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California Energy Commission
Dockets Unit
1516 Ninth Street
Sacramento, CA 95814-5512

RE: ENERGY COMMISSION STAFF SUPPLEMENTAL STAFF ASSESSMENT AND TESTIMONY PALEN SOLAR ELECTRIC GENERATING SYSTEM DOCKET NO. (09-AFC-7C)

Enclosed for filing is staff's supplemental staff assessment and testimony for the Palen Solar Electric Generating System (09-AFC-7C).

Sincerely,

Christine Stora

CHRISTINE STORA
Compliance Project Manager
Siting, Transmission and Environmental Protection

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STATE OF CALIFORNIA
Energy Resources Conservation
And Development Commission

In the Matter of: Application for Certification for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	Docket No. 09-AFC-07C

ENERGY COMMISSION STAFF SUPPLEMENTAL TESTIMONY

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INTRODUCTION

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Palen Solar Holdings, LLC (PSH) has filed a Petition for Amendment of the Palen Solar Power Project (PSPP) which was approved by the Energy Commission on December 15, 2010 (Order No. 10-1215-19, the "Final Decision", 09-AFC-7). The Petition proposes to eliminate the use of solar parabolic trough technology and replace it with BrightSource's LPT solar power tower technology. The proposed amended project is referred to as the Palen Solar Electric Generating System (PSEGS).

The Committee held evidentiary hearings on the proposed amendment in October and November of 2013, and issued the Presiding Member's Proposed Decision (PMPD) on December 13, 2013. The PMPD recommends denial of the amendment without prejudice. The committee granted Petitioner's Request for a Delay in the Schedule filed on December 23, 2013. At the January 7, 2014 Committee Conference, the Committee provided PSH an opportunity to supplement the record. After providing additional information, PSH filed a Motion to Reopen the Evidentiary Record on March 21, 2014.

The Committee granted Petitioner's Motion in an order docketed on May 21, 2014.

Per the Committee's Order Granting the Petitioner's Motion to Reopen the Evidentiary Record, these evidentiary hearings are limited to the following topics:

a. Avian impacts;

b. Flying invertebrate species (insects);

c. Curtailment provision;

d. Avian deterrent strategies;

e. Visual Resources (glint and glare)[1];

f. Alternatives (PPA milestone status and economic feasibility);

g. Overriding considerations;

h. Natural gas consumption; and

i. Cultural Resources mitigation (Condition of Certification **CUL-1**).

A revised scheduling order was docketed on June 2, 2014 requiring all parties to file testimony by June 23, 2014. Staff completed a thorough review of the newly proposed evidence provided by the petitioner and provides new testimony on the specific topics where the committee has asked for additional evidence. Staff's testimony is organized into the following topics:

[1] Please note that the most appropriate technical area to discuss the issue of glint and glare impacts to pilots is Traffic and Transportation. Testimony on this issue will be found in the Traffic and Transportation section.

a. Project Description (includes testimony on the project schedule which will be relevant to Alternatives testimony);

b. Biological Resources (includes testimony on avian impacts, flying invertebrates, curtailment provisions and avian deterrents);

c. Cultural Resources;

d. Traffic and Transportation (includes testimony on glint and glare effects on pilots);

e. Natural Gas Consumption; and

f. Storage (includes testimony relevant to overriding considerations).

PROJECT DESCRIPTION

Supplemental Testimony of Christine Stora

INTRODUCTION

In the Committee's order dated May 21, 2014, the Committee asked that "(a)ny party seeking a modification of the PMPD's conclusion on economic infeasibility should submit evidence sufficient to support such a modification" (CEC 2014).

Since the publication of the Final Staff Analysis (FSA), staff has additional scheduling questions related to feasibility of the proposed construction schedule and obtaining the Investment Tax Credit (ITC).[2]

SCHEDULE

In the Petition to Amend (PTA), the petitioner provides a project schedule for construction. Perimeter fencing installation, site preparation, and grading for the Palen Solar Project was expected to start in the fourth quarter of 2013 with commercial operation occurring in June of 2016. Construction of the PSEGS would last for 33 months. The construction workforce would have an average of approximately 998 workers, with a peak workforce of 2,311 workers (Palen 2012a).

In a workshop held on April 16, 2014, staff asked the petitioner whether or not the delay in the planned schedule would impact the construction schedule. The petitioner indicated that the workforce numbers would not increase beyond the original peak workforce of 2,311 workers and that the project would still start commercial operation in 2016 to take advantage of the Investment Tax Credit (ITC). In order to obtain the 30% ITC, the project must be placed in service on or before December 31, 2016 (N.C. State University 2014).

Given the extended review of the petition past the anticipated start of construction, staff asks for an updated schedule including workforce numbers, shift personnel estimates, and construction hours. Staff also asks if the Petitioner plans to construct both Solar Plant 1 (West) and Solar Plant 2 (East) over a similar time frame as stated in the Petition to Amend, with construction of Solar Plant 1 beginning only a few months prior to that for Solar Plant 2. According to the California Public Utilities Commission, the PPA's for Palen Solar Plant 1 and 2[3] would be commercially operational in December 2016 and July of 2017, respectively (CPUC 2009). Changes in these areas could impact technical sections such as Socioeconomics and Noise and Vibration. Changes to the construction schedule may also have secondary impacts to construction water use, construction related air emissions, and traffic estimates to name a few. Please provide a full discussion of how shorting the construction schedule will change the construction portion of the project description for PSEGS for each tower.

[2] Charles Turlinski stated that having to amend "either the PPA's or the LGIA would essentially make the project infeasible because it would no longer be able to be constructed in sufficient time to qualify for the Investment Tax Credit." (Applicant's Alternatives Opening Testimony, Page 3)

[3] PPA 6 and 7 as they appear on page 9 of the PUC Resolution E-4269 are for the Palen Solar Project.

Staff would also like to better understand how PSEGS is relying on the ITC for financing of each tower and how the ITC is driving the project schedule.

REFERENCES

CEC 2014- California Energy Commission/Darlene Burgess (TN 202362). Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record and Setting Revised Schedule. Submitted to CEC/Docket Unit on May 21, 2014

Palen 2012a—Palen Solar Holdings, LLC/Galati Blek, Scott Galati (TN 68910). Palen Solar Holdings LLC's Petition for Amendment, dated December 17, 2012. Submitted to CEC/C. Stora on December 18, 2012

CPUC 2009- Public Utilities Commission of California (CPUC). Resolution E-4269, Pacific Gas and Electric Company (PG&E), date of issuance September 29, 2009.

Solar Millennium 2009a – Solar Millennium (TN 52937). Application for Certification Vol. 1 & 2, dated 8/24/2009.

N.C. State University 2014- North Carolina State University (N.C. State University) and U.S. Department of Energy. Database of State Incentives for Renewables and Efficiency (DSIRE) website: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F. Accessed May 29, 2014.

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BIOLOGICAL RESOURCES

Supplemental Testimony of Carol Watson, Geoff Lesh, and Chris Huntley

INTRODUCTION

Staff has prepared testimony in response to the topics identified by the Committee pursuant to the May 21, 2014 Order Granting Petition's Motion to Reopen the Evidentiary Record. The testimony included below responds to specific questions regarding (1) Avian Impacts, (2) Flying Invertebrate Species (insects), (3) Curtailment Provision, and (4) Avian Deterrent Strategies. This testimony supplements and incorporates staff's Final Staff Assessment (TN 202442), prior Rebuttal Testimony (TN 201338), and Responses to the Petitioners Motion to Reopen the Evidentiary Record (TN 202210).

1. AVIAN IMPACTS

The Committee comments on avian impacts are as follows:

> "The PMPD identified insufficiencies in the data regarding the impacts to avian species. Petitioner's proposed data would add to the information available to us. Several parties argue that more time is necessary to gather sufficient data and question various aspects of Petitioner's offerings. Those questions are best resolved through the hearing process, not by ruling on arguments contained in pleadings." (TN 202362)

STAFF SUMMARY OF AVIAN MORTALITY DATA

The Petitioner provided preliminary avian mortality data for the Ivanpah Solar Electric Generating System (ISEGS) - a concentrating solar power tower project; the Genesis Solar Energy Project (GSEP) - a parabolic trough project; and the Desert Sunlight Solar Farm (DSSF) - a photovoltaic plant (PV) (TN 201811). The data collection at ISEGS was based on incidental finds. The data from GSEP and DSSF is nearly completely incidental, except for routine surveys of evaporation ponds at both sites where avian mortalities and/or entrapment are known to occur.

Intervener Center for Biological Diversity docketed a report from the National Fish and Wildlife Service Forensic Laboratory (Forensics Lab Report) addressing avian mortality at the same locations (TN 201977) using some of the same avian mortality data provided by the Petitioner. The Forensics Lab Report provides direct forensic evidence demonstrating mortality to birds from exposure to solar flux, collision, electrocution, and general information on unknown sources of mortality (i.e., where no obvious sign of death was recorded). Staff provided an assessment of this data in Staff's Response to Petitioner's Motion to Reopen Evidentiary Record (TN 202210), and continues to believe the information provided does not change staff's conclusions regarding project impacts to birds. Staff would recommend augmenting Condition of Certification **BIO-16** to provide additional monitoring and mitigation for impacts to insects and birds.

STAFF SUMMARY OF FALL 2013 NOCTURNAL MIGRATION SURVEYS AND FALL 2013 AVIAN FIELD SURVEYS

The Petitioner submitted a report of radar surveys that were conducted for the PSEGS during the fall of 2013 from August 19 through October 31 (TN 202000) and a report documenting bird use, shorebird/waterfowl surveys, and avian mist net surveys conducted from August 19 through December 15, 2013 (TN 202002).

The radar studies included sampling periods during 50 nights of the fall 2013 migration period. The avian surveys provided by the Petitioner confirm the presence of numerous large raptors and turkey vultures in the PSEGS area and broaden the suite of sensitive species known or expected to occur on the PSEGS site. In addition, the report documents 185 species of birds including 32 species considered sensitive at the state or federal level. Some of the sensitive birds identified in the surveys included the state listed Swainson's hawk, bank swallow, willow flycatcher, and Gila woodpecker. The subspecies of flycatcher detected during the migration surveys is unknown however the southwestern willow flycatcher is a federally listed species and the PSEGS project site is within that subspecies expected migratory range. Six federal priority shorebirds were also noted to use the agricultural ponds located adjacent to the PSEGS (See page 34 Table 13 of the Fall 2013 Nocturnal Migration Surveys and Fall 2013 Avian Field Surveys).

STAFF RESPONSE

Staff supports the collection and review of avian data that facilitates the analysis of potential impacts to birds from the construction and operation of the PSEGS project. The information presented in the avian mortality data and technical reports provided by the parties provide valuable information, especially regarding the types of species subject to mortality risk from exposure to solar flux, collision, and other sources at facilities representing the three technologies.

The avian mortality information is valuable because it confirms the analyses presented in the Final Staff Assessment (FSA) that birds are at risk from exposure to elevated levels of solar flux. The information further suggests that solar flux injuries appear limited to power tower technologies. The survey data highlights that rare species including state and federally listed species will likely be subject to mortality from the operation of the PSEGS facility. The radar studies confirm that birds and insects are present in the project area to varying degrees.

The current data cannot be used to provide a meaningful estimate of the numbers of birds that would die as a result of the operation of the different facilities. Nor is the current data adequate to accurately assess the source of mortality or provide any meaningful comparison of mortality between different solar technologies. For example, at the Genesis parabolic trough project, more species of birds have been killed or injured onsite than were detected during siting and preconstruction surveys. This highlights the need to interpret survey data cautiously. This is the approach that staff has taken throughout this siting process, and have consistently informed the petitioner of the constraints of available data.

The avian mortality data submitted by the Petitioner and CBD are informative but the power of the data to draw informed conclusions regarding the risk to birds from the operation of a solar thermal power facility is limited. Avian mortality data collected randomly or incidental to other activities is not sufficient nor does it have the empirical or statistical power to accurately assess the types of risk to birds from different solar technologies. Nor does the data provide a reasonable estimate of the number of birds that are subject to mortality at a given location.

At the public workshop conducted on April 16, 2014 to discuss the mortality data from the ISEGS, GSEP, and DSSF projects, and the Forensics Lab Report, the Petitioner suggested the mortalities as reported numbered in the "tens, twenties, and thirties." The Petitioner stated that the mortality at ISEGS is similar to that noted at other renewable energy project sites, and that the information gained from ISEGS provides sufficient operational data to allow the Committee to make an informed decision to issue an override for the PSEGS project. Staff is concerned the Petitioner is attempting to minimize the risk to birds by referencing incomplete, incidental, or preliminary data without disclosing the inherent flaws in the data collection methods or by failing to interpret the information correctly. Staff disagreed with the Petitioner's contention that avian impacts were similar for solar thermal and photovoltaic technologies in Staff's Response to Petitioner's Motion to Reopen Evidentiary Record (TN 202210). Staff reiterates that most of the existing data is preliminary, collected without systematic protocols or methodologies, and does not have the empirical or statistical power to support the conclusions suggested by the Petitioner.

The Data Does Not Allow a Reasonable Method to Estimate the Number of Birds that Could be Subject to Mortality from Different Solar Technologies

The current avian data cannot be used to accurately estimate the expected number of birds that would be subject to mortality. Reliance on this raw data would result in serious miscalculations regarding the number of birds subject to direct or indirect effects from the project. It would be misleading, inappropriate, and contrary to the basic principles of data collection and interpretation. Information collected in an arbitrary and incomplete manner skews the ability of the analyst to provide a rational basis for developing conclusions on risks to birds. Accurate methods to determine the risk to avian mortality can be developed through the implementation of a systematic sampling design subject to robust statistical analysis on a fully operational (i.e., generating levels of flux that pose a risk to birds) facility. In staffs Response to the Petitioner's Motion to Reopen the Evidentiary Record (TN 202210) staff indicated that until the data on scavenger or observer bias trials are completed and the mortality data is scaled up to account for the project size the survey data must be treated as preliminary.

Rigorous avian monitoring studies are underway at the ISEGS facility and preliminary data is under discussion by the Technical Advisory Committee (TAC). Surveys for this project cover approximately 20 percent of the facility and 100 percent for the areas around each tower (e.g., a circle with an approximate 800-foot radius). Table 1 provides a preliminary review of avian mortality data from surveys conducted in March, April, and May 2014 on approximately 25 percent of the ISEGS site. The data is submitted to the USFWS in compliance with a special purpose utility permit (SPUT) for migratory bird mortality monitoring. In March, approximately 54 dead birds were found, 23 of which exhibited clear evidence of feather damage from solar flux. In April, 90 birds were found, 42 showing obvious flux damage. In May, 79 birds were found, 44 showing obvious signs of flux damage. This period generally conforms to spring migration periods and carcass searches were being conducted across the facility site.

Table 1 Summary of Raw March-May Avian Mortality for the ISEGS Project*.

Survey Period	Total Number Birds	Flux Injury	Collision	Other
March 2014	54	23	2	29
April 2014	90	42	8	40
May 2014	79	44	5	30
Total	**223**	**109**	**15**	**99**

*Approximately 25 percent of the area surveyed. Figures include incidental discoveries and carcass surveys but do not account for searcher bias, scavenger removal rates, nor have they been scaled up to account for the size of the project area.

This data represents a subsample of the ISEGS project and does not take into consideration other factors that limit the power of the data to assess risk to birds from power tower technology. Some of these include: the data has not been corrected for the rate of scavenger removal, searcher efficiency or bias, or off-site mortality (i.e., birds that are injured yet able to fly off the site and perish). In addition, the data has not been scaled up to account for the large size of the facility or adjusted for seasonal variation in avian use. The mortality estimates must also consider birds found dead on the project site with no apparent injuries which may still be attributed to the operation of the facility.

Scavengers such as ravens and kit foxes are extremely adept at locating sources of prey, and when they eat and remove a carcass, the data must be corrected to account for this loss. The ISEGS project will conduct trials to determine the estimated rate of carcass removal, and this factor will be used to correct raw mortality numbers. Scavenger bias is also used to adjust the frequency of the surveys; higher scavenger rates often require more frequent surveys.

Searcher efficiencies address the ability of the avian monitor to detect birds during a survey. It is reasonable to predict that avian monitors will more often miss carcasses or the remains of smaller birds, simply due to difficulties in detection. Young et al (2003) found the incidence of detecting small birds averaged 60 percent compared to 87 percent for medium birds and 93 percent for large birds. However, searcher efficiencies can vary widely depending on habitat conditions, fatigue and weather conditions. The searcher efficiency rate has not been reported at the ISEGS site; however a monitoring study is underway at this facility.

The data must be corrected to account for off-site mortality. As described on Page 4.2-163 of the FSA “Staff believes that many birds may continue flying for a few seconds or minutes, perhaps long enough to escape the hazard, but will be unable to fly effectively, find food, or escape predators and will die a short time after the exposure or persist for longer periods but with reduced reproductive success.” These birds may have been exposed to elevated levels of solar flux that resulted in hyperthermia, retinal damage, or non-visible feather damage that ultimately resulted in the mortality of the bird.

Another important consideration is determining the cause of death for birds located on or near the project site that do not demonstrate a clear source of mortality (i.e., singed feathers, broken beak etc.). In many instances avian monitors find only feather spots or dead birds where the cause of death is unknown. Staff believes that some percentage of the unknown mortality sources can be attributed to the ISEGS project rather than to background mortality (i.e., natural loss through predation or other causes). Similar to birds that may fly off the project site birds may die or be predated after colliding with the facility or after suffering hyperthermia.

A report on monitoring trials and avian data from late October 2013 through early March 2014 for the ISEGS is expected prior to the evidentiary hearings for PSEGS. When available, staff will review this information and be prepared to incorporate any relevant findings on avian mortality.

The location and intensity of the flux field is another important factor not considered in the monitoring data. Figure 1 depicts the operational data of the ISEGS project from January through March, 2014. From January to March, 2014, the facility ran at less than 20 percent of full capacity. It is unknown what the distribution or intensity of the flux field was during this period; however, since the project does not defocus mirrors based on operational constraints, heliostats would have been positioned in standby zones.

When the project is in standby it still concentrates flux to dangerous levels, even when the project is not operating, or running at less than full capacity. The avian data provided needs to be correlated with operational data to provide accurate estimates of the project operating at full capacity. Staff understands that the ISEGS monitoring report will be correlated with the operational data. This data cannot be expected to predict outcomes at the PSEGS; not only because of this factor, but because of the geographic differences, the presence of a defined avian migration route, the higher towers and larger project site.

Further review of this information will likely provide valuable data regarding the *actual* risk to avian species once the sampling methods and data have been revised to account for seasonal variation, sampling size, scavenger loss, searcher bias, and operational status.

The Data Cannot be Used to Conclude PV, Solar Trough, and Power Tower Technologies Pose the Same Risk to Birds.

The raw avian data from ISEGS, DSFF, and GSEP does not provide adequate information to make an informed comparison that mortality risks are similar for the different technologies. The Forensics Lab Report provides direct forensic evidence demonstrating mortality to birds from exposure to solar flux, collision, electrocution, and unknown sources of mortality. The report highlights that collision risks occur at both PV and solar thermal facilities. What is clear from the Forensics Lab Report is solar flux injuries have only been detected at power tower projects.

Staff's caution of the preliminary mortality data for birds is based on an extremely small sample size and reporting period, during which much of the data collection was based on incidental finds. The Forensics Lab Report also suggests the data is preliminary and not suitable for statistical analysis. Until adequate studies are completed it is misleading to conclude that the risks to birds are the same from the different solar technologies.

While birds may collide with solar panels at the different facilities the collision risk at PSEGS is compounded from the two 750-foot tall power towers. The PSEGS would also generate flux which has been demonstrated to injure and kill birds.

The Avian Surveys and Radar Data Demonstrate the Project Area Supports a Wide Variety of Resident and Migratory Birds.

The Fall Avian Survey Data collected in 2013 is extremely useful in disclosing the types of common and rare birds detected in the PSEGS area. The report provides the estimated elevation of resident and migratory birds and highlights species not previously reported on the PSEGS site including at least three listed birds. This suggests the value of conducting intensive avian surveys to fully assess potential impacts to listed species.

The report documented that fall avian use during this study was consistent with that recorded during the spring and summer surveys. Surveys conducted by the Petitioner documented 185 species of birds including 32 species considered sensitive at the state or federal level. Some of these include the state listed Swainson's hawk, bank swallow, willow flycatcher, and Gila woodpecker. Two fully protected species including the golden eagle and peregrine falcon were also observed. Six federal priority shorebirds were observed at the ponds adjacent to the PSEGS.

Most of these birds have behaviors or flight patterns that put them at risk from exposure to solar flux. As stated on page 4.2-156 of the FSA "Species with the greatest potential to suffer adverse effects resulting from exposure to elevated levels of solar flux are expected to include members of two families, swallows (Family: Hirundinidae) and swifts (Family: Apodidae). There is existing documentation for the vulnerability of these families from previous studies at solar power tower energy generating facilities (McCrary et al 1986)." Bank swallows, a state listed species, have been killed at ISEGS and were observed by the Petitioner during fall surveys. It is reasonable to conclude these types of species will be subject to mortality risk at PSEGS.

The PSEGS Site Supports Unique Habitats and is Important To Migrants

The report suggests the habitat and surrounding landscapes are not unique nor do they appear to be particularly preferred or crucial to migrants (TN 202002 page 36-37). Staff disagrees with the Petitioner that the site does not support unique habitats. As described on page 4.2-24 of the FSA "five of the seven natural communities—desert dry wash woodland, active desert dunes, desert sink scrub, dry lake bed (playa) and stabilized and partially stabilized desert dunes—are considered rare natural communities by CDFW (CDFG 2010) and are also NECO-designated sensitive communities". Staff noted on page 4.2-31 of the FSA "The importance of ephemeral streams to wildlife in the desert is undisputed and well-documented in the literature, the sum of which represents decades of observations and surveys (Levick et al. 2008; Baxter 1988; Kirkpatrick et al. 2007; Kubick & Remsen 1977; Tomoff 1977; Daniels & Boyd 1979, and others).

Kirkpatrick et al. (2007) noted that even dry, ephemeral washes have greater avian abundance and species richness than adjacent uplands. In a study of 66 plots on BLM lands in California, dry washes supported 1.5 times more breeding species and twice as many wintering species as the more common desert scrub (Kubick & Remsen 1977; Tomoff 1977; Daniels & Boyd 1979, and others)." The presence of the date plantation and agricultural ponds, supporting a variety of shorebirds identified during the 2013 fall surveys also represent unique access to water in an otherwise arid region. Staff believes the Petitioners suggestion that the PSEGS site is not particularly preferred by migrants is not supported by existing conditions on the project site or the literature.

The Palen region supports broad sheet migration and natural topographic features that funnel migrants through the region including the thousands of turkey vultures and hundreds of Swainson's hawks detected by the Petitioner. Nonetheless migratory patterns ebb and flow and shift both regionally and seasonally in response to weather and storm patterns.

Although only one season of surveys was conducted the report concluded that the PSEGS area is located in an area of low nocturnal migration use (TN 202000 page I of Executive Summary). Staff is uncertain how this conclusion is supported by a sample of one migratory period in an area known to support migratory birds. Additionally, the Petitioner's radar data indicate an abundance of insects based on the fact that on 13 nights, insects "cluttered" or obfuscated the results such that data could not be accurately collected. Considering the discussion presented above for migratory birds staff considers this conclusion overreaching.

These Surveys Likely Do Not Capture the Full Range or Number of Resident and Migratory Birds

Other important factors to consider include the collection and interpretation of data during drought conditions. Drought has been demonstrated to decrease abundance and species richness of avian communities (Albright et al. 2010). California has been subject to a severe drought for the last three years. The year 2013 was the driest in California's recorded history and rainfall levels in 2014 have been low. Riverside County, where the project would be located, is described as being under "severe drought" (US Drought

Monitor 2013). El Nino climate patterns also have been documented to affect birds. The chance of El Niño is 70 percent during the Northern Hemisphere summer and reaches 80 percent during the fall and winter (Climate Prediction Center, 2014). Staff believes that avian data collected during drought years would detect low populations of resident and migratory birds because resident birds may have depressed populations and or the result of restricted forage opportunities for some migratory birds. These types of events are known to alter species abundance and may temporarily shift migratory patterns.

CONCLUSION

Staff strongly disagrees with the Petitioner's contention that avian impacts are similar for all solar thermal and photovoltaic technologies. The existing data is preliminary, mostly incidental, and does not have the empirical or statistical power to support these conclusions. Data collected without a standardized method cannot be used to evaluate avian risk in any meaningful way. Use of these data alone to draw conclusions regarding the risk to birds from the operation of the different technologies could result in serious miscalculations regarding the number of birds subject to direct or indirect effects from the project.

At ISEGS, protocol surveys are underway and staff believes the collection of data at this location will provide useful information regarding the risk to birds at that location. However, there are several important differences between the projects.

- PSEGS is located in an area known to support thousands of migrating birds including large numbers of turkey vultures and Swainson's hawks
- PSEGS is located in an area where topographical features support migration and is close to important bird areas such as the Salton Sea and Colorado River
- PSEGS is substantially larger than ISEGS

Staff recommends that additional data should be collected from ISEGS before approving the PSEGS facility at this time. The data should be scaled up to account for the size of the facility and corrected for important factors such as searcher efficiency, and scavenger removal rates. The data should be corrected to adjust for birds that are injured yet able to fly off the site and avoid detection. Another important consideration is none of the mortality data provides any potential for mass mortality events if flocks of birds fly through the flux field. Staff considers this a predictable event based on the large flocks of birds detected at PSEGS during Fall 2013 surveys and that many of these species have flight characteristics or behaviors that would expose the birds to elevated levels of solar flux.

2. FLYING INVEREBRATE SPECIES (INSECTS)

The Committee comments on flying invertebrate species are as follows:

> "Information from the Ivanpah Solar Electric Generating System (ISEGS) project experience leads staff to believe that insects are adversely affected by the solar flux to degrees not previously recognized and that the conditions should be modified to address those impacts. It is appropriate to receive evidence on those questions." (TN 202362)

STAFF RESPONSE

Staff supports the collection and review of insect mortality data to further understand the risk to insects from exposure to solar flux. Page 4.2-153 of the FSA stated “Wagner et al. (1982) documented insect kills at a much smaller facility, Solar One, in excess of up 800 insects in under a minute, but the methods the authors used to make this estimate is unclear." Insect mortalities have now been documented at the ISEGS site; however it is uncertain what the exact assemblage of species is most at risk. The Forensic Laboratory Report on avian mortality noted that monarch butterflies were one of the species subject to mortality from exposure to solar flux. Monarch butterfly populations have been in substantial decline across the United States for a variety of reasons. The Xerces Society for Invertebrate Conservation indicates that monarch butterfly populations have declined by 90 percent since the 1990’s (http://www.xerces.org/monarchs/). Preliminary observations at ISEGS suggest butterflies and possibly dragonflies are at risk from solar flux. Beetles, butterflies, and dragonflies all have flight patterns that expose them to risk within the flux field.

Microphyll woodlands, ephemeral washes, agricultural practices, and artificial water sources are present on and adjacent the PSEGS site and would be expected to support a variety of insects. Staff recommends that insect monitoring be included as part of Condition of Certification **BIO-16** to collect and identify what types of insects are subject to mortality and assess if mitigation is warranted should significant impacts occur. The risk to insects varies on a number of factors. Insects may be attracted to the facility resulting in the facility acting as a population sink. It is also possible that insects are passively carried through the flux field on prevailing winds. Some insects such as dragonflies and beetles are attracted to polarized light and may drop out of the air column misidentifying the heliostats for bodies of water. To address the risk to insect’s staff recommends the development of monitoring protocols within the context of **BIO-16**. Important monitoring considerations would include:

- Identify if state or federally protected insects are subject to mortality;
- Identify if insects subject to mortality are attracted to polarized light;
- Evaluate the risk to declining species such as monarch butterflies and if project effects substantially contribute to their decline;
- Conducting multi season surveys to account for seasonal variations in insect populations and assemblages;
- Perform surveys in off-site locations in up and downwind areas; and
- Account for the irruptive ecology of most insects by performing surveys during normal or above average rain years.

Staff is currently collaborating with insect specialists to identify further recommendations that could for the development of insect monitoring protocols for the PSEGS project. If available, specific revisions to **BIO-16** would be presented in rebuttal testimony.

3. CURTAILMENT PROVISION

The Committee comments on curtailment provision are as follows:

> "The Committee desires testimony and comment regarding whether it is feasible or appropriate to add a condition requiring temporary or seasonal cessation of project operations in the event that the adaptive management program provided for in Condition **BIO-16** proves insufficient to mitigate impacts from solar flux below biologically significant levels. We invite the parties to identify what level of mortality would be biologically significant and how such a level should be determined."(TN 202362)

STAFF RESPONSE

Curtailment Could Be a Useful Tool to Avoid Solar Flux Mortality

Staff supports the use of temporary or seasonal curtailment as a method to avoid mortality to birds from exposure to solar flux. Curtailment has been recommended for some wind farms. For example the Ocotillo wind farm, permitted by the BLM, has implemented an avian monitoring program to detect eagles and curtail turbines to prevent collision risk.

