SECTION 2.0

Project Description

2.1 Introduction

This Application for Certification (AFC) for the Ivanpah Solar Electric Generating System (Ivanpah SEGS) has been prepared in accordance with the California Energy Commission's (CEC) Power Plant Site Certification Regulations (March 2007). This Application is being made by Solar Partners I, LLC; Solar Partners II, LLC; Solar Partners VIII, LLC, the owners of the three separate solar plants, and Solar Partners IV, LLC, the owner of shared facilities required by the three solar plants (the "Applicant"). These four project limited liability companies are Delaware limited liability companies. BrightSource Energy, Inc. (BrightSource), a Delaware corporation, is a technology and development company and the parent company of the limited liability companies. The Applicant will use BrightSource's solar thermal technology for Ivanpah SEGS.

The Applicant is developing three solar energy plants to be located in the Ivanpah Basin in California, 4.5 miles southwest of Primm, Nevada (see Figure 2.1-1, Regional Map; all figures are located at the end of this section). The three plants will be separately owned and operated by Solar Partners I, LLC; Solar Partners II, LLC; and Solar Partners VIII, LLC to facilitate the construction, financing, and possible sale of three separate plants. In addition, a fourth company, Solar Partners IV, LLC, will own the shared facilities that are required for the operation of each of the solar plants. The first 100-megawatt (MW) (nominal) plant at the south end of the project, known as Ivanpah 1, will be owned by Solar Partners II, LLC. Solar Partners I, LLC will own the middle 100-MW (nominal) plant known as Ivanpah 2. The northernmost 200-MW (nominal) plant, known as Ivanpah 3, will be owned by Solar Partners VIII, LLC. The three plants and their shared facilities collectively are known as the "Ivanpah Solar Electric Generating System" or "Ivanpah SEGS." The Applicant is seeking a separate certification from the CEC and a separate right-of-way (ROW) grant from the Bureau of Land Management BLM for each of the three plants owned by Solar Partners I, LLC; Solar Partners II, LLC; and Solar Partners VIII, LLC; and for the shared facilities owned by Solar Partners IV, LLC.

Each 100-MW site requires about 850 acres (or 1.3 square miles); the 200-MW site is about 1,660 acres (or about 2.6 square miles). The total area required for all three phases, including the shared facilities is approximately 3,400 acres. The Applicant has applied for ROW grants for the land from BLM. Although this is a phased project, it is being analyzed as if all phases are operational.

Each phase of the project includes a small package natural gas-fired start-up boiler to provide heat for plant start-up and during temporary cloud cover. The project's natural gas system will be connected to the Kern River Gas Transmission Line, which passes less than half a mile to the north of the project site. Raw water will be drawn daily from one of two onsite wells, located east of Ivanpah 2. Each well will have sufficient capacity to supply water for all three phases. Groundwater will go through a treatment system for use as boiler make-up water and to wash the heliostats. To save water in the site's desert environment, each plant will use a dry-cooling condenser. Water consumption is, therefore, minimal (estimated at no more than 100 acre-feet per year for all three phases). Each phase includes a small onsite wastewater plant located in the power block that treats wastewater from domestic waste streams such as showers and toilets. A larger sewage package treatment plant will also be located at the Administration Building/Operations and Maintenance area, located between Ivanpah 1 and 2. Sewage sludge will be removed from the site by a sanitary service provider. No wastewater will be generated by the system, except for a small stream that will be treated and used for landscape irrigation. If necessary, a small filter/purification system will be used to provide potable water at the Administration Building.

To reduce impacts on the land and provide operating efficiencies, the three plants share certain infrastructure. There will be one groundwater well (with a second well for 100 percent redundant back-up) and water lines that will provide water to all three plants. The three plants will share access via a realigned Colosseum Road. In addition, each project will have perimeter access/maintenance roads. It is currently anticipated that a portion of the Ivanpah 2 perimeter road will be used for access to Ivanpah 3. The shared facilities will also include an administration building, maintenance facilities and control room for maintenance crew and operators. A 1,400-foot section of electrical poles will carry electrical circuits for both Ivanpah 2 and Ivanpah 3, as the generation tie lines approach the entrance to the substation. These facilities are located between Ivanpah 1 and Ivanpah 2, outside of the fence-line of either plant. These shared facilities will be owned by a single company, Solar Partners IV, LLC, that will hold the BLM ROW for the land for the shared facilities. A single natural gas pipeline will serve all three plants, and all three plants will interconnect to a single new substation.

Section 2.2 describes the Generating Facility Description, Design, and Operation. The project Engineering follows in Section 2.3. Section 2.4 then discusses Facility Closure, followed by a discussion of the applicable laws, ordinances, regulations, and standards (LORS) in Section 2.5.

The proposed project site includes three solar concentrating thermal power plants, based on distributed power tower and heliostat mirror technology, in which heliostat (mirror) fields focus solar energy on power tower receivers near the center of the heliostat array. In each plant, one Rankine cycle reheat steam turbine receives live steam from four solar boilers, and reheat steam from one solar reheater, at the top of its own distributed power tower adjacent to the turbine. The reflecting area of an individual heliostat is about 7.04 square meters. The solar field and power generation equipment are started up each morning after sunrise and insolation build-up, and shut down in the evening when insolation drops below the level required to keep the turbine on line. Main project plant parameters are presented in Table 2.1-1.

TABLE 2.1-1
Primary Project Parameters

Plant	Capacity, Net MW	No. of Heliostats (approx.)	Annual Production, MWH	Utility Interconnection
Ivanpah 1	100 MW	68,000	240,000	SCE 115 kV
Ivanpah 2	100 MW	68,000	240,000	SCE 115 kV
Ivanpah 3	200 MW	136,000	480,000	SCE 115 kV

The plants will be operated and maintained by common crews of operators, working out of an administration and maintenance complex located between Ivanpah 1 and 2.

2.2 Generating Facility Description, Design, and Operation

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

2.2.1 Project Location and Jurisdiction

The proposed site is located in San Bernardino County 4.5 miles southwest of Primm, Nevada, 3.1 miles west of the California-Nevada border (see Figure 2.1-1). The site is located in Township 17N, Range 14E, and Township 16N, Range 14E on land administered by BLM. Solar Partners I, LLC; Solar Partners II, LLC; Solar Partners IV, LLC; and Solar Partners VIII, LLC have filed Form 299 ROW grant applications for use of the land with the BLM Needles office.

Based on the CEC's exclusive jurisdiction for the licensing of thermal powerplants of 50 MW or more and given that the project will be on BLM lands and considered a major federal action under NEPA, the Applicant anticipates that the BLM and Commission's processes will be conducted jointly. The BLM applications cover about 7,040 acres (the Property Boundary); the fenced area for the three plants within the project area (including substation and central administration area) is about 3,400 acres. Access to the site is via the Yates Well Road interchange on I-15 and Colosseum Road (spelling in accordance with Bureau of Land Management map) to the west of the Primm Valley Golf Club.

2.2.2 Process Description

The heliostat (or mirror) fields focus solar energy on the power tower receivers near the center of each of the heliostat arrays. (There are three arrays in the 100-MW plants and four arrays in the 200-MW plant). In each plant, one Rankine-cycle reheat steam turbine receives live steam from the solar boilers and reheat steam from one solar reheater—located in the power block at the top of its own tower (see Figures 2.2-1a-c, 2.2-2a-b, and 2.2-3a-c). The reheat tower is located adjacent to the turbine. Additional heliostats are located outside the power block perimeter road, focusing on the reheat tower. Their locations are not shown on the drawings, because they will be finalized only after power block equipment outlines and elevations are finalized. The solar field and power generation equipment are started each morning after sunrise and insolation build-up, and shut down in the evening when insolation drops below the level required to keep the turbine online.

Each plant also includes a partial-load steam boiler, which will be used for thermal input to the turbine during the morning start-up cycle to assist the plant in coming up to operating temperature more quickly. The boiler will also be operated during transient cloudy conditions, in order to maintain the turbine on-line and ready to resume production from solar thermal input, after the clouds pass. After the clouds pass and solar thermal input resumes, the turbine will be returned to full solar production and the boilers will be shut down.

Each plant uses an air-cooled condenser or dry cooling, to minimize water usage in the site's desert environment. Water consumption is, therefore, minimal—mainly to provide water for washing heliostats. Auxiliary equipment at each plant includes feed water heaters, a deaerator, an emergency diesel generator, and a diesel fire pump.

Ivanpah 1, 2, and 3 will be interconnected to the Southern California Edison (SCE) grid through upgrades to SCE's 115-kilovolt (kV) line passing through the site on a northeast-southwest ROW. These updates will include the construction by SCE of a new 220/115-kV breaker-and-a-half substation between the Ivanpah 1 and 2 project sites. This new substation and the 220-kV upgrades will be for the benefit of Ivanpah and other Interconnection Customers in the region. The existing 115-kV transmission line from the El Dorado substation will be replaced with a double-circuit 220-kV overhead line that will be interconnected to the new substation. Power from Ivanpah 1, 2 and 3 will be transmitted at 115 kV to the new substation. SCE may add three new 115-kV lines to increase capacity to the existing El Dorado-Baker-Cool Water-Dunn Siding-Mountain Pass 115-kV line heading southwest. The timing of this upgrade depends upon the development of wind projects ahead in the interconnection queue, and is not affected by the Ivanpah SEGS project. Figure 2.2-4 shows the recreation areas within 1 mile of the transmission line.

2.2.3 Power Cycle

The plant's power cycle is based on a Rankine cycle turbine with three pressure stage casings. A preliminary heat balance diagram for the 100-MW plant is included in Figure 2.2-5. Primary thermal input is via solar receiver boilers, superheater and reheaters at the top of four distributed power towers. Live superheated steam enters a high pressure turbine casing at 140 bar and 1,004°F (540°C). It leaves the HP casing via two extractions to high pressure preheaters, and is exhausted to a reheat circuit.

The reheat steam is heated in a solar reheater (similar to the solar boiler), at the top of a power tower located in the power block adjacent to the turbogenerator. The reheated steam enters an intermediate pressure turbine casing at 3.5 bar and 896°F (480°C). It leaves the IP casing via two extractions – one to a deaerator and one to a preheater.

The IP exhaust then enters the low-pressure casing at 4.5 bar and 432°F (222°C). Exhaust steam at 0.1265 bar is condensed in an air-cooled condenser.

Condensate is sent from the condenser well through three low pressure preheaters, to the deaerator, which serves also for feedwater reserve storage and is the point of feedwater make-up injection. From the deaerator, high pressure feedwater pumps send feedwater through two high pressure preheaters out to the solar field boilers.

2.2.4 Solar Field, Solar Receiver Boiler, Steam Turbine Generator, and Condenser

Electricity is produced by each plant's Solar Receiver Boiler and the STG. The following sections describe the major components of the generating facility.

2.2.4.1 Solar Field

The heliostat mirrors are arranged around each solar receiver boiler. Each mirror tracks the sun throughout the day and reflects the solar energy to the receiver boiler. The heliostats are 7.2 feet high by 10.5 feet wide (2.20 meters by 3.20 meters) yielding a reflecting surface of 75.6 square feet (7.04 square meters). They are arranged in arcs around the solar boiler towers asymmetrically, as described below.

2.2.4.1.1 100-MW Plant

1. Tower structure height is 262 feet (80 meters)
2. Boiler/superheater panel height is 39 feet (12 meters), with another 10 feet (3 meters) of added height for upper steam drum and protective ceramic insulation panels; overall tower boiler height is therefore 312 feet (95 meters).
3. The first row arc of heliostats has a radius of 164 feet (50 meters).
4. The longest arc radius, 1,970 feet (600 meters), is in the northern section of the heliostat array. This is due to the greater collection efficiency of heliostats in the northern section in the northern hemisphere. With the sun predominantly in the southern sky, the cosine effect of incidence and reflection angles is less in the northern heliostats than in the southern ones. The converse (lower collection efficiency in the southern section) is also true, and, therefore, the maximum southern arc radius is the shortest, 984 feet (300 meters), and the southern heliostat field is the smallest.
5. The eastern sector heliostat energy collection is more valuable than the western sector collection, because afternoon energy collection, during on-peak utility hours, is more valuable than morning energy collection, during part-peak or off-peak hours. The maximum eastern row arc radius (1,640 feet or 500 meters) is therefore greater than the maximum western row arc radius (1,312 feet or 400 meters).

2.2.4.1.2 200-MW Plant

1. Tower structure height is 371 feet (113 meters).
2. Boiler/superheater panel height is 56 feet (17 meters), with another 15 feet (4.5 meters) of added height for upper steam drum and protective ceramic insulation panels; overall tower boiler height is therefore 459 feet (140 meters).
3. The first row arc radius is 164 feet (50 meters) on all sides.
4. Maximum northern sector arc radius is 2,782 feet (848 meters).
5. Maximum southern sector arc radius is 1,391 feet (424 meters).
6. Maximum eastern sector arc radius is 2,320 feet (707 meters).
7. Maximum western sector arc radius is 1,857 feet (566 meters).
8. Reasons for arc radius distribution per sectors are identical to those of the 100-MW plant

Solar boilers are similar to those for the 100-MW plant, with appropriate scaling.

2.2.4.2 Steam Turbine Generator

The steam turbine system consists of a condensing steam turbine generator (STG) with reheat, gland steam system, lubricating oil system, hydraulic control system, and steam admission/induction valving. HP and IP steam from the superheater receiver enters the associated steam turbine sections through the inlet steam system. The steam expands through multiple stages of the turbine, driving the generator. On exiting the LP turbine, the steam is directed into the surface condenser.

2.2.5 Major Electrical Equipment and Systems

The bulk of the electric power produced by the facility will be transmitted to the grid. A small amount of electric 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 power will also be converted from alternating current (AC) to direct current (DC), which will be used as backup power for control systems and 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 three STGs at 19 kV (hydrogen cooled) and then stepped up by transformers for transmission to the grid. The plants will connect to the utility at 115 kV. Surge arresters will be provided at the high-voltage bushings to protect the transformers from surges on the system caused by lightning strikes or other system disturbances. The transformers will be set on concrete pads within containments designed to contain the transformer oil in the event of a leak or spill. Fire protection systems will be provided for the transformers. The high-voltage side of the step-up transformers will be connected to each plant's switchyard. From the switchyard, power will be transmitted via a 115-kV transmission line to the substation.

