2.0 PROJECT DESCRIPTION

2.1 INTRODUCTION

The Russell City Energy Center (RCEC) will be a 600 megawatt (nominal gross output) natural gas-fired combined-cycle electrical generating facility, with a 230-kilovolt switchyard. The RCEC will be located on 14.7 acres at the west end of Enterprise Avenue in the City of Hayward, in Alameda County directly south of the Hayward Water Pollution Control Facility (WPCF). A new 230-kV double-circuit transmission line will exit the RCEC switchyard eastward toward Pacific Gas and Electric Company's (PG&E) existing Eastshore-Grant 115-kV transmission corridor, and then follow the existing corridor to PG&E's Eastshore Substation. The total length of this new transmission line will be 1.1 miles.

A new Advanced Wastewater Treatment (AWT) Plant will be constructed immediately west of the energy center to supply tertiary treated water for makeup to the facility's cooling and process makeup water systems. A number of water and wastewater pipelines under Enterprise Avenue will connect the energy center and the AWT plant with the City of Hayward's WPCF. The City will also supply potable water to the RCEC site for domestic use and for fire fighting.

The RCEC and the AWT plant are discussed separately below.

2.2 RCEC PROJECT DESCRIPTION, DESIGN, AND OPERATION

This section describes the design and operational characteristics of the proposed RCEC plant.

2.2.1 Site Plan and Access

The site arrangement shown in Figure 2.2-1 and the typical elevation views shown in Figures 2.2-2a and 2.2-2b illustrate the location and size of the RCEC. Approximately 12.55 fenced acres will be required to accommodate the generation facilities, control/administration building, switchyard, emission control equipment, storage tanks, parking area, and storm water detention basins.

The RCEC will be visually compatible with existing and planned industrial and commercial development in the adjacent properties to the west and north of the site. An architectural screening treatment will be applied to the outside of the major project structures, including the heat recovery steam generators (HRSGs) and cooling tower, to make the facility an architectural landmark that will welcome commuters and visitors to the Hayward community as they travel eastbound across the Hayward-San Mateo Bridge.

Access to the RCEC will be from a new entrance driveway on Enterprise Avenue. Most of the surface within the fenced area will be paved to provide internal access to all project facilities and on-site buildings.

The existing Union Pacific Railroad Company (UPRR) industrial rail spur located immediately south of the site will be used for delivery of heavy equipment components during construction.

2.2.2 Process Description

The energy center's power train will consist of two Siemens Westinghouse 501 FD Phase 2 combustion turbine generators (CTGs) equipped with dry, low oxides of nitrogen (NO_x) combustors and steam injection power augmentation capability; two heat recovery steam generators (HRSGs) with duct burners; a single condensing steam turbine generator (STG); a deaerating surface condenser; a mechanical draft (wet/dry) plume-abated cooling tower; and associated support equipment.

Each CTG will generate a maximum of approximately 200 MW. The CTG exhaust gases will be used to generate steam in the HRSGs. The HRSGs will employ reheat design with duct firing. Steam from the HRSGs will be admitted to a condensing STG. A maximum of 235 MW will be produced by the steam turbine. The project is expected to have an overall annual availability in the general range of 92 to 98 percent.

The heat balance for power plant baseload operation is shown in Figures 2.2-3a and 2.2-3b. The predicted net electrical output of this facility under these conditions is 553 MW. This balance is based on an ambient temperature of 59°F with water fog cooling of the combustion air, no augmentation steam injection, and no duct firing.

Associated equipment will include emission control systems necessary to meet the proposed emission limits. NO_x emissions will be controlled to a maximum of 2.5 (3-hour average, annual average of 2.0) parts per million by volume, dry basis (ppmvd), corrected to 15 percent oxygen, by a combination of dry, low NO_x combustors in the CTGs and selective catalytic reduction (SCR) systems in the HRSGs. Carbon monoxide (CO) will be controlled to 6 ppmvd at 15 percent oxygen under all operating conditions.

2.2.3 Power Plant Cycle

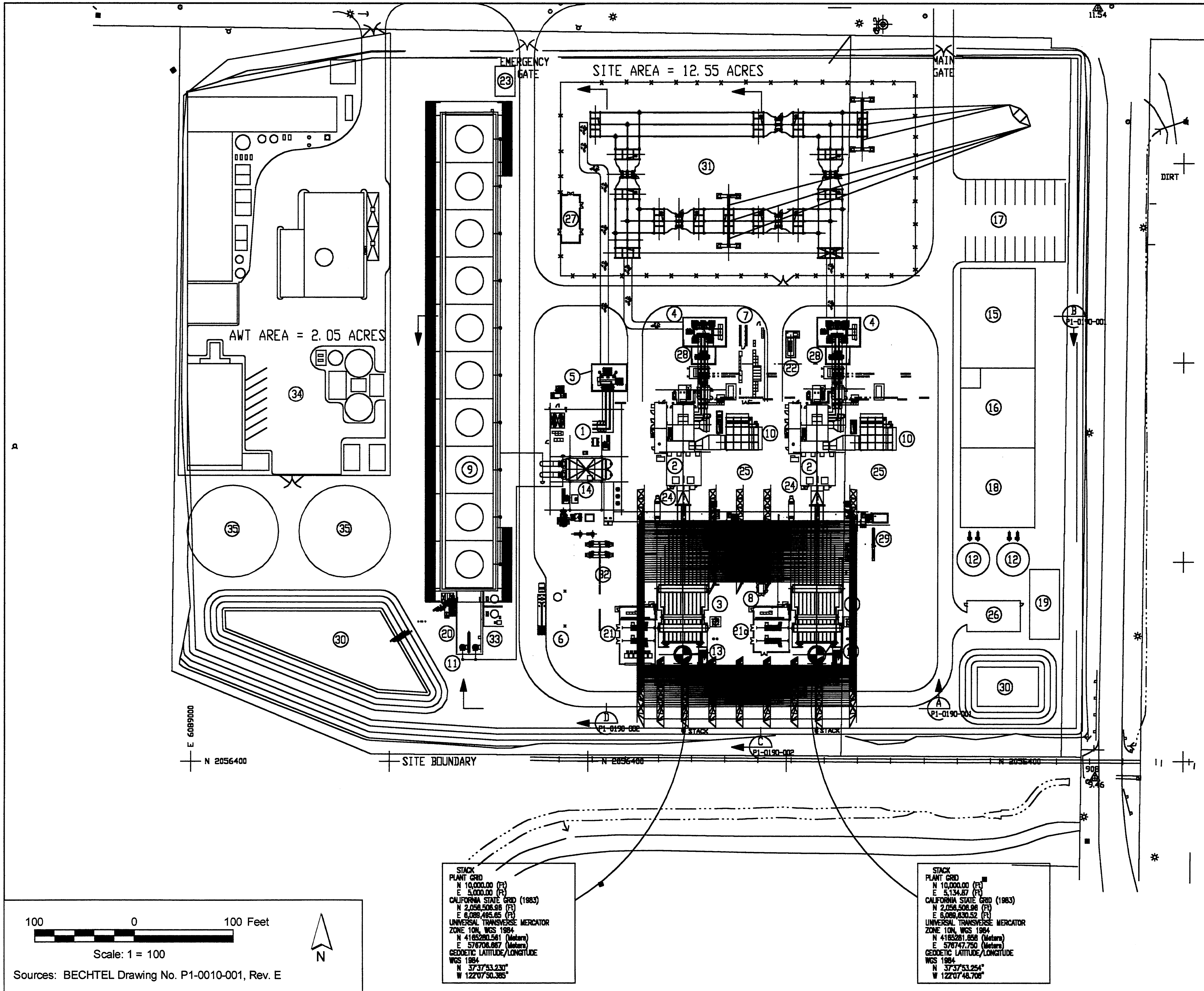
CTG combustion air will flow through the inlet air filters and water foggers and associated air inlet ductwork, be compressed, and then enter the combustion sections. Natural gas fuel will be injected into the compressed air in the combustion sections and ignited. The hot combustion gases will expand through the turbine sections of the CTGs, causing them to rotate and drive both the electric generators and CTGs compressors. The hot combustion gases will exit the turbine sections and enter the HRSGs, where they will heat water (feedwater) that will be pumped into the HRSGs. The feedwater will be converted to superheated steam and delivered to the steam turbine at three pressures: high-pressure (HP), intermediate-pressure (IP), and low-pressure (LP). The use of multiple steam delivery pressures will permit an increase in cycle efficiency and flexibility. High-pressure steam, delivered to the HP section of the steam turbine, will exit the HP section as "cold reheat" steam and be combined with IP steam before passing through the reheater sections of the HRSGs. This mixed, reheated steam (called "hot reheat") will then be delivered to the IP steam turbine section. Steam exiting the IP section of the steam turbine will be mixed with LP steam and expanded in the LP steam turbine section. Steam leaving the LP section of the steam turbine will enter the surface condenser and transfer heat to circulating cooling water, which will cause it to condense to water. The condensed water, or condensate, will be delivered to the HRSG feedwater system. The condenser cooling water will circulate through a wet, mechanical draft cooling tower where the heat absorbed in the condenser will be rejected to the atmosphere via evaporation of cooling water.

2.2.4 Combustion Turbine-Generators, Heat Recovery Steam Generators, Steam Turbine-Generator, and Condenser

Power will be produced by the two CTGs and the STG. The following paragraphs describe the major components of the generating facility.

2.2.4.1 Combustion Turbine Generators

Thermal energy will be produced in the CTGs through the combustion of natural gas, which will be converted into the mechanical energy required to drive the combustion turbine compressors and electric generators. Each CTG system will consist of a CTG with supporting systems and associated auxiliary equipment. The CTGs will have power augmentation capability by the use of steam injection upstream of the turbine section.



Sources: BECHTEL Drawing No. P1-0010-001, Rev. E

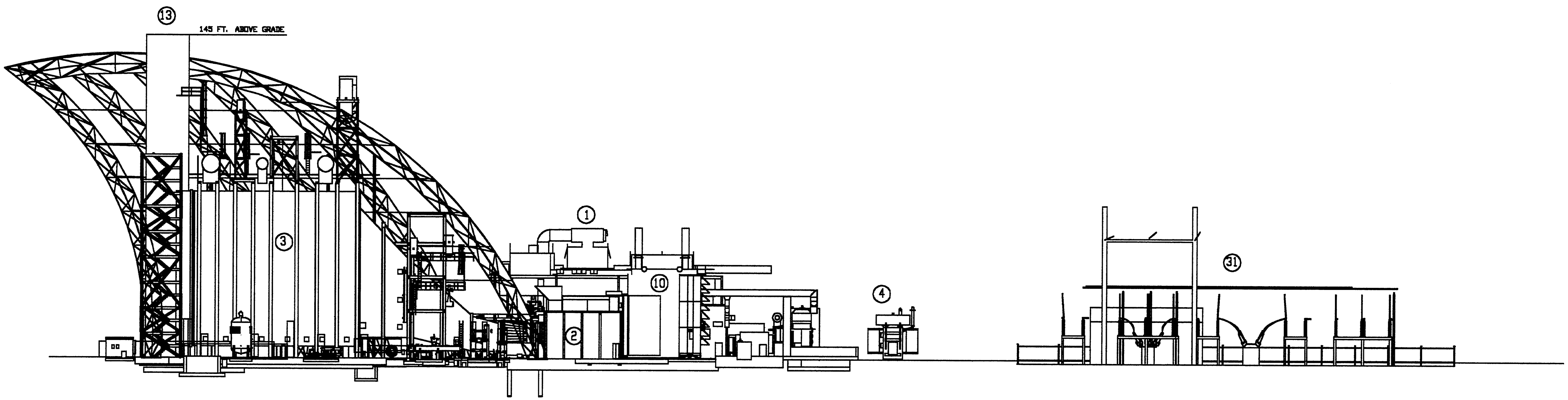
1	STEAM TURBINE (S.T.)
2	COMBUSTION TURBINE (C.T.)
3	H.R.S.G.
4	C.T. MAIN TRANSFORMER
5	S.T. MAIN TRANSFORMER
6	AMMONIA UNLOADING/STORAGE AREA
7	SWITCHGEAR BUILDING W/ BATTERY ROOM
8	AIR COMPRESSOR SKID
9	COOLING TOWER
10	C.T. AIR INLET FILTER
11	CIRCULATING WATER PUMP AREA
12	DEMINERALIZED WATER STORAGE TANK
13	STACK
14	SURFACE CONDENSER
15	WAREHOUSE / MAINTENANCE SHOP
16	ADMINISTRATION BUILDING W/CONTROL ROOM
17	PARKING
18	WATER TREATMENT BUILDING/LABORATORY
19	GAS METERING AREA
20	COOLING TOWER BASIN/PUMPHOUSE BUILDING
21	BOILER FEEDWATER PUMP/CHEMICAL FEED BLDG
21a	BOILER FEEDWATER PUMP BLDG
22	EMERGENCY GENERATOR
23	FIRE WATER PUMP BUILDING
24	ROTOR AIR COOLER
25	MOBILE CRANE ACCESS AREA
26	GAS COMPRESSOR BUILDING
27	SWITCHYARD CONTROL ROOM
28	UNIT AUX. XFMR
29	GAS SCRUBBER/HEATER STATION
30	STORMWATER RETENTION BASIN
31	SWITCHYARD
32	CCW HEAT EXCHANGERS/CCW PUMPS
33	CHLORINATION SKID
34	ADVANCED WASTEWATER TREATMENT PLANT
35	FINAL PRODUCT WATER STORAGE TANK