Biological Resources staff is uncertain as to the feasibility of reducing solar flux levels in the event a protected bird or raptor was identified entering the flux field. If it is possible to reposition the heliostats to prevent flux injuries to birds staff would consider this an effective tool. Seasonal restrictions (i.e., during spring and fall migration periods) would be effective in avoiding risks to resident and migratory birds including reducing the threat of mass mortality events if large flocks of birds flew through the flux field. However, some collision risk would remain depending on the stow position of the mirrors. The risk to wintering birds including many raptors would still persist.

Feasibility of Short-Term Curtailment

Staff does not have enough information to determine the feasibility of short term curtailment of the flux field. To determine the feasibility of shifting the heliostats from an operational configuration into a configuration that would not present hazardous flux densities to birds would require several different sources of information. Some of the questions that staff would require information regarding includes:

- How long does it take to de-energize the solar field by turning the mirrors down? What would be the configuration, heliostat reflections to the ground, or to the sky? If heliostats are to be turned to the sky, birds might have underside flux of about one sun in addition to the topside flux already coming from the sun; which may still damage a bird. It is unknown how long an animal could withstand the energy of two suns without damage, or if any damage would be sustained
- How much advance notice of curtailment would be available

- How long would the curtailment period need to be in place to protect target birds? Some species may rapidly overfly an area while other birds may be attracted to the flux field. In the period it would take for a bird to potentially cross the three solar fields, would the bird suffer heat exhaustion? Note standby positions would not reduce the hazard as there is actually a larger hazard zone (and more energy passing over and exiting the solar field) when the heliostats are directed to their standby positions than when their beams are intercepted by the solar receiver at the tower. This would be true of any standby configuration where heliostat beams are concentrated in aerial locations other than on the tower receiver
- How long could a curtailment last before the steam system cooled to the point that would inhibit the facility from operating in the same day? How does the power plant recovery time relate to a flux-outage duration? Could the plant come back online the same day? Would thermal heat storage assist with this? Can the on-site boilers respond quickly enough and forcefully enough to mitigate for the outage time? Would the boilers have to be running all the time to maintain adequate temperatures to keep the liquid piping hot for quick delivery? It is staffs understanding that at ISEGS, "intermittent cloud cover" can be sufficient to trip the steam turbines off line for the rest of the day
- How severe would the curtailment need to be? Should we assume 100% over the whole field, or part of a field
- How reliable would advance notice predictions of bird flyovers be? Could there be a probability/consequence threshold associated with a flyover advance notice prediction
- If the power plant is able to restart the day as a curtailment would the process affect the maintenance and reliability of the plant similar to a daily startup? At the time PSEGS would finish construction and become operational, will it run at full capacity? Or is it experimental, like ISEGS, requiring a ramp up phase. If so, how long would this last
- Has there ever been a full-scale demonstration or simulation of this kind of short-term sudden shutdown, with or without an immediate restart for an electric power producing water/steam-based solar tower
- How long will it take to test mirrors, position, and sync them to the operating system (Sphinx) being utilized to control positioning? At ISEGS, this was also a lengthy process, and resulted in flux likely being concentrated offsite, and a high reliance on the standby positions. At ISEGS, it was necessary to spend time "training" the mirrors and syncing Sphinx for standby position. ISEGS employs a system of infrared cameras to track heliostat beams, and search for "lost" mirrors. Is it possible for the Petitioner to use a similar camera system at the proposed PSEGS to report on mirrors that are focused offsite

Conclusions of Short-Term Curtailment

Staff does not have enough information to determine the feasibility of short term curtailment of the flux field. Without additional information and an understanding of how curtailment would be implemented, staff does is uncertain if curtailment is possible and cannot make an informed decision if curtailment would be effective.

Feasibility of Long-Term Curtailment

- PSEGS shuts down near sunset and restarts again near each day. The shutdown process causes thermal cycling of plant equipment, which has some negative effect on equipment maintenance intervals and lifetimes. Assuming there is a feasible means to forecast avian passage over the PSEGS the plant could remain idle during these periods. However there are many factors that would affect long term curtailment, such as how often would this happen? How good would the forecasts be? Forecasters would need a model of expectancy of flyovers based on prior surveys, including information on what happened in previous years on the same date, in similar weather, and having a daily census of numbers and locations of migrating birds along the flyway near the power plant.

Such data could only be gained after several years of closely monitoring the site and bird movement patterns during migration as well as throughout the year. While it may be possible that certain groups of migrants would migrate over the site at predictable times, there are always variations in migratory flight paths as well as altitude of flight, and timing of flights, that are correlated to weather, food sources, and other factors. It is possible that pulses, or flocks, or sensitive species may pass over the site outside a prescribed window of curtailment. This approach would benefit migrants, but would likely not benefit year-round resident species. A possible means of reducing the risk of exposure of year-round resident species to concentrated flux would be to curtail the project during nesting and fledging, when birds are quite active as they build nests, exhibit courtship behaviors, and feed young.

Conclusions on Long-Term Curtailment

Staff believes long term curtailment would be effective in reducing the risk to birds from exposure to solar flux. Staff is unaware of what mechanism would be used to determine the curtailment period or if it would be feasible to implement. Further, given the constant take of birds at the ISEGS site, it seems that while curtailment during migratory periods may reduce or avoid the loss of flocks of special status species, significant take of both special status and unlisted birds (still protected under Migratory Bird Treaty Act) is still expected to occur. Condition of Certification **BIO-16**, which provides for avian and bat use and behavior surveys may begin to yield such data, but would need to be expanded to include insects, and rigorously implemented by the project owner. Staff is working to develop long-term curtailment provisions into **BIO-16**, and will present these in rebuttal testimony.

Mortality Thresholds

Staff is uncertain, even with the implementation of **BIO-16**, if impacts to migratory or resident birds could be reduced to less than significant levels. Mortality would be expected to occur annually for birds for the life of the project. In Staff's Response to the Petitioners Motion to Reopen Evidentiary Record, staff stated that thresholds or triggers requiring additional mitigation based on the collection of additional data would be valuable but highlighted setting discrete thresholds (i.e., a given number of birds or each species) would be extremely difficult and potentially arbitrary. There are a number of ecological factors, many unavailable to staff or the Petitioner, that must be considered when attempting to use absolute numbers as discrete thresholds to reduce impacts to below biologically significant levels. Some of these include:

- The populations for many birds are unknown or poorly understood.
- Which population center is the bird from? The loss of a few birds from a robust population center has potentially lower consequences than the removal of a few birds from a small or isolated breeding group.
- The age and sex of the bird. Removing reproductive females from a population may have more deleterious effects than removing juvenile male birds.
- Other threats associated with migratory birds such as loss of habitat, disease at wintering sites, and drought must be accounted for in assessing thresholds.

These and many other factors including local and regional weather patterns all contribute to bird abundance. Implementing additional mitigation for avian species based on thresholds or triggers would provide a mechanism to reduce impacts to the guilds of birds most subject to loss (e.g. waterbirds, swifts, and swallows) but may never mitigate the impacts to levels below significance. If discrete thresholds are proposed staff recommends the Commissioners consider requiring supplemental mitigation to off-set impacts to avian species when the following thresholds are met for the PSEGS project. This is important for state listed species which have a full mitigation standard as required by the California Endangered Species Act (CESA). To comply with CESA and meet the full mitigation standard impacts from the take must be incidental to an otherwise lawful activity; mitigation must be provided roughly proportional to the loss; be capable of successful implementation; and adequately funded to accomplish a no net loss of the species. The take must also not jeopardize the continued existence of a state listed species.

Species that are state listed such as bank swallows have been subject to mortality art ISEGS and are known to occur in the PSEGS project area. Based on the data it is predictable that state listed birds would be subject to loss at PSEGS. Mitigation therefore should be focused on ensuring the project complies with these standards.

Listed or Proposed Threatened or Endangered Species: One dead or injured bird if the mortality or injury is attributable to direct or indirect effects of the project. The rationale for this low threshold is that these species have been identified by the responsible agencies as highest priority for conservation management, based on the best available information.

State Designated Fully Protected Species: One dead or injured bird if the mortality or injury is attributable to direct or indirect effects of the project. The rationale for this low threshold is that these species have been identified as fully protected by the State with limited take authority except under specific programs such as an HCP.

California Bird Species of Special Concern: Five or more mortalities attributable to direct or indirect effects of the project during a one-year period (i.e., total number projected from the sampling data), for all species combined. There is significant conservation concern for each of these species, but not enough species-specific data to set significance thresholds for each Species of Special Concern.

Other Special-Status Birds: Ten or more mortalities attributable to direct or indirect effects of the project during a one-year period (i.e., total number projected from the sampling data), for all species combined. This category will include any species ranking S1, S2, or S3 or rankings on watch lists or other sources, including (but not limited to) Bureau of Land Management, US Forest Service, National Audubon Society, or American Bird Conservancy, and included in the "Special Animals" compendium (CNDDB 2011). There is documented conservation concern for each of these species, but not enough species-specific data to set significance thresholds for each one.

Raptors: Five or more mortalities attributable to direct or indirect effects of the project during a one-year period (i.e., total number projected from the sampling data), for all species combined. Raptors will include all hawks, falcons, eagles, owls, and vultures. The rationale for this low threshold is that raptors have relatively low populations (compared with other birds) because they are predators (i.e., "high on the food chain") and often have large foraging territories.

Local Resident Species (according to season): For bird species regularly observed in the project area (based on project bird count data) during breeding or winter seasons, or both, 10 or more of any one species during a one-year period (i.e., total number projected from the sampling data), or 40 or more for all species combined.

Migratory or Non-Resident Species, including Shorebirds and Waterfowl: For bird species rarely observed in the project area (based on project bird count data) during breeding or winter seasons, 5 or more total in any single monitoring event (all species combined), or 20 or more during a one-year period (i.e., total number projected from the sampling data) for all species combined.

Abundant Native Birds and Non-native Birds: For selected species, no significance thresholds are proposed at this time. These species are either (1) so common in the general area that project-related mortality is unlikely to significantly affect local populations, or (2) non-native or invasive species. There is no documented conservation concern for any of these species. However, setting no limits for apparently common birds may result in long term cumulative impacts depending on the species.

CONCLUSION

Staff recommends Condition of Certification **BIO-16** be revised to include the development of a Curtailment Plan. Seasonal curtailment should be considered if impacts to state or federally listed species, or fully protected species are linked to direct or indirect effects of the PSEGS and supplemental mitigation for these effects has not been demonstrated to be effective. Staff recommends the avian monitoring plan specify monitoring regimes appropriate for the testing and mirror syncing phase of the project, as well as during full operations.

4. AVIAN DETERRENT STRATEGIES

The Committee comments on avian deterrent strategies are as follows:

> "Petitioner offers a list of potential measures to discourage avian species from entering the flux field. Petitioner must identify any of these measures it proposes to incorporate in the project. Parties may address whether inclusion of these deterrent strategies requires further analysis. We desire testimony to assist us in determining whether such measures are feasible and what, if any, environmental impacts they might cause if they were implemented." (TN 202362)

STAFF RESPONSE

The Petitioner provided a review of currently available avian deterrent methodologies (TN 201838). The review did not identify what methods would be recommended for the PSEGS project or provide an evaluation if any of the deterrents would be effective in preventing birds from entering the flux field.

Avian deterrent methods (i.e., hazing) have been implemented for many years at airports, evaporation ponds, agricultural fields, and other locations where birds pose a collision risk, damage crops, or where birds are hazed for their own protection to avoid entrapment or poisoning from oil spills or evaporation ponds. The effectiveness of hazing methods has been long studied and some methods have proven highly effective at dispersing birds for short periods of time (i.e., use of dogs, cannons, lasers, falcons, and remote controlled aircraft); however, many birds quickly acclimate or return to the area when the hazing has stopped.

Staff embraces any feasible and effective method that reduces avian mortality and morbidity by deterring birds from flying into the flux field or colliding with facility structures. Staff reviewed the avian deterrent methods provided by the Petitioner and conducted a literature search of available technologies in order to assess their efficacy in diverting birds from a given area. Staff is concerned that many of the methods identified by the Petitioner would be ineffective at PSEGS. The PSEGS would occupy an area of approximately five square miles (ca. 3,800 acres) with largely invisible flux fields generated around two 750-foot tall power towers. Dangerous levels of flux would be expected to occur several hundred feet off the ground. For the hazing to be effective birds must be prevented from entering the flux field. Methods that may be useful to prevent landing or disperse birds may be ineffective in preventing birds from entering an invisible flux field.

By definition hazing techniques are intended to scare, harass, or disturb an animal until it leaves or is displaced from a given area. The implementation of hazing techniques for the PSEGS project may result in unintended impacts to plants and wildlife that occur adjacent to the PSEGS project or are not the intended target of the hazing. The magnitude and type of effect would be related to the method of hazing imposed, the location and timing of the hazing, and the frequency a given method is deployed. Below is a concise overview of some potential impacts from different deterrent technologies. A more comprehensive review would be possible once the specific types and locations of the deterrents are understood.

Balloons, tethered kites, and scarecrows can be effective for short periods of time for some species and may prevent birds from landing in proximity to the visual device. However, high winds known from this portion of the desert may limit their effectiveness and guy wires used to position the units pose a collision risk to birds. If placed near the perimeter of the facility or in off-site locations they may result in collision risk to local flying birds.

Cannons and pyrotechnics have been demonstrated to be effective for dispersing birds however; they may not be effective in preventing birds from flying at elevations where they are at risk from solar flux. It is also possible that use of these devices may flush birds into the flux fields. Noise from the devices would adversely affect wildlife in adjacent habitat and may disrupt foraging for desert kit fox, desert tortoise or Mojave fringe-toed lizards. If units are deployed in habitat off the project site, plants and animals could be subject to tramping, the spread of weeds or increased risk of wildfires.

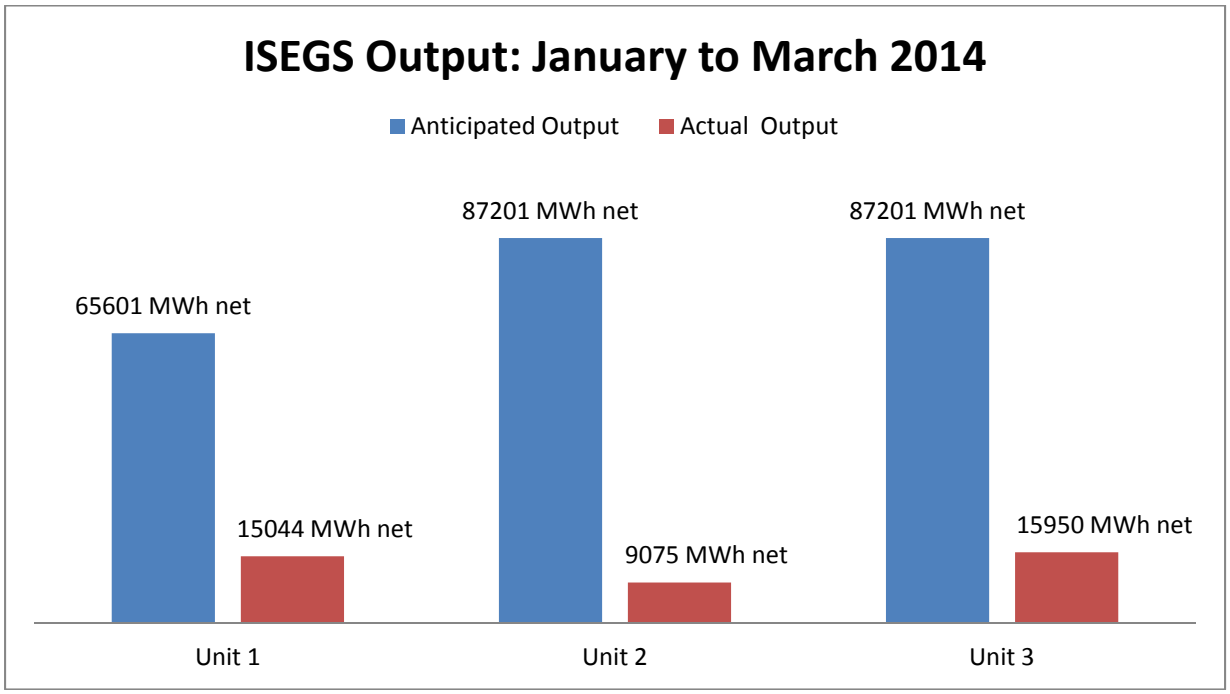
Dogs, falcons, or unmanned aerial vehicles if used off the project site would disturb native wildlife including ground nesting birds, desert kit fox, and Mojave fringe-toed lizards. Depending on how they are deployed routine use of dogs may result in the abandonment of habitat for desert kit fox. Aerial vehicles could displace or prevent birds from foraging in surrounding habitat and disrupt breeding. These impacts could degrade habitat values or restrict the use of adjacent habitat by wildlife.

Irritant fogging if used at PSEGS could result in direct impacts to sensitive plants and wildlife. Chemical fogs that blow off the project site can damage sensitive plants and may act as a chemical stabilizer of dune communities if they leave a sticky residue. This may degrade habitat values for Mojave fringe-toed lizards; ground nesting birds, and other species. Staff is unaware how this system would be deployed or if it would be effective based on the scale of the project.

Bird alert systems and use of long range acoustic devices may be effective under certain circumstances. However, systems that are radar activated may result in unintended impacts to other species of wildlife or non-target bird species that are at low risk from exposure to solar flux. Staff is uncertain as to the effectiveness of these devices on a project of this scale.

Many of the deterrent methods submitted by the Petitioner have the potential to result in direct and indirect impacts to sensitive plants and wildlife depending on how they are utilized. Hazing methods that occur off the project site or that degrade habitat values in off-site locations or result in the displacement of non-target species may warrant additional mitigation.

Figure 1



The Anticipated Output based on the Final Decision Efficiency Table 1 (TN 58716). Source: Quarterly Fuel and Energy Report CEC-1304 Power Plant Data Reporting; submitted by the Ivanpah Solar Electric Generating System project owner.

REFERENCES

Albright, T. P., A. M. Pidgeon, C. D. Rittenhouse, M. K. Clayton, C. H. Flather, P. D. Culbert, B. D. Wardlow, and V. C. Radeloff. 2010. Effects of drought on avian community structure. Global Change Biology 16:2158–2170.

TN 201838 Palen Solar Holdings, LLC's Review of Potential Bird Deterrent Strategies for Large Scale Solar Facilities

TN 201901 Palen Solar Holdings, LLC's Updated Compilation of Avian Data as of 3-21-14

TN 202000 Fall 2013 Nocturnal Migration Surveys for Palen Solar Electric Generating

TN 202002 Fall 2013 Avian Field Surveys for Palen Solar Electric Generating System

TN 202013 Forensic Lab Report Evaluation

TN 202210 CEC Staff's Response to Petitioner's Motion to Reopen Evidentiary Record

TN 202362 Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record and Setting Revised Schedule

U.S. States Drought Monitor, 2014. U.S. Drought Monitor West. Available at: http://droughtmonitor.unl.edu/Home/RegionalDroughtMonitor.aspx?west. Accessed on June 6, 2014.

D.P. Young, Jr., W.P. Erickson, M.D. Strickland, R.E. Good, and K.J. Sernka. 2003. Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines Subcontract Report July 1999 – December 2000. Prepared for National Renewable Energy Laboratory, Golden, Colorado. NREL/SR-500-32840.

CULTURAL RESOURCES

Supplemental Testimony of Michael McGuirt, MS, Thomas Gates, and Lorey Cachora

BACKGROUND

The Palen Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record[4] is germane to cultural resources addressed in Condition of Certification **CUL-1**, a condition that addresses potential Palen Solar Energy Generating System (PSEGS) impacts to the Chuckwalla Valley portion of the Pacific to Rio Grande Trail Landscape (PRGTL). Staff is generally instructed as follows:

> Any new evidence should be relevant to the issues and findings we [the Committee] are required to address. [New evidence] may improve the depth or quality of our environmental or LORS analysis or offer the potential to change one or more findings or conclusions.[5]

Cultural Resources staff is further guided in three areas to:

> [1] offer evidence to explain the funding increase it recommends. Staff and Petitioner are invited [2] to address CRIT's objections and [3] explain the nexus between the impacts to the Pacific to Rio Grande Trails Landscape and the mitigation contained in Conditions of Certification **CUL-1**.[6]

It is evident from staff's recent visit to the Ivanpah Solar Electric Generating System (ISEGS) that the operation of the PSEGS facility would introduce visual elements into the daytime landscape that are more brilliant and disruptive than originally understood [see **Figure 1**]. Consequently, Energy Commission staff has reassessed the potential direct effects of PSEGS on the Chuckwalla Valley portion of PRGTL, and reaffirms staff's prior conclusion[7] that the construction and operation of the amended project would have significant and unmitigable effects on the environment. The potential effects of the amended project continue to be direct effects.

The following supplemental testimony responds in three sections to the three areas of guidance enumerated above. A revised **CUL-1** is attached. Finally, this supplemental testimony concludes with a combined list of Bureau of Land Management (BLM) and Native American Heritage Commission (NAHC) listed tribes affiliated with the Chuckwalla Valley.

[4] Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record and Setting Revised Schedule (TN 202362)
[5] *ibid* (TN 202362) pp. 3
[6] *ibid* (TN 202362) pp. 5
[7] *Palen Solar Electric Generating System Final Staff Assessment - Part B* (TN 200564),Chapter 4.3 pp.158–159

STAFF EVIDENCE THAT EXPLAINS FUNDING INCREASE IT RECOMMENDS

CUL-1 mitigation was proposed in the cultural resources section of the PSEGS Final Staff Assessment (FSA) and mentioned by staff at the Palen October/November 2013 Hearing.[8] Staff proposed a suite of studies, proposed a public outreach component, afforded affiliated tribes with opportunity to participate and otherwise be integrated into all of the study activities, and proposed additional funded initiatives at the request of tribes ascribing heritage values to the Chuckwalla Valley. No monetary amount was identified. At the hearing, the Petitioner argued that **CUL-1** fiscal uncertainty was burdensome because the studies were not monetarily capped.[9] In the Opening Brief, staff responded to the Petitioner's fiscal uncertainty concerns by providing a **CUL-1** budget of $2.96 million.[10] The Presiding Member's Proposed Decision adopted **CUL-1** as it was proposed in the FSA.[11]

At the January 7, 2014, Committee Conference, the Committee presiding member advised that there were two interests that warranted mitigation: a state or historic preservation interest and a tribal cultural/spiritual perpetuation interest,[12] and that the staff-proposed **CUL-1** mitigation concepts and costs were more oriented towards the place (state) interest. Staff was advised, should the evidentiary hearings be re-opened, in re-assessing **CUL-1** mitigation, to consider ways to include a tribal voice and also provide the Petitioner with greater fiscal certainty.[13]

In preparation for a subsequent cultural workshop, the Petitioner reacted to the January 7, 2014, Committee advice by proposing a total of $2.96 million of which $1 million would be allocated for the place interest and $1.96 million for the tribal people interest.[14] In the Petitioner's proposed revision, the place interest studies appear to not be costed-out to show how the studies could be completed for the amount proposed; an amount significantly less than what staff had costed-out for comparable studies. It also appears as though the "tribal voice" was only afforded to the Colorado River Indian Tribes (CRIT) who provided some unspecified feedback.[15] And finally there appears to be a discrepancy of $0.5 million that can be discerned in the tribal people interest section.

[8] *Palen Solar Electric Generating System Final Staff Assessment - Part B* (TN 200564),Chapter 4.3 pp.178–182, Transcript of the 10/28/13 Evidentiary Hearing (TN 201234) pp.52, ln. 7 – ln. 16
[9] Transcript of the 10/28/13 Evidentiary Hearing (TN 201234) pp78, ln 20 –pp81,ln 1
[10] ENERGY COMMISSION STAFF OPENING BRIEF (TN 201338) pp. 6
[11] Presiding Member's Proposed Decision (TN 201434) pp. 6.3-63 – 6.3-70
[12] These two interests have been characterized in various ways. Staff has chose to characterize the "state interest" as an interest in "place" and the "tribal spiritual/cultural perpetuation" interest as an interest in "tribal people." **CUL-1A** mitigates for the place interest and **CUL-1B** mitigates for the tribal people interest.
[13] Palen Transcript of the Committee Conference held January 7, 2013 (TN 201546) pp. 17 ln. 15 – pp. 20 ln. 7
[14] Palen Solar Holdings, LLC's Proposed Revisions of Staff's Condition of Certification CUL-1 (TN 201700) pp. 1 – 5
[15] Palen Solar Holdings, LLC's Status Report 5 (TN 201808) pp. 5

Also in preparation for the April 2014 cultural resources workshop, and in reaction to the January 7, 2014, Committee advice, and the Petitioner's proposed revision, staff proposed a revised **CUL-1**.[16] The revised **CUL-1** reflected a renewed round of tribal consultation invitations, a review of the Genesis Solar Energy Project (Genesis) Tribal Working Group forum in order to better understand the advantages and disadvantages of a proposed Native American Advisory Group, an exploration with those tribes that responded to an Energy Commission renewed invitation to consult on **CUL-1** concerning the suite of concepts that might best address their cultural and spiritual perpetuation impacts,[17] a recalculation of the proposed study costs, and discussions with the BLM Palm Springs Field Office to ascertain if they felt the suite of concepts and amounts were sufficient. The collected information informed staff's revised **CUL-1** resulting in an increase for place interest studies (**CUL-1A**) from $2.46 million to $3.2 million.[18] Staff then took the Petitioner's proposed $1.96 million for tribal people interest (**CUL-1B**), added $150,000 estimated for Tribal Advisory Group support and management, bringing the total for tribal people interest to $2.11 million. This figure, combined with the place interest portion of $3.2 million, results in a total staff-proposed **CUL-1** budget of $5,313,273 that covers both state and tribal people interests.

Aspects of **CUL-1A** that require tribal integration into the study activities are not intended to mitigate for the tribal peoples' interests or values. Rather, tribal integration is meant to ensure that the proposed studies, meant to further understand the cultural landscape that is intricately tied to affiliated tribes' cultures, are conducted in ways that include their perspectives and therefore render the study methods and scientific and interpretive findings more valid.

Tables illustrating the specific mitigation items and allocations of the above budget figures are provided below (Cultural Resources Tables 1 and 2).

[16]Condition of Certification CUL-1: Staff Response to Committee Direction from the Jan. 7, 2014 Committee Conference on the PMPD (TN 201965)

[17]Invitations to Tribes and Tribal Leaders to Participate in California Energy Commission/Tribal Consultation(TN 201619)

[18] Condition of Certification CUL-1: Staff Response to Committee Direction from the Jan. 7, 2014 Committee Conference on the PMPD (TN 201965), pp 15, fn 1,2 and 3

Cultural Resources Table 1

Proposed Mitigation Budget for CUL-1A			
Programs	**Cost**	**Tribal Integration Percentage and Cost of Study**	**Total**
Program Management	$185,550	10% or $18,555	$204,105
Class II Surveys	$1,370,640	20% or $274,128	$1,644,768
Paleoenvironmental Study	$300,000[19]	15% or $45,000	$345,000
Petroglyph Study	$400,000	40% or $160,000	$560,000
PTNCL/PRGTL Context and Field Manual Revision	$100,000[20]	5% or $5,000	$105,000
Public Outreach	$200,000[21]	5% or $10,000	$210,000
Treatment for Cumulative Effects	$134,400	0%	$134,400
TOTAL	$2,690,590	$512,683	$3,203,273

Cultural Resources Table 2

Proposed Mitigation Budget for CUL-1B	
Programs	**Costs**
Native American Advisory Group Support/ Management	$150,000
Program Implementation Funds	$1,960,000
TOTAL	**$2,110,000**

As staff prepares for new focused evidentiary hearings, staff realizes that, pursuant to the Commission's authority, a further increase to the **CUL-1B** tribal people interest mitigation amount could be justified based on the following factors.

1. Glint and glare would be greater (based upon Ivanpah SEGS operations), than what staff originally predicted would occur were PSEGS to be approved in Chuckwalla Valley. [See **Figure 1**].

2. The greater glint and glare impacts mentioned above would have an increased and significant impact on PRGTL and the Native American traditional practitioners that rely upon the Chuckwalla Valley for the continuance of their lifeways.

3. Achieving fiscal parity between the two interests and realizing that the tribal people interest would be to mitigate for 15 tribes' losses or interest[s].