A detailed discussion of the transmission system is provided in Section 3 of the AFC.

2.2.5.2 AC Power—Distribution to Auxiliaries

Auxiliary power to the steam turbine power block will be supplied at 4,160 volts AC by a double-ended 4,160-volt switchgear lineup. The oil-filled, 19-to-4.16-kV unit auxiliary stepdown transformers will supply primary power to the switchgear. The high-voltage side (19 kV) of the unit auxiliary transformers will be connected to the outputs of each of the three STGs. This connection will allow the switchgear to be powered from any of the three generators or by back-feeding power from the switchyard through the Station Auxiliary Transformer. Low-voltage side (19-kV) generator circuit breakers will be provided for the STGs. These circuit breakers are used to isolate and synchronize the generators, and will be located between the generators and the connections to the transformers. The 4,160-volt switchgear lineup supplies power to the various 4,160-volt motors, and to the load center (LC) transformers, rated 4,160 to 480 volts, for 480-volt power distribution. The switchgear will have vacuum interrupter circuit breakers for the main incoming feeds and for power distribution.

The LC transformers will be oil-filled, each supplying 480-volt, 3-phase power to the double-ended load centers.

The load centers will provide power through feeder breakers to the various 480-volt motor control centers (MCCs). The MCCs will distribute power to 480-volt motors, to 480-volt power distribution panels, and lower voltage lighting and distribution panel transformers. Power for the AC power supply (120-volt/208-volt) system will be provided by the 480-volt MCCs and 480-volt power panels. 480-120/208-volt dry-type transformers will provide transformation of 480-volt power to 120/208-volt power.

2.2.5.3 125-Volt DC Power Supply System

One common 125-volt DC power supply system consisting of one 100 percent capacity battery bank, two 100 percent static battery chargers, a switchboard, and two or more distribution panels will be supplied for balance-of-plant and STG equipment.

Under normal operating conditions, the battery chargers supply DC power to the DC loads. The battery chargers receive 480-volt, three-phase AC power from the AC power supply (480-volt) system and continuously charge the battery banks while supplying power to the DC loads.

Under abnormal or emergency conditions, when power from the AC power supply (480-volt) system is unavailable, the batteries supply DC power to the DC system loads. Recharging of a discharged battery occurs whenever 480-volt power becomes available from the AC power supply (480-volt) system. The rate of charge depends on the characteristics of the battery, battery charger, and the connected DC load during charging. The anticipated maximum recharge time will be 12 hours.

The 125-volt DC system will also be used to provide control power to the 115- and 220-kV generator breakers, 4,160-volt switchgear, to the 480-volt LCs, to critical control circuits, and to the emergency DC motors.

2.2.5.4 Uninterruptible Power Supply System

The steam turbine power block will also have an essential service 120-volt AC, single-phase, 60-hertz (Hz) uninterruptible power supply (UPS) to supply AC power to essential instrumentation to critical equipment loads and to unit protection and safety systems that require uninterruptible AC power. A UPS system in the power block will also back up critical 4,160-volt AC loads in the feeding solar boiler tower equipment.

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

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

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

The distributed control system (DCS) operator stations will be supplied from the UPS. The continuous emission monitoring (CEM) equipment, DCS controllers, and input/output (I/O) modules will be fed using either UPS or 125-volt DC power directly.

2.2.6 Fuel System

Natural gas supply for Ivanpah SEGS will connect to the Kern River Gas Transmission Company (KRGT) pipeline about 0.5 miles north of the Ivanpah 3 site. However, KRGT is not a natural gas retailer. Current plans are for gas supply to be obtained from Southwest Gas Company, which has completed a preliminary estimate for the required facilities. It is possible that the applicant could seek gas supply directly from KRGT shippers currently holding transmission capacity on KRGT. Were this option pursued, the required ROW and physical facilities would be the same.

For each plant, the physical facilities of the natural gas line, starting at the tap station on the main KRGT transmission pipeline are: a 1.4-mile, 6-inch pipeline to a fenced metering set at Ivanpah 3; from there a 3.8-mile, 4-inch pipeline that will pass through Ivanpah 2 ending at Ivanpah 1. There will be fenced metering sets at Ivanpah 1 and 2. The new 4- to 6-inch gas pipeline will extend south from the KRGT pipeline tap point through the Ivanpah 3 and Ivanpah 2 sites to the power block of the Ivanpah 1 site. The total distance from the tap point to the Ivanpah 1 power block is about 5.3 miles

A gas-metering station will be required at the KRGT tap point to measure and record gas volumes. In addition, facilities will be installed to regulate the gas pressure and to remove any liquids or solid particles. The metering station will require a minimum area of approximately 50 feet by 150 feet. In addition, the three plant metering sets will require a fenced enclosure of approximately 10 feet by 30 feet.

Construction activities related to the metering station and metering sets will include grading a pad and installing above- and belowground gas piping, metering equipment, gas conditioning, pressure regulation, and possibly pigging facilities. A distribution power line for metering-station-operation lighting, communication equipment, and perimeter chain-link fencing for security will also be installed.

2.2.7 Water Supply and Use

This subsection describes the quantity of water required, the sources of the water supply, and water treatment requirements. A water balance diagram for the 100-MW plant is included as Figure 2.2-6 (the 200-MW plant would have the same process with twice the volumes).

Raw water will be drawn daily from one of two wells, located east of Ivanpah 2. To reduce impacts on the land and provide operating efficiencies, the wells will provide water to all three plants. These wells and a portion of one water line are shared facilities owned by Solar Partners IV, LLC. The complete 400-MW Ivanpah SEGS will require up to 46 gallons per minute (gpm) raw water make-up which will be drawn from the wells and distributed to the plants via underground HDPE or PVC pipe.

Each plant will have a raw water tank with a capacity of 250,000 gallons. A portion of the raw water (100,000 gallons) is for plant use while the majority will be reserved for fire water.

The Ivanpah SEGS will operate an average of about 10 hours a day, 7 days a week throughout the year, with the exception of a scheduled shutdown in late December for maintenance. However, the water treatment plant will operate continuously, in order to minimize water treatment system size and capital cost, and to use off-peak energy at night.

A more detailed description of the water supply system, treatment, and permits is provided in AFC Section 5.15, Water Resources.

2.2.7.1 Water Requirements

A breakdown of the estimated average daily quantity of water required for operation of Ivanpah 1, 2 and 3, is presented in Table 2.2-1. The daily water requirements shown are estimated quantities based on the plant operating at full load.

TABLE 2.2-1
Average Daily Water Requirements with All 3 Plants in Operation

Water Use	Average Daily Use (gpm)	Annual Use (ac-ft/yr)
Process and heliostat wash	46	75*
Potable water service	1.8	3

* ac-ft/yr = acre-feet per year (based on an annual operation of 3,650 hours/year at full plant output)

2.2.7.2 Water Supply

The plants use air-cooled condensers to save water in the site's desert environment. Water consumption is, therefore, minimal—mainly to replace boiler feedwater blowdown and provide water for washing heliostats. The latter is required in a washing cycle of 2 weeks, during which all heliostats are washed, to maintain them at full performance. Because of dust created during site grading, this washing cycle may be more frequent (but not likely more than double) when one plant is operating and another is being graded. Thus, for the first few months of construction of the second plant, the first plant could use up to 50 ac-ft/yr of water. Similar water use will occur for the first two plants during construction of the third plant.

2.2.7.3 Water Quality

Section 5.15, Water Resources, includes a projection of the water quality based on data from the wells that serve Primm Golf Club. The project wells are farther west, away from the dry lake, and therefore, expected to have equal or better quality water than the golf club wells.

2.2.7.4 Water Treatment

The main water treatment subsystems will be supplied by a water treatment specialty company, and will include for following components.

2.2.7.4.1 Granular Activated Carbon Filters

The granular activated carbon (GAC) filters will be periodically replaced by the treatment company and backwashed offsite. Alum injection will be included before the GAC inlet.

2.2.7.4.2 De-Ionization Trailer

A company will supply a trailer containing de-ionization media and columns to make de-ionized water. When the media have been exhausted, the water treatment company will replace the trailer and re-charge the de-ionization media offsite. After filtration and de-ionization, the water is stored in the de-ionized water tank.

2.2.7.4.3 Mixed Bed

In the mixed bed, de-ionized water is polished to boiler feedwater quality and stored in the boiler make-up storage tank, from which it is withdrawn and injected into the Deaerator tank, as required to maintain feedwater volume. The mixed bed is also periodically replaced and regenerated offsite by the water treatment system vendor.

2.2.7.4.4 Drying Beds

No reject streams from water treatment are planned to be generated onsite under the planned treatment scheme. However, for current planning purposes, two concrete-lined drying beds of about 40 feet by 60 feet are included in the power block. They can be used on a temporary basis for boiler commissioning and emergency outfalls from any of the processes.

2.2.8 Plant Cooling Systems

The cycle heat rejection system will consist of an air-cooled steam condenser system. The heat rejection system will receive exhaust steam from the low-pressure section of the steam turbine and feed water heaters and condense it back to water for reuse. The condenser will be designed to normally operate at a pressure of about 2.5 inches of mercury. The condenser will remove heat from the condensing steam up to a maximum of 1,193 MMBtu/hr (1,259x10^3 MJ/hr), depending on ambient temperature and plant load.

2.2.9 Waste Management

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

2.2.9.1 Wastewater Collection, Treatment, and Disposal

The primary wastewater collection system will collect process wastewater from all of the plant equipment, including the boilers and water treatment equipment. To the extent practical, process wastewater will be recycled and reused. Each plant includes a small package sewage system for potable water streams, including showers and toilet. When needed, sewage sludge will be removed from site by a sanitary service. Treated wastewater from the package sewage treatment plant will be used to maintain local landscaping.

2.2.9.1.1 Plant Drains and Oil/Water Separator

General plant drains will collect containment area washdown, sample drains, and drainage from facility equipment drains. Water from these areas will be collected in a system of floor drains, hub drains, sumps, and piping and routed to the wastewater collection system. Drains that potentially could contain oil or grease will first be routed through an oil/water separator. Water from the plant wastewater collection system will be returned back into the raw water storage tank.

2.2.9.1.2 Power Cycle Makeup Water Treatment Wastes

Distillate from the mixed bed system will be used as the feed water for the power cycle makeup treatment system. The mixed bed unit will be a self-contained skid mounted unit. Drains from the water treatment equipment will be routed to the raw water storage tank.

2.2.9.1.3 Boiler Blowdown

Boiler blowdown will consist of boiler water discharged from each receiver boiler to control the concentration of dissolved solids and silica within acceptable ranges. Boiler blowdown will be discharged to flash tanks. Steam will be condensed and the condensate cooled. During the day, when the power plant operates, boiler feedwater is made-up and blown down at a rate of 6 m^3/hr. Blowdown will be used for mirror washing. Out of the blowdown, 6.2 gpm is flashed to steam and returned to the feedwater cycle via the Deaerator. The remaining 20.3 gpm of blowdown is returned to the raw water tank. Well pumps will operate continuously pumping 11 gpm into the raw water tank until the tank is full and the pumps automatically shut down.

2.2.9.2 Solid Wastes

Ivanpah SEGS 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 solid wastes, including the typical refuse generated by workers. Solid wastes will be trucked offsite for recycling or disposal (see Section 5.14, Waste Management).

2.2.9.3 Hazardous Wastes

Several methods will be used to properly manage and dispose of hazardous wastes generated by Ivanpah SEGS. 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. Workers will be trained to handle hazardous wastes generated at the site.

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

2.2.10 Management of Hazardous Materials

There will be a variety of chemicals stored and used during construction and operation of Ivanpah SEGS. The storage, handling, and use of all chemicals will be conducted in accordance with applicable LORS. Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals will be stored in storage tanks, and most other chemicals will be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills. Concrete containment pits and drain piping design will allow a full-tank capacity spill without overflowing the containment. For multiple tanks located within the same containment area, the capacity of the largest single tank will determine the volume of the containment area and drain piping. Drain piping for reactive chemicals will be trapped and isolated from other drains to eliminate noxious or toxic vapors.

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

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

2.2.11 Emission Control and Monitoring

Air emissions from the combustion of natural gas in the start-up boiler will be controlled using state of-the-art systems. To ensure that the systems perform correctly, continuous emissions monitoring for NO_x and CO will be performed. Section 5.1, Air Quality, includes additional information on emission control and monitoring.

2.2.11.1 NO_x Emission Control

The boiler will be provided with a Natcom low-NO_x burner and 20 percent flue gas recirculation, to guarantee maximum NO_x emission of 9 ppm (0.012 lb/MMBtu), which complies with the NSPS NO_x standard of 0.2 lb/MMBtu.

2.2.11.2 Particulate Emission Control

Particulate emissions will be controlled by the use of best combustion practices, the use of natural gas, which is low in sulfur, as the sole fuel for the boilers, and high efficiency air inlet filtration.

2.2.11.3 Continuous Emission Monitoring

For each gas-fired boiler, a separate CEMS will sample, analyze, and record fuel gas flow rate, NO_x and CO concentration levels, and percentage of O_2 in the exhaust gas from the boiler stacks. The CEMS will transmit data to a data acquisition system (DAS) that will store the data and generate emission reports in accordance with permit requirements. The DAS will also include alarm features that will send signals to the plant DCS when the emissions approach or exceed pre-selected limits.

2.2.12 Fire Protection

The fire protection system will be designed to protect personnel and limit property loss and plant downtime in the event of a fire. The primary source of fire protection water will be the raw water storage tank.

An electric jockey pump and electric-motor-driven main fire pump will be provided to increase the water pressure in the plant fire main to the level required to serve all fire fighting systems. In addition, a back-up diesel engine-driven fire pump will be provided to pressurize the fire loop if the power supply to the electric-motor-driven main fire pump fails. A fire pump controller will be provided for each fire pump.

