# DESCRIPTION OF THE PROPOSED PROJECT AND ALTERNATIVES

# B.1 – PROPOSED PROJECT

## B.1.1 INTRODUCTION

On December 2, 2008, Stirling Engine Systems Solar One, LLC, (SES Solar Three, LLC and SES Solar Six, LLC) submitted an Application for Certification (AFC) to the California Energy Commission to construct and operate the Stirling Energy Systems Solar One Project (SES Solar One) on public land managed by the Bureau of Land Management (BLM) in San Bernardino County, California. On May 6, 2009, the Energy Commission accepted the AFC as complete. In January 2010, the project formally changed its name to the Calico Solar Project. The applicant, SES Solar Three, LLC, was merged into SES Solar Six, LLC, and that surviving entity was re-named Calico Solar, LLC. Calico Solar is a subsidiary of Tessera Solar™. The applicant's development plans have been updated several times since filing its original right-of-way (ROW) application with the BLM and/or AFC applications with the Energy Commission. The most substantial revisions are summarized as follows in the **Project Description Table 1**.

**Project Description Table 1**
**Summary of Applicant's Updates to the Calico Solar Development Plans**

| Posted Date | Reference Document | Revisions to Proposed Project |
|---|---|---|
| 07/21/2009 | Data Response #49-70, 74-45, 80, 82-84, 86-91 | Additional information regarding evaporation pond design. |
| 08/25/2009 | Data Response #113-127 | Removes Satellite Services Complex from project scope |
| 09/03/2009 | Data Response #1-48, 81, 109-112 | Reduction in Project roads, vehicle type changes, fuel type changes, revisions to construction practices, sequencing and schedule, revision to placement of support facilities, vehicle travel pattern changes |
| 12/01/2009 | Data Response #71-73, 76-79, 85, 128-141 | Removal of access road alternative options 2 through 4 as discussed in the AFC; hydrogen gas to be produced on site and brought to SunCatchers via a distributed system. |
| 12/16/2009 | | Updated project map |
| 01/11/2010 | Submittal | CAISO reports |
| 01/12/2010 | Submittal | Geotechnical engineering report |
| 01/28/2010 | | Change of project name and applicant name |
| 02/08/2010 | Supplemental Analysis for the AFC | Cadiz Water provided as primary water source for the Project |
| 02/17/2010 | | Drainage layout figure and project layout figure |
| 02/26/2010 | | Drainage layout figure; depicts Project phases and other layout changes resulting from agency and public input |

## B.1.2 PROJECT LOCATION

The Calico Solar Project site is proposed to be located on public land managed by the BLM. The proposed project site is approximately 37 miles east of Barstow, California, 17 miles east of Newberry Springs, 57 miles northeast of Victorville, and approximately 115 miles east of Los Angeles (straight line distances). The following sections or portions of sections in Townships 8 and 9 North, Ranges 5 and 6 East of the San Bernardino Meridian identify the project site and the planned boundary for development of the Calico Solar Project (see **Project Description Figure 1**).

The project is proposed for development in two phases. Phase I is located on approximately 2,320 acres (3.6 square miles). Phase II is located on approximately 5,910 additional acres (9.2 square miles). The total area required for both phases is approximately 8,230 acres.

**PHASE ONE (BLM ADMINISTERED LAND)**

Within Township 8 North, Range 5 East:

- the portion of the northeast quarter section of Section 11 north of the railroad ROW, and
- the portion of Section 12 north of the railroad ROW.

Within Township 8 North, Range 6 East:

- the portion of Section 7 north of the railroad ROW,
- the portion of Section 8 west of the SCE Transmission ROW,
- the portion of Section 9 west of the SCE Transmission ROW,
- the portion of Section 17 west of the SCE Transmission ROW and north and south of the railroad ROW,
- the portion of Section 18 north of the railroad ROW,
- the southwest and southeast quarter sections of Section 6, and
- the southwest quarter of Section 5,

Within Township 9 North, Range 6 East:

- the northeast quarter and the portion of the northeast quarter-quarter section of the northwest section of Section 32, and
- the northwest quarter and the portion of the northwest and southwest quarter-quarter section of the northeast section of Section 33.

**PHASE TWO (BLM ADMINISTERED LAND)**

Within Township 8 North, Range 5 East:

- eastern half of Section 2,

- the southwest, northeast, southeast quarter of Section 10,
- the portion of Section 14 north of the I-40 ROW,
- the portion of the northeast and northwest quarter sections and the northeast quarter-quarter sections of the southeast quarter section of Section 8 south of the railroad ROW and north of the I-40 ROW,
- the portion of Section 11 south of the railroad ROW,
- the portion of Section 12 south of the railroad ROW, and
- the portion of Section 15 north of the I-40 ROW.

Within Township 8 North, Range 6 East:

- the portion of Section 4 west of the SCE Transmission ROW,
- the northeast, northwest, southeast quarter sections of Section 5,
- the northwest and northeast quarter sections of Section 6,
- the portion of Section 7 south of the railroad ROW, and
- the portions of Section 18 west of the SCE Transmission ROW, south of the railroad ROW and north of the I-40 ROW.

Within Township 9 North, Range 5 East:

- the eastern half of Section 35.

Within Township 9 North, Range 6 East:

- all of Section 31,
- the southwest and southeast quarters and the portion of the southwest quarter-quarter sections of the northwest quarter of Section 32, and
- the southwest quarter and the portion of the northwest and southwest quarter-quarter sections of the southeast quarter of Section 33.

The proposed Calico Solar Project also includes a new 230-kilovolt (kV) Calico Solar Substation, 2.0 miles of electrical transmission line, an administration building, maintenance complex, onsite routes interior to the project boundaries, a site access road and bridge over the Burlington Northern Santa Fe railroad tracks. Approximately 739 feet of the 2-miles of single-circuit, 230-kV generation interconnection transmission line would be constructed off the project site but still on BLM managed land. The transmission line would connect the proposed Calico Solar Substation to the existing Southern California Edison (SCE) Pisgah Substation. The main access for traffic to the project site during construction will be from Interstate 40 (I-40) to the project entrance on Hector Road through an existing at-grade crossing of the Burlington Northern Santa Fe (BNSF) Railroad tracks. This at-grade crossing will be used during the initial phases of construction until a bridge is constructed that will span the railroad. Traffic will exit the project site at Hector Road and the existing Hector Road crossing during the initial phases of construction. Once the bridge is completed, all traffic will use the bridge for ingress egress (see **Project Description Figure 2**).

## B.1.3 PROCESS DESCRIPTION

The SunCatcher™ is a 25-kilowatt-electrical (kW) solar dish Stirling system designed to automatically track the sun and collect and focus solar energy onto a power conversion unit (PCU), which generates electricity. The system consists of a 40-foot-high by 38-foot-wide solar concentrator in a dish structure that supports an array of curved glass mirror facets. These mirrors collect and concentrate solar energy onto the solar receiver of the PCU (see **Project Description Figure 3**).

The PCU converts the focused solar thermal energy into grid-quality electricity. The conversion process in the PCU involves a closed-cycle, 4-cylinder, 35-horsepower reciprocating Stirling Engine utilizing an internal working fluid of hydrogen gas that is recycled through the engine. The Stirling Engine operates with heat input from the sun that is focused by the SunCatcher's dish assembly mirrors onto the PCU's solar receiver tubes, which contain hydrogen gas. The PCU solar receiver is an external heat exchanger that absorbs the incoming solar thermal energy. This heats and pressurizes the hydrogen gas in the heat exchanger tubing, his gas in turn powers the Stirling Engine.

