3.1 FACILITY DESIGN, EFFICIENCY AND RELIABILITY

3.1.1 Facility Design

The Commission Decision determined that the preliminary facility design of the Approved Project demonstrated that the Approved Project would comply with all applicable LORS (Commission Decision, Facility Design at 3). As with the Approved Project, the Conditions, as modified in this Amendment, would ensure that the Modified Project is designed and constructed in accordance with applicable laws and in a manner that protects public health and safety.

3.1.1.1 Summary of Project Changes Related to Facility Design

The Commission evaluated detailed descriptions of the Project site, including soils, seismic conditions, and flood hazards, during the licensing of the Approved Project and, as noted above, determined that this information, together with the facility design information presented, demonstrated that the Approved Project would comply with all applicable LORs. For a significant portion of the Approved Project's major structures and equipment, the descriptions considered by the Commission in approving the Approved Project would also not change under the Modified Project.

While the facilities would be relocated under the Modified Project, the basic descriptions and design criteria would remain unchanged for the following facilities:

- lighting systems, heating, ventilation, and air conditioning systems, and building construction;
- tank sizing and descriptions; and
- water supply and treatment equipment and facilities.

Under the Modified Project, the main change from the Approved Project would be the use of PV. The PV modules are described in the Project Description section and would be designed and constructed according to applicable industry standards and codes, as well as applicable LORS. A description and table summarizing the new electrical equipment needed for the PV modules is included in the Section 2 of this Petition. The PV Inverter Blocks would be installed in 1.52 MW blocks where all the direct current power generated by the modules would be delivered to inverters, which then would be converted to alternating current, stepped up and transferred to the on-site substation. All power entering the on-site substation would be collected and synchronized for transmission to the Pisgah substation. All intermediate power transmission and substation design features would conform to applicable industry standards and codes.

3.1.1.2 Consistency with LORS

The Commission Decision concluded that, with implementation of the Conditions, the Approved Project would comply with all applicable LORS. As with the Approved Project, the Modified Project would comply with all applicable LORS.

3.1.1.3 Conditions of Certification

The Commission Decision concluded that Conditions GEN-1 through GEN-8, CIVIL-1 through CIVIL 4, STRUC-2 through STRUC-4, MECH-1 through MECH-3 and ELEC-1 would ensure that the Approved Project is designed and constructed in accordance with applicable law and in a manner that protects public health. Implementation of these conditions, as modified below to conform with the Modified Project, would ensure that the Modified Project is similarly designed and constructed in accordance with applicable requirements and in a manner that protects public health and safety.

The only modifications necessary to the Facility Design Conditions of Certification is the following Table 2 should replace the Table 2 in Condition of Certification **GEN-2** and **ELEC-1** should be modified as shown below.

Facility Design Table 2
Major Structures and Equipment List

Equipment/System	Quantity (Plant)
PV Inverter Blocks	1 Lot
Modules	1 Lot
Administration Building Structure, Foundation and Connections	1
Maintenance Building Structure, Foundation and Connections	1
Collector Group Generator Step-up Unit Transformer Foundation and	1 Lot
Generator Collection Power Center	1 Lot
Generator Collection Sub-panel	1 Lot
Power Factor Capacitor	1 Lot
Open Bus Switch Rack	6
Shunt Capacitor Bank	~~6~~1
Dynamic VAR Compression System	~~6~~1
Disconnect Switch	15
Power Transformer Foundation and Connections	6
Coupling Capacitor Voltage Transformer Foundation and Connections	6
Diesel Power Generator Set Foundation and Connections	1
Fire Water Pump Foundation and Connections	1
Water Treatment System Foundation and Connections	1

Potable/Fire Water Tank Structure, Foundation and Connections	1
Well Water Storage Tank Structure, Foundation and Connections	1
Demineralized Water Storage Tank Structure, Foundation and	2
Chemical Storage Area	1 Lot
Drainage Systems (including sanitary drain and waste)	1 Lot
High Pressure and Large Diameter Piping and Pipe Racks	1 Lot
HVAC and Refrigeration Systems	1 Lot
Temperature Control and Ventilation Systems (including water and	1 Lot
Building Energy Conservation Systems	1 Lot
Equipment/System	**Quantity (Plant)**
Substation, Switchboards, Transformers, Buses and Towers	1 Lot
Electrical Breakers, Cables/Duct Banks	1 Lot
Prefabricated Assemblies	1 Lot