The fire pump will discharge to a dedicated underground firewater loop piping system. Normally, the jockey pump will maintain pressure in the firewater loop. Both the fire hydrants and the fixed suppression systems will be supplied from the firewater loop. Fixed fire suppression systems will be installed at determined fire risk areas such as the transformers and turbine lube oil equipment. Sprinkler systems will also be installed in the Administration/Control/Warehouse/Maintenance Building and Fire Pump enclosure as required by National Fire Protection Association (NFPA) and local code requirements. Handheld fire extinguishers of the appropriate size and rating will be located in accordance with NFPA 10 throughout the facility.

Section 5.5, Hazardous Materials Handling, includes additional information for fire and explosion risk, and Section 5.10, Socioeconomics, provides information on local 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 provides personnel with illumination for operation under normal conditions and for egress under emergency conditions, and includes emergency lighting to perform manual operations during an outage of the normal power source. The system also provides 120-volt AC convenience outlets for portable lamps and tools.

2.2.13.2 Grounding

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

The station grounding grid will be designed for adequate capacity to dissipate the ground fault current from the ground grid under the most severe conditions in areas of high ground fault current concentration. The grid spacing will maintain safe voltage gradients.

Bare conductors will be installed below-grade in a grid pattern. Each junction of the grid will be bonded together by an exothermic weld.

Ground resistivity readings will be used to determine the necessary numbers of ground rods and grid spacing to ensure safe step and touch potentials under severe fault conditions.

Grounding conductors will be brought from the ground grid to connect to building steel and non-energized metallic parts of electrical equipment.

2.2.13.3 Distributed Control System

The DCS provides modulating control, digital control, monitoring, and indicating functions for the plant power block systems. The following functions will be provided:

- Controlling the STG, boilers, heliostat mirrors, 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 delivery of this information to plant operators

- Providing control displays (printed logs, LCD video monitors) for signals generated within the system or received from I/O
- Providing consolidated plant process status information through displays presented in a timely and meaningful manner
- Providing alarms for out-of-limit parameters or parameter trends, displaying on alarm video monitors(s), and recording on an alarm log printer
- Providing storage and retrieval of historical data

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

- Personal Computer (PC)-based operator consoles with liquid-crystal diode (LCD) video monitors
- 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 DCS will have a functionally distributed architecture comprising a group of similar redundant processing units linked to a group of operator consoles and the engineer workstation by redundant data highways. Each processor will be programmed to perform specific dedicated tasks for control information, data acquisition, annunciation, and historical purposes. By being redundant, no single processor failure can cause or prevent a unit trip.

The DCS will interface with the control systems furnished by heliostat mirror and STG 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, as well as 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 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.

2.2.13.6 Instrument Air

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

2.2.14 Interconnect to Electrical Grid

Ivanpah 1, 2, and 3 will be interconnected to the SCE grid through an upgraded SCE 115-kV line passing through the site on a northeast-southwest ROW (see AFC Figure 3.1-1). SCE has developed a service plan to interconnect six projects and allow for future growth. SCE's service plan will include: (1) the construction by SCE of a new 220-kV/115-kV breaker-and-a-half substation between the Ivanpah 1 and Ivanpah 2 project sites (called the Ivanpah Substation); (2) the replacement of the existing 115-kV transmission line from the El Dorado Substation with a double-circuit 220-kV overhead line that will be interconnected to the new substation; (3) the potential construction of a double-circuit 115-kV line and the addition of a circuit to the existing pole line to increase the capacity of the existing El Dorado-Baker-Cool Water-Dunn Siding-Mountain Pass 115-kV line heading southwest; and (4) a new Wheaton Substation for the interconnection of a proposed wind powered generation plant. This new Ivanpah Substation and system upgrades will be for the benefit of Ivanpah SEGS and other interconnecting customers in the region, as well as future growth. The Ivanpah Substation and 220-kV upgrade will be completed before the Ivanpah SEGS comes on line; the timing of the 115-kV upgrade between Ivanpah Substation and the Mountain Pass Substation will depend on the development of other generation projects ahead in the queue. Power from each Ivanpah plant will be interconnected to the California Independent System Operator (CAISO) grid via 115-kV generator tie lines (gen-tie lines) to the new Ivanpah Substation. The design of the Ivanpah Substation and associated line upgrades will be performed by SCE and is analyzed conceptually from input provided by SCE based on the requirements of Ivanpah and other generation projects in the queue, as well as future load growth requirements. Figure 2.2-7 is a single line diagram of the plant transmission system. Interconnection is discussed in more detail in Section 3.0, Transmission System Engineering.

2.2.15 Project Construction

Construction of the generating facility, from site preparation and grading to commercial operation, is expected to take place from the First Quarter of 2009 to the Fourth Quarter of 2012 (48 months total). Major milestones are listed in Table 2.2-2; however, the construction order may change. Construction of the shared facilities would occur with the construction of the first plant.

TABLE 2.2-2
Project Schedule Major Milestones

Activity	Date
Phase 1 (Ivanpah 1)	
Begin construction	First Quarter 2009
Startup and test	Fourth Quarter 2010
Commercial operation	Fourth Quarter 2010
Phase 2 (Ivanpah 2)	
Begin construction	First Quarter 2010
Startup and test	Fourth Quarter 2011
Commercial operation	Fourth Quarter 2011
Phase 3 (Ivanpah 3)	
Begin construction	First Quarter 2011
Startup and test	Fourth Quarter 2012
Commercial operation	Fourth Quarter 2012

There will be an average and peak workforce of approximately 474 and 959, respectively, of construction craft people, supervisory, support, and construction management personnel onsite during construction. The peak construction site workforce level is expected to occur in Month 32.

Typically, construction will be scheduled to occur between 5 a.m. and 7 p.m. on weekdays and Saturdays. Additional hours may be necessary to make up schedule deficiencies, or to complete critical construction activities (e.g., pouring concrete at night during hot weather, working around time-critical shutdowns and constraints). During some construction periods and during the startup phase of the project, some activities will continue 24 hours per day, 7 days per week.

Table 2.2-3 provides an estimate of the average and peak construction traffic during the 48-month construction period for the plant and associated linear facilities.

TABLE 2.2-3
Average and Peak Construction Traffic

Vehicle Type	Average Daily Trips	Peak Daily Trips
Construction Workers	19 buses + 95 personal vehicles	39 buses + 192 personal vehicles
Deliveries	62	145
Total	**176**	**376**

The construction laydown and parking area will occupy those areas of the plant sites that are outside the edges of the heliostat fields (see Figure 2.1-2). Construction access will generally be from Colosseum Road to the plant entrance road. Materials and equipment will be delivered by truck

2.2.16 Generating Facility Operation

Management, engineering, administrative staff, skilled workers, and operators will serve multiple plants. Ivanpah SEGS is expected to employ up to 90 full-time employees: 35 with Ivanpah 1, 20 with Ivanpah 2, and 35 with Ivanpah 3. The facility will be operated 7 days a week, 14 hours per day.

Long-term maintenance schedules are currently unavailable in detail, but will include periodic maintenance and overhauls in accordance with manufacturer recommendations. Solar field component replacement rates are anticipated to be 0.5 percent per year, on average. Most unskilled labor demand includes 12 hours of nightly mirror washing, covering the entire solar field over a period of 2 weeks, to maintain heliostat performance degradation below 3 percent.

Ivanpah SEGS is expected to have an annual plant availability of 92 to 98 percent. It will be possible for plant availability to exceed 98 percent for a given 12-month period.

The facility may be operated in one of the following modes:

- The facility would be operated at its maximum continuous output for as many hours per year as thermal input allows.
- A full shutdown will occur if forced by equipment malfunction, transmission line disconnect, or scheduled maintenance.

2.3 Engineering

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

2.3.1 Facility Design

A detailed description of the Ivanpah SEGS project is provided in Section 2.2, Generating Facility Description, Design, and Operation. Design for safety is provided in Section 2.3.1.1, Facility Safety Design. Appendix 5.4A contains a Geotechnical Report for the Ivanpah SEGS site based on borings taken at the project site.

Descriptions of the design criteria are included in the following appendices:

- Appendix 2A, Civil Engineering Design Criteria
- Appendix 2B, Structural Engineering Design Criteria
- Appendix 2C, Mechanical Engineering Design Criteria
- Appendix 2D, Electrical Engineering Design Criteria

- Appendix 2E, Control Engineering Design Criteria
- Appendix 2F, Chemical Engineering Design Criteria
- Appendix 2G, Geologic and Foundation Design Criteria

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

- **Power Generation**—See Section 2.2.4, Steam Turbine Generators (STGs), Boilers, and Condenser. Also see Appendix 2C and Section 2.2.5 through 2.2.13, which describe the various plant auxiliaries.

- **Heat Dissipation**—See Section 2.2.8, Plant Cooling Systems, and Appendix 2C.

- **Air Emission Control System**—See Section 2.2.11, Emission Control and Monitoring, and Section 5.1, Air Quality.

- **Waste Disposal System**—See Section 2.2.9 and Section 5.14, Waste Management.

- **Noise Abatement System**—See Section 5.7, Noise.

- **Switchyards/Transformer Systems**—See Section 2.2.5, Major Electrical Equipment and Systems; Section 2.2.13.2, Grounding; Section 2.2.5.1, AC Power-Transmission; Section 2.2.14, Interconnect to Electrical Grid; Section 3.0, Electric Transmission; and Appendix 2D.

2.3.1.1 Facility Safety Design

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

2.3.1.1.1 Natural Hazards

The principal natural hazard associated with the project site is earthquakes. The site is located in UBC Seismic Risk Zone 3. Structures will be designed to meet the seismic requirements of CCR Title 24 and the 2001 California Building Code (CBC). Section 5.4, Geologic Hazards and Resources, includes a review of potential geologic hazards, seismic ground motion, and potential for soil liquefaction due to ground-shaking. Potential seismic hazards will be mitigated by implementing the 2001 CBC construction guidelines. Appendix 2B, Structural Engineering, includes the structural seismic design criteria for the buildings and equipment.

Flooding is not a hazard of concern at the Ivanpah SEGS site. According to the Federal Emergency Management Agency (FEMA), the site is not within either the 100- or 500-year flood plain. Section 5.15, Water Resources, includes additional information on the potential for flooding.

2.3.1.1.2 Emergency Systems and Safety Precautions

This subsection discusses the fire protection systems, emergency medical services, and safety precautions to be used by project personnel. Section 5.10, Socioeconomics, includes additional information on area medical services, and Section 5.16, Worker Safety, includes additional information on safety for workers. Appendices 2A through 2G contain 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 are designed to protect personnel and limit property loss and plant downtime from fire or explosion. The project will have the following fire protection systems.

<u>Steam Turbine Lube Oil Areas Water Spray System.</u> This system provides suppression for the steam turbine area lube oil piping and lube oil storage.

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

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

Local Fire Protection Services

Ivanpah SEGS is within the jurisdiction of San Bernardino County Station #53 in Baker, California, which provides fire services in the area to the state border. Their approximate response time is 45 minutes. Station #53 has a Type 1 engine and a brush patrol vehicle. They have 3 staff on duty at all times (1 captain, 1 engineer, and 1 firefighter). San Bernardino County Fire Department also has a Mutual Aid Agreement with Clark County (Nevada) Fire Department for responses requiring more assistance.

The Hazardous Materials Risk Management Plan (see Section 5.5, Hazardous Materials Handling) for the plant will include all information necessary to allow fire-fighting and other emergency response agencies to plan and implement safe responses to fires, spills, and other emergencies.

Personnel Safety Program

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

2.3.2 Facility Reliability

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

2.3.2.1 Facility Availability

Because of the Ivanpah SEGS system needs, it is anticipated that the facility will normally operate at high average annual capacity factors during periods of sunlight.

Ivanpah SEGS will be designed for an operating life of 50 years. Reliability and availability projections are based on this operating life. Operation and maintenance procedures will be consistent with industry standard practices to maintain the useful life status of plant components.

The percent of time that the power plants are projected to be operated is defined as the service factor. The service factor considers the amount of time that a unit is operating and generating power, whether at full or partial load. The projected service factor for the power block, which considers projected percent of time of operation, differs from the equivalent availability factor (EAF), which considers the projected percent of energy production capacity achievable.

The EAF may be defined as a weighted average of the percent of full energy production capacity achievable. The projected equivalent availability factor for the Ivanpah SEGS is estimated to be approximately 92 to 98 percent.

The EAF, which is a weighted average of the percent of energy production capacity achievable, differs from the availability of a unit, which is the percent of time that a unit is available for operation, whether at full load, partial load, or standby.

2.3.2.2 Redundancy of Critical Components

The following subsection identifies equipment redundancy as it applies to project availability. A summary of equipment redundancy is shown in Table 2.3-1. Final design could differ.

TABLE 2.3-1
Major Equipment Redundancy

Description	Number	Note
Solar Receiver Boilers	Three trains – Ivanpah 1 & 2 Four trains – Ivanpah 3	Steam turbine bypass system allows all boiler trains to operate at base load with the steam turbine out of service for 30 seconds until heliostat defocusing.
Solar boiler Superheater	Three – One per plant	See note above pertaining to Solar Receiver Boilers.
STG	Three – One per plant	See note above pertaining to Solar Receiver Boilers.
Boiler feedwater pumps	One – 100 percent per boiler	One spare for all Solar Receiver Boilers.
Condensate pumps	Three – 50 percent capacity per plant	—
Condenser	One per plant	Condenser must be in operation for plant operation or operation of boilers in steam turbine bypass mode. The condenser will be provided with split water boxes to allow online tube cleaning and repair.

TABLE 2.3-1
Major Equipment Redundancy

Description	Number	Note
Circulating water pumps	Two – 60 percent capacity per receiver-boiler	The facility may operate at reduced load with one of the two circulating water pumps in service.
Fuel gas booster compressors	One – 100 percent capacity per plant	
Demineralizer system	One – 100 percent capacity per plant	

2.3.2.2.1 Power Block

Ivanpah 1 and 2 will have three separate boiler steam generation trains and Ivanpah 3 will have four separate trains that will operate in parallel. Thermal energy from the steam generation system will be converted to mechanical energy, and then electrical energy in the STG. The expanded steam from the STG will be condensed and recycled to the feedwater system.