[19] This figure is $100,000 greater than the figure proposed in staff's opening brief (tn201338:6). The increase is responsive to new information from BLM Palm Springs Field Office staff that the costs of paleoenvironmental analyses have been higher on other recent projects in Palm Springs Field Office portion of the California Desert Conservation Area, and also that the costs of the laboratory analysts' field collaboration on the collection of paleoenvironmental samples has been inadvertently left out of recent paleoenvironmental budgets.

[20] This figure is $17,000 greater than the figure proposed in staff's opening brief (tn201338:6). The increase is responsive to new information from BLM Palm Springs Field Office staff that the costs of the revisions to the PTNCL/PRGTL context and field manual, on the basis of their cost to date under 09-AFC-8C and 09-AFC-6C, would be greater than the initially budgeted amount.

[21] This figure is $100,000 greater than the figure proposed in staff's opening brief (tn201338:6). The increase is responsive to new information from BLM Palm Springs Field Office staff that the costs of public outreach initiatives have consistently exceeded the minimal budgets afforded them on other recent projects in the jurisdiction of the Palm Springs Field Office.

4. Avian deterrence measures, depending on if and how such deterrence is considered, could increase project visual effects and introduce adverse auditory effects to the Chuckwalla Valley portion of the PRGTL.

5. The costs for *staffing and managing* the tribal people interest portion of the funds should not be counted as part of the funds directed towards *ameliorating tribal losses* or interests (as recently demonstrated via lessons learned during the current Genesis Tribal Working Group deliberations).

STAFF RESPONSE TO CRIT'S OBJECTIONS

CRIT provides several objections, including objections to **CUL-1**, to the proposed project.[22] The objections and staff responses are enumerated below.

1. Government to Government Consultation not Made Available to CRIT

The January 7, 2014, Committee Conference advised staff of at least two means of achieving tribal people interest mitigation concepts and costs: consult directly with tribes to develop concepts and related costs, or provide a capped amount devoid of concepts that, if the project were approved, could then be distributed per direct tribal advisement.[23] Staff did both. Some (5) tribal discussions took place resulting in some suggested and prioritized concepts; but because the concepts were divergent and only some of the affiliated tribes participated in consultations,[24] staff maintained a tribal advisory group concept (building upon the Genesis Tribal Working Group forum) that would provide a means for distributing tribal people interest funds and deliberating on how to best achieve tribal integration into the **CUL-1A** proposed studies. All consulted tribes agreed that the current proposed tribal people interest budget was not enough to accommodate 15 affiliated tribes. Staff did have discussions with CRIT; but these discussions were at most "informational" because Energy Commission decision makers were not a party to the discussions, due to ex parte rules,[25] and the meeting (between staff and a party to the PSEGS proceeding) was not noticed to the public and therefore discussions of substantive issues are not allowed.[26] Staff does find that, while a project decision is pending, most tribes are reluctant to discuss mitigation concepts and costs because they feel that such discussions could be used to justify or embolden approval and ostensibly and falsely signal tribal consent for approval.

[22] Response of Intervenor Colorado River Indian Tribes to Petitioners' Motion to Reopen Evidentiary Record (TN 201973 and Supplemental Response to Motion to Reopen Evidentiary Record(TN 202225)
[23]Palen Transcript of the Committee Conference held January 7, 2013 (TN 201546) pp. 19 ln. 4– ln. 17
[24]Invitations to Tribes and Tribal Leaders to Participate in California Energy Commission/Tribal Consultation(TN 201619) and Condition of Certification CUL-1: Staff Response to Committee Direction from the Jan. 7, 2014 Committee Conference on the PMPD (TN201965) pp 3
and TN # 201965 p.3
[25]Cal Code Regs., tit. 20, §1216(a)
[26]Cal Code Regs., tit. 20, §1710(a)

2. Cultural Concerns Related to Avian Mortality Not Considered

Thermal solar avian mortality issues are currently discussed among biologists and articulated in related biological documents and mitigated per biological conditions of certification. Biologists tend to focus on those species that are state or federally listed as endangered, threatened or other special status. Regardless of focus, those biological discussions mostly lack tribal input. However, the Chuckwalla Valley portion of the PRGTL documented by staff includes as contributing attributes, the culturally significant plants and animals of the Chuckwalla Valley. Some culturally significant plants (95 species) and animals (50 species, including insects and birds), are listed and provided in cultural resources staff analysis.[27] However, mitigations for cultural losses of culturally significant plants or animals (including insects and birds), is not directly or specifically called out in any cultural conditions of certification. **CUL-1A** studies may reflect some study focus towards plants and animals and some tribal entities, and some **CUL-1B** funds could eventually be applied via the currently proposed concepts laid out in **CUL-1B**,[28] towards cultural plant and animal mitigations. Cultural resources staff is concerned that additional proposals to deter birds from proposed PSEGS solar fields and flux could increase impacts to the Chuckwalla Valley portion of the PRGTL.

3. Ivanpah (ISEGS) Glare and ISEGS Need for Increased Natural Gas Usage Suggest Increased Project Effects

Ivanpah SEGS has become operational since staff filed its original PSEGS testimony. Staff has become aware that the spectral glare has an impact that is greater than the original staff focus on just the glare that ensues from solar flux. Staff does not think that an increase in natural gas at PSEGS would increase impacts to the cultural landscape.

4. Environmental Baseline Should Consider Pre-License Conditions

CRIT argues that because a re-opened evidentiary hearing is now scheduled and because the Petitioner argues that a solar trough alternative is not feasible, then the environmental baseline should allow for an analysis that considers more than the difference between what has been previously licensed and what is now proposed. Cultural resources staff has no opinion to this objection. Staff only assessed impacts to cultural resources based upon only those impacts that would result from the difference between what was previously licensed and what is now proposed.

5. No New Information Provided Warranting a New Focused Evidentiary Hearing

As stated in Staff's Response to Petitioner's Motion to Reopen Evidentiary Record, staff remains neutral on this objection.

[27]Ethnographic Report Informing the Final Staff Assessment (TN 200847) pp.125 –139
[28]Condition of Certification CUL-1: Staff Response to Committee Direction from the Jan. 7, 2014 Committee Conference on the PMPD (TN 201965) pp. 11

6. CUL-1 is an Insufficient Amount – No Amount Sufficient

CRIT argues that no amount of mitigation will ever fully compensate CRIT and other tribes for the loss of the cultural landscape. Staff generally agrees with this line of argumentation but does not contend that "no amount is ever sufficient." Staff may find that some future mitigation amount could reduce some future proposed project's impacts to a cultural landscape to less than significant; however that amount would be exponentially greater than the $5.31 million currently proposed per **CUL-1**. Despite not finding the current proposed mitigation to reduce impacts to less than significant, staff contends that proposing compensatory mitigation, to the extent feasible, is a regulatory requirement that, were staff to not suggest mitigation, would be remiss in its responsibilities and obligations to consider impacts to all the Native American tribal entities affected by the project. While staff acknowledges additional impacts (based upon Ivanpah SEGS operations), those impacts would not significantly increase study costs for mitigating place interests per **CUL-1A**. However, staff does acknowledge that the costs for mitigating tribal people interest per **CUL-1B** are less precise.

7. The Tribal Advisory Group Model, Like that Used for the Genesis Project Mitigation Plan, Pits Tribes Against One Another

NextEra Energy Resources (owner of the Genesis project) did convene a tribal working group to assist in the deliberation of the tribal/public outreach portion ($1 million) of a larger ($3 million) mitigation to address the impacts to portions of one archaeological site discovered (and subsequently removed) during project construction. The Genesis Tribal Working Group is convened to help guide the project owner in the judicious expenditure of the tribal outreach portion of the budget. The tribal representation (13 of 15 affiliated tribes) of the Genesis Tribal Working Group is the same as what may be convened for PSEGS **CUL-1B**.

There has been some suggestion that the tribal interest funds simply be divided among the number of affiliated tribes and therefore dispensing with the need for a tribal working group. Staff finds this approach to be problematic in that there is no funding formula currently available to weigh the various tribes' relative injuries and needs (e.g., tribes' land bases, membership sizes and cultural affiliations are not convertible one to another, and tribes' cultural and spatial proximities to the project site differ). A further problem with automatic disbursement is that staff would not be able to maintain mitigation outcomes that preserve the nexus between impacts and mitigations. A final problem is that by utilizing a funding formula disbursement method, staff would lose the ability to efficiently offer some mitigation that may be uniformly acceptable to all affiliated tribes (e.g. training). Ultimately a funding formula disbursement plan would still pit tribes against one another. Staff finds the working group model to be the best currently available method for disbursement of **CUL-1B** funds, should PSEGS be licensed. However, there are several areas of improvement (currently being considered for Genesis) and that could be made upon the Tribal Working Group model. The following are suggested:

1. require each participatory tribe (via tribal letter head or resolution) to identify one tribal representative and a proxy representative, regardless of how many people may show up from meeting to meeting from one or another tribes,

2. provide parliamentary procedures for deliberating, particularly when the group must vote on an agenda item,

3. maintain meeting minutes to maintain a track record of all group deliberations,

4. provide transparent budgets that identify for all participating tribes what expenditures are made and how the budget will diminish as the **CUL-1B** mitigation transpires,

5. identify the cost of doing business (meeting space rental, travel, print and copy, consultant facilitator costs, etc) and keep that amount separate from the cost applied to mitigation items, and

6. require that the project owner's sole responsibility is to fund the mitigation by transferring a total amount into an Energy Commission account; and that staff facilitate the group and make the necessary expenditures.

While staff has not achieved mitigation concept specificity that incorporates much tribal input, staff also feels that a tribal working group, with funds and procedures but no mitigation concepts may result in early inefficiencies. Staff has therefore put some boundaries around the concepts as enumerated in **CUL-1B**. Staff has derived the **CUL-1B** concepts from 1) the advice provided by the committee at the January 7, 2014, Committee Conference, 2) the concepts provided to staff by some tribes during the most recent tribal consultations, and 3) those Genesis discovery mitigation concepts that remain tribally acceptable after two years of Genesis Tribal Working Group deliberations.

8. Avian Mortality Data Not Adequate

Other than the staff response to CRIT concern # 2 above, cultural resources staff is not qualified to determine the validity of this assertion.

STAFF EXPLANATION OF THE NEXUS BETWEEN IMPACTS TO THE CHUCKWALLA VALLEY PORTION OF THE PRGTL AND MITIGATION CONTAINED IN CUL-1

The impacts to the Chuckwalla Valley portion of the PRGTL can be divided into two broad interest areas. These have been characterized as "place," and "tribal people" interest or values.[29]

[29] Condition of Certification CUL-1: Staff Response to Committee Direction from the Jan. 7, 2014 Committee Conference on the PMPD (TN 201965) pp. 1-2, 17

PLACE INTEREST

Place interests ensue from the significance criteria by which the landscape was found eligible per state historic preservation law (Pub. Resources Code, § 5024.1.(c)). The four significance criteria are: A) events that contribute to the broad patterns of California history and cultural heritage (i.e. migration and origins); B) is associated with the lives of persons important in our past; C): possesses high artistic values (i.e. petroglyphs); and D) yields information important in prehistory (relation between prehistoric/proto-historic habitation, travel and resource extraction and procurement). Staff's analysis in the FSA found criteria A, C and D applicable to the Chuckwalla Valley portion of the PRGTL, but could not find association with a specific person or persons important to California's past. Staff further argued, and the committee concurred, that the Chuckwalla Valley portion of the PRGTL presently retains degrees of integrity (setting, feeling and association), sufficient to convey the significance of each of these values. The impact of the project on the landscape and the associative, artistic and information values it conveys would lessen the ability of the landscape to convey its significance to the people of the State of California. As the significance of the landscape is reduced because of the construction and operation of an energy facility, so also is the opportunity of the people of the State of California to experience the landscape and the significant historic meanings that it conveys. This is the "state" or "place" interest. Therefore the mitigations proposed in **CUL-1A** are intended to capture that loss of significance through conducting a number of studies to thoroughly document the events and broad patterns of history and cultural heritage, the artistic values of the petroglyphs of the Chuckwalla Valley and the paleo-environmental scientific baseline of the Chuckwalla Valley. Upon completion of these studies, salient findings, after being screened for issues of confidentiality, would be conveyed to the public in video and other readily consumable media.[30]

TRIBAL PEOPLE INTEREST

Tribal people interests ensue from the fact that tribal people currently rely upon the Chuckwalla Valley as a source of nutritional, medicinal, historical, and religious identity. This cultural identity is transmitted generation to generation. The impairment of a landscape diminishes Native American peoples' ability to perpetuate their cultures. This impairment is disproportionately placed on Native American cultures that have relied, and continue to rely, upon the Chuckwalla Valley for thousands of years. No other cultures or peoples can claim this specific locale coupled with such a depth in time. Therefore an impact to the Chuckwalla Valley Portion of the PRGTL is an impact to the lived, shared and perpetuated cultures of the people of the affiliated tribes. Staff is generally aware through this and other siting case ethnographic investigations involving solar power tower technology that Native American traditional practitioners are concerned about the intensity of the sun being brought to a focus so close to the surface of cultural landscapes that are understood to facilitate indigenous travel of both the living and the deceased. While the sun is recognized by Native American traditionalist to be a source of life, it is only considered as such in its standard and normal seasonal positions relative to those on the ground. Bright lights, that

[30] *Ibid* pp. 20

approximate the intensity of the sun and that are close to the earth, are understood to be ominous, herald the approach of death, and are to be avoided.[31]

Therefore **CUL-1B** mitigations are intended to compensate for the Native American people's diminishment of their ability to practice and perpetuate their cultures. While staff is competent to identify and cost out the proposed place interest mitigations (studies) for **CUL-1A**, staff has less ability to identify and cost out proposed tribal people interest mitigations. The staff inability ensues from:

1) the consequence of most tribes not wanting to discuss potential mitigations pre-certification,

2) tribal concepts provided by some tribes (total of 5) cannot be considered sufficient to represent all affiliated tribes (total of 15), and

3) staff not being intimately involved in the living dynamics of the tribal communities.[32]

Therefore staff has proposed some general concepts, and focused more on structuring a tribal forum where tribes and agencies can deliberate, should the project be approved. Staff has selected general mitigation concepts that are land based (easements and management plans) because the impacts are to a landscape. In addition staff has proposed a tribal cultural resources granting program to accommodate tribally proposed concepts.

The petitioner insists on financial certainty and this situation places staff in an awkward position of determining an amount, devoid of specific concepts that reflect robust tribal input. However if staff were to assume that the place interest and the tribal people interest are equal, or in some way proportional (applicant has determined the mix to be 1/3 to 2/3)[33], and because staff can readily calculate the place interest[34], then an extrapolation can be made from the place interest amount to the tribal people interest amount.

CONDITIONS OF CERTIFICATION

The funding amounts included in this condition of certification remain as staff proposed at the PSEGS Cultural Resources public workshop held in April 2014. Should the Committee find that the additional direct visual impacts and cumulative effects identified in this supplemental testimony warrant additional compensatory mitigation, then staff suggests that **the amount specified in CUL-1B is increased to equal or achieve parity with the amount ultimately specified in CUL-1A.**

(Additions in **Bold**, deletions in ~~strikethrough~~)

[31] Cachora, personal communication to Thomas Gates, 2014

[32] Ethnography can yield some insight into tribal community dynamics but only after lengthy immersions into the 15 affiliated tribal communities. The Energy Commission siting process does not afford enough time for such immersion.

[33] Palen Solar Holdings, LLC's Status Report (TN 201808) pp. 4

[34] Condition of Certification CUL- 1: Staff Response to Committee Direction from the Jan. 7, 2014 Committee Conference on the PMPD (TN 201965 p.15

CUL-1A TREATMENT OF THE CHUCKWALLA VALLEY PORTION OF THE PACIFIC TO RIO GRANDE TRAILS LANDSCAPE (PRGTL)

The project owner shall contribute a total of $3,203,273.00 to the Energy Commission's PRGTL account. The Energy Commission will create this account to finance the completion of the multiple programs set out in this condition, the collective purposes of which are to mitigate, in part, for the amended project's direct visual effects and cumulative physical and visual effects on the Chuckwalla Valley portion of the PRGTL, and to integrate tribal participation in such programs. The Compliance Project Manager (CPM) in consultation with the US Bureau of Land Management (to avoid duplication of effort) will administer the disbursement of these funds and will provide regulatory oversight of the implementation of the multiple programs.

Treatment for Direct Visual Effects

Field Inventory and Documentation of PRGTL Contributing Elements

The ~~project owner~~ **PRGTL account** shall **be used by the CPM to fund the** design and conduct of reconnaissance pedestrian (class II) surveys of the Palen Mountains Resource Area; the Coxcomb Mountains Resource Area; the Eagle, Chuckwalla, and McCoy Mountains Resource Areas, as these areas are depicted in the FSA; the Coxcomb Fringe and Raceway Mesquite Areas, as also depicted in the FSA; ~~and~~ the BLM's Palen Dry Lake ACEC**; and Palen Dunes/Palen Lake, Ford Dry Lake, McCoy Spring, Chuckwalla Spring, Corn Spring, North Chuckwalla Petroglyph District, North Chuckwalla Mountain Quarry District, Long Tank, Alligator Rock, Dragon Wash, and San Pascual Well Traditional Cultural Properties, as depicted in the FSA.** The scope of the Palen Mountains reconnaissance is limited to the portions of the mountains in Sections 13, and 24–26, T. 4 S., R. 17 E. and east of those sections into the unsectioned areas of T. 4 S., R. 18 E.; in sections 1 and 13, T. 5 S., R. 17 E., and east of those sections into the unsectioned areas of T. 5 S., R. 18 E.; and north of sections 31–33, T. 5 S., R. 18 E. into the unsectioned portions of that township. The scope of the Coxcomb Mountains reconnaissance is limited to the portions of the mountains in sections 11 and 14, T. 4 S., R. 16 E. and northwest of those sections into the unsectioned areas of that township; in section 22, T. 4 S., R. 16 E., and north of that section into the unsectioned areas of that same township; and in section 16, T. 4 S., R. 16 E. and northeast into, again, the unsectioned portions of that township. The principal purpose of these surveys is to document a statistically valid sample of the archaeological deposits, and the potential prehistoric and ethnographic sources of natural resources in each of the subject areas. The primary, although not exclusive focus of the surveys shall be prehistoric archaeological resources that have the potential to be eligible for listing in the CRHR under Criteria 1 or 3. Resources encountered would typically include, but would not be limited to, rock art, intaglios, caves or other natural features that may evidence ritual use, apparent altars or shrines, cleared circles, rock alignments, rock cairns, caches, and trail segments. One secondary focus of the surveys shall be

natural resource locales, places in the mountain and mesquite resource areas which may have been used as water sources, or places where plant, animal, or mineral resources may have been extracted. Such places may include springs, seeps, tanks, or plunge pools; stands of plants which have the potential to have been food sources or sources of medicinal compounds; habitats of high value animal populations; or mineral resource outcrops or deposits where materials such as high quality toolstones, quartz crystals, or turquoise may have been extracted. Another secondary focus of the surveys shall be any source of paleoenvironmental data such as packrat middens or pockets of perennially moist, organic sediments.

The research designs and the methods used for these class II surveys shall reflect the character of the different resource areas and include thorough documentation of each archaeological resource, natural resource extraction locale, and source of paleoenvironmental data. The sample design and the field methods for each mountain and mesquite resource area shall evidence a balanced consideration of local topographic constraints and the requirement to acquire a statistically valid sample of each area. The ~~project owner shall completely document~~ **PRGTL account shall be used by the CPM to fund the complete documentation of** every archaeological site found on California State Parks DPR 523 Series forms per California State Parks instructions (CA State Parks 1995). The descriptions of resource assemblages and the spatial distribution internal to those assemblages shall be detailed enough on the subject forms to facilitate meaningful archaeological analysis of the surface manifestation of each archaeological resource. Documentation of potential natural resource extraction locales and sources of paleoenvironmental data shall include field notes and photographs of each such locale or source, vicinity and larger-scale location maps, submeter GPS coordinates, and, for rock and mineral sources, hand samples of the rocks or minerals sufficient for formal identification. The research designs for the mountain and mesquite resource areas shall also provide for chronometric, source, and other germane laboratory analyses.

The research design for the BLM's Palen Dry Lake ACEC survey shall include a thorough review of the BLM's extant documentation on the ACEC and any other extant peer-reviewed and proprietary literature to determine whether a statistically valid sample of the archaeological inventory of the area already exists, and, if that sample does not exist, the project owner shall design and conduct a further class II pedestrian survey to acquire the requisite supplementary data to complete that sample.

The ~~project owner shall provide for~~ **PRGTL account shall be used by the CPM to fund** Native American involvement in the design**, monitoring,** and execution of the fieldwork for these surveys, and in the interpretation and presentation of the results of the surveys. **Eligible participating tribes shall include only those tribes listed with the BLM or the NAHC as affiliated with the Chuckwalla Valley. These tribes are listed after the verification for CUL-1B.**

The ~~project owner~~ **PRGTL account** shall ~~conclude~~ **used by the CPM to fund the conclusion of** the efforts to inventory and document the above contributing elements of the PRGTL with the preparation and submission of one or multiple, comprehensive technical report(s).

Paleoenvironmental Study

The ~~project owner~~ **PRGTL account** shall **be used by the CPM to** ~~develop~~ **fund the development** and ~~prepare~~ **preparation of** a report of a paleoenvironmental study germane to the period of significance for the Chuckwalla Valley portion of the PRGTL. The purpose of the study is to provide an updated and more reliably informed paleoenvironmental context to enhance the interpretation of the Chuckwalla Valley portion of the PRGTL. The research design for the study shall make use, at a minimum, of the available peer-reviewed and proprietary Quaternary science literatures, recent Quaternary research conducted in conjunction with the licensing and construction of the Genesis Solar Energy Project, the geoarchaeological research done in conjunction with the licensing and amendment processes for the amended project, new packrat midden analyses, and new Palen Dry Lake sediment core data.

The ~~project owner~~ **PRGTL account** shall ~~provide for~~ **be used by the CPM to fund** Native American involvement in the design**, monitoring,** and execution of the fieldwork for ~~these surveys~~ **this study**, and in the interpretation and presentation of the results of the ~~surveys~~ study. **Eligible participating tribes shall include only those tribes listed with the BLM or the NAHC as affiliated with the Chuckwalla Valley. These tribes are listed after the verification for CUL-1B.**

The ~~project owner~~ **PRGTL account** shall ~~conclude~~ **fund the conclusion of** the paleoenvironmental study effort with the preparation and submission of a comprehensive technical report.

Petroglyph Study

The ~~project owner~~ **PRGTL account** shall ~~develop~~ **be used by the CPM to fund the development**, conduct, and ~~submit~~ **submission of** a technical report of a petroglyph study germane to the period of significance for the Chuckwalla Valley portion of the PRGTL. The purpose of this study is to provide for the integration of the numerous petroglyph sites within the PAA in one comprehensive study. The research design should incorporate recent studies conducted at the behest of Southern California Edison for mitigation related to the siting and construction of the Red Bluff substation's impacts to the North Chuckwalla Mountains Petroglyph District. Complete photo/GIS inventories of individual petroglyph motifs and of articulated motif panels shall be completed for Dragon Wash, Corn Springs, Chuckwalla Springs and McCoy Springs. In addition a reasonable sampling of the various smaller and disparate petroglyph motifs and panels throughout the Valley shall be inventoried. These disparate petroglyph sites can be ascertained from the list of known sites in the PAA that staff has collected as part of their independent

analysis and from any newly discovered petroglyph sites located in conducting field inventories required above. Petroglyph data shall then be analyzed spatially to discern trends at a micro-site scale and at a macroscale across the Valley with other petroglyph sites and other cultural resources that contribute to the Chuckwalla portion of the PRGTL. A research design shall also propose targeted dating techniques (e.g., patina analysis), including super-impositioning analysis on a relevant subset of the sites in the Chuckwalla Valley.

The ~~project owner~~ **PRGTL account** shall ~~provide for~~ **be used by the CPM to** fund Native American involvement in the design**, monitoring,** and execution of the fieldwork for ~~these surveys~~ **this study**, and in the interpretation and presentation of the results of the ~~surveys~~ **study**. **Eligible participating tribes shall include only those tribes listed with the BLM or the NAHC as affiliated with the Chuckwalla Valley. These tribes are listed after the verification for CUL-1B.**

The ~~project owner~~ **PRGTL account** shall ~~conclude~~ **be used by the CPM to fund the conclusion of** the efforts to inventory**,** ~~and~~ document**, and analyze** the above contributing elements of the PRGTL with the preparation and submission of one or multiple, comprehensive technical report(s).

Revision of Prehistoric Trails Network Cultural Landscape Context (PTNCL) and Field Manual

The ~~project owner~~ **PRGTL account** shall ~~contribute to a special~~ **be used by the CPM to** fund ~~set up by the Energy Commission an amount sufficient to finance~~ the revision of the extant draft context for the Prehistoric Trails Network Cultural Landscape (PTNCL) and the PTNCL's draft companion field manual. The revision shall recast the subject context to more explicitly consider the trail routes in Chuckwalla Valley, and the cultural resources which are thematic constituents of those routes, as elements that may contribute to the historical significance of the Pacific to Rio Grande Trails Landscape. The final technical reports for the class II surveys of the mountain and mesquite resource areas, the paleoenvironmental study, and the petroglyph study shall inform the context revision.

The PRGTL account shall be used by the CPM to fund Native American involvement in the design and execution of the revised PTNCL Field Manual. Eligible participating tribes shall include only those tribes listed with the BLM or the NAHC as affiliated with the Chuckwalla Valley. These tribes are listed after the verification for CUL-1B.

Public Outreach

The ~~project owner~~ **PRGTL account** shall **be used by the CPM to** fund the production and distribution of video or web-based content the purpose of which is to interpret the Chuckwalla Valley portion of the PRGTL for the **non-Native American** general public. The interpretive perspectives that are to inform said content shall derive from academe as well as from the Native

American communities who ascribe heritage values to the valley. **Eligible participating tribes shall include only those tribes listed with the BLM or the NAHC as affiliated with the Chuckwalla Valley. These tribes are listed after the verification for CUL-1B.**

The ~~project owner~~ **Tribal People Interest account of CUL-1B** shall **be used by the CPM to** fund initiatives the purposes of which are to directly, albeit partially, compensate Native American communities who ascribe heritage values to Chuckwalla Valley and, more specifically, to the broader PRGTL for PSEGS' degradation of the associative and emic ethnographic values of their ancestral homelands.

Treatment for Cumulative Effects

The project owner shall contribute **$134,400** to ~~a special fund to be comprised of multiple owners of cumulative project contributors set up~~ the **extant** PTNCL fund set up **previously** by the Energy Commission to help finance the completion of the documentation program for the Chuckwalla Valley portion of the PRGTL.

The amount of the contribution shall be $~~70~~**35**.00 per acre that the project encloses or otherwise disturbs. Any additional contingency contribution is not to exceed an amount totaling 20 percent of the original contribution. The contribution to the special fund may be made in installments at the approval of the CPM, with the first installment to constitute one-third of the total original contribution amount.

If a project is not certified, or if a project owner does not build the project, or, if for some other reason deemed acceptable by the CPM, a project owner does not participate in funding the PRGTL documentation program, the other project owner(s) may consult with the CPM to adjust the scale of the PRGTL documentation program research activities to match available funding. A project owner that funds the PRGTL documentation program and then withdraws will be able to reclaim their monetary contribution, to be refunded on a prorated basis.

CUL-1B TREATMENT OF TRIBES AFFECTED BY IMPACTS TO THE CHUCKWALLA VALLEY PORTION OF THE PACIFIC TO RIO GRANDE TRAILS LANDSCAPE (PRGTL)

The project owner shall contribute a total of $2,110,000 to a Tribal People Interest account that the Energy Commission will set up to finance the completion of multiple programs set out in this condition, the collective purposes of which are to mitigate, in part, for the amended project's impacts to tribes' abilities to perpetuate their cultures as those abilities will be degraded as a consequence of the project's physical and visual damage to the Chuckwalla Valley portion of the PRGTL. The Compliance Project Manager (CPM) in consultation with the US Bureau of Land Management (to avoid duplication of effort)

will administer the disbursement of these funds and provide regulatory oversight for the implementation of the multiple programs.

Native American Advisory Group

The CPM shall develop and create a Native American Advisory Group that shall meet, deliberate, and recommend to the CPM the use of the funds dedicated to the specific programs of this condition. Each participating affected Tribe (eligible participating tribes shall include only those tribes listed with the BLM or the NAHC as affiliated with the Chuckwalla Valley and as listed at the end of this condition) shall designate one representative and one proxy and determine in writing the extent of representation that has been delegated to the representative. The Native American Advisory Group shall meet no less than every two months on a continuing basis until such time when all special interest tribal funds have been distributed. The Native American Advisory Group shall operate per parliamentary procedures. Meeting minutes shall be kept by the CPM of all Native American Advisory Group attendances and consensus or voted recommendations. Meetings shall be attended by Energy Commission staff for the purposes of documenting recommendations. Advisory group attendance and recommendations will be posted on the Energy Commission website.

