June 22, 2010

Eric Solorio
Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

RE: Ridgecrest Solar Power Project (RSPP), Docket No. 09-AFC-9, Ridgecrest Solar Power Project Potential Mission Impacts – Response to Naval Air Warfare Center, date May 25, 2010

Dear Mr. Solorio:

Attached please find a letter to Department of the Navy, Naval Air Warfare Center, Weapons Division, China Lake. This letter is the Ridgecrest Solar Power Project ("RSPP") response to the comments officially filed by the Navy Air Warfare Center Weapons Division ("Navy") on the project's SA/DEIS.

The letter is intended to assure the Navy that many of its concerns are being addressed in the regulatory process and the new ones raised by the above referenced letter will be addressed with the Navy's assistance.

This has been docketed in accordance with CEC requirements.

If you have any questions, please feel free to contact me at 510-809-4662 (office) or 949-433-4049 (cell).

Sincerely,

Billy Owens
Director, Project Development

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BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
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APPLICATION FOR CERTIFICATION For the *RIDGECREST SOLAR POWER PROJECT*

Docket No. 09-AFC-9

PROOF OF SERVICE (Revised 6/9/2010)

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DECLARATION OF SERVICE

I, Elizabeth Copley, declare that on June 22, 2010, I served and filed copies of the attached Ridgecrest Solar Power Project (Docket No. 09-AFC-9) Responses to Department of the Navy Comments on the SA/DEIS. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at:

[http://www.energy.ca.gov/sitingcases/solar_millennium_ridgecrest].

The documents have been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(C*heck all that Apply*)

For service to all other parties:

X sent electronically to all email addresses on the Proof of Service list;

_ by personal delivery;

X by delivering on this date, for mailing with the United States Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses **NOT** marked "email preferred."

AND

For filing with the Energy Commission:

X sending an original paper copy and one electronic copy, mailed and emailed Respectively, to the address below (preferred method);

OR

__ depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-9
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct.

Via Digital Communication

June 22, 2010

Scott M. O'Neil
Executive Director
Department of the Navy
Naval Air Warfare Center Weapons Division
1 Administration Circle 575, Suite 1
China Lake, CA 93555-6100

RE: Ridgecrest Solar Power Project Potential Mission Impacts – Response to Naval Air Warfare Center, date May 25, 2010

This letter is Ridgecrest Solar Power Project ("RSPP") response to the comments officially filed by the Navy Air Warfare Center Weapons Division ("Navy") on the project's SA/DEIS.

The letter is intended to assure the Navy that many of its concerns are being addressed in the regulatory process and the new ones raised by the above referenced letter will be addressed with the Navy's assistance.

It should be noted the CEC and BLM held workshops on RSPP on April 22 & 23 in Ridgecrest where all subjects raised by your letter (with the exception of radio interference for mission or base operations and encroachment of military influence areas) were discussed at great length. A representative of the base did not speak on its concerns.

This is not the first time military operations have expressed concern about the potential interference of its mission by a solar thermal project. The Crescent Dunes central station solar project proposed by Solar Reserve, conducted a confidential study for Nellis Air Force Base on many of the mission critical issues raised by the Navy for China Lake. The major difference in technology and source of concern was the use of a central tower (not used by RSPP) for the collection focused solar energy collection. The 2009 study resolved the issues and Nellis withdrew its objection to the project.

1. **Air Clarity Impacts Associated with Cooling Tower Plume**

   Air clarity/visible plume impacts are associated with a wet cooling tower that operates through evaporative cooling resulting in a visible moisture plume that also contains fine particulate matter. RSPP is proposing to construct an air cooled condenser (ACC) rather than a wet cooling tower for steam cycle condensation. An ACC is essentially a large horizontal radiator with fans blowing ambient air past heat exchanger tubes to eliminate excess heat. There is no moisture involved and no visible vapor plume is produced by operation of an ACC. The only plume produced is one of ambient air heated approximately 10°C above ambient temperature due to passage across the exposed heat exchanger tubes.

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2. Thermal Signature

It is difficult for RSPP to determine if the project will interfere with the Navy's operation without confidential information from the Navy. We are providing heat related information which will allow the Navy to examine the potential impact.

There is a possibility the Navy is using a specific infrared band(s) that may not be impacted by the ACC's heat signature. However, the infrared spectrum is rather large to perform targeted analysis of discrete bands, and limiting of the spectrum to a range of interest would be advantageous.

Air Cooled Condenser (ACC) Exhaust Plume

The ACC thermal plume exits at 10 degrees K above ambient air temperature. Even at exit the thermal IR contrast will be quite low. The midday temperature of the desert surface is approximately 330-340 deg K. Even for a hot day, (318 deg K air at shelter height) the desert surface is more than 10 deg above the air temperature. The ACC thermal plume base is 10,000 square meters. Looking across the desert it would disappear in the thermal IR glare of the warmer desert. However, for the longest wavelength the Planck's law relation suggests that there may be some contrast in these cooler infrared 'colors'. The specifics of this contrast would need to be evaluated for specific spectral bands. Suggestions for general ranges of the infrared spectrum of interest would allow specific 'band' calculations to be made.

During the evening hours the desert surface cools rather quickly, perhaps more quickly than the ACC operation. If the ambient air near the 38 m exit height remains warm relative to the desert, and the ACC is still operating in the early evening, it is possible that there is a time window when the thermal plume would have a maximum contrast against a cooling desert. This is likely to occur for Navy operations outside of the 800-1700 hour daytime operations windows. If time periods of interest lie outside such a window a thermal contrast analysis would potentially be warranted.

In the case where one is sighting from the ground, into the sky the observation point would need to close since the region of significant thermal deviation is rather shallow as shown in Figure 1. Otherwise the observation angle would need to be extremely shallow.

In principle short wave visibility plume models like the EPA's PLUVUE (ref) could be adapted to the infrared. The perturbation in terms of deciviews of an infrared reference band (like the 550 nanometer band for visible light) caused by the thermal plume itself against a clear sky could be calculated. Such an approach would require further analysis and some selections for a reference band of interest.

Collector Collimated IR Beam

The thermal collector lines at the reflector focal points are at a temperature of 688 deg K during midday operation. These lines are shielded so as to minimize heat loss, so they do not show up as direct radiating lines of 668 deg K blackbody IR. The primary IR radiative loss is back radiation to the reflectors which reflect the radiation back through a collimated beam directed towards the sun. The temperature of this collimated beam would be in the worst case equal to a black body radiator. The irradiance would be reduced by division by the collector efficiency ratio.

A secondary and possibly more important source is the blackbody radiation from the collector surfaces themselves. A simple no storage heat balance study for a ¼ inch thick polished aluminum surface yields a summer midday temperature of 348 deg K. This surface temperature is slightly higher than the desert and the ACC thermal plume. It would not be collimated and behave as a hot plane surface representing the collector mirror apertures, aligned facing the local solar zenith angle. As an object the collectors would appear hotter than the desert surface. The specific of this IR glare radiance can be calculated using Planck's law if it is found that the orientation of the tilted collector surfaces will align into the Navy's operations region of influence at the surface, or along flight paths aloft. Additional information about the region of influence (ROI) would be needed to complete such a calculation.

3. **Glint**

The mirrors proposed for installation at the RSPP are composed of parabolic mirror troughs with a small heat conducting element (HCE) tube running the length of the trough. All troughs will be aligned north-south (true) in order to track the east to west transit of the sun during the day. As discussed in the following paragraphs, the production of glint/glare from the mirror array, or in more accurate terminology, specular reflection, is not due to direct reflection of the sun by the parabolic mirror but is due to three sources of light of much lower intensity:

1. The reflection of incoming sunlight from a small linear area along the front of the Heat Conducting Element (HCE) that is normal (perpendicular) to the sun and intercepts and reflects a small portion of the incoming sunlight.

2. Direct reflection of sunlight from metal components of the parabolic mirror array such as connectors along the HCE tube and structural elements.

3. Sunlight that is first refracted, reflected, and/or scattered by the glass tubes comprising the HCE that then strikes the mirror and is subsequently reflected outwards in a columnar beam, but at a greatly reduced intensity.

Specular reflection must obey the Law of Reflection, derived from Snell's Law of Refraction, in which the incoming and outgoing light rays form the same angle of incidence from the normal to the reflecting surface. The mirror arrays at all solar trough power plants are aligned north-south to allow east-west tracking of the sun. The normals for any given HCE tube are therefore east and west of the solar array, and therefore reflections can only occur to the east and west. The only time specular reflection can occur from the RSPP mirror array and be visible by a ground level observer is when the observer is to the east or west of the mirror; the sun is low on the horizon, to the back of the observer and slightly over the observer's shoulder; and the observer is looking at the mirror array. The same geometrical constraints apply to pilots in passing aircraft. There is a very restrictive geometrical alignment that is required for a pilot to experience specular reflection from the solar array. Specifically, specular reflection can occur when the sun-pilot-solar mirror is in a direct line and the parabolic mirror is pointed directly at the pilot. What is observed is not a direct, intensified reflection from the sun, but rather a light of a much lower intensity due to the collimated reflection by the mirror of the much weaker scattered, reflected, and refracted line from the HCE tube.

For a properly situated ground level observer, the only time glare would be visible is in the first few hours after sunrise, or before sunset, when the sun is low on the horizon and contributing its own glare. It is important to reiterate that the reflection (glare or glint) is specular reflection from the HCE tube with lesser amounts of scattered and refracted light, not direct reflection of the sun from the parabolic mirror.

As part of the studies in support of the licensing proceedings for the Blythe Solar Power Project, the owners of RSPP commissioned an aircraft flight on June 1, 2010, at the Kramer Junction SEGS facility to observe glint/glare from the facility at low sun angles near sunset. Mr. Howard Balentine was an observer on this flight and Mr. Douglas Moss was the pilot. Fly-by passes of the SEGS facility were as low as 500 ft above ground level and would be representative of pilots at low altitude in approach to land. During the fly-bys that were conducted over an approximate 45 minute period, intensity of the glint/glare from the SEGS mirrors was low and much less bright than the setting sun in the opposite direction. During the entire flight, the solar array could be viewed continuously without need to look away due to brightness.

In his flight test report, the pilot of the flyby, Mr. Douglas Moss, stated:

> "Based upon my education, training, and experience, it is my opinion, to a reasonable degree of engineering certainty that neither the glint/glitter characteristics of solar arrays nor the convective plume characteristics of an ACC array pose a significant threat to general aviation aircraft operating at traffic pattern altitudes.
>
> Specifically with respect to the solar array plan and ACC locations proposed for the Blythe Solar Power Plant (BSPP), it is my opinion that the currently proposed design and location of the ACCs and solar arrays will not present a significant hazard to aviation."

A copy of the Flight Test Report of Mr. Moss and the memorandum documenting the observations of Mr. Balentine during the Flight Test can be found as Enclosure 1.

It should be noted Mr. Moss is a former U.S. Air Force fighter pilot, test pilot and instructor at the test pilot flight school.

While the study is not specific to the Ridgecrest location, RSPP believes it offers evidence the threat to aircraft or mission is not significant.

4. Fugitive Dust

RSPP appreciates the base's concerns with the dust storms from Owens Lake. We have submitted our grading and drainage plan to the CEC and BLM for review. While the SA/DEIS noted the difference in water use for construction for RSPP, the reasons for the differences are based upon the differences in our grading plan and the local soil conditions at the site.

The construction water use (1500 acf) over a 32 month period at RSPP has been established using a relatively controlled method of grading. Wind fences will be installed to mitigate wind flow across the site. The site is not fully graded at one time, but rather only small sections are "worked" at any one time to minimize the soil disturbance. There is a substantial use of dust palliatives proposed rather than daily use of water for dust control.