The major components of the combined-cycle power block are described below. The power block is served by the balance-of-plant systems described in Section 2.3.2.2.2.

Steam Generation Subsystems

The steam generation subsystems consist of the receiver boiler and blowdown systems. The receiver boilers collect solar energy from the heliostat mirrors and transfer it to feedwater for steam production. This heat transfer produces steam at the pressures and temperatures required by the steam turbine. The blowdown system maintains feedwater quality. The system includes safety and auto relief valves and processing of continuous and intermittent blowdown streams.

Steam Turbine Generator Subsystems

The steam turbine converts the thermal energy in the steam to mechanical energy to drive the STG. The basic subsystems include the steam turbine and auxiliary systems, turbine lube oil system, and generator/exciter system. The generator will be hydrogen cooled.

2.3.2.2.2 Distributed Control System

The DCS will be a redundant microprocessor-based system that will provide the following functions:

- Control the Heliostat mirrors, STG, 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 DCS will have functionally distributed architecture comprising a group of similar redundant processing units linked to a group of operator consoles and an engineer workstation by redundant data highways. Each processor will be programmed to perform specific dedicated tasks for control information, data acquisition, annunciation, and historical purposes.

Plant operation will be controlled from the operator panel located in the control room. The operator panel will consist of two individual video/keyboard consoles and one engineering workstation. Each video/keyboard console will be an independent electronic package so that failure of a single package does not disable more than one video/keyboard. The engineering workstation will allow the control system operator interface to be revised by authorized personnel.

2.3.2.2.3 Boiler Feedwater System

The boiler feedwater system transfers feedwater from the LP steam turbine to the solar receiver boilers. The system will consist of two pumps, each pump sized for 100 percent capacity for supplying all boilers. The pump will be multistage, horizontal, motor-driven with intermediate bleed-off, and will include regulating control valves, minimum flow recirculation control, and other associated piping and valves. One 100 percent capacity spare pump will be available for all boilers.

2.3.2.2.4 Condensate System

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

2.3.2.2.5 Demineralized Water System

The demineralized water system will consist of a filter and demineralizer train from an onsite water treatment system consisting of activated carbon filters, de-ionization columns, and a mixed bed polisher. The unit will be a self-contained trailer-mounted unit. Demineralized water will be stored in a 25,000-gallon demineralized water storage tank; boiler feedwater make-up water will be stored in another 25,000-gallon tank.

2.3.2.2.6 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 and chemical cleaning operations. Major components of the system are the demineralized water storage tank, providing for more than a 14-hour supply of demineralized water at peak load, and two 100-percent capacity, horizontal, centrifugal, cycle makeup water pumps.

2.3.2.2.7 Compressed Air

The compressed air system provides instrument air and service air to points of use throughout the facility. The compressed air system will include two 100-percent capacity motor-driven air compressors, two air dryers with prefilters and after filters, an air receiver, instrument air header, and service air header. All instrument air will be dried. A control valve will be provided in the service air header to prevent high consumption of service air from reducing the instrument air header pressure below critical levels.

2.3.2.3 Fuel Availability

Natural gas will be delivered via pipeline as described above and in Section 4.0, Gas Supply.

2.3.2.4 Water Availability

The project will use up to 100 ac-ft/yr of well water for general process use. The boiler blowdown will be flashed into steam and condensate and the remaining water will be used to wash mirrors.

Potable water for drinking, safety showers, fire protection water, service water, and sanitary uses will be served from the onsite wells and treated appropriately.

The availability of water to meet the needs of Ivanpah SEGS is discussed in more detail in Section 5.15, Water Resources.

2.3.2.5 Project Quality Control

The Quality Control Program that will be applied to Ivanpah SEGS is summarized in this section. The objective of the Quality Control Program is to ensure that all systems and components have the appropriate quality measures applied; whether it be during design, procurement, fabrication, construction, or operation. The goal of the Quality Control Program is to achieve the desired levels of safety, reliability, availability, operability, constructability, and maintainability for the generation of electricity.

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

2.3.2.5.1 Project Stages

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

- **Conceptual Design Criteria.** Activities such as definition of requirements and engineering analyses.
- **Detail Design.** Activities such as the preparation of calculations, drawings, and lists needed to describe, illustrate, or define systems, structures, or components.
- **Procurement Specification Preparation.** Activities necessary to compile and document the contractual, technical, and quality provisions for procurement specifications for plant systems, components, or services.
- **Manufacturer’s Control and Surveillance.** Activities necessary to ensure that the manufacturers conform to the provisions of the procurement specifications.
- **Manufacturer Data Review.** Activities required to review manufacturers’ drawings, data, instructions, procedures, plans, and other documents to ensure coordination of plant systems and components, and conformance to procurement specifications.

- **Receipt Inspection.** Inspection and review of product at the time of delivery to the construction site.
- **Construction/Installation.** Inspection and review of storage, installation, cleaning, and initial testing of systems or components at the facility.
- **System/Component Testing.** Actual operation of generating facility components in a system in a controlled manner to ensure that the performance of systems and components conform to specified requirements.
- **Plant Operation.** As the project progresses, the design, procurement, fabrication, erection, and checkout of each generating facility system will progress through the nine stages defined above.

2.3.2.5.2 Quality Control Records

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

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

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

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

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

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

2.4 Facility Closure

Facility closure can be temporary or permanent. Temporary closure is defined as a shutdown for a period exceeding the time required for normal maintenance, including closure for overhaul or replacement of the steam turbine. Causes for temporary closure include a disruption in the supply of natural gas or damage to the plant from earthquake, fire, storm, or other natural acts. Permanent closure is defined as a cessation in operations with no intent to restart operations owing to plant age, damage to the plant beyond repair, economic conditions, or other reasons. Section 2.4.1 discusses temporary facility closure; Section 2.4.2 discusses permanent facility closure.

2.4.1 Temporary Closure

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

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

2.4.2 Permanent Closure

When the facility is permanently closed, the closure procedure will follow a plan that will be developed as described below.

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

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

- Proposed decommissioning activities for the facility and all appurtenant facilities constructed as part of the facility
- Conformance of the proposed decommissioning activities to all applicable LORS and local/regional plans
- Activities necessary to restore the site if the plan requires removal of all equipment and appurtenant facilities

- Decommissioning alternatives other than complete restoration
- Associated costs of the proposed decommissioning and the source of funds to pay for the decommissioning

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

2.5 Laws, Ordinances, Regulations, and Standards

The LORS in Section 2.5.1 are generally applicable to the engineering aspects of the project. The applicable local LORS involved in administration and enforcement are described in Section 2.5.2. LORS for the environmental aspects are provided in each of their subsections in Section 5 of the AFC.

2.5.1 General Laws, Ordinances, Regulations, and Standards

- California Building Standards Code—2001
- Uniform Fire Code, Article 80
- Occupational Safety and Health Act—29 CFR 1910 and 29 CFR 1926
- Environmental Protection Agency—40 CFR 60, 40 CFR 75, 40 CFR 112, 40 CFR 302, 40 CFR 423, 40 CFR 50, 40 CFR 100, 40 CFR 260, 40 CFR 300, and 40 CFR 400
- California Code of Regulations—Title 8, Sections 450 and 750 and Title 24, 2001, Titles 14, 17, 19, 20, 22, 23, 26, and 27
- California Department of Transportation—Standard Specifications
- California Occupational Safety and Health Administration—Regulations and Standards
- California Business and Professions Code—Sections 6704, 6730, and 6736
- California Vehicle Code—Section 35780
- California Labor Code—Section 6500
- Federal Aviation Agency—Obstruction Marking and Lighting AC No. 70/7460-1H

Codes and standards pertinent to the generating facility are presented in Engineering Appendices 2A through 2F.

2.5.2 Local LORS

The Ivanpah SEGS site zoning is consistent with the development of a solar energy facility (see Section 5.6, Land Use). The site is located on land designated L and M in the California Desert Conservation Area Plan; this designation envisions solar energy development.

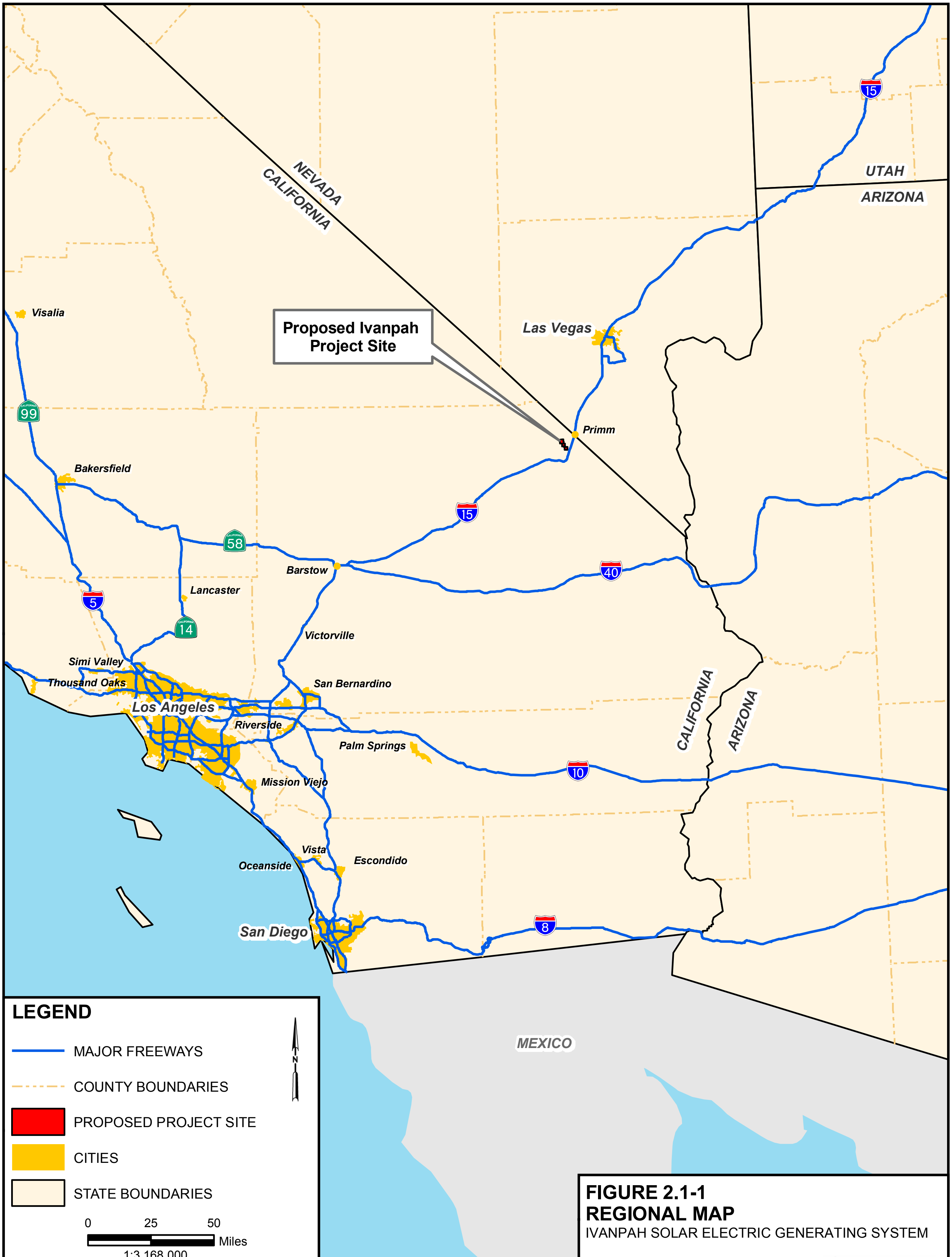

FIGURE 2.1-1
REGIONAL MAP
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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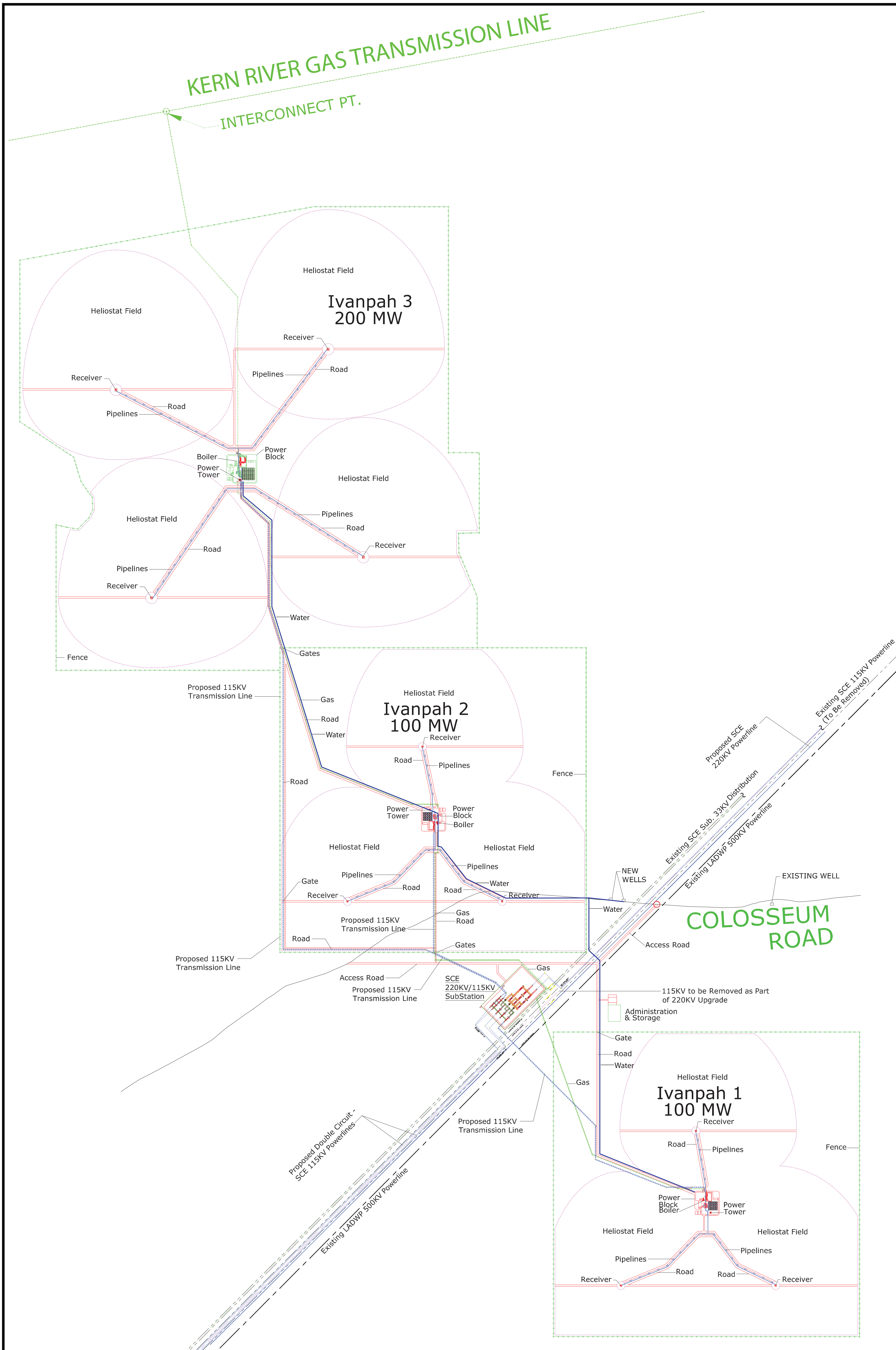