Funds shall be used to facilitate the Native American Advisory Group and disbursed by the CPM among all or some of three broad programs for the direct benefit of any or all affected tribes, as those three programs are further specified below.

1) **Resource Management Planning**

   Funds may be used to facilitate representative tribal involvement in resource management planning efforts that may result from approval of a) the Palen Solar Electric Generating System, b) other resource management plans proposed in, or that partially include the Chuckwalla Valley, or c) tribal resource management plans on or near reservations of the representative tribes. Funds could include but are not limited to, employee or consultant costs, including travel and per diem to attend meetings, provide draft language for management plans or to gather pertinent background information that may contribute to a specific planning process.

2) **Conservation Easement Funding**

   Funds may be used to facilitate tribal understanding, identification, negotiation or holding of conservation easements that are intended solely, or in part, to protect cultural resources or natural resources of cultural value to the representative tribe(s). The specific Conservation Easement concepts that appeal to the affected tribe(s) shall be recommended to the CPM by the Native American Advisory Group.

3) **Cultural Preservation and Education Grants**

Funds may be used to facilitate cultural preservation and education grants as proposed by any or all of the affected tribes. The specific grant themes and per-grant maximum amounts shall be recommended to the CPM by the Native American Advisory Group. Grant themes may include, but not limited to such activities as:

- **land acquisition for the purposes of tribal historic preservation or tribal cultural education,**
- **archival or ethnographic research and cultural practice documentation,**
- **elder youth cultural perpetuation/mentoring opportunities,**
- **training and workshops concerning aspects of historic preservation, and**
- **capital improvement and related funding for historic preservation restoration, rehabilitation or interpretation.**

Verification 1A: Treatment for Direct Visual Effects

~~Field Inventory and Documentation of PRGTL Contributing Elements~~

~~1. Within 90 days of the start of ground disturbance, the project owner shall submit, for the review and approval of the CPM, separate draft research designs for reconnaissance pedestrian (class II) surveys of the Palen, Coxcomb, Eagle, Chuckwalla, and McCoy Mountains Resource Areas, the Coxcomb Fringe and Raceway Mesquite Areas, and the BLM's Palen Dry Lake ACEC. The research designs may be developed as a single document, multiple separate documents, or in any combination convenient to the project owner. Whether prepared separately or as one or several bundles, the research designs shall be explicit about the methods to be used in the survey of each area and the anticipated routes of the pedestrian transects through each area.~~

~~2. Prior to the project owner's submission of any one draft technical report of the results of the class II pedestrian survey of any one of the areas in verification 1 above, or of any combination of multiple areas, the project owner shall first submit, for the review and approval of the CPM, California State Parks DPR 523 Series form sets, complete per California State Parks instructions (CA State Parks 1995) and in accordance with the language of this condition of certification.~~

~~3. Upon the approval of the CPM, the project owner shall, within 14 days of said approval, formally submit each approved DPR 523 Series form set for each cultural resource to the Eastern Information Center of the California Historical Resources Information System and to the BLM's Palm Springs-South Coast Field Office.~~

~~4. Within 120 days of the CPM's approval of any research design for any of the areas in verification 1 above, the project owner shall submit, for the review and approval of the CPM, a draft technical report of the results of the class II pedestrian survey for each such area. Draft technical reports for the subject areas may be developed separately or in any combination convenient to the project~~

owner.

5. Upon the approval of the CPM, the project owner shall, within 14 days of said approval, formally submit each approved technical report of the results of each class II pedestrian survey to the Eastern Information Center of the California Historical Resources Information System and to the BLM's Palm Springs-South Coast Field Office.

6. Should the project owner petition to suspend or terminate the license for the subject facility, subsequent to the execution of any fieldwork that had been done in partial fulfillment of this condition, but prior to the submission of draft DPR 523 Series form sets or draft technical reports, the project owner shall, no later than 90 days prior to filing a petition to suspend or terminate said license, submit complete draft form sets for each field-observed cultural resource to the CPM, the Eastern Information Center of the California Historical Resources Information System, and the BLM's Palm Springs-South Coast Field Office, and further submit to the CPM and the BLM's Palm Springs-South Coast Field Office organized and legible copies of all of the field documentation for the surveys that have been completed by that time and the drafts, however incomplete, of any technical reports in preparation.

Paleoenvironmental Study

1. Within 90 days of the start of ground disturbance, the project owner shall submit for the review and approval of the CPM and in accordance with CUL-1 a draft research design for a paleoenvironmental study of the Chuckwalla Valley portion of the PRGTL. The draft research design shall be explicit about the sources of the data and the analytic methods that would be used to inform the study.

2. Within 180 days of the CPM's approval of the research design for the subject Chuckwalla Valley paleoenvironmental study, the project owner shall submit, for the review and approval of the CPM, a draft technical report of the results of that study.

Petroglyph Study

1. Within 90 days of the start of ground disturbance, the project owner shall submit, for the review and approval of the CPM and in accordance with CUL-1, a draft research design for a petroglyph study of the Chuckwalla Valley portion of the PRGTL. The draft research design shall be explicit about the sources of the data and the analytic methods that would be used to inform the study.

2. Within 180 days of the CPM's approval of the research design for the subject Chuckwalla Valley petroglyph study, the project owner shall submit, for the review and approval of the CPM a draft technical report of the results of that study.

Revision of Prehistoric Trails Network Cultural Landscape Context

1. Within 30 days of the start of ground disturbance, the project owner shall make a contribution to a special fund set up by the Energy Commission the purpose of which would be to completely finance the revision of the extant draft context for the Prehistoric Trails Network Cultural Landscape (PTNCL) and the PTNCL's draft companion field manual.

~~Public Outreach~~

~~1. Within 180 days of the finalization of all research related to the mitigation of the Palen Solar Energy Generating System project's effects on cultural resources the project owner shall facilitate the convention of a steering committee that shall represent the interests of academe, Native American stakeholders, and state and federal agency regulatory interests in the production and distribution of video or web-based content, the purpose of which is to interpret the Chuckwalla Valley portion of the PRGTL for the general public. Major goals of the steering committee will be to frame the content to be produced, select the medium for the content's distribution, and select a contractor to deliver draft and final products. The steering committee will accomplish this goal through the development and release of a request for proposals, and the review and selection of the actual contractor. The selection of the contractor will occur within 90 days of the date of the convention of the steering committee.~~

~~2. The project owner shall bear the complete cost of all expenses associated with the production and distribution of the subject video or web-based content. Such costs shall include, but shall not be limited to, the convention of the steering committee and all subsequent steering committee meetings, the contractor selection process, and all work associated with the production and release of said content. The project owner shall also bear all travel and per diem expenses for steering committee members and for the contractor, as such costs are made part of the project owner's ultimate contract with that party.~~

~~3. Within 180 days of the finalization of all research related to the mitigation of the Palen Solar Energy Generating System project's effects on cultural resources, the project owner shall facilitate the convention of a steering committee that shall represent the interests of Native American stakeholders and include the participatory facilitation of state and federal agency staff in the development of compensatory initiatives for Native American communities who ascribe heritage values to Chuckwalla Valley. The major goal of the steering committee will be to develop and select the suite of initiatives to be funded. The selection of the initiatives will occur within 270 days of the date of the convention of the steering committee.~~

~~4. The project owner shall bear the complete cost of all expenses associated with the development of compensatory initiatives for Native American communities who ascribe heritage values to Chuckwalla Valley. Such costs shall include, but shall not be limited to, the convention of the steering committee and all subsequent steering committee meetings, and all work associated with the implementation of said initiatives. The project owner shall also bear all travel and per diem expenses for steering committee members and for any contractors, as such costs are made parts of the project owner's ultimate contracts with those parties.~~

1. The project owner shall transfer $3,068,873.00 to the Energy Commission's PRGTL account no later than 90 days prior to the initiation of ground disturbance anywhere on the project site.

2. **No later than 10 days after receiving notice of the successful transfer of funds to the Energy Commission's PRGTL account, the project owner shall submit a copy of the notice to the Energy Commission's Compliance Project Manager (CPM).**

Treatment for Cumulative Effects

3. **The project owner shall transfer $134,400.00 to the Energy Commission's previously established PTNCL account no later than 90 days prior to the initiation of ground disturbance anywhere on the project site**.

4. **No later than 10 days after receiving notice of the successful transfer of funds** ~~for any installment~~ **to the Energy Commission's** ~~and/or BLM's special PTNCL fund~~ **PTNCL account, the project owner shall submit a copy of the notice to the Energy Commission's Compliance Project Manager (CPM).**

Verification 1B

1. **The project owner shall transfer $2,110,000 to the Energy Commission's Tribal Interest account no later than 90 days prior to the initiation of ground disturbance anywhere on the project site.**

A Combined List of BLM and NAHC Listed Tribes Affiliated with the Chuckwalla Valley

Agua Caliente Band of Cahuilla Indians

Augustine Band of Cahuilla Indians

Cabazon Band of Mission Indians

Cahuilla Band of Mission Indians

Chemehuevi Indian Tribe

Cocopah Indian Tribe

Colorado River Indian Tribes

Fort Mojave Indian Tribes

Fort Yuma Quechan Tribe

Morongo Band of Mission Indians

Ramona Band of Mission Indians

San Manuel Band of Mission Indians

Soboba Band of Luiseno Indians

Torres-Martinez Desert Cahuilla Indians

Twenty-nine Palms Band of Mission Indians

REFERENCES

CEC 2013a– California Energy Commission/Christine Stora (TN 200564). Final Staff Assessment – Part B, dated September 23, 2013. Submitted to CEC/Docket Unit on September 23, 2013

CEC 2013b California Energy Commission/Thomas Gates, Ph.D. and Matthew Braun, M.A. (TN 200847). Ethnographic Report Informing the Final Staff Assessment, dated August 2013. Submitted to CEC/Docket Unit on October 15, 2013

CEC 2013c – California Energy Commission/Ken Celli (TN 201234). Transcript of the Palen Evidentiary Hearing, dated October 28, 2013. Submitted to CEC/Docket Unit on November 16, 2013

CEC 2013d– Energy Commission/Staff Opening Brief. (TN 201338), Submitted to CEC/Docket Unit on November 26, 2013

CEC 2013e–California Energy Commission/Karen Douglas (TN 201434) Presiding Member's Proposed Decision, Submitted to CEC/Docket Unit on December 13, 2013

CEC 2013f , California Energy Commission Staff (TN 201546),Palen Transcript of the Committee Conference held January 7, 2013, Submitted to CEC/Docket Unit January 13, 2014

CEC 2013g–California Energy Commission/Thomas Gates (TN 201619) Invitations to Tribes and Tribal Leaders to Participate in California Energy Commission/Tribal Consultation, Submitted to CEC/Docket Unit on February 3, 2014

CEC 2013h–Galati | Blek LLP (TN201700) Palen Solar Holdings, LLC's Proposed Revisions of Staff's Condition of Certification CUL-1, Submitted to CEC/Docket Unit on February 10, 2014

CEC 2013i Galati | Blek LLP (TN 201808) Palen Solar Holdings, LLC's Status Report 5, Submitted to CEC/Dockets Unit on February 28, 2014

CEC 2013j California Energy Commission/Jon Hilliard, (TN 201965) Condition of Certification CUL-1: Staff Response to Committee, Direction from the Jan 7, 2014 Committee Conference on the PMPD, Submitted to CEC/Docket Unit on April 4, 2014

CEC 2013k California Energy Commission (TN 202362) Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record and Setting Revised Schedule, Submitted to CEC/Docket Unit on May 21, 2014

Figure 1
Nipton exit overview of Ivanpah SEGS Units 2 and 3 - April 2014

TRAFFIC AND TRANSPORTATION

Supplemental Testimony of James Adams, Andrea Koch, and Dr. Gregg Irvin

GLINT AND GLARE

The proposed Palen Solar Electric Generating System (PSEGS) would cause viewers, including pilots, to experience glint and glare, as discussed in the **TRAFFIC AND TRANSPORTATION** analysis in the December 2013, Energy Commission's Presiding Member's Proposed Decision (PMPD) for the project. However, the PMPD adopted Energy Commission staff's conclusions in the PSEGS Final Staff Assessment that glint and glare from the PSEGS's heliostats would cause less than significant impacts to pilots with implementation of Condition of Certification **TRANS-7**, which would require the project owner to maximally limit direct solar reflections from the heliostats (DSRH) on all observers through effective heliostat positioning. The PMPD stated that with implementation of **TRANS-7**, individual or sequential DSRH events might cause mild discomfort to pilots, but would not be expected to induce severe discomfort or disability glare that would compromise pilots' abilities to operate their aircraft (CEC 2013).

On May 21, 2014, the PSEGS Amendment Committee issued an order granting Palen Solar Holdings' (Petitioner's) Motion to Reopen the Evidentiary Record (CEC 2014). One of the topics to be considered at the new evidentiary hearing is glint and glare. Two of the parties in the PSEGS amendment proceeding, Basin and Range Watch and Colorado River Indian Tribes, cited pilot complaints related to glare from the recently operational Ivanpah Solar Electric Generating System (ISEGS) as a reason to reopen the evidentiary record. The reports of glare at ISEGS are relevant because both the ISEGS and the PSEGS use solar power tower technology, although the height of the towers differs for both projects: 750 feet for PSEGS and 459 feet for ISEGS. The Committee Order notes that "it is appropriate to consider whether this new information calls into question any of the discussion or the efficacy of the mitigation measures in the PMPD." Therefore, this supplemental testimony discusses ISEGS glare issues and potential ramifications if the Commission grants the project owner a license to construct and operate the PSEGS.

Energy Commission staff (staff) first became aware of reports of glare events related to ISEGS when the Clark County Department of Aviation (CCDOA) in Nevada sent a letter dated March 10, 2014 to several parties,[35] including the Energy Commission, requesting a number of actions be taken in response to glare incidents reported by pilots and air traffic controllers (CCDOA 2014). (Some of these actions are identified in the ISEGS project owner's (NRG Energy's) Draft Heliostat Positioning Plan (HPP) and others will be addressed in the NRG glare investigation report.) In addition, the director of the National Aviation and Space Administration (NASA) Aviation Safety Reporting System (ASRS) provided staff with two reports on March 14, 2014 about glare incidents that occurred in August 2013 (NASA ASRS 2014a). Both reports noted that pilots flying near ISEGS, located near the California/Nevada border south of the town of Primm, encountered bright and significant glare generated by the solar facility. One pilot

[35] The letter was sent to the U.S. Bureau of Land Management (BLM) Needles Field Office, the Energy Commission ISEGS Compliance Project Manager, and BrightSource Energy, the owner of ISEGS at that time.

reporting this significant glare was flying at an altitude between 6,000 and 12,000 feet mean sea level (MSL) while the other pilot was at 36,000 feet MSL.

On April 9, 2014, the ASRS Director sent staff another report of glare generated by ISEGS during the month of March 2014 (NASA 2014b). A pilot and a member of the flight crew of a corporate turbojet were executing an approach to Las Vegas' McCarran International Airport flying north-northeast at 13,000 feet MSL, approximately 13-15 miles west-northwest of ISEGS, when they "were temporarily blinded by bright lights (reflections) from the ground". The report further stated: "These reflections, coming from the new solar power station, were so bright that any attempt to look outside the plane was met with pain and temporary blindness even when looking back inside. Any attempt to see and avoid was useless and trying to find the airport during this time was painful as well. Exposure lasted about 5 minutes. We notified ATC [Air Traffic Control] and were told that they get a lot of complaints." (NASA ASRS 2014b)

Glare reports have been so numerous that the Federal Aviation Administration (FAA) issued the following Letter to Airmen regarding ISEGS glare on April 22, 2014:

"Recently the Ivanpah Solar Electric Generating System at Ivanpah Dry Lake, CA (LAS189036-LAS193034) has commenced generating electricity. This plant covers approximately 3,500 acres west of Interstate Highway 15 near the California-Nevada State Line with roughly 175,000 mirrors surrounding three collection towers. These towers employ a new technology that has not been utilized at this level before.

Beginning in August 2013, as the facility neared completion, Las Vegas Terminal Radar Approach Control (TRACON) and Los Angeles Air Route Traffic Control Center (ARTCC) began receiving numerous pilot reports of glare associated with the power plant. Since December 2013, when the facility began production, more reports have surfaced. To appropriately document these conditions, pilots and other air crew members are urged to utilize NASA's Aviation Safety Reporting System (ASRS) and provide an Electronic Report Submission (ERS) via the web at http://asrs.arc.nasa.gov/report/electronic.html" (FAA 2014a).

The Letter to Airmen was sent out electronically by the Las Vegas Terminal Radar Approach Control Air Traffic Manager and can be accessed at http://notams.aim.faa.gov/notamSearch/. The FAA encourages pilots to visit this recently developed website as part of their flight preparation process to identify any applicable notices or letters to airmen for any airport or air traffic control center.

In response to these reports of glare from ISEGS, staff has formed an investigation team and is working with the FAA, Caltrans Aeronautics, CCDOA, and ASRS to acquire more specific information, if available, about the reported incidents of glare and possible solutions to protect pilots and the public from further glare disturbances. To determine the characteristics of aircraft flying near the ISEGS site that could potentially experience glare, staff obtained an aeronautical study from the FAA for ISEGS on June 10, 2014 (FAA 2014c). The study provided flight information showing that approximately 11,969 flights occurred from surface level to 50,000 feet MSL within a 15 nautical mile (NM)

radius of the ISEGS site during May 2014[36]. These flights occurred during the day and night, with approximately 90 percent taking place during the day. The study also included approximate flight altitude, departure and arrival airports, time of day, and type of aircraft for all flights. Key observations from the study are:

- Flights most frequently occurred between 10,000 and 20,000 feet MSL, followed by flights between 20,000 and 30,000 feet MSL;
- Heaviest departure airport demand was for Las Vegas and Los Angeles;
- Heaviest arrival airport demand was for Las Vegas and Los Angeles;
- The majority of flights were commercial jets with 70 passenger seats or more; and
- Flights occurred most frequently in this airspace between 9 am and 4 pm, although they occurred throughout the day as well.

The FAA study provides a more complete picture of the heavily used airspace in the ISEGS area and identifies the large number of pilots that could be exposed to significant glare from the solar power tower facility.

To determine the approximate number of aircraft flying near the PSEGS site that could potentially experience glare, staff obtained an aeronautical study for PSEGS from the FAA on June 6, 2014 (FAA 2014b). The study showed that approximately 8,458 flights occurred from surface level to 50,000 feet MSL within a 15 NM radius of the PSEGS site during May 2014. Approximately 86 percent of these flights occurred during the day. The study also included approximate flight altitude, departure and arrival airports, time of day, and type of aircraft for all flights. Key observations from the study are:

- Flights most frequently occurred between 30,000 and 40,000 MSL, followed by flights between 20,000 and 30,000 MSL;
- The most frequent departure area was Southern California, with many aircraft departing from airports such as Los Angeles International, San Diego, Ontario, Palm Springs, and John Wayne-Orange County;
- The most frequent arrival airport was Phoenix, followed by John Wayne-Orange County and San Diego;
- The majority of flights were commercial jets with 70 passenger seats or more; and
- Flights occurred most frequently in this airspace between 8 am and noon, although they occurred throughout the day as well.

The FAA study shows that like the airspace near the ISEGS, the airspace near the PSEGS is heavily used. It indicates that a large number of aircraft pilots could be exposed to significant glare from the facility, which could potentially compromise pilots' ability to safely operate their aircraft. The FAA and Caltrans Aeronautics are concerned about ISEGS glare incidents and expect modifications needed for ISEGS would be incorporated into the PSEGS design to minimize glare and the potential hazard to navigable airspace in the PSEGS area.

[36] Flight track data was from the Performance Data Analysis and Reporting System and the Los Angeles Air Route Traffic Control Center.

As part of staff's investigation of glare reports at ISEGS, Energy Commission and Caltrans Aeronautics staff flew around ISEGS on May 8, 2014 in a single-engine Bonanza aircraft and took a variety of photographs (Attachment A) and a video at different elevations from 13,000 to 5,000 feet MSL. Staff experienced significant glare that was generated by the ISEGS throughout the approximately 20-minute flight around the project that began at 11:45 am. The brightest glare was generated by heliostats in the standby position. The Caltrans pilot said that he preferred not to look at the glare for more than a second because it would interfere with flying the aircraft in a safe manner. In a subsequent e-mail to Energy Commission staff, he indicated that glare from ISEGS was the brightest, most extensive amount of glare he had seen in his aviation career, which began in 1986. He stated that while flying eastbound near the ISEGS site at 13,000 MSL, he had to shield his eyes from the glare with his hand while scanning for air traffic (Caltrans 2014).

After participating in the air flight over ISEGS, staff's glint and glare consultant submitted a report (Attachment B) that included the following observations:

1) Substantial intermittent and sustained levels of glare occur in airspace above the ISEGS.

2) The greatest glare levels are sustained (often for many seconds) and appear to be generated from DSRH events from heliostats in the standby position. The number of heliostats simultaneously producing DSRH events is not known, but it is substantial and varies with respect to the position of the aircraft and time of day. Multiple DSRH events from heliostats in the standby position are sufficient to result in disability glare, compromised visual performance, and judgments by pilots that the glare is unacceptable for flight safety.

3) The sustained glare from multiple heliostats reflecting the sky in close proximity to the sun, but not reflecting the sun itself, is acceptable.

4) There are frequent 'rogue' individual DSRH events coming from seemingly random field locations. Although they are visually distracting, individual DSRH events do not produce unacceptable levels of glint and glare.

5) The sustained glare from the solar receiver steam generators (SRSGs) atop the towers is acceptable.

Staff's observations of ISEGS during the flyover are consistent with the PSEGS PMPD's determination that glare from the SRSGs atop the towers would be acceptable. However, staff's observations of ISEGS's significant glare from the heliostats now calls into question the PMPD's determination that DSRH events at the PSEGS would result in less than significant glare to pilots with implementation of TRANS-7, as ISEGS had a similar condition of certification. From reading the ISEGS glare reports and personal observation of ISEGS during a flyover, staff concludes that because the PSEGS and ISEGS use similar technology, the PSEGS also has the potential to cause significant glare to pilots from multiple DSRH events, particularly from heliostats in the standby position.

Staff has considered a variety of possible approaches for mitigating glare from ISEGS and possibly PSEGS. These approaches are based on staff's initial assessments and are limited in implementation detail due to an incomplete understanding of the engineering requirements for maintaining efficient plant power generation operations. Possible engineering modifications include minimizing the number of mirrors in the standby position, changing the geometry of the standby ring, improving calibration and positioning algorithms, and providing a "light dump" instead of reflecting glare into surrounding airspace. Details are below.

1. Limiting the number of mirrors in the standby position:

   During nominal full sun operations, the vast majority of heliostats are either reflecting directly onto the tower receiver or into a standby ring surrounding the tower. The heliostats in the standby position provide the flexibility to quickly reorient the reflected beams to the tower receiver to maintain optimal power generation. A typical event that would result in reorienting from standby to the tower receiver would be a cloud passing over the site. Events requiring this repositioning may be sufficiently predictable, perhaps by many minutes, to enable fewer heliostats to be present in the standby position at any one time.

2. Changing the geometry of the standby ring:

   Changing the geometry of the standby ring may provide an additional level of mitigation. For example, if the standby ring was extended spatially, perhaps horizontally into a larger ring area or vertically into a larger cylindrical extent, reflections from heliostats in the standby ring would be more dispersed into the surrounding airspace. This could reduce the number of heliostat reflections on an aircraft at any one time when within the projection space of the standby heliostats.

3. Improving calibration and positioning algorithms:

   Improved calibration and positioning algorithms for the heliostats could potentially reduce the number of heliostats which have been observed in non-aligned or 'rogue' positions. In these positions, individual heliostats often produce a DSRH event. Reducing these individual heliostat glare events could contribute to effective glint and glare mitigation.

4. Providing a "light dump":

   Rather than heliostats in the standby position projecting their reflected beams into the surrounding airspace, it is possible to engineer a receiver, a light trap or "light dump" into which heliostats, in a viable engineering standby position, could project. Although staff recognizes that there would be many engineering considerations and implementation details, including costs, associated with such an approach, it could greatly reduce the level of glare experienced by pilots.

Staff recognizes that the PSEGS engineering and operations team has much greater knowledge and insight into the requirements, capabilities and limitations of plant operations, and hence greater insight into viable approaches and mechanisms for the effective mitigation of any anticipated airborne glare effects. The possible suggestions provided by staff above are considered as an initial assessment of possible mitigation

strategies and are not considered as either complete or comprehensive. Instead, they serve as a starting point for discussion and as a stepping stone for the development of a more comprehensive mitigation strategy and plan.

Because ISEGS and PSEGS might differ slightly with regard to certain project characteristics, like heliostat positioning algorithms, these mitigation measures could be slightly different for PSEGS than for ISEGS. These modifications would need to be incorporated into the construction and operation of the PSEGS pursuant to Condition of Certification **TRANS-7** (Heliostat Positioning and Monitoring Plan). Implementation of one or more of the suggested engineering modifications would likely be required to mitigate PSEGS glint and glare impacts to a level less than significant.

CONCLUSION

Based on the experience with ISEGS, it is likely that pilots using the local airspace could experience significant glare generated by PSEGS. Staff intends to work with NRG Energy to identify engineering modifications for ISEGS that could possibly reduce the glare to a less than significant level. Possible modifications include minimizing the number of mirrors in the standby position, better algorithm calibration, changing the geometry of the standby ring, and providing a “light dump” instead of reflecting glare into surrounding airspace. These modifications would need to be incorporated into the construction and operation of the PSEGS pursuant to Condition of Certification **TRANS-7** (Heliostat Positioning and Monitoring Plan). However, because ISEGS and PSEGS might differ slightly with regard to certain project characteristics, like heliostat positioning algorithms, these mitigation measures could be slightly different for PSEGS than for ISEGS. With the appropriate mitigation, staff believes that glare from the PSEGS could possibly be mitigated to less than significant.

REFERENCES

Caltrans 2014 -- California Department of Transportation, Division of Aeronautics, E-mail from Gary Cathey, Chief, to James Adams, California Energy Commission, on May 9, 2014.

CEC 2013 – California Energy Commission, Palen Solar Electric Generating System, Presiding Member's Proposed Decision, dated December 2013.

CEC 2014 – California Energy Commission, Palen Solar Electric Generating System Amendment, Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record and Setting Revised Schedule, dated May 21, 2014.

CCDOA – 2014 -- Clark County Department of Aviation, Letter from Teresa R. Motley, Airport Planning Manager, Las Vegas McCarran International Airport, to Raymond C. Lee, Field Manager, Bureau of Land Management, Joseph Douglas, Compliance Project Manager, California Energy Commission, and Jennifer Wallens, BrightSource Energy, Inc., dated March 10, 2014.

FAA 2014a – E-mail from Rex MacLean to James Adams on April 30, 2014 with attached Letter to Airmen regarding ISEGS, Issued on 4/22/2014, Effective 5/5/2014.

FAA 2014b – E-mail from Dan Rollins with attached Palen Solar Project Aeronautical Study to James Adams on 6/6/2014.

FAA 2014c – E-mail from Dan Rollins with attached Ivanpah Solar Project Aeronautical Study to James Adams on 6/10/2014.

NASA ASRS 2014a – National Aviation and Space Administration, Aviation Safety Reporting System, E-mail from Linda Connell, Director, to Joseph Douglas, California Energy Commission, on March 14, 2014a.

NASA ASRS 2014b – E-mail from Linda Connell to James Adams on April 9, 2014.