Water use during the construction period is estimated based on the cubic yards of dirt that would be cut and filled, together with the moisture content required for adequate compaction, with an allowance for evaporation. Added to that number is an estimate of the water use for dust suppression which is calculated based on the working area (i.e., the area in which cut and fill, grading, compaction, etc, are taking place) multiplied by a water application rate and frequency. RSPP is proposing a just-in-time construction approach which will minimize the active working area that requires dust suppression, thus minimizing water use. Once earthwork in an area is complete, Solar Millennium would apply dust palliatives to suppress dust, thus eliminating the need for continued watering.

This mitigates dust and particulates from being release once disturbed. We are scheduling the site construction to progress from upwind to downwind to take advantage of the wind fences and air foil effect of the 23 foot solar panels as they are erected. The access roads to the control block and around the control block, and to the warehouse and lay down yard will all be paved at the earliest stage of construction so that dust is controlled. All of these elements will be included in the construction process to minimize water use. The differences of soil type, use of dust palliatives, paved surfaces, grading controls, and work progression are all factors that will affect the total water use.

The CEC proposes various construction conditions for monitoring wind and visibility upwind and downwind of the project perimeter. High winds or violation of opacity standards will require the cessation of construction.

Regarding operations, on behalf of RSPP, AECOM prepared an analysis comparing the wind erosion potential of the Project site as it currently exists (undeveloped) to the Project site during normal operations of the Project. This evaluation demonstrates a significant reduction in fugitive emissions. The emission reductions can be attributed to compaction, use of dust palliatives, paving the heavily traveled portions of the site, and watering for dust suppression. The wind erosion evaluation was submitted to CEC as DR-AIR-3 in its January 2010 Data Request submittal.

The Navy has had to address dust control for its own expansion projects over the years at the China Lake base, including current construction; perhaps the base would share its approach to dust mitigation.

5. **Light Pollution**

We are perplexed by your concern for the lightning at our facilities. . The base currently lies north and east of the City of Ridgecrest and Inyokern, much larger light sources than our proposed project lie between our project and the base concentrated over several squire miles. The indirect lighting at our administrative building and substation should cause no problems.

The facility will have to comply with OSHA safety requirements, but to the extent possible outdoor lighting will be shielded and motion activated in areas with light activity. The International Dark Sky Association has recommended fully shielded outdoor lighting. There will be no perimeter fence lighting or lighting of the solar arrays at night. There will be no stadium effect. If the Navy has specific standards of lighting it uses on the base and would prefer for the CEC and our consideration, please specify. Night time simulations of the lighting are on file with the CEC.

6. Radio-Frequency Encroachment

The Navy Office of Sustainability letter of July 19, 2009 specified a condition that if adopted would not cause significant mission impact if adopted in the project's approval document. RSPP has no problem with the condition as restated below:

> "Solar Millennium will provide the information on planned use of the electronic spectrum at the project facilities to Department of Defense (DOD) representatives as soon as possible, but not later than completion of the final design. The information provided will be in sufficient detail for DOD agencies to evaluate whether project use of specific radio frequencies would cause interference with DOD activities. As needed, based on the feedback provided by DOD, Solar Millennium will modify the facility's planned frequency use, provide data on these modifications to DOD activities, and obtain written confirmation from DOD that the frequency spectrum usage for the project will not interfere with DOD activities. Solar Millennium will provide documentation to the CEC Compliance Project Manager (CPM) of the DOD's confirmation of the acceptability of the Project's planned use of radio frequencies spectrum prior to the installation of electronic systems that potentially could affect DOD activities."

The RSPP facility will use fiber optics to a great extent, but personnel working in the open will require other communication within the boundaries of the site.

RSPP is not aware of the communication, navigation, and operational frequencies in use during operations at China Lake and therefore a detailed assessment of potential radio frequency interference for specific frequency bands is not possible at this time.

There are two sources of radio noise from the proposed facility: corona discharge from conductors and gap noise from hardware. Corona noise is typically a foul (rain) weather phenomenon that results from the breakdown of air at the surface of the conductor due to the stress on the electric field on air molecules. One of the key measures of that stress is the electric field gradient on the surface of the conductor. This gradient is in-turn directly affected by the impressed line to ground voltage conductor and the diameter of the conductor (as well as bundling of the conductor). The proposed facility will have a line to ground voltage of approximately 130kV and a conductor with a diameter of 1.762 inches. There is one conductor, and hence no bundling. This conductor is larger than typical for a 230kV facility as it is needed to carry a fairly large power flow over a short distance; one of the side benefits of this selection is improved corona performance. These configuration details results in a very low conductor surface gradient (9kV/cm), significantly below typical corona inception level of 17.5kV/cm. Further at a typical airport navigation communications frequency of 117MHz, corona noise is not productive even at higher surface gradient.

Some interference for AM radio (which is broadcasting between 0.520 MHz–1.610 MHz) is expected under the facility transmission line typical of what one might experience while passing under in a car. For typical airport navigation and air-ground communications around a frequency of approximately 117MHz, 230kV power line radio noise corona is very weak (less than 4dBμV/m) even directly under the power line. At lower line voltages, corona discharge is even lower.

Radio interference from gap noise typically occurs in fair, dry weather from the transmission line hardware (e.g. insulators). The sources of this noise are surface imperfections on the hardware and dust (or other solid air pollution). This facility will be constructed with polymer insulators and other hardware for high pollution areas. This will emulate to the greatest extent possible the surface tracking that would occur and reduce the levels of radio noise; which is negligible at 230kV in any case. The use of polymer insulator and other similar hardware will increase the reliability of the circuit under the condition of dryness with sand and other airborne particulates.

All hardware to be used at RSPP will be commercially available and will conform to FAA and FCC requirements for minimization of radio frequency interference.

7. Impact to Water Resources

RSPP has examined the water situation in the area very carefully. The initial proposal for wet cooling has been changed to dry cooling resulting in a 90% reduction in operational demand. Construction water needs will be the largest demand, so we have selected an approach to use water very wisely and rely on palliatives for dust control. The project has agreed to fully mitigate its water use trough a variety of options, the largest being the fallowing of agricultural land. The opportunities for saving water or retiring water rights are well beyond our cumulative demand upon the aquifer.

As part of our application and subsequent Water Mitigation Offset Plan, RSPP modeled the potential impact of our water use with the same model used by the local aquifer users to manage water resources. Enclosure 2 the data response dated January 25, 2010 to the CEC which modeled potential impacts to wells in the region from RSPP's water use. The modeling (see response #133) revealed that NO adjacent water supply well to the proposed project pumping wells (IWVWD 18, 33, and 34) would "see" a drawdown of 5 feet or more at the end of the model period of 30 years. Five feet of drawdown is the standard that has been used in licensing projects to indicate a measure of significance of impacts to adjacent wells from pumping. Of the wells shown on the maps that would "see" any drawdown (0.5 foot or greater) (see figures 133-1 through 133-3), none of these wells appear to belong to the NAVY. The database provided by the IWVWD as part of the Brown and Caldwell Model (2008), which the Navy was a co-author was examined, and though there is limited data on ownership, none of the wells appear to belong to the Navy within the cone of depression contour of 0.5 foot.

8. Encroachment into Military Influence Areas

RSPP has no interest in the expansion of water services in the City of Ridgecrest. This is an issue between the Navy and the City. New service to parties other than RSPP will follow prescribed local government ordinances and procedures. The approval of this project does not approve new customers beyond RSPP.

RSPP believes this addresses your concerns. RSPP will undertake additional analysis as needed to ensure your concerns are addressed. I look forward to meeting with you and other staff to discuss this further.

Sincerely,

Billy Owens
Director, Project Development

CC:
Eric Solorio, CEC

Enclosures

Moss Test Flight Report

Enclosure 1

Glint/Glitter Evaluation of SEGS, and Convective Plume Evaluation of Walter Higgins Power Plant

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Memorandum

To	File: Solar Millennium 60139695 Task 6300	Page	1
CC	Carl Lindner, Mark Luttrell, Arrie Bachrach		
Subject	DRAFT: Overflight Report of SEGS Kramer Junction power plant and Walter E. Higgins Power Plant Air Cooled Condenser		
From	Howard Balentine		
Date	June 4, 2010		

I was an observer in a flyby of the Kramer Junction solar power plant on the evening of June 1, 2010, and two overflights of the air cooled condenser (ACC) at the Nevada Power Walter E. Higgins Power Plant in Primm, Nevada, on June 2, 2010. The Pilot was Mr. Douglas Moss of AeroPacific Consulting and the aircraft was a V-Tail Bonanza, Tail Number N9366Y.

Kramer Junction SEGS Flyby

The first flight began when I was picked up at the Oxnard Airport for a flight to Jean, Nevada. We departed Oxnard at approximately 6:00 PM EDT on June 1. We arrived in the vicinity of the Kramer Junction facility about 7:00 PM and proceeded to have an approximately 45 minute flyby of the SEGS plant. The solar elevation angle during the 45 minute flyby was 10° decreasing to 2° above the horizon. The objective of the flyby was to examine the potential for glint and reflection to be of such a magnitude so as to cause significant distraction of a pilot on a simulated final approach to a nearby runway. We terminated the flyby when the sun was reaching the horizon

Multiple passes were made at varying bearings and altitudes down to 500 feet above the ground on the west side if the solar field, including simulations of an aircraft on a glide slope to an airport. At no time did we overfly the SEGS facility. Passes were made at varying altitudes parallel to the west edge of the solar field and perpendicular to the solar field. The purpose of the various passes was to determine those azimuths, if any, which created the proper sun – observer – parabolic mirror geometry and produced glint or reflections that could be a hazard to flight.

At no time during the flight did I observe any glint or reflection from the solar array that I felt to be objectionable or would interfere with my ability to operate a machine such as an automobile. Midway through the flight, it became possible to look directly at the sun with more than a momentary glance. The intensity of the setting sun was much more significant than any glint or reflection observed from the parabolic mirrors. The brightest reflections occurred on the normal to the solar troughs with the sun – observer – mirror inline in the same plane. I specifically looked for reflections at large “off-normal” incidence angles, but did not observe any such reflections. If such reflections were to occur, our multiple flyby passes would have allowed us to observe such off-normal reflections.

I observed that the brightest reflections from the solar array occurred from two sources, in decreasing order of intensity:

1. Mirrors out of service such that the back sides of the mirrors were observable and produced reflections from the non-mirrored surface of the mirror back. These reflections were comparable to a row of overlapping lights along the length of a mirror segment and were not objectionable. It was easy to look directly at the lights for an extended period of time with no after image and no need to look away. The intensity of the light was less than that of the setting sun.
2. The bottom lip of the first row of mirrors. While the top of the mirrors were generally brown and were obviously presenting an image of the ground, the bottoms of the mirrors were presenting an image of the sky just above the horizon. The bright image along the bottom lip of the front row of mirrors was not continuous but rather consisted of individual spots, possibly due to minor local warping of the edge of the mirror. The bright spots were not objectionable and moved along the mirror array as the position of the aircraft moved. Again, it was easy to look directly at the local bright spots for an extended period of time with no after image and no need to look away. The intensity of the light was less than that of the setting sun and was no different than looking at a street light in the distance.

As the aircraft moved past the solar array on a parallel path, the image presented by the solar array was of a generally dark background that transitioned into a slight shimmering glow and culminated in a brighter area around the normal point to the sun. Within the bright area, there were individual brighter spots likely representing out of service mirrors, reflections from slightly warped mirror lips, and reflections from supports and other non-mirror surfaces. The shimmering glow and brighter center spot appeared to flow across the solar array as the aircraft passed by and was very entrancing to observe. At no time were any of these reflections objectionable or distracting.