SOURCE: LUZ II DRAWING NO. 01-GE-D-D-003
REVISION L

FIGURE 2.1-2
SITE PLAN AND LINEAR FACILITIES
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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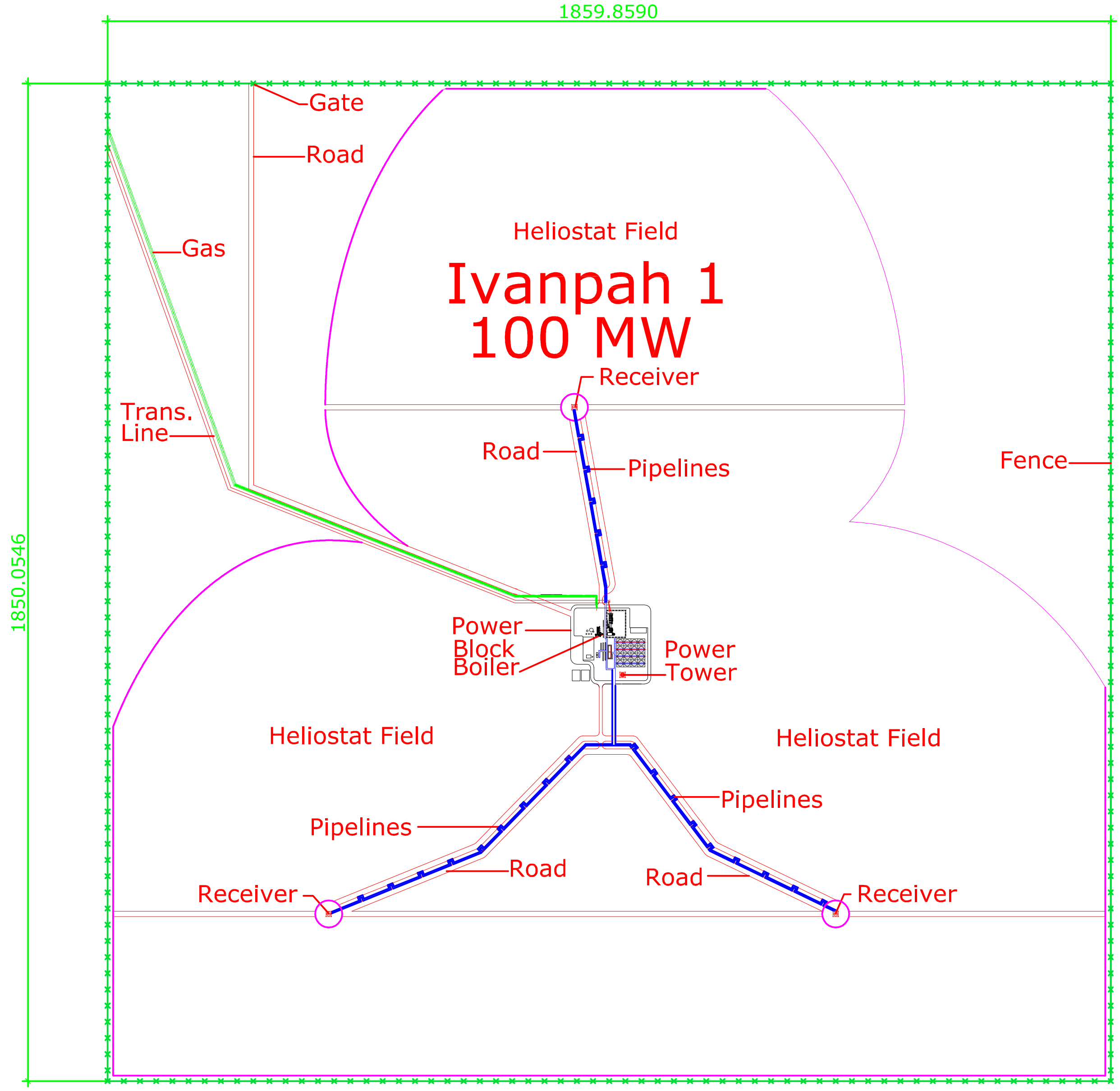

FIGURE 2.2-1a
IVANPAH 1 SOLAR FIELD LAYOUT
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

Source: DWG 12-SF-M-D-002 Rev A

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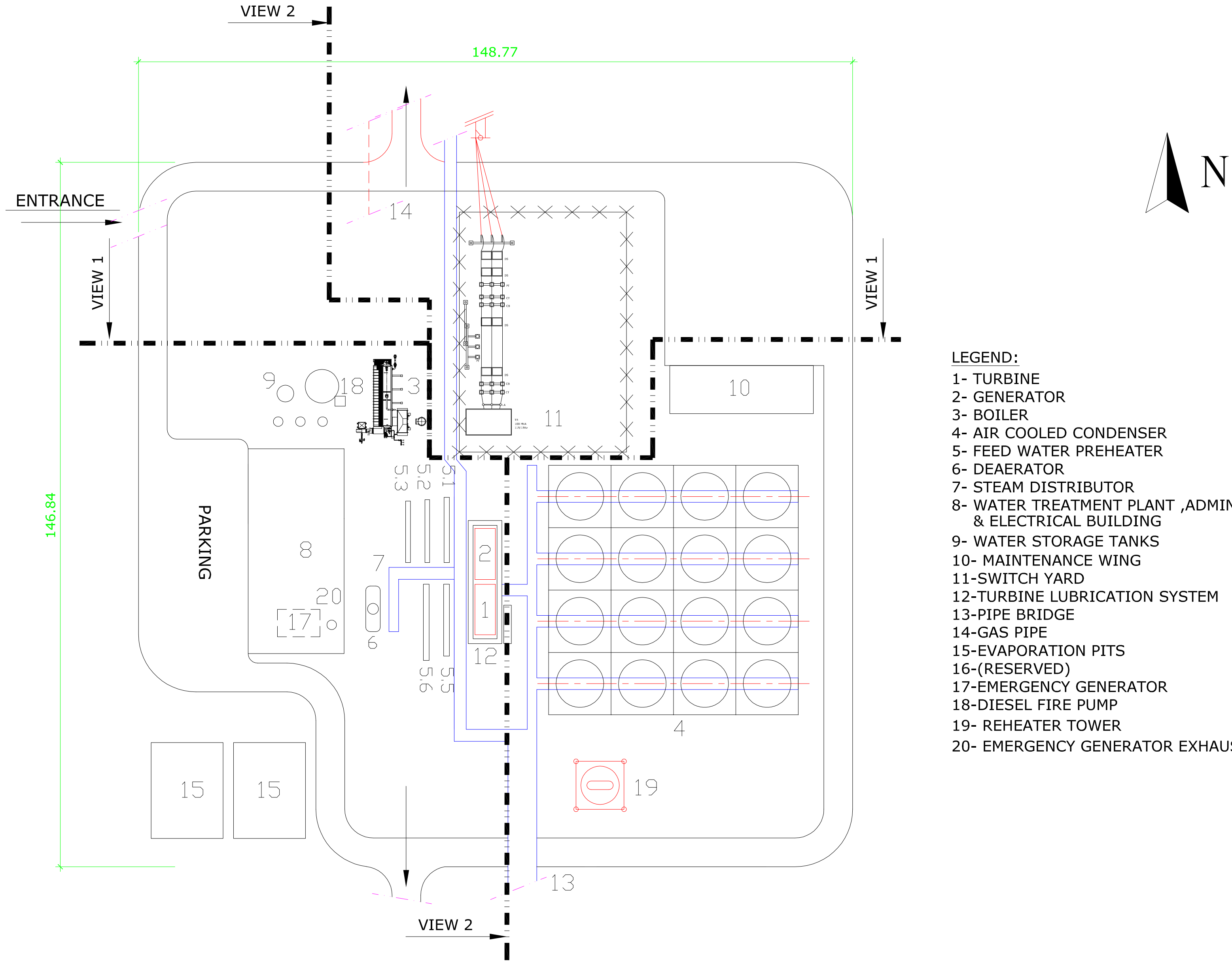

LEGEND:

1- TURBINE
2- GENERATOR
3- BOILER
4- AIR COOLED CONDENSER
5- FEED WATER PREHEATER
6- DEAERATOR
7- STEAM DISTRIBUTOR
8- WATER TREATMENT PLANT ,ADMINISTRATION & ELECTRICAL BUILDING
9- WATER STORAGE TANKS
10- MAINTENANCE WING
11-SWITCH YARD
12-TURBINE LUBRICATION SYSTEM
13-PIPE BRIDGE
14-GAS PIPE
15-EVAPORATION PITS
16-(RESERVED)
17-EMERGENCY GENERATOR
18-DIESEL FIRE PUMP
19- REHEATER TOWER
20- EMERGENCY GENERATOR EXHAUST

Source: DWG 012-PB-L-D-001

FIGURE 2.2-1b
IVANPAH 1 POWER BLOCK LAYOUT
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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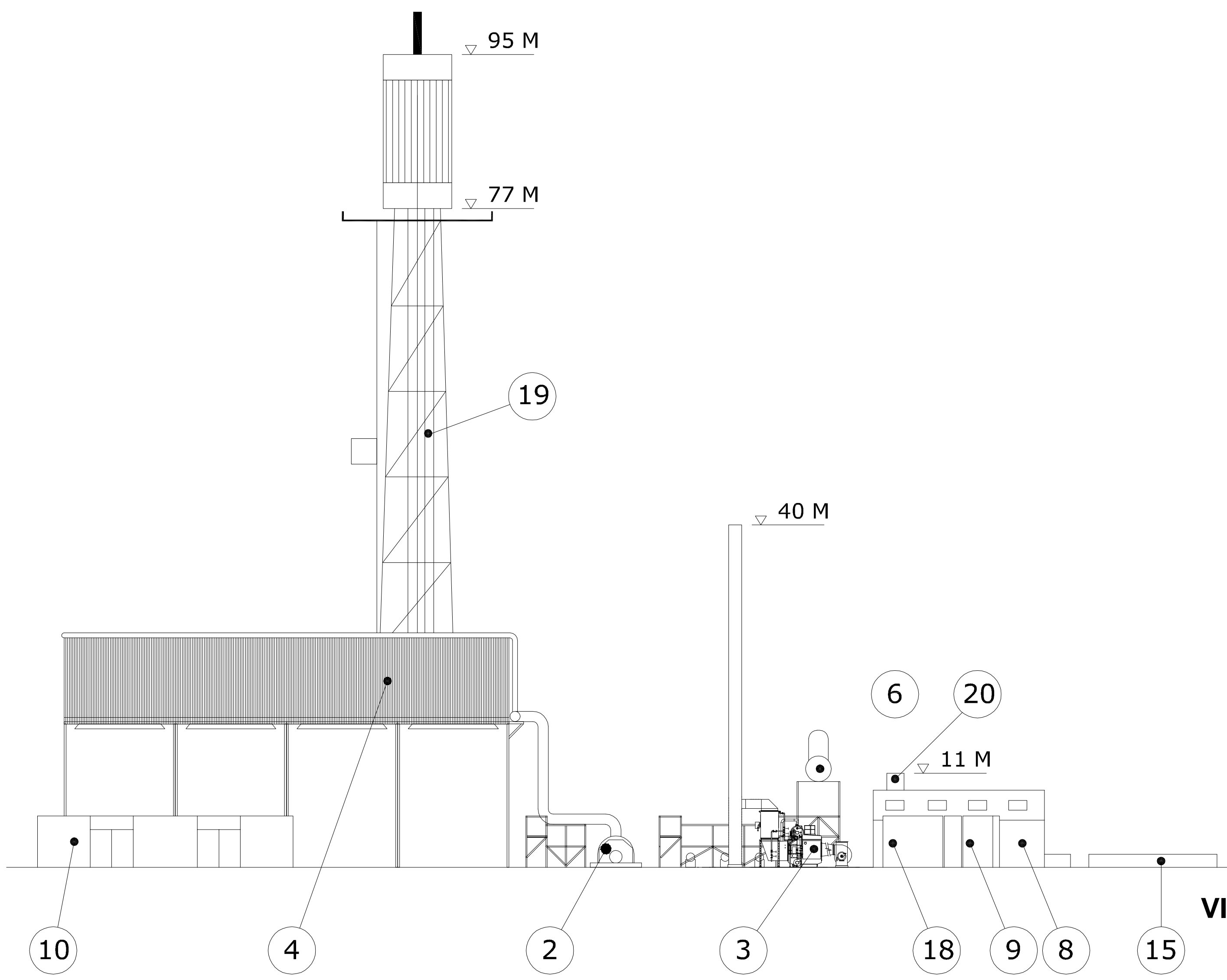
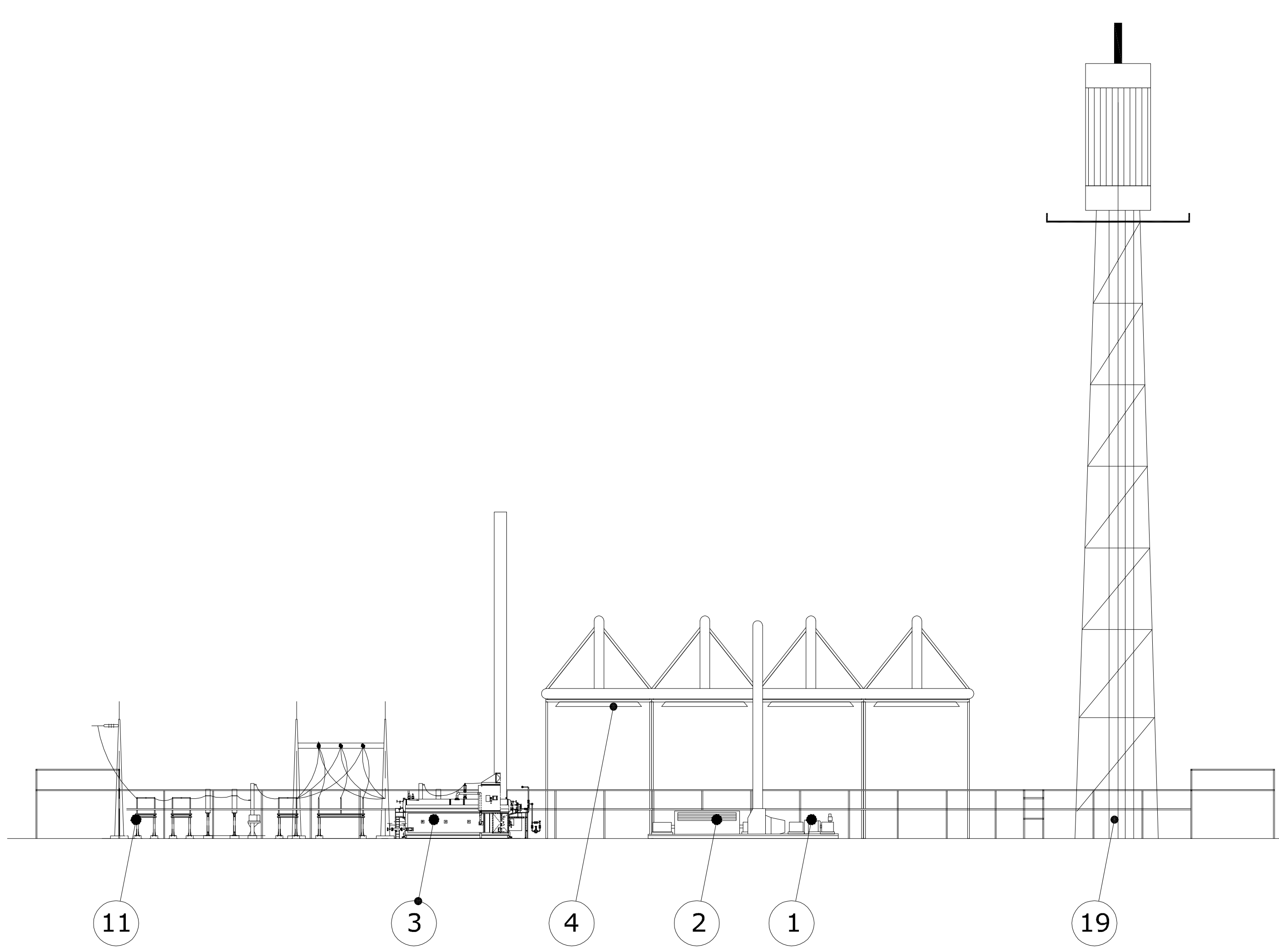
LEGEND:

