Elevation Drawings (Looking East)**  
 Alamos Energy Center  
 Long Beach, California



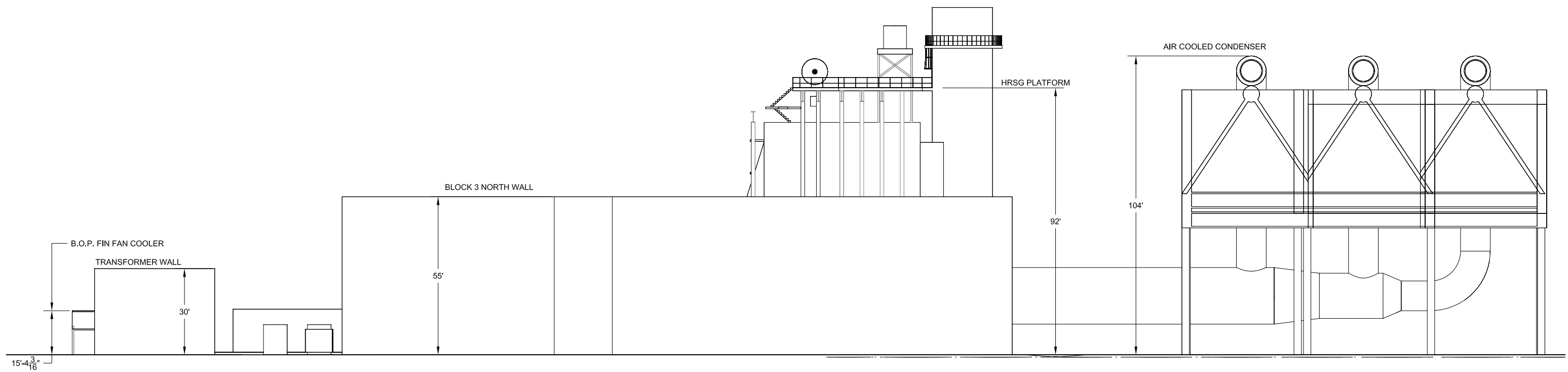


FIGURE 2.1-3b  
**Elevation Drawings (Looking South)**  
 Alamos Energy Center  
 Long Beach, California

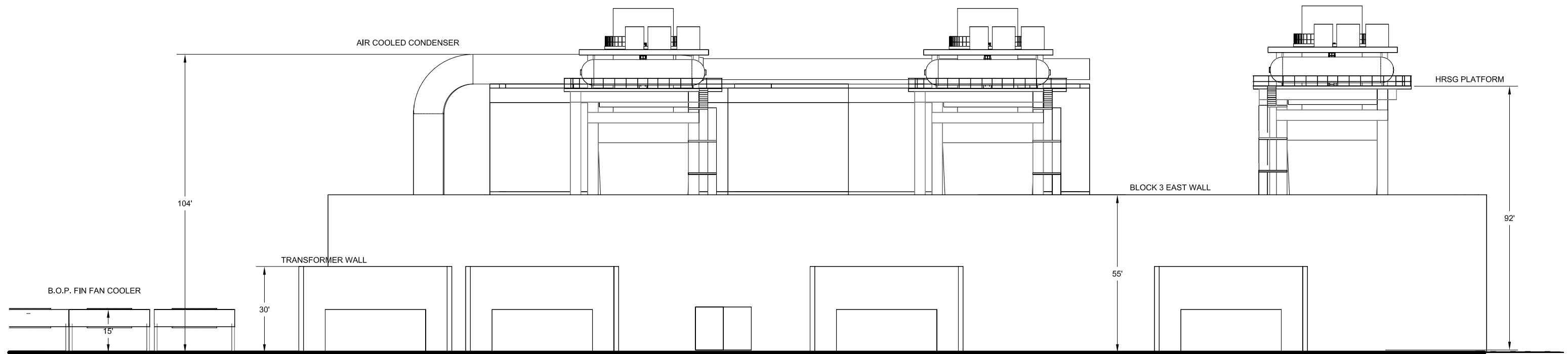


FIGURE 2.1-3c  
**Elevation Drawings (Looking West)**  
 Alamos Energy Center  
 Long Beach, California

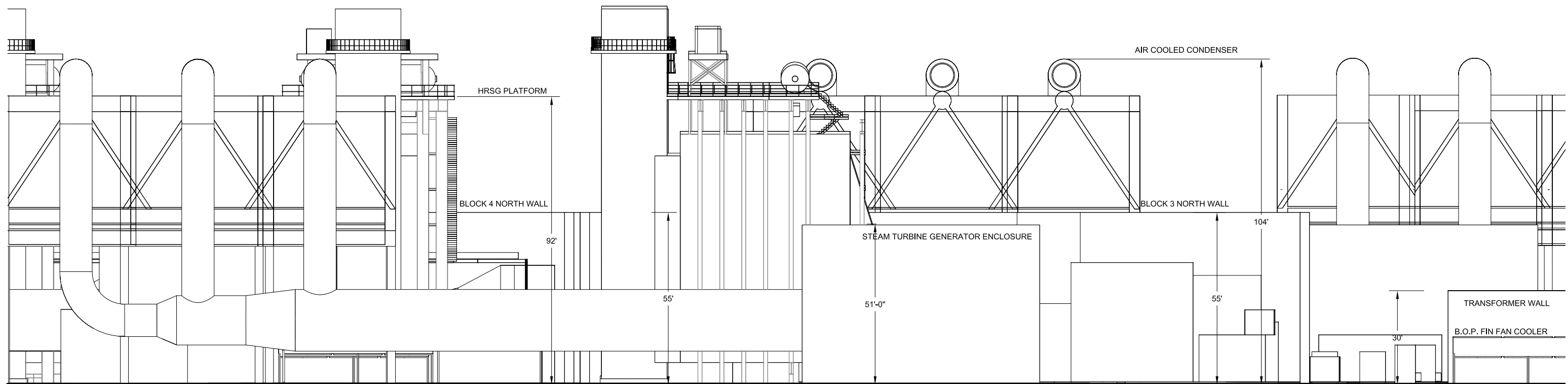


FIGURE 2.1-3d  
**Elevation Drawings (Looking North)**  
 Alamos Energy Center  
 Long Beach, California

### 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 and the secondary source will be supplied from an existing 428,000-gallon onsite fire/service water storage tank, which will be operated in accordance with National Fire Protection 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 as necessary.

