Executive Summary

Rice Solar Energy, LLC (RSE), a wholly owned subsidiary of SolarReserve, LLC, proposes to construct, own, and operate the Rice Solar Energy Project (RSEP or the project). The RSEP will be a concentrating solar power (CSP) facility constructed on a privately owned site located in unincorporated eastern Riverside County, California. The project will have a nominal generating capacity of 150 megawatts (MW), and will be capable of delivering 450,000 megawatt hours (MWh) of renewable energy annually to help meet California's Renewable Portfolio Standard (RPS) energy procurement goals.

RSE's concentrating solar power technology consists of a large field of mirrors or heliostats that concentrate and focus the sun's energy onto a central receiver positioned on top of a tower. The project features thermal energy storage that allows solar energy to be captured throughout the day and retained in a liquid salt heat transfer fluid. When electricity is to be generated, the hot liquid salt is routed to a series of heat exchangers to produce steam. The steam is used to generate electricity in a conventional steam turbine cycle; an air-cooled condenser (ACC) is utilized to minimize water consumption.

The liquid salt solar generating system for the RSEP is proprietary technology of the United Technologies Corporation (UTC) with engineering by UTC's Pratt & Whitney Rocketdyne subsidiary in Canoga Park, California. This U.S.-developed technology was demonstrated successfully in the Department of Energy sponsored 10-MW *Solar Two* project near Barstow, California, in the 1990s. SolarReserve has the exclusive, worldwide rights for this technology under a long-term license agreement.

Central tower technology with integral energy storage offers the following benefits.

- Energy storage allows RSE to "decouple" the process of solar energy collection from that of electricity generation, allowing the plant to generate steady and uninterrupted power during hours of peak electricity demand, despite cloud cover, and even at night.
- By focusing all the solar energy on a central point, the liquid salt can be heated to very high temperatures, achieving high steam turbine cycle efficiencies and maximizing the cost-effectiveness of integral storage.
- Using a large central tower with a compact power island allows for a dense heliostat field and a minimal piping footprint, affording improved economies of scale that lower the unit cost of electricity.

RSEP technology can be distinguished from other CSP technologies through its use of liquid salt [1] as the heat transfer medium. Liquid salt has inherent thermal energy storage properties, has greater heat retention capacity and can operate at far higher operating temperatures than alternatives such as synthetic oil, and will not vaporize or burn.

[1] The salt is a mixture of sodium nitrate, a common ingredient in fertilizer, and potassium nitrate, a fertilizer and food additive. These mineral products will be mixed onsite as received directly from mines in solid crystallized form and used without additives or further processing other than mixing and heating.

Unlike parabolic trough systems that require miles of exposed fluid piping, RSEP technology employs a single, common receiver placed at the top of a tall central tower. The receiver consists of several panels containing hundreds of vertical, thin-walled tubes. The panels are piped together to form a compact, circular heat exchanger. Solar energy reflected from the entire field is concentrated onto the central receiver. Liquid salt flowing within the tubes absorbs the heat, which is ultimately collected in the "hot" salt storage tank near the base of the tower. In a separate process, hot salt is pumped through the steam generation system, giving up its heat through a series of heat exchangers that efficiently produce superheated steam that powers a turbine to generate electricity. The salt is then collected in the "cold" salt tank, from which it is pumped back to the receiver.

Liquid salt is chosen for this process due to highly beneficial properties for solar applications. In the liquid state, salt has viscosity and appearance similar to that of water. Unlike water, which becomes steam at relatively low temperatures, the salt remains in liquid state even at very high temperatures. Thus, large quantities of thermal energy can be captured and retained for days at a time and extracted on demand, whether or not the sun is shining. The technology can therefore produce electricity whenever it is needed, including periods of high electricity demand that often extend well past sunset. In addition, because the process of collecting solar energy is decoupled from the electricity generation process, RSE's technology can deliver a stable, predictable, and controllable supply of electric power without any of the intermittency associated with other popular forms of renewable energy. RESP affords a stable and efficient electricity supply that can be sustained during prolonged periods of daytime cloud cover without using fossil fuels to maintain or enhance steam cycle operation. Thus, operation of the RSEP facility does not involve any combustion systems, producing reliable electricity in a sustainable manner.