Figure 2.2-1

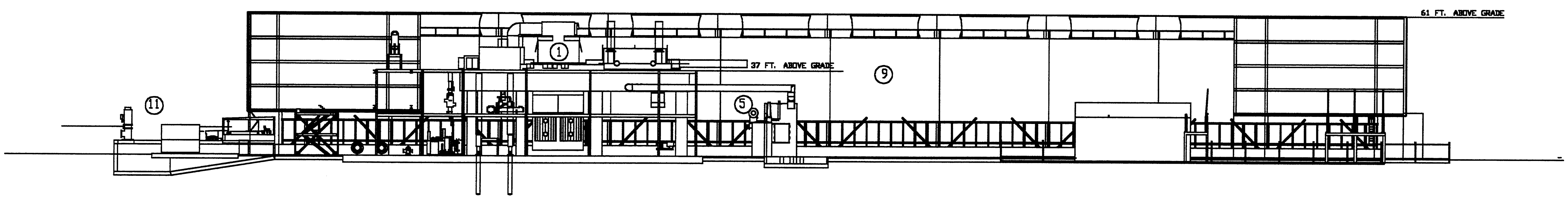
SITE ARRANGEMENT

RUSSELL CITY ENERGY CENTER

FOSTER WHEELER ENVIRONMENTAL CORPORATION



SECTION C
P1-0010-001



SECTION D
P1-0010-001

50 0 50 Feet

Scale: 1 = 50

Sources: BECHTEL Drawing No. p1-0190-002, Rev. D

Figure 2.2-2a

Site Elevation

RUSSELL CITY ENERGY CENTER

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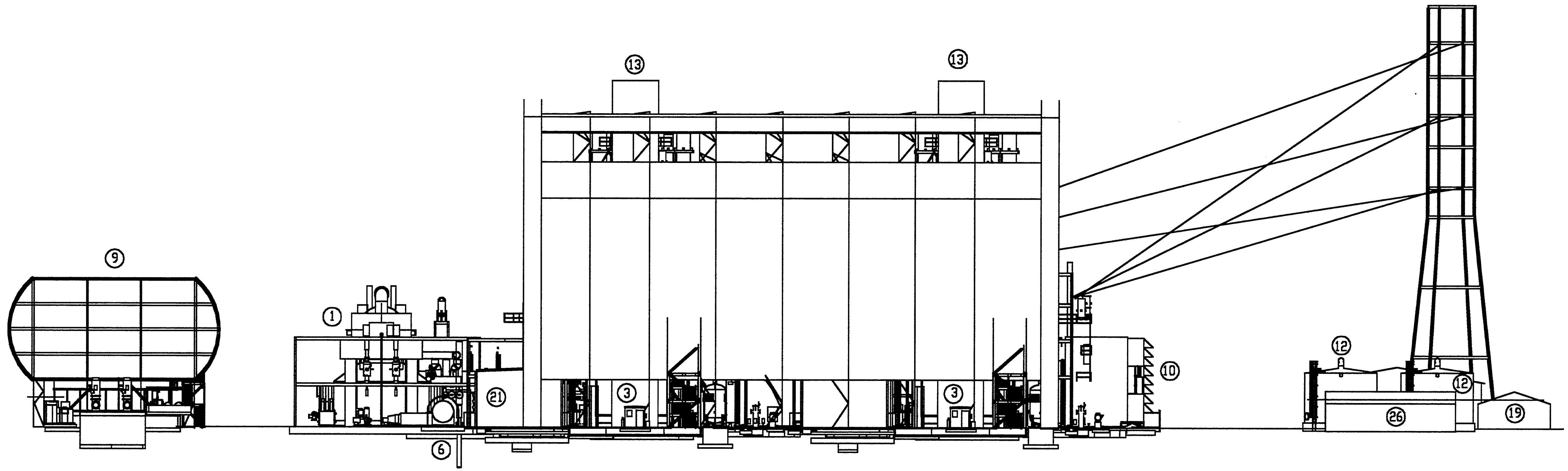
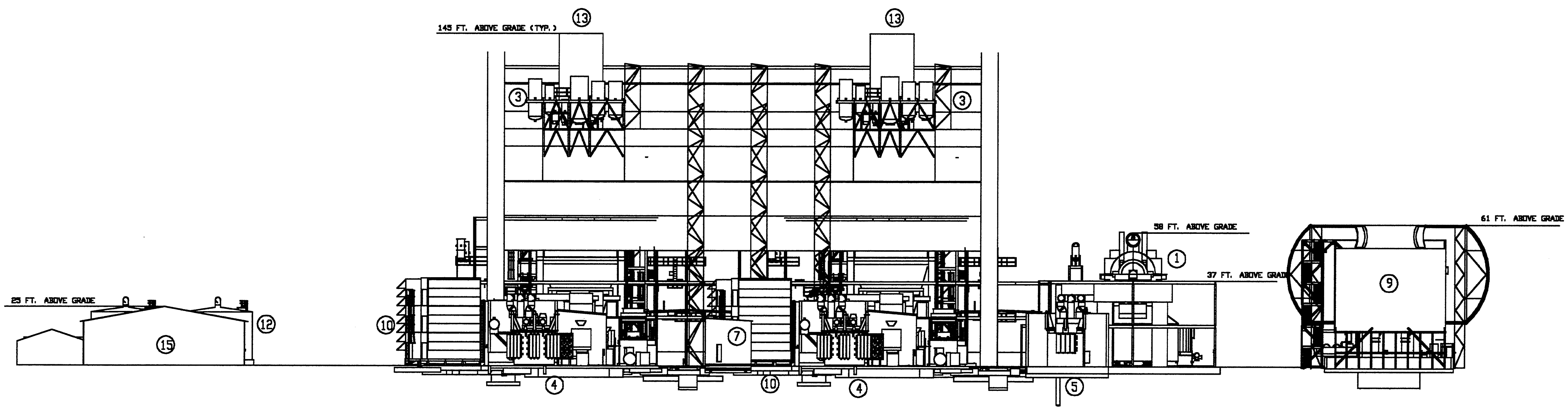


SECTION A
P1-0010-001



SECTION B
P1-0010-001

50 0 50 Feet

Scale: 1 = 50

Sources: Bechtel Drawing No. p1-0190-001, Rev. D

Figure 2.2-2b

Site Elevation

RUSSELL CITY ENERGY CENTER

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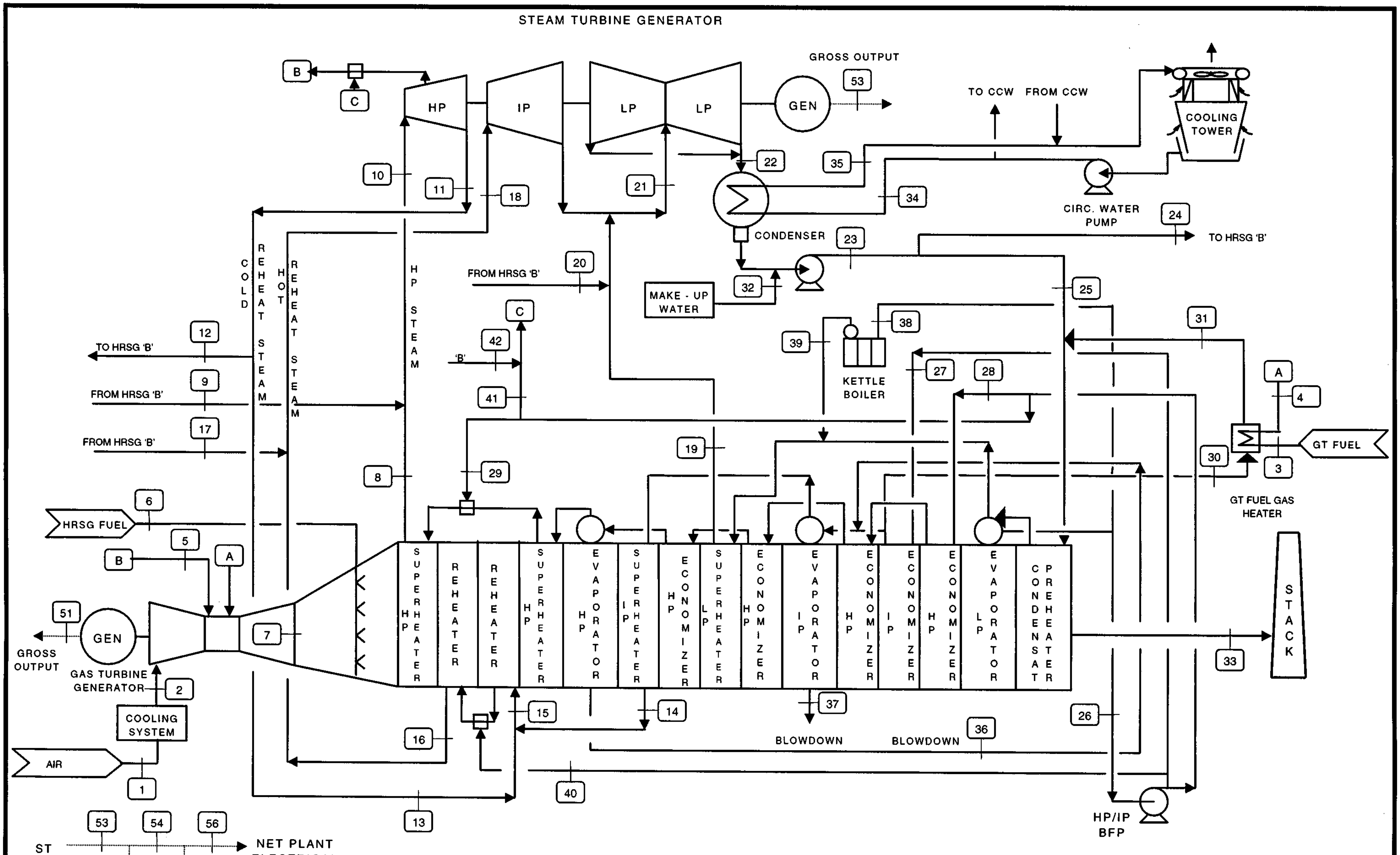

Figure 2.2-3a

Heat Balance Diagram
RUSSELL CITY ENERGY CENTER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Russell City Energy Center AFC

May 2001

59 °F / 68% RH / 14.691 PSIA

GAS FIRED ANNUAL AVERAGE - 100% LOAD

STREAM NO.	UNITS	1	2	3	4	5	6	7	8
Mass Flow	lb/hr	3,662,780	3,666,110	81,340	81,340	0	0	3,747,450	439,540
Temperature	°F	59	55	60	280	n/a	n/a	1,107	1,047
Pressure	psia	14.691	14.554	410	400	n/a	n/a	15.240	1,808

STREAM NO.	UNITS	9	10	11	12	13	14	15	16
Mass Flow	lb/hr	439,540	879,090	863,870	431,930	431,930	69,730	501,670	501,670
Temperature	°F	1,047	1,042	706	704	704	576	685	1,048
Pressure	psia	1,808	1,748	497	481	481	481	481	453

STREAM NO.	UNITS	17	18	19	20	21	22	23	24
Mass Flow	lb/hr	501,670	1,003,330	85,080	85,080	1,185,710	1,185,710	1,188,710	594,360
Temperature	°F	1,048	1,045	525	525	575	96	97	95
Pressure	psia	453	437	75	75	70	0.847	119	108

STREAM NO.	UNITS	25	26	27	28	29	30	31	32
Mass Flow	lb/hr	594,360	537,860	98,320	439,540	0	28,590	28,590	3,000
Temperature	°F	95	311	313	316	n/a	451	107	60
Pressure	psia	108	80	531	1,960	n/a	496	486	25

STREAM NO.	UNITS	33	34	35	36	37	38	39	40
Mass Flow	lb/hr	3,747,450	65,803,360	65,803,360	0	0	20,350	20,350	0
Temperature	°F	191	70	87	n/a	n/a	311	312	n/a
Pressure	psia	14.691	35	25	n/a	n/a	80	80	n/a

STREAM NO.	UNITS	41	42	43	44	45	46	47	48
Mass Flow	lb/hr	0	0	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Temperature	°F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pressure	psia	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

STREAM NO.	UNITS	51	52	53	54	55	56
Output	kW	184,260	184,260	198,360	566,880	14,330	552,550

	UNITS	
Net Heat Rate	BTU/kWh LHV	6,177

Figure 2.2-3b

Mass Balance Diagram

RUSSELL CITY ENERGY CENTER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Russell City Energy Center AFC

May 2001

The CTGs will be equipped with the following required accessories to provide safe and reliable operation:

- Inlet air fogging system
- Inlet air filters
- Metal acoustical enclosure
- Single lube oil cooler
- Dry, low NO_x combustion system
- Compressor wash system-both online and offline
- Fire detection and protection system (utilizing FM200)
- Fuel gas system, including flow meter, strainer, duplex filter, and fuel gas heater.
- Starter System
- Turbine controls
- Direct-air-cooled synchronous generators
- Generator controls, protection, excitation, Power System Stabilizer, and Automatic Generation Control (AGC)

The CTGs and accessory equipment will be contained in a metal acoustical enclosure.

2.2.4.2 Heat Recovery Steam Generators

The HRSGs will provide for the transfer of heat from the exhaust gases of the CTGs to the feedwater, which will become steam. The HRSGs will be three-pressure, natural circulation units equipped with inlet and outlet ductwork, duct burners, insulation, lagging, and separate exhaust stacks.

Major heat transfer components of each HRSG will include an LP economizer, LP drum, LP evaporator, LP superheater, IP economizer, IP evaporator, IP drum, IP superheater, HP economizer, HP evaporator, HP drum, and HP superheaters. The LP economizer will receive condensate from the condenser hot well via the condensate pumps. The LP economizer will be the final heat transfer section to receive heat from the combustion gases before they are exhausted to the atmosphere.

Condensate will be directed through the LP drums and then to the boiler feed pumps. The boiler feed pumps will provide additional pressure to serve the separate IP and HP sections of the HRSG. Similarly, as described above, the IP and HP steam will be produced for supply to the steam turbine.

Feedwater from the LP drum will be sent to the HP section of the HRSG. High-pressure feedwater will flow through the HP economizers to the HP steam drum, where a saturated liquid state will be maintained. Next, the saturated water will flow from the steam drum through downcomers to the inlet headers of the HP evaporator. The saturated water will flow upward through the HP evaporator tubes by natural circulation. Saturated steam will form in the tubes while energy from the combustion turbine exhaust gas is absorbed. The HP-saturated liquid/vapor mixture will then return to the steam drum, where the two phases will be separated by the steam separators in the drum. The saturated water will return to the HP evaporator while the vapor passes to the HP superheater inlet. The saturated steam (vapor) will pass through the HP superheater to the HP steam turbine entrance.