Walter E. Higgins Power Plant Overflight

Two overflights of the Higgins plant occurred in the morning of June 2. The first overflight commenced at 7:18 AM PDT and ended at 8:28 AM. The second overflight commenced at 11:57 AM and ended at 11:23 PM. Forecast winds for the morning of the flight were 3 mph for 08:00 – 10:00 and 5 mph 11:00 – 13:00. (See Figure 1). At takeoff at 07:15, the Jean airport wind sock was limp and stayed that way through the takeoff for the second flight. Winds were forecast to be from the south-southwest veering to south by midday. A windsock was located on the ACC. Observation of the windsock, approximately 210 feet above the ground, indicated generally southwest to variable light winds.

The Higgins power plant is composed to two natural gas fired combustion turbines with heat recovery steam generations (HRSGs) and one steam turbine. The plant is cooled by two adjoining 5x4 cell air cooled condensers forming a continuous structure approximately 54 meters wide, 153 meters long and approximately 200 feet high. The long axis of the ACC is aligned north-south. East of the ACC are the two HRSG stacks, one approximately 64 meters from the east-center edge of the ACC and the second 45 meters farther east. The facility manager, Mr. Felix Fuentes, in a phone call after the first flight stated that both units of the Higgins plant were operating during the first flight at approximately 70 percent load (~350 MW). Figure 2 presents an aerial view of the plant.

The objective of the first flight was to determine the potential hazard posed to aircraft by overflight of the ACC during early morning conditions with low wind/calm conditions and full load on the ACC. The calm condition goal was met, and the load condition was approximately met, at 70 percent load.

The overflight began with a north to south run at an altitude of 5,300 feet mean sea level with an aircraft speed of 100 mph. The ground elevation is approximately 2,600 feet at the plant with approximately 200 feet to the top of the ACC, resulting in a clearance over the top of the ACC of approximately 2,500 feet. The initial aircraft bearing was 200° magnetic. No impact of the plume was felt on the first run, or the second run at 4,800 feet.

On the 5^{th} run at 7:31 at an altitude of 700 feet near the ACC, a slight burble (high frequency oscillation) was felt, as was also a case the 6^{th} pass at 600 feet. There were no visual cues to determine the ACC and HRSG plume locations except for the surface location of each structure. Starting with run 7, we passed through a plume at approximately 500 feet elevation, resulting in changes in aircraft altitude and easily corrected changes in aircraft pitch and bank. Starting with run 9, the aircraft flew directly along the long axis (north-south) of the ACC and directly over the ACC. Starting with Run 11 and for all subsequent passes, the pilot lowered the landing gear, extended the flaps, and reduced the air speed to 80 mph.

The runs following Run 7 (for a total of 24) were at a flight altitude of 500 feet above the ACC and alternated between a north to south run and a south to north run. The flight track deviated to the right and left of the centerline of the ACC to examine the potential instability introduced by the plume impacting a single wing. There were runs directly over the ACC at 500 feet where no turbulence was encountered. In general, any runs to the east side of the ACC (adjacent to the HRSG stack) experienced turbulence but not all runs directly over the ACC or to the west side of the ACC experience turbulence. On the final run of the Overflight 1, we passed directly over the centerline of the ACC at 500 feet and did not experience any turbulence. My impressions as an observer was that there was negligible impact on aircraft attitude produced by the thermal plume from the ACC. Rather, it was most likely that the bulk of the observed turbulence was due to flying near or through the plume from the nearby HRSG stack. During the runs, the windsock on the ACC was limp or indicating light winds from the southwest or variable.

The pilot commented during the flight that at all times, the changes to aircraft attitude and attitude were easily corrected, and by implication, did not affect flight safety.

While early in the day, we experienced some convective turbulence during the first overflight. The objective of the second overflight was to determine the potential impact on flight safety during a period where there was significant ambient turbulence due to natural convection. A total of 10 runs, number 31-40, were made during the second overflight. Five runs were made with a clean configuration and five with flaps and landing gear extended. All runs were at 500 feet above the ACC and were parallel to the ACC centerline. On all runs except Run 37 encountered turbulence. Run 37 was at 80 mph with flaps and landing gear extended and passed directly over the centerline of the ACC. No turbulence was experienced on Run 37. The turbulence experience on the other runs was indistinguishable from that produced by the natural convection occurring in the desert surrounding the plant, including a run that directly overflew the HRSG stack closest to the ACC. Run 39 stands out. During the run, there was an increase in aircraft performance when the turbulence was encountered consisting of an altitude gain of 150 feet and an increase in airspeed of 15 mph. This turbulence was encountered prior to passing over the ACC and the pilot and I collectively attributed the turbulence to that from a convective cell and not the ACC or HRSG plume. In Run 34, we experience a double hit likely due to striking a convective cell followed by a plume.

My conclusions, based on these two overflights of the Higgins plant are the following:

1. At conventional power plants, the closeness of the HGSG stacks to the ACC makes it very difficult or impossible to differentiate between the ACC plume and the HRSG plume unless some visual marker were added to the plumes.
2. Natural convective turbulence in the desert produces impacts on aircraft altitude and attitude that are equal to or greater than that produced by the HRSG plume at the Higgins plant.
3. My impression is that much of the turbulence experienced during the overflight of the ACC was due to either natural convection or comingling of the ACC plume with the adjoining HRSG plume.
4. The overall potential for an impact on flight safety of flying through an ACC plume is negligible.
5. The magnitude of the turbulence experienced in the second overflight was greater than that of the morning overfight due to the enhancement of plume turbulence by the boundary layer micrometeorological conditions leading to the natural convective turbulence. As a result, mid-day low wind speed conditions with strong insolation are more conducive to worst-case plume impacts on aircraft than calm wind conditions during the early morning when natural convection is dampened.

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Las Vegas, NV

Home News Organization Search for: [ ] ⊙NWS ○All NOAA (Go)

Point Forecast: 27 Miles WNW Searchlight NV
35.62N 115.39W (Elev. 2640 ft)

Last Update: 2:44 am PDT Jun 1, 2010

Tabular Forecast

[hide menu] | Font Size: A A A XML

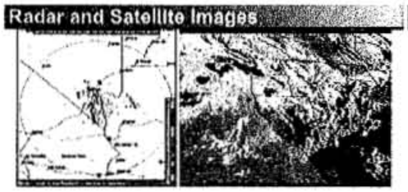
- ☑ Temperature (°F)
- ☑ Dewpoint (°F)
- ☐ Heat Index (°F)
- ☑ Surface Wind (mph)
- ☑ Sky Coverage
- ☐ Precipitation Potential
- ☑ Relative Humidity
- ☐ Thunder
- ☐ Rain

48-Hour Period Starting: [1pm Tue, Jun 1] (Submit) Back 2 Days | Forward 2 Days

Date	06/01											06/02												
Hour (PDT)	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12
Temperature (°F)	88	89	91	91	92	90	88	84	79	76	73	71	68	67	65	64	63	63	67	71	75	81	83	86
Dewpoint (°F)	28	28	28	28	28	30	30	32	33	34	35	35	34	35	35	37	37	37	38	39	37	38	38	38
Wind (mph)	20	21	21	21	21	21	21	15	15	15	10	10	10	6	6	6	5	5	5	3	3	3	5	5
Wind Dir	SSW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SSW	SSW	SSW	SSW	SSW	SSW	SSW	SSW	SSW	S	S
Gust	26	29	29	29	29	29	29	21	21	21														
Sky Cover (%)	52	52	52	52	42	42	42	42	42	42	32	32	32	32	32	32	32	32	32	32	32	32	31	31
Rel. Humidity (%)	12	11	11	10	10	12	12	16	18	21	24	26	29	30	32	37	37	39	35	31	25	22	20	19

Date												06/03												
Hour (PDT)	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12
Temperature (°F)	89	90	92	93	94	92	90	86	82	78	75	73	70	70	68	66	66	65	70	74	78	84	86	89
Dewpoint (°F)	36	35	34	31	31	32	32	32	32	32	32	32	31	32	31	33	33	33	34	35	35	36	36	37
Wind (mph)	5	6	6	6	11	11	11	11	11	11	8	8	8	8	8	8	5	5	5	5	5	5	9	9
Wind Dir	S	SSW	SSW	SSW	SW	SW	SW	SW	SW	SW	SSW	SSW	SSW	SSW	SSW	SSW	S	S	S	S	S	S	SSW	SSW
Gust																								
Sky Cover (%)	31	31	31	31	31	31	31	31	31	31	27	27	27	27	27	27	24	24	24	24	24	24	34	34
Rel. Humidity (%)	15	14	13	11	11	12	13	15	16	18	20	22	23	24	25	29	29	30	27	24	20	19	17	16

Radar and Satellite Images



Additional Forecasts & Information

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Forecast Discussion
7-Day Forecast
Hourly Weather Graph
Quick Forecast
Road Conditions
Fire Weather

Webmaster
NOAA's National Weather Service
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Figure 1. Forecast for Primm, Nevada, June 2, 2010.

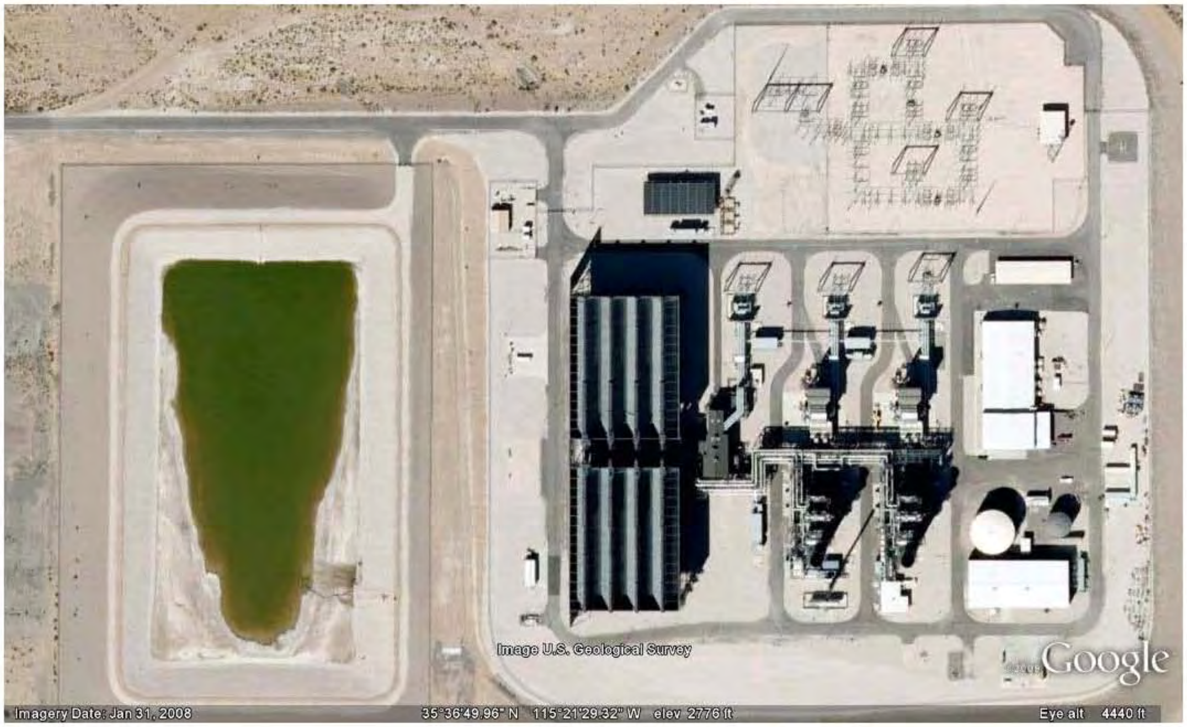

Figure 2. Nevada Power Walter E. Higgins Power Plant, Primm, Nevada

AeroPacific Consulting

Flight Test Report

Glint/Glitter Evaluation of SEGS, and Convective Plume Evaluation of Walter Higgins Power Plant

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Table of Contents

Executive Summary

The test objectives were to assess the impacts to flight safety of both the glint/glitter of a solar power plant and the convective plumes from a set of Air Cooled Condensers (ACC) from a power plant.