A generator is connected to the Stirling Engine; this generator produces the electrical output of the SunCatcher. Each generator is capable of producing 25 kW at 575 volts alternating current (VAC)/60 hertz (Hz) of grid-quality electricity when operating with rated solar input. Waste heat from the engine is transferred to the ambient air via a radiator system similar to those used in automobiles.

The hydrogen gas is cooled by a standard glycol-water radiator system and is continually recycled within the engine during the power cycle. The conversion process does not consume water. The only water consumed by the SunCatcher is for washing of the mirrors to remove accumulated dust and replenishing small losses to the cooling system radiator in a 50-50 ethylene glycol-water coolant.

### B.1.3.1 SUNCATCHER COMPONENTS

This section provides an overview of the three major SunCatcher components: the foundation/pedestal, the dish assembly, and the PCU.

**Foundation/Pedestal**

The solar dish would typically be mounted on a foundation consisting of a metal pipe that is hydraulically driven into the ground. This foundation is preferred because no concrete is required, no spoils are generated, and the foundations can be completely removed when the project is decommissioned. When conditions are not conducive to the use of the metal pipe foundation, the foundation would consist of rebar-reinforced concrete constructed below grade. Both of these foundation designs meet all applicable structural design requirements and applicable LORS.

The SunCatcher pedestal on which the SunCatcher Dish Assembly would be secured is approximately 18 feet 6 inches in height and would be an integrated part of the metal pipe foundation or would be a separate structure fastened to the rebar-reinforced concrete foundation at ground level.

## Dish Assembly

The SunCatcher Dish Assembly would be fitted with a trunnion that attaches to the pedestal. Each Dish Assembly would consist of a 38-foot wide by 40-foot high steel structure that supported an array of curved glass mirror facets. These mirrors would form a curved shape engineered to concentrate solar energy onto the solar receiver portion of the PCU. The Dish Assembly includes azimuth and elevation drives for tracking the sun and a PCU support boom.

The SunCatcher Dish Positioning Control System employs proprietary algorithms to track the sun. This system focuses the solar energy onto the solar receiver by controlling elevation and azimuth drives, and executes startup, shutdown, and de-track procedures. These procedures allow the dish to "wake up" from the night-stow position in the morning to focus the dish mirror facets on the solar receiver of the PCU, and then to track the sun during the daylight operating time of the project. The dish control system also communicates with and receives instructions from the central control room via the Supervisory Control and Data Acquisition (SCADA) system. The system is designed to place the dish into a "wind stow" position when sustained winds exceed 35 miles per hour to protect the system from wind damage. The system also places the dish into "wind stow" position on loss of communications with the central control room or on receipt of a fault signal from the PCU control system.

## Power Conversion Unit

The SunCatcher PCU converts the solar energy into grid-quality electricity. Hydrogen gas is used in a closed-cycle heating/expansion – cooling/compression cycle to drive a high-efficiency, 380-cubic-centimeter displacement, 4-cylinder reciprocating Solar Stirling Engine. The Stirling Engine powers an electrical generator that produces 25 kWe net output after accounting for on-board parasitic loads at 575-volt alternating current, 60 Hz of grid-quality electricity. The PCU attaches to the end of the PCU boom.

The dimensions of the PCU are approximately 88 inches (7 feet) long by 63 inches (5 feet) wide by 37 inches (3 feet) high. The PCU weighs approximately 1,400 pounds.

The PCU consists of six subsystems: solar receiver, Stirling Engine, generator, cooling system, gas management system, and the PCU control system. Each subsystem is described below.

- **Solar Receiver:** The SunCatcher solar receiver consists of an insulated cavity with an aperture that allows the solar energy to enter. Within the cavity are 4 heater heads. Each heater head forms a tube network for one quadrant of the engine. The solar flux, radiant energy from the sun, heats the metal tubes and the heat is then transferred through the tubes to the working hydrogen gas. The heat absorbed at the solar receiver drives the Solar Stirling Engine.
- **Solar Stirling Engine:** The kinematic Stirling Engine has evolved from a Kockums kinematic Stirling Engine design. The Kockums kinematic Stirling Engine is used as a propulsion source for submarines and is highly reliable, low maintenance, and highly efficient. SES has further developed and improved the engine design specifically for use in the SunCatcher.

- **Generator:** A generator is connected to the Stirling Engine to produce the electrical output of the SunCatcher. The PCU generator attached to each Solar Stirling Engine is capable of producing up to 25 kW at 575 VAC, 60 Hz of grid-quality electricity when operating with a solar input of between 250 and 1,000 $W/m^2$. The generator output is connected to the power collection system.
- **Cooling System:** Waste heat from the hydrogen gas within the engine is transferred to the ambient air via a radiator system similar to the type used in automobiles. The SunCatcher cooling system is made up of ethylene glycol fluid, a cooler in the gas circuit, a radiator, a fluid circulation pump, and a cooling fan. The cooling fan and circulation pump are driven by electric motors.

  The system is used to cool the hydrogen gas before the compression portion of the cycle. The pump circulates the cooling fluid through the gas cooler and radiator. Waste heat from the hydrogen gas is transferred to the ethylene-glycol fluid in the cooler. The coolant is then pumped through the radiator where the fan forces ambient air over the cooling fins to remove heat. The heat is transferred to the atmosphere via the airflow over the radiator.
- **Gas Management System:** The gas management system controls the working pressure to ensure high efficiencies. The hydrogen gas is contained within a closed and sealed cycle, yet a very small amount of the hydrogen working fluid does leak (less than 200 cubic feet per dish per year) by the rod seals and is lost to the atmosphere. As a result, an on-site distributed hydrogen system has been proposed to replenish hydrogen lost to the atmosphere.
- **Control System:** The SunCatcher PCU control system monitors, controls, and communicates PCU performance. Thermal detectors are monitored by the PCU control system and the data are used to control the thermal balancing of the PCU. Alarms and faults monitored by the PCU control system are communicated to the Dish Positioning Control System and the Project SCADA system.

## B.1.4 PROJECT DESCRIPTION

The proposed Calico Solar Project would be a nominal 850-megawatt (MW) Solar Stirling Engine project. The project is proposed for development in two phases. Phase I includes 11,000 SunCatchers located on approximately 2,320 acres (3.6 square miles) to produce 275 MW. Phase II would include an additional 23,000 SunCatchers on an additional approximately 5,910 acres (9.2 square miles) to produce an additional 575 MW for the total 850 MW planned production. The total area required for both phases, including the area for the operation and administration building, the maintenance building, and the substation building, is approximately 8,230 acres.

Construction is planned to begin in late 2010. Although construction would take approximately 44 months to complete, power would be available to the grid as each 60-unit group of SunCatchers is completed. The project includes construction of an on-site 230-kV Calico Substation near the center of the project area, and a 230-kV transmission line from the Calico Substation that would run southeast parallel to the north side of the BNSF railroad ROW inside the project area, then cross the railroad right of way (ROW) to run southwest and parallel the SCE transmission lines to the existing SCE Pisgah Substation.

The primary equipment for the generating facility would include approximately 34,000 SunCatchers, their associated equipment and systems, and their support infrastructure. The project site covers 8,230-acres (13 square miles) and is located on public land managed by the BLM. No private lands are located within the 8,230 acres under BLM application.