Feedwater from the LP drum will also be sent to the IP section of the HRSG by an interstage bleed from the boiler feed pumps. This IP feedwater will flow through an IP economizer to the IP steam drum where a saturated liquid state will be maintained. Next, the saturated water will flow from the steam drum through downcomers to the inlet headers of the IP evaporator. The saturated water will flow upward through the IP evaporator tubes by natural circulation. Saturated steam will form in the tubes as energy from the combustion turbine exhaust gas is absorbed. The IP-saturated liquid/vapor mixture will then return to the steam drum where the two phases will be separated. The saturated water will return to the IP evaporator, while the vapor passes to the IP superheater inlet. The saturated steam (vapor) will pass through the IP superheater to the IP steam turbine entrance.

Duct burners will be installed in the HRSGs. These burners will provide the capability to increase steam generation, increase operating flexibility, and improved steam temperature control. The duct burners will burn natural gas. The duct burner for each HRSG will be sized to release up to 200 million British thermal units (MMBtu higher heating value or HHV basis) per hour per HRSG.

The HRSGs will be equipped with an SCR emission control system that will use ammonia vapor in the presence of a catalyst to reduce the NO_x concentration in the exhaust gases. The catalyst module will be located in the HRSG casing. Diluted ammonia vapor (NH_3) will be injected into the exhaust gas stream through a grid of nozzles located upstream of the catalyst module. The subsequent chemical reaction will reduce NO_x to nitrogen and water, resulting in a NO_x concentration of no more than 2.0 (annual average basis) ppmvd at 15 percent oxygen (O_2) in the HRSG exhaust gas.

2.2.4.3 Steam Turbine System

The steam turbine system will consist of a reheat steam turbine, gland steam system, lubricating oil system, hydraulic control system, and steam admission/induction valving. The steam turbine will drive a a hydrogen-cooled synchronous generator.

Steam from the HRSG HP, IP, and LP superheaters will enter the associated steam turbine sections through the inlet steam system. The steam will expand through the turbine blading, driving the generator. On exiting the turbine, the remaining steam will flow into the condenser.

2.2.5 Major Electrical Equipment and Systems

The electric power produced by the facility will be transmitted to the PG&E grid. Some power will be used onsite to power auxiliaries such as pumps and fans, control systems, and general facility loads, including lighting, heating, and air conditioning. Some will also be converted from alternating current (AC) to direct current (DC) for use as backup power for control systems and for other uses. Transmission and auxiliary uses are discussed in the following subsections.

2.2.5.1 AC Power—Transmission

Power will be generated by the two CTGs at 15 kV, and one STG at 18 kV. An overall single-line diagram of the facility's electrical system is shown in Figure 6.2-1. The generator outputs will be connected by isolated phase bus to individual oil-filled generator step-up transformers, which will increase the voltage to 230-kV. 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 containments, which will contain the transformer oil in the event of a leak or spill. Fire protection systems will be provided. The high voltage side of each step-up transformer will be connected to the plant's on-site 230-kV switchyard. From the switchyard, power will be transmitted through new overhead transmission lines to PG&E's existing Eastshore Substation.

2.2.5.2 AC Power—Distribution to Auxiliaries

Auxiliary power to the combustion turbine and steam turbine power block will be supplied at 4,160 volts AC by a 4,160-volt switchgear lineup. Primary power to the switchgear will be supplied by one of two redundant oil-filled 15- to 4.16-kV station Auxiliary Transformers. The high voltage sides (15-kV) of the auxiliary transformers will be connected to each of the CTGs. These connections will allow the switchgear to be powered from either of the Auxiliary Transformers by power generated by the connected CTG or by backfeeding power from the 230-kV switchyard via the connected CTG's stepup transformer. A natural gas-fired emergency generator will be provided to supply power to emergency loads when power is not available through the 230-kV interconnection to the PG&E grid.

The 4,160-volt switchgear lineup will supply power to the various 4,160-volt motors, to the combustion turbine starting system, and to the load center (LC) transformers rated 4,160 to 480 Volts for 480-volt power distribution. The switchgear will have vacuum breakers for the main incoming feeds and fused contactors for power distribution.

The LC transformers will be of the dry type if located inside and will be of the oil-filled type if located outside. Each transformer will supply 480-volt, 3-phase power to LC switchgear. The LC switchgear will provide power through feeder breakers to the various 480-volt motor control centers (MCCs). The MCCs will distribute power to 460-volt motors, to 480-volt power panels, and to other intermediate 480-volt loads. The MCCs will distribute power to 480-480/277-volt isolation transformers when 277-volt, single-phase lighting loads are to be served. The 480-volt power panels will distribute power to small 480-volt loads.

Power for the AC power supply (120-volt/208-volt) system will be provided by the 480-volt MCCs and 480-volt power panels. Transformation of 480-volt power to 120/208-volt power will be provided by 480-120/208-volt dry-type transformers.

2.2.5.3 DC Power Supply

One common DC power supply system consisting of one 125-volt DC battery, two 100 percent 125-volt DC full-capacity battery chargers, metering, ground detectors, and distribution panels will be supplied for balance-of-plant and steam turbine equipment.

Under normal operating conditions, the battery chargers will supply DC power to the DC loads. The battery chargers will receive 480-volt, three-phase AC power from the AC power supply (480-volt) system and continuously charge the battery. The ground detection scheme will detect grounds on the DC power supply system.

Under abnormal or emergency conditions, when power from the AC power supply (480-volt) system is unavailable, the battery itself, rather than the charger, will provide DC power for the DC system loads. Recharging of a discharged battery will occur whenever 480-volt power becomes available from the AC power supply (480-volt) system. The rate of charge will depend on the characteristics of the battery, battery charger, and connected DC load during charging. The anticipated maximum recharge time will be 24 hours.

The 125-volt DC system will also be used to provide control power to the 4,160-volt switchgear, to the 480-volt LCs, to critical control circuits, and to the emergency DC motors.

2.2.5.4 Essential Service AC Uninterruptible Power Supply (UPS)

The combustion turbines and steam turbine power block will also have an essential service 120-volt AC, single-phase, 60-Hz power source. This source will supply AC power to essential instrumentation, to critical equipment loads, and to unit protection and safety systems that require uninterruptible AC power. The essential service AC system and DC power supply system will be designed to ensure that critical safety and unit protection control circuits have power and can take the correct action on a unit trip or loss of plant AC power.

The essential service AC system will consist of one full-capacity inverter, a solid-state transfer switch, a manual bypass switch, an alternate source transformer and-voltage regulator, and an AC panelboard.

The normal source of power to the system will be the DC power supply system through the inverter to the panelboard. A solid-state static transfer switch will monitor the inverter output and the alternate AC source continuously. 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.

A manual bypass switch will also be included to enable isolation of the inverter-static transfer switch for testing and maintenance without interruption to the essential service AC loads.

2.2.6 Fuel System

The CTGs will be designed to burn natural gas. Maximum natural gas requirements during base load operation are approximately 99,000 MMBtu/day, HHV basis.

The pressure of natural gas delivered to the site via a 0.9 mile pipeline (see Section 5) is expected be approximately 250 pounds per square inch gauge (psig). The natural gas will flow through a revenue meter and then be pressurized by onsite compressors, as needed, and then gas scrubber/filtering equipment, a gas pressure control station, a fuel gas heater, and unit flow metering stations before entering the combustion turbines. LP gas for the HRSG duct burner systems, emergency generator, and building heating systems will be provided by a central pressure reduction station and an LP gas distribution system.

2.2.7 Water Supply and Use

This section describes the quantity of water required, the primary and back-up water supply sources, water quality and water treatment requirements, and planned discharges for the RCEC. Process flow schematics for the energy facility are shown in Figure 7-1 in Section 7. Design specifics for the AWT are discussed in Section 2.3. Peak and average water requirements and flow rates throughout the system are shown. Details of the water requirements, water supply, water treatment, and water discharges are summarized below and provided in Section 7.

2.2.7.1 Water Requirements

A water balance diagram for project operation, showing the various water requirements and estimated flow rates for the facility, is presented in Figure 2.2-4. Operation of the RCEC will require 3.33 million gallons per day (mgd) (2,313 gallons per minute), or 43,730 acre-ft/year during average water supply demand conditions (assumed at 60°F ambient temperature with no fog injection and power augmentation) and 5.27 mgd (3,660 gpm), or 5,904 acre-ft/year during peak water supply demand conditions (assumed at 90°F ambient temperature with no fog injection and power augmentation). These flow rates account for losses in the water treatment process, to produce the final product demand for the plant of 2.41 mgd during average conditions and 3.8 mgd at peak conditions. In evaluating water supply requirements and

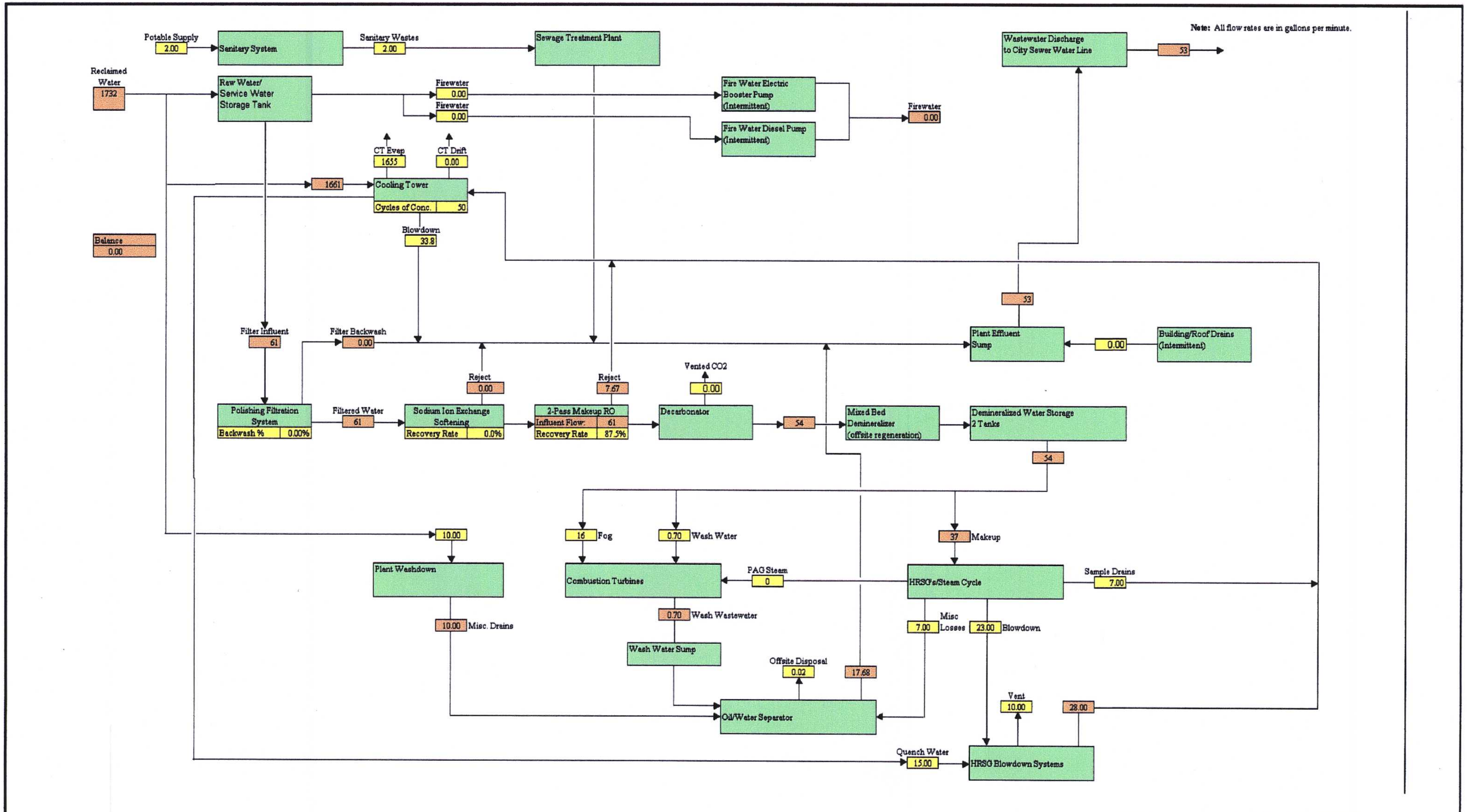

Figure 2.2-4

Water Balance Diagram
RUSSELL CITY ENERGY CENTER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

impacts, the data for 60°F were used most often because this is essentially the average temperature at the project site (Section 8.15.1.1). Worst-case water impact scenarios are based on the data for 90°F, with inlet air fogging, power augmentation, and duct firing.

2.2.7.2 Water Supply

The City of Hayward will provide the industrial process water supply for the RCEC. The City will own and operate the AWT plant, and will supply tertiary treated water produced by the AWT plant to meet cooling and process makeup requirements. A "will-serve" letter describing the City's water supply agreements is included in Appendix 7-A.

Water required for domestic uses and fire fighting will also be provided by the City of Hayward. A new connection would be made to the existing 12-inch potable water line that runs along Enterprise Avenue, shown on Figure 2.3-2. The City of Hayward's water supply comes from the City of San Francisco's Hetch Hetchy Aqueduct.

2.2.7.3 Water Quality

An analysis of the water sources is provided in Section 7, Water Supply.

2.2.7.4 Water Treatment

Secondary effluent is not suitable for use as process water or cooling water without filtration and disinfection to meet California Code of Regulations Title 22 standards for turbidity and coliform content. The AWT will be constructed adjacent to the RCEC to treat secondary effluent from the WPCF to the level of quality required for both the cooling water and process makeup water for the HRSGs.

2.2.8 Plant Cooling Systems

The steam turbine cycle heat rejection system will consist of a deaerating steam surface condenser, cooling tower, and cooling water (circulating water) system. The heat rejection system will receive exhaust steam from the low-pressure steam turbine and condense it to water for reuse. A surface condenser is a shell and tube heat exchanger; the steam condenses on the shell side, and the cooling water flows in one or more passes inside the tubes. The condenser will be designed to operate at a pressure of approximately 2.5 inches of mercury, absolute (in. HgA) at an ambient temperature of 90°F. It will transfer approximately 1,330 MMBtu/hr from condensing steam to cooling water. Approximately 133,000 gallons per minute (gpm) of circulating cooling water is required to condense the turbine exhaust steam at maximum plant load at 90 °F.