A total of three test flights were flown - one to assess the glint/glitter of the Solar Energy Generation System (SEGS) near Kramer Junction, California; and two flights to assess the convective plumes at the Walter E. Higgins power plant near Primm, Nevada.

During the photo flight, photographs were taken of the SEGS facility from a low sun angle, approaching from the west, near sunset. Both visual impressions and photographs indicated a collimated beam of specular reflection from the facility when the aircraft was appropriately located along the reflected beam. This reflected light was not objectionable to the observer and would not present a hazard to a pilot trying to land an aircraft at a nearby airport. Numerous photographs were taken to illustrate the characteristics of the reflections.

Thirty-four test points were flown at the Higgins Power Plant near Primm, Nevada. During these flights, quantitative data were taken of the aircraft's response to the convective plume and the workload required of the pilot to control the aircraft. Both cruise and landing configurations were flown, simulating an aircraft on a downwind leg in a landing pattern and one on final approach immediately prior to landing. Various altitudes were flown over the power plant, but most of the emphasis was placed at the 500 foot altitude above the ACC. The aircraft response to the plumes varied from high-frequency/low-amplitude aerodynamic chop to oscillatory bank angle changes of up to 25 degrees of bank. The variations generally were more prominent when the aircraft was closer (in altitude) to the source of plume. Since the ACC was adjacent to the Heat Recovery Steam Generators (HRSG), some of the aircraft responses were likely due to the HRSG plume as opposed to the ACC plume. For those points where the ACC was the contributor, the aircraft response was more benign. Even at 500 feet above the facility, the aircraft was fully controllable and recovery from any dynamic upset was fully within the capability of a student pilot with limited experience.

Based upon my education, training, and experience, it is my opinion, to a reasonable degree of engineering certainty that neither the glint/glitter characteristics of solar arrays nor the convective plume characteristics of an ACC array pose a significant threat to general aviation aircraft operating at traffic pattern altitudes.

Specifically with respect to the solar array plan and ACC locations proposed for the Blythe Solar Power Plant (BSPP), it is my opinion that the currently proposed design and location of the ACCs and solar arrays will not present significant glint/glitter or convective plume hazard to aviation.

Introduction

General

Background

Tests were conducted to determine the hazards to flight safety of the proposed Blythe Solar Power Plant (BSPP). The Solar Energy Generating System (SEGS), near Kramer Junction, California was used as a basis for evaluating the negative impact of flying a general aviation aircraft near a solar plant. The Walter E. Higgins Power Plant, near Primm, Nevada was used to evaluate the extent of any degradation to aircraft flying qualities or other negative impacts of a convective plume typical of Air Cooled Condensers (ACC).

Previous tests of thermal plume effects have been accomplished by others. Those tests, however, categorized the deleterious effects of a convective plume in terms of a turbulence level. This correlation was inappropriate for the relevant hazards of the convective plume of a power plant. Turbulence, as defined by the Federal Aviation Administration, relates primarily to passenger comfort and ability to walk and serve food and beverages. In extreme cases this definition may also relate to potential for aircraft damage. The actual hazard with convective plumes of a power plant to general aviation aircraft, however, is the pilot's temporary loss of aircraft control while close to the ground. A general aviation aircraft is more susceptible to convective plumes than a large airliner primarily due to its lower wing loading and mass moment of inertia about the longitudinal (roll) axis. The wing loading of a typical airliner is between 120 and 130 lb_f/ft^2. This is significantly higher than the wind loading of a Cessna C-152 (10.4 lb_f/ft^2) or a Beech Bonanza (16.9 lb_f/ft^2). The lower the wing-loading, the more an aircraft responds to a convective plume - both in normal acceleration and roll moment. Thus, choosing a criteria other than turbulence was necessary to determine hazards of a convective plume. For the tests conducted for this report, the changes in bank angle and pitch attitude after a 2-second delay was used as the criteria.

Test Objectives

The objectives of this tests were to:

1. Assess the flight hazards associated with the glint/glitter of a solar power plant as it affects general aviation aircraft in the approach and landing phases.
2. Assess the flight hazards associated with the convective plume of an Air Cooled Condenser (ACC) as it affects general aviation aircraft in the approach and landing phases.

Test Equipment

The test aircraft was a 1960 Beechcraft M35 Bonanza, registration N9366Y. The aircraft was equipped with an IO-470N, 6-cylinder, fuel-injected engine. The aircraft was also equipped with two Osborne fuel tanks on the wing tips. These tanks, however, were intentionally empty of fuel in order to minimize the

Figure 1. N9366Y

mass moment of inertia along the longitudinal (roll) axis. This allowed the maximum amount of roll angle response to a given amount of asymmetric convective plume.

The aircraft was also equipped with a Shadin fuel computer that measured fuel flow and computed fuel used and fuel remaining. The fuel remaining values were then added to the aircraft's Zero-Fuel-Weight (ZFW) to determine the aircraft's weight for each test point. The aircraft's empty weight was 2,135 lbs. The weight of the pilots and luggage was 435 lbs. This resulted in an aircraft ZFW of 2,570 lbs.

The aircraft was equipped with a ventral skeg to reduce directional (yaw-axis) dynamic oscillations. Additionally, the aircraft was equipped with a S-TEC electronic yaw damper and an S-TEC 50 autopilot. Neither of these two electronic devices were engaged during the execution of these tests.

The g-loadings (n_z) were measured with the accelerometer incorporated into an Apple iTouch device. The G-Meter application (app) was used to display the instantaneous and maximum normal g-levels for each test point.

A Sony V-O-R Micro Cassette model M-635VK audio recorder was used to record the pilot comments through the aircraft's intercom system.

Altitude values were measured using the aircraft's altimeter, with the local altimeter setting.

Pitch and bank angles were measured using the aircraft's attitude indicator.

A Nikon D60 Single Lens Reflex (SLR) camera was used to photograph the SEGS facility.

Test Limitations

These tests were conducted within the requirements of FAR Part 91 (General Operating and Flight Rules), FAR Part 61 (Certification of Pilots), and FAR Part 43 (Maintenance), among others.

Specifically, the tests adhered to the minimum altitude requirements of FAR Part 91.119 (Minimum Safe Altitudes), whereas the areas flown over during the photo flights and plume assessments were considered to be uncongested areas and a 500 ft minimum distance from any structure was maintained. Furthermore, sufficient altitude was always maintained in order to select and achieve a suitable landing surface in the event of engine failure.

SEGS Glint/Glitter Evaluation

Test Procedures

The aircraft was flown over the SEGS Solar Power Plant, near Kramer Junction, CA in the Mojave Desert. The photographic portion began around 7 PM on June 1, 2010. Sunset on that date was published as 7:59 PM. A series of patterns were flown, both parallel and perpendicular to the western edge of the solar power plant. The aircraft's elevation angle in relation to the power plant was controlled so that the aircraft was directly between the sun and the power plant - thus maximizing any specular reflection from the solar troughs. The minimum altitude flown was 500 ft above the ground and away from any objects.

Results and Analysis

The glint and glitter effects were evaluated from numerous angles and altitudes. The most significant visual aspect was what appeared to be specular reflection of the sun observed as a collimated brilliance that translated along the area of the reflectors consistent with the aircraft's movement along the reflector axes (see Fig 2). The intensity of the beam was not extreme and was of less intensity than the direct sun. This reflection would not be considered distracting to a pilot.

Figure 2. Collimated specular reflection

The second-most significant visual observation was the specular reflection of some of the leading-edge panels of the arrays. These appeared to be more prominent than panels in the rear or midsection as viewed by an observer. The reflections from these leading edge panels, however, would not considered to be distracting to a pilot. (see Fig 3).

Figure 3. Leading edge panel reflections

Occasionally, small spot reflections were observed from unique features within the solar array, most likely representing isolated panels that were misaligned with respect to its adjacent panels, or possibly irregular objects. (see Fig 4).

Figure 4. Spot reflections in 3rd and 5th rows

Pilots naturally adapt themselves to their environment. It is a necessary skill of their occupation. Visual distractions frequently occur in aviation. Examples include bright ramp lights shining in the pilot's eyes at night, a setting sun co-aligned with the runway during takeoff or landing, or off-angle reflections of the sun from highly-reflective objects. Pilots develop techniques for dealing with these distractions. Furthermore, most of the time they occur with adequate warning thus allowing the pilot adequate time to compensate. In summary, it is my opinion that the glint and glitter observed during the overflight of SEGS would not pose a hazard to aviation.

Walter E. Higgins Plume Evaluation

Test Procedures

The convective plume tests were conducted in the early morning in order to ensure calm winds and avoid solar heating and natural convective turbulence.

As a safety precaution, the tests were planned to go from high to low altitudes over the power plant. The land upon which the ACC is located was 2, 600 ft Mean Sea Level (MSL). The height of the ACC was 210 ft. Therefore, the top of the ACC was 2,810 ft MSL. The first fly-over altitude was flown at 4,310 ft (MSL). Consequently, the first flyover point was 2,500 feet above the top of the ACC. All subsequent altitudes in this report will correlate to altitudes above the top of the ACC. The lowest altitude flown during any test point was 500 ft above the top of the stack. Additionally, for safety considerations, adequate altitude was maintained at all times in order to select and glide to a suitable landing surface in the event an engine-failure occurred.

Subsequent over-flights were performed at successively lower altitudes after assessing that the aircraft response was easily controllable on the previous test point.

After entering the plume, the control column was held fixed by the pilot. Any bank angle or pitch attitude changes induced by the plume was not counter-acted by the pilot until after 2 seconds had elapsed. After such time, the pilot manipulated the controls in an operationally representative fashion to recover the aircraft to stabilized level flight. The 2-second delay was used to simulate the "startled" effect of pilots who were not mentally prepared to react to a convective plume.

The run-in heading used for most of the runs was approximately 170-350 degrees magnetic. This line was selected because, at the time of testing, the identity of the operating ACC was not known. Additionally, this run-in line gave the maximum separation from the two Heat Recovery Steam Generator (HRSG) stacks.

A figure-eight pattern was flown by making an approximately 30-degree heading change to the right, after flying over the ACC, followed by a left turn to the subsequent run-in heading. Comments were recorded during the turn.

The test was telephonically coordinated with the Las Vegas Flight Standards District Office (FSDO). Their suggestion was for us to coordinate further with Las Vegas Approach Control (ATC). Although we attempted to coordinate with ATC, our working altitudes were below their radar and radio coverages. Consequently, we coordinated directly with other local airborne traffic on the Jean Airport UNICOM (122.9 MHz). This was felt to be more effective than working with ATC radar.

The test points were flown in one of two configurations and speeds. The first set was flown in Cruise configuration - landing gear and flaps retracted, cowl flaps closed, and airspeed of 100 mph. This was used to simulate an aircraft in the downwind pattern, nominally at 800-1,000 ft AGL. The second set was flown in Landing configuration - gear and flaps fully extended, cowl flaps closed, and airspeed of 80 mph.

The test points were flown so as to fly through the ACC plume, either directly or offset slightly so that one wing would receive the direct force of the plume and the other wing would miss the plume. This was perceived to be the worst-case scenario.

Results and Analysis

Thirty-four test points were flown during the two flights. Both flights investigated the characteristics associated with Cruise and Landing Configurations.

Cruise Configuration

The first test point was flown at 2,500 ft above the ACC and no noticeable plume was observed. The next test point was flown at 2,000 ft above the ACC. At this height, the exhaust created a high-frequency, low-amplitude burble on the airframe. Most pilots would classify this as “light chop.” No noticeable pitch and bank changes occurred.