The applicant has applied for a right-of-way (ROW) grant for the project site from the BLM Barstow Field Office. Although the project is phased, it is being analyzed in this SA/DEIS as if all phases would be operational at the same time.

### B.1.4.1 PROJECT SITE ARRANGEMENT

The basic building blocks for the project are 1.5-MW solar groups consisting of 60 SunCatchers. The 1.5-MW groups would be connected in series to create 3-, 6-, and 9-MW solar groups. The 3-, 6-, and 9-MW groups would be connected to overhead collection lines rated at 48 MW or 51 MW. The typical solar groups would be arranged as necessary to fit the contours of the site.

The entire project would be fenced for security, however the design of the fencing is being determined in coordination with regulatory and resource agencies to protect sensitive ecological areas and address storm flows in washes. The project would have a laydown area on 14 acres adjacent to the Main Services Complex.

During project construction and operation, the main access to the project site would be from the south, off of Interstate 40 from the Hector Road exit. The AFC proposed the development of the following roadways on the project site: approximately 25.2 miles of paved roadways, approximately 168 miles of north-south access routes, and approximately 102 miles of east-west access routes. The access routes would be surface-treated to reduce fugitive dust while allowing full access to all dishes and infrastructure. Polymeric stabilizers will be used in lieu of traditional road construction materials for paved roads and/or to stabilize unpaved roads. All access to the project site would be through controlled gates.

### B.1.4.2 SOLAR POWER PLANT EQUIPMENT AND FACILITIES

**Project Description Table 2**, Significant Structures and Equipment, lists the major equipment and significant structures required for the Calico Solar Project.

## Project Description Table 2
## Significant Structures and Equipment

| Description | Quantity | Length (feet) | Width (feet) | Height (feet) |
|---|---|---|---|---|
| SunCatcher power generating system | 34,000 | 38 diameter | | 40 |
| Main Services Complex administration building | 1 | 200 | 150 | 14 |
| Main Services Complex maintenance building | 1 | 180 | 250 | 44 |
| Main SunCatcher assembly buildings | 3 | 170 | 211 | 78 |
| Well water storage tank and Fire Water 230,000 gallons | 1 | 40 diameter | | 20 |
| Demineralized water tank, 17,000 gallons | 2 | 18 diameter | | 10 |
| Potable Water Tank, 5,000 gallons | 1 | 40 diameter | | 20 |
| 230kV transmission line towers, double-circuit with upswept arms | 12 to 15 | -- | 32 | 90 to 110 |
| Generator collection sub-panel; distribution panel, 42 circuit, 400A, 600V, with circuit breakers in a weatherproof enclosure | 2,834 | 1 | 2.67 | 5 |
| Generator collection power center, 2,000-A distribution panels with six 400-A circuit breakers | 567 | 2 | 3.33 | 7.5 |
| Collector group generator step-up unit transformer (GSU), 1,750kVA, 575 V to 34.5kV, with taps | 567 | 6.67 | 7.5 | 6.67 |
| Power factor correction capacitor, 600V, 1,000kVAR, switched in five, each 200kVAR steps | 567 | 2.5 | 6.67 | 7.5 |
| Open bus switch rack, 35kV, 7 bay with five 35kV, 1,200-A, 40kVA INT, circuit breakers, insulators, switches, and bus work | 6 | 105 | 20 | 30 |
| Shunt capacitor bank, 34.5kV, 90 MVAR switched in six each 15 MVAR steps | 6 | 15 | 8 | 20 |
| Dynamic VAR (DVAR) compensation system in coordination with shunt capacitor banks – size to be determined by studies | 1 | 60 | 12 | 16 |
| Disconnect switch, 35kV, 3,000 A, 200kV BIL, group-operated | 6 | 3 | 11 | 16 |
| Power transformer, three phase, 100/133/167 mega volt amp, 230/132.8-34.5/19.9kV, 750kV BIL, oil filled | 6 | 15 | 35 | 23 |
| Power circuit breaker, 242kV, 2000A, 40 kilo amp interrupting capacity | 7 | 12 | 20 | 16 |
| Coupling capacitor voltage transformer for metering, 242kV, 900kV BIL, 60 Hertz, Potential Transformer ratio 1,200/2,000:1 | 6 | 1 | 1 | 25 |
| Disconnect switch, 242kV, 2000A | 9 | 10 | 25 | 25 |

Source: Calico Solar, LLC

Notes: A = ampere (amp), BIL = basic impulse level, gpd = gallons per day, HP = horsepower, Hz = hertz, INT = international, kA = kilo amps kV = kilovolt, kVA = kilovolt amps, Kvar = kilovolt amp reactive, kW = kilowatt, kWe = kilowatt-electric, MVA = megavolt amps MVAR = megavolt amp reactive MW = megawatts, V = volts, VAR = volt amp reactive W = watts

### B.1.4.3 SITE GRADING AND DRAINAGE

The original layout for the Calico Solar Project site was based on avoiding major washes and minimizing surface-disturbing activities. Following the completion of the 30% engineering in April 2009, the applicant determined that it would be necessary to place some SunCatcher units in washes to attain the proposed 850 MW yield.

Brush trimming would be conducted between alternating rows and would consist of cutting the top of the existing brush while leaving the existing native plant root system in place to minimize soil erosion. To minimize shading on SunCatchers and prevent potential brush fire hazards, natural vegetation trimmings would be cleared in the area of each SunCatcher as well as on either side of the surface-treated arterial roadways.

After brush has been trimmed, blading for roadways and foundations would be conducted between alternating rows to provide access to individual SunCatchers. Blading would consist of limited removal of terrain undulations. Although ground disturbance would be minimized wherever possible, the applicant proposes that localized rises or depressions within the individual 1.5-MW solar groups would be removed to provide for proper alignment and operation of the individual SunCatchers. Paved roadways would be constructed as close to the existing topography as possible, with limited cut-and-fill operations to maintain roadway design slope to within a maximum of 10%.

The layout of the proposed Calico Solar Project would maintain the local pre-development drainage patterns where feasible, and water discharge from the site would remain at the southern and western boundaries. The paved roadways would have a low-flow, unpaved swale or roadway dip as needed to convey nuisance runoff to existing drainage channels/. It is expected that storm water runoff would flow over the crown of the paved roadways, which are typically less than 6 inches from swale flow line to crown at centerline of roadway, thus maintaining existing local drainage patterns during storms. The applicant has proposed that unpaved roads would utilize low-flow culverts.

The applicant has proposed localized channel grading on a limited basis to improve channel hydraulics within the dry washes and to control flow direction where buildings and roadways are proposed. The Main Services Complex would be protected from a 100-year flood by berms or channels that would direct the flow around the perimeter of the building site, if required.

Arizona Crossings (roadway dips) would be placed along the roadways or low-flow culverts consisting of a small-diameter storm drain with a perforated stem pipe, as needed to cross the minor or major channels/swales. These designs would be based on Best Management Practices (BMPs) for erosion and sediment control.

Arizona Crossings (roadway dips) would be used for major washes where the channel cross section exceeds 8 feet in width and 3 feet in depth or exceeds 20 feet in width and 2 feet in depth. The roadway section at the channel flow line would be without a crown.