## 2.1.2 Overview of Demolition Activities

Demolition of the retired Alamitos Generating Station Unit 7 will commence in the first quarter of 2016. Demolition of Units 5 and 6 is scheduled to commence in the fourth quarter of 2018, demolition of Units 3 and 4 is scheduled to commence in the first quarter of 2022, and demolition of Units 1 and 2 is scheduled to commence in the third quarter of 2025.

## 2.1.3 Process Description

The AEC power train will consist of the following equipment: twelve MPSA 501DA CTGs equipped with dry low-NO<sub>x</sub> combustors and evaporative coolers; twelve unfired HRSGs; SCR for NO<sub>x</sub> emission control, and oxidation catalyst equipment to control CO and VOCs; four single-casing, axial-exhaust STGs; four air-cooled condensers; and associated support equipment.

Each CTG will generate approximately 119 MW (gross) at SAAT conditions. The CTG exhaust gases of approximately 1,100°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 rated at approximately 143 MW (gross) under SAAT conditions. The project is expected to have an overall annual availability of more than 99 percent.

The heat balances for the project's base load operation with and without evaporative cooling is shown in Figures 2.1-4a and 2.1-4b. The heat balances are based on operation of new units at SAAT conditions, with no evaporative cooling of the CTG inlet air. 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 1,936 MW at a heat rate of approximately 7,522 British thermal units per kilowatt hour (Btu/kWh) on a lower heating value (LHV) basis. This corresponds with a thermal 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<sub>x</sub> 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<sub>x</sub> combustors and SCR. An oxidation catalyst will also be used to control CO emissions to 2.0 ppmvd at 15 percent oxygen and VOC 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<sub>10</sub>] and 2.5 microns [PM<sub>2.5</sub>]) and sulfur dioxide emissions will be controlled with the exclusive use of natural gas with a sulfur content not to exceed 0.75 grains per 100 dry standard cubic feet (dscf). Emissions of excess ammonia not used in the SCR process (ammonia slip) will be limited to 5.0 ppmvd at 15 percent oxygen.

## 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 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 CTGs and accessory equipment will be contained in acoustical enclosures for noise reduction as appropriate.

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 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<sub>x</sub> 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 (electrical turning motor)
- 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.

Case 1 Heat Balance Number 1a

Three Combustion Turbines Operating at Maximum Heat Input without Evaporative Cooling

Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%

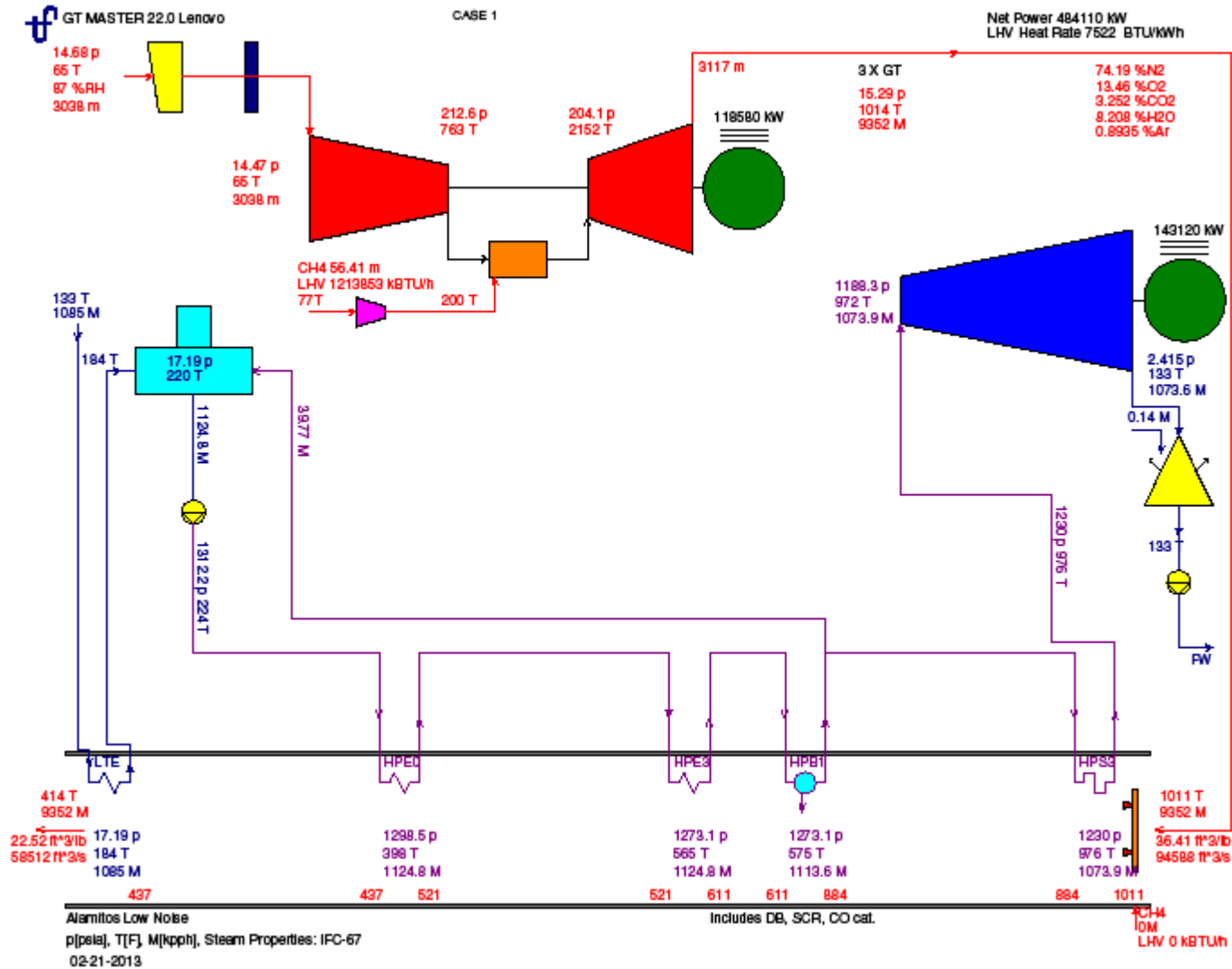


FIGURE 2.1-4a  
Heat and Mass Balance Diagram - Case 1  
Alamitos Energy Center  
Long Beach, California