Next, test points were flown at 1,000 and 1,500 ft above the ACC with no noticeable effects. It is likely that the aircraft flight-path passed to the side of the plume. There was a slight wind out of the west, as visualized by the orange wind sock on the top of the ACC. Thus, the lateral position of the exhaust plume at the aircraft’s altitude had to be estimated. Flying a run-in heading directly into the wind was considered in order to minimize any drift error of the plume, but that westerly heading would have made the aircraft fly directly over the HRSG stack in addition to the ACC, which would have contaminated the data.

The first noticeable g-loading increase was felt at 700 ft above the ACC. It was associated with a light burble.

At 600 ft above the ACC, two runs were made where medium-amplitude burbles were felt on both runs, with a maximum n_z of 1.6 g. All day long, the maximum g readings, as a result of the exhaust plume, were not noticeably different from that experienced from the ambient convective turbulence created by solar heating of the terrain.

At 500 ft above the ACC, three runs were made in the Cruise configuration. Each time the aircraft entered the plume, the aircraft responded with a 5 to 10 degree oscillatory bank angle change (wing-rock), a 2 degree oscillation in pitch, and an n_z of 1.7 to 1.8 g. These deviations from stable flight were easily controlled by the pilot and would have been within the capability of a student pilot possessing limited experience.

Landing Configuration

The natural aircraft response to pilot inputs in the landing configuration was naturally slower than the cruise configuration because of the slower airspeed. This implies that any deviation from stable flight may be more hazardous because the pilot would have less time to respond since the aircraft response is slower.

During the tests in the Landing Configuration, the deviations in bank angle were slightly larger. During one test point, a 25-degree deviation in bank angle occurred, requiring a moderate correction by the pilot. If this had truly occurred on final approach and close to the ground, then it would have been a challenge for the pilot to quickly recover. It, however, would have been little different from the destabilizing effects of ambient turbulence typically experienced in the summer. Furthermore, it appeared that this test point encountered the plume from the HGSR, instead of that of the ACC.

On several points while configured for landing, the plume resulted in a momentary stall warning by the aircraft's artificial stall-warning system. The inherent restorative dynamic stability of the aircraft, however, quickly and naturally recovered from this momentary increase in angle-of-attack.

Due to the aircraft's naturally slower response to control-wheel deflections, the workload and time required for the pilot to respond to the dynamics of the convective plume was more prominent at the slower speed in the Landing Configuration. At no time, however, did the workload exceed that of a student pilot possessing limited experience.

Additionally, it should be noted that the natural thermal convective conditions associated with surface heating was equivalent to that experienced while flying through the plume. In fact, the largest bank angle excursions occurred between test points while the aircraft was maneuvering to set up for the next run-in.

Applicability to the Blythe Solar Power Plant (BSPP)

The primary issue with BSPP is the location of ACC 4 - approximately 14,000 feet from the approach-end of runway 17. Aircraft operating in a conventional right-hand traffic pattern would not overfly this ACC. It is foreseeable, however, that some aircraft may overfly this ACC while entering the traffic pattern for runway 17 in an unconventional manner. Even if doing so, however, their altitude would either be 800 feet above the runway, level at pattern altitude, or on a curved glideslope to landing at approximately 700 feet above the runway. Therefore, the only ACC convective plume encounter that would be applicable to BSPP would be one in which the aircraft was at approximately pattern altitude and at a speed measureably above that of final approach speed.

During all the tests conducted, there was no indication of a hazard to aviation due to an ACC convective plume encounter - down to 500 feet above the ACC in the Cruise configuration.

Conclusions

Based upon my education, training, and experience, it is my opinion, to a reasonable degree of engineering certainty that neither the glint/glitter characteristics of solar arrays nor the convective plume characteristics of an ACC array pose a significant threat to general aviation aircraft operating at traffic pattern altitudes.

Specifically with respect to the solar array plan and ACC locations proposed for the Blythe Solar Power Plant (BSPP), it is my opinion that the currently proposed design and location of the ACCs and solar arrays will not present a significant hazard to aviation.

Appendices

Flight Test Data

Run	Alt (ft) Above ACC	time	Config	Speed (mph)	ΔH (ft) alt	ΔΘ (deg) pitch	ΔΦ (deg) bank	Δn_z (g)	Fuel (gal)	Comments
1	2,500	7:18	Cruise	100						No detectable plume.
2	2,000	7:22	Cruise	100						Light bit of high-freq burble
3	1,500	7:25	Cruise	100					60.7	No plume
4	1,000	7:28	Cruise	100					60.2	No plume
5	700	7:31	Cruise	100					59.7	Ambient turbulence felt from surrounding area. Light burble in plume, slight normal bump of approx ¾ sec duration.
6	600	7:33	Cruise	100					59.9	Light high-freq/low amplitude burble.
7	600	7:36	Cruise	100		0	9	1.6	58.8	Starting using N-S headings from here on. High-frequency/low amplitude burble, oscillatory in bank, light chop.
8	500	7:39	Cruise	100		0	10		58.3	Light chop, with off-center hit resulting in wing rise
9	500	7:42	Cruise	100	+80	2	5	1.8	57.8	Light chop, small increase in altitude
10	500	7:45	Cruise	100		2	9	1.7	57.1	Larger oscillations in bank angle. Slight off-center
11	700	7:49	Land	80	+130		25	1.6	56.2	Probable HRSG plume. Large increase is altitude and large bank angle change. Moderate workload to recover from 25 deg bank angle change. Tolerable and controllable.
12	700	7:53	Land	80	+100	2	15	1.6	55.3	Easy to control. Probable HRSG plume.
13	600	7:56	Land	80	+50	2	8	1.5	54.7	
14	500	8:00	Land	80					53.8	No plume
15	500	8:02	Land	80					53.2	No plume
16	500	8:05	Land	80		0	10	1.5	52.6	Encountered turb 4 secs past stack, probable natural convection
17	500	8:07	Land	80					51.9	No plume
18	500	8:11	Land	80		5			51.0	Very light chop
19	500	8:13	Land	80	0	0	10		50.4	Light chop, easy to control
20	500	8:16	Land	80					49.8	No plume
21	500	8:18	Land	80	+100			1.8	49.2	Momentary stall warning
22	500	8:21	Land	80	+50	2	15	1.6	48.6	
23	500	8:24	Land	80	+40	1	15	1.7	48.0	

24	500	8:27	Land	80					47.3	
Run	**Alt (ft Above ACC)**	**time**	**Config**	**Speed (mph)**	**ΔH (ft) alt**	**ΔΘ (deg) pitch**	**ΔΦ (deg) bank**	**Δn_z (g)**	**Fuel (gal)**	**Comments**
31	500	11:57	Cruise	100	+50	0	0	2.0	61.8	Ambient turbulence averages approx 1.5 g. Very noticeable and abrupt onset of plume. Not objectionable. Controllable. Could feel more energy in that one.
32	500	12:01			+70	1	10		61.2	Possible HRSG stack on right. Hard to differentiate between ACC and HRSG. Not objectionable. Blends in with ambient turbulence.
33	500	12:03			-	1	0	2.0	60.7	Symmetrical bump, less than ½ sec in duration. Not objectionable.
34	500	12:05				2	10	0.4 - 1.7	60.3	Double hit, secondary bump. Standard kick in vertical, followed by drop-down. Ambient turbulence seems to be increase as the flight continues.
35	500	12:08			+50	1	10	2.3	59.8	Momentary stall warning. Symmetrical bump. Ambient turbulence. Worst bank angle for this series so far. Not objectionable.
36	500	12:11	Land	80	+80	1	10	1.9	59.0	
37	500	12:14							58.3	No plume
38	500	12:16			+100	1	15	1.9	57.9	Easily controllable

39	500	12:20			0	0	12	1.8	57.0	Increase performance prior to plume, +150ft and +15 mph attributed to ambient convection. Not objectionable. Easily controllable with conventional pilot inputs and responses. Left wing over ACC but right wing went up b/c of plume from HRSG.
40	500	12:22			+40		20	2.2	56.4	Momentary stall warning consistent with ambient convective turbulence.

Curriculum Vitae

Douglas Moss

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Doug.Moss@aeropacific.net

Firm/Expert Profile:

Douglas Moss (BS Engr, MS Engr, MBA, JD) is a trained and experienced professional pilot and engineer. He provides research and investigations of aircraft accidents to determine the causal factors. His professional experience spans over 33 years in aviation as an engineer and professional pilot, including assignments as a USAF fighter pilot, USAF experimental test pilot, McDonnell Douglas engineering test pilot, airline pilot, and general aviation pilot. His academic education includes both bachelor and master degrees in engineering, with additional advanced degrees in business and law. He has also been a faculty instructor at the USAF Test Pilot School, teaching aircraft certification, flying qualities, performance, systems, and human factors. He currently instructs courses in Aviation Human Factors at USC's Viterbi School of Engineering.

His analysis of aviation accidents typically involve considerations of:

- Engineering and scientific bases
- Operational factors
- Human factors
- Aircraft certification compliance (14 CFR Parts 21 and 25)
- FAR statutory compliance (14 CFR Parts 91, 121 and 135)
- Strict products liability
- Aircrew standard of care

Professional Experience:

Over 11,400 flight hours
Faculty instructor of Human Factors at the USC's Viterbi School of Engineering
USAF experimental test pilot
McDonnell Douglas engineering test pilot
USAF Test Pilot School instructor
Airline pilot
ATP Typed DC-9, MD-80, MD-90, MD-11, A320 and Flight Engineer
Qualified in various models of Cessna, Piper, and Beechcraft

Education/ Training:

Concord Law School, Juris Doctor
University of Southern California - Aviation Safety & Security Course
University of Phoenix: Master of Business Administration
Georgia Institute of Technology: Master of Science – Mechanical Engineering
Georgia Institute of Technology: Bachelor of Engineering - Nuclear Engineering
US Air Force: USAF Test Pilot School, Air War College, Air Command & Staff College, Squadron Office School

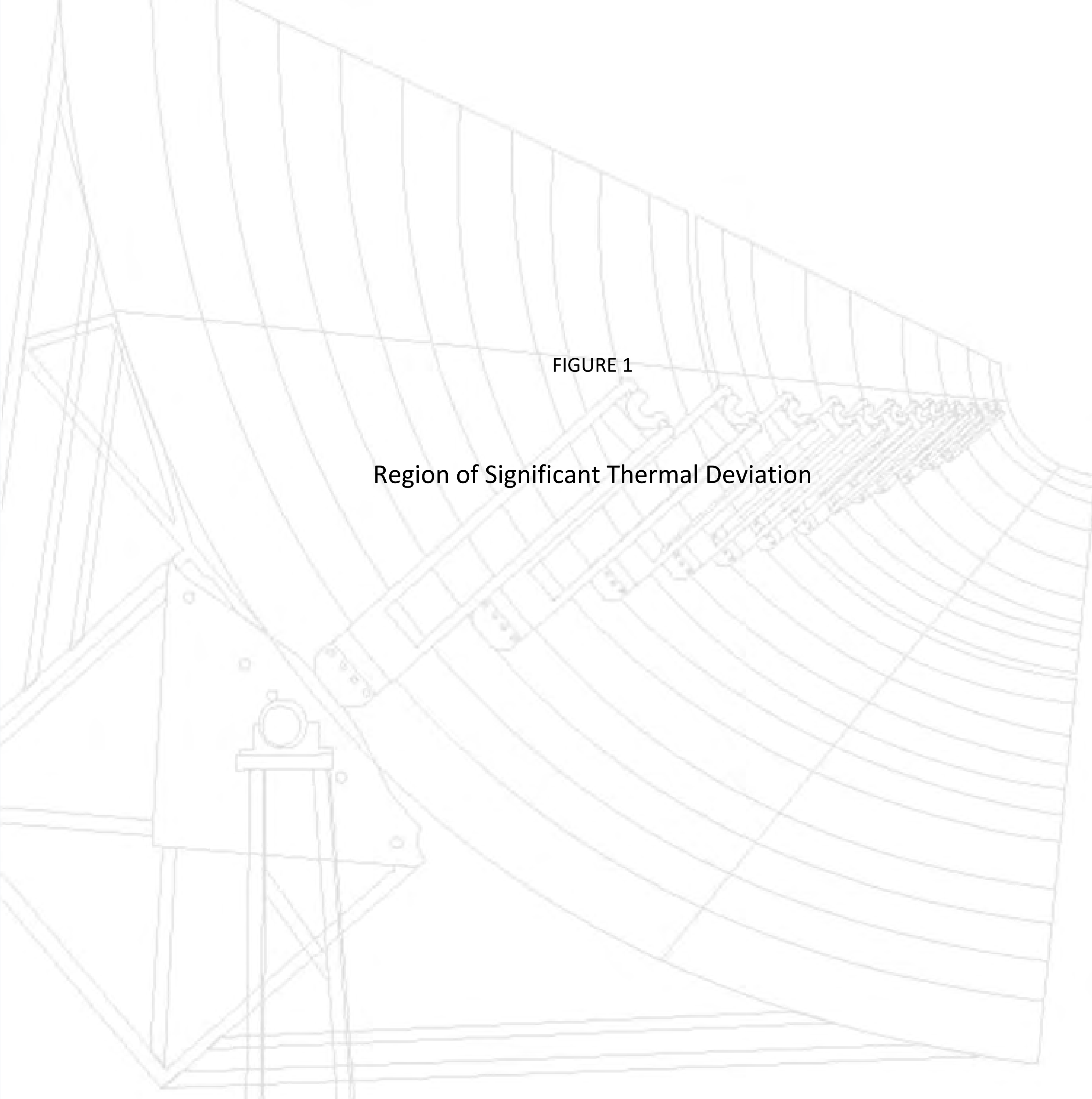
Professional Qualifications:

Airline Transport Pilot
Type Certificates: A320, MD-11, DC-9 (MD-80, MD-90)
Type Qualifications: F-15, F-4, A-37, T-33, T-34, T-37, T-38, T-46
Single-Engine, Land & Sea; Multi-Engine; Instrument
Flight Engineer – Turbojet Powered

Professional Affiliations:

Society of Experimental Test Pilots
Air Line Pilots Association
Aircraft Owners and Pilots Association
American Institute of Aeronautics and Astronautics
Society of Automotive Engineers - SAE International
Association of Aviation Psychology

FIGURE 1



Region of Significant Thermal Deviation

Solar Millennium LLC
1625 Shattuck Ave. Suite 270
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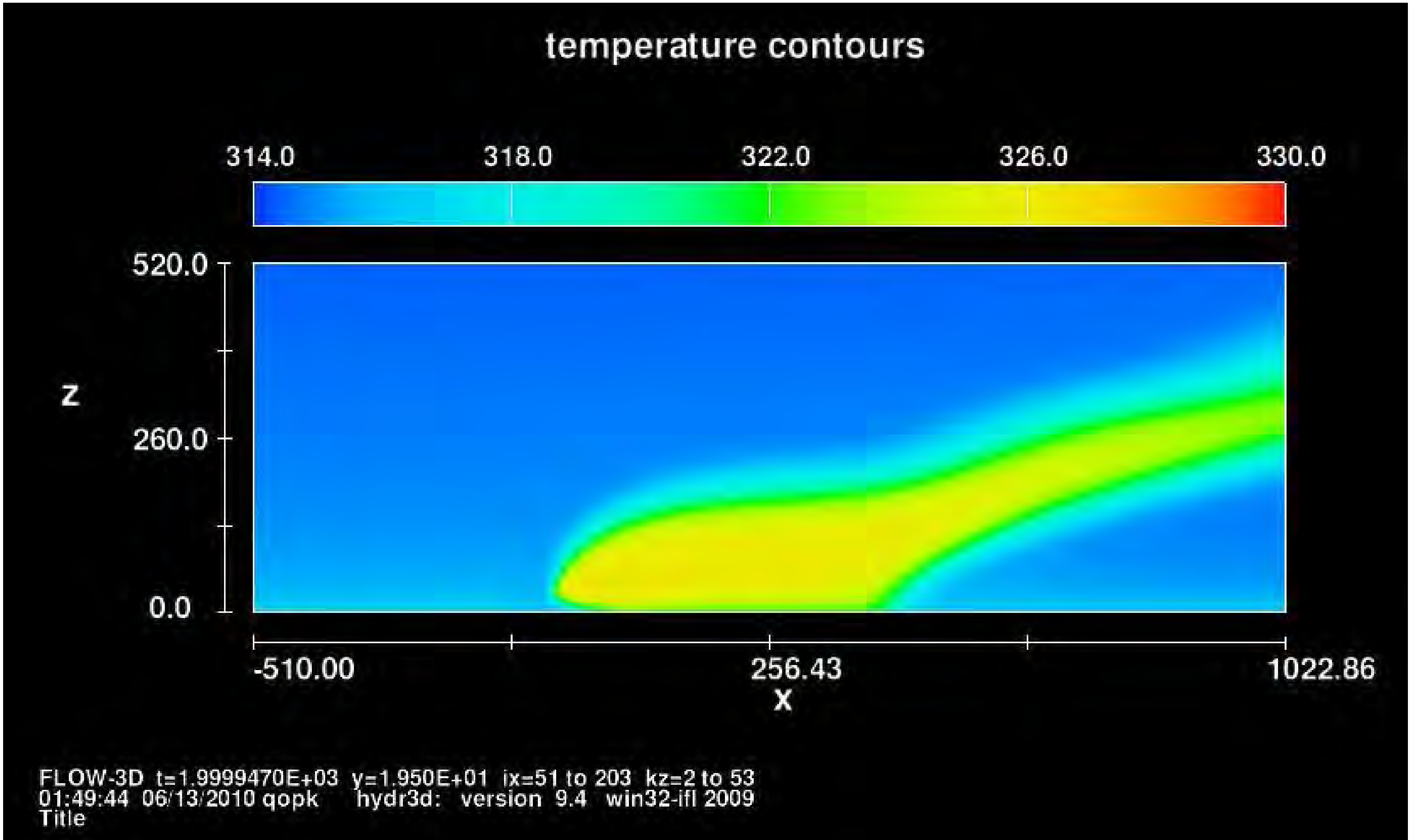

Figure 1
Region of Significant Thermal Deviation

Enclosure 2

Water Modeling Data Request DR S&W 133
Dated January 25, 2010

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DR-S&W-132

Information Required:

Please provide an assessment of changes in the groundwater basin balance and water levels, and potential impacts related to project pumping by IWVWD that would occur in single dry year and multiple dry year drought scenarios for the life of the project.

Response:

Please refer to the response to DR-S&W-133.

DR-S&W-133

Information Required:

Please provide an assessment of changes in the groundwater basin balance and water levels, and potential cumulative impacts related to groundwater pumping by IWVWD for the project and reasonably foreseeable projects. The assessment should include consideration of water supply and demand planning that may be included in Groundwater Management Plan and/or Urban Water Management Plan for the basin.

Responses:

The primary concern expressed in DR-S&W-132 and DR-S&W-133 is the impact to the groundwater basin (water level decline and storage depletion) from the project pumping under normal and dry year conditions and a future projected condition and the possibility of a basin-wide increase of pumping during the life of the project. The response to the data request was addressed utilizing the Brown and Caldwell (BC 2009) model constructed for the Indian Wells Valley Groundwater Basin for the Indian Wells Valley Water District (District). Because DR-S&W-132 and DR-S&W-133 are related, these two requests are addressed together based on the results of systematically designed model simulations.

Seven model scenarios (Runs 1, 2a, 2b, 3a, 3b, 4a and 4b) were conducted to progressively evaluate various stresses on the groundwater basin through changes in recharge (i.e., single and multi-year dry seasons) and project and regional pumping. Run 1 provides a baseline scenario in which the BC (2009) model was extended to the end of the project (year 2043). Runs 2a and 2b were designed to assess impact under dry year conditions. In Runs 3a and 3b, the basin was further stressed with increased pumping based on the District's projected water use estimate for 2010 to 2020 adding onto the dry condition assessment in Runs 2a and 2b. Finally, in Run 4a and 4b, the Project water use was added to assess the impact by comparison with previous scenarios. Below are detailed descriptions of each model scenario.

Run 1 – Baseline scenario

In the BC (2009) model, the transient calibration ends at the end of 2007. Before conducting predictive simulations, the BC model had to be extended to the beginning of 2011 (i.e., the beginning of the project). To reflect pumping conditions between 2007 and 2010, the pumping rate for proposed District supply wells #18, #33 and #34 to be used for the Project were set at 600 gallons per minute (gpm). This was the base rate prior to adding the Project pumping. This is based on the information provided by the District (Attachment DR-SW-133)

The historical pumping rates of the other wells in the model domain vary from year to year. Comparison of the pumping rate in 2007 (the last year of the BC model) and the average pumping rate of the last ten years of the BC model (1998-2007) indicates that the average pumping rate is higher than that in the last year (2007). To provide a representative baseline, the average pumping rate for the other wells within the model was used through the entire duration of the model simulation (2011 through 2043).

Run 2a – Single and multiple dry years scenario (25% of baseline inflow)

Run 2a provides a dry year scenario in which the inflow (i.e., recharge) was 25% of the baseline amount (Model Run 1). In this run, the model setup between 2008 and 2010 is identical to that in Run 1. However, from the beginning of 2011 to the end of the project (2043), three dry periods were included in the project duration. The dry periods consisted of two single dry years (2018, 2036) and one multiple dry year period (2026, 2027, 2028).

To properly place dry years in the project duration, a "dry year" had to be defined. Many methods were developed to define "dry" or drought condition; however given the available data, it is believed that use of precipitation data to approximate "dry year" is appropriate. The concept used in the modeling is that precipitation is directly related to the mountain front recharge, which, based on the BC (2009) model report, is the primary recharge to the Indian Wells Valley Groundwater Basin.

The precipitation data from the Western Regional Climate Center for both Inyo-Kern station (1940-2009) and Indian Well Canyon station (1996-2009) were reviewed. The data from the Indian Well Canyon station are of a very short duration and not sufficient for "wet-dry" cycle analysis. Therefore, only the historical precipitation data for Inyo-Kern located in the vicinity of the Inyo-Kern Airport and within the Indian Wells Valley Groundwater Basin were analyzed. The detailed steps in the analysis of wet-dry year cycles are as follows:

- Calculate the minimum, average and maximum annual precipitation and the standard deviation for the period of 1940 to 2009.
- Determine the upper limit of precipitation for the dry year (mean minus standard deviation:1.27 inches)
- Identify the dry years (i.e., all the years with precipitation at or less than 1.27 inches)
- Determine percentage of precipitation in a dry year relative to an average year using minimum precipitation divided by average precipitation (15%)
- Determine percentage of precipitation in a dry year relative to an average year using the average precipitation in dry years divided by average precipitation (25%)
- Determine the frequency of occurrence of dry year(s) (any year with precipitation less than 1.27 inches) using number of times occurred over the history (about every seven years for a single dry year and there are no consecutive years)

Based on the results of the analysis, it was determined that zero precipitation is not supported by the data and therefore it is not appropriate to consider zero inflow in the model scenarios. In addition, there are no consecutive dry years as defined above. With these analyses, Run 2a was conducted with the recharge being 25% of the baseline amount (Run 1). The occurrences of dry year(s) are based on the frequency determined and placed in 2018, 2026, 2027, 2028, 2036 based on actual project duration (Figure DR- S&W -133-1). Although there are no multiple dry years documented; but an occurrence of multiple dry years was placed in the operation as described to simulate the worst case scenario.

Run 2b – Single and multiple dry year scenario (15% of baseline inflow)

Run 2b is identical to Run 2a except for the inflow input. Run 2b provides a worse-case scenario in comparison with Run 2a because of the larger inflow reduction (15% of the baseline amount).