The cooling water will circulate through a counter-flow mechanical draft cooling tower that uses electric motor-driven fans to move the air in a direction opposite to the flow of the cooling water. The heat removed in the condenser will be discharged to the atmosphere by heating the air and evaporating some of the cooling water. Maximum drift (the fine mist of water droplets entrained in the warm air leaving the cooling tower) will be limited to 0.0005 percent of the circulating water flow.

2.2.9 Waste Management

Waste management is the process whereby all wastes produced at the RCEC plant will be properly collected, treated if necessary, and disposed. Wastes will include wastewater, solid nonhazardous waste, and hazardous waste (liquid and solid). Waste management is discussed in more detail in Section 8.14.

2.2.9.1 Wastewater Collection, Treatment, and Disposal

Expected wastewater streams (excluding sanitary wastewater) and flow rates for the RCEC are shown on the process flow schematic, Figure 7-1. The average flow rates shown are based on 60° F ambient temperature (with no inlet air fogging or power augmentation) and the peak flow rates assume 90° F ambient temperature (with inlet air fogging and power augmentation).

Wastewater discharges from the plant include the following:

- Cooling Tower Blowdown (peak 46 gpm, average 33 gpm)
- Sanitary Wastewater (2 gpm)
- RCEC Plant Drainage (peak 66 gpm, average 53 gpm)

Pipelines for each of these discharges are shown on Figure 2.3-2. Details of each of these waste streams are included in Section 7.

2.2.9.2 Solid Waste

The RCEC Plant 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 miscellaneous solid wastes, including the typical refuse generated by workers. These materials will be collected by a waste collection company, such as Browning Ferris, Inc. (BFI), and transported to a material recovery facility (MRF), such as one owned by BFI located at the Newby Island Landfill in Milpitas. Recyclables will be removed, and the remaining residue will be deposited in a landfill such as the Newby Island Landfill (see Section 8.14). Waste collection and disposal will be in accordance with applicable regulatory requirements to minimize health and safety effects.

2.2.9.3 Hazardous Wastes

Several methods will be used to properly manage and dispose of hazardous wastes generated by the RCEC Plant. 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 catalyst will be recycled by the supplier or disposed of in a Class I landfill. Workers will be trained to handle any hazardous waste generated at the site.

Chemical cleaning wastes will consist of alkaline and acid cleaning solutions used during pre-operational chemical cleaning of the HRSGs, acid cleaning solutions used for chemical cleaning of the HRSGs after the units are put into service, and turbine wash and HRSG fireside wash waters. These wastes, which are subject to high metal concentrations, will be stored temporarily onsite in portable tanks. They will be disposed of offsite by a licensed chemical cleaning contractor in accordance with applicable regulatory requirements.

2.2.10 Management of Hazardous Materials

Various chemicals will be stored and used during the construction and operation of the RCEC Plant. All chemicals will be stored, handled, and used in accordance with applicable laws, ordinances, regulations, and standards (LORS). Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals will be stored in storage tanks, and other chemicals will be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills. Berm and drain piping design will allow a full-tank capacity spill without overflowing the berms. For multiple tanks located within the same bermed area, the capacity of the largest single tank will determine the volume of the bermed area and drain piping. Drains from the chemical storage and feed areas will be directed to a neutralization area for neutralization, if necessary. Drain piping for volatile chemicals will be trapped and isolated from other drains to eliminate noxious or toxic vapors. After neutralization, water collected from the chemical storage areas will be directed to the facility's industrial wastewater collection system.

Aqueous ammonia will be stored in a horizontal tank mounted within a covered secondary containment. Ammonia vapor detection equipment will be installed to detect escaping ammonia and activate alarms and the automatic vapor suppression features.

Safety showers and eyewashes will be provided adjacent to, or in the area of, all chemical storage and use areas. Hose connections will be provided near the chemical storage and feed areas to flush spills and leaks to the neutralization facility. State-approved personal protective equipment will be used by plant personnel 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. Electric equipment insulating materials will be specified to be free of polychlorinated biphenyls (PCBs).

A list of the chemicals anticipated for use at the power plant is provided in Section 8.5, Hazardous Materials Handling. This table identifies each chemical by type and intended use and estimates the quantity to be stored onsite. Section 8.14, Waste Management, includes additional information on hazardous materials handling. Section 8.12, Traffic and Transportation, contains information on the transport of hazardous materials.

2.2.11 Emission Control and Monitoring

Air emissions from the combustion of natural gas in the CTGs and duct burners will be controlled using state-of-the-art systems. Emissions that will be controlled include NO_x, reactive organic compounds (ROCs), CO, and particulate matter. Continuous emissions monitoring (CEM) will be employed in accordance with regulatory requirements. Section 8.1, Air Quality, includes additional information on emission control and monitoring.

2.2.11.1 NOx Emission Control

SCR will be used to control NO_x concentrations in the exhaust gas emitted to the atmosphere to an annual average of 2.0 ppmvd at 15 percent oxygen from the gas turbines (2.5 ppmvd at 15% oxygen, 3 hour average basis). The SCR process will use aqueous ammonia as the source of the ammonia vapor that will react with NO_x, in the exhaust gas to produce harmless N_2 and water. Ammonia slip, the unreacted ammonia in the exiting exhaust gas, will be limited to a concentration of 5 ppmvd at 15 percent oxygen. The SCR equipment will include a reactor chamber, catalyst modules, ammonia storage system, ammonia vaporization and injection system, and monitoring equipment and sensors.

2.2.11.2 CO and ROC Emission Control

The formation of CO and ROC will be controlled at the CTG combustor and HRSG duct burners by state-of-the-art combustion technology.

2.2.11.3 Particulate Emission Control

Particulate emissions will be controlled using combustion air filtration and natural gas, which is low in particulates, as the sole fuel for the CTGs and duct burners. Cooling tower mist elimination will control the emission of particulate matter from the cooling tower.

2.2.11.4 Continuous Emission Monitoring

CEM systems will sample, analyze, and record fuel gas flow rate, turbine and stack NO_x and stack CO concentration levels, and percentage of O_2 in the exhaust gas from each of the two HRSG stacks. This system will generate reports of emissions data in accordance with permit requirements and will send alarm signals to the plant distributed control and information system (DCIS) in the plant control room when the level of emissions approaches or exceeds pre-selected limits. Ammonia slip will be calculated in the CEMs Data Acquisition System from ammonia injected into the SCR, and turbine exhaust and stack NO_x CEM measurements.

2.2.12 Fire Protection

The fire protection system will be designed to protect personnel and limit property loss in the event of a fire. Water for fire fighting will be supplied from the City of Hayward's existing fire mains. An electric jockey pump and electric motor-driven main fire pump will be provided to increase the water pressure in the plant fire mains to the level required to serve all fire fighting systems. In addition, a diesel engine-driven fire pump will be provided to pressurize the fire loop if the power supply to the main fire pump fails. A fire pump controller will be provided for the back-up fire pump. Both the main fire pump and the emergency fire pump will draw water from the City's fire mains.

Both pumps will discharge to a dedicated underground fire loop piping system. All fire hydrants and the fixed suppression systems will be supplied from the plant fire water loop. Fixed fire suppression systems will be installed at determined fire risk areas, such as the transformers, turbine lubrication oil equipment, and cooling tower. The plant fire mains will also supply a vapor suppression system at the aqueous ammonia storage tank area. Sprinkler systems will also be installed in the Control/Administration Building and Fire Pump Building, as required by NFPA and local code requirements. The CTG units will be protected by an FM200 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 8.5, Hazardous Materials Handling, includes additional information on fire and explosion risk, and Section 8.10, Socioeconomics, provides information on city and county fire protection capability.

2.2.13 Plant Auxiliaries

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

2.2.13.1 Lighting

The lighting system will provide personnel with illumination for operation under normal conditions and for egress under emergency conditions. The system will include emergency lighting to perform manual operations during an outage of the normal power source. The system also will provide 120-volt convenience outlets for portable lamps and tools.

2.2.13.2 Grounding

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

The station grounding grid will be designed for a capacity adequate to dissipate heat from ground current under the most severe conditions in areas of high ground fault current concentration. The grid spacing will be adequate to maintain safe voltage gradients. Bare conductors will be installed below grade in a grid pattern. Each junction of the grid will be bonded by an exothermal welding process or mechanical clamps.

Ground resistivity as determined as part of the final geotechnical study will be used to determine the necessary number of ground rods and grid spacings to ensure safe step and touch potentials under severe fault conditions. Grounding stingers ("pigtails") will be brought from the ground grid to connect to building steel and non-energized metallic parts of electrical equipment.

2.2.13.3 Distributed Control and Information System

The Distributed Control and Information System (DCIS) will provide modulating control, digital control, monitoring, and indicating functions for the plant power block systems. The following functions will be provided:

- Controlling the STG, CTGs, HRSGs, and other systems in a coordinated manner
- Controlling the balance-of-plant systems in response to plant demands
- Monitoring controlled plant equipment and process parameters and delivering this information to plant operators
- Providing control displays (printed logs, cathode ray tube [CRT]) for signals generated within the system or received from input/output (I/O)
- Providing consolidated plant process status information through displays presented in a timely and meaningful way
- Providing alarms for out-of-limit parameters or parameter trends, displaying on alarm CRT(s), and recording on an alarm log printer
- Storing and retrieving historical data

The DCIS will be a redundant microprocessor-based system consisting of the following major components:

- CRT-based operator consoles
- Engineer work station
- Distributed processing units
- I/O cabinets
- Historical data unit
- Printers
- Data links to the combustion turbine and steam turbine control systems

The DCIS 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 the 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. Since they will be redundant, no single processor failure can cause or prevent a unit trip.

The DCIS will interface with the control systems furnished by the combustion turbine and steam turbine suppliers 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 an uninterruptible power source.

As part of the quality control program, daily operator logs will be available for review to determine the status of the operating equipment.

2.2.13.4 Cathodic Protection

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

2.2.13.5 Freeze Protection

The freeze protection system will provide heat to protect various outdoor pipes, gauges, pressure switches, and other devices from freezing temperatures. Power to the freeze protection circuits will be controlled by an ambient thermostat.

2.2.13.6 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.

2.2.13.7 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 building where pneumatic operators and devices will be located.

2.2.14 Interconnect to Electrical Grid

The two CTGs and one STG will each be connected to a dedicated 3-phase step-up transformer (a total of three) that will be connected to the plant's new 230-kV switchyard. The switchyard will consist of a ring bus arrangement with airbreak disconnect switches and SF_6 circuit breakers. From the switchyard, the generated power will be transmitted into the PG&E Eastshore Substation via a 1.1-mile 230-kV transmission line. Chapter 6 for additional information on the switchyard and transmission line.

2.2.15 Project Construction

Construction of the RCEC and AWT plant is planned to begin the summer of 2002, and require a total duration of 18 to 21 months. Major milestones are listed in Table 2-1.

Table 2-1. Project schedule major milestones.

Activity	Date
Begin Construction	Summer 2002
Startup and Test	Spring 2004
Commercial Operation	Summer 2004

The RCEC will be accessed for construction from Enterprise Avenue. During construction, this property will be used for temporary offices, parking, and outdoor material storage (Figure 2.2-1).

The average and peak workforce on the project during construction will be approximately 277 and 485, respectively, including construction craft personnel, and supervisory, support, and construction management personnel (see Section 8.10, Socioeconomics).

Construction will be scheduled between the hours of 6 a.m. and 6 p.m., Monday through Saturday. Additional hours may be necessary to complete critical construction activities. During the startup phase of the project, some activities will continue 24 hours per day, 7 days per week. Materials and equipment will be delivered by both truck and rail.

At the site, the peak construction workforce is expected to last from month 11 through month 16 of the construction period, with month 15 being the peak month.

2.2.16 Power Plant Operation

The RCEC plant will be operated by 2 operators per 12-hour rotating shift, with 2 relief operators; there will also be 5 maintenance technicians and 5 administrative personnel during the standard 8-hour workday. The facility will be operated 7 days per week, 24 hours per day.

The RCEC plant is expected to have an annual availability in the general range of 92 to 98 percent. It will be possible for plant availability to exceed 98 percent for a given 12-month period.

- **Base Load**—The facility would be operated at maximum continuous output for as many hours per year as scheduled by load dispatch. During high ambient temperature periods, when gas turbine output would otherwise decrease, duct firing and/or power augmentation by steam injection into the combustion turbines may be employed to keep plant output at the desired load.
- **Load Following**—The facility would be operated to meet contractual load, but the sum would be less than maximum continuous output at all times of the day. The output of the unit would therefore be adjusted periodically to the desired load.
- **Partial Shutdown**—At certain times of any given day and any given year, it may be necessary to shut down one CTG/HRSG. This mode of operation could generally be expected during late evening and early morning hours, when system demand may be low.
- **Full Shutdown**—This would occur if forced by equipment malfunction, fuel supply interruption, or transmission line disconnect.

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 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 the protection of public health, safety, and the environment. Depending on the expected duration of the shutdown, the plan may include the draining of all chemicals from storage tanks and other equipment and the safe shutdown of all equipment. All wastes will be disposed of according to applicable LORS. If the cessation of operations becomes permanent, decommissioning will be undertaken (see Section 4, Facility Closure).

2.2.17 Facility Safety Design

The RCEC Plant will be designed to maximize safe operation. Hazards that could affect the plant 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.

2.2.17.1 Natural Hazards

The principal natural hazards associated with the RCEC Plant site are earthquakes and floods. The site is located in Seismic Risk Zone 4. Structures will be designed to meet the seismic requirements of CCR Title 24 and the 1998 California Building Code (CBC). Section 8.4, Geologic Hazards and Resources, discusses the geological hazards of the area and site. This section includes a review of potential geologic hazards, seismic ground motions, and the potential for soil liquefaction due to ground shaking. Appendix 10 includes the structural seismic design criteria for the buildings and equipment.