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Attachment A

Figures 1-3

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TRAFFIC & TRANSPORTATION - FIGURE 1
Ivanpah Solar Electric Generating System - Overflight of Ivanpah

CALIFORNIA ENERGY COMMISSION, SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION
SOURCE: Aircraft Photo Taken During CEC Staff's Overflight on May 8, 2014

TRAFFIC & TRANSPORTATION - FIGURE 2

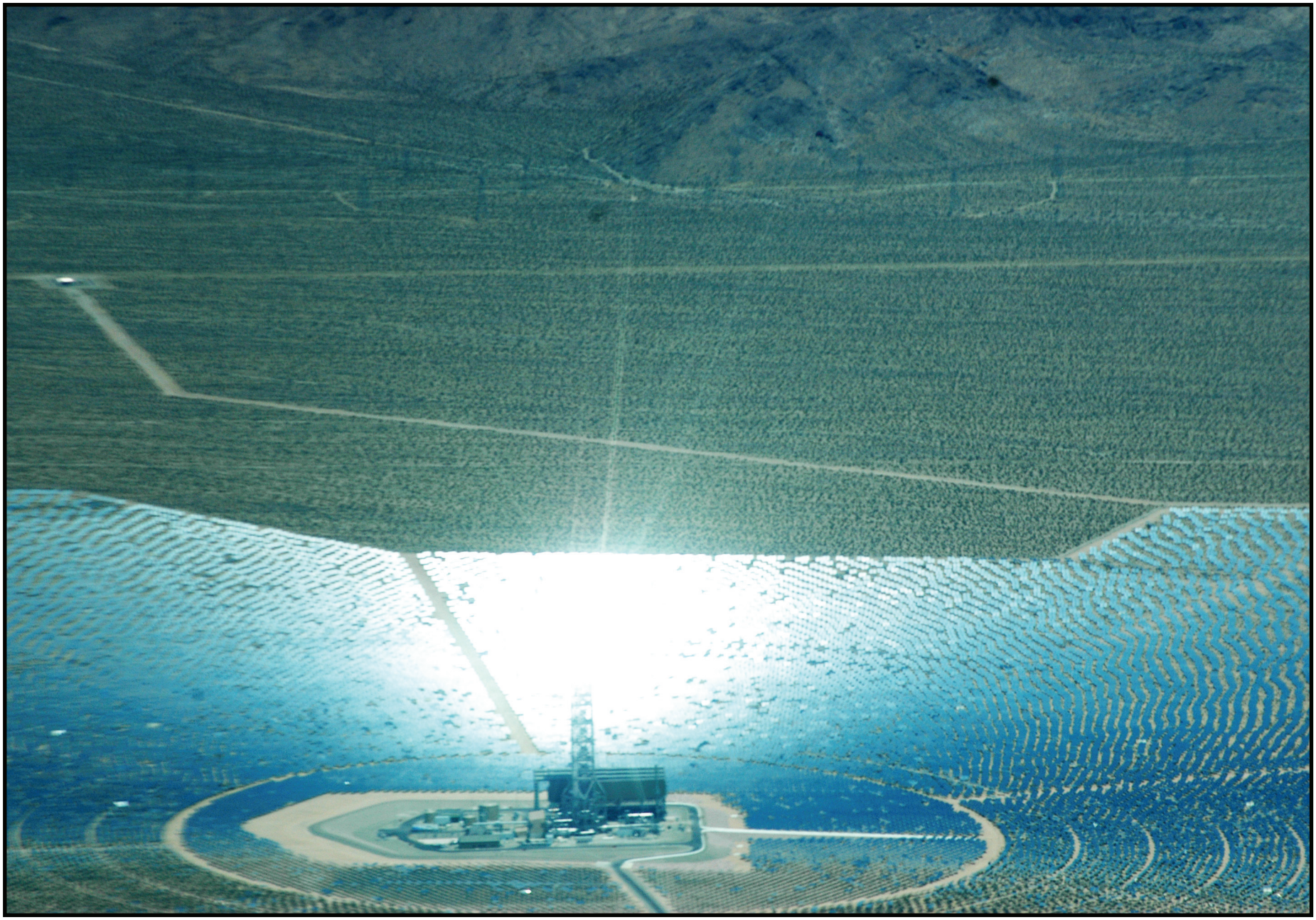
Ivanpah Solar Electric Generating System - Overflight of Ivanpah

CALIFORNIA ENERGY COMMISSION, SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION

SOURCE: Aircraft Photo Taken During CEC Staff's Overflight on May 8, 2014

TRAFFIC & TRANSPORTATION - FIGURE 3

Ivanpah Solar Electric Generating System - Overflight of Ivanpah



CALIFORNIA ENERGY COMMISSION, SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION

SOURCE: Aircraft Photo Taken During CEC Staff's Overflight on May 8, 2014

Attachment B

A Flyover of the Ivanpah Solar Electric Generating System (ISEGS) Observations Regarding Glare

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ATTACHMENT B

A Flyover of the Ivanpah Solar Electric Generating System (ISEGS) Observations Regarding Glare

The Ivanpah Solar Electric Generating System (ISEGS) at Ivanpah Dry Lake, CA covers approximately 3,500 acres west of Interstate Highway 15, six miles south of the California-Nevada State Line, with roughly 175,000 mirrors surrounding three collection towers. Beginning in August 2013, as the facility neared completion of construction, the Las Vegas Terminal Radar Approach Control (TRACON) and Los Angeles Air Route Traffic Control Center (ARTCC) began receiving numerous pilot reports of glare associated with the power plant. Since the facility began power generation operations in December 2013, there have been more reports of airborne glare effects.

To obtain an estimate of the number of flights in the vicinity of ISEGS, the Clark County Department of Aviation (CCDOA) provided information regarding aircraft operations within 15 nautical miles (NM) of the ISEGS facility between January 1 and April 17, 2014. For the 76 days assessed, 29,757 operations passed within 15 NM of ISEGS, an average of 392 flights per day. The altitude data captured varied from 1,225 feet mean sea level (MSL) to 20,000 feet MSL, the maximum altitude that the radar systems were capable of detecting. A Federal Aviation Administration representative has advised California Energy Commission staff that a significant number of flights occur at altitudes greater than 20,000 feet MSL. From this data, it is apparent that the airspace over ISEGS is used heavily, making it especially important to assess any glare effects from ISEGS.

Energy Commission and Caltrans Aeronautics staff decided to conduct an overflight of the ISEGS facility to perform empirical observations of glint and glare and to videotape and photograph any such effects. Staff planned the flight to replicate the experience of a pilot who encountered and reported severe glare in March 2014 at the same location and flight trajectory. A portion of the report (CAN: 1156120) is provided below for context.

> *Narrative: 1*
> *While on the KEPEC3 arrival into LAS (McCarran International Airport in Las Vegas) we were temporary blinded by bright lights (reflections) from the ground. These reflections, coming from the new solar power station, were so bright that any attempt to look outside the plane was met with pain and temporary blindness even when looking back inside. Any attempt to see and avoid was useless and trying to find the airport during this time was painful as well. Exposure lasted about 5 minutes. We notified ATC (air traffic control) and were told that they get a lot of complaints about these reflections.*

Callback: 1
The reporter stated that he was in the left seat and viewed the mirror reflections for only seconds, then was able to get his head sheltered below the glareshield and away from the light. However, even after the brief exposure, he had blue dots in his vision for about 5 minutes. The First Officer had no way to avoid the light even while not looking directly at it. The First Officer was literally blind for more than five minutes, and neither pilot's vision was capable of detecting objects outside of the cockpit for a period of time. When the crew reported the event to ATC, the response was "Yes, we get lots of complaints".

On May 8, 2014, Gary Cathey, Caltrans Aeronautics Division Chief, Jim Adams, Energy Facility Siting Planner with the Energy Commission, and Gregg Irvin, glint and glare consultant with the Energy Commission, departed from Sacramento on a 4-seat, single-engine Bonanza aircraft to observe ISEGS from the air. The initial approach to ISEGS was from the west at an altitude of 13,000 feet MSL with arrival at the initial CLARR waypoint 13 miles northwest of ISEGS. Upon arriving at CLARR at approximately 11:45 AM, the ISEGS facility came into view as it was unmasked by the Clark and Mesquite mountains. Visibility was unlimited (greater than 30 miles). Staff began videotaping and photographing ISEGS at this point. Photo 1 shows the view of ISEGS from the CLARR waypoint.

All three observers were surprised by the level of brightness and glare they experienced. At this point the pilot, Mr. Cathey, commented that the glare was too excessive for him and that he would no longer look in the direction of the ISEGS for the remainder of the overflight. He stated that he would focus on flying the plane while Mr. Adams and Mr. Irvin observed the ISEGS and directed him which way to turn and which altitudes to assume so that they could better observe the plant’s glint and glare effects. The flight around the ISEGS took approximately 20 minutes.

Photo 1. *Arrival at CLARR waypoint at an altitude of 13,000 feet, 13 miles west of the ISEGS. The photo was taken from the west. From left to right: Tower 3 (in the center of the photo); and Tower 2, which was not operating during the flight. Tower 1 is just out of the picture to the right.*

It is important for the reader to note that photographic documentation cannot possibly capture the subjective experience of brightness and glare experienced in-person. The photographic image can only be as bright as this sheet of paper. However, the photographs (and video documentation) are very instructive and do provide a reasonable substitute for viewing the plant in-person.

Photo 2 shows all three towers when viewed at a distance of approximately 11 to 12 miles to the north at an altitude of approximately 11,000 to 12,000 feet MSL. The amount of glare from the different towers' heliostat fields differs depending on the photographer's position relative to the heliostats. For example, the viewpoint to Tower 3 is just outside of the direct solar reflections from the heliostats (DSRH) produced by Tower 3's heliostats in the standby position. The periphery of Tower 3's heliostat field reflects the blue sky while the heliostats closer in visual alignment with the tower produce brighter reflections, as these heliostats are reflecting the brighter sky region in closer proximity to the sun. However, no DSRH are visible as none of the heliostats are directly reflecting the sun at the observer. The tower itself has its standard glow and the ring of reflections produced by heliostats in the standby position (standby ring) is not visible. In general, this is a situation not producing disability glare. A variety of bright individual heliostats can be seen which are apparently out of alignment, with one (to the right of the tower) very close to producing a DSRH event.

However, as shown in Photo 2, the photographer is situated so that Tower 1's standby ring is visible, with the heliostats flanking the left and right side of the tower producing exceptionally bright DSRH events in a steady state manner. The position of the photographer in relation to the position and orientation of the heliostats results in disability glare to the viewer. Although the standby ring circumscribes the tower (much like a doughnut shape with the tower as the hole in the middle) it appears that the glare is emanating from the left and right portions of the ring. This is because the line of sight through the ring (the doughnut) has the greatest density on the sides and the greatest number of heliostats producing DSRH events. The glare from the tower under these conditions is overwhelmed by the standby ring brightness and often is not even visible through the standby ring glare.

Photo 2. *Photo of the ISEGS site taken from the north. From left to right: Tower 3; Tower 2, not in operation; and Tower 1. The photographer's position in relation to heliostat position and orientation results in no DSRH from Tower 3, but strong DSRH from Tower 1 which causes disability glare.*

After staff took the above photographs, the aircraft made a gradual decent while making a single clockwise circle around the ISEGS facility. Turbulence in and around the towers was quite extensive, making photographic and video documentation difficult. During the remainder of the flyover, at altitudes from 5,000 to 10,000 MSL and distances from 2-3 to 10 miles from ISEGS, the frequency of large DSRH events from the standby rings was extensive. During these DSRH events, the standby rings were extremely bright at all air flight distances, and all three observers agreed that these levels of brightness and sustained glare clearly constituted a disability glare level. While filming the ISEGS with a high-band 8 mm camera, Mr. Irvin noted that he could no longer see the image on the display because his vision was so compromised. He also could no longer see the text on the camera display, so he was uncertain if he was still recording, and the visibility of

the display image was so compromised that he could not tell if he was accurately pointing the camera. This disability glare condition lasted during the entire flyover. Afterimages produced by the glare were prominent, central vision was noticeably compromised from observing the glare, and at times the glare field was actually painful.

As staff circled the ISEGS heliostat field, they found that the glare from certain angles was acceptable. An example of this is shown in Photo 3, where the line of sight to the tower is outside of the standby ring projection. The glow of the tower receiver together with the heliostats' reflections of the sky in proximity to the sun is at acceptable levels and is not producing any DSRH event. Note that there are a number of heliostats that appear to be in unique positions, perhaps out of alignment. Also, there is a band of heliostats in some other position, perhaps in stow, a cleaning position, or simply off-line.

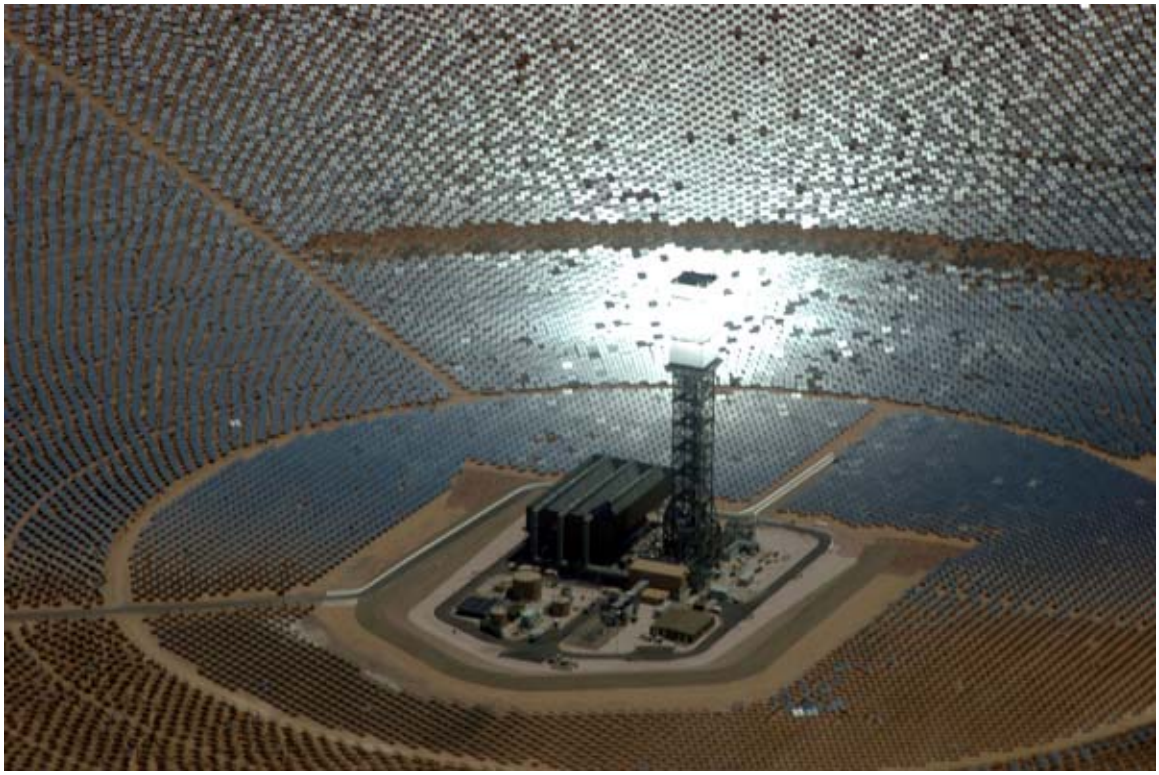

Photo 3. (ISEGS) *Example of line of sight geometry to Tower 3 outside of the DSRH projections of the standby ring. The photo was taken from the west.*

In addition to the extreme glare from the standby rings, staff experienced frequent individual DSRH events from single heliostats. These events occurred as the aircraft flew through the reflected glare 'beam' of a heliostat, and each event lasted between 1 and 5 seconds. Although individual DSRH events were common and the brightness of an individual DSRH event was quite high, staff did not consider DSRH from single heliostats as sufficiently bright or extended in duration to result in disability glare. Also, individual DSRH events appeared to be coming from heliostats that were clearly out of a set alignment position. Staff estimated that approximately 10-15% of the heliostats appeared to be in random orientations.

Photo 4 provides several examples of glare within and at the margins of the DSRH projection field of the heliostats in the standby rings. More photos of ISEGS and a video of the flyover are available for review upon request.

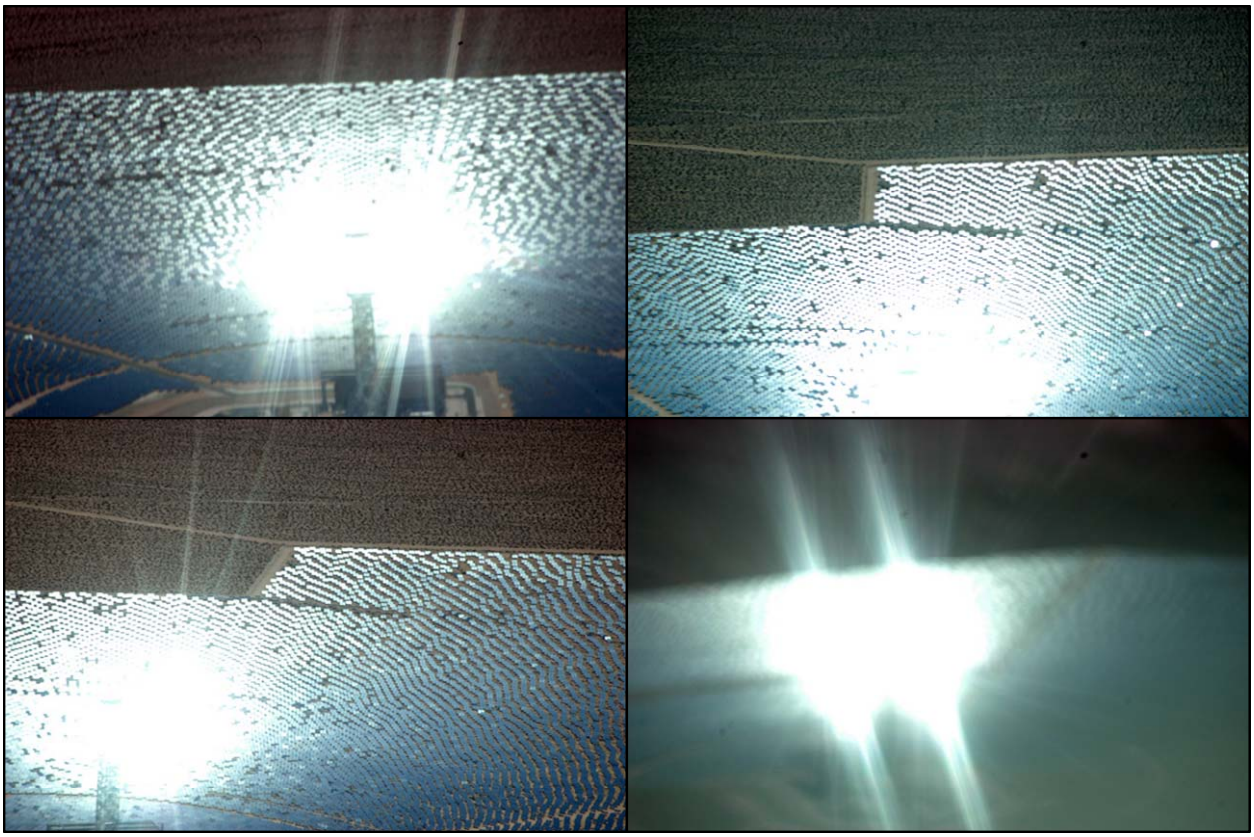

Photo 4. *Several glare examples from a variety of positions within and at the boundaries of the DSRH projection field of the heliostats in the standby rings. Lack of good focus due to pronounced turbulence.*

In summary, during normal ISEGS power operations, there are large volumes of airspace in which a passing aircraft can experience elevated levels of glare sufficient to disrupt pilot performance. Although the full impact on airborne operations and the extent of the airspace volume in which these levels of glare occur is unknown, it is clear that the glare experienced during overflight is significant. Of particular note are the following observations:

6) Substantial intermittent and sustained levels of glare occur over a wide range of airspace.

7) The greatest glare levels are sustained (often for many seconds) and appear to be generated from DSRH events from heliostats in the standby position. The number of heliostats simultaneously producing DSRH events in the standby position is not known, but it is substantial and certainly varies with respect to the particular airborne geometry and time of day. Staff believes that glare events could be worse during mid-morning or mid-afternoon when the sun is at a 45° angle in the sky instead of being directly overhead as it was during the May 8 overflight.

8) DSRH events resulting from multiple heliostats in the standby position are sufficient to result in disability glare and compromise visual performance, and are judged by pilots as being at levels that are unacceptable for flight safety.

9) A significant percentage of the heliostats, 10-15%, appear to be out of alignment from the defined standard positioning schemes. An apparent consequence of this is frequent ‘rogue’ individual DSRH events coming from seemingly random field locations. Although suboptimal and visually distracting, individual DSRH events are not considered as producing unacceptable levels of glint and glare.

10) The sustained glare from the tower receivers is at acceptable levels.

11) The sustained glare from multiple heliostats (often many hundreds) with a line of sight in proximity to the towers (i.e., heliostats reflecting the sky in close proximity to the sun, but not the sun itself) is at acceptable levels.

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OVERRIDING CONSIDERATIONS - THERMAL ENERGY STORAGE

Supplemental Testimony of Edward Brady and Shahab Khoshmashrab

INTRODUCTION

At the January 7, 2014 Committee Conference, Presiding Member Commissioner Douglas asked about the feasibility of adding thermal energy storage (TES) to Palen Solar Electric Generating System (PSEGS) or to construct the project in such a way that storage could be incorporated after the fact (Committee Conference 2014, p. 13). The petitioner provided responses to this comment in its Overriding Considerations Supplemental Testimony (Supplemental Testimony 2014) and at the April 16, 2014 public workshop. In these responses, the petitioner concluded TES cannot be incorporated in the project now because first, revisions to the Power Purchase Agreements would have to occur and be approved by regulators, and market and policy conditions would have to evolve. The petitioner indicated that PSEGS could accommodate the addition of a future TES system at each power block without modifying the solar field. The petitioner further indicated that it does not have specific information upon which staff could perform a thorough reliability or technical feasibility analysis, and that at this time this TES is only hypothetical.

Since the petitioner's proposed TES retrofit would be undertaken only after the PSEGS has been built and has become operational, the proposed changes would be limited in scope to the construction of the hot and cold molten salt storage tanks and modification of the existing piping to accommodate the installation of heat exchangers, supplemental pumps, and control valves. The heliostat solar field would remain unchanged and storage capacity would be restricted to 2-hour duration.

This analysis considers if future incorporation of TES is technically feasible for PSEGS after the project has been built and has become operational. This analysis is limited to technical feasibility and reliability analysis.

ANALYSIS

Staff reviewed the petitioner's supplemental testimony regarding the feasibility of incorporating TES at the project site. Below is staff's evaluation and findings as the result of this review.

TES SYSTEM DESCRIPTION

The petitioner's TES proposal presents modifications that would enable PSEGS to operate in three distinct modes: 1) Charge Mode, 2) Stand-alone Discharge Mode, and 3) Mixed Discharge Mode. The Charge Mode would incorporate a piping circuit which would run in parallel with the solar receiver steam generation (SRSG), providing a single circuit loop to store thermal energy into the cold storage tank (CST) and hot storage tank (HST). Each tank would contain molten salt, which would be heated to above its solidification temperature of 290^{o}C (554^{o}F) in the CST and 485^{o}C (905^{o}F) in the HST. The CST would provide a baseline temperature for the TES. The HST would

provide the liquid mass to add (charge) and remove (discharge) the stored thermal energy, providing flexibility to shift solar capacity during weather anomalies or shift operation to critical high demand hours.

The Stand-alone Discharge Mode would use the same parallel circuit to release thermal energy to operate the steam turbine when solar energy is not otherwise available.

In a mild overcast when solar insolation is reduced, the TES would use the system feedwater pump to circulate water simultaneously through the SRSG circuit and TES circuit at the same time, recovering solar energy to the extent it is available. The steam generated by TES and the SRSG would be mixed before entering the steam turbine. This is called the Mixed Discharge Mode.

The petitioner's analysis assumes a gross power output of 270 MW, also referred to as maximum continuous rating, or MCR, exclusive of plant internal auxiliary loads, e.g., condensate and feedwater pumps, air cooled condenser fans, and TES heat exchanger pumps. Based on the energy balance provided in the petitioner's supplemental testimony, PSEGS would operate at a full load conversion efficiency of 49 percent, which is notably high.

The use of molten salt as a thermal storage medium has been done at commercial scale. The TES design is based on the 12.8 MW demonstration project called Solar Two[37] that provided a 3-hour storage capacity (Solar Two 2002).

TES DESIGN FLEXIBILITY

The petitioner's proposal (Supplemental Testimony 2014) uses the primary system feedwater pump to provide single circuit or dual circuit flow, allowing the SRSG to recover and store solar power (Charge Mode) (Supplemental Testimony 2014, p. 4, Fig. 1), providing parallel flow through the SRSG and TES circuit in periods of low insolation (Mixed Discharge Mode), and running exclusively through the steam circuit when no insolation is available (Discharge Stand-Alone Mode) (Supplemental Testimony 2014, p. 5, Fig. 5).

HELIOSTAT FIELD, ISH BOILER, AND STORAGE TANKS

In this TES scenario, the petitioner assumes that the PSEGS solar system would be able to provide full MCR power production, or 270 MW gross, while charging the molten salt storage tanks to their full capacity. The quantity of heliostats for each of the two solar fields for the currently proposed project is projected to be 85,000 (two 12.5 feet high x 8 feet wide panels comprise a single heliostat). The heliostats fields have already been sized to include standby service to queue the panels onto and off of the SRSG,

[37] The Solar One demonstration system was located in Barstow, California and operated between 1982 and 1986. In 1995, the number of panels was doubled and thermal storage tanks were added, utilizing a molten salt solution of 40 percent potassium nitrate and 60 percent sodium nitrate. The plant was renamed Solar Two and operated from 1995 to 1999, after which, it was decommissioned and dismantled. (http://en.wikipedia.org/wiki/The_Solar_Project)

accounting for opacity due to dust, oblique-angle reflection, collector damage, and the characteristic cosine effect of a reflective flat panel design.[38]

Using the information furnished in the petitioner's supplemental testimony, the system provides the MCR input of 1884.6 mmBtu/hr[39] of thermal energy, equivalent to 270 MW. Estimating the peak solar insolation at 800 watts per square meter (97.9 Btu per ft^2-hr), an overall heliostat conversion efficiency of 50 percent,[40] and a 10 percent safety and standby factor, the required number of panels is 81,257,[41] which is within the 85,000 heliostats provided in the current design. The remaining 3,743 heliostats would be available to store energy in the TES tanks.

Setting aside 10 percent of the remaining heliostats as a reserve, 3,402 heliostats[42] would be able to store thermal energy in the TES at the rate of 345.3 mmBtu/hr.[43] Additionally, a supplemental natural gas boiler, referred to as independent superheater boiler, or ISH boiler, would be able to store thermal energy in the TES at a rate of 284.6 mmBtu/hr, calculated by staff.[44] This calculation shows that a boiler of this capacity can provide the needed thermal energy to superheat the steam to the desired TES temperature.[10] The sum of these thermal energy rates would result in recharging the TES system in about 6 hours.[45] Since only a pair of 2.3 million gallon (salt) CST and HST tanks is needed based on staff's calculation[46], the pair of the proposed 2.5 million gallon tanks is adequately sized to store the required thermal energy in the 2-hour TES.

For the reasons discussed above, staff agrees with the petitioner's assessment that the number of solar collectors and the size of the storage tanks are adequate to provide the projected 270 MW MCR and thermally charge the TES storage tanks over a typical diurnal cycle, and that the ISH boiler can provide the needed thermal energy to adequately supplement the solar energy provided by the heliostats to reach the desired TES temperature.

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[38] equal angle reflected toward the SRSG surface. The cosine of this compound angle is directly proportional to the intensity of solar energy hitting the panel. This phenomenon is called the cosine effect.

[39] MCR (Maximum Continuous Rating) = (mass flow rate) x ($h_{out} - h_{in}$) = (3525 – 1287)kj/kg x 247 kg/sec x 3600 sec/hr x (0.947 Btu/kj) x (mmBtu/10^6 Btu) = 1884.6 mmBtu/hr. Sources: ***Steam Tables***, Keenan & Keyes, John Wiley & Sons, 1969 (International Edition – Metric Units), ***Thermodynamic Properties of Steam,*** Keenan & Keyes, John Wiley & Sons, 1936 (I-P Edition).

[40] Collector Efficiency = 0.90 (shadow) x 0.95 (blockage) x 0.96 (spillage) x 0.92 (absorbance) x 0.90 (reflectivity) x 0.74 (average cosine effect) = 0.5029. *Use 50 percent*.

[41] No. of Heliostats at MCR = (1884.6 mmBtu/hr) x (m^2/800 W) x 0.5029η x (heliostats/18.58 m^2) x (w/3.413 Btu) x (10^6 Btu/mmBtu) x (1.10 SF) = 81,257 heliostats < 85,000 *(ok)*.

[42] No. of Excess Heliostats at MCR = 85,000 – 81,258 = 3,742. (3,742/1.10SF) = 3,402.

[43] Q_{in} (From Solar Energy Only – Excess Heliostats) = (3,402 x 2 panels x 200 ft^2) (800 W/m^2/10.76 ft^2/m^2) x (3.413 Btu/W-hr) x (10^6 Btu/mmBtu) = 345.3 mmBtu/hr.

[44] Q_{ISH} (From Natural Gas Only - Independent Superheater) = (3525 – 3187)kj/kg x (247 kg/sec) x (3,600 sec/hr) x (0.947 Btu/kj) x (mmBtu/10^6Btu) = 284.6 mmBtu/hr.