It is anticipated that roadway maintenance would be required after rainfall events. For minor storm events, it is anticipated that the unpaved roadway sections may need to be bladed to remove soil deposition, along with sediment removal from stem pipe risers at the culvert locations. For major storm events, in addition to the aforementioned maintenance, roadway repairs may be required due to possible damage to pavement where the roadways cross the channels and where the flows exceed the culvert capacity. Additional maintenance may be required after major storm events to replace soil eroded from around SunCatcher pedestals located in washes.

Building sites would be developed per San Bernardino County drainage criteria, with provision for soft bottom storm water retention basins. Rainfall from paved areas and building roofs would be collected and directed to the storm water retention basins. Volume on retention or detention basins should have a total volume capacity for a 3-inch minimum precipitation covering the entire site. Volume can be considered by a combination of basin size and additional volume provided within paving and/or landscaping areas.

The retention basins would be designed so that the retained flows would empty within 72 hours after the storm to provide mosquito abatement. This design can be accomplished by draining, evaporation, infiltration, or a combination thereof.

The post-development flow rates released from the project site are expected to be less than the pre-development flow rates, thus complying with BMPs. The expected flow reduction is based on the following factors.

- Except for the building sites, roads, and two evaporation ponds, the majority of the project site would remain pervious; only a negligible portion of the site would be affected by pavement and SunCatchers foundations.
- The increased runoff expected from the building sites would be over-mitigated by capturing 100% of the runoff in a retention basin, where the storm runoff would be infiltrated and/or evaporated to the atmosphere.
- The proposed perforated risers to be constructed upstream of the roadway culverts would provide for additional detention.

### B.1.4.4 BUILDINGS

All buildings would be constructed in accordance with the appropriate edition of the California Building Code (CBC) and other applicable LORS.

The Main Services Complex would be located within the project site in a central location that provides for efficient access routes for maintenance vehicles servicing the SunCatcher solar field. The main control room would be located at the Main Services Complex.

Warehouse and shop spaces would provide work areas and storage for spare parts for project maintenance. The Main Services Complex would contain meeting and training rooms, maintenance and engineering offices, and administrative offices.

The project administration offices and personnel facilities will be located in a one-story operation and administration building. The operation and administration building will measure approximately 200 feet long by 150 feet wide by 14 feet high. This building will also contain meeting and training rooms, engineering offices, a visitor’s room, and support services.

The project maintenance facilities, shop, and warehouse storage will be located adjacent to the operation and administration building. The maintenance building will measure 180 feet wide by 250 feet long by 44 feet in height. This building will contain maintenance shops and offices, PCU rebuild areas, maintenance vehicle servicing bays, chemical storage rooms, the main electrical room, and warehouse storage for maintenance parts to service the SunCatchers.

The three assembly buildings will be located beside the Main Services Complex. Assembly buildings will be decommissioned after the project's SunCatchers are assembled and installed.

A water treatment shade structure will be located next to the Main Services Complex and to the northeast side of the Main Services Complex. The water treatment structure will house water treatment equipment and safe storage areas for water treatment chemicals. A motor control center for the water treatment equipment and pumps will be located within this structure. Two wastewater evaporative ponds designed for water treatment wastewater containment will be located just north of the water treatment structure. A control building will be located near the project substation. This building will contain relay and control systems for the substation in one room and the project operations control room in another room or rooms. A diesel-powered fire water pump and a diesel operated standby power generator will be located adjacent to the operation and administration building on the north side.

Electric service for the Main Services Complex will be obtained from SCE. Electric power will be provided via overhead service from an SCE overhead distribution line located on the north side of I-40. Communications service for the Main Services Complex will be obtained from the local phone company. Communications service will be provided via an overhead service from existing underground communications lines located on the north of I-40.

The operation and administration building, maintenance building, and Main Services Complex would be painted with a matching desert sand color and would be manufactured buildings. The water treatment building and the water holding tanks, including the potable water, raw water, and demineralized/fire protection water tanks located at the Main Services Complex would also be painted with a matching desert sand color.

SunCatcher assembly would be performed on-site in temporary structures. These buildings would be decommissioned after all project SunCatchers are assembled and installed. The assembly buildings would be located beside the Main Services Complex.

The primary purpose of the SunCatcher assembly buildings would be the assembly of the SunCatcher superstructure, the main beam assembly and trusses, the pedestal trunnion, mirrors, wire harnesses, control systems, drive position motors, and the calibration of the mirrors and control systems before field installation. Each assembly bay would be equipped with an automated platform on locating rails to move the SunCatcher through the assembly process.

The exterior material for the assembly buildings would be a fire retardant vinyl fluoride film with ultraviolet blocking characteristics and would be chemical and weather resistant. The exteriors would be painted desert sand to match the other structures.

Transport trailer storage would be located adjacent to the assembly building. The storage area would allow the project to maintain a supply of 3 to 5 days of inventory of SunCatcher parts during the assembly phase of construction.

These assembly buildings would be decommissioned and salvaged after all SunCatchers for the Project are installed.

### B.1.4.5 WATER SUPPLY AND TREATMENT

The following types of water would be required for the project:

- equipment washing water,
- potable water,
- dust control water, and
- fire protection water.

When completed, the Calico Solar Project would require a total of approximately 36.2 acre-feet of raw water per year. SunCatcher mirror washing and operations dust control under regular maintenance routines will require an average of approximately 10.4 gallons of raw water per minute.

The applicant originally pursued the use of ground water from the Lavic Groundwater Basin. Calico initiated the drilling of four water wells adjacent to the project site, within the Lavic Groundwater Basin. As wells are drilled the flow rate (gallons per minute – gpm) were determined, concern over sufficiency of this water supply lead to the identification of a new primary water supply from Burlington Northern Santa Fe (BNSF). The Lavic Ground Basin wells may be used as a backup water source, but lack the capacity to provide for construction water needs.

The applicant has identified the water from BNSF owned and operated water well within the Cadiz Valley Groundwater Basin as the new primary source of water from the project. Data from the CA State Water Data Library shows several wells in the Cadiz Groundwater Basins. Some historical data of wells in Cadiz show that well depths were approximately 200 feet below water levels. With the recharge rate, the applicant does not believe that the project requirements would significantly impact the wells in the area.

Similar to the wells mentioned in the AFC, the water from the Cadiz well is characterized as raw water and will require treatment to remove dissolved solids for SunCatcher mirror wash water applications. The water will be required to be demineralized to prevent mineral deposits forming on the SunCatcher mirrors. Processes available for demineralization are Reverse Osmosis (RO) and ion exchange.

Calico believes that with these sources, the project would obtain the water to provide an appropriate quantity and quality for mirror washing.

**Potable Water:** Potable water to meet plant requirements would be delivered by truck or rail and stored in a 5,000-gallon tank in the water treatment area. This tank would be able to provide all required potable water for the operating facility for 2-3 days at which time it would need to be replenished.

**Mirror Washing and Fire Protection Water:** The Main Services Complex will include a location for an approximately 175,000-gallon tank that will be used to store water for SunCatcher mirror washing and fire protection applications. This volume of water will meet all LORS, including fire protection water for the Newberry Springs and the Harvard Station 46 (a County Fire Department staffed station), and for the San Bernardino Fire Department.

**Dust Control Water:** The water will be conveyed to the Main Services Complex via a 6 to 8-inch-diameter water line. The expected average well water consumption for the project during construction is approximately 50 acre-feet per year. Under normal operation (inclusive of mirror cleaning, dust control, and potable water usage), water required will be approximately 36.2 acre-feet per year. Emergency water may be trucked in from local municipalities. The Applicant would seek agreements at the time of the emergency.