Case 4 Heat Balance Number 2a

Three Combustion Turbines Operating at Maximum Heat Input with  
Evaporative Cooling

Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%

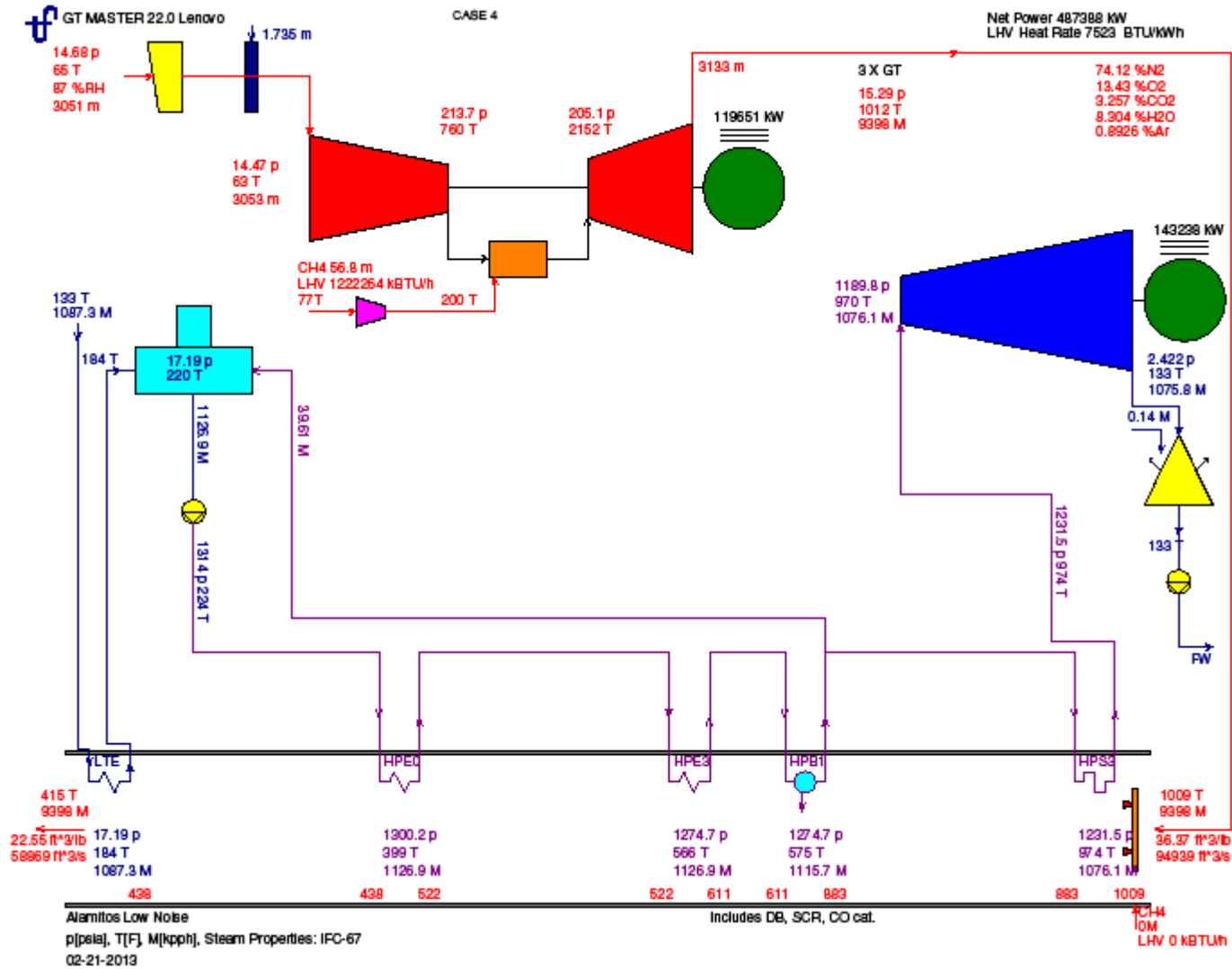


FIGURE 2.1-4b  
Heat and Mass Balance Diagram - Case 4  
Alamos Energy Center  
Long Beach, California

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 the AEC will be configured and deployed as an 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. Each AEC power block will have the ability to generate power from approximately 110 MW (1-on-1 combined-cycle gas turbine [CCGT] minimum load state) to approximately 490 MW (3-on-1 CCGT maximum load state) while maintaining a relatively consistent heat rate. The steam system, including STG, is designed to function across all states from a 1-on-1 configuration at minimum load up to the maximum heat input of three combustion turbines operating at 100 percent load in new and clean condition.

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<sub>x</sub> 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<sub>x</sub> to nitrogen and water leaving only 2.0 parts per million of NO<sub>x</sub> in the exhaust stream. Both catalysts begin removing their respective emissions at approximately 400°F.

### **2.1.5.3 Steam Turbine System**

Each 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 STGs will be single-casing, single-flow, impulse axial exhaust condensing turbines for outdoor installation.

Each 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 steam 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**

Electric power produced by the AEC 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 AEC interconnection to the existing SCE 230-kV switchyard). A small amount of electric station 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 twelve CTGs and four STGs at 13.8-kV and stepped up by sixteen 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 multiple separate station unit service transformers, which will step the power down to 4.16 kV for onsite use. 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 the AEC 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, 13.8-kV/4.16-kV station unit service transformers on each power block 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.

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 13.8-kV bus duct between the generator output breakers and the GSU low-voltage connection.

### **2.1.6.3 Essential Services Bus**

A 480-volt 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. Each of the four power blocks will have a 480-volt AC bus.