[45] Recovery (Recharge) = (1,884.6 mmBtu/hr x 2 hr)/(345.3 + 284.6 mmBtu/hr) = 6.0 hr.

[46] Critical Tank Volume (1,884.6 mmBtu/hr x 2 hr) x (10^6Btu/mmBtu) x [(lb_m-F^o/0.35 Btu)/(351F^o)] x (ft^3/110 ft^3 lb_m) x (7.48 gallon/ft^2 x 1.10SF) = 2.3 million gallons *(ok).*

LIMITATIONS OF THE SOLAR RECEIVER STEAM GENERATOR (SRSG)

The most restrictive component is the SRSG. Since this is the receiver for the concentrating solar radiation, it experiences the highest temperature conditions in the system because its superheater section must boost the temperature of steam vapor to 585^{o}C (1085^{o}F), placing the receiver temperature in the 1250^{o}F range. The petitioner proposes the addition of an ISH (independent superheater) natural gas-fired auxiliary boiler in the primary high pressure steam line to localize the impact of superheated system in both the Discharge Stand-Along and the Mixed Discharge Modes. This provides an element of flexibility to startup, steady-state operation, and load shifting capabilities of PSEGS. Secondly, it also provides an avenue to monitor and control thermal conditions in the SRSG.

Conceptually, the petitioner's proposal to retrofit PSEGS without modification to the solar field is reasonable; the number of heliostats seems adequate. It is assumed that all of the available heliostats would be in use to generate the required thermal energy needed to provide the MCR of 270 MW while recharging the TES system. It is also assumed that the SRSG is currently designed to handle the thermal energy resulting from the 81,257 heliostats required to generate the 270 MW at MCR. It is, however, unclear if the SRSG, as currently designed, could handle the additional thermal energy necessary for the TES system from the additional 3,402 heliostats, while the same time, all of the 81,257 heliostats are being focused on the SRSG.

AUXILIARY BOILERS

The ISH boiler would be the third special-purpose boiler being utilized in current generation of solar power tower systems. Two other boilers are in the current PSEGS design. First, the nighttime preservation boiler would be called on to maintain minimum system temperature during non-operating hours. Second, the auxiliary startup boiler would provide thermal assistance in bringing the power plant up to full steam in anticipation of sunrise or provide thermal energy when solar insolation drops below the level required to keep the steam turbine online. Finally the ISH boiler would provide supplementary heat to bring the system up to fully superheated conditions while operating in both the Stand-Alone and Mixed Discharge Modes.

The presence of the nighttime, startup, and ISH boilers in the TES design is emblematic of the need to provide operational flexibility for systems like the PSEGS system. Independent of regulatory issues, it has become apparent from a technical standpoint that, with the ascendancy of these kinds of renewable technologies into commercial service, solar plants will require the kind of operational flexibility that these boilers provide. The addition of the ISH boiler provides operational checks and balances which would improve long-term reliability of PSEGS and its descendent systems.

The TES would allow PSEGS to sustain output capacity through reduced solar conditions and ensure maximum output capacity during hours of high demand (i.e.; cloud cover in peak demand hours).

As explained above, conceptually, the petitioner's proposal to retrofit PSEGS without modification to the solar field is reasonable; the number of heliostats seems adequate.

However, it is unclear if the SRSG, as currently designed, could handle the total thermal energy resulting from focusing the required number of heliostats on it (81,257 for MCR plus 3,402 for TES) in order to fully recharge the TES system and generate the MCR output, simultaneously.

Achieving plant reliability requires an adequate level of equipment availability without extended periods of plant shutdown for repairs or maintenance over the life of the project. Staff remains unclear on what restrictions (i.e.; thermal stresses) the size of the existing SRSG system would have on its degradation rate and availability over a period of time (months or years), considering the high temperatures required in the SRSG to sustain maximum power output while frequently recharging the TES. It is further unclear if after PSEGS has gained operational experience with this TES, it would be necessary to expand the physical size of the SRSG or install an additional SRSG at that time to ensure it would continuously perform reliably.

Thus, staff cannot perform a thorough technical feasibility or reliability analysis for the proposed TES. To help staff perform an adequate analysis in this regard, the petitioner needs to: 1) provide information demonstrating that the current design of the SRSG is adequate to handle the thermal energy resulting from all of the heliostats required to produce the MCR of 270 MW and fully recharge the TES system simultaneously, or alternatively, propose a revised design for the SRSG to address this issue; and 2) provide projections on the degree of the SRSG's degradation over the life of the project, should TES be incorporated into PSEGS.

CONCLUSION

Based on staff's review of the petitioner's TES retrofit proposal, the number of solar collectors and the size of the storage tanks are adequate, and the ISH boiler can provide the needed thermal energy to adequately supplement the solar energy provided by the heliostats to reach the desired TES temperature. Staff recognizes the benefit of TES in allowing PSEGS to sustain output capacity through reduced solar conditions and ensure maximum output capacity during hours of high demand.

However, staff remains unclear if the SRSG, as currently designed can handle the thermal energy resulting from all of the heliostats required to produce the MCR of 270 MW while fully recharging the TES system. It is also unclear what restrictions the size of the existing SRSG system would have on its degradation rate and availability over a period of time.

At this time, staff does not have enough information to perform a thorough technical feasibility or reliability analysis for the proposed TES. To help staff perform an adequate analysis in this regard, the petitioner needs to demonstrate that the current design of the SRSG is adequate to handle the thermal energy resulting from all of the heliostats required to produce the MCR output and fully recharge the TES system simultaneously, or alternatively, propose a revised design for the SRSG to address this issue; and provide projections on the degree of the SRSG's degradation over the life of the project, should TES be incorporated into PSEGS.

REFERENCES

Committee Conference 2014 - January 7, 2014 Committee Conference for Palen Solar Electric Generating System, TN 201608

Solar Two 2002 - Final Test and Evaluation Results from the Solar Two Project, James E. Pacheco, Editor, Solar Thermal Technology, Report No. SAND2002-0120, Sandia National Laboratories

Supplemental Testimony 2014 - Palen Solar Holdings, LLC's Overriding Considerations Supplementary Testimony; TN 201704 dated 2/10/14

NATURAL GAS CONSUMPTION

Testimony of Edward Brady, Jacquelyn Record, Shahab Khoshmashrab, and Gerry Bemis

INTRODUCTION

Ivanpah Solar Electric Generating System (ISEGS), employing the solar power tower technology began commercial operations in December 2013. Based on actual power plant operations to date, the operators of ISEGS have learned that ISEGS needs approximately 60 percent more natural gas than initially thought in order to ensure stable operations during periods where solar insulation is less than optimal. Palen Solar Electric Generating System (PSEGS) would employ the solar power tower technology, as well. This analysis evaluates if, similar to ISEGS, PSEGS would need to increase its natural gas consumption to ensure optimal and stable operations during such periods.

ANALYSIS

The Application for Certification and the Energy Commission Decision for the ISEGS project both stated that 328 million standard cubic feet (mmscf) of natural gas per year for each power plant unit rated at a nominal 125 MW would be needed. However, based upon actual plant operations, the ISEGS' operators indicate they are unable to ensure stable operations in the steam turbines during periods where solar insulation is less than optimal. Thus, in its recent Petition to Amend, or PTA No. 4, ISEGS requests to increase the 328 mmscf of annual natural gas consumption to 525 mmscf annually for each 125 MW unit in order to use the auxiliary boiler to compensate for inadequate solar insulation (ESH 2014). This would result in a 60 percent increase in natural gas consumption. Specifically, the ISEGS PTA (ESH 2014, pp.3-4) states the following:

> "*ISEGS is unique. For some aspects of operation, the only way to fully understand how the systems work has been through the experience of operating the power plant. Petitioner first became aware of the need to increase annual fuel use after the completion of construction and commencement of commercial operations, which began in December 2013. The experience gained during commercial operations indicates that more boiler steam would be needed than previously expected in order to operate the system efficiently and in a manner that protects plant equipment, and to maximize solar electricity generation.*
>
> - *Auxiliary boilers typically need to operate an average of approximately 4.5 hours a day during startup (an increase from 1 hour daily average originally expected) in order to ensure that (1) steam flow is sufficient to carry excess heat from the receivers in the towers, and (2) when weather conditions are sufficient to permit plant operation, plant equipment and systems are ready to operate as designed.*
> - *Actual operation of the plants informs the need for additional fuel use during some days to compensate for intermittent cloud cover in order to maintain peak power production and prevent the steam turbine from tripping off line.*
> - *When cloud cover is dense enough and/or persists long enough to trip the plant offline, steam generated by the auxiliary boilers is needed to restart solar power production.*

- *Auxiliary boiler operation is needed at the end of the day to stabilize/support steam turbine operation, particularly during the peak summer period, to maximize the capture of solar energy as solar insolation declines.*

Based on this experience, petitioner has revised the annual operating scenario to account for the need to operate the boiler more often during the daily startup period; during periods of intermittent cloud cover to maintain peak output and to prevent steam turbine trips; for restarts of a power block due to extended periods of cloud cover; at the end of the day to extend the capability for solar power production; and to account for days when a system start is terminated when it becomes apparent that persistent cloud cover precludes operation of the solar collectors."

PSEGS would employ the solar power tower technology, as well. Interveners Basin and Range Watch, Center for Biological Diversity, and Colorado River Indian Tribes commented that based on the ISEGS' request for additional quantities of natural gas, they wonder if a similar request would be necessary for PSEGS.[47] Subsequently, the Committee commented that it, too, wonders if such a request would be necessary and, if so, it prefers to address it now rather than in a subsequent amendment process.[1] To address these comments, at the April 16, 2014, PSEGS public workshop, staff asked the PSEGS petitioner whether it believes there would be a need for PSEGS to increase its needed quantities of natural gas to avoid similar issues that have occurred at ISEGS. The PSEGS petitioner replied that it does not think so, because its technology is different than the ISEGS', but did not offer any further explanation.

The 525 mmscf annual fuel use for each 125 MW unit at ISEGS would be used in an auxiliary boiler with a capacity rated at 249 million British Thermal Units per hour (mmBTU/hr) and in a nighttime preservation boiler rated at 6.7 mmBTU/hr. In its amendment request to convert the facility technology from solar trough to solar power tower, PSEGS proposes to use 355 mmscf of natural gas per year for each power plant unit rated at a nominal 250 MW. This fuel would be used in an auxiliary boiler with a capacity rated at 249 mmBTU/hr and in a nighttime preservation boiler rated at 10.5 mmBTU/hr. As apparent here, even though the thermal capacities of the two projects' auxiliary boilers are comparable, PSEGS proposes substantially less natural gas per MW than ISEGS needs (355 mmscf/250 MW = 1.4 mmscf/MW for PSEGS versus 525 mmscf/125 MW = 4.2 mmscf/MW for ISEGS).

In order to determine whether or not PSEGS would have sufficient quantities of natural gas to ensure optimal and stable operations during periods where solar insolation is less than optimal, while consuming substantially less natural gas than ISEGS, staff needs to better understand how much annual natural gas would be necessary for PSEGS to use under actual field conditions. Thus, staff needs more details on the PSEGS' site conditions, designs, and annual operating profiles. Specifically, staff needs to know the following:

[47] Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record and Setting Revised Schedule, issued on May 21, 2014, TN 202362

1. What level of analysis has been completed, including field studies, to ensure that the amount of gas expected to be used for PSEGS is actually sufficient under actual field conditions; those conditions described above based on actual operations of ISEGS? (Those conditions can include the need to operate the auxiliary boilers longer than anticipated to ensure steam flow is sufficient to carry excess heat from the heat recovery steam generator in the towers; to ensure plant equipment and systems are ready to operate as designed; and to prevent the steam turbine from tripping off line in the morning, during dense and/or long periods of cloud cover, and at the end of the day.)

2. What are the specifics of the PSEGS' generating technology, such as the steam cycle (including steam quality requirements), steam turbine generator, solar receiver steam generator, and heliostat field, which could explain the lack of need for PSEGS to increase its natural gas consumption?

3. What would be the PSEGS' annual operating profile, including its annual capacity factor, and its annual equivalent electricity production rate from operating on natural gas only, that could explain the lack of need for PSEGS to increase its natural gas consumption?

4. Are there any other supporting documents that would support PSEGS' statement that its expected quantities of natural gas are sufficient?

Unless the petitioner provides complete responses to the above questions, staff is unable to concur that the quantities of natural gas proposed by the petitioner are sufficient to ensure reliable PSEGS operations. Staff would prefer that responses to these question be allowed to be public information, but if the petitioner determines that this must be handled confidentially we encourage the petitioner to file it under a request for confidentiality.

NATURAL GAS DUE TO THERMAL ENERGY STORAGE

Thermal energy storage (TES) may also become an aspect of this project. Currently, PSEGS proposes a natural gas-fired nighttime preservation boiler and a natural gas-fired auxiliary boiler. The purpose of the nighttime boiler is to maintain minimum system temperature during non-operating hours. The purpose of the auxiliary boiler is to provide thermal assistance in bringing the power plant up to full steam in anticipation of sunrise or to provide thermal energy when solar insolation drops below the level required keeping the steam turbine online. TES would also require a natural gas-fired boiler of its own to provide supplementary heat for bringing the steam up to fully superheated conditions. If TES is ever proposed, an amendment would need to be filed to request its incorporation into the project. Then, the amount of additional natural gas required for TES should be evaluated and considered when deciding if the amendment should be approved. Thus, the overall quantities of natural gas that would be needed for the sum of these three boilers cannot be ascertained at this time.

NATURAL GAS USE AND AIR QUALITY PERMITING

Determination of Compliance

If PSEGS is required to use additional natural gas to ensure stable operations, the South Coast Air Quality Management District (SCAQMD) would need to issue a new or revised Determination of Compliance (DOC). This would require additional evaluation of criteria pollutants for compliance with ambient air quality standards and could possibly also require Prevention of Significant Deterioration (PSD) review as discussed further below.

Prevention of Significant Deterioration

Staff included data on PSEGS expected emissions of greenhouse gases in **Greenhouse Gas Table 3** of Appendix Air-1—Greenhouse Gas Emissions of the Final Staff Assessment, Part C (TN 201097). The table indicates that PSEGS is expected to emit 44,631 metric tons per year of carbon dioxide equivalents (CO2e) and that the auxiliary boilers would be responsible for the majority of these emissions, 37,659 metric tons per year of CO2e. If additional natural gas use were necessary, and subsequently PSEGS were to increase stationary source greenhouse gas emissions, auxiliary boiler emissions would have to more than double before the facility would emit enough CO2e to trigger PSD review, which is 100,000 short tons per year (TPY) of CO2e. The trigger level for PSD is evaluated only for stationary emission sources and does not include emissions associated with activities such as washing of heliostats.

If PSEGS' actual commercial operations necessitate an increase in natural gas use, it is not clear if this increase would be large enough to trigger a PSD permit evaluation by the SCAQMD.

CONCLUSIONS

At this time, due to the lack of adequate information, staff cannot complete an objective evaluation of whether or not PSEGS would need to use additional natural gas under actual field conditions. However, increased natural gas use would certainly require a new or revised DOC and could be large enough to trigger a PSD permit evaluation.

REFERENCES

CEC Final Staff Assessment, Part C, TN 201097, November 1, 2013.

ESH 2014, Ellison, Schneider & Harris L.L.P., Ivanpah Petition to Amend No. 4, TN 201928, March 26, 2014 (http://docketpublic.energy.ca.gov/PublicDocuments/07-AFC-05C/TN201928_20140326T164429_Ivanpah_Petition_to_Amend_No_4.pdf)

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Declarations
&
Resumes

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DECLARATION OF
James Adams

I, **James Adams**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Planner II** for **Traffic and Transportation.**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I assisted in the preparation of the supplemental staff testimony on **Glint and Glare** for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 6/18/14

At: Sacramento, California

Signed: James Adams

James S. Adams
Environmental Protection Office
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5504
PH (916) 653-0702, FAX (916) 654-3882
Jim.Adams@energy.ca.gov

5/1999
Present **Environmental Planner**
Review applications for certification to acquire permits from the California Energy Commission to build electric generating power plants. Specific technical fields include socioeconomics and traffic and transportation.

11/1997
Present **Energy and Resource Consultant**
Provide clients with technical expertise on various issues related to natural resource use and development. Current activities include managing an Intervention by the Redwood Alliance before the California Public Utilities Commission regarding the decommissioning of the Humboldt Bay Power Plant's nuclear reactor.

9/1994--
10/1997 **Senior Analyst - Safe Energy Communication Council (SECC)**
Responsible for developing and/or implementing campaigns on various energy issues involving the promotion of energy efficiency and renewable energy and advocating less reliance on nuclear power. Managed educational outreach efforts to newspaper editorial writers throughout the U.S. to encourage coverage of energy issues. Participated in meetings and negotiations with key Clinton administration officials, members of Congress and staff, national coalitions, and grassroots organizations on important energy issues (e.g. U.S. Department of Energy Budget for Fiscal Years 1996-1998). Successfully raised $140,000 from private foundations to support SECC activities.

6/1978--
12/1992 **Principal Consultant - Redwood Alliance**
Provided consulting services to the Alliance; a renewable energy/political advocacy organization. Major responsibilities included managing and/or participating in several interventions/appearances before the California Public Utilities Commission, California Energy Commission, California Legislature, U.S. Congress and the U.S. Nuclear Regulatory Commission. Issues included electric utility planning options, greater reliance on energy efficiency and renewable energy, nuclear power economic analyses, decommissioning cost estimates, and nuclear waste management and disposal.

2/1983--
8/1986 **Natural Resource Specialist**

Assisted private consulting, firms, non-profit corporations and government agencies in various projects related to the enhancement and protection of national forests in Northern California and Southern Oregon. This included contracts with the U.S. Forest Service, Fish and Wildlife Service, National Park Service, the California Coastal Conservancy, and private landowners.

6/1978--
1999 Consultant/Journalist/Paralegal/Lobbyist

Throughout the period of work outlined above, I have written a considerable amount of news articles and reports connected to ongoing-projects and issues of personal interest. The leg, al/administrative interventions have required extensive paralegal work to support attorneys, and technical expertise to identify and assist consultants. In addition, many of the projects required consulting services and lobbying, at the local, state and federal level whenever necessary, as well as working with the print and television media as appropriate.

From 1978 through 1984 1 served on the Board of Directors for two locals non-profit agencies devoted to sustainable community development, Redwood Community Development Council and Redwood Community Action Agency (RCAA). I also was hired on staff at RCAA as a natural resource specialist which is explained more fully above. I am proficient with computers, printers, fax machines and related equipment.

EDUCATION

M.A. Social Science. Political science and natural resources emphasis. California State University at Humboldt. Graduated December 1988.

B.A. Political Science. Political and economic aspects of natural resource development, with a particular emphasis in forest ecology and appropriate technology. California State University at Humboldt. Graduated June 1978.

Academic
Honors. Member of PI GAMMU MU Honor Society since 1986.

MILITARY SERVICE

7/1969--
9/1975 U.S. Navy. Air Traffic Controller.
Honorable Discharge.

DECLARATION OF
Gerry Bemis

I, **Gerry Bemis**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as an **Air Resources Supervisor I.**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I supervised and partially prepared the supplemental staff testimony on **Natural Gas Consumption** for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 6-23-14 Signed: 

At: Sacramento, California

GERALD R. (Gerry) BEMIS

Experience Summary

Over thirty years of experience in the energy field, including electric power plant facility siting, advanced electricity production technologies, energy research and development; energy transportation technology and policy and analysis of regulatory issues.

Education

B.S.; Civil Engineering (CSU Sacramento, 1969)
M. Engr; Civil/Environmental Engineering (UC Davis, 1978).

Registered Professional Civil Engineer (California).

Experience (at California Energy Commission):

2009-present – Air Resources Supervisor, Systems Assessment and Facilities Siting Division. Supervise and lead the review and evaluation of power plant proposals, identify issues and resolutions; coordinate with other agencies; and prepare testimony, in the areas of:

- Air quality resources and potential impacts, and mitigation measures;
- Public health; and
- Transmission line safety and nuisance.

Coordinate with local air quality districts, the Air Resources Board (ARB) and U.S. Environmental Protection Agency (U.S. EPA).

2001-2009 – Developed and updated the statewide California Greenhouse Gas (GHG) emissions inventory, including training ARB to take over responsibility for the GHG inventory as part of Assembly Bill 32 (in 2007). Also developed a strategy to enable California's light-duty vehicle sector to do its "fair share" of emissions reductions to meet a 2050 goal of reducing statewide GHGs to a level 80 percent below 1990 levels.

1994-2001 – Managed Fuel Resources Office. This consisted of a staff of 23 professionals who performed various activities related to fuel supply adequacy, including natural gas for power plants and petroleum for transportation.

1991-1994 – Supervised Heavy-Duty Alternative Fuels Program. This group was responsible for the $100 million Safe School Bus Program and provided funding for several clean fuel transportation technology research and grant activities.

1982-1991 – Supervised or performed technical analyses and support for several activities, including the Energy Technologies Status Report used to document the commercial availability of advanced technologies which were alternatives to conventional power plants during Energy Commission siting cases.

1977-1982 – Reviewed and evaluated large thermal power plant siting proposals, coordinating with the U.S. EPA, ARB and local air quality districts.

DECLARATION OF
Edward Brady

I, **Edward Brady**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Mechanical Engineer .**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I prepared the supplemental staff testimonies on **Overriding Considerations - Thermal Energy Storage** and **Natural Gas Consumption**, for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 6|19|14

Signed: Edward Brady

At: Sacramento, California

Edward James Brady
Mechanical Engineer

Summary of Experience

Forty years of experience in the profession of mechanical engineering as a staff engineer to the California Energy Commission, engineering consultant, design group supervisor in a major power plant project, senior engineer for a gas and electric utility, sales and design engineer for a contractor, and instructor in a community college.

Education

- BSME, Santa Clara University, 1972
- Graduate Engineering Studies, Santa Clara University
- Graduate Business Studies, University of San Francisco
- Continuing Education, UC Extension

Professional Registration

- Mechanical Engineer (M17924) California
  (25505) Washington
  (33082) Colorado
  (9248, Inactive) Nevada
- Civil Engineer (C36194) California

Affiliations

- American Society of Mechanical Engineers (ASME), Member
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), Life Member

Curriculum Vitae

2011 – Present	**Staff Mechanical Engineer**, California Energy Commission, Siting, Transmission, and Environmental Protection Division (STEP). Performs analysis of generating capacity, reliability, efficiency, noise and vibration, and the mechanical, civil, electrical, and structural aspects of power plant siting and construction cases.
1988-2011	**Principal Mechanical Engineer,** Brady Engineering. Provided design and consulting services for the permitting and construction of industrial and commercial facilities, and residential buildings in the fields of heating, ventilating air conditioning (HVAC), plumbing, fire protection and energy analyses.
1984-1988	**Design Group Supervisor,** Joint PG&E and Bechtel Project. Worked as the mechanical group supervisor responsible for the design modifications required for the licensing of Diablo Canyon Power Plant, Units 1 and 2.
1980-1988	**Senior Mechanical Engineer,** PG&E Civil Engineering Department, Architectural Section. Provided work group supervision and design of building mechanical systems for common utility plant facilities (CUP) and balance of plant systems for power production facilities.
1977-1980	**Mechanical Engineer,** PG&E Civil Engineering Department, Architectural Section. Provided HVAC and plumbing design for CUP and power production facilities.
1974-1977	**Instructor,** San Francisco Community College District, John O'Connell Evening School. Provided apprenticeship training in the technical fields of HVAC and refrigeration.
1977	**Design Engineer,** Charles and Braun Consulting Engineers, San Francisco. Worked as a staff designer in the fields of HVAC and plumbing for commercials facilities include a sentence detention facilities and a proto-type regional facility for a federal agency.
1972-1976	**Sales and Design Engineer,** Scatena York Company, San Francisco. Worked as a sales and design engineer for a refrigeration contractor, which provided design and installation of refrigeration systems for supermarkets and cold storage facilities.

Power Plant/Utility Experience

California Energy Commission, Rio Mesa Solar Electric Generation Station (RMSEGS). 500 MW Solar Power Tower. Riverside County, California.

, Hidden Hills Solar Electric Generating Station (HHSEGS). 500 MW Solar Power Tower. Inyo County.

, Hydrogen Energy California (HECA). 405 MW Combined Cycle, Fuel Gasification, CO_2 Sequestration, Ammonia Production. Kern County, California.

, Quail Brush Generating Project (QBGP). 1100 MW Reciprocating Engine Electric Generation. City of San Diego, California.

, Huntington Beach Energy Project (HBEP). 939 MW Combined Cycle. City of Huntington Beach, California.

, Redondo Beach Energy Project (RBEP). 496 MW Combined Cycle. City of Redondo Beach, California.

, Palen Solar Electric Generating Station (PSEGS). 400 MW Solar Power Tower, Riverside County, California

, Bottle Rock Power Plant (BRPP). 55 MW Geothermal Facility, Lake County, California.

, Alamitos Energy Center (AEC). 1996 MW Natural Gas Combined Cycle Systems, Long Beach, California

, El Segundo Energy Facility Modification (ESEM). 425 MW Natural Gas Combined Cycle and Fast Start Peaker Systems. El Segundo, California.

PG&E , Diablo Canyon Power Plant, Units 1 and 2. Licensing of safety related systems.
, Diablo Canyon Power Plant, Administration Building, SLO County Emergency Response Building

, Geysers Power Plant, Units 16, 17, 20, and 21. Ventilation and cooling for turbine building and hazardous waste disposal facilities, administration building.

, Helms Pumped Storage Facility, Kern County. Smoke control ventilation for underground transformer vaults.

, Humboldt No. 3, Eureka. Decommissioning of nuclear facility and construction of hazardous materials storage and handling.

, Moss Landing Power Plants, Units 1 through 6, Monterey County

, Morro Bay Power Plant, Morro Bay

, Hunters Point Power Plant, San Francisco

, Potrero Power Plant, San Francisco. Combined Cycle

, Gas Transmission Facilities, Line 300 and 400, Topock and Corning Compressor Stations, McDonald Island and Brentwood Gas Storage Facilities

, Central Computer Facilities, San Francisco and Vacaville

, 77 Beale Street, San Francisco. Energy Management System

, 215 Market Street, San Francisco. Boiler Replacement

, Underground Fuel Tank Replacement. Upgrade of more than 500 gallon fuel storage tanks to meet double containment requirements.

, Contra Costa Power Plants, Unit 1 through 6, Water Treatment

, Pittsburg Power Plants, Unit 1-5, Water Treatment Facilities

, Avon, Martinez and Oleum (AVO), Water Treatment Upgrade

, Tiger Creek Powerhouse, North Fork Feather River

, Kirchoff No. 2 Pump Storage Facility.

, Technical Support Services, Marketing Department

South Bay Sanitary Authority, 1400 Radio Road, Redwood Shores. San Mateo County, California. Gas piping and boiler conversion.

LOREY CACHORA

Winterhaven, California

EXPERT WITNESS QUALIFICATIONS:

Lorey Cachora is a Quechan Tribal member and a traditional knowledge bearer of the Quechan and the broader Yuman Culture from the Colorado River region. He is familiar with both the written and oral history and traditions of the Quechan people. He has provided expert witness testimony before and is familiar with the laws and regulations for the protection of cultural resources, historic sites, and the environment.

WORK EXPERIENCE /CULTURAL RESOURCE MANAGEMENT:

Mr. Cachora has been appointed by the Quechan Tribal Council to serve as a consultant to the Quechan Cultural Committee and has held that position for over 30 years. He also consults with the Quechan Historic Preservation Officer, Tribal Council and Tribal departments and groups. During this period, he also consulted with other Tribes throughout the Southwest and for government institutions, agencies, and their consultants.

These include:

Bureau of Land Management (BLM)
Bureau of Reclamation (BOR)
Imperial Irrigation District
Western Area Power Authority (WAPA)
Union Pacific Railroad
US Army Yuma Proving Ground
Anza Borrego Institute (Instructor)
Bureau of Indian Affairs (BIA)
Wellton Mohawk Irrigation District
Bard Water District
Yuma Crossing State Park
Barry Goldwater Bombing Range
USMC Marine Corps Air Station Yuma

EXPERT WITNESS AREAS OF EXPERTISE:

Indigenous Trail Networks
Cultural Landscapes
Quechan Cosmology
Petroglyphs, Geoglyphs, and Intaglios
Indigenous Material Remains (Archeology)
Tribal Monitoring Methods and Practices
Tribal Consultation
Ethnography – Oral History and Songscapes
Sensitive Native Species (Plants, animals, and habitat)
Environmental Stewardship (Natural Resource Traditional Management/Protection)
Military – identification of historic sites and remains/artifacts/land modifications

EDUCATION:

Imperial Valley College: Law Enforcement (Certified), Business Management Degree (2 semesters)
4 Years in the US Army: Officer's Training Academy, Advisor, Instructor. Educator (see Biography)

DECLARATION OF
Thomas Gates

I, **Thomas Gates**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a Cultural Resources Analyst .