The Calico Solar Project water supply requirements are tabulated in **Project Description Table 3**, Water Usage Rates for Operation. The table provides both the expected maximum water usage rates and the annual average usage rates.

**Project Description Table 3**
**Water Usage Rates for Operation**

| Water Use | Daily Average (gallons per minute) | Daily Maximum (gallons per minute) | Annual Usage (acre feet) |
|---|---|---|---|
| **Equipment Water Requirements** | | | |
| SunCatcher Mirror Washing | 11.8[1] | 19.7[2] | 16.1[3] |
| **Water Treatment System Discharge** | | | |
| Brine to Evaporation Ponds | 6.0 | 11.1[4] | 8.1 |
| **Potable Water Use** | | | |
| For drinking and sanitary water requirements | 3.8[5] | 4.6[6] | 5.2[7] |
| **Dust Control** | | | |
| Well water for dust control during operations | 4.2 [8] | 8.3[9] | 6.7[10] |
| **Totals** | **25.8** | **43.7** | **36.2** |

Source: Stirling Energy Systems, Inc.

1 Based on 34,000 SunCatchers requiring a monthly wash with an average of 14 gallons of demineralized water per spray wash and a 5-day work week (21 work days per month).

2 During a 3-month period, all SunCatcher mirrors are given a scrub wash requiring up to three times the normal wash of 14 gallons per SunCatcher. Therefore, the Daily Maximum usage rate is based on 2/3 of the SunCatchers receiving a normal wash and one third receiving a scrub wash.

3 Based on every SunCatcher having approximately 8 normal washes per year with one additional scrub wash.

4 Based on the maximum amount of demineralized water required for mirror washing and assumes a decrease in raw water quality requiring an additional 20% of system discharge.

5 Assumes 30 gallons per person per day for 182 people. 6 Max. amount assumes a 20% contingency over the Daily Avg.

7 Assumes a 6-day work week and average daily usage. 8 Assumes 5,000 gallons per day.

9 Assumes up to 10,000 gallons per day. 10 Assumes daily average dust control operations.

## B.1.4.5 WASTEWATER AND WASTE MANAGEMENT

The water treatment wastewater generated by the reverse osmosis (RO) unit would contain relatively high concentrations of total dissolved solids (TDS). Wastewater or brine generated by the RO unit would be discharged to a polyvinyl chloride (PVC)-lined concrete evaporation pond that meets the requirements of the local Regional Water Quality Control Board. Each pond would be sized to contain 1 year of discharge flow, approximately 2.44 million gallons. A minimum of 1 year is required for the water treatment waste to undergo the evaporation process. The second pond would be in operation while the first is undergoing evaporation. The two ponds would alternate their functions on an annual basis.

After the brine has gone through the evaporation process, the solids that settle at the bottom of the evaporation pond will be tested by the applicant and disposed of in an appropriate non-hazardous waste disposal facility. The solids would be scheduled for removal during the summer months, when the concentration of solids is at its greatest due to an increase in evaporation rates, in order to achieve maximum solids removal.

Sanitary wastewater generated at the facility cannot be conveyed to an existing sewage facility or pipeline as there are no public or private entities that manage sanitary wastewater flows for locations in the vicinity of the project site. The wastewater generated at the Main Services Complex will be discharged into a sub-surface wastewater disposal system with septic tanks and leach fields, and will be designed in accordance with the applicable LORS, including San Bernardino County, California State Regional Water Quality Board, and the Department of Health Services.

The general threshold limit for a standard approval process for septic tanks and leach fields through the local Regional Water Quality Control Board (RWQCB) is 500 gallons per acre per day. The expected daily sanitary wastewater flow from Calico Solar ranges from an average of 5,500 gallons to a peak of 6,600 gallons; the required set aside area given this flow is approximately 14 acres. Given the Project Site area is much greater than 14 acres, the threshold limit for septic tank and leachfield applications will be met. The required leachfield area is estimated to be approximately 1,100 square-feet (0.025 acre).

## B.1.4.6 HAZARDOUS WASTE MANAGEMENT

Hazardous materials used during facility construction and operations would include paints, epoxies, grease, transformer oil, caustic electrolytes (battery fluid), and products that would be generated by the construction equipment, such as waste fuel and waste oil. Several methods would be used to properly manage and dispose of hazardous materials and wastes. Waste lubricating oil would be recovered and recycled by a waste oil recycling contractor. Chemicals would be stored in appropriate chemical storage facilities. Bulk chemicals would be stored in large storage tanks, while most other chemicals would be stored in smaller returnable delivery containers. All chemical storage areas would be designed to contain leaks and spills in concrete containment areas.

### B.1.4.7 DISTRIBUTED HYDROGEN SYSTEM

The project described the hydrogen use, supply and storage in the AFC, filed December 2, 2008. The hydrogen system was described as a k-bottle of hydrogen on each Power Conversion Unit (PCU). One hydrogen gas cylinder would contain approximately 195 cubic feet of hydrogen, used to replenish lost hydrogen gas within the gas circuit. Each k-bottle was to be supported from the base of the PCU boom. Each PCU's k-bottle would either need to be removed and replaced or refilled at each dish site as required (approximately two times per year). The applicant reconsidered the plan for providing hydrogen to the PCUs and has proposed an on-site hydrogen gas supply, storage and distribution system that would eliminate the need for the delivery of hydrogen k-bottles.

As a response to a staff data request, the applicant filed a modified the original project description to propose having the hydrogen gas supply produced through electrolysis by one on-site hydrogen generator. It is important to note that the hydrogen will not be generated from natural gas. The generator is capable of producing 1065 standard cubic feet of hydrogen per hour (scfh) and requires 146 watts/scf of electricity and 2.58 cubic inches of water/scf/hour during operation. Approximately 184 gallons of water per day, or 0.0133 acre feet per year would be required for this generator.

Water for the generator would be obtained from the BNSF Cadiz Valley groundwater wells or from groundwater wells adjacent to the project site, processed through the on-site Water Treatment Plant to produce de-mineralized Water and fed to the electrolyzer mounted on the hydrogen generator skid. The electrolyzer would eliminate any final impurities in the water prior to processing. The annual power consumption to meet the hydrogen production needs is 100 KW per day, or 36.64 MW per year. Although the hydrogen generator could run full time if needed to support SunCatcher hydrogen requirements, the generator would normally be operated at off-peak electric hours using grid power. The hydrogen gas would be stored in a steel storage tank capable of storing approximately a 2-day supply of hydrogen gas. It would be piped through a 1.5-inch stainless steel piping system to 87 individual compressor groups. Each compressor group will be electrically operated and consist of a compressor, delivering gas at approximately 2,900 pounds-force per square inch gauge (psig), and a high pressure supply tank.

Initially, it would take 3.4 scf of hydrogen to charge the Stirling engine. Each PCU is estimated to lose about 200 scf per year. Each high pressure supply tank would supply hydrogen gas to 360 SunCatchers via a 0.25-inch stainless tubing. A low pressure dump tank would be installed with each compressor group utilizing a 0.25-inch stainless steel return line to recover hydrogen gas when the SunCatchers are not in-service. This would reduce hydrogen leaks through fittings and seals on the Stirling Engine. In the event that the hydrogen generator fails, an unloading station designed to receive and transfer hydrogen gas to the storage tank would be installed to allow for the delivery of hydrogen gas to the site by an outside supplier. The hydrogen gas storage tank would provide a few days of hydrogen supply as a back-up system. The applicant would complete all scheduled maintenance to the hydrogen generator, when the gas supply is adequate.