### **2.1.6.4 125-volt DC Power Supply System**

Each power block will have a 125-volt DC power supply system consisting 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 four combined-cycle power block 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**

Each power block will have a critical service 120-volt AC, single-phase, 60-hertz bus. It will be powered through the 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 through 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 panel board. 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 Construction and Commissioning Power Supply**

The AEC will use power from an existing onsite 66-kV source located adjacent to the 220-kV switchyard 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 14,665 MMBtu/hr (LHV basis, total for twelve CTGs).

Natural gas will be delivered to the site via the existing SoCalGas natural gas pipelines, which are 30-inch-diameter pipelines that operate at a nominal pressure of 165 pounds per square inch gage. 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 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**

Each of the four steam turbine cycle heat rejection systems will consist of an air-cooled condenser, which will eliminate the need for ocean water for once-through cooling. Each 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 to 4 pounds per square inch absolute during base load operation at summer design conditions of 85°F dry bulb and 69°F wet bulb. It will transfer approximately 986 MMBtu/hr to the ambient air as a result of condensing steam at these operating conditions.

Balance of plant systems will be cooled by closed-loop fluid coolers using potable 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 through 2.1-5c provide the water balances for the AEC representing three operating conditions. Figure 2.1-5a represents operation under SAAT conditions with the CTGs at 100 percent load and no CTG inlet air evaporative cooler. Figure 2.1-5b represents operation at site peak summer ambient temperature (SPSAT)<sup>5</sup> conditions with the CTGs operating at 100 percent load with CTG inlet evaporative cooling operating. Figure 2.1-5c represents site summer ambient temperature<sup>6</sup> conditions with the CTGs at 100 percent load with CTG inlet air evaporative cooling operating.

The AEC will use potable water provided by the LBWD for process and potable uses. The project will continue to use the existing water main connection along Studebaker Road.

### 2.1.9.1 Water Requirements

The water requirements for the AEC combined-cycle units were developed assuming 2,335 hours at the SAAT conditions and 1,350 hours at summer conditions (twelve CTGs at 100 percent load with inlet air evaporative cooling operating). The water requirements for the AEC combined-cycle units were developed using the following temperature conditions:

- For the SAAT conditions, the water use under full plant output will be approximately 165.6 gallons per minute (gpm).
- For the site summer conditions, the maximum water use under full plant output conditions will be approximately 404.5 gpm.
- For the combined SAAT and summer operating conditions, plus a startup allowance, the maximum water use under full plant output conditions will be approximately 165.6 gpm (or 176 acre-feet per year).
- For the SPSAT peak flow conditions, station maximum water use will be approximately 905 gpm.

The annual water requirements for the AEC, assuming it would operate continuously for the maximum permitted hours per year (3,685 hours per year or a 42 percent annual capacity factor) will be approximately 176 acre-feet per year, substantially less than the actual historical water consumption of the existing Alamitos Generating Station. Based on water volumes from 2010 through 2012, the Alamitos Generating Station has historically used approximately 255 gpm and 412 acre-feet per year while operating at only 8 percent of its maximum capacity.

Plant makeup water will be fed directly from LBWD service connections through metering equipment into an existing 428,000-gallon service water tank, of which 228,000 gallons of water will be dedicated solely to firefighting supply. The remaining 200,000 gallons of water will be used as plant service water, irrigation water, makeup to the combustion turbine inlet air evaporative coolers, and raw feed to the steam cycle makeup water treatment system. A second 150,000-gallon service water tank will be added to the project and an existing 300,000-gallon storage tank will be used for service water as well. A new 150,000-gallon deionized water tank will be added to the project (in addition to three existing 300,000-gallon storage tanks that will be reused) to provide approximately 5 days of operational service water storage. Table 2.1-1 lists the estimated daily and annual water use for AEC operations.

<sup>5</sup> Maximum Summer (1 hour) conditions (107°F dry bulb and 67.5°F wet bulb, and 10 percent relative humidity)

<sup>6</sup> The summer ambient temperature corresponds to 85°F dry bulb and 69.4°F wet bulb, and 45.8 percent relative humidity, which is where the station expects to need evaporative cooling on a regular basis.