ELEC-1 Prior to the start of any increment of electrical construction for all electrical equipment and systems 480 Volts or higher (see a representative list, below), with the exception of underground duct work and any physical layout drawings and drawings not related to code compliance and life safety, the project owner shall submit, for CBO design review and approval, the proposed final design, specifications, and calculations. Upon approval, the above listed plans, together with design changes and design change notices, shall remain on the site or at another accessible location for the operating life of the project. The project owner shall request that the CBO inspect the installation to ensure compliance with the requirements of applicable LORS. All transmission facilities (lines, switchyards, switching stations, and substations) are handled in Conditions of Certification in the **Transmission System Engineering** section of this Decision.

A. Final plant design plans shall include:

1. one-line diagrams for the 480 V, 1000 V, 34.5 kV and 230 kV systems; and
2. system grounding drawings.

B. Final plant calculations must establish:

1. short-circuit ratings of plant equipment;
2. ampacity of feeder cables;
3. voltage drop in feeder cables;

4. system grounding requirements;
5. coordination study calculations for fuses, circuit breakers and protective relay settings for the 480 V, 1000 V, 34.5 kV and 230 kV systems;
6. system grounding requirements; and
7. lighting energy calculations.

C. The following activities shall be reported to the CPM in the monthly compliance report:

1. Receipt or delay of major electrical equipment;
2. Testing or energization of major electrical equipment; and
3. A signed statement by the registered electrical engineer certifying that the proposed final design plans and specifications conform to requirements set forth in the Energy Commission decision.

Verification: At least 30 days (or project owner- and CBO-approved alternative time frame) prior to the start of each increment of electrical construction, the project owner shall submit to the CBO for design review and approval the above listed documents for such increment. The project owner shall include in this submittal a copy of the signed and stamped statement from the responsible electrical engineer attesting compliance with the applicable LORS, and shall send the CPM a copy of the transmittal letter in the next monthly compliance report.

3.1.2 Power Plant Efficiency

The Commission determined that:

- the Approved Project would not use fossil fuel to generate electricity;
- the Approved Project's fuel consumption would be negligible;
- the impact of the Approved Project's fuel consumption on energy supplies and energy efficiency would be insignificant; and
- the Approved Project would decrease reliance on fossil fuel and increase reliance on renewable energy (Commission Decision, page Efficiency 5).

The Modified Project would not alter these conclusions.

3.1.2.1 Engineering Baseline

The Approved Project would rely entirely on SunCatcher technology to generate electricity. The Modified Project would replace SunCatchers with PV modules. As with

SunCatchers, PV technology does not use any fossil fuels but rather solar energy to produce electricity.

One of the issues discussed during the licensing proceedings was the land use efficiency of the SunCatcher technology. The Commission Decision relied on the 850 MW 6,215-acre Proposed Project to determine that the SunCatcher technology had a power-based land use efficiency of 0.14 MW/acre or 7.3 acres/MW assuming the generating capacity and acreage of the Approved Project (Commission Decision, page Efficiency 3 and 4). Based on this assumption, the Commission concluded that the energy-based efficiency would be approximately 296 megawatt hours (MWh)/acre-year. As shown in Table 3.1-1, the power-based land use efficiency under the 663.5 MW 4,613-acre Approved Project was calculated to be 0.14 MW/acre and the energy-based land use efficiency would be 311 MWh/acre-year. For the Modified Project, using a PV Tracker system, the power-based land use efficiency would be 0.16 MW/acre and the energy-based land use efficiency would be 441 MWh/acre-year. For the Modified Project, using a PV Fixed Tilt system, the power-based land use efficiency would be 0.13 MW/acre and the energy-based land use efficiency would be 327 MWh/acre-year.