Project Objectives

The RSEP is being developed to provide sustainable, renewable, cost-effective energy, with energy storage for operating flexibility that contributes to the achievement of the renewable portfolio standards. Project objectives include the following:

- Generate controllable, predictable renewable power using integral thermal storage technology that:
  - captures solar energy throughout the day, through varying sunshine and even periods of dense cloud cover
  - stores thermal energy for electricity production during hours of peak electricity demand, including nighttime hours
  - generates stable power that enhances grid system stability and helps to facilitate integration of new intermittent renewable resources elsewhere
  - avoids the need for support from costly grid resources such as spinning reserves and peaking turbines
- Deliver a minimum of 450,000 MWh of cost-competitive renewable power annually

- Generator output sized to maximize energy deliveries, reliably, during high electric demand hours
- Minimize use of public lands by siting the project on private property that is formerly disturbed
- Produce a reliable electricity supply free of carbon emissions to help diversify California's electrical power generation portfolio

Project Components

The RSEP design incorporates the following principal elements.

- Heliostat field with up to 17,500 tracking heliostats, each approximately 24 feet tall by 28 feet wide, arranged in a circular array that will reflect and concentrate the sun's energy onto a tower-mounted receiver (The field covers 1,410 acres, which include the 80-acre power block near its center.)
- A concrete central tower approximately 540 feet tall, upon which is mounted a receiver approximately 100 feet tall topped with a small maintenance crane, for an overall structure height of 653 feet
- A liquid salt storage system featuring insulated "hot" and "cold" salt storage tanks
- A steam turbine generator system rated at 150 MW (net)
- A 20-cell ACC to provide water-free cooling and condensing of the steam turbine exhaust
- A 10-mile, 230-kilovolt (kV) generator tie-line to connect the RSEP with the existing Western Area Power Administration (Western) Parker-Blythe transmission line (The new tie-line has been routed along existing dirt roads for approximately 5.4 miles and will require minimal construction of approximately 4.6 miles of single-lane dirt access road for construction and inspection. A new interconnection substation [approximately 3 acres in size] for the tie-in to Western's system will be constructed adjacent to the existing transmission line. The generator tie-line will cross land managed by the Bureau of Land Management [BLM].)
- Extension of the existing low-voltage power distribution network spanning about 1 mile, including a span of less than 200 feet across BLM land, to supply ancillary facilities
- Two onsite water wells to provide water for heliostat washing, steam cycle makeup and other process uses in an amount not expected to exceed 180 acre-feet per year
- Three lined evaporation ponds of approximately 5 acres each to capture all process wastewater discharge from the project's water treatment system, process blowdown, and stormwater drainage from within equipment areas
- Stormwater drainage features to channelize offsite stormwater flows from upstream of the project site, diverting offsite stormwater around the project site, and rejoining the natural flow channels to the south of the property

- Two emergency diesel generators and associated equipment to supply emergency backup power for the safe shut-down and protection of vital equipment and facilities
- Onsite fire protection facilities, which consist of two sets of electric-motor-driven and diesel-engine-driven fire pumps and related fire detection and protection equipment
- Various buildings for plant control room, administration offices, maintenance and storage, and crew comfort facilities
- Physical security systems including fencing, closed-circuit television, and other means to protect against unwanted entry consistent with electric utility and Department of Homeland Security requirements

These facilities are described in further detail in Section 2.0.

Project Location

The RSEP site is a privately owned parcel located in eastern Riverside County. The site is adjacent to State Route (SR) 62, which parallels a portion of the Arizona-California Railroad and the Colorado River Aqueduct, near the junction of SR 62 and Blythe-Midland Road, and near the sparse remains of the abandoned town of Rice, California. The nearest occupied residence is approximately 15 miles northeast at the rural crossroads community of Vidal Junction, California. The nearest town is Parker, Arizona (population 3,181), approximately 32 miles east. A small permanent residential settlement is located at the Metropolitan Water District of Southern California's Iron Mountain Pumping Plant, approximately 17 miles west.

The RSEP is within a larger, privately owned holding that is 3,324 acres (the ownership property). Within this larger property, the RSEP is sited within a new square-shaped parcel (the project parcel) that will be created by merging what are currently four different assessor's parcels, each of them a discrete section (square mile) of land, resulting in a single 2,560-acre parcel. Within this project parcel will be the administration buildings area, heliostat field with power block, and evaporation pond areas, (collectively, the project site or facility site) totaling 1,410 acres, that will be surrounded by a security fence. Areas outside the facility site but within the project parcel will not be fenced or developed or disturbed as part of the RSEP.