The RCEC site is essentially flat, with an average elevation of approximately 14 feet above mean sea level (MSL). The ground floor of plant facilities will be at 14 feet MSL. According to the Federal Emergency Management Agency (FEMA), the site is not within either the 100- or 500-year floodplain. Section 8.15, Water Resources, includes additional information on the potential for flooding.

2.2.17.2 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 8.10, Socioeconomics, includes additional information on area medical services, and Section 8.16, Worker Health and Safety, includes additional information on safety for workers. Appendix 10 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.

Fire Protection Systems

The project will rely on both onsite fire protection systems and local fire protection services.

Onsite Fire Protection Systems

The fire protection systems will be designed to protect personnel and limit property loss and plant downtime from fire or explosion. The project will have the following fire protection systems.

FM 200 Fire Protection System

This system will protect the turbine, generator, and accessory equipment compartments from fire. The system will have fire detection sensors in all compartments. Actuating one sensor will provide a high temperature alarm on the combustion turbine control panel. Actuating a second sensor will trip the combustion turbine, turn off ventilation, close ventilation openings, and automatically release the FM 200. The FM 200 will be discharged at a design concentration adequate to extinguish the fire.

Transformer Deluge Spray System

This system will provide fire suppression for the generator transformers and auxiliary power transformers in the event of a fire. The deluge systems will be fed by the plant underground fire water system.

Steam Turbine Bearing Pre-action Water Spray System

This system will provide suppression for the steam turbine bearing in the event of fire. The pre-action system will be fed by the plant underground fire water system.

Steam Turbine Lubrication Oil Areas Water Spray System

This system will provide suppression for the steam turbine area lubrication oil piping and lubrication oil storage.

Cooling Tower Dry Pipe System

This system will provide protection for the cooling tower cells. Water will be supplied from the plant underground fire water system.

Fire Hydrants/Hose Stations

This system will supplement the plant fire protection system. Water will be supplied from the plant underground fire water system.

Fire Extinguisher

The plant administrative building and other buildings will be equipped with portable fire extinguishers as required by the local fire department.

Local Fire Protection Services

In the event of a major fire, plant personnel will be able to call upon the City of Hayward Fire Department for assistance. The closest Hayward fire station is approximately 2 miles away at 1401 W. Winton Avenue. The Hazardous Materials Risk Management Plan (see Section 8.5, Hazardous Materials Handling) for the plant will include all information necessary to permit all firefighting and other emergency response agencies to plan and implement safe responses to fires, spills, and other emergencies.

Personnel Safety Program

The RCEC Plant 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 8.16, Worker Health and Safety.

2.2.18 Facility Reliability

This section discusses the expected plant availability, equipment redundancy, fuel availability, water availability, and project quality control measures associated with the RCEC.

2.2.18.1 Plant Availability

Due to the RCEC's high predicted efficiency, it is anticipated that the facility will normally be called upon to operate at high average annual capacity factors. The facility will be designed to operate between 30 and 100 percent of baseload to support dispatch service in response to customers' demands for electricity.

The RCEC plant will be designed for an operating life of 30 years. Reliability and availability projections are based on this operating life. Operation and maintenance (O&M) procedures will be consistent with industry standard practices to maintain the useful life status of plant components.

The percentage of time that the combined cycle power block (and the HRSG duct burners) is projected to be operated is defined as the "service factor." The service factor includes the amount of time that a unit is operating and generating power at full or partial load. The projected service factor for the combined cycle power block, which includes the projected percentage of time of operation, differs from the equivalent availability factor (EAF), which includes the projected percentage of energy production capacity achievable.

The EAF may be defined as a weighted average of the percentage of full energy production capacity achievable. The projected EAF for the RCEC is estimated to be approximately 92 to 98 percent. The EAF differs from the "availability of a unit," which is the percentage of time that a unit is available for operation, whether at full load, partial load, or on standby.

2.2.18.2 Redundancy of Critical Components

The following subsections identify equipment redundancy as it applies to project availability. Specifically, redundancy in the combined cycle power block and in the balance-of-plant systems that serve it are described. The combined cycle power block will be served by the following balance-of-plant systems: fuel supply system, DCIS, boiler feedwater system, condensate system, demineralized water system, power cycle makeup and storage, circulating water system, closed cycle cooling water system, and compressed air system. Major equipment redundancy is summarized in Table 2-2; redundancy following final design may differ.

Combined Cycle Power Block

Two separate combustion turbine/HRSG power generation trains will operate in parallel within the combined cycle power block. Each train will be powered by a combustion turbine. Each combustion turbine will provide approximately 30 to 35 percent of the total combined cycle power block output. The heat input from the exhaust gas from each combustion turbine will be used in the steam generation system to produce steam. Heat input to each HRSG can be supplemented by firing the HRSG duct burners, which will increase steam flow from the HRSG. 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 steam turbine will be condensed and recycled to the feedwater system. Power from the STG subsystem will contribute approximately 30 to 35 percent of the total combined cycle power block output. The combined cycle power block comprises the major components described below.

CTG Subsystems

The combustion turbine subsystems will include the combustion turbine, inlet air filtration and water fogging 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. Power output can be increased through steam injection upstream of the turbine section of the CTG. Exhaust gas from the combustion turbine will be used to produce steam in the associated HRSG. The CTG generators will be totally enclosed, water/air cooled. The generator excitation system will be a solid-state static system. Combustion turbine control and instrumentation (interfaced with the DCIS) will cover the turbine governing system, the protective system, and sequence logic.

HRSG 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 and from the supplemental combustion of natural gas in the HRSG duct burner for the production of steam. This heat transfer will produce steam at the pressures and temperatures required by the steam turbine. Each HRSG system will consist of ductwork, heat transfer sections, an SCR system, and space for a CO catalyst module. The HRSG system will include safety and auto relief valves and processing of continuous blowdown drains.

STG Subsystems

The steam turbine will convert the thermal energy to mechanical energy to drive the STG. The basic subsystems will include the steam turbine and auxiliary systems, turbine lubrication oil system, and generator/exciter system. The steam turbine's generator will hydrogen-cooled.

Table 2-2. Major equipment redundancy.

Description	Number	Note
Combined cycle CTGs and HRSGs	Two trains	Steam turbine bypass system allows both CTG/HRSG trains to operate at base load with the steam turbine out-of-service.
STG	One	See note above pertaining to CTGs and HRSGs.
HRSG feedwater pumps	One – 100 percent per HRSG	One complete HRSG feedwater pump will be maintained in the plant warehouse.
Condensate pumps	Three – 50 percent capacity	
Condenser	One	Condenser must be in operation for combined cycle operation or operation of CTGs in steam turbine bypass mode.
Circulating water pumps	Two – 60 percent capacity	
Cooling tower	One	Cooling tower is multi-cell mechanical draft design.
Closed cycle cooling water pumps	Two – 100 percent capacity	
Closed cycle cooling water heat exchangers	Two – 100 percent capacity	
Demineralizer—RO System	Three – 50 percent trains	Redundant installed pumps will be provided.
Natural Gas Compressors	Two - 100 percent	

Distributed Control and Information System

The DCIS will be a redundant microprocessor-based system. It will provide the following control, monitoring, and alarm functions for plant systems and equipment:

- Control the HRSGs, STG, CTG, and other systems in response to unit load demands (coordinated control)
- Provide control room operator interface
- Monitor plant equipment and process parameters and provide this information to the plant operators in a meaningful format
- Provide visual and audible alarms for abnormal events based on field signals or software generated signals from plant systems, processes, or equipment

The DCIS 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. Since they will be redundant, no single processor failure can cause or prevent a unit trip.

The DCIS will interface with the control systems furnished by the combustion turbine and steam turbine suppliers 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. 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 the control room. The operator panel will consist of two individual CRT/keyboard consoles and one engineering workstation. Each CRT/keyboard console will be an independent electronic package so that failure of a single package does not disable more than one CRT/keyboard. The engineering workstation will allow the control system operator interface to be revised by authorized personnel.

Boiler Feedwater System

The boiler feedwater system will transfer feedwater from the LP drum to the HP and IP sections of the HRSGs. The system will consist of one pump with 100 percent capacity for supplying each HRSG. Each pump will be multistage, horizontal, and motor-driven with intermediate bleed-off and will include regulating control valves, minimum flow recirculation control, and other associated pipes and valves.

Condensate System

The condensate system will provide a flow path from the condenser hotwell to the HRSG LP drums. The condensate system will include three 50 percent capacity multistage, vertical, motor-driven condensate pumps.

Demineralized Water System

Makeup to the demineralized water system will be from the Product Water Storage Tanks at the AWT plant described in Section 2.3. The demineralized water system will consist of three 50 percent RO trains and portable, mixed bed, demineralizer tanks. Demineralized water will be stored in two 153,000-gallon demineralized water storage tanks.

Power Cycle Makeup and Storage

The power cycle makeup and storage subsystem provides demineralized water storage and pumping capabilities to supply high purity water for system cycle makeup, combustion air fogging, and chemical cleaning operations. The major components of the system are the demineralized water storage tanks (two), which provide an approximate 24-hour supply of demineralized water; (including 16 hours per day of power augmentation operation) and 2 full-capacity, horizontal, centrifugal, cycle makeup water pumps per tank.

Circulating Water System

The circulating water system provides cooling water to the condenser for condensing steam turbine exhaust and steam turbine bypass steam. In addition, the system supplies cooling water to the closed cycle cooling water heat exchangers. Major components of this subsystem are two 60 percent, motor-driven, vertical pumps and associated pipes and valves, as required.

Closed Cooling Water System

The closed cooling water system transfers heat from various plant equipment heat exchangers to the circulating water system through the cooling water heat exchangers. Major components of this subsystem are two 100 percent, motor-driven, centrifugal pumps and two 100 percent cooling water heat exchangers.

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 pressure control valve will be set at approximately 85 psi to cut off the air supply to the service air header once the system pressure falls below 85 psi.

Bleed air from the combustion turbine compressors is used to supply compressed air demand. The air supply system will include a header between both combustion turbines, double block valves on the exhaust bleeds from the CTG compressors, a finned tube, air cooled heat exchanger to reduce the air temperature to 95° F, and an air pressure regulator.

One 100 percent capacity oil free rotary screw package air compressor, water cooled, will supply compressed air to the service and instrument air systems during outages and startups, and will provide backup when the combustion turbines are operating.

2.2.18.3 Fuel Availability

Fuel will be delivered by PG&E from Line 153, located approximately 0.9 miles east of the RCEC, along the Union Pacific Railroad right-of-way. PG&E has confirmed that its system has sufficient capacity to supply the RCEC from this location.

2.2.18.4 Water Availability

Cooling water and non-cooling process makeup water will be tertiary treated water from the AWT plant. The availability of water to meet the needs of the RCEC is discussed in more detail in Section 7.0, Water Supply, and Section 8.15, Water Resources (see Appendix 5-A).

2.2.18.5 Project Quality Control

The objective of the RCEC Quality Control Program will be to ensure that all systems and components have the appropriate quality measures applied during design, procurement, fabrication, construction, and operation. The goal of the Quality Control Program is to achieve the desired levels of safety, reliability, availability, operability, constructibility, and maintainability for the generation of electricity.

Assurance of the quality required for a system is obtained by applying appropriate controls to various activities. 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 project activities.

Project Stages

For quality assurance planning purposes, project activities have been divided into the following nine stages:

Conceptual Design Criteria

Activities such as the 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 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 products upon delivery to the construction site.

Construction/Installation

Inspection and review of storage, installation, and cleaning and initial testing of systems or components at the plant site.

System/Component Testing

Actual controlled operation of power plant components in a system to ensure that the performance of systems and components conforms to specified requirements.

Plant Operation

Actual operation of the power plant system.

As the project progresses, the design, procurement, fabrication, erection, and checkout of each power plant system will progress through the nine stages defined above.

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 include consideration of suppliers' and subcontractors' personnel, production capability, past performance, and quality assurance program.

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

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

A plant O&M program typical for a project of this size will be implemented to control O&M quality. A specific program for this project will be defined and implemented during initial plant startup.

2.2.19 Construction Laydown and Worker Parking Areas

Three candidate areas for construction laydown and off-site worker parking have been identified. These are: 1) a 10-acre parcel currently used for tractor-trailer storage at 3548/3600 Depot Road, 2) a 5-acre parcel across Whitesell Street from the RCEC site at 3600 Enterprise Avenue (Mag Trucking), and 3) the open and unused land surrounding PG&E's Eastshore Substation (approximately 10 acres) (Figure 2.2-5).

2.3 ADVANCED WASTEWATER TREATMENT PLANT

The AWT will be constructed adjacent to the RCEC for treatment of secondary effluent from the WPCF, for both the cooling water and process makeup water for the HRSG's, in compliance with Title 22. The AWT Plant will be designed and constructed by Calpine/Bechtel and owned and operated by the City of Hayward.

The water supply and discharge, treatment process design, and operation of the AWT plant is described below.

2.3.1 Awt Plant Description, Design, and Operation

This section describes the facility's conceptual design and proposed operation.

2.3.1.1 Site Plan and Access

The AWT plant will occupy 2 acres adjacent to the RCEC plant as shown on Figure 2.2-1. The AWT plant will be visually compatible with existing and planned industrial and commercial development in the adjacent properties to the west and north of the site. Architectural screening treatment will be applied to the outside of the major project structures, particularly along Enterprise Avenue to resemble the façade of an office or light industrial building.

Access to the AWT plant area will be from a newly constructed entrance driveway on Enterprise Avenue, separate from the entrance to the RCEC power plant (Figure 2.3-1). Most of the site will be paved to provide internal access to all project facilities and on site buildings. The AWT plant will be surrounded by a fence which will separate it from the RCEC facilities.

2.3.1.2 Water Supply and Use

The water supply for the AWT, including Hayward Water Pollution Control Facility (WPCF) secondary effluent, EBDA/USD secondary effluent, and potable water, will be provided by the City of Hayward. A "will-serve" letter describing the City's water supply agreements is included in Appendix 7-A.