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I helped prepare the staff supplemental testimony on **Cultural Resources**, for the **Palen Solar Electric Generating System** Amendment **(09-AFC-07C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: June 23, 2014 Signed: Thomas Gates

At: Sacramento, California

Thomas M. Gates, Ph.D.
Curriculum Vitae

EDUCATION
University of North Carolina at Chapel Hill, Ph.D., Anthropology, **Chapel Hill, NC 8/95**
Humboldt State University, B.A., Anthropology, B.A., Philosophy, Minor Studio Painting, **Arcata, CA**, **6/87**

NON-ACADEMIC EMPLOYMENT
California Energy Commission, Sacramento, CA, 1/1/12 – Present
Cultural Resources Analyst – Planner II
Work with a team of cultural resources professionals to review and respond to energy facility siting applications proposing energy facility construction or facility amendments located within the State of California. Specifically provide tribal consultation and ethnographic methods expertise.

Preservation Management Services, Sacramento, CA, 9/14/11 – Present
Self-Employed Owner
Secure, perform and complete contract work for tribal, federal, state, and local governments. Work includes following services: Tribal Historic Preservation Office (THPO) program development, operations and related training; THPO Cultural Resources Management Planning and facilitation; Cultural Landscape, traditional Cultural Property and Sacred Site Assessments, Cultural Resources Surveys and Cultural Resources monitor mitigation.

North State Resources, Inc., Sacramento, CA, 11/1/2009 – 11/08/11
Senior Program Manager:
Direct Cultural Resource Program for a team of CRM professionals to secure, perform and complete CRM cultural resource contracts on behalf of diverse client base (government agencies, developers, tribal governments. Also provided services in cultural resources training and tribal government planning facilitation.

SWCA Environmental Consultants, Sacramento, CA, 6/23/08-10/30/09
Senior Program Manager:
Direct Cultural Resource Program for a team of CRM professionals to secure, perform and complete CRM cultural resource contracts on behalf of diverse client base (government agencies, developers, tribal governments). Also provide training for Tribal Historic Preservation Officer (THPO) programs, NHPA Section 106 and Consultation with Indian Tribes.

Yurok Tribe, Klamath, CA, 5/1/03- 6/15/08
Self Governance Officer:
Coordinated Yurok governmental functions with local, state, federal governments; negotiated contracts, compacts, annual funding agreements, memorandums of understanding per the Indian Self Determination Act. More recently, handled tribal land appraisals, acquisitions, land acquisition funding, sustainable forestry management, tribal park planning and youth workforce creation.

Yurok Tribe, Klamath, CA, 9/4/96-6/15/08
Heritage Preservation Officer:
Performed Tribal Heritage Preservation Officer functions for Yurok Tribal Lands per NHPA § 101d(2)NPS Agreement. Provided Section 106 comment and made National Register nominations related to undertakings affecting tribal lands. Coordinated CHRIS Info Center/Tribal Inventory. Reviewed archeology survey reports and site records. Participated in the North Coast Strategic Partnership Coalition.

Yurok Tribe, Klamath, CA, 10/1/93– 5/1/03
Culture Department Director:
Directed a department with four divisions: Archeology, Archives, NAGPRA, Mapping and Compliance. Coordinated Tribal Elder's Cultural Committee, represented the tribe in Federal and State consultations pertaining to Yurok Culture. Managed multi-account program budget ($300,000/year) of base funding, grants and contracts for ethnographic research, archeological survey and monitoring and related planning.

USFS - Inyo NF, Bishop, CA, 6/1/80 – 8/31/89 (Seasonal)
Watershed Restoration Crew Leader/Member:
Supervised summer work-crews performing erosion control, dam construction, trail and road work and trout spawning site restoration in remote wilderness and back country settings; coordinated crew safety program.

ACADEMIC EMPLOYMENT

Humboldt State University, Arcata, CA, 6/1/92 - 5/31/07
Lecturer:
Cultural Anthropology, North American Indians and Anthropology of Religion

College of the Redwoods,Eureka, CA, 8/94-5/98
Adjunct Instructor:
Cultural Anthropology, Archeology, Folklore

University of North Carolina at Chapel Hill, Chapel Hill, NC, 8/1/88-5/31/90
Instructor:
General Anthropology
Teaching Assistant:
General and Cultural Anthropology

RESEARCH and PROJECTS

NSR – Assessing Effects to Indian Trust Resources and Cultural Values as a Result of Implementing the Klamath Basin Settlement Agreement to Remove Four Dams Along the Klamath River. 2010 – 2011. Project manager responsible for facilitating project Sub team (BIA and BOR) tribal consultations with 6 Klamath Basin Tribal governments and owners and heirs of Public Domain Allotments. Project also entails writing a Background Technical Report that assesses historic and current operation effects on trust resources. A final report is also being completed that assesses future operations affects on trust resources for two broad alternatives: "dams in" and "dams out."

SWCA – California Indian Heritage Center, Sacramento, CA, 2008 – 2011
Consult on behalf of California State Parks with tribal entities throughout the State of California in relation to the planning, design and construction of a $50 million facility and grounds located in Sacramento, and representing all California Tribes. Center will feature archaeological collections, archives, education classrooms, botanical gardens and demonstration village along banks of Sacramento River.

Yurok Tribal Park and Homeland Restoration, Klamath, CA, 2003 – 2008
Team Leader:
Coordination, planning, and acquisition for the Yurok Tribe initiative to regain homelands through creation of a tribal park system, marine sanctuary, community forest and related land purchases and transfers.

Yurok Tribe Condor Re-Introduction, Klamath, CA, 2007 – 2008
Principal:
Study of historic and environmental conditions conducive to the re-introduction of condor into Yurok territory.

Tsurai Village Site Management Plan, Trinidad, CA, 2003-2008
Team Leader:
Coordinated document drafting, community scoping, and negotiations leading to the transfer of a Yurok Archaeological site from the City of Trinidad to the Yurok Tribe.

North Coastal Information Center of the CHRIS, Klamath, CA, 2000-2008
Coordinator:
Negotiated, established and coordinated the North Coastal Information Center with CA SHPO; managed archeological and historical records and clearing house; provided review and compliance support for CEQA, Coastal Act, NEPA, NHPA, ARPA and CDF Timber Harvest Rule projects occurring in Humboldt and Del Norte counties.

Bald Hills Ethnographic Landscape Study, Orick, CA, 1999 – 2001
Co-Principal: Yurok Ethnographic use study of Bald Hills, Redwood National and State Parks (RNSP), Interview, field survey and record

Dissertation Fieldwork: Yurok Trail System, Klamath, CA, 1991-1995
Ph.D. Candidate: Compiled a history of Yurok trail systems, obtaining information from ethnographic interviews, literature, cartographic inventories, and archeological surveys.

Origins of the Peruvian Potato Project, Chapel Hill, NC, 1988
Research Assistant: University of North Carolina – Anthropology Lab. Peruvian Weather data entry, analysis – Assessment of trail distances between Andean potato gardens and villages in relation to garden sun exposure.

PUBLICATIONS

Yurok Tribe Comprehensive Cultural Resource Management Plan A 15 Year Plan for the Implementation of the Yurok Tribe - NPS Agreement to perform § 101d(2) functions of NHPA and other cultural resource related Tribal, Federal and State laws.

Along the Ridgelines: The History of Yurok Trail Systems, (Ph.D. Dissertation, UNC), **12/94**

The Asdiwal Myth Complex of the Tsimshian of the N*orthwest Coast of British Columbia* (4th semester paper, UNC), **5/89**

***Watershed Restoration Construction Safety Precautions Watershed Restoration Construction Manual* 6/87,** Inyo National Forest, U.S. Forest Service

APPOINTMENTS

National Association of THPOs – Co-founder and Board member	**1998-2008**
Historic Resource Information Centers of California – President	**1999-00**
Jacoby Creek Land Trust – Board Member and Recording Secretary	**1998-00**

AWARDS

CA State Senator Chesbro - *Recognition of Achievement* – for the passage of the 2002 Native American Historical Resources Protection Act

Research and Teaching Assistantships, UNC Dept. of Anthropology	**1987, 88, 89, 90**
USFS Employee Award – *Outstanding Service in the Field*	**1980, 81, 82, 86**

TRAINING

PSMJ Project Management Bootcamp, Phoenix, Arizona	**2009**

AFFILIATIONS

National Association of Tribal Heritage Preservation Officers
Society for California Archeology
National Trust for Historic Preservation
American Anthropological Association
California State Park Foundation
National Park Conservation Foundation
Smithsonian Institute
American Hiking Society

PERSONAL

Born 1962, Married 1984, two children (born: 1986, 1988)
Hobbies/Recreational Interests: watercolor painting, basketball, backpacking, gardening, landscaping, piano

REFERENCES

Larry Myers, Native American Heritage Commission
Tel: 916 653 3356 Email: lm_nahc@pacbell.net

Bambi Kraus, President, National Association of Tribal Historic Preservation Officers
Tel: 202 628-8476 Email: bambi@nathpo.org

Destry Jarvis, President, Outdoor Recreation and Parks Services Consulting
Tel: 540 338-6970 Email: destryjarvis@earthlink.net

Lynda Roush, Arcata Field Office Director, BLM
Tel: 707 825-2309 Email: Lynda_Roush@ca.blm.gov

Dan Hall, Archaeologist, BIA Sacramento Regional Office
Tel: 916 978-6041 Email: dan.hall@bia.gov

Troy Fletcher, Senior Policy Analyst, Yurok Tribe
Tel: 530 625 4015 Email: troy_fletcher@earthlink.net

Rhea Graham, Program Manager – Klamath River Dams Project, Bureau of Reclamation
Tel: 916 978 5113 Email: rgraham@usbr.gov

DECLARATION OF
Chris Huntley

I**, Chris Huntley,** declare as follows:

1. I am presently employed by **Aspen Environmental Group** as a **Senior Biologist**.

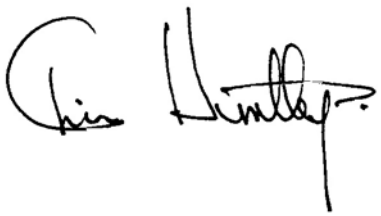
2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I helped prepare the staff testimony on **Biological Resources** for the **Palen Solar Electric Generating System Final Staff Assessment (PSEGS) (09-AFC-7C)** my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.



Dated: June 19, 2014 Signed: _____

At: **Agoura Hills, CA**

CHRISTIAN S. HUNTLEY
Senior Associate/Biological Group Manager, Southern California

Academic Background

Graduate Studies, Biology, California State University Northridge
BA, Biology, University of California at Santa Cruz, 1992

Professional Experience

Mr. Huntley has 15 years of experience with Aspen conducting CEQA/NEPA analysis to support large scale electrical transmission and energy projects. He has extensive local experience in the Mojave and Colorado Deserts working on several large scale infrastructure projects including solar thermal, photovoltaic, and electrical transmission lines. Mr. Huntley has worked as an extension of CDFW staff to address effects to Mohave ground squirrel, desert tortoise, and bighorn sheep in the Lucerne Valley and for a suite of sensitive resources in southern California. Mr. Huntley has broad experience conducting biological assessments, managing large-scale construction and restoration projects, and supporting agency clients with permitting tasks including compliance with California Department of Fish and Wildlife (CDFW) 1600 and 2081 permits, US Fish and Wildlife Service (USFWS) Section 7 process, Regional Board 401 compliance, and US Army Corps (Corps) 404 permits. Recently Mr. Huntley worked as a member of an interagency team with the BLM, CDFW, and USFWS to identify and approve mitigation lands for desert tortoise, fringe toed lizards, burrowing owls, and State Waters. Supported by a solid background in biology and a practical knowledge of BLM procedures, CEQA/NEPA, USDA Forest Service requirements, regulatory consultation, and over a decade of construction management experience; Mr. Huntley is able to prepare and develop effective CEQA/NEPA documents and maintain objectivity during the regulatory process. Some of the relevant projects Mr. Huntley has worked on are described below.

Aspen Environmental Group.....1998-present

Energy Experience

- **Palen Solar Energy Project (formerly PSPP Project), California Energy Commission, Biologist (2013-present).** Mr. Huntley is preparing the desert tortoise, rare plant, state waters, and burrowing owl impact analysis for the 3,947 acre solar energy project located east of Palm Springs California.
- **Hidden Hills Solar Energy Generating Station, California Energy Commission, Biologist (2012-2013).** Mr. Huntley prepared sections of the the biological resources analysis of the Staff Assessment for this 3,700 acre solar energy project located in Inyo County, California. Key issues included burrowing owl, desert tortoise, bighorn sheep, golden eagles and migratory birds.
- **Calico Solar Project (formerly SES Solar One Project), California Energy Commission, Biologist (2009-2010).** Mr. Huntley prepared the biological resources analysis of the Staff Assessment/EIS for this solar energy project proposed by Calico Solar, LLC. The proposed project would be located in San Bernardino County and included the construction and operation of an 850 MW Stirling engine solar generation facility, which would include approximately 34,000 SunCatcher solar dish Stirling systems on approximately 8,230 acres. Key issues include potential impacts to desert tortoise, Mojave fringe-toed lizard, Nelson's bighorn sheep, burrowing owl, and golden eagle, as well as large-scale modifications to existing drainages and interference with regional wildlife movement.
- **Palmdale Hybrid Power Plant, California Energy Commission, Biologist (2009-present).** Mr. Huntley is preparing the biological resources analysis of the Staff Assessment for this power generation project proposed by the City of Palmdale. The proposed project would be located in northern Los Angeles County and includes the construction and operation of a 570 MW hybrid combined-cycle and solar thermal electrical generation facility, which would include an approximate 333-acre plant site and a

35.6-mile transmission line to connect the project to the existing Southern California Edison (SCE) Vincent Substation, as well as four pipelines to transport water, gas, and wastewater (ranging from 1.5 to 7.4 miles in length). Key issues include potential impacts to Swainson's hawk, desert tortoise, Mojave ground squirrel, and golden eagle.

- **Rice Solar Energy Project, California Energy Commission, Biologist (2009-2010).** Mr. Huntley is contributing to the biological resources analysis of the Staff Assessment/EIS prepared for this solar energy project proposed by Rice Solar Energy, LLC (a wholly owned subsidiary of SolarReserve, LLC). The proposed project would include a 150 MW solar generation facility consisting of up to 17,500 solar-tracking heliostats, a central tower, and associated infrastructure and appurtenant structures. The solar field site would be located on approximately 1,410 acres of privately owned land in eastern Riverside County. In addition, a 10-mile 230 kV generator tie-line would be constructed to interconnect the project with Western Area Power Administration's existing Parker-Blythe transmission line. The new transmission line would traverse lands primarily under the jurisdiction of the Bureau of Land Management (BLM). The new transmission line would also require the construction of a new 4.6-mile access road, also largely located on BLM lands. Key issues include potential impacts to desert tortoise and golden eagle, and potential impacts to birds in general from the solar technology.
- **Amonix Solar Energy Development, California Department of Fish and Game, Biologist (2012).** Mr. Huntley worked as an extension of CDFG (CDFW) staff for this photo voltaic energy project in the Lucerne Valley. Formerly the Chevron Energy project; work on this facility was suspended in 2012.
- **Emergency Siting Team Power Plant Development, California Energy Commission, Compliance Project Manager.** For two years, Mr. Huntley's duties included management of technical staff for the completion of CEQA equivalent environmental permitting for over nine new emergency power plants, review of applicant submittals, drafting of Memoranda of Understanding with Chief Building Officials, conducting audits of building officials, and coordinating with affected agencies to resolve concerns with potential resource impacts. Other duties included maintaining contractor construction milestones, compliance monitoring and reporting, development of mitigation measures and conflict resolution for power plant compliance issues.
- **Coastal Power Plant Study, California Energy Commission, Deputy Project Manager/Biologist.** Mr. Huntley conducted biological surveys at 21 coastal power plants as part of the Energy Commission's coastal power plant study. Site visits characterized habitat within the footprint of the power plant, landscaping, and identified potential environmental and permitting issues associated with potential expansion of the power plants.
- **Hydroelectric Power Plant Inventory Study, California Energy Commission, Deputy Project Manager/Natural Resources Analyst.** Mr. Huntley coordinated a team that collected power and environmental data on over 200 hydroelectric power plants located in California. Physical power data included electrical output, system upgrades, water storage capacity and peaking availability. Environmental information included developing a data base addressing sensitive species issues, fish screens and ladders, monitoring parameters and a map of known hydroelectric facilities and barriers to anadromous fish passage. Mr. Huntley also obtained water use information on thermal power plants in support of the Energy Commission's bi-annual environmental performance report.
- **Topaz Solar Farm EIR, San Luis Obispo County, Issue Area Coordinator/Biologist (2009-2011).** Mr. Huntley served as the issue area coordinator for natural resources on this solar energy project proposed by Topaz Solar Farms, LLC (wholly owned by First Solar, Inc.). The proposed project would consist of a 550 MW solar photovoltaic energy generating facility on approximately 6,200 acres in the Carrizo Plain area of eastern San Luis Obispo County. Key issues included potential impacts to San Joaquin kit fox, jurisdictional drainages, vernal pools, rare plants, and nesting birds.

- **California Valley Solar Ranch EIR, San Luis Obispo County, Issue Area Coordinator/Biologist (2009-2011).** Mr. Huntley served as the issue area coordinator for biological resources on this solar energy project. The proposed project involved construction and operation of a 250 MW photovoltaic solar power plant in the unincorporated portion of eastern San Luis Obispo County. The project would be owned by High Plains Ranch II, LLC, a wholly owned subsidiary of SunPower Corporation Systems. A 3.5-acre substation and approximately 2.5 miles of 230 kV transmission would be required to connect to the existing Pacific Gas and Electric (PG&E) Midway to Morro Bay 230 kV transmission line. The project is one of two solar power plants proposed in the Carrizo Plain. Key issues include potential impacts to San Joaquin kit fox, blunt-nosed leopard lizard, and giant kangaroo rat.
- **Panoche Valley Solar Farm EIR, County of San Benito, Biologist (2010-present).** Mr. Huntley is technical support for this large-scale solar energy project. The proposed project would consist of a 420 MW solar energy generation facility on approximately 4,717 acres in the Panoche Valley of southeastern San Benito County. The facility would consist of 1,822,800 solar photovoltaic panels and associated infrastructure. Key issues include potential impacts to California tiger salamander, blunt-nosed leopard lizard, San Joaquin antelope squirrel, giant kangaroo rat, San Joaquin kit fox, San Joaquin coachwhip, mountain plover, golden eagle, northern harrier, burrowing owl, loggerhead shrike, and American badger. In addition, suitable habitat for the following special-status species exists at the project site: vernal pool fairy shrimp, Swainson's hawk, western spadefoot, California horned lizard, merlin, pallid bat, and western mastiff bat.
- **Pacific Wind Energy Project EIR, Kern County, Biologist (2009-2010).** Mr. Huntley oversaw the preparation of the biological resources analysis of this EIR evaluating a proposed 250 MW wind energy generation facility in the Mojave region of Kern County. The proposed project would be located on approximately 8,300 acres in the Tehachapi Wind Resource Area. Key issues include potential impacts to birds and bats from the wind turbines as well as potential impacts to desert tortoise, California condor, Swainson's hawk, and golden eagle.
- **Alta–Oak Creek Mojave Project EIR, Kern County, Biologist (2008-2009).** Mr. Huntley oversaw the preparation of the biological resources analysis of this Initial Study and EIR evaluating a proposed 800 MW wind development in the Tehachapi Wind Resource Area. The proposed project site consists of three distinct land areas comprising a total of approximately 10,750 acres. Key issues include potential impacts to birds and bats from the wind turbines as well as potential impacts to desert tortoise, California condor, Swainson's hawk, golden eagle, and Bakersfield cactus.

Transmission Line Experience

- **Downs Substation and Transmission Line Project IS/MND, California Public Utilities Commission (2010-present), Issue Area Coordinator/Biologist.** Mr. Huntley acted as issue area coordinator for biological resources on this transmission line upgrade to be completed by Southern California Edison in the Mojave Desert. Key issues included desert tortoise, Mohave ground squirrel, and burrowing owls. Portions of this project span lands administered by the BLM.
- **Devers–Palo Verde Transmission Line Project No. 2 EIR/EIS, California Public Utilities Commission (CPUC)/Bureau of Land Management (BLM), Issue Area Coordinator/Biologist (2005-present).** Mr. Huntley acted as issue area coordinator for biological resources on this 230-mile 500 kV transmission line upgrade to be completed by SCE. This project crosses key wildlife areas including the KOFA Wildlife Sanctuary, the San Bernardino National Forest, the Mojave and Sonoran Desert habitats, and sections of the Riverside Multiple Species Conservation Area. Currently, Mr. Huntley is supporting the biological monitoring team responsible for implementing CPUC and BLM monitoring requirements during construction of the project.

- **Tehachapi Renewable Transmission Project, CPUC/US Forest Service, Issue Area Coordinator/Biologist (2007-present).** Mr. Huntley is acting as the issue area coordinator and principal author for biological resources on this 500 kV transmission line project proposed by SCE in support of wind energy projects. This transmission line is 173 miles in length and includes two separate segments that cross the Angeles National Forest (ANF). Some of the key issues on this project include potential impacts to Mojave ground squirrel, desert tortoise, arroyo toads, California condors, spotted owl, and a host of forest sensitive plant and wildlife species. As part of the project, Mr. Huntley mapped over 190 riparian related features and completed extensive surveys of the ANF. Mr. Huntley managed an extensive biological staff and organized the completion of comprehensive botanical surveys for the proposed right-of-way. Other key issues involve the coordination with State Park, Forest Service, and resource agency staff.
- **Antelope Transmission Project, Segments 2 & 3 EIR, CPUC/US Forest Service, Issue Area Coordinator/Biologist (2006-2011).** Mr. Huntley acted as issue area coordinator for biological resources on this 500 kV transmission line proposed by SCE in support of wind energy projects. Key issues on this project include potential impacts to Mojave ground squirrel, California red-legged frog, burrowing owl, and rare plants. As part of this project, Mr. Huntley conducted focused surveys for arroyo toads and coordinated ESA compliance with the USFS and USFWS. As part of the project Mr. Huntley completed the BE/BA to comply with the provisions of the ESA and the Management Indicator Species Report for ANF compliance. Currently, Mr. Huntley provides technical assistance to monitoring staff.
- **El Casco Sub-Transmission Project EIR, CPUC, Issue Area Coordinator/Biologist (2006-present).** Mr. Huntley acted as issue area coordinator for biological resources and completed the impact analysis section of the EIR for this 17-mile sub-transmission line upgrade to be completed by SCE. This line is located in the Western Riverside Multiple Species Conservation Area and crosses areas supporting several federally protected species including least Bell's vireo, southwestern willow flycatcher, and Stephens' kangaroo rat. Currently, Mr. Huntley provides technical assistance to monitoring staff.
- **Antelope-Pardee Transmission Project EIR/EIS-BE/BA, CPUC/US Forest Service, Issue Area Coordinator/Biologist (2005-2010).** Mr. Huntley was the issue area coordinator for biological resources on this 500 kV transmission line upgrade to be completed by SCE. Key issues on this project included compliance with the US Forest Service Forest Plan and sensitive species including California condor, burrowing owl, and rare plants. Mr. Huntley reviewed and prepared the Biological Resource Section for the EIR/EIS, developed project alternatives, coordinated with Forest Service staff, and conducted sensitive species surveys for arroyo toad in support of this project. Currently, Mr. Huntley provides technical assistance to monitoring staff.
- **SCE Valley-Auld Power Line Project, CPUC, Environmental Monitor.** Conducted inspections of construction of this 11-mile power line upgrade for compliance with the project's Mitigated Negative Declaration mitigation measures and compliance plans. Other tasks included review of pre-construction compliance materials, maintaining inspection documentation, and coordination with SCE and its subcontractors.
- **Sunset Substation IS/MND and Biological Site Assessment, City of Banning, Biologist (2006-2007).** Mr. Huntley prepared the biology section of the IS/MND as a subcontractor to R. W. Beck. In addition, Mr. Huntley conducted burrowing owl surveys and managed surveys for Los Angeles pocket mouse at select locations along the proposed right-of-way.
- **Viejo System Project IS/MND, CPUC, Biologist.** Conducted biological surveys and completed the biological section of the Initial Study and Mitigated Negative Declaration for SCE's transmission line upgrade project.

Pipeline Experience

- **Santa Fe Pacific Pipeline, CPUC, Environmental Monitor.** Inspected construction of three petroleum distribution station sites for compliance with approved project mitigation measures and compliance plans.
- **Line 401 PG&E Redwood Expansion Project, CPUC, Lead Environmental Monitor.** Under contract to the CPUC, Mr. Huntley acted as Lead Environmental Monitor and supervised two environmental monitors in the field on the implementation of the CPUC's conditions of approval for construction of this 14-mile natural gas pipeline. Responsibilities included: supervision, guidance and development of environmental monitors, onsite field monitoring, compliance review and mitigation development of pre-construction plans, and mitigation compliance documentation. Other duties included review of variance and temporary extra work space (TEWS) requests; recommendations for CPUC issuance of Notices to Proceed with construction and variance approvals; approval of TEWS requests; preparation of weekly reports for all monitoring activity; and coordination with PG&E, construction managers and subcontractors, local municipalities, affected and interested agencies and the public.
- **Horsethief Creek Road Repairs Project, IS/MND and Biological Assessment, California Department of Water Resources, Biologist/Project Manager (2005-2009).** Mr. Huntley prepared the biological resource section and managed the completion of the IS/MND and the BA for construction of an all weather road at Horsethief Creek located near Lake Silverwood in San Bernardino County. Mr. Huntley also assisted DWR through formal consultation with the USFWS. The project was intended to provide an all-weather access to DWR facilities while avoiding impacts to federally endangered arroyo toads. Mr. Huntley also managed and conducted several of the sensitive species surveys required for this project including arroyo toad, two-striped garter snake, and southwestern pond turtles. Mr. Huntley managed the monitoring efforts at the site to comply with permit regulations identified by the Biological Opinion.

NEPA Experience

- **Littlerock Dam and Reservoir Restoration Project EIR/EIS-BE/BA, Palmdale Water District/US Forest Service, Deputy Project Manager/Biologist (2004-present).** Mr. Huntley is currently acting as deputy project manager and project biologist for the sediment removal activities associated with the Littlerock Dam and Reservoir in the ANF. Mr. Huntley is working to develop project alternatives for sediment disposal while avoiding impacts to federally endangered arroyo toads. Mr. Huntley is managing the sensitive species surveys for this project and completing the biological resources section of the EIR/EIS, Management Indicator Species Report, and BE/BA.
- **Newhall Ranch Project, California Department of Fish and Game, Biological Coordinator and CDFG Reviewer (2005-2009).** Mr. Huntley provided biological expertise and assisted CDFG staff in reviewing and revising the EIR/EIS for the proposed 6,000-acre Newhall Development Plan EIR/EIS in Santa Clarita. Primary issues concern the land use conversion of several thousand acres of wild lands and agricultural areas located in and adjacent to the Santa Clara River. This region is known to support numerous threatened and endangered species including least Bell's vireo, southwestern willow flycatcher, California condor, arroyo toad, unarmored three-spine stickleback, and San Fernando Valley spineflower. Other concerns associated with the development include wildlife movement corridors, and effects to riparian habitats. Mr. Huntley reviewed, commented and revised the environmental documents, scheduled and coordinated meetings with resource professionals and agency staff, and provided technical review of the document. Mr. Huntley will be assisting CDFG staff in the response to comments on the Draft EIR/EIS.

- **Matilija Dam Ecosystem Restoration Project EIR/EIS, US Army Corps of Engineers, Biologist.** Mr. Huntley conducted biological surveys and assisted in the completion of the EIS/EIR to assess impacts to sensitive biological resources located on Matilija Creek and the Ventura River downstream of the of the Matilija Dam. The analysis focused on potential impacts associated with dam removal on sensitive species known to occur on the Ventura River and the beneficial impacts of the restoration of spawning territory for the endangered Evolutionary Significant Unit of Southern Steelhead.
- **Fort Irwin Environmental Baseline Survey Reports, US Army Corps of Engineers, Project Manager/Biologist (2005).** Mr. Huntley managed the preparation of two Environmental Baseline Survey reports near Fort Irwin, San Bernardino County to support the land acquisition of over 95 parcels by the US Army for the Fort Irwin National Training Center. Mr. Huntley conducted site investigations, documented existing biological conditions and managed the preparation of the report.