The RSEP site was used during World War II as Rice Army Airfield, a part of the Army's Desert Training Center/California-Arizona Maneuver Area (DTC/CAMA). The Rice Army Airfield and adjacent Camp Rice were part of a three-state ad hoc training environment established to acclimatize troops to desert warfare between 1942 and 1944 and involved infantry, artillery, and air support forces. The DTC/CAMA consisted of more than 14 widely separate encampments or bivouac facilities and large maneuver and training areas surrounding the camps. After World War II, the military disposed of the airfield, transferred it to the county and later sold it into private ownership. Rice Airfield was operated privately until it was abandoned between 1954 and 1958.

The RSEP generator tie-line will follow a 10.0-mile-long path from the project site to an intercept point along the existing Western Parker-Blythe transmission line, southeast of the project site. A new interconnection substation of approximately 300 feet by 400 feet (less than 3 acres) will be constructed at the tie-in point for the new circuit breakers that will accommodate the RSEP. The generator tie-line will cross land owned by the federal

government and managed by the U.S. Bureau of Land Management and is proposed to cross two small private parcels. The transmission line will follow an existing dirt road for 5.4 miles and will require construction of 4.6 miles of a new single-lane, dirt access road.

Project Owner

The RSEP will be owned and operated by RSE, a wholly owned subsidiary of SolarReserve, LLC, a Delaware limited liability company with its principal place of business in Santa Monica, California.

Project Schedule

RSE is filing this Application for Certification (AFC) under the California Energy Commission's (CEC) standard certification process. Construction of the project is planned to begin in spring 2011, assuming all necessary permits have been received. Based upon an anticipated construction period of approximately 30 months, commercial operation is targeted for October 2013. RSE is presently in negotiations with California utilities for long-term purchase power agreements from the RSEP which, when executed, would require deliveries of power from the RSEP facility by this date.

Project Alternatives

The central receiver tower design with integral liquid salt thermal storage is the technology and design that best meets RSE's project objectives. As stated earlier, the objectives include producing cost-competitive renewable and carbon-free electricity, with operational flexibility, a stable power supply, and the capability to operate during periods of peak electrical demand on cloudy days and after the sun goes down. The liquid salt technology provides efficient thermal energy storage and heat transfer to the steam generator because it remains stable at high temperatures, allowing for a highly efficient steam turbine cycle. Thermal energy retained in the salt can be stored with very little heat loss over long periods. None of the commonly available solar technologies can meet these project objectives as effectively and efficiently as the central tower technology with liquid salt thermal storage.

RSE chose the Rice location on which to develop the project because it is in a remote area on privately owned and previously disturbed land with few competing uses. This site minimizes the use of public lands and potential impacts on sensitive habitats and biological resources. The remote location avoids sensitive receptors of noise and reduces visual impact concerns significantly.

RSE considered using water cooling technology and rejected it in favor of the ACC (dry-cooling) technology. Only small amounts of water from local wells will be used for cooling ancillary equipment, thus preserving scarce water resources.

Environmental Considerations

This AFC addresses sixteen areas of possible environmental effects of the project, pursuant to the requirements set forth in existing environmental laws and the CEC's regulations.

Detailed descriptions and analyses of these areas are presented in Sections 5.1 through 5.16. As discussed in detail in these sections, with the implementation of the proposed mitigation measures, there will be no significant environmental impacts associated with the construction and operation of the RSEP. This executive summary highlights findings related to five subject areas that have historically received the greatest level of attention in CEC proceedings: air quality, biological resources, noise, visual resources, and water resources. Additionally, the topic of cultural resources is discussed here because the project site is the location of the former Rice Army Airfield, a World War II training facility.

Air Quality

The RSEP site is located in the Mojave Desert Air Basin (MDAB), which includes the desert portion of San Bernardino County and those portions of Riverside County commonly known as the Palo Verde Valley. The MDAB is considered to be in a state of non-attainment of the federal ambient air quality standards for ozone (1-hour) and is in attainment or unclassified in relation to the federal standards for fine particulates known as $PM_{2.5,}$ as well as PM_{10}, carbon monoxide, nitrogen dioxide, and sulfur dioxide. The MDAB is considered as not attaining the state ambient air quality standards for ozone (1- and 8-hour) and fine particulates (24-hour and annual).