Water Requirements

The RCEC would require 3.33 million gallons per day (mgd) (2,313 gallons per minute), or 3,730 acre-ft/year of secondary effluent during average water supply demand conditions (assumed at 60°F ambient temperature, with no inlet air fogging or power augmentation) and 5.27 mgd (3660 gpm), or 5,904 acre-ft/year, during peak water supply demand conditions (assumed at 90°F ambient temperature, with inlet air fogging and power augmentation). These flow rates account for losses in the water treatment process, to produce the final product water demand for the plant of 2.41 mgd during average conditions and 3.8 mgd at peak conditions. Approximately 95 percent of the final product water would be used as makeup for evaporation losses of the cooling tower. The remaining 5 percent would be used for process makeup water to produce steam and for plant general service water. An additional 2 gpm of city potable water will be required to meet the limited domestic demands for the project.

Water Supply

A major benefit of the proposed location of the RCEC is its use of secondary effluent from the adjacent Hayward WPCF as a primary water supply, rather than potable water. Secondary effluent from the City of Hayward's WPCF will be the primary source of water for both cooling water and process water for the RCEC following treatment in the AWT. Secondary effluent from the WPCF would be delivered to the AWT via a gravity pipeline beneath Enterprise Avenue. Figure 2.3-2 shows the proposed location of that pipeline.

In the event of an interruption of supply of secondary effluent from the Hayward WPCF to the AWT Plant, secondary effluent from the Union Sanitary District's Alvarado Waste Water Treatment Plant (USD) would be provided. Long-term interruptions are not expected; however, short-term upsets in water quality due to unpredictable discharges to the WPCF could occur resulting in the need for a back-up supply. USD secondary effluent is discharged into East Bay Dischargers Authority's (EBDA) effluent transport pipeline, which runs north-south, just to the west of the Hayward WPCF. A connecting pipeline from the EBDA line will be constructed so that during upsets of the WPCF, water from the EBDA pipeline would be delivered to the AWT Plant via the same pipeline crossing Enterprise Avenue that normally conveys secondary effluent from Hayward's WPCF. A pipeline will be constructed from the EBDA 60-inch force main east, within the Hayward WPCF property, to the primary water supply pipeline as shown on Figure 2.3-2. A valve box will be located at the intersection of these two pipelines so that either the primary supply or the back-up supply could be directed into the single secondary effluent supply pipeline across Enterprise Avenue to the AWT Plant. A pump station may be required adjacent to the existing EBDA pipeline because of the hydraulics of the EBDA pipeline. If a pump station is not

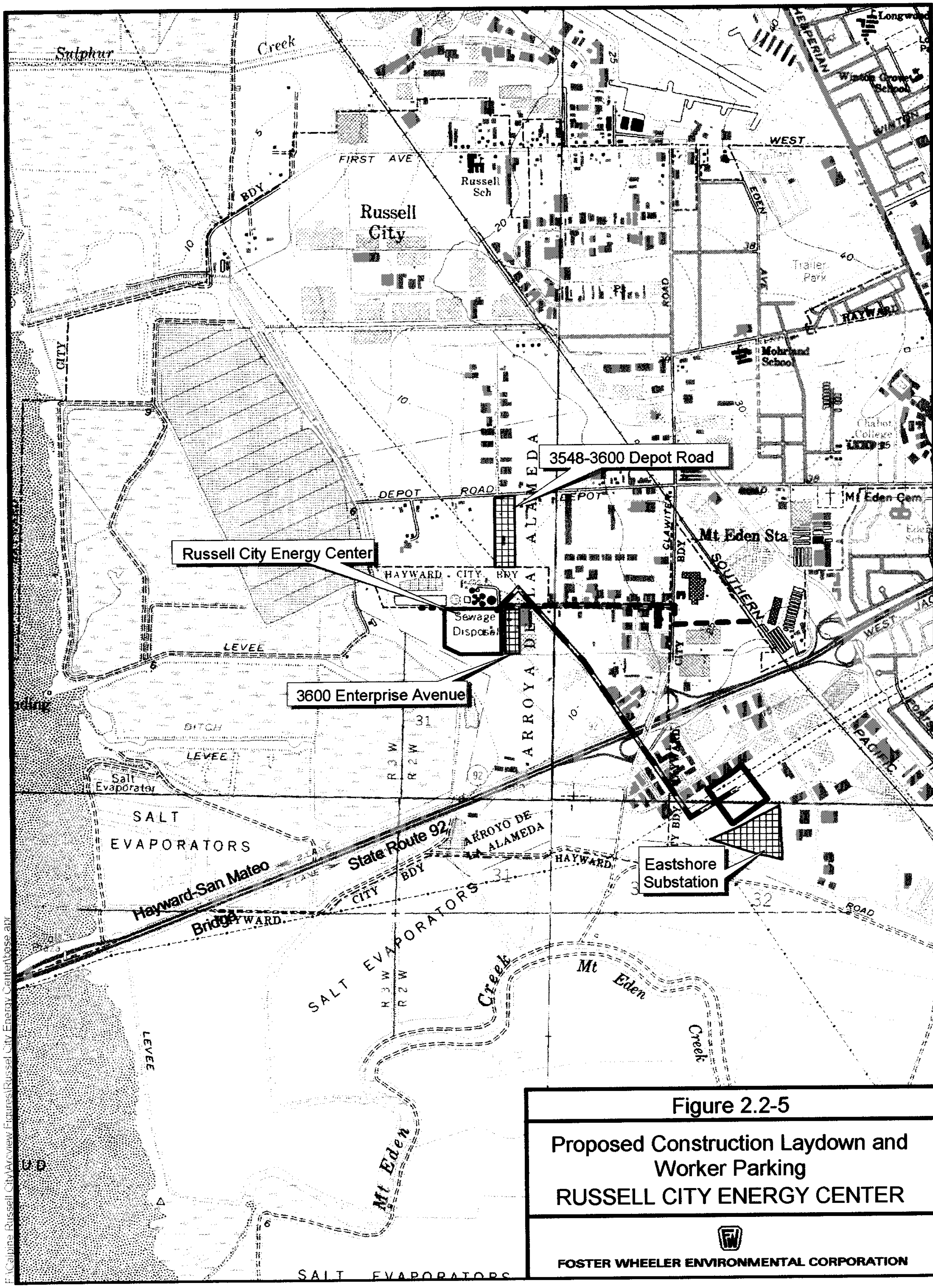

Figure 2.2-5

Proposed Construction Laydown and Worker Parking

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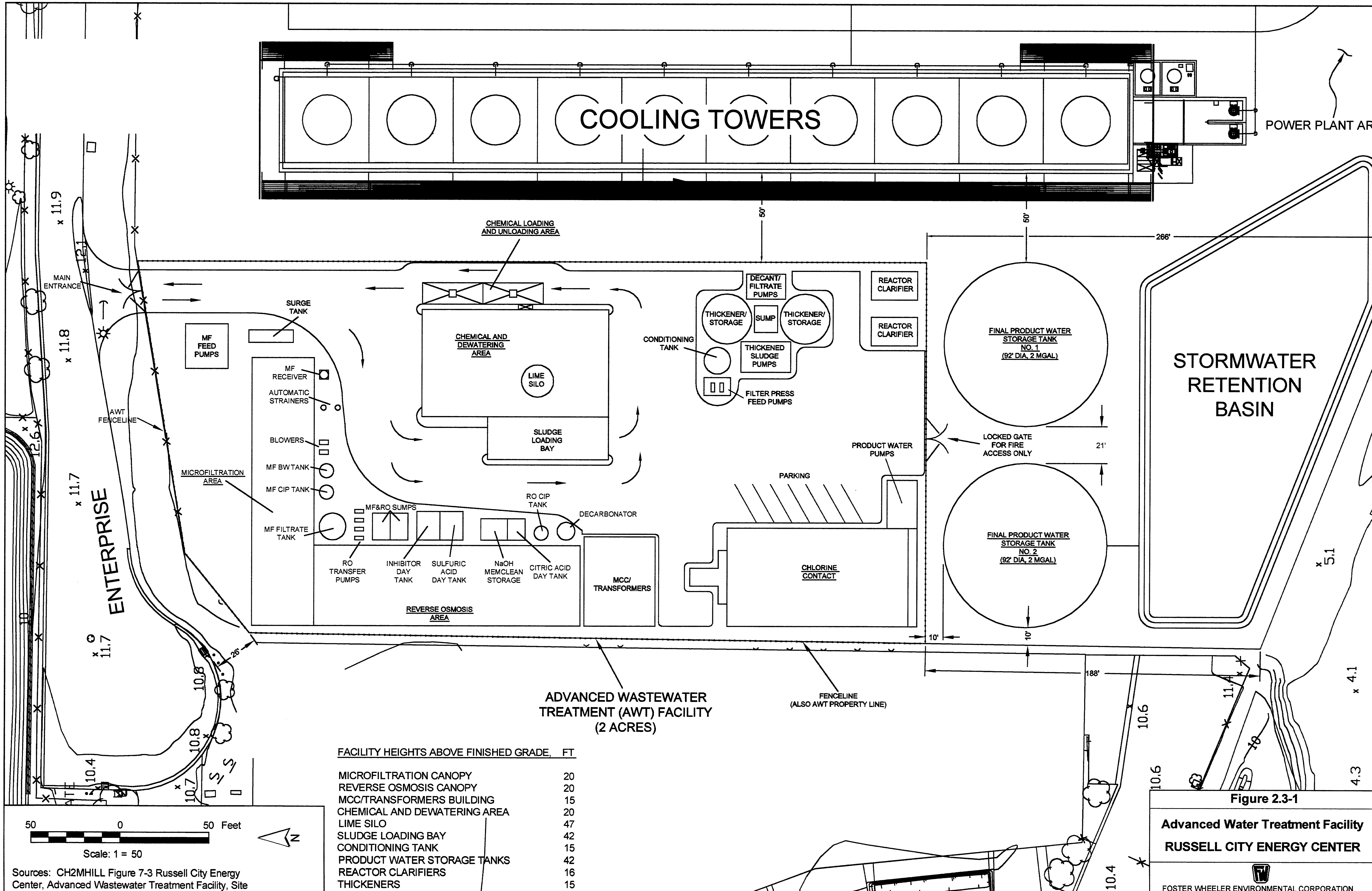
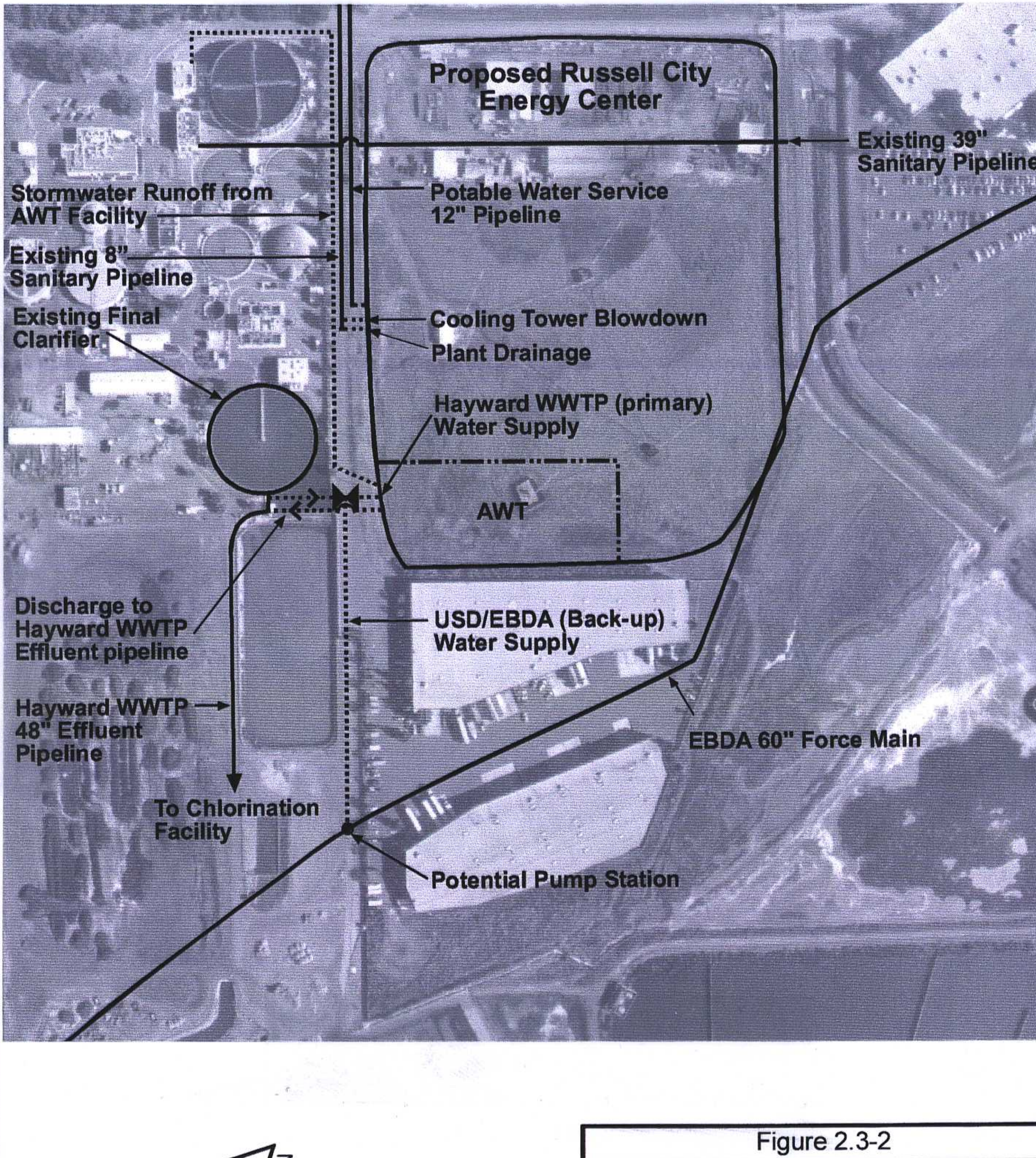


FACILITY HEIGHTS ABOVE FINISHED GRADE,	FT
MICROFILTRATION CANOPY	20
REVERSE OSMOSIS CANOPY	20
MCC/TRANSFORMERS BUILDING	15
CHEMICAL AND DEWATERING AREA	20
LIME SILO	47
SLUDGE LOADING BAY	42
CONDITIONING TANK	15
PRODUCT WATER STORAGE TANKS	42
REACTOR CLARIFIERS	16
THICKENERS	15

Sources: CH2MHILL Figure 7-3 Russell City Energy Center, Advanced Wastewater Treatment Facility, Site Layout

Figure 2.3-1
Advanced Water Treatment Facility
RUSSELL CITY ENERGY CENTER



Source: CH2M Hill

Figure 2.3-2

Water Pipeline Routes
RUSSELL CITY ENERGY CENTER

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needed, a valve station will be installed at the site of the connection to the EBDA line with a valve operator and a telemetry station on a 10-foot by 10-foot fenced site. The pump station, if needed, would be built on a structure surrounded by a fence, approximately 30 feet square, adjacent to the EBDA pipeline. The depth of excavation for the connection to the EBDA force main will be approximately 15 feet below grade to connect to the bottom of the EBDA pipeline. A wet well or dry well with in-line pumps will be used to pump water from the EBDA pipeline, through an isolation valve that will isolate flow to the AWT Plant. Three pumps will be included, such that two of the pumps will be able to deliver the peak flow to the AWT plant (5.27 mgd) if one of the three pumps is temporarily removed from service. The pumps are expected to be low head (pressure) pumps due to the relatively short distance and elevation change to the AWT plant. The site will be prepared with a limited amount of grading. All site work and excavation during construction of the pump station will be performed with extreme caution so as to provide appropriate protection of the EBDA pipeline. A hot tap will be installed into the EBDA pipeline, so that the line will not need to be removed from service during construction of the pump station. All electrical power will be provided to the pump station by the City of Hayward WPCF, via a buried trench with a concrete-encased conduit.