## B.1.4.8 TRANSMISSION SYSTEM INTERCONNECTION AND UPGRADES

This section describes the on-site substation and the transmission interconnection between the Calico Solar Project and the existing SCE electric grid.

The proposed project would include the construction of a new 230-kV Calico Solar Substation approximately in the center of the project site. The proposed project substation would consist of an open air bus with 15, 35-kV collection feeder circuit breakers. Each feeder breaker would be connected to one of the 48-MW or 51-MW overhead collection lines. Additional 35-kV circuit breakers would connect to power factor correction capacitor banks located in the substation yard. This new substation would be connected to the existing SCE Pisgah Substation via an approximately 2-mile, single-circuit, 230-kV transmission line. Other than this interconnection transmission line, no new transmission lines or off-site substations would be required for the 275-MW Phase I construction.

For the 275-MW Phase I of the project, the first interconnection substation would initially consist of 2 power transformers rated at 120/160/200 megavolt amperes (MVA) each to convert the generation collection voltage from 34.5 kV to the transmission tie voltage of 230 kV. The substation would ultimately contain 6 120/160/200-MVA, 34.5-kV to 230-kV step-up power transformers. Each power transformer would serve 3 of the 15 overhead collection lines (one 48-MW line and 2 51-MW lines).

The power transformers would be protected by 230-kV power circuit breakers. Provisions would be made to expand the Calico Solar Substation from 275 to 850 MW with the addition of 3 power transformers in Phase II of the proposed project. Each transformer would collect 150 MW of generation via 3 overhead 34.5-kV collection circuits, each protected by a 35-kV power circuit breaker. The 34.5-kV feeders would be terminated on outdoor circuit breakers.

Control, metering, and protection systems for the line, substation, and collection systems would be contained within a control building located adjacent to the Calico Solar Substation. The control building would also contain the necessary communications equipment to meet owner, California ISO, and SCE requirements. Additional substation equipment would include a 34.5-kV power-factor correction capacitor control system designed to meet the power factor and zero and low-voltage ride-through requirements of the Interconnect Agreement.

The on-site portion of the interconnection transmission line would be installed in a 100-foot ROW from the Calico Solar Project substation southeast to point of intersection with the SCE transmission ROW, then southwest to parallel the transmission ROW to the Pisgah Substation.

The transmission line towers would consist of H-Frame towers at the undercrossing of the existing 500-kV transmission line and double-circuit lattice steel towers and/or steel poles elsewhere. Both circuits of the overhead 230-kV transmission line would be constructed with one 1,590-kilo circular miles/phase, aluminum steel-reinforced conductor per line, each thermally rated to carry full project output in emergency conditions and one-half of project output in normal conditions. Two fiber optic cables would be provided for communication with SCE and the California Independent System Operator (California ISO).

## B.1.5 RELATED FACILITIES (REASONABLY FORESEEABLE FUTURE ACTIONS)

This section describes reasonably foreseeable future actions related to the Calico Solar Project, that are outside of the BLM ROW grant and Energy Commission Decision addressed in this SA/DEIS. A series of upgrades for transmission capability purposes are anticipated by SCE. These projects would require additional environmental review and permitting.

### B.1.5.1 SCE RELIABILITY NETWORK UPGRADES

Construction of the 275-MW Phase I of the Calico Solar Project would require an upgrade of the existing Pisgah Substation to a 500/220 kV substation designed for four 500/220 kV transformer banks. An upgrade would also be required to implement the Reduced Acreage Alternative of the Calico Solar project.

Construction of the 575-MW Phase II of the Calico Solar project, and delivery of the additional renewable power to the SCE system, would require the construction of Phase 2 Reliability Network Upgrades by SCE. The California Public Utilities Commission (CPUC) is the lead agency for CEQA compliance and the BLM is the lead agency for NEPA compliance on the Phase 2 Reliability Network Upgrades project. The SCE will need a Certificate of Public Convenience and Necessity from the CPUC for these Network Upgrades.

The SCE Phase 2 Reliability Network Upgrades Project consists of expansion of the Pisgah Substation and installation of new power transmission facilities. The major components of the upgrades project include:

- Extension of the existing Lugo 500kV Substation East and West Buses to provide for a new 500 kV transmission line position
- Removal of 65 miles of the existing Lugo-Pisgah No. 2 220 kV transmission line between Lugo Substation and Pisgah Substation
- Construction of approximately 65 miles of new 500 kV transmission line between the Lugo and Pisgah Substations. Approximately 55 miles of the new transmission line will utilize the right-of-way (ROW) vacated by the removal of the existing 220 kV line, and approximately 10 miles will require new ROW
- Looping the existing Eldorado-Lugo 500 kV transmission line into the expanded Pisgah 500 kV Substation to form the Eldorado-Pisgah 500 kV transmission line and the Lugo-Pisgah No. 1 500 kV transmission line
- Obtaining required ROW as follows:
    i. New ROW to accommodate new 500/220 kV Pisgah Substation, estimated to require 0.6 acres adjacent to the existing substation location.

ii. Update existing ROW to support construction of the new Lugo-Pisgah No. 2 500 kV transmission line within the existing ROW

iii. Approximately 10 miles of new ROW (near Lugo, California) to support construction of the new Lugo-Pisgah No. 2 500 kV transmission line when use of the existing ROW is not feasible

The environmental review of SCE's Phase 2 Reliability Network Upgrades project by the BLM and CPUC has not yet been initiated although applications have been received by BLM. Therefore the discussion related to SCE network upgrades are being addressed in this document as reasonably foreseeable future actions per NEPA.

## B.1.6 CONSTRUCTION

The project would be constructed in two phases. Phase I of the project would consist of up to 11,000 SunCatchers configured in 183 1.5-MW solar groups of 60 SunCatchers per group, and have a net nominal generating capacity of 275 MW. Phase II would add approximately 23,000 SunCatchers, expanding the project to a total of approximately 34,000 SunCatchers configured in 567 1.5-MW solar groups with a total net generating capacity of up to 850 MW (see **Project Description Figure 2)**.

Heavy construction for the project would be scheduled to occur between 0700 and 1900 Monday through Friday. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities.

Some activities would continue 24 hours per day, 7 days per week. These activities include, but are not limited to, SunCatcher assembly, refueling of equipment, staging of materials for the next day's construction activities, quality assurance/control, and commissioning.

Project construction would be performed in accordance with plans and mitigation measures that would assure the project conforms to applicable LORS and would avoid significant adverse impacts. These plans that are to be developed by the applicant, for which some have already been prepared in draft and reviewed by staff to support this environmental analysis, and the necessary mitigation measures, are specified in the Conditions of Certification as appropriate of each technical area of this SA/DEIS.

## B.1.7 OPERATION AND MAINTENANCE

The Calico Solar Project would be an "as-available" resource. Therefore, the project would operate anywhere between a minimum of approximately 18 MW net when the first units are interconnected to the grid during the construction period to 850 MW on completion of construction. The capability for independent operation of all 34,000 units would give maximum flexibility in operations. The applicant expects that the project would have an annual availability of 99%.