1- TURBINE
2- GENERATOR
3- BOILER
4- AIR COOLED CONDENSER
5- FEED WATER PREHEATER
6- DEAERATOR
7- STEAM DISTRIBUTOR
8- WATER TREATMENT PLANT ,ADMINISTRATION
& ELECTRICAL BUILDING
9- WATER STORAGE TANKS
10- MAINTENANCE WING
11-SWITCH YARD
12-TURBINE LUBRICATION SYSTEM
13-PIPE BRIDGE
14-GAS PIPE
15-EVAPORATION PITS
16-(RESERVED)
17-EMERGENCY GENERATOR
18-DIESEL FIRE PUMP
19-REHEAT TOWER
20-EMERGENCY GENERATOR EXHAUST



VIEW 1



VIEW 2

Source: DWG 012-PB-L-D-001

FIGURE 2.2-1c
IVANPAH 1 POWER BLOCK
ELEVATION VIEWS
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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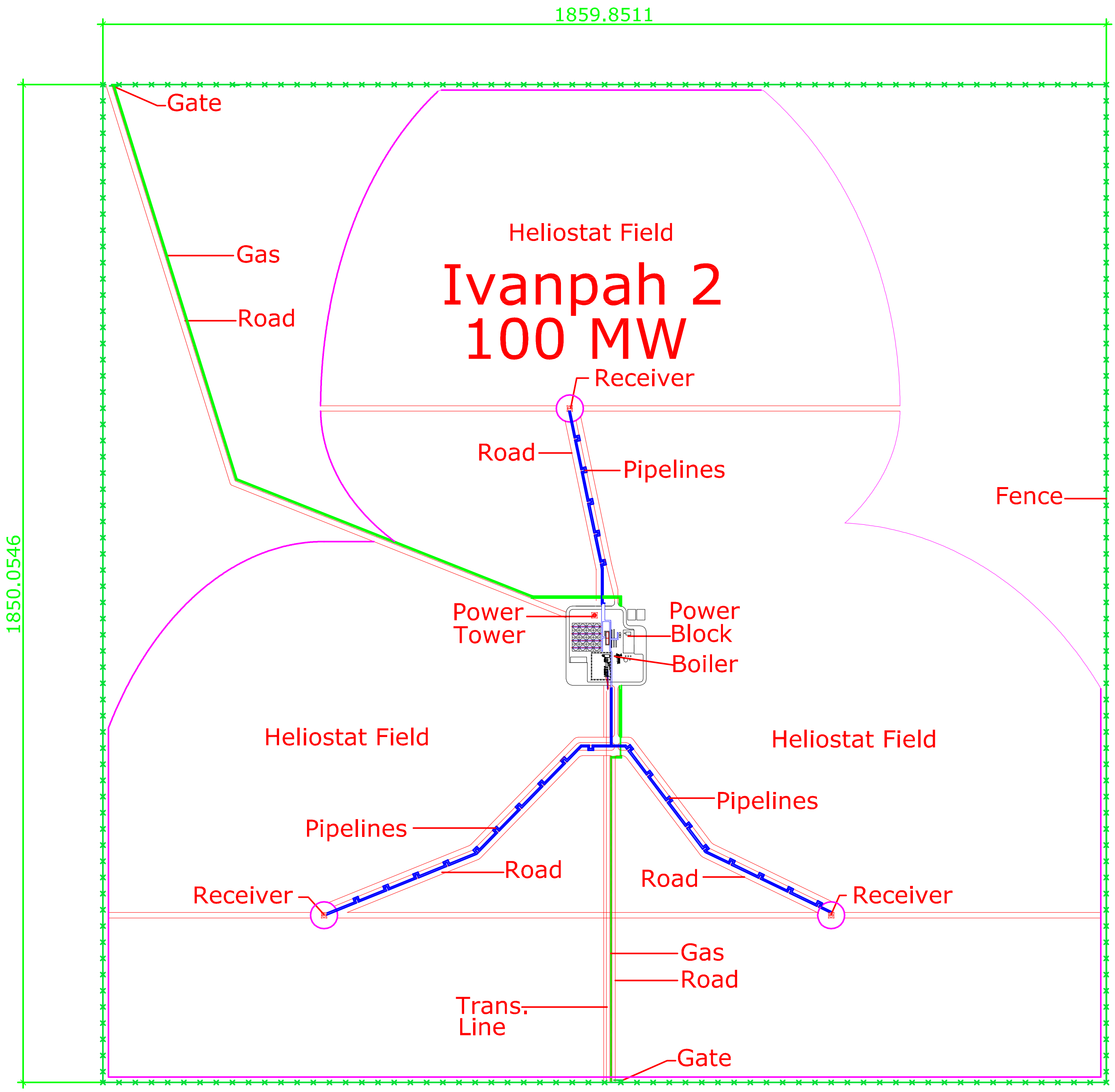
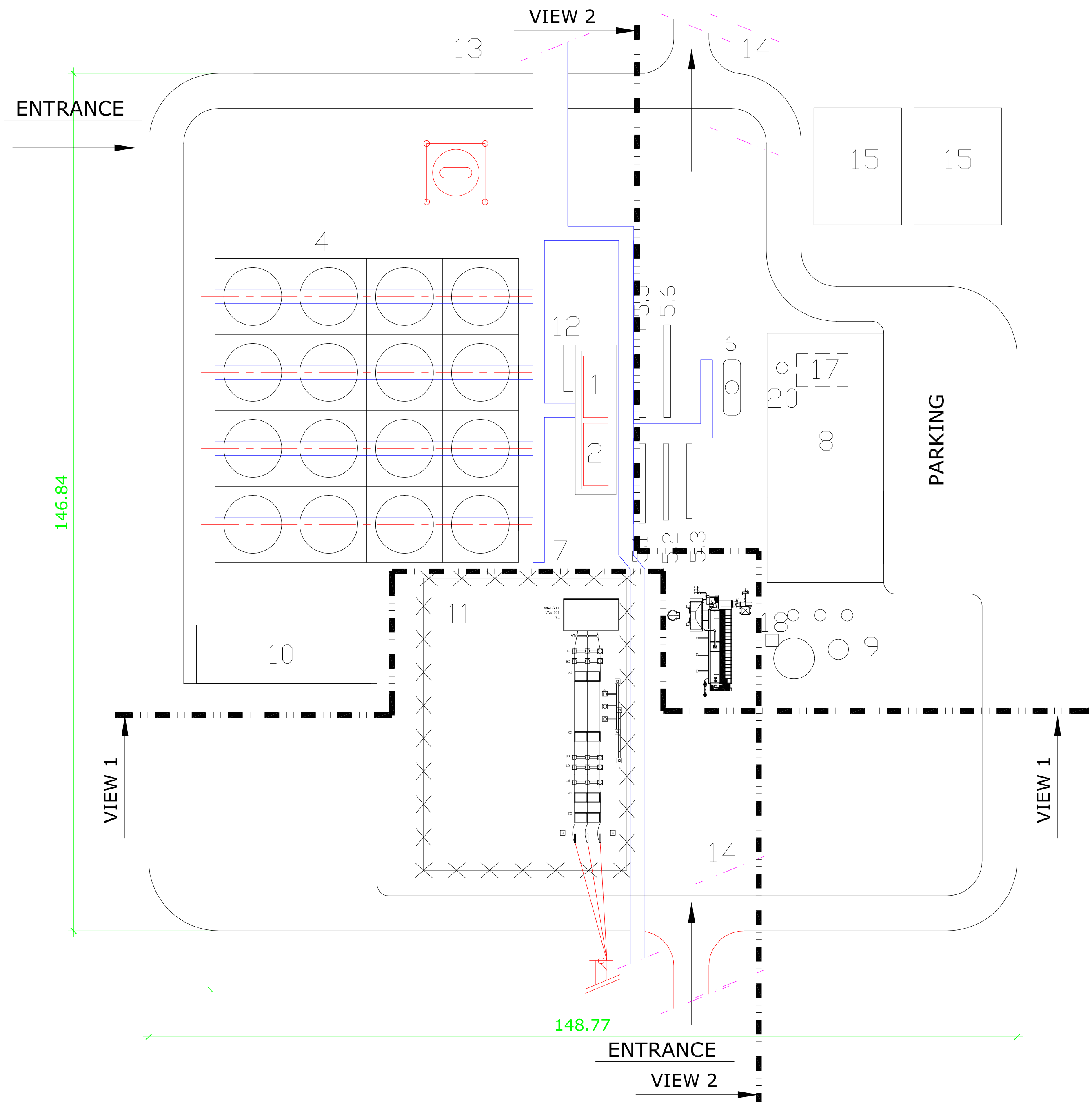


Source: DWG 07-SF-M-D-100 Rev D

FIGURE 2.2-2a
IVANPAH 2 SOLAR FIELD LAYOUT
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

CH2MHILL



LEGEND:

1- TURBINE
2- GENERATOR
3- BOILER
4- AIR COOLED CONDENSER
5- FEED WATER PREHEATER
6- DEAERATOR
7- STEAM DISTRIBUTOR
8- WATER TREATMENT PLANT ,ADMINISTRATION & ELECTRICAL BUILDING
9- WATER STORAGE TANKS
10- MAINTENANCE WING
11-SWITCH YARD
12-TURBINE LUBRICATION SYSTEM
13-PIPE BRIDGE
14-GAS PIPE
15-EVAPORATION PITS
16-[RESERVED]
17-EMERGENCY GENERATOR
18-DIESEL FIRE PUMP
19-REHEAT TOWER
20-EMERGENCY GENERATOR EXHAUST

Source: DWG 012-PB-L-D-001 Rev D

FIGURE 2.2-2b
IVANPAH 2 POWER BLOCK LAYOUT
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