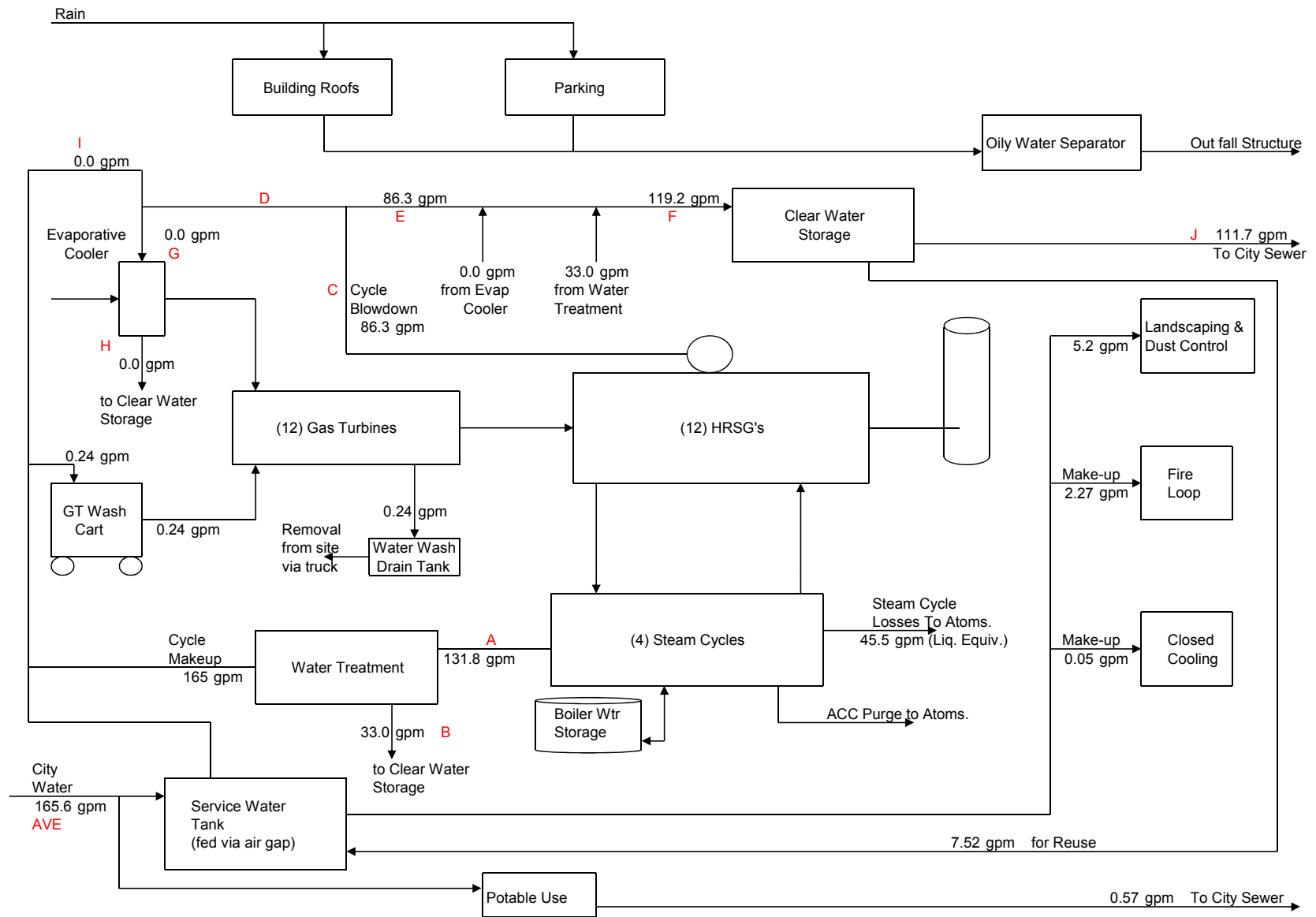


FIGURE 2.1-5a  
**Water Balance SAAT Conditions**  
 Alamitos Energy Center  
 Long Beach, California

Source: Power Engineers Collaborative, LLC., 5/16/2013.

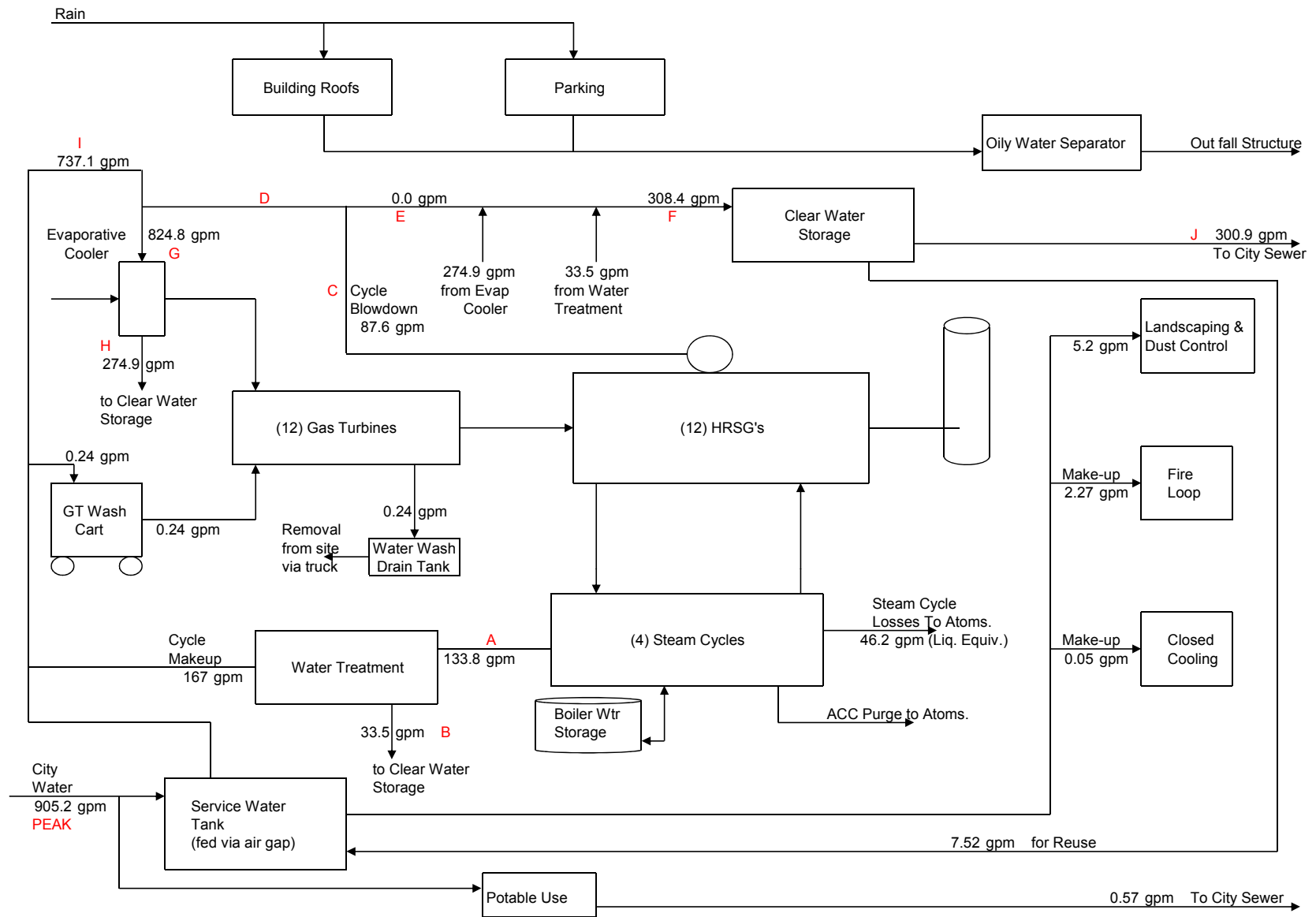


FIGURE 2.1-5b  
**Water Balance SPSAT Conditions**  
 Alamitos Energy Center  
 Long Beach, California

Source: Power Engineers Collaborative, LLC., 5/2/2013.