The project would be dispatched by the California ISO, through day-ahead, hour-ahead, and real-time scheduling, as required to meet the demands of the Southern California market. The market would dictate unit operations and total power requirements. The

Calico Solar Project would operate approximately 3,500 hours per annum and is expected by the applicant to have an overall availability of 99% or higher. The number of available operating hours is determined by the availability of the sun's energy at greater than 250 watts per square meter. SunCatchers would be unable to generate electricity when the sun's energy is below 250 watts per square meter in the early morning or late evening hours and when cloud cover limits the sun's energy for power generation. Also, SunCatchers would be unable to generate electricity during daylight hours when the wind speed exceeds 35 miles per hour, as SunCatchers would be stowed in a safe de-track position at this wind speed to prevent damage. SunCatchers are designed to withstand wind speeds of 50 miles per hour in the operating mode and 90 miles per hour in the stowed position. Because the SunCatchers move slowly, they start moving into stow position once winds reach 35 miles per hour in order to be in stow position by the time winds reach 50 miles per hour. Because of the geographical size of the project, cloud cover and/or wind conditions may only affect a portion of the project at any given time.

It is expected that the Calico Solar Project would be operated with a staff of approximately 182 full-time employees. The project would operate 7 days per week, generating electricity during normal daylight hours when the solar energy is available. Maintenance activities would occur 7 days a week, 24 hours a day to ensure SunCatcher availability when solar energy is available.

Mirror washing would be needed approximately once every month, requiring 14 gallons of water per dish with an average washing rate of 20 minutes per washed dish pair. In addition to monthly washing, seasonal scrubbing is anticipated. Seasonal scrubbing would occur prior to peak electricity demand season, June through September.

Maintenance of the PCU's and associated vehicle operations would be required every 6,000 hours of running time.

## B.1.8 DECOMMISSIONING AND RESTORATION

### Introduction

Project closure can be temporary or permanent. Temporary closure is defined as a shutdown for a period exceeding the time required for normal maintenance. Causes for temporary closure include inclement weather and/or natural hazards (e.g., winds in excess of 35 mph, or cloudy conditions limiting solar insolation values to below the minimum solar insolation required for positive power generation, etc.), or damage to the project 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 project age, damage to the project that is beyond repair, adverse economic conditions, or other significant reasons.

### Temporary Closure

In the unforeseen event that the project is temporarily closed, a contingency plan for the temporary cessation of operations will be implemented. The contingency plan will be followed to ensure conformance with applicable LORS and to protect public health, safety, and the environment. The plan, depending on the expected duration of the shutdown, may include the draining of chemicals from storage tanks and other equipment and the safe shutdown of equipment. Wastes will be disposed of according to applicable LORS, as discussed in the **WASTE MANAGEMENT** section.

**Permanent Closure**

The planned life of the Calico Solar Project is 40 years. However, if the project is still economically viable, it could be operated longer. It is also possible that the project could become economically noncompetitive before 40 years have passed, forcing early decommissioning. Whenever the project is permanently closed, the closure procedure will follow a plan that will be developed as described below.

The removal of the project from service, or decommissioning, may range from “mothballing” to the removal of 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 Energy Commission, the BLM, and other applicable agencies for review and approval as part of the decommissioning plan. The decommissioning plan would discuss the following:

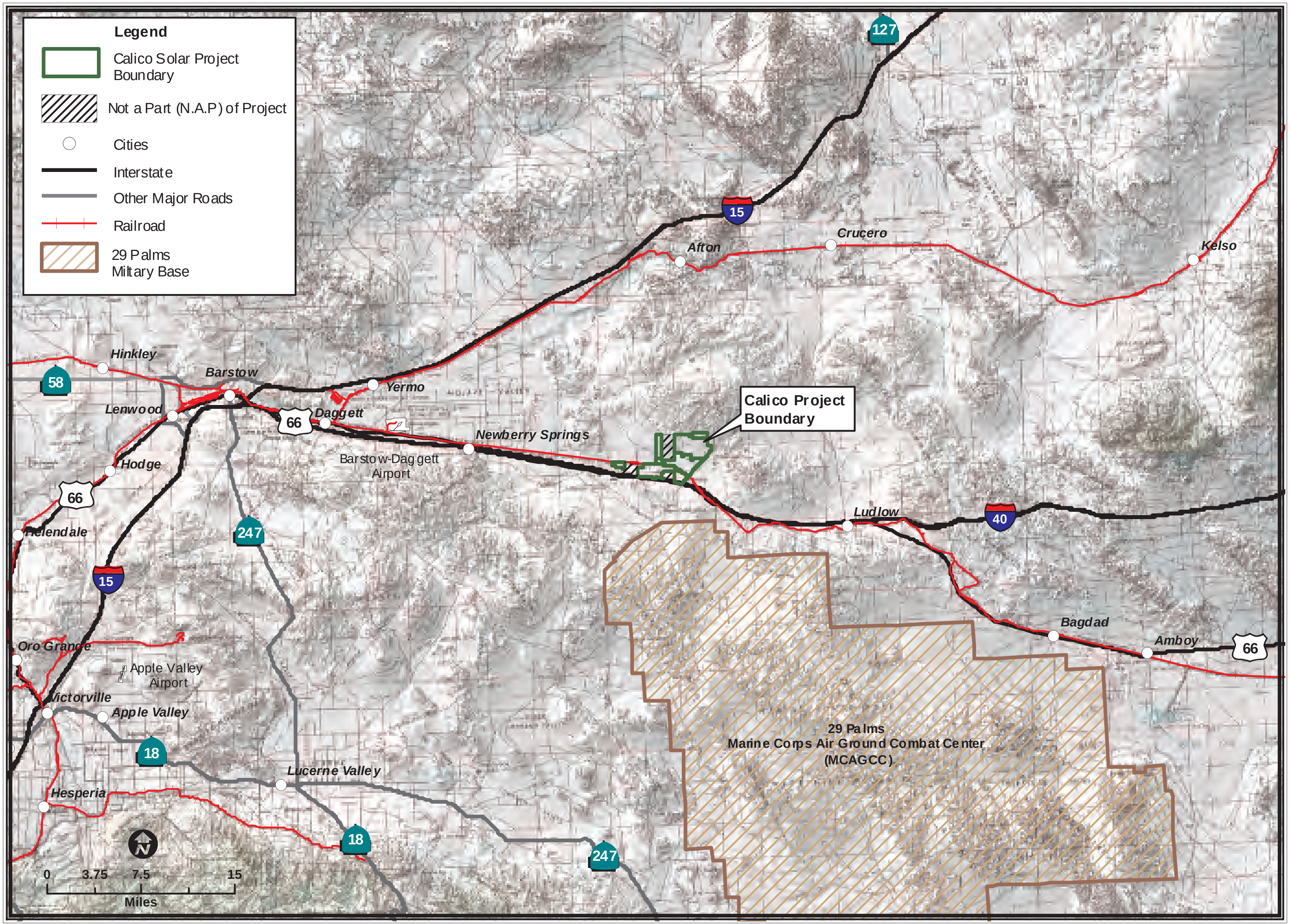
- proposed decommissioning activities for the project and appurtenant facilities constructed as part of the project,
- conformance of the proposed decommissioning activities with applicable LORS and local/regional plans,
- activities necessary to restore the project site if the plan requires removal of equipment and appurtenant facilities,
- decommissioning alternatives other than complete restoration to the original condition, and
- associated costs of the proposed decommissioning and the source of funds to pay for the decommissioning.