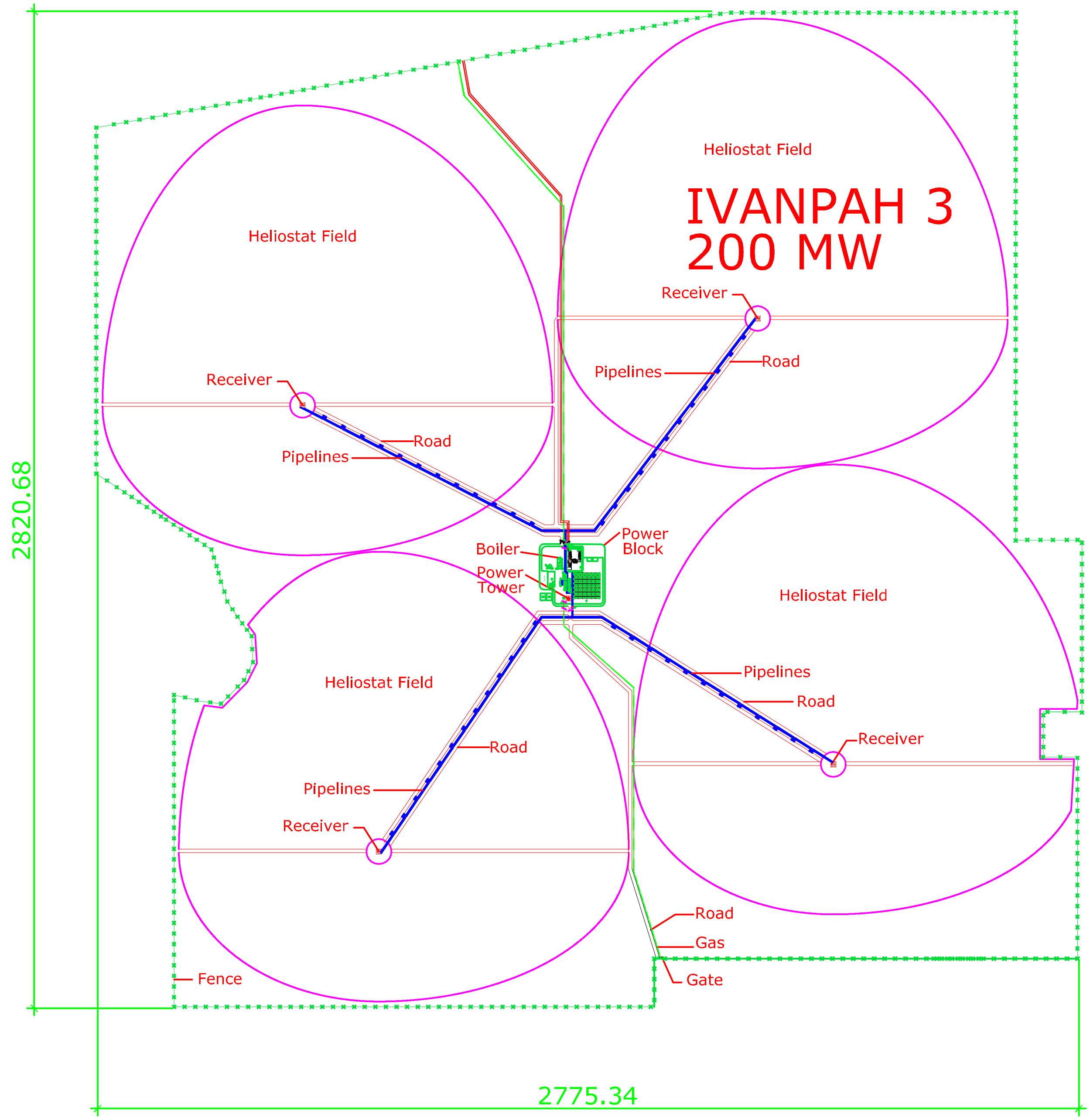
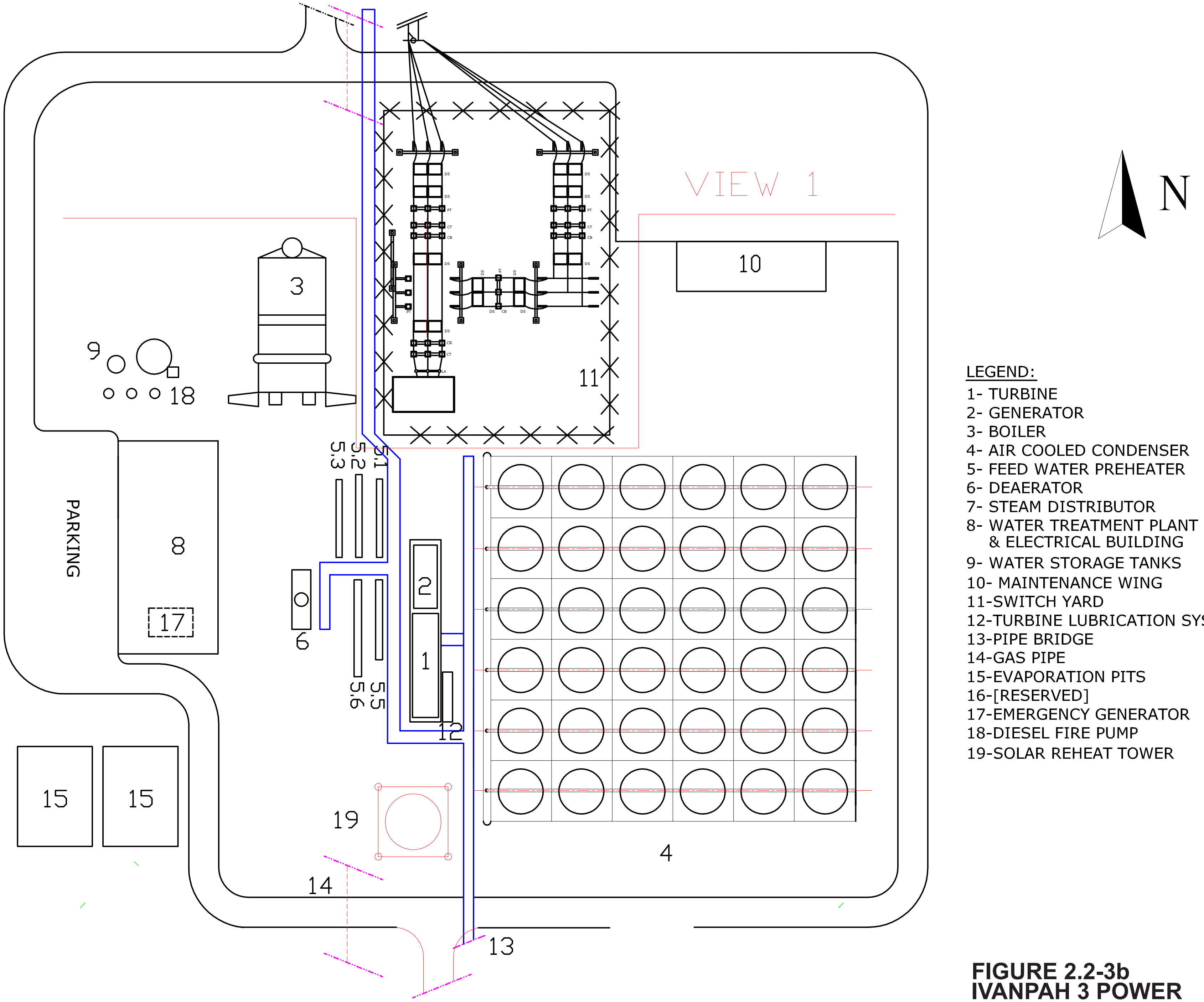


FIGURE 2.2-3a
IVANPAH 3 SOLAR FIELD LAYOUT
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

Source: DWG 07-SF-M-D-100 Rev D



LEGEND:

1- TURBINE
2- GENERATOR
3- BOILER
4- AIR COOLED CONDENSER
5- FEED WATER PREHEATER
6- DEAERATOR
7- STEAM DISTRIBUTOR
8- WATER TREATMENT PLANT ,ADMINISTRATION & ELECTRICAL BUILDING
9- WATER STORAGE TANKS
10- MAINTENANCE WING
11-SWITCH YARD
12-TURBINE LUBRICATION SYSTEM
13-PIPE BRIDGE
14-GAS PIPE
15-EVAPORATION PITS
16-[RESERVED]
17-EMERGENCY GENERATOR
18-DIESEL FIRE PUMP
19-SOLAR REHEAT TOWER

Source: DWG 07-PB-L-D-001 Rev B

FIGURE 2.2-3b
IVANPAH 3 POWER BLOCK LAYOUT
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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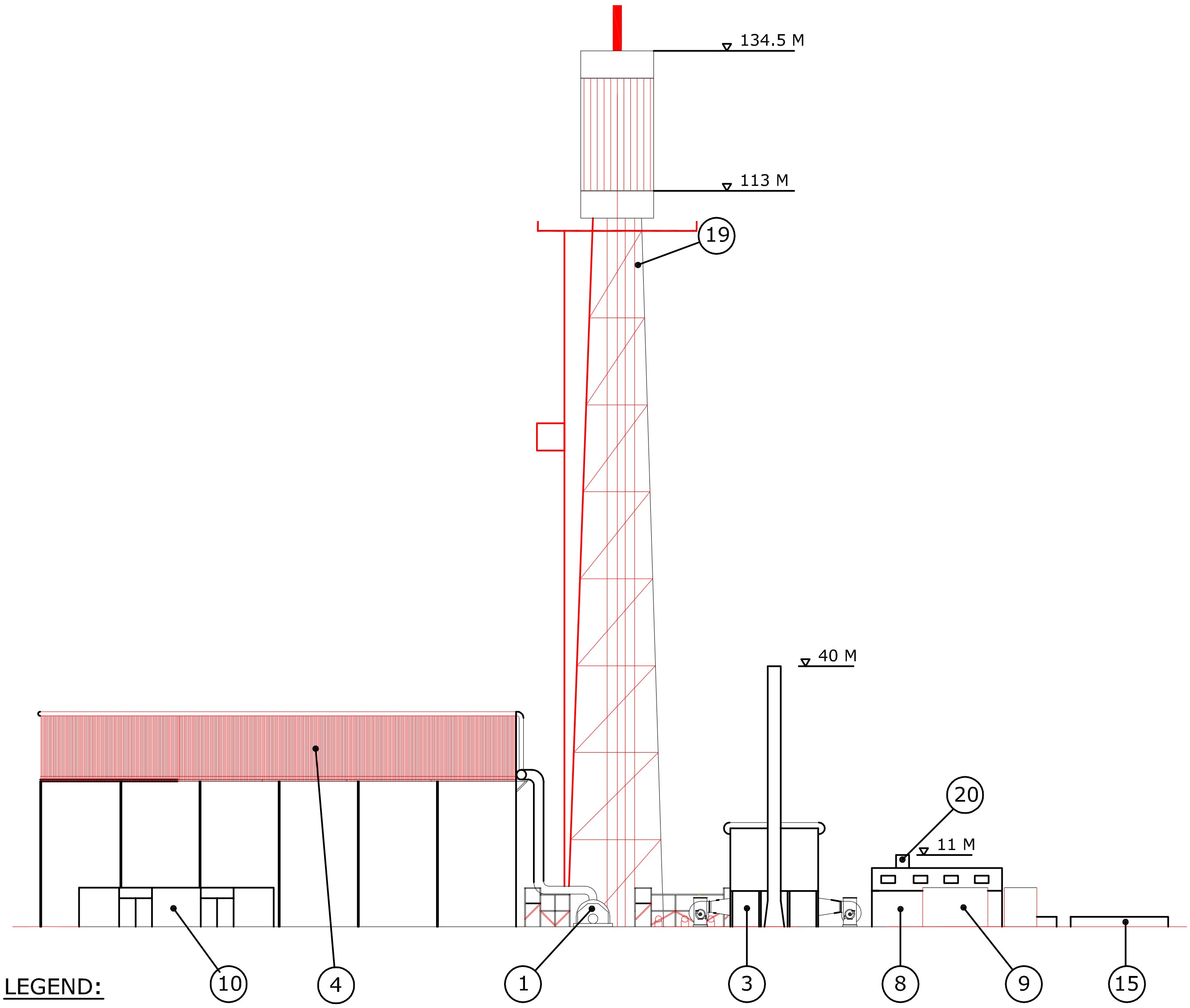

LEGEND:

1- TURBINE
2- GENERATOR
3- BOILER
4- AIR COOLED CONDENSER
5- FEED WATER PREHEATER
6- DEAERATOR
7- STEAM DISTRIBUTOR
8- WATER TREATMENT PLANT ,ADMINISTRATION & ELECTRICAL BUILDING
9- WATER STORAGE TANKS
10- MAINTENANCE WING
11-SWITCH YARD
12-TURBINE LUBRICATION SYSTEM
13-PIPE BRIDGE
14-GAS PIPE
15-EVAPORATION PITS
16-[RESERVED]
17-EMERGENCY GENERATOR
18-DIESEL FIRE PUMP
19- REHEATER TOWER
20- EMERGENCY GENERATOR EXHAUST

Source: DWG 07-PB-L-D-100 Rev D

FIGURE 2.2-3c
IVANPAH 3 POWER BLOCK ELEVATION
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