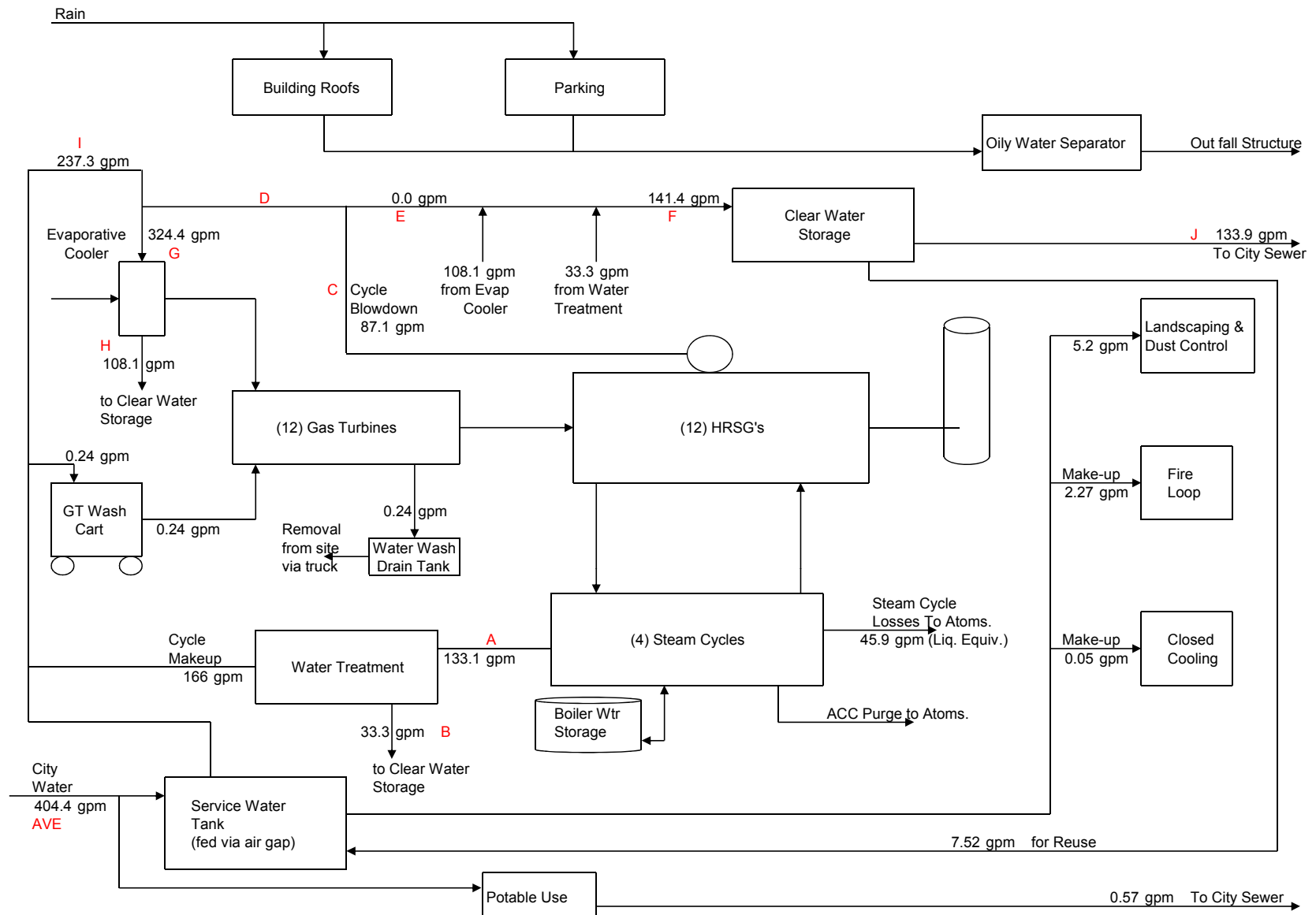


FIGURE 2.1-5c  
**Water Balance without Inlet Air  
 with Evaporative Cooling**  
 Alamitos Energy Center  
 Long Beach, California

Source: Power Engineers Collaborative, LLC., 5/16/2013.

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

Water Use	Average Ambient Use Rate (gpm)	Peak Use Rate (gpm)	Average Annual Use* (acre-feet per year)
Potable water	165.6	905.2	176.3

\*Assumes 3,685 hours of operation

### 2.1.9.2 Wastewater Requirements

The wastewater requirements for the AEC combined-cycle units while operating at the maximum daily and peak consumption rate (twelve CTGs at 100 percent load with inlet air evaporative cooling operating) were limited to approximately 190 gpm as recommended by the LBWD.

Maximum annual discharge volumes to the city sewer for the plant operating at the maximum permitted hours per year (3,685 hours per year) will be approximately 81.7 acre-feet per year (Table 2.1-2).

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

Wastewater Use	Maximum Discharge Rate (gpm)	Average Annual Discharge* (acre-feet per year)
Wastewater to LBWD	190	81.7

\*Assumes 3,685 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 brine stream from the reverse osmosis system will be mixed into a new 20,000-gallon clear water holding tank for storage and reuse onsite. Any unused portion of the brine will ultimately be discharged to the sewer and such possible amounts are included in the discharge amounts specified in Section 2.1.9.2. The deionized water will be sent to a new 150,000-gallon storage tank and three existing 300,000-gallon storage tanks. These tanks will provide approximately 5 days of storage at the 134 gpm steam-cycle makeup rate. Deionized water is used for feedwater makeup for the steam cycle.
- 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 the clear water storage holding tank for reuse. Any unused portion will ultimately be discharged to the sewer.
- 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 re-used portion will flow to the service water tank for storage and reuse. The unused portion will ultimately be discharged to the sewer.
- 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 two existing retention basins and will be discharged to the existing outfalls. 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 each of the four STGs 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**

Each power block will have a closed-loop cooling system that 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 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<sub>x</sub>, and CO 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<sub>x</sub> Emission Control**

SCR will be used to control NO<sub>x</sub> 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 two, 24,000-gallon ammonia tanks, a spill containment basin, and a refilling station with a spill containment basin and sump.