Selected Technical Experience/Training and Certifications

- SWPPP trained 2006
- California Energy Commission Outstanding Performance Award, 2001
- CDFG Scientific Collecting Permit for pond turtle and garter snake.
- Certified Caltrans Horizontal Directional Drilling Inspector 2001
- Desert Tortoise Handling Workshop, Ridgecrest, California 2001
- CEC Expert Witness Training 2001
- Railroad Right-of-Way Safety Training 2002
- Small boat handling, licensed and certified since 1993
- Research Scuba-diving certification and training since 1989

DECLARATION OF
Gregg Irvin, Ph.D.

I**, Gregg Irvin**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Visual Resources / Glint and Glare Technical Specialist.**

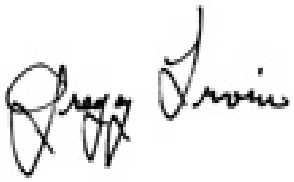
2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I helped prepared the supplemental staff testimony on the Traffic and Transportation section, for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.



Dated: 20 June 2014 Signed: _____

At: Dayton, Ohio

GREGG E. IRVIN, PH.D.
3731 Blossom Heath Road
Dayton, OH 45419
937-271-2715

EMPLOYMENT

2005-Present	President, Spectrus, Ltd.
1996-2005	Principal Partner and Director of Operations, Mobium Enterprises, Inc.
1994-1997	Executive Director, Assistive Technologies Group
1996-2000	Employee Consultant, National Security Studies and Strategies Group, Science Applications International Corporation (SAIC), McLean, VA.
1993-1996	Assistant Vice President, SAIC, Dayton, OH.
1995-1996	Division Manager, Human Systems Technology Division, SAIC
1992-1995	Division Manager, Aerospace Systems Division, SAIC
1990-1991	Chief Scientist, Human Performance Technology Division, SAIC
1989-1990	Senior Scientist, Human Performance Technology Division, SAIC
1986-2000	Director, ICON Consultants, Birmingham, AL & Dayton, OH.
1985-1989	Senior Research Scientist, Systems Research Laboratories, Dayton, Ohio.
1984-1985	Visual Neurophysiologist, Vision Science Research Center, University of Alabama Medical School at Birmingham.

EDUCATION

1982-1984	National Eye Institute, Postdoctoral Fellow, Electrophysiology, Vision Science Research Center, School of Optometry, University of Alabama Medical School at Birmingham.
1981-1982	Postdoctoral Research Associate, Visual Neurophysiology, Department of Physiological Optics, School of Optometry, University of Alabama Medical School at Birmingham.
1981	Ph.D. Physiological Psychology, Syracuse University.
1976	B.A. Psychology, Syracuse University.

AWARDS/FELLOWSHIPS/DISTINCTIONS

1995-2003	Adjunct Faculty, Department of Biomedical and Human Factors Engineering, Wright State University, Dayton, OH.
1982-1984	National Eye Institute, Individual National Research Service Award
1979	Behavioral Neurobiology Scholarship, Cold Spring Harbor Research Laboratory, Syracuse University School of Engineering, Institute for Sensory Research.
1978-1980	Graduate Fellowships in Biopsychology (two awards), Syracuse University.
1977-1978	Graduate Fellowship in Physiological Psychology, Syracuse University.
1976-1977	Research Associate, Visual Psychophysics Laboratory, Syracuse University.

PROFESSIONAL SUMMARY

Dr. Irvin is a sensory neurophysiologist/ psychologist with a multidisciplinary background in visual science related fields including; applied experimental psychology, sensory perception, visual physiology and psychophysics, human systems interface, advanced image processing, human information processing, human perception and performance, mathematical visualization, neurobiology and human factors engineering.

Dr. Irvin is president of Spectrus, Ltd. Spectrus is a diversified small business providing services in engineering, human factors, neuroscience, physics, chemistry and life sciences. Spectrus develops advanced sensing technologies for indirect view multispectral and hyperspectral applications, which incorporate proprietary spectral mapping principles and (active and passive) frequency agile sensing capabilities. Spectrus also provides sensory modeling, image understanding, computational vision, specialized spectral sampling applications, advanced Human-System Interface development, and multidisciplinary sensing strategy services.

Dr. Irvin has strong leadership and managerial skills with a record of success in leading major research and development programs. This includes Air Force Research Laboratory programs developing physiologically based computer vision systems (stereovision, detection, and texture generation), low-observable technologies, and multispectral adaptive and passive camouflage, concealment and deception technologies. Efforts include developing and interfacing both head-steerable and advanced helmet mounted displays with integrated multisensor fusion capabilities for strategic aircraft, developing imaging architectures, information visualization technologies, and display technologies incorporating specialized chromatic, motion, and texture processing. Contributions to visual science include a model of developmental amblyopia, various models of human visual detection, studies of information transfer to primate visual cortex, and structure-function studies of neuronal morphology and visual information processing. Dr. Irvin's experience and qualifications span basic and applied advanced research and development, and technology transfer and application. Dr. Irvin has been featured in National Geographic "The Sense of Sight" and in a PBS NOVA documentary "The Disguises of War."

EMPLOYMENT EXPERIENCE

Spectrus, Ltd. (2005-Present)

President, Spectrus, Ltd. is an Ohio based Limited Liability Company established in January 2005 and provides consulting services to Government and industry. Dr. Irvin is the president and sole partner in Spectrus, Ltd. Spectrus represents a reorganization of Mobium Enterprises, Inc. and Mobium, Inc., for which Dr. Irvin was the president of both.

Representative Research and Development Efforts at Spectrus: Note: Multiple program summaries deleted due to classification issues.

Security Lighting Development Program. (2011-). Consultant to Acuity Brands Lighting, Inc., Northeast Innovation Center (NEIC) for the development of RGB LED lighting hardware, software and supporting algorithms for visual, physiological and psychological disruption and disabling human performance effects. Lead developer for strategic architecture design and disruptive algorithm development to support a modular and adaptable security lighting system for a variety of industrial and government applications.

Solar Power Plant Develop for the California Energy Commission. (2010-). Providing analytic and modeling support to Traffic and Transportation, Visual Resources, and Biological Resources for the assessment of the visual impacts of heliostat mirror fields and solar power towers for proposed Solar Electric Generation Facilities (SEGF). Ongoing and past research includes determining the magnitude of visual and thermal effects (e.g., glint, glare, aesthetics, avian mortality), their level of significance, and the development of potential mitigating procedures for the proposed Calico, Rio Mesa, and Hidden Hills SEGFs.

Raytheon CV-22 Helmet Mounted Display. (2011) Subcontract to Raytheon for proposal development and review for the Boeing Defense Space and Security Division CV-22 Helmet Mounted Cueing System (HMCS). Activities included HDM architecture and functional capabilities for HMD interfaces, processing and control equipment, NVG capability, resolution, field of view, eye relief and exit pupil, display brightness and internal contrast ratios, luminance uniformities, and helmet tracking, slew and acceleration rates, latency and readout stability.

Mobium Enterprises, Inc. (1996-2005)

Principal partner, Director of Operations of Mobium Enterprises, Inc. Mobium is an Ohio C Corporation headquartered in Dayton, with offices in Alabama, Colorado, Massachusetts and New York. Mobium is active on local, state and national levels promoting strategic alliances between and among academe, industry, and government for the development of seminal technologies to enhance human perception and performance. Mobium seeks to reveal broader markets for the commercialization of human-systems technologies by emphasizing common needs and by emphasizing flexible modular technology that can be adapted to meet a variety of needs. Mobium is actively involved in a variety of joint technology development initiatives.

Mobium commercialization ventures include: a) a patented and licensed fluid jet array technology to reduce fluid precursor requirements to prepare thin films in semiconductor manufacturing, b) a differential ultra-violet filter technology (patent pending) for fabrication into optical filters using liquid and polymeric hosts, c) SWIFT – Stored Waveform Inverse Fourier Transform software package for the design of gradient index optical filters (patent in process), d) a plasma based ultra-thin film corrosion-inhibiting primer coating technology for stainless steel and aluminum to replace toxic chromium primer techniques (joint development venture in process). Additionally, Mobium is engaged in a software development project entitled MathWeb™. MathWeb™ is a Java-based tensor analysis and display package that is designed to run on distributed and heterogeneous networks and parallel computers.

Mobium provides expertise in advanced optical design and the analysis of multispectral imagery. Principals of Mobium have served as consultants to the U.S. Air Force on advanced human-system interfaces, and man-machine integration. Mobium personnel also have designed camouflage for the U.S. and European Armies and are aware of a broad range of programs sponsored by the DoD, NASA, DARPA, and other agencies concerned with the acquisition and interpretation of multispectral imagery. Mobium has developed a suite of sequential algorithms for enhancing the visualization and display of complex data sets and has examined the human factors that constrain the performance of integrated sensor suites in Uninhabited Aerial Vehicles.

Dr. Irvin's focus within Mobium is on the development of advanced sensing capabilities to facilitate human perception and performance. Dr. Irvin specializes in information extraction and enhancement through the application of advanced spectral sampling methodologies and the subsequent information transformation and representation for specialized human-in-the-loop applications.

Representative Research and Development Efforts at Mobium: Note: Multiple program summaries deleted due to classification issues.

Human-Systems Technology For Uninhabited Aerial Vehicle (UAV) Ground Stations.
Provided support to Air Force Armstrong Laboratory Phase I SBIR program (AL/CF). The approach is based on a structured methodology for the development and commercialization of human-systems technology. The Technical Objectives are to: (1) identify human-systems interfaces (HSI) and virtual-reality (VR) technologies that require development to ensure the

maturity necessary for a UAV VR control station or center, (2) propose a UAV VR concept demonstration supporting intelligent aiding, decision support, and mission management flexibility, and (3) identify issues and design tradeoffs involving human performance variables and VR properties.

Unmanned Combat Air Vehicle (UCAV) Program Support. Program Manager. Provided support to Raytheon E-Systems as a team member within the UCAV Ground Segment IPT to enhance the Unmanned Combat Aerial Vehicle (UCAV) IRAD project execution. Support focused on the: 1) study, analysis, identification and development of advanced Human Systems Interface (HSI) and Human Computer Interaction (HCI) functionality segmentation, 2) the inclusion of Automated Decision Aids to support HSI and HCI, and 3) analysis and identification of relevant technology domains pertinent to HSI technology insertion related to the UCAV Ground Station. Mobium provided trade study documents and support to the various Program Milestone and Technical Interchange Meetings.

Collaborative Commercialization, Research and Development Efforts with Syracuse University:

Dr. Irvin managed Mobium Enterprises extensive joint relationship with the Scalable Concurrent Programming (SCP) Laboratory at Syracuse University (SU) for technology development and commercialization through technology transfer. From 1999-2002 Mobium engaged in a variety of collaborative research and development programs with SU that include Distributed Real-Time Sensors Project and the Information Resiliency: Strategic Concepts for Assurance and Recovery Project. As a result of these collaborations Mobium maintained an office at the Syracuse University CASE (Computer Applications and Software Engineering) Center providing support to the SU research team on a daily basis. A brief description of the joint SU-Mobium initiatives and the resulting commercial technologies are as follows:

Distributed Real-Time Sensor Fusion. Project Manager. In a collaborative research effort with the SU-CASE center investigated the use of multiple sensors to increase the capability of intelligent system dealing with multi-sensor fusion and integration (MFI). Mobium developed distributed spectral-screening PCT algorithms for fusing hyper-spectral images in remote sensing applications. The algorithms provided intrusion tolerance from information warfare attacks using the framework of computational resiliency. Dynamically regenerative replication algorithms were integrated with replication-based fault tolerance mechanisms to respond to intrusion attacks and system failures. The utilization of application independent library technologies masked the details of communication protocols required to achieve dynamic replication and reconfiguration in distributed applications.

Computational Resiliency, Heterogeneous Reliable Applications. Project Manager. In conjunction with the Center for Systems Assurance (CSA) and the Computer Applications and Software Engineering Center at Syracuse University this initiative investigated the development of distributed computing systems to provide fault-tolerance through group communication based active replication, automatic reconfiguration and recovery from the attacks and failures, and load balancing over heterogeneous resources. The research focused on intrusion detection, high-confidence design, network security, information assurance, computer forensics, process migration, split/merge of processes, and camouflage techniques to achieve reasonable resiliency goals within defined predictive analytical models of performance assessment.

Remote Sensing Multispectral Image Exploitation. This joint initiative involves the development of advanced parallel algorithms and display technologies to facilitate the real-time data acquisition and exploitation of multispectral image streams. The resulting technology suite, currently in the final stages of development for proof-of-concept demonstration, provides the basis for commercial products to support various terrestrial and airborne remote sensing applications (e.g., land resource management, agricultural and crop monitoring, military target identification), and medical applications (e.g., multispectral endoscopy and ophthalmology). This initiative involves the development of: a) adaptive temporal-spectral real-time multispectral image acquisition, b) optimized real-time decorrelation and compression algorithms, c) advanced human-system interface for physiologic information bandwidth optimization, and d) the development of supporting distributed and concurrent computer architectures. A multispectral image exploitation algorithm suite is currently under development to support the Spectral Embedding Methodologies R&D Program for the development of next-generation sensor hardening for direct and indirect-view airborne military optical systems.

Cyber-Eye™ Multispectral Camera Systems. A natural outgrowth of the collaboration for multispectral image exploitation was the development of a multispectral imaging camera system to support laboratory and field data acquisition. The result was the design and development of a family of high-speed digital multispectral imaging systems supported by high performance multiprocessing. The Cyber-Eye camera series includes multispectral digital imaging systems capable of real-time 12 spectral band image acquisitions and processing at 120 frames per second. The commercialization of these systems is in process. A Cyber-Eye system was developed for the Air Force to support the Spectral Embedding Methodologies program referenced above.

MathWeb™. MathWeb is a tensor-based applications development product specifically designed to support distributed concurrent and heterogeneous computing environments. This commercial product has been used in a variety of government and industry applications. One such application in the final development stages is an integrated suite of image processing tools for real-time processing of multispectral and hyperspectral sensor data, image exploitation, and unique visualization techniques for human-system interface. Both the Cyber-Eye Multispectral Camera Systems and I-STORM incorporate MathWeb as the basis operating system.

Assistive Technologies Group (1994-1996)

ATG develops consortia and strategic alliances, and serves as a technology and information broker to support biobehavioral technology transfer initiatives.

Dr. Irvin founded and served as executive director of the Assistive Technologies Group (ATG). ATG's mission is to develop and transition advanced federal technologies to a sustainable national industrial capability within the commercial market of assistive technologies for Americans with disabilities. As a not-for-profit company, ATG served to promote and participate in research on limitations to human perception and performance that are due to disabling physiological or environmental conditions, and, promote and participate in the development of technology that can restore or enhance otherwise impaired human perception and performance. ATG nurtured links between research and technology development by promoting biobehavioral research that is commensurate with engineering descriptions and specifications. ATG is active on local, state and national levels to promote strategic alliances between academe, industry and government to develop seminal technologies that can identify or ameliorate biomedical constraints on human behavior. ATG has established a Memorandum of Agreement

(MOA) with the Federal Laboratory Consortium for Technology Transfer, Midwest Region (FLC-MW) to define and translate assistive technology requirements, identify and select federal technologies for transfer, and, to develop, prototype and produce assistive technologies that are economically viable and commercially sustainable. ATG is a member of the FLC-MW Roundtable and serves as the Internet Gatekeeper for technology transfer for assistive technologies.

Past Research and Development Efforts at ATG:

Needs Assessment for Federal Technology Transfer for Individuals with Developmental Disabilities. Project Manager. State Grant Plan 95-6 Ohio Department of Mental Retardation and Developmental Disabilities, Ohio Developmental Disabilities Planning Council (ODDPC). This effort seeks to expand the technological solutions to selected problems encountered by individuals with disabilities. End user requirement assessments and technology evaluations are conducted to produce descriptions of abilities and disabilities in a classification framework that can provide appropriate requirement-technology linkages. Mechanisms of translation are applied between engineering and biobehavioral domains for the analysis of specific functional life activities and the selection of potential supporting technologies. The approach seeks to reveal how common dimensional descriptions of both human and system capabilities and limitations can facilitate purposeful technology synthesis. The approach will demonstrate how a variety of technologies and their combination can produce a general purpose and modular technology bundle that can be easily adapted to special purpose device implementations that fulfill a variety of functional activities and achieve maximum population inclusion.

Ohio Initiative in Human Systems Technology. Project Manager. State Grant Tech-96-035 Ohio Department of Development, Ohio Science and Technology Council (ODOD/OSTC). This effort developed support for a center of excellence for the advancement of the emerging industry of assistive human-systems technology and seeks to establish the State of Ohio on the leading edge of this industry. The Human Systems Technology Center would provide business access to state-of-the-art biobehavioral research and technology performed in-house or obtained through linkages with federal laboratories, universities and other institutions; provide access to education and training programs, conferences, seminars and other networking opportunities; and provide access to services that reveal the biobehavioral needs of the general population and that translate these needs into commensurate technology solutions. Activities include the identification of; the needs and market for human-systems technology; the resources for human-system technology development; mechanisms for matching needs and resources in human-systems technology, and; government, industry and academic partners.

Employee Consultant, Science Applications International Corporation (1996-2000)

Provided consulting services to the National Securities Studies and Strategies Group at SAIC, McLean, VA. Corporate support includes business development, facilitating inter-corporation strategic alliances, developing marketing strategies and supporting various marketing initiatives. Technical support is also provided to select programs. A recent program win included the Crew Centered Design Technology (CCDT) Advanced Development Project at AFRL/HE

Past Employee Consulting Efforts at SAIC:

Sensor Support to Special Operations Forces. Provided support to the Defense Advanced Research Projects Agency, Sensor Technology Office (DARPA/STO) for the identification of advanced sensor technologies to support the Special Operations Commands. As the lead for sensor technology assessment and applications support was provided to define current sensor capabilities and limitations across the full spectrum of available and in-development sensing technologies. The program goal was the identification of advanced sensing technologies that can facilitate the mission requirements of the Air Force, Army, Navy, Marine, and Joint Special Operations Forces.

NATO Special Group of Experts in Camouflage, Concealment and Deception. Provided invitational support to NATO AC/243, Special Group of Experts in Camouflage, Concealment and Deception (SGE/CCD), Working Group A: Measurements and Backgrounds, for the conduct of a three year multi-national program entitled "Background Characterization for Camouflage Pattern Development." Program support was provided for: the development of multispectral camouflage patterns that accurately replicate background texture, the identification of US multispectral camouflage capabilities, test site selection and characterization metrics, test design and performance evaluation metrics, and test conduct to the Chairman of NATO AC/243 SGE/CCD WG-A at the US Army CECOM, Research Development & Engineering Center, Night Vision & Electronic Sensors Directorate (AMSEL-RD-NV-CD-CCD).

Survivability Integration (SURVINT) - Force Survivability and Weapons of Mass Destruction. Provided support to the Defense Special Weapons Agency (DWSA), Electronic Systems Directorate, Survivability Assessments Division for the integration of DWSA research efforts to maximize the survivability of US forces and associated systems and infrastructure against a variety of wartime threats, to include conventional weapons, improved conventional weapons, and weapons of mass destruction. A prototype Survivability Simulation and Planning System (SSPS) was developed for the interactive analysis and planning of the employment of extant and future survivability assets to address global wartime contingencies at the unit/airbase, Joint Task Force, and Theater levels. Responsibilities included scenario definition, technology identification, selection of signature and force-on-force models, and task leadership for visual, electro-optic and thermal countermeasures and modeling.

Science Applications International Corporation (1989-1996)

Corporate responsibilities included serving as an SAIC Assistant Vice President, management of the Human Systems Technology Division, and direct supervision of the Human Performance Data Management Division. Functions included Corporate, Group and Division financial and technical planning, personnel management, marketing, and Program Management for multiple technical efforts. Managed all human factors and human engineering support for the Armstrong Laboratory, Human Engineering Division, Crew Systems Integration Branch (AL/CFHI) Strategic Integration Design Evaluation Facility (SIDEF) support contract (5yr, 16M) at Wright-Patterson Air Force Base, Ohio. The Air Force Service Effort Description Area for SIDEF is Human Systems Interface: Performance Assessment and Design. The SIDEF research objective is to: a) apply multiplace/distributed human-systems design research, evaluations and assessment tools to prototype crew station designs and systems for evaluation in current (B-1, B-2) and future automated multiplace cockpits, b) assess impacts of crew aiding technologies on multiplace crew performance, workload and situational awareness, and c) conduct information requirements analysis and conceptual workstation interface designs for distributed information warfare architectures. The Multiplace and Distributed Crew Systems

Technologies Program functional research and development areas include: a) Crew-Centered Aiding, Advanced Reconnaissance, Surveillance, and Target Acquisition, b) Design Assessment for Advanced Crew Systems, c) Crew Systems for Information Management and Display Technologies, d) Systems Engineering Design and Technical Analysis.

Past Research and Development Efforts at SAIC:

B-1 Sustaining Research Support Program. Human Factors lead. This Human-Systems Interface (HSI) Research Program provided the AL/CFHI Multi-Operator Design Assessment Laboratory (MODAL) and the B-1 SPO (ASC/YD) with a rapid response capability to address current and emerging issues by providing the Human Factors and Engineering expertise to address Multi-Operator Crew Aided Systems problem domains in the context of a B-1 research simulator. Human Factors research activities included: the review and analysis of multiplace/distributed human-systems design research, evaluations and assessment tools; conceptual development and prototyping of components to support crew station designs and systems for evaluation in current B-1 and future automated multiplace cockpits; development and assessment of crew aiding technologies on multiplace crew performance, workload and situational awareness; and the conduct of information requirements analyses and conceptual workstation interface designs for distributed information architectures.

B-2 Sustaining Research Support Program. Human Factors lead. This Human-Systems Interface (HSI) Research Program provided the AL/CFHI Multi-Operator Design Assessment Laboratory (MODAL) and the B-2 SPO with a rapid response capability to address current and emerging issues by providing the capability to prototype crewstation designs and multiplace and distributed crew systems, and provided the human factors capabilities to address Multi-Operator Crew Aided Systems and Human System Interface research for multiplace cockpit control and display-related issues in the context of a B-2 research simulator and associated research tools.

Multispectral Aerosol Obscurant Effects on Synthetic Aperture Radar Target Acquisition Program. Project Manager. Provided support to the U. S. Army Edgewood Research, Development and Engineering Center, and the Naval Surface Warfare Center, Warfare Systems Department, Countermeasures Division, Research Branch to examine human target acquisition performance using Synthetic Aperture Radar (SAR) systems in an air-to-ground offensive when defensive multispectral obscurants (MSO) are deployed. A high-resolution ground mapping radar simulator and specialized image processing algorithms were used to conduct experiments to determine separable MSO attenuation and backscatter effects on man-machine system performance during SAR target acquisition and designation processes. The research addressed multiple target classes in operationally representative simple and complex background target environments. Research objectives included development of optimized image processing algorithms to maximize an operator's ability to "see-through" various obscurant countermeasures, and, development of optimized obscurant designs.

Tactical Decision Aid Human Performance Modeling and Analysis Program. Project Manager. Provided support to the Wright Laboratory, Avionics Directorate, Electro-Optics Branch (WL/AARI) and the Phillips Laboratory, Geophysics Directorate, Atmospheric Sciences Division (PL/PGA) in the development, implementation and integration of visual detection, identification and recognition ranging algorithms to enhance the various Tactical Decision Aid (TDA) models (Infrared, Direct View, Electro-Optical and Television TDAs') predictive capabilities. The visual system algorithms were based on a space/spatial frequency pyramid

representation incorporating physiologic adaptive luminance and contrast gain control mechanisms. Laboratory analysis and psychophysical experimentation supported the parameterization and subsequent integration into the Air Combat Targeting Electro-Optical Simulation Program (ACT/EOS) mission planning effort. The project provided Air Force mission planners accurate human performance predictive capabilities of target data embedded in Geographic Information Systems (GIS) and Global Positioning Systems (GPS) derived reference environments combined with satellite imagery and the simulation of how real-world weather effects various sensor imaging capabilities. The approach allowed for high value complex target classes and complex backgrounds to be incorporated into the various TDA models and the ACT/EOS with accurate predictive modeling capabilities.

Camouflage, Concealment, Deception and Obscuration (CCDO) Program. Project Manager. Providing human factors, human engineering, and research technical-analytic support to AL/CFH for concept development and both laboratory and field, test and evaluation of various CCDO techniques to support Air Base Operability and Survivability (ABOS) initiatives. Research includes the design, development, and implementation of an advanced Texture Image Processing System (TIPS) to enable the conduct of research for the development and evaluation of spatial camouflage and disruptive patterns. Multispectral texture generation algorithm concepts are being developed for the development and evaluation of site-specific urban and foliated spatial camouflage patterning.

B-2 Cursor Design and Mechanization Program. Sponsored by the B-2 Systems Program Office (SPO), this program supported human factors research in the AL/CFHI B-2 simulator for the development and optimization of display cursor design and mechanization. Responsibilities included cursor mechanization design, and experimental design and evaluation in B-2 mission relevant contexts for Synthetic Aperture Radar (SAR) updates, and using a simulation of the Global-Positioning Aided Targeting System (GATS).

Fixed Facility Camouflage, Concealment and Deception Joint Test and Evaluation (JCCD): Test Design. Project Manager for Program Test Design. Provided support to the Office of the Secretary of Defense, Under Secretary of Defense, Acquisition, (OSD USD(A)), Weapons Systems Assessment, Special Test and Evaluation Program (WSA/STEP) and the JCCD Joint Test Force for the development and conduct of the JCCD Test and Evaluation program (4yr, 32M). Developed JCCD Program Test Design (PTD) document. This defined program test objectives, methodology, procedures, scenario requirements, and all test site requirements including ground and airborne instrumentation, data reporting formats, flight operation requirements, and environmental and safety assessments. Subsequent support was provided to develop the Program Test Plan, Program Database Management and Analysis Plan, Target Characterization Requirements, and Program Human Factors Plan. Created the Human Performance Data Management Division, to support the ongoing JCCD program conduct for the quantitative evaluation of the effectiveness of CCD against all modern threat weapons systems.

Laser Guided Weapons Countermeasures Program. Sponsored by the Defense Weapons Systems Agency and the Air Force Aeronautical Systems Center (ASC/YQ), this program is developing active countermeasure (CM) systems to defeat threat laser guided weapon systems. Responsibilities included analysis, development and systems specification for laser designation detection and signal processing, CM response algorithms, CM laser transmitters, beam transport systems, end optics, damage minimization zones, and evaluation of the adaptability of the proposed CM defensive systems against future precision guided weapon threats.

Deceptive Technique Evaluation Program. Project Manager. Camouflage, Concealment and Deception (CCD) research efforts involved (a) the development and evaluation of hybrid CCD techniques (b) the development and evaluation of aircraft masking patterns (c) experimentation on the perceptual basis of the deceptive effectiveness of 2-D decoys and masking patterns (d) luminance and chrominance tonedown strategies for air base facilities (e) large scale static and dynamic visual disruption techniques, (f) fixed facility decoy and signature reduction and enhancement techniques, and (g) requirements specifications for spectral properties of false operating surfaces. Supported various CCD field evaluations including Dusty Demo, Gallant Eagle and Creek Shadow. Responsibilities included all aspects of (a) data acquisition and analysis for visual, infrared and radar treatments (b) aircrew pre-brief, de-brief and questionnaire development, and (c) radar bomb scoring data and head-up display (HUD) analysis for various fighter aircraft sensor imagery.

Ideal Masking Pattern Program. Project Manager. Under Air Force Armstrong Laboratory, Directors Funding initiative developed a biologically-based parallel image processing system to compute optimal 2-dimensional spatial camouflage and masking patterns. The resulting Advanced Texture Image Processing System (ATIPS) combines spatially global (Fourier), spatially local (physiologic) and traditional image processing technologies into a common processing architecture for the rendering of ideal camouflage/ masking designs for any arbitrary environmental scenario.

Aim Sight Phase I Development Program. Human Systems Interface (HIS) lead designing, interfacing, and demonstrating advanced man-machine interfaces (MMI) in a full mission simulation for the B1-B and advanced strategic aircraft. Developed multisensor integration concepts and crew coordination and control integration concepts for a head-steerable FLIR (forward-looking infrared) imaging system applied to a night vision airborne reconnaissance search task and weapons delivery for strategic relocatable targets. Developed a virtual environment MMI demonstration capability provided to the Visually Coupled Airborne Systems Simulator (VCASS) Super Cockpit Program.

Optical Countermeasures (OCM) Program. Project Manager. Provided technical and experimental direction in the development, analysis and evaluation of various laser countermeasures against the human visual system and sensor/weapons systems. Research was conducted to evaluate OCM effects on aircrew performance including aircraft control, visual