TABLE 3.1-1
ESTIMATED SOLAR LAND USE EFFICIENCY

	Proposed Project (Calculation based on Project as Submitted)	Approved Project (Calculation based on Approved MW and Acreage)	PV Tracker Modified Project	PV Fixed Tilt Modified Project
Generating Capacity (MW net)	850	663.5	618	514
Annual Energy Production (MWh net)	1,840,000	1,435,200	1,700,000	1,260,000
Annual Fuel Consumption (MMBtu LHV)	0	0	0	0
Footprint (acres)	6,215	4,613	3,851	3,851
Land Use Efficiency (Power-Based) (MW/acres)	0.14	0.14	0.16	0.13
Land Use Efficiency (Energy-Based) (MWh/acre-year)	296	311	441	327

Under the Modified Project, the overall land-use efficiency based on energy (i.e., MWh) would be higher than the Approved Project, and, based on energy (i.e., MW), the Modified Project would be close to or better than the Approved Project, depending on the final technology selection (module type and tracking system or fixed tilt system).

3.1.3 Power Plant Reliability

The Commission made the determinations listed below for the Approved Project.

- No North American Electric Reliability Corporation (NERC)[3] statistics for solar power plants were available at that time.
- The technology that would be used by the Approved Project has certain potential reliability advantages compared to other generating technologies, including its modularity and the ability to maintain and repair individual units without materially affecting overall output, and certain disadvantages, including a relative lack of historical field data on commercial-scale installations.
- The Approved Project is anticipated to operate at an annual capacity factor of approximately 20 to 25 percent depending upon climate trends, atmospheric dust levels, and maintenance schedules.
- Implementation of quality assurance/quality control (QA/QC) programs during design, procurement, construction, and operation of the plant, as well as adequate maintenance and repair of the equipment and systems, would ensure that the Approved Project would be adequately reliable.
- Implementation of appropriate Conditions included in the Facility Design section of the Commission Decision would ensure implementation of the QA/QC programs and conformance with seismic design criteria.
- The Applicant would use water from a private well adjacent to the Project site to supply water for the Project. Evidence regarding the adequacy of the water supply consisted, in part, of additional information regarding the Lavic Groundwater Basin. This evidence, in combination with implementation of Condition SOIL&WATER-9, would ensure that the water supply would be adequate for the Project.
- The Project would meet or exceed reliability during seismic events, flooding and high winds.
- The Project would incorporate an appropriate redundancy of function for its equipment (Commission Decision, page Reliability 6).

[3] NERC reliability standards define the reliability requirements for planning and operating the North American bulk power system; they are developed using an industry-driven ANSI-accredited process.

The Commission concluded that the Approved Project "…would meet or exceed industry norms for reliability and would not degrade the overall reliability of the electrical system" (Commission Decision, page Reliability 7). Under the Modified Project, the SunCatchers on site would be replaced with PV modules, which are widely utilized and proven to be very reliable. Consequently, the Modified Project would also meet or exceed industry norms and not degrade electricity system reliability.

3.1.3.1 Engineering Baseline

The primary responsibility for ensuring the reliability of California's electricity system falls to the CAISO. The Commission evaluates the reliability of a proposed power plant to ensure that it does not degrade the reliability of the interconnected electricity system and "…exhibit a level of reliability similar to that of power plants of past decades" (Commission Decision, page Reliability 1). In its evaluation, the Commission considers both a power plant's "…actual ability to generate power when it is considered to be available and failures at startup and unplanned (or forced) outages." The Commission seeks to ensure that power plants "…are able to operate for extended periods without shutting down for maintenance of repairs" (Commission Decision, page Reliability 1).

In evaluating the reliability of the power plant associated with the Approved Project, the Commission assessed five factors: (1) adequacy in levels of equipment availability, (2) plant maintainability with scheduled maintenance outages, (3) fuel and water availability, (4) resistance to natural hazards, and (5) comparison with industry norms. A comparison of these factors under the Approved Project and the Modified Project is provided in Table 3.1-2.

TABLE 3.1-2
COMPARISON OF POWER PLANT RELIABILITY FACTORS UNDER APPROVED AND MODIFIED PROJECT

Factor	Approved Project (Commission Decision, page Efficiency 2-6)	Modified Project
Equipment Availability	Reliability determined through: • Use of appropriate QA/QC programs • Use of qualified suppliers • Use of independent testing contracts • Use of specific Conditions • Use of manufacturer's warranty obligations and fulfillment program	Reliability determined through: • Use of appropriate QA/QC programs • Use of qualified suppliers • Use of independent testing contracts • Use of specific Conditions • Use of manufacturer's warranty obligations and fulfillment program
Plant Maintainability	Reliability determined through: • Use of redundant pieces of equipment • Positive trend in long-term availability factor at existing commercial facility • Use of Condition to report on SunCatcher reliability and maintenance data	Reliability determined through: • Long operating history with PV modules
Fuel and Water	Reliability determined through: • No use of natural gas or fossil fuels	Reliability determined through: • No use of natural gas or fossil fuels