CH2MHILL

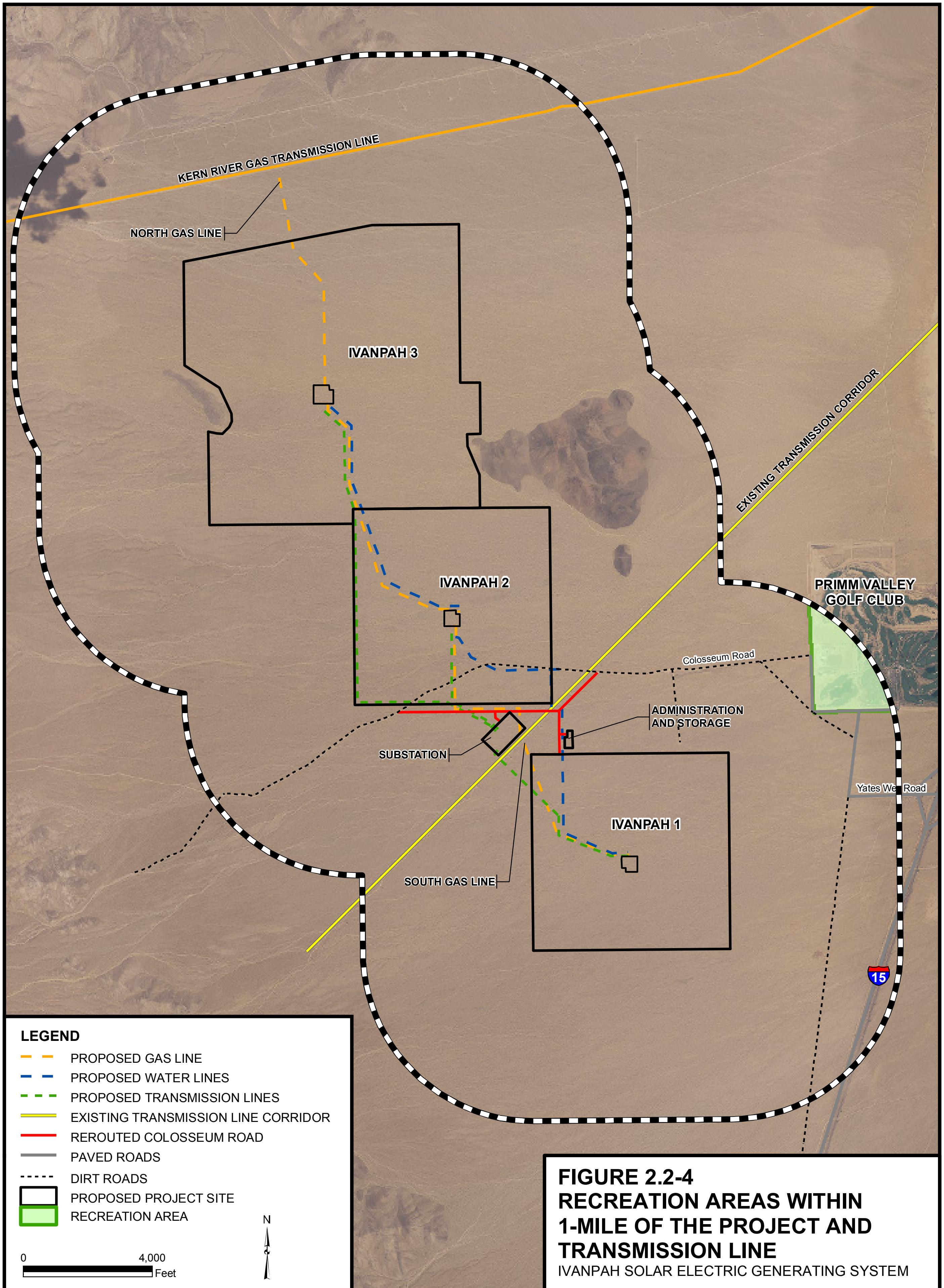

FIGURE 2.2-4
RECREATION AREAS WITHIN 1-MILE OF THE PROJECT AND TRANSMISSION LINE
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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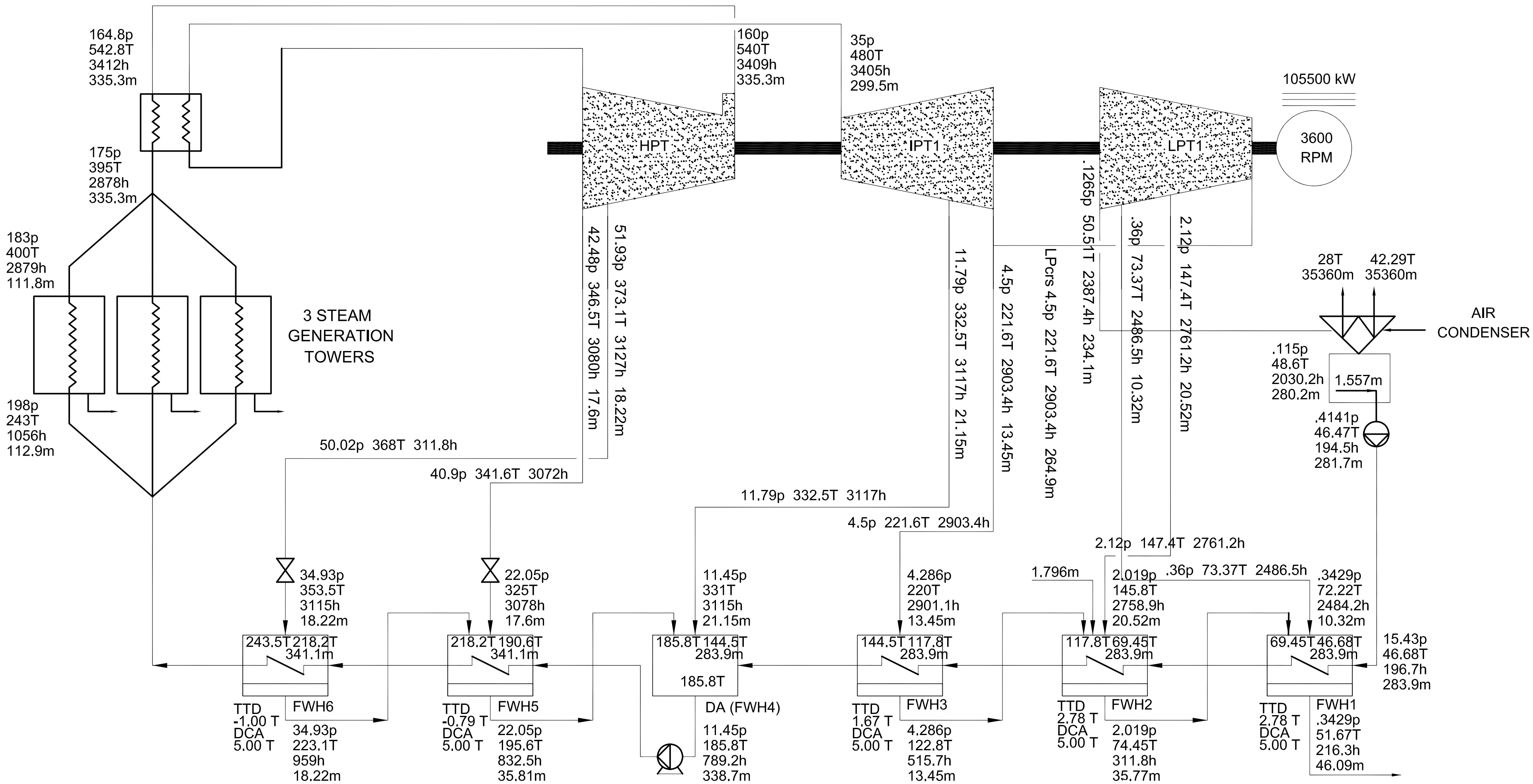

LEGEND:

p - PRESSURE (bar)
T - Temperature (°C)
h - Enthalpy (Kj/Kg)
m - Mass (Tons /hr)

Qin=247.7 MWth
NET POWER 100 MW
GROSS / NET PLANT HR 8452 / 8917 kJ/kWh (42.59% / 40.37%).

FIGURE 2.2-5
100 MW HEAT BALANCE
100% SOLAR
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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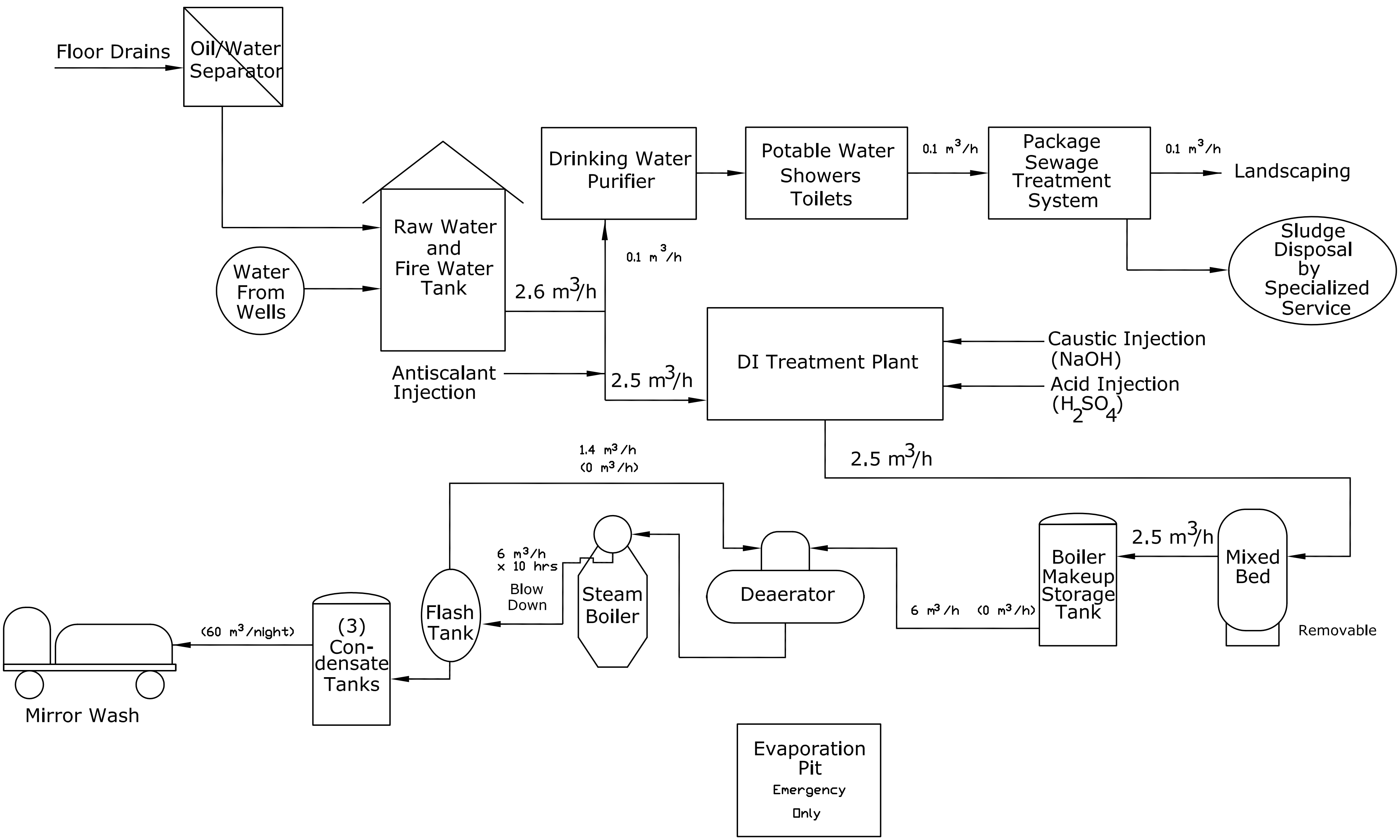

FIGURE 2.2-6
100 MW WATER BALANCE DIAGRAM
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

Source: DWG 01-PB-F-D-100 Rev A

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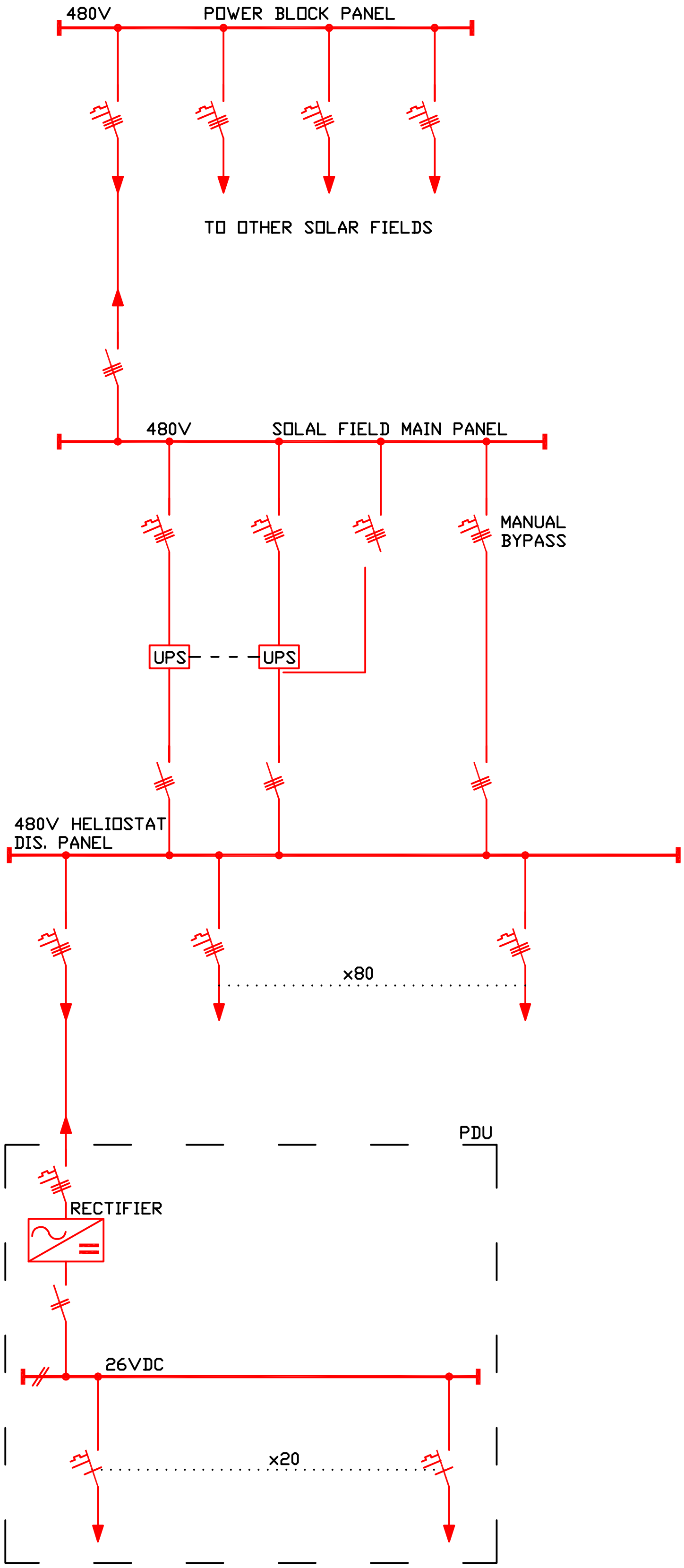

Source: DWG 01-SF-ED-001 Rev A

FIGURE 2.2-7
IVANPAH 1 SOLAR FIELD
SINGLE-LINE DESIGN
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM
BRIGHT SOURCE ENERGY

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ES062007009SAC Figure_2.2-7 08/23/2007 afint