The pump station would be constructed in conjunction with the construction of the AWT plant.

As mentioned above, water required for domestic and fire fighting uses would also be provided by the City of Hayward. Connection would be to the 12-inch potable water line that runs along Enterprise Avenue, shown on Figure 2.3-2. The City of Hayward's water supply comes from the City of San Francisco's Hetch Hetchy Aqueduct.

Water Quality

An analysis of the water sources is provided in Section 7, Water Supply.

2.3.1.3 Process Description

To achieve the desired water quality and minimize impacts associated with discharge from the facility, a membrane filtration and reverse osmosis (MF/RO) AWT Plant will be constructed. Figure 2.3-1 shows the preliminary layout for the AWT Plant, including the MF/RO facility. The MF/RO process is described in detail below. Additionally, copper treatment and solids clarification processes will be used to improve the quality of the reverse osmosis concentrate and microfilter backwash before they are discharged to the EBDA system, and ultimately the San Francisco Bay via the EBDA outfall. Treatment of these waste streams is summarized below and described in detail in Section 7.

MF/RO Technology Process Description

Under the AWT plant process, secondary effluent from the City of Hayward will undergo tertiary microfiltration (MF) and reverse osmosis (RO) treatment processes. The major treatment processes, major process stream flows, operating pressures, chemical applications, and waste discharges are indicated in the MF/RO process flow diagram see Section 7, (Figure 7-2). Secondary effluent will flow by gravity to the MF feed pump station. Transfer pumps will provide sufficient pressure to down-stream treatment processes. Automatic strainers and pressure control facilities will condition the feed supply. Microfiltration will be used as pretreatment prior to the RO system. Microfiltration filtrate will flow to a storage tank from which it will be pumped to the RO system. Waste backwash from the MF system and automatic strainers will be conveyed to the post treatment facilities (solids clarification) for metals and solids removal prior to discharge to the City of Hayward's effluent. Flow equalization is provided to prevent upsetting the post-treatment facility. Permeate from the RO system will undergo decarbonation to remove residual carbon dioxide. Product transfer pumps will transfer water from the product clearwell to the product water storage tanks. RO concentrate will flow to the on-site concentrate (post) treatment facilities for metals and solids removal prior to discharge to the City of Hayward's WPCF. Chemical feed facilities will be included for sodium hypochlorite, sulfuric acid, threshold inhibitor, and chemicals associated with the MF and RO cleaning systems (see Section 8.5 for more details) regarding the chemicals used.

AWT Water Quality

The AWT plant will produce water suitable for use as cooling tower makeup and other process water uses. Anticipated process water quality data for key parameters is summarized in Table 7-2.

MF/RO Plant Hydraulic Capacities

The plant hydraulic capacities are based on a final product demand of 2,873 gpm (4.14 mgd), which is the projected water need for the power plant operating at 90°F ambient temperature, including a slight safety factor. A Process Stream Flow Summary is included on the MF/RO Process Flow Diagram (Figure 7-2), indicating instantaneous and average flow values for major streams in the treatment process, including MF feed, filtrate, and backwash, as well as RO feed, permeate, and concentrate streams. The average flow values shown on Figure 7-2 are indicative of the power plant operating at peak conditions. The maximum flow values shown on Figure 7-2 are instantaneous rates that would occur for brief periods during the backwashing of the microfilters. RO and combined MF/strainer recoveries are each 85 percent, for an overall treatment process recovery of 72 percent. Therefore, the input to the MF/RO process is 5.27 mgd at peak conditions, to account for the losses in the unit processes, and produce the final product demand for the plant.

Feed Pump Station

The MF Feed pumps will deliver secondary effluent to the MF strainers with sufficient head to provide approximately 35 psi feed pressure at the MF system, downstream of the strainers. The MF system operates at a constant, fixed pressure over a wide range of flow. Variations in flow primarily result from the MF unit backwash sequences. The feed delivery system, therefore, must be designed for continuous duty, fast response, and heavy cycling, when faced with frequent, near instantaneous changes in flow. Based on analyses conducted as part of past projects, it is anticipated that a hydropneumatic surge tank will be required.

Automatic Strainers

To protect downstream membrane treatment systems from large particles, secondary effluent from the WPCF will undergo 500-micron straining. The strainers will be the motor-operated, automatic backwash, stationary basket, rotating arm type. Backwashing will be accomplished by venting feedwater to waste through a backwash valve. Initiation of backwash will be by differential pressure, fixed time, or remote initiation from the supervisory control system. Backwash will be conveyed to post treatment facilities for metal and solids removal.

Microfiltration (MF) Treatment System

The purpose of the MF system is to provide pretreatment (particulate removal) ahead of the reverse osmosis system. The MF treatment process is uniquely capable of consistently producing a high quality filtrate from a secondary effluent feed supply, exceeding standard prerequisites for reverse osmosis feed (in terms of turbidity and silt density index) with a significant economy of space when compared to other conventional treatment alternatives. The system relies on pressure-driven membrane filtration systems incorporating hollow fiber membranes in an "outside-in" flow configuration. This preliminary design is based on use of a positive pressure-driven MF membrane configured in above-grade, skid-mounted units.

The MF system operating capacity will be set to provide 3,380 gpm (the requisite flow to the RO, including a safety factor). Components of each system are discussed in additional detail below.

The MF system will include the following components:

- Skid mounted continuous microfiltration (CMF) units
- A compressed air system
- A membrane clean-in-place system
- A waste backwash collection system
- An instrumentation and control system

Preliminary design criteria for the system are included in Table 2.3-1.

Table 2.3-1. MF/RO design criteria.

Unit Model No.	**90M10C**
System Rated Capacity, mgd	4.87 (on a 24-hour basis)
No. of CMF Units	9
No. of Membrane Modules per CMF Unit	90
Module Production at Rated Capacity, gpm/mod.	4.43 (on 24-hour basis)
Backwash Cycle Interval, minutes	15
Backwash Cycle Time, minutes	2.5
Operating Flux at Rated Capacity, gpm/m^2	0.340 (instantaneous)
Minimum Recovery, percent	87

MF Units

Each CMF unit incorporates the tubular MF membrane modules, piping, valves, instruments, electrical panel, and pneumatic panel, all mounted on a structural steel frame. Individual units will be manifolded on common feed, filtrate, cleaning (feed and return), backwash waste, filtrate exhaust, process air, and control air headers to achieve the desired rate of system production. As discussed above, system operation is pressure driven. Feed to each unit is distributed to the MF membrane modules mounted vertically on the frame. Each module contains a bundle of hollow fine membrane fibers and operates in dead-end filtration mode, with all of the feed water passing from outside of the fibers to the interior lumens and exiting as filtrate. A filtrate control valve on each unit modulates to achieve a setpoint flow, thereby regulating flow through each on-line unit. Aside from filtration, the other main operational mode of on-line unit is backwash. To remove accumulated debris from the membrane surface, each unit periodically undergoes a backwash sequence consisting of the following main steps:

1) Remove the unit from filtrate production
2) Drain unit piping and the shell side of the fibers to waste
3) Exhaust the lumen side of the fibers to waste
4) Introduce high pressure (90 psig) process air to the lumen side of the fibers
5) Introduce a high feedwater sweep flow to the shell side of the fibers with exhaust to waste

6) Refill the unit piping and manifolds, rewet the membranes, and return the unit to filtration mode

The above sequence takes roughly 2.5 minutes from the time the unit is taken off-line until it is back on-line producing filtrate. Proper operation of both the filtration and backwash modes requires a constant feed manifold pressure between 30 and 35 psig.

In wastewater applications, the primary backwash initiation trigger is elapsed time of filtration (typically either 15 or 20 minutes). Since the units within a row share common backwash and filtrate exhaust headers, only a single unit within a given row can backwash at one time. This effectively limits the allowable number of units within a row to the elapsed-time-of-filtration setpoint (backwash cycle interval) divided by the backwash sequence time. Operating experience from CMF units operated on secondary effluent indicate that an appropriate backwash frequency is 15 minutes at unit operating capacities listed in Table 2.3-1.

Compressed Air System

Compressed air is used in the MF system as process air during the unit backwash sequences and as control air for pneumatic valve actuators employed on the units and in the clean-in-place system.

Clean-in-Place (CIP) System

The MF CIP system will allow in-situ cleaning of the MF membrane modules. Clean membranes will operate at a differential (trans-membrane) pressure of roughly 4 to 6 psid (pounds per square inch differential). In spite of periodic backwash sequences, residual foulant will begin accumulating on the membrane surface, gradually increasing trans-membrane pressure (TMP). Once a threshold TMP is reached, somewhere between 15 and 20 psid, the modules must be cleaned. Cleaning solutions will be made up with RO permeate and either citric acid or caustic, and a detergent. Cleanings will be initiated manually but conducted automatically by the MF control system. The operating CMF unit to be cleaned will be taken off-line, isolated, and replaced in service by the standby unit. Prepared cleaning solutions will be recirculated through the unit via the cleaning feed and return manifolds. Following cleaning, the unit will be brought back on-line temporarily with filtrate diverted to waste to remove residual cleaning solution from the modules. Following this, the unit will be put back on-line or into standby mode, depending on operational requirements. While the unit is off-line for the CIP procedure, the overall filtrate flow setpoint is maintained by the remaining units as a result of excess capacity and operation at increased unit filtrate flow. Estimated cleaning frequency is once a month. CIP cleaning wastes will be conveyed to post-treatment facilities.

Backwash Collection System

During backwash, filtrate exhaust and feedwater sweep sequences discharge large volumes of an expanding mixture of compressed air and water out the filtrate exhaust and backwash waste manifolds, respectively. These manifolds will be routed to a large tank vented to atmosphere to allow energy dissipation and release of entrained air. An arrester will be provided on the tank vent to eliminate misting.

MF Filtrate Tank

The MF filtrate tank will provide intermediate storage between the MF and RO systems. Storage is required for two primary reasons. First, it helps de-couple operation of the MF and RO systems to a certain degree, limiting the impact of short-term flow transients and mismatches between MF system production and RO demand. Second, it provides necessary flow equalization for variable rates of MF filtrate production during periods of unit backwash and regeneration.

The design basis is for ten minutes of residence time at the required reverse osmosis system feed flow at a permeate flow of 4.9 mgd. This results in a tank volume of 35,000 gallons.

RO Transfer Pump Station

The RO transfer pumps will take suction from the MF filtrate storage tank and provide a continuous, stable flow through the cartridge filters and in-line RO membrane feed pumps. In addition to providing the required head for cartridge filtration, the transfer pumps allow for flushing the RO trains with low pressure feedwater during startup and following cleaning. The pumps will be constant speed and will accommodate variations in flow during startup and shutdown flush sequences by operating along their curve. An operating head of 100 feet (43 psi) allows up to 15 psig of pressure drop across the cartridge filters and provides at least 20 psig of residual head at the membrane feed pump suction.

Reverse Osmosis (RO) Treatment System

The purpose of the RO system is to remove dissolved solids and other priority constituents from the plant feedwater, conditioning it for use as a cooling water and process water supply. The RO system will include the following components:

- Sulfuric acid and threshold inhibitor chemical feed systems
- Cartridge filtration
- RO membrane feed pumps
- RO trains (pressure vessel racks, pressure vessels, membrane elements, pipe manifolds, valves, instrumentation)
- RO clean-in-place (CIP) system
- Membrane flush system
- Decarbonators
- Interconnecting piping and valves
- Instrumentation and controls

Primary components of the system are discussed below.

Cartridge Filtration

The cartridge filter will consist of a stainless steel pressure vessel housing a bank of cylindrical wound depth polypropylene filter elements. It is not intended for heavy-duty filtration service but will be used to protect the membrane feed pumps and RO membrane elements from unforeseen upsets in the pretreatment system. Estimated replacement rate for filter elements is once every nine months. Filter changes will be coordinated with normal facility maintenance periods. Filters will be disposed of in a non-hazardous waste landfill.

RO Membrane Feed Pump

Each RO train will be equipped with a single, non-redundant membrane feed pump. The pump will be sized to deliver the required feed flow at a recovery of 85 percent. Anticipated operating pressures range from a low of 150 psig with new membrane up to a maximum of 300 psig. Each pump will be equipped with a variable frequency drive to allow maintenance of train permeate flow as required operating pressures increase. Maximum pump motor speed will be limited to 1800 rpm to minimize pump noise and extend operating life.

RO Train

Four 33 percent capacity RO trains will be provided. The trains will be designed to operate continuously at 1.4 mgd each, without substantial variations in flow during normal operation. Product water recovery for the train will be held constant at 85 percent.