Emission sources associated with operation of the RSEP are two emergency diesel fire pumps, two emergency diesel generators, and an evaporative wet surface air cooler (WSAC). There is no combustion involved in the production of electrical power. Additionally, the process of initial melting and conditioning of the liquid salt that takes place during the commissioning period will emit criteria pollutants, primarily nitrogen dioxide as a result of decomposition of magnesium nitrate, a contaminant in the salts, and operation of a fired heater necessary to melt the salt mixture from solid to liquid form. The initial melting of the salt is completed during the commissioning phase and this process is not necessary during the operational life of the project. Consequently, standard operation of the plant will not result in air emissions from permitted sources. The potential air quality effects of the salt conditioning process during commissioning and from periodic running of emergency diesel engines during operations will be mitigated by the installation and operation of best available control technology. The project will have no significant adverse impact on air quality or public health. See Section 5.1 for a detailed analysis of air quality and Section 5.9 for an analysis of public health.

Biological Resources

A literature search conducted for the project indicated that several species considered sensitive by the biological resources regulatory agencies have the potential to reside at or near the RSEP site. Biological resources field inventories were conducted at the project site and along the 10.0-mile-long generator tie-line corridor. Intensive field surveys for the desert tortoise, a species that is federally and state listed as threatened, were conducted according to the U.S. Fish and Wildlife Service (USFWS) survey protocol for this species. The surveys indicated that desert tortoises are present on the project site. Seven tortoises, along with shell-skeletal remains, burrows, egg shell fragments, and scat were recorded during the surveys as present on the RSEP site, along the generator tie-line route, and within the 1-mile-wide zone of influence surrounding the project site. Because the project is likely to directly affect individuals and habitat of the desert tortoise, RSE will develop a plan

to mitigate this effect, in consultation with the key regulatory agencies: BLM, USFWS, CEC, and the California Department of Fish and Game. Additionally, western burrowing owl, Mojave fringe-toed lizard, and loggerhead shrike are sensitive wildlife species present in or near the project area and may require avoidance and mitigation measures.

Intensive botanical surveys also were conducted on the plant site and along the proposed transmission line route. Approximately 30 to 40 individuals of Harwood's milk-vetch, a species listed as sensitive by the California Native Plant Society, were found at five separate locations along the transmission line corridor. The botanical surveys also found two individuals of chaparral sand-verbena, also a species listed as sensitive by the California Native Plant Society, on the project site. Measures to mitigate potential effects on these species could include avoidance or transplantation.

Noise

Noise from the RSEP during normal operation at the project fenceline would be between 45 and 52 dBA. The project's noise sources are located entirely within an 800-foot-diameter power island positioned near the center of the solar field and not less than 3,200 feet from the closest point on the project's boundary. Modeling of these sources indicates that the project's contribution to ambient noise at or near the nearest residence or occupied structure at Vidal Junction, located 15 miles northeast of the RSEP, will be 4 dBA or less, a negligible amount that would not increase the perceived ambient noise levels at Vidal Junction. Because the project site is relatively far from any residential use or sensitive receptor, there was no need to conduct a 25-hour ambient noise survey to assess the project's effects on sensitive receptors.

Visual Resources

The RSEP site is located in the northern Sonoran desert, an area that can afford scenic vistas across broad expanses of open desert, bounded by the mountain ranges. Potential viewers of the project area include travelers along SR 62, which runs east-west along the project's northern boundary. SR 62 is eligible for designation as a scenic highway in Riverside and San Bernardino Counties, but it has not been designated as such. A second group of potential viewers includes recreational viewers traveling to and from off-highway use and wilderness areas on unpaved roads traveling mostly north-south. There are BLM-designated wilderness areas to the north (Turtle Mountains) and south (Palen-McCoy, Rice Valley, and Riverside Mountains) of the project site. Several communication towers and smaller power distribution poles and structural ruins of the abandoned community of Rice are found in the vicinity of the RSEP site. Other nearby infrastructure includes the Arizona-California Railroad and Colorado River aqueduct, which parallel SR 62 just north of the project site.