#### **2.1.10.2 Carbon Monoxide and Volatile Organic Compounds**

An oxidizing catalytic converter will be used to reduce the CO 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 (PM<sub>10</sub> and PM<sub>2.5</sub>) will be controlled through the use of best combustion practices and the sole use of inherently low-sulfur natural gas fuel. The BACT for particulate emissions from combustion sources is the use of clean natural gas. In addition, particulate emissions from the AEC 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-NO<sub>x</sub> 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<sub>x</sub> 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 the AEC 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 a process drain system, which will consist of oil/water separators and two retention basins. Stormwater that falls within the plant in pavement area and outside the process equipment containment areas will either percolate directly into the soil or drain over the surface into the retention basins to assist with the removal of suspended solids. Stormwater that falls in process equipment containment areas will flow to an oil/water separator for oil/grease removal and will then flow to one of the two retention basins. The stormwater collected in the retention basins will be discharged through the existing outfalls. The residual oil-containing sludge collected in the oil/water separation tanks will be collected via vacuum truck and disposed of as hazardous waste. The water balance diagrams, Figures 2.1-5a through 2.1-5c, show the expected wastewater streams. Table 2.1-2 shows the flow rates for the AEC 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. The AEC will have three oil/water separators: one for Blocks 1 and 2 and one each for Blocks 3 and 4. Each oil/water separator will be an aboveground tank with a capacity of 3,000 gallons and a maximum throughput of 300 gallons per minute. 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 a new sewer line. The water balance diagrams, Figures 2.1-5 a through 2.1-5c, show the expected wastewater streams. Table 2.1-2 shows the flow rates for AEC for the annual average and maximum conditions, respectively.

##### **2.1.11.4 Solid Wastes**

The AEC 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 the AEC. 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 AEC construction and operation. The storage, handling, and use of all chemicals will be conducted in accordance with applicable 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 the AEC 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 the AEC 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 8-inch onsite fire water loop and hydrants will be constructed at the facility. No new offsite linears will be needed for fire protection.

The secondary source of fire protection water will be supplied from an existing 428,000-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 existing 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 and maintenance buildings 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**

The AEC will 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 the AEC 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 each power block.

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 demand
- Monitor controlled plant equipment and process parameters and deliver this information to plant operator
- 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, each 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 twelve CTGs and four STGs will be connected to separate two-winding, three-phase, GSU transformers. The GSUs 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 AEC 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, including completion of all demolition, is expected to take place from the first quarter of 2016 to the third quarter of 2027. Actual onsite construction and demolition from site preparation to completion of all mechanical, electrical and balance of plant equipment and demolition of Alamos Generating Station Units 1 through 6 is expected to take approximately 139 months. Major milestones are listed in Table 2.2-1.

TABLE 2.2-1  
AEC Project Schedule Major Milestones

Activity	Commence Activity	Commercial Operation
Begin Demolition of Alamos Generating Station Unit 7	First Quarter 2016	NA
Begin Construction of Block 1	Third Quarter 2016	Second Quarter 2019
Begin Construction of Block 2	Fourth Quarter 2016	Second Quarter 2019
Begin Demolition of Alamos Generating Station Units 5&6	Fourth Quarter 2018	NA
Begin Construction of Block 3	First Quarter 2020	Third Quarter 2022
Begin Demolition of Alamos Generating Station Units 3&4	First Quarter 2022	NA
Begin Construction of AEC Block 4	Second Quarter 2023	Fourth Quarter 2025
Begin Demolition of Alamos Generating Station Units 1&2	Third Quarter 2025	NA

As noted in Table 2.2-1, demolition of the existing Alamos Generating Station (as described in Section 2.3) will occur throughout the construction period of the AEC.

### 2.2.1 Construction Schedule and Workforce

There will be an average and peak workforce of approximately 146 and 447, respectively, of construction and demolition craft people, supervisory, support, and construction management personnel onsite during construction and demolition. Peak workforce will occur in months 29 through 31, currently anticipated to be May–July 2018. Appendix 5.10B provides the projected construction craft manpower by month.

The construction plan is based on a single shift composed of a 10-hour workday, Monday through Friday, and a single 8-hour shift on Saturday. Construction will typically take place between the hours of 7:00 a.m. and 7:00 p.m., Monday through Friday, and 9:00 a.m. and 6:00 p.m. on Saturday. Overtime and additional shift work may be used to maintain the construction 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, some activities may continue 24 hours per day, 7 days per week.

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 Alamitos 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 north of existing Units 1 through 4 and the area between existing Units 1 and 2 and their intake canal, and includes an existing warehouse bounded by these two features. Construction access will be generally from Studebaker Road. Large or heavy equipment, such as the turbines, generators, GSU transformers, and HRSG modules will be delivered to the site by heavy haul truck/trailer.

Figure 2.1-1 identifies the areas both onsite and offsite that have been reserved for construction laydown and parking. Approximately 8 acres have been allocated onsite, and approximately 10 acres have been allocated offsite. At all times, more laydown space will be available than illustrated in the figure due to the sequential nature of the project's construction.

### **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 LBWD. Average daily use of potable water is expected to be approximately 18,000 gallons per power block. During the 60-day power block 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 of 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 7:00 p.m. Monday through Friday, and 9:00 a.m. to 6:00 p.m. on Saturday. 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 AEC construction will be completed while the existing Alamitos 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 AEC 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 during daylight hours. 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) as permitted by the applicable LORS. 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

The project will commence with the demolition of Alamitos Generating Station Unit 7 and other ancillary structures in order to make room for the construction of AEC Blocks 1 and 2 on the Alamitos Generating Station site. The demolition of Alamitos Generating Station Unit 7 will commence in the first quarter of 2016. The construction of Block 1 is scheduled to commence in the third quarter of 2016 and Block 2 construction is scheduled to commence in the fourth quarter of 2016. The demolition of Alamitos Generating Station Units 5 and 6 is scheduled to commence in the fourth quarter of 2018. The demolition of Alamitos Generating Station units 5 and 6 will make space for the construction of AEC Block 3. AEC Block 3 construction is scheduled to commence in the first quarter of 2020. The demolition of Alamitos Generating Station Units 3 and 4 is scheduled to commence in the first quarter of 2022. The demolition of Alamitos Generating Station Units 3 and 4 will make space for the construction of AEC Block 4. AEC Block 4 construction is scheduled to commence in the second quarter of 2023. The demolition of Alamitos Generating Station Units 1 and 2 is scheduled to commence in the third quarter of 2025.