The RO trains will use seven 8-inch diameter, 40-inch long, spiral-wound membrane elements per pressure vessel, at nominal operating flux of roughly 12 gallons per square foot per day (gfd). Pressure vessels will be arranged on racks supporting 12 vessels, limiting vessel row height to 6 vessels maximum. This will allow access to any vessel in the train from the operating floor.

Clean-in-Place (CIP) System

A permanently piped CIP system will be provided to allow cleaning of the RO membranes in-situ. The CIP system will consist of a tank, pump, interconnecting piping, valves, instrumentation, and controls. The tank will be fitted with a flanged immersion heater, access platform, and bag loader. The bag loaders will allow batching of dry-fed cleaning chemicals directly to each tank. The cleaning pump will be used to recirculate the tank contents for mixing and feed to/from the vessels in the train being cleaned. Estimated cleaning frequency for the train is twice per year. CIP cleaning wastes will be conveyed to post-treatment facilities.

Membrane Flush System

A membrane flush system will be provided to allow flushing of each train on system shutdown. If an individual train has been off-line for a period in excess of 30 minutes without being restarted, a permeate flush cycle will be initiated. A train flush will be accomplished by pumping permeate through the flush feed valve on the suction side of the RO membrane feed pump of the train being flushed for roughly 20 minutes. A flush waste valve will be opened off the train concentrate line ahead of the control valve, routing the flush water to post-treatment facilities. If more than one train requires a flush, the system will be configured to flush each train in sequence. The flush system will consist of a pump, interconnecting piping, valves, instrumentation and controls. The flush pump will take suction from the final product wet well.

Decarbonation System

Permeate from the RO train will be routed to the top of the decarbonator where it will be distributed over plastic packing material and flow down the packing. The packing will provide a large surface area to facilitate mass transfer so that carbon dioxide in the water can be transferred to the countercurrent airflow being supplied by the integral forced air blower at the base of the tower. The base of each tower will include a catch basin to allow equalization and provide head for gravity flow to the final product wet well.

Product Transfer Pump Station

The product transfer pumps will take suction from the final product wet well. The pumps will be furnished with adjustable frequency drives.

Chemical Feed Systems

Chemicals used at the AWT plant will include the following:

- Sodium Hypochlorite
- Sulfuric Acid
- Threshold Inhibitor
- MF Cleaning Chemicals

- RO Cleaning Chemicals

Sodium Hypochlorite Feed System

Sodium hypochlorite will be used ahead of the MF and RO systems for biofouling control. Dosing to the MF feed is used to improve operation of the MF membranes, which have exhibited increased cleaning intervals when treating waters with a 1 to 3 mg/L residual of combined chlorine (chloramine). Dosing to the MF filtrate will allow periodic chlorination (presence of ammonia in the RO feed will result in formation of chloramines) of the feedwater to the RO system if required for system maintenance (biofouling control). The selected MF and RO membranes have demonstrated long-term tolerance of these concentrations of chloramine in secondary effluent applications.

Sulfuric Acid Feed System

Sulfuric acid will be used in the RO system to reduce the pH of the RO feedwater. The target feedwater pH will be set to maintain a Langelier Saturation Index (LSI) in the concentrate stream of +2.0.

Threshold Inhibitor Feed System

A threshold inhibitor compound will be added to the RO feedwater to prevent the precipitation of sparingly soluble salts in the concentrate stream. Inhibitor will be fed full strength (undiluted) from storage totes located adjacent to the injection point. To minimize the potential for adverse interactions between the inhibitor and high concentrations of acid, the inhibitor injection point will be located downstream of the point of acid addition to insure the acid is thoroughly mixed prior to contact with the inhibitor.

MF CIP Chemical Dosing Systems

Standard cleanings of the MF membranes will be conducted in-situ with a heated solution made up of RO permeate and cleaning chemicals. In each case, cleaning chemicals will be dosed directly to the main cleaning solution make-up tank(s) through a top nozzle. All chemicals will be batched to the tank as liquid. Sodium hypochlorite, sodium hydroxide and detergent, as required, will be stored as liquid solutions adjacent to the CIP tank(s). Citric acid solutions will be made up in a separate mix tank from dry chemical.

RO CIP Chemical Dosing Systems

Standard solutions used to clean the RO membranes in place will be made up of RO permeate and a variety of detergents. To allow maximum flexibility, all cleaning chemicals will be batched in dry form directly to the tank from the top. A bag loader with platform that can be accessed by forklift will be provided for this purpose.

Process Waste Collection and Disposal

MF Backwash and Strainer Drain

Waste created during periodic backwash cycles on the influent strainers as well as MF backwash waste will be routed to the MF waste sump and conveyed to the solids handling/post treatment facilities described in Section 7.

RO Concentrate Disposal

Concentrate from the RO train will be routed to the RO waste sump, prior to transfer to the solids concentrate post-treatment facilities described in Section 7.

2.3.1.4 Major Electrical Equipment and Systems

The electrical power for the AWT plant will be provided by PG&E. Power will be distributed to all loads via one or more double-ended load centers and motor control centers.

The estimated load for the AWT is 540 kW. The estimated energy usage is 5 million kWh/yr.

2.3.1.5 Waste Management

Waste management is the process whereby all wastes produced at the AWT plant will be properly collected, treated if necessary, and disposed of. Wastes will include wastewater, solid nonhazardous waste, and hazardous waste (liquid and solid). Waste management is discussed in more detail in Section 8.14.

Wastewater Collection, Treatment, and Disposal

Expected wastewater streams (excluding sanitary wastewater) and flow rates for the AWT Plant and associated power plant activities are shown on the process flow schematic, Figure 7-1. The average flow rates shown are based on 60° F ambient temperature (with no inlet air fogging or power augmentation) and the peak flow rates assume 90° F ambient temperature (with inlet air fogging and power augmentation).

Wastewater discharges from the AWT Plant include combined liquid streams from copper removal/treatment, solids clarification, and microfilter backwash (peak: 1.46 mgd; average: 0.92 mgd). A stormwater discharge will also occur from the AWT, which is a maximum of approximately 2.6 mgd (4 cfs) assuming a 25-year, 24-hour storm over an industrial area with 95 percent runoff coefficient. The treated discharge stream will be conveyed by a pipeline from the AWT to the existing Hayward WPCF effluent pipeline. The stormwater runoff from the AWT will be conveyed by a pipeline to the WPCF headworks. Pipelines for each of these discharges are shown on Figure 2.3-2. Details of each of these waste streams are included in Chapter 7 (Water Supply).

Solid Waste

Associated with the copper removal process described in Section 7, solids will be generated which will be handled onsite, prior to ultimate disposal in a landfill. The solids quality of the sludge is described in Section 7 to be non-hazardous, and unlikely to face any restrictions with respect to disposal from a hazardous waste standpoint.

Approximately 9 tons/day (average) to 12 tons/day of 50% solids sludge will be generated, requiring one to two truckloads per day. All lime storage, copper treatment, and solids handling facilities are shown in Figure 2.3-1.

Additionally, cartridge filters required for the MF/RO treatment process will be replaced every nine months. Used filters will be disposed of in a non-hazardous waste landfill.

Hazardous Wastes

No hazardous wastes will be discharged from the AWT plant.

2.3.1.6 Management of Hazardous Materials

Various chemicals will be stored and used during the construction and operation of he AWT plant. Locations of chemical storage facilities are shown on Figure 2.3-1 a table listing of the chemicals anticipated for use at the AWT plant is provided in Section 8.5, Hazardous Materials Handling. This table identifies each chemical by type and intended use and estimates the quantity to be stored onsite.

Section 8.14, Waste Management, includes additional information on hazardous materials handling. Section 8.12, Traffic and Transportation, contains information on the transport of hazardous materials.

All chemicals will be stored, handled, and used in accordance with applicable laws, ordinances, regulations, and standards (LORS). Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals will be stored in storage tanks, and other chemicals will be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills. Berm and drain piping design will allow a full-tank capacity spill without overflowing the berms. For multiple tanks located within the same bermed area, the capacity of the largest single tank will determine the volume of the bermed area and drain piping. Drains from the chemical storage and feed areas will be directed to a neutralization area for neutralization, if necessary. Drain piping for volatile chemicals will be trapped and isolated from other drains to eliminate noxious or toxic vapors. After neutralization, water collected from the chemical storage areas will be directed to the facility's industrial wastewater collection system.

Safety showers and eyewashes will be provided adjacent to, or in the area of, all chemical storage and use areas. Hose connections will be provided near the chemical storage and feed areas to flush spills and leaks to the neutralization facility. State-approved personal protective equipment will be used by plant personnel 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. Electric equipment insulating materials will be specified to be free of polychlorinated biphenyls (PCBs).

2.3.1.7 AWT Plant Construction

Construction of the AWT plant will occur simultaneously with construction of the RCEC (see Table 2-1) The AWT plant will be accessed for construction from Enterprise Avenue. The average and peak workforce on the project during construction will be approximately 25 and 40 respectively, including construction craft personnel, and supervisory, support, and construction management personnel (see Section 8.10, Socioeconomics). Construction will be scheduled between the hours of 6 a.m. and 6 p.m., Monday through Saturday. Additional hours may be necessary to complete critical construction activities. During the startup phase of the project, some activities will continue 24 hours per day, 7 days per week. Materials and equipment for the AWT plant will be delivered by truck.

At the site, the peak construction workforce is expected to be required during months 3 and 4 (building of structures) and months 8 through 9 or 10 (equipment installation) of the construction period.

2.3.1.8 AWT Plant Operation

Operation of the AWT plant will be integrated with the operation of the City's existing WPCF. Incrementally, its operation would require a maximum of 3 operators per shift. The facility will operate 7 days per week, 24 hours per day in conjunction with power plant needs. In normal operations the facility would be operated remotely from the WPCF via distributed control system.

2.3.2 Facility Safety Design

The AWT plant will be designed to maximize safe operation. 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.

2.3.2.1 Natural Hazards

The principal natural hazards associated with the AWT plant site are earthquakes and floods. The site is located in Seismic Risk Zone 4. Structures will be designed to meet the seismic requirements of CCR Title 24 and the 1998 California Building Code (CBC). Section 8.4, Geologic Hazards and Resources, discusses the geological hazards of the area and site. This section includes a review of potential geologic hazards, seismic ground motions, and the potential for soil liquefaction due to ground shaking. Appendix 10 includes the structural seismic design criteria for the buildings and equipment.

The site is essentially flat, with a post-construction average elevation of approximately 14 feet above mean sea level (MSL). The ground floor of plant facilities will be at 14 feet MSL. According to the Federal Emergency Management Agency (FEMA), the site is not within either the 100- or 500-year floodplain. Section 8.15, Water Resources, includes additional information on the potential for flooding.

2.3.2.2 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 8.10, Socioeconomics, includes additional information on area medical services, and Section 8.16, Worker Health and Safety, includes additional information on safety for workers. Appendix 10 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.

Fire Protection Systems

The AWT plant will rely on the City of Hayward's fire protection services.

Fire Extinguishers

The AWT plant will be equipped with portable fire extinguishers as required by the local fire department.

Local Fire Protection Services

In the event of a major fire, plant personnel will be able to call upon the City of Hayward Fire Department for assistance. The closest Hayward fire station is approximately 2 miles away at 1401 W. Winton Avenue. The Hazardous Materials Risk Management Plan (see Section 8.5, Hazardous Materials Handling) for the plant will include all information necessary to permit all firefighting and other emergency response agencies to plan and implement safe responses to fires, spills, and other emergencies.

Personnel Safety Program

The AWT plant 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 8.16, Worker Health and Safety.

2.3.3 Facility Reliability

This section discusses the expected plant availability, equipment redundancy, fuel availability, water availability, and project quality control measures associated with the AWT plant.

2.3.3.1 Plant Availability

The AWT plant is designed to be available to provide water to the RCEC on demand as the RCEC generates electricity in response to consumer demand. The AWT plant will be available to the RCEC 24 hours a day, seven days a week. The AWT plant will be designed for an operating life of 30 years. Reliability and availability projections are based on this operating life. Operation and maintenance

(O&M) procedures will be consistent with industry standard practices to maintain the useful life status of plant components.

2.3.3.2 Redundancy of Critical Components

The following subsections identify equipment redundancy in the AWT, as it applies to project availability.

Membrane Filtration

Two standby CMF units are included in the design to provide redundancy in the event of malfunction of one of the microfiltration units and during routine cleanings. A detailed description of procedures involved in the routine cleaning of each backwash unit is presented above.

Reverse Osmosis Train

Four 33 percent capacity RO trains will be provided. The trains will be designed to operate continuously at 1.4 mgd each, without substantial variations in flow during normal operation. In the event that one of the RO trains malfunctions, the flux rate of the remaining RO train could be temporarily increased to meet treated average water demand of the power plant.

Final Product Water Storage

The AWT plant includes storage tanks designed to hold the 24-hour peak water demand of approximately 4 million gallons. In the event of an interruption in the operation of any component of the AWT plant, water will be available from these storage tanks to provide 24 hours of supply.

2.3.3.3 Water Availability

Secondary effluent supply to the AWT plant and product water will be provided by the City of Hayward as agreed to in the "will-serve letter" included in Appendix 7-A. The primary water supply will be secondary effluent from the City of Hayward's WPCF and the back-up supply will be secondary effluent from the EBDA pipeline.

2.3.3.4 Project Quality Control

The Quality Control Program to be implemented for the AWT plant will be the same as that for the RCEC.

2.4 LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

The applicable laws, ordinances, regulations, and standards for each engineering discipline are included as part of Appendix 10.

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3.0 DEMAND CONFORMANCE

The California Energy Commission is no longer required to determine whether or not a proposed project conforms with an integrated assessment of electrical demand or need. Senate Bill 110 (California Construction Articles 4, Section 8), which took effect on January 1, 2000, states:

> *Before the California electricity industry was restructured, the regulated cost recovery framework for generating facilities justified requiring the commission to determine the need for new generation, and site only generating facilities for which need was established. Now that generating facility owners are at risk to recover their investments, it is no longer appropriate to make this determination.*

Accordingly, this AFC does not include an assessment of need.

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