Simulated views of the project as it would appear from key observation points (KOPs) representing the views that members of these key viewer groups would experience indicate that the RSEP would introduce a change to this natural landscape by the addition of a new infrastructure element. Potential viewers transiting SR 62 number more than 2,000 per day. Passersby would not have a clear view of the heliostat field, which slopes away to the south. Drivers' field-of-vision would generally be oriented away from direct views of the solar receiver tower situated more than 1 mile south of the roadway. The solar receiver tower would be more directly in their field of view from greater distances, most prominently at

5 miles east and 2 miles west (the KOP locations). From these locations, however, the tower would not be a dominant element in the larger landscape viewshed.

Rice Valley Road is an off-highway vehicle (OHV) track extending south from SR 62 toward the Rice Valley along the RSEP's transmission line corridor. This road provides access to off-highway vehicle tracks and the Riverside Mountains and Rice Valley wilderness areas. Users of this roadway represent a relatively small viewing population because of the remoteness of this location; BLM closed the Rice Valley Dunes OHV area several years ago citing lack of use. Views from along the transmission line and Rice Valley Road would include the power block, transmission line, and heliostat field. At this distance, however, the project would not cause a substantial change to the view quality. Construction of the project would not be likely to substantially degrade or alter the existing visual character in the project area, nor would it result in a significant and adverse impact on visual quality or valuable or important viewsheds.

Water Resources

The project will use an ACC (dry-cooled technology) for steam-process cooling. For this reason, the project will use significantly less water than a conventional plant using a wet cooling tower in a conventional evaporative cooling process. The RSEP's water use will generally be less than 180 acre-feet per year. Nearly half the expected water consumption will be for periodic washing of heliostats to maintain the maximum optical performance of the solar array. Other consumptive uses include makeup flow to replace evaporative loss from a small WSAC that is employed to reject heat from the auxiliary equipment coolant system and to replenish boiler blowdown (purge) necessary for maintenance of proper boiler chemistry.

Process water will be supplied by two new wells that will be installed on the project site. There are no other permitted wells within one half-mile of the planned RSEP wells, and hydrological well influence simulation modeling studies show that the project's influence on the nearest offsite well would be less than 0.8 foot over 30 years. The facility will have three 5-acre evaporation ponds to process wastewater from the onsite water treatment operation, process blowdown, and surface drainage from outdoor equipment areas protected by an oil/water separator. Drive gears on each heliostat throughout the solar field are hermetically sealed, which precludes leakage of lubricating oil and eliminates the possibility of stormwater contamination.

Stormwater runoff is currently channeled by large berms constructed upslope of the RSEP for the Colorado River Aqueduct and Arizona-California Railroad. Water is funneled by these berms to two separate locations where it crosses under the railroad, aqueduct, and SR 62 and empties onto the project site. The stormwater drainage design for the RSEP calls for a slightly elevated roadway encircling the heliostat field that will include a drainage swale along the outer edge of the roadway. All stormwater approaching the project site from upstream will be channelized to flow around the project site to the southern end of the heliostat field, where flow from both sides will rejoin the natural flow channels and sheet-flow off the property to the south. Stormwater runoff from inside the heliostat field and power block will run naturally as sheet-flow through the heliostat field and into the southern portion of the heliostat field, which will be designed to act as a 30-acre stormwater detention pond.

Cultural Resources

The RSEP is located on the site of the former Rice Army Airfield. This airfield and the adjacent Camp Rice, which lies outside of the RSEP fenceline, were constructed as part of the Army's effort during World War II to acclimatize and train fighting forces for the North Africa campaign. The Army constructed no less than fourteen such temporary encampments and other installations in the Mojave and Sonoran deserts of California and Arizona. Collectively, the camps were called the Desert Training Center and later the California-Arizona Maneuver Area (DTC/CAMA). The fourteen training facilities (seven camps and three airfields in California and four camps in Arizona) were first established in 1942 and operated until the last troops were deployed. The DTC/CAMA was demobilized and abandoned in 1944, and Rice Airfield was eventually transferred into private ownership and remained operational until the late 1950s.