In general, the decommissioning plan for the project would attempt to maximize the recycling of project components. Calico Solar would attempt to sell unused chemicals back to the suppliers or other purchasers or users. Equipment containing chemicals would be drained and shut down to ensure public health and safety and to protect the environment. Nonhazardous wastes will be collected and disposed of in appropriate landfills or waste collection facilities. Hazardous wastes will be disposed of according to applicable LORS. The site will be secured 24 hours per day during the decommissioning activities, and Calico Solar will provide periodic update reports to the Energy Commission, the BLM, and other appropriate parties.

Similar to project construction and facility operations, decommissioning would be performed in accordance with plans and mitigation measures that would assure the project conforms to applicable LORS and would avoid significant adverse impacts. These plans that are to be developed by the applicant, for which some have already been prepared in draft and reviewed by staff to support this environmental analysis, and the necessary mitigation measures, are specified in the Conditions of Certification as appropriate for each technical area of this SA/DEIS. The BLM would also require mitigation and restoration as stipulated in the identified Plan of Development, as well as other federal agency requirements. The authorized project would be bonded consistent with agency policy.

**PROJECT DESCRIPTION - FIGURE 1**

Calico Solar Project - Regional Transportation Network



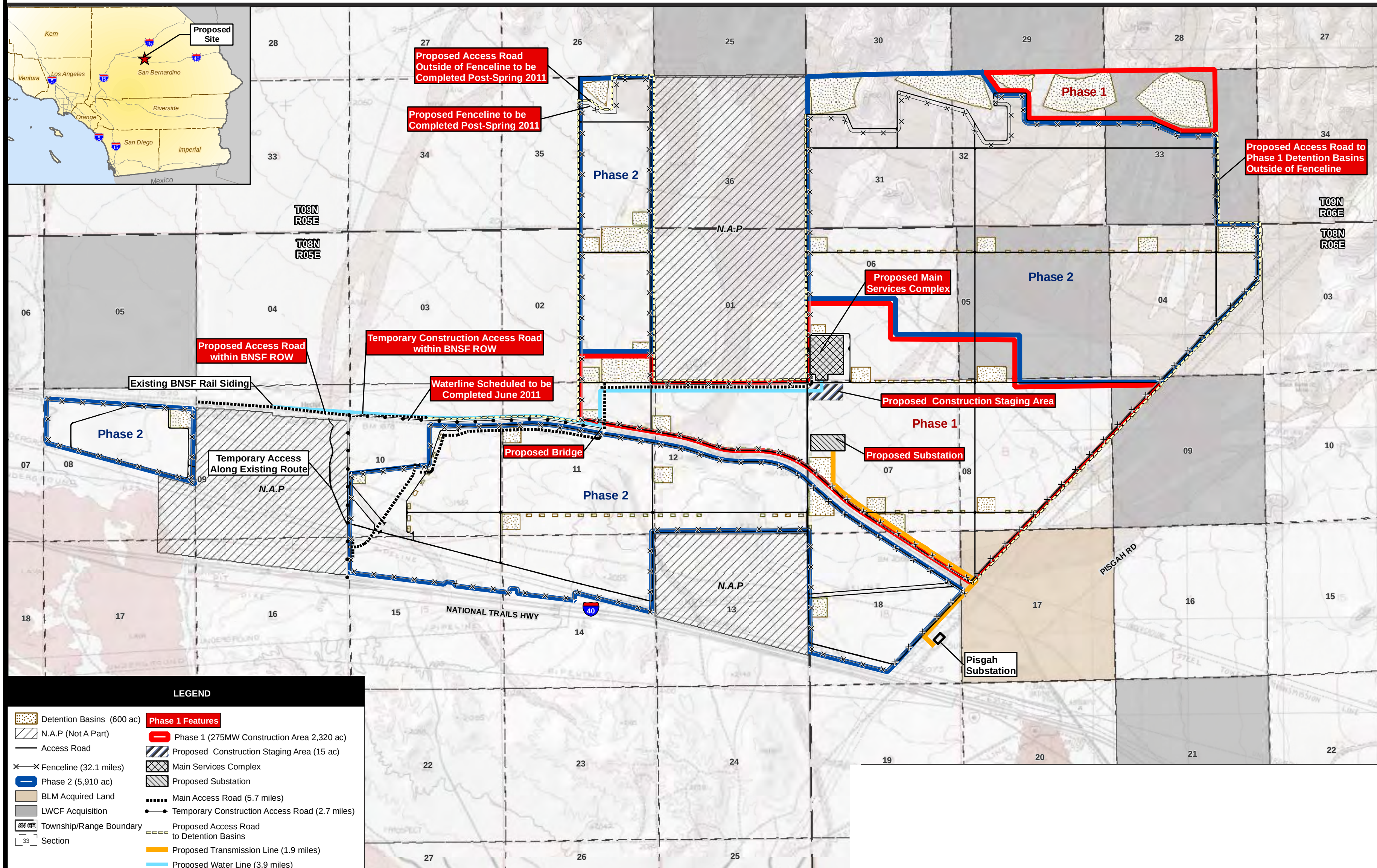



U.S. BUREAU OF LAND MANAGEMENT and CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, MARCH 2010

SOURCE: California Energy Commission - Tele Atlas Data - San Bernardino County

## PROJECT DESCRIPTION - FIGURE 2

Calico Solar Project - Existing Projects - Project Layout

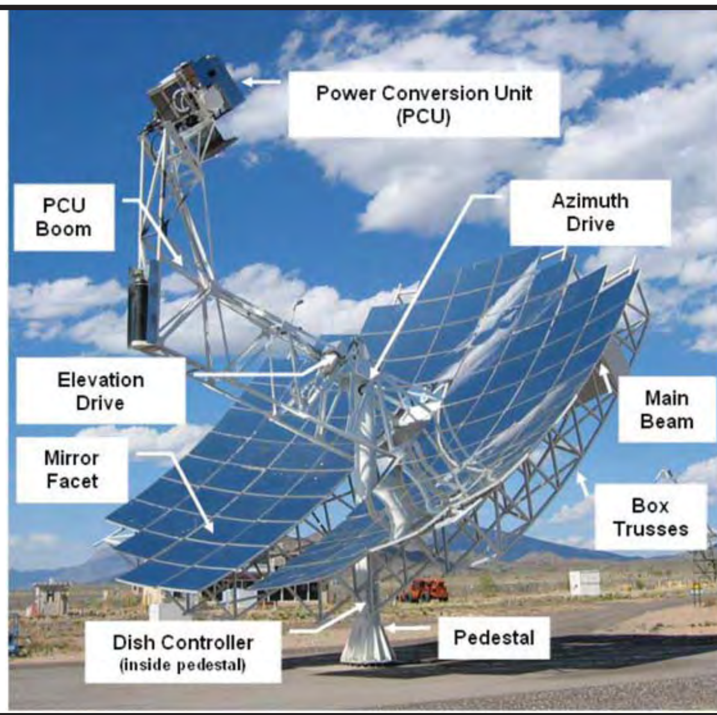



**CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, MARCH 2010**

SOURCE: URS

**PROJECT DESCRIPTION - FIGURE 3**

Calico Solar Project - SunCatcher Details


**CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, MARCH 2010**

SOURCE: SES Solar Two Project - AFC Photograph 1-1 and 1-2