Run 3a – Impact from District projected water use increase (25% of baseline inflow)

Run 3a is identical to Run 2a with regard to the recharge reduction; but differs in the pumping rate of some of the wells in the model domain. To further stress the aquifer, the projected pumping rates into the future for wells operated by the District were added. Based on the projections in annual use provided by the District for the period between 2010 and 2020, the annual pumping increase from a baseline of 2007 is projected to be 721 gpm in 2011 to 950 gpm in 2020. Because it is not clear in the projection how the increase is allocated across District wells, the amount of increase was evenly distributed to proposed water supply wells #18, #33 and #34 for the project. By placing all of the projected increase in the proposed water supply wells, not across the entire District well field, it should be noted that this will bias the cone of depression in the area of the proposed Project water use.

Because the projected increase for the years 2021 to 2043 was not provided by the District the future increase to the term of the model period (2043) was based on the trend of annual increase provided for 2013 to 2020. From this period from 2013 to 2020 (0.2% to 0.3%), the amount of increase was estimated by cumulative increase of 0.3% from 2020 to 2043. The increase in the pumping rates were applied to the proposed pumping wells for the project and the pumping rates for all other wells in the model domain were not changed from the baseline condition (Run 1).

Run 3b – Impact from District projected water use increase (15% of baseline inflow)

Run 3b is identical to Run 2b except for the inflow input. Run 3b provides a worst case scenario in comparison with Run 3a because of the larger recharge reduction (15% of the baseline amount).

Run 4a – Impact assessment from proposed Project water use (25% of baseline inflow)

Run 4a is identical to Run 3a except that the Project water use was incorporated into the model by adding the pumping rate (190 gpm per well for construction and 30 gpm per well for the operation) to each of the three wells (#18, #33 and #34).

Run 4b – Impact assessment from proposed Project water use (15% of baseline inflow)

Run 4b is identical to Run 4a except for the change in recharge. Run 3b provides a worst case scenario in comparison with all other scenarios because of the incorporation of the larger inflow reduction (15% of the baseline amount), projected increased pumping from IWV and addition of the RSI project water use.

Model results and impact evaluation

The results of the modeling are shown to:

- Illustrate the difference in groundwater level drawdown between Scenario 3a/3b, which include the effects of draught conditions and projected increases in pumping and project pumping drawdown (Scenario 4a/4b) at the end of construction and at the end of the project (Figures DR-S&W-133-2 and DR-S&W-133-3), and
- Changes in the storage depletion between the no project condition (Scenario 3a/3b) and proposed project pumping (Scenario 4a/4b) (Table DR-S&W-133-1).

When groundwater pumping exceeds the natural recharge, water has to be taken out of the basin storage to balance the water budget in the model. The deficit of recharge leads to basin storage depletion. In the seven model runs, the amount of water taken out of the basin storage or storage depletion was calculated and presented in Table DR-S&W-133-1 for each of the scenarios (Runs 1 through 4b) and for five periods starting with the end of construction (2013) through a single and multiple dry years (2018, 2028, 2036) and end of the project (2043). The table shows the individual model year and the deficits between scenarios for each year (i.e., vertical column) and the cumulative model deficit for each scenario through the model period (i.e., horizontal row).

As can be observed, at the end of construction in year 2013, the storage depletion is identical for Runs 1, 2a and 2b, and between 3a and 3b, and between 4a and 4b, The changes in depletion at the end of the construction period reflect changes in the projected regional pumping (3a/3b) and adding the proposed project pumping (4a/4b). The similarity between Run 1 and 2a/2b reflects the fact that for this period there was no dry year condition. Beyond the construction period, from Run 2a/2b to Run 3a/3b, draught conditions were added (less recharge) and more pumping was applied beyond the baseline condition to simulate future changes in projected water supply as provided by the District (Table DR-S&W-133-1).

Storage depletion can also be evaluated by comparison using percentage increase between scenarios. As can be observed, occurrence of dry years (less recharge) could lead to up to 6% increase of storage depletion (change between Scenarios 1 vs. 2). The projected pumping increase through the District could lead to additional 6% increase of storage depletion (comparison between Scenarios 2 vs. 3).

The impact from the proposed Project water use can be assessed by comparison between Scenario 3 and Scenario 4. As shown in Table DR-S&W-133-1, more storage depletion occurs at the end of construction due to higher pumping rate. For all other periods of interest, increase of storage depletion by the Project is only 1% by comparison to Scenario 3a/3b.

Figures DR-S&W-133-2 and DR-S&W-133-3 show the difference in drawdown from Project induced pumping by comparison to the no project Scenario 3a/3b which includes the draught year conditions and increases in projected regional pumping through the District. The figures show the difference in the predicted drawdown for the end of construction (2013) and for the end of the project (model year 2043). As shown for Scenario 4a (25% of the baseline recharge) the Project-induced pumping adds less than 5 feet of drawdown in the area of the pumping wells, and between 0.5 and 1 foot of drawdown to the most proximal adjacent water supply wells (Figure DR-S&W-133-2). As shown for Scenario 4b (15% of the baseline recharge) the results are the same, revealing that the model is not sensitive to variations in the draught scenarios and the change in recharge at the frequency applied in the model (Figure DR-S&W-133-3).

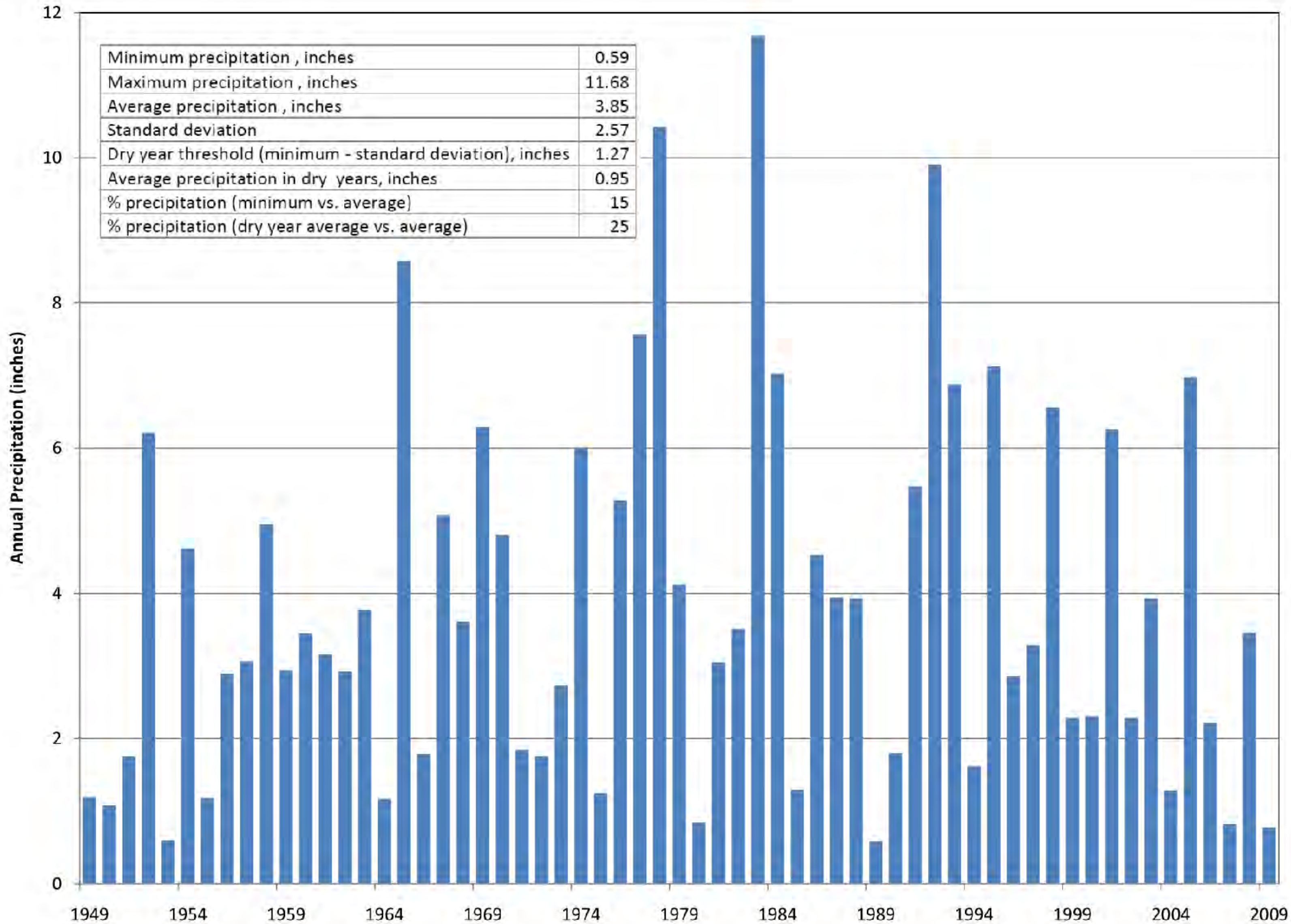
Table DR-S&W-133-1 Basin Storage Depletion as Modeled for Dry Years and Increased Pumping Scenarios

Model Scenario		Year 2013 End of construction	Change from Previous Run	Year 2018 End of dry year	Change from Previous Run	Year 2028 End of multiple dry years	Change from previous run	Year 2036 End of dry year	Change from previous run	Year 2043 End of operation	Change from previous run
		Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet
Water taken out of basin storage to balance pumping (storage depletion)											
Run 1	Baseline[1]	55,390		195,388		431,113		612,181		749,535	
Run 2A	Single and multiple dry years at 25% of inflow[2,3]	55,390	(0)	201,371	(5984)	454,812	(23699)	641,082	(28901)	777,581	(28046)
Run 2B	Single and multiple dry years at 15% of inflow[2,3]	55,390	(0)	202,169	(6782)	457,970	(26857)	644,937	(32756)	781,328	(31793)
Run 3A	Run 2A with projected increased pumping[4]	58,202	(2,812)	212,316	(10,944)	481,054	(26,242)	679,716	(38,634)	826,001	(48,420)
Run 3B	Run 2B with projected increased pumping[4]	58,202	(2,812)	213,114	(10,944)	484,213	(26,243)	683,572	(38,636)	829,750	(48,422)
Run 4A	Run 3A with Project water use added[5]	59,619	(1,417)	214,565	(2,249)	484,712	(3,658)	684,476	(4,760)	831,611	(5,610)
Run 4B	Run 3B with Project water use added[5]	59,619	(1,417)	215,362	(2,249)	487,872	(3,659)	688,331	(4,759)	835,361	(5,611)
Percent Increase of Storage Depletion											
Run 2A vs. Run 1		0%		3%		5%		5%		4%	
Run 2B vs. Run 1		0%		3%		6%		5%		4%	
Run 3A vs. Run 2A		5%		5%		6%		6%		6%	
Run 3B vs. Run 2B		5%		5%		6%		6%		6%	
Run 4A vs. Run 3A		2%		1%		1%		1%		1%	
Run 4B vs. Run 3B		2%		1%		1%		1%		1%	

1. Baseline conditions include District Wells #18, 33, and 34 each pumping at 600 gpm and setting the pumping rate through 2043 for other wells in the modeling using the 1999 - 2007 average.
2. Single dry years were simulated for 2018 and 2036 by decreasing recharge to 15% or 25% of baseline for those years.
3. Multiple dry years were simulated by decreasing recharge to 15% or 25% of baseline for 2026, 2027, and 2028.
4. For Runs 3A and B the project increase in pumping was varied from a basinwide increase of 721 gpm in 2011 to 950 gpm in 2020 and 953 gpm in 2021 to 1,018 gpm in 2043 (distributed evenly to wells #18, 33, 34).
5. For Runs 4A and B the pumping rate for each well (#18, 33, and 34) was increased by 190 gpm for construction and 30 gpm of operation