TABLE 3.1-2
COMPARISON OF POWER PLANT RELIABILITY FACTORS UNDER APPROVED AND MODIFIED PROJECT

Factor	Approved Project (Commission Decision, page Efficiency 2-6)	Modified Project
Availability	• No water for power plant cooling • Use of Condition to monitor long-term trends in groundwater levels and storage	• No water for power plant cooling • Use of Condition to monitor long-term trends in groundwater levels and storage
Natural Hazards	Reliability determined through: • Commitment to Project design and construction using latest applicable seismic, wind, and other LORS • Compliance with Facility Design Conditions • Commitment to Project design and construction that would provide adequate levels of flood resistance	Reliability determined through: • Project design and construction using latest applicable seismic, wind, and other LORS • Compliance with Facility Design Conditions • Commitment to Project design and construction that would provide adequate levels of flood resistance

The Commission also considered how the Approved Project would compare with industry reliability norms. Information collected on the Maricopa Plant that was submitted during the certification proceeding demonstrated that SunCatcher technology is able to achieve an overall availability factor of 96.1 percent. Based on this information, the Commission determined that the Approved Project would be likely to achieve NERC's typical availability factors of 94 to 98 percent. However, in late 2011 Stirling Energy Systems, the manufacture of the SunCatcher technology went bankrupt and the technology was determined to no longer be a viable option for the Modified Project development.

PV technology has achieved mainstream acceptance worldwide for power generation. Worldwide, installed PV capacity grew to almost 23 gigawatts in 2009, with the greatest expansion in Europe. Indications are that growth continued apace through 2010. PV technology has entered the main stream of power production technology.

With the worldwide expansion of PV module demand and production capacity, the industry has matured. A robust network of manufacturers, sub-component suppliers, financiers and end users has developed, with commensurate gains in product reliability. PV technology has demonstrated reliability in a variety of countries and a variety of applications, including utility and industrial service applications. The per-watt price of PV modules has fallen in the last few years, and forecasts show continued price reductions and rising demand (GlobalData 2011). An expanding universe of engineers, constructors, insurance companies and lenders are adept at developing and servicing solar projects, thus providing improved service and support for PV projects.

Commercial facilities of the size proposed for the Modified Project are still relatively new, and limited long-term reliability data are available. Unlike conventional power

plants, PV plants are not subject to single-point failure modes, such as failure of a steam turbine or boiler. If an individual module fails, the loss is only about 1/3 kW, which is a miniscule fraction of the total plant output. Similarly, if an inverter fails, the loss is only 0.76 MW, which is only 1/10 percent of the total plant output. And, even in the tracker system, if a tracker motor or gearbox fails, the affected modules would continue to generate power in a fixed position, albeit at slightly reduced output.

Replacement of these items – modules, inverters, and tracker motor/gearboxes – is a simple operation that does not require heavy cranes or equipment. Spares of all these items would be stored in the facility warehouse. Modules weigh only about 55 pounds and require less than 10 bolts and 3 snap-type wire connectors. Inverters can be installed with a forklift or small mobile crane. Tracker motors can be lifted into place manually.

In summary, the PV portion of the Modified Project would consist of large numbers of small, easily replaceable components. Availability and reliability is expected to match the performance of conventional power plants. Manufacturers of PV modules typically offer 12 year warranties against failure, and 25 year warranties on sustained performance. Based on a review of the factors considered for determining power plant reliability, the Modified Project would meet the same reliability considerations as the Approved Project.

3.1.3.2 Conditions of Certification

The Commission included Condition of Certification REL-1 in its Final Decision related to collecting and reporting data on the Maricopa Plant, the first commercial-scale power plant using the SunCatcher technology. The data included quarterly reliability and maintenance data, equipment failure logs and plant operating logs. Because the Modified Project will no longer use SunCatcher technology, this Condition of Certification REL-1 should be deleted.