Rice Army Airfield consisted of two 5,000-foot-long oiled runways, along with aircraft parking dispersal stands and taxiways, a parade ground, and small support buildings. Camp Rice, immediately east of the RSEP facility site, was a large tent city used to house infantry and artillery units such as the 5th Armored Division. Portions of the Rice Airfield are within the boundary of the RSEP site, whereas Camp Rice is located entirely outside the project's fenceline.

The remains of Rice Airfield include remnants of runways and dispersal pads, a cement parade ground, and concrete pads that were foundations for administrative structures, barracks, etc. The entire site has been recolonized by burrobush and native grasses, but only partially by fully developed creosote bush scrub. Archaeological surveys of the Rice Airfield conducted for this AFC resulted in the recording of 39 artifact concentrations, including Army ration can and glass dumps, dumps of burned ration debris, and construction debris; and 128 structural features, including concrete foundations, stone aerial markers, rock alignments, rock-lined pits, and other various pits. No prehistoric archaeological sites were encountered or recorded during the survey.

A BLM historic context and overview of the DTC/CAMA facilities concluded that Rice Army Airfield and Camp Rice meet the criteria for listing in the National Register of Historic Places. Because the construction of the RSEP would involve envelopment of some of the remains at Rice Army Airfield, consultation under Section 106 of the National Historic Preservation Act will be required through the co-lead federal agencies, Western and BLM, and the California Office of Historic Preservation to develop a mitigation plan to resolve the potential adverse effects of constructing the RSEP. Mitigation could include measures such as more detailed mapping of the site, interviews with veterans who trained at Rice Army Airfield and Camp Rice, development of a detailed historical context statement, collection and analysis of artifact concentrations, and other measures.

Key Project Benefits

Environmental Benefits

The RSEP will use a highly innovative solar energy technology that will provide renewable electric power through a concentrating solar-thermal energy process that does not utilize toxic heat transfer fluid and avoids the combustion of fossil fuels and associated greenhouse gas emissions that contribute to global climate change. The project will help diversify

California's electrical power generation supply, reduce hazardous air emissions associated with conventional power supplies, and promote a more sustainable energy supply while avoiding the intermittency associated with other forms of renewable energy.

The RSEP technology features a highly efficient thermal storage system that allows the project to generate sustained power when it is needed, up to 16 hours per day at rated output during summertime. The RSEP's ability to capture and store the sun's energy in liquid salt offers significant grid benefits in terms of plant efficiency, power conditioning, operating stability, and grid system operation. It also can contribute to the displacement of obsolete fossil-fired power plant technologies that emit large quantities of air pollutants and greenhouse gases, particularly peaking turbines, given that RSEP has been optimized to generate power reliably during the hours of peak electric demand.

The project's use of dry cooling (with an ACC) for the steam cycle means that it will use only a relatively small amount of water for cooling of ancillary equipment, compared with highly consumptive wet evaporative cooling tower technology.

Employment and Economic Benefits

The RSEP will be constructed over a 30-month period, providing skilled and semi-skilled jobs with a peak monthly employment projected at approximately 438 workers. The average number of workers during the construction period in any given month will be approximately 280. During the operations phase, the facility is expected to permanently employ approximately 47 persons, including power plant operators, electricians, engineers, mechanics, maintenance technicians, and management and administrative personnel. As of August 2009, the unemployment rate in the nearby city of Blythe, California, was reported at 17.7 percent, compared with 15.0 percent countywide and 12.2 percent statewide.[2] The RSEP is expected to provide significantly enhanced construction and permanent employment opportunities and to bring crucial diversification to the area's economy.

In addition to the direct employment benefit, the RSEP will require and use the services of local or regional firms for major maintenance and overhauls, plant supplies, and other support services throughout the life of the facility. Indirect and induced employment in the project area is estimated at up to 16 permanent jobs.

The RSEP is expected to bring increased property tax revenue to Riverside County in an area that is presently economically dormant. The RSEP will generate significant new property tax revenues annually. Sales and use tax revenues attributed to the purchase of equipment and materials during construction of the RSEP are projected in the tens of millions of dollars. Operations and maintenance activities for the RSEP are expected to contribute substantially to local sales taxes.

[2] State of California, Employment Development Department, Labor Market Information Division, Monthly Labor Force Data for Cities and Census Designated Places, August 2009 (Preliminary), dated September 18, 2009.