Attachment

Soil and Water Figures



Minimum precipitation , inches	0.59
Maximum precipitation , inches	11.68
Average precipitation , inches	3.85
Standard deviation	2.57
Dry year threshold (minimum - standard deviation), inches	1.27
Average precipitation in dry years, inches	0.95
% precipitation (minimum vs. average)	15
% precipitation (dry year average vs. average)	25

Map Location

Ridgecrest Solar Power Project

Figure DR-S&W-133-1
Inyo-Kern Station
Annual Precipitation
1949 - 2009

Solar Millennium

AECOM

Project: 60139696
Date: January 2010

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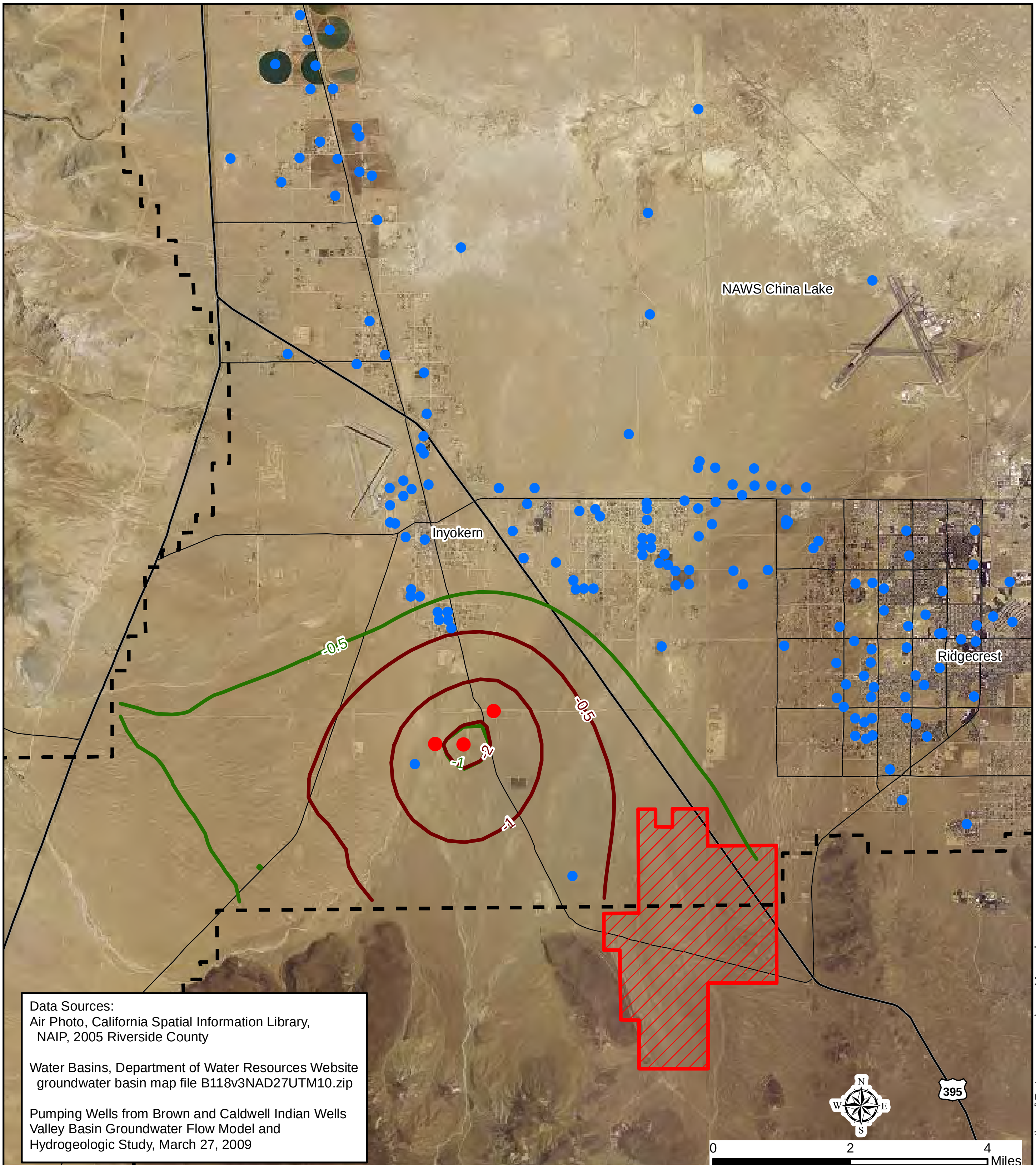

Data Sources:
Air Photo, California Spatial Information Library, NAIP, 2005 Riverside County

Water Basins, Department of Water Resources Website groundwater basin map file B118v3NAD27UTM10.zip

Pumping Wells from Brown and Caldwell Indian Wells Valley Basin Groundwater Flow Model and Hydrogeologic Study, March 27, 2009

Legend
- Project Right-of-Way
- Model Boundary
- Pumping Well Locations based on Brown and Caldwell Pumping Well Database
- Pumping Wells used in the Simulation (Well No. 18, 33 & 34)

Water Level Difference in Feet
- 2013
- 2043

Simulation with Dry Years at 25% of Recharge

Ridgecrest Solar Power Plant

Figure DR-S&W-133-2 Predicted Water Difference 2013 and 2043 Scenario(3a) and Project (4a)

Solar Millennium

AECOM

Project: 60139696
Date: January 2010

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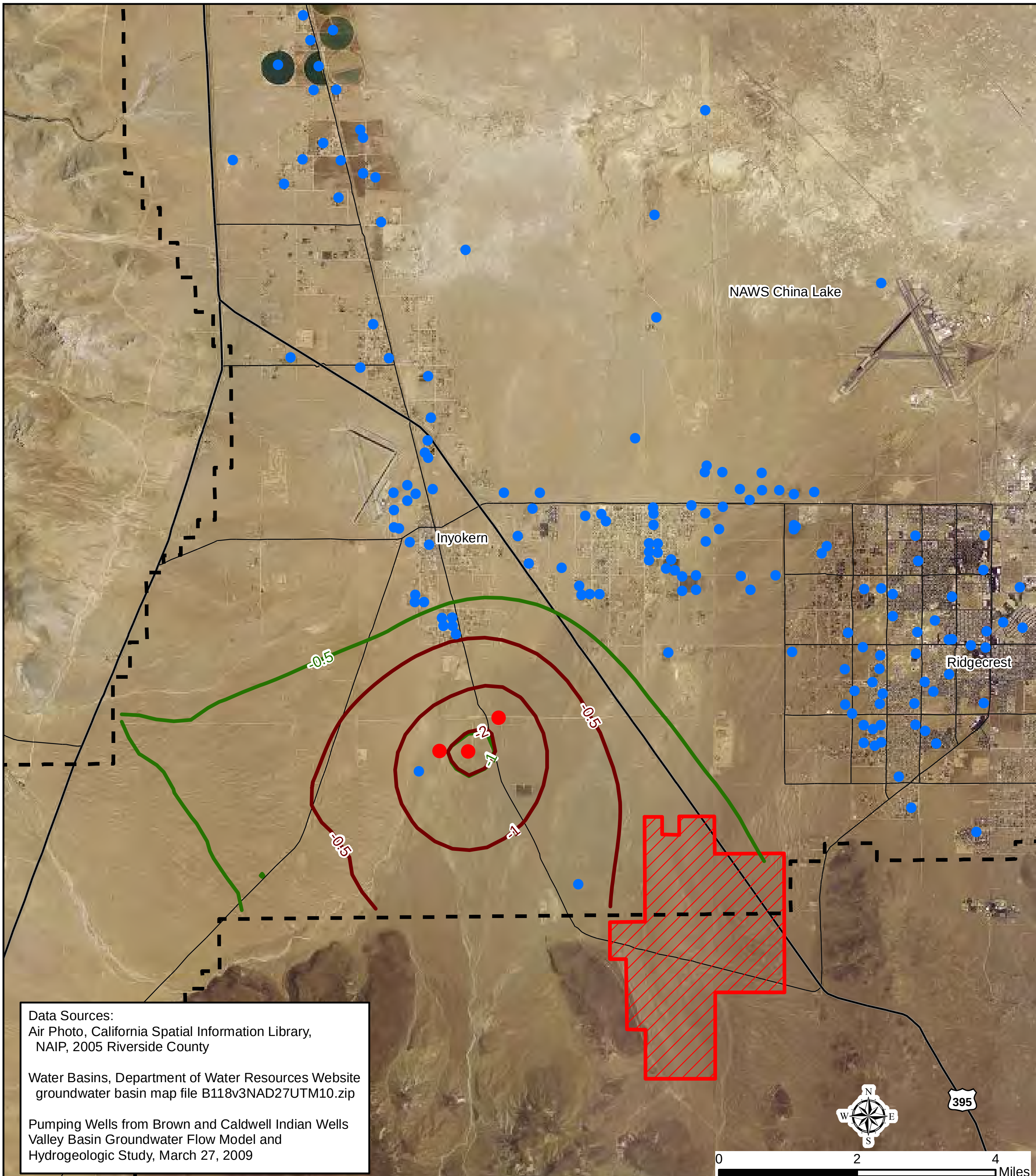

Data Sources:
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Water Basins, Department of Water Resources Website groundwater basin map file B118v3NAD27UTM10.zip

Pumping Wells from Brown and Caldwell Indian Wells Valley Basin Groundwater Flow Model and Hydrogeologic Study, March 27, 2009

Map Location

Legend

- Project Right-of-Way
- Model Boundary
- Pumping Well Locations based on Brown and Caldwell Pumping Well Database
- Pumping Wells used in the Simulation (Well No. 18, 33 & 34)

Water Level Difference in Feet

- 2013
- 2043

Simulation with Dry Years at 15% of Recharge

Ridgecrest Solar Power Plant

Figure DR-S&W-133-3 Predicted Water Difference 2013 and 2043 Scenario(3b) and Project (4b)

Solar Millennium

AECOM

Project: 60139696
Date: January 2010

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Attachment DR-SW-133

Indian Wells Valley Water District
Domestic Water System
Production Demands and Production Capacity

Attachment DR - S&W - 133

INDIAN WELLS VALLEY WATER DISTRICT
DOMESTIC WATER SYSTEM
PRODUCTION DEMANDS AND PRODUCTION CAPACITY

YEAR	Historical Production Demand Acre-Feet	Projected Base Demand By Least Squares Acre-Feet (1)	Navy Connections		Navy Connections with 1.7 Service Multiplier		Navy Non-BRAC Demand Acre-Feet	BRAC Demand Acre-Feet	Average Annual Demand	
			Non-BRAC	BRAC	Non-BRAC	BRAC			w/o BRAC Acre-Feet	w/BRAC Acre-Feet
1997	8336								8336	8336
1998	8699								8699	8699
1999	8154								8154	8154
2000	8331								8331	8331
2001	8447								8447	8447
2002	8865								8865	8865
2003	8605								8605	8605
2004	8992								8992	8992
2005	8543								8543	8543
2006	8865								8865	8865
2007	9077								9077	9077
2008	8496								8496	8496
2009	8413 (2)								8413	8413
2010		8800	100	500	170	850	120	590	8920	9510
2011		8820	100	500	170	850	240	1180	9060	10240
2012		8850	100		170		360	1180	9210	10390
2013		8880					360	1180	9240	10420
2014		8910					360	1180	9270	10450
2015		8940					360	1180	9300	10480
2016		8960					360	1180	9320	10500
2017		8990					360	1180	9350	10530
2018		9020					360	1180	9380	10560
2019		9050					360	1180	9410	10590
2020		9070					360	1180	9430	10610
TOTALS					510	1700				

NOTES
(1) Slope = 27.815, Intercept=-47112
(2) Production for December 2009 based on average of December production from 2006 – 2008