### 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. Construction/demolition personnel requirements will peak at approximately 447 workers in months 29–31 (May 2018–July 2018) of the AEC construction and demolition period. Average workforce over the approximately 139-month construction and demolition period is 146 workers. Professional labor for the demolition will include project management, construction management, planning and permitting specialists, health and safety specialists, 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 will be used for the demolition of the Alamitos Generating Station facilities. Actual equipment may vary depending on the selected demolition contractor and the availability of equipment.

- 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 as water trucks (dust control), fueling/service vehicles, and pickup trucks

During peak activities at the site it is likely that a maximum of 15 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 AEC 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 a single 8-hour shift on Saturdays. Demolition will typically take place between the hours of 7:00 a.m. and 7:00 p.m., Monday through Friday, and 9:00 a.m. and 6:00 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

The facility will be capable of being dispatched throughout the year and will have annual availability in the general range of 98 percent. It will be possible for plant availability to exceed 99 percent for a given 12-month period.

The AEC will employ a staff of 51 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	35
Control Specialists	5
Mechanic	3
Administration	4
<b>Total</b>	<b>51</b>

The AEC is designed as an MSG facility 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). The AEC is expected to have an annual capacity factor between 15 and 25 percent. Because the AEC 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 for any of the four power blocks) at any given time. It is expected the operating profile of the AEC 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 AEC 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 AEC 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 power blocks 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 consistent with permitting limitations.
- **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.
- **Partial Shutdown or Intermediate Load (1-on-1 or 2-on-1 state).** One or two of the CTGs/HRSBs 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, contractual obligations, scheduled maintenance of equipment, or extraordinary events (equipment malfunction, fuel supply interruption, or transmission system issues).

As California's intermittent 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 MSG units employed at the AEC. By being able to deliver flexible operating characteristics across a wide range of generating capacity, at a relatively consistent and superior heat rate, the AEC 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, depending on the expected duration of the shutdown (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 AEC design and engineering. The LORS applicable to 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 following design criteria are included in Appendix 2D:

- 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

The AEC 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 AEC site are earthquakes, floods, and tsunamis. 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, Geological Hazards and Resources, discusses the geological hazards of the area and site. This section includes a review of potential geological 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 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 buildings, 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 unlikely event of a fire not contained by the AEC's fire suppression systems and the plant's personnel, the City of Long Beach Fire Department would be called upon 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

The AEC 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 Operating Range and Availability

The AEC will be designed to operate between about 8.5 and 100 percent of maximum load to support dispatch service in response to customer demands for electricity. The AEC will be designed for an expected 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 operating 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 the AEC is estimated to be approximately 99 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 AEC availability. Specifically, redundancy in each combined-cycle power block and in the balance-of-plant systems that serve it is described. The AEC will be served by the following balance-of-plant systems: fuel supply system, DCS, boiler feedwater system, condensate system, deionized 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 & Percent Redundancy	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.
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. The condenser will include approximately 15 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%	—
Deionized bottle polishers	100% spare capacity	Mixed Bed – bottles to be generated offsite
Condensate polishers	2 – 100%	Mixed Bed – bottles to be generated offsite

### 2.6.2.1 Combined-Cycle Power Blocks

Three CTG/HRSG power generation trains will operate in parallel within each combined-cycle power block. Each train will be powered by a CTG. Each CTG will provide approximately 20 to 25 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 30 to 35 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, 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, and 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 panel within each CTG. The control 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 each 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**

A single water treatment system will be used to provide power cycle makeup water to the four power blocks. The water treatment system 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 deionized 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 deionized 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 to maintain the minimum required instrument air pressure.

Each power block will be equipped with two, 100-percent-capacity, oil-free, rotary screw package air compressors, which will supply compressed air to the service and instrument air systems. Two, 100-percent-capacity, heatless desiccant air dryers will be provided to dry the service and instrument air.

## **2.6.3 Fuel Availability**

Fuel will be delivered via the existing SoCalGas 30-inch-diameter gas pipelines. SoCalGas has confirmed that its system has enough capacity to supply the AEC at this location. A will-serve letter from SoCalGas is included in Appendix 2E.

## **2.6.4 Water Availability**

The AEC will use, on average, 176 acre-feet per year of potable water provided by the LBWD for power plant process water, fire protection, and potable uses.

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

## **2.6.5 Sewer and Wastewater Treatment Availability**

The AEC will discharge a maximum of 81.7 acre-feet per year of wastewater, consisting of process and sanitary wastewater. Sanitary wastewater and process water will be discharged to the public sewer system.

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

## **2.6.6 Project Quality Control**

The AEC 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 the AEC 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 the AEC is approximately 46 percent on a LHV basis. This level of efficiency is achieved when a power block 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. The AEC design, however, achieves a very high level of efficiency across a wide range of generating capacity. The basis of AEC operations will be system dispatch within California's power generation and transmission system. It is expected that the AEC 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 16,000 MMBtu/hr (LHV basis) at minimum ambient conditions.

While the AEC's annual electrical production for the years 2019 and beyond cannot be forecasted with certainty, because of the efficiency of the plant and given the operating characteristics as described above, the AEC 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 7,134 gigawatt hours per year (based on an annual average facility base load megawatt rating of 1,936 MW per power block, 99 percent availability and 3,685 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, or other reasons. The following sections discuss temporary and permanent facility closure.

### 2.8.1 Temporary Closure

For a temporary facility closure, 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 handled according to applicable LORS, as discussed in Section 5.14, Waste Management.

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, Hazardous Materials Handling. 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 expected operating life of the generation facility is 30 years, though it may be capable of being operated beyond this expected life, depending on actual operating conditions and demand on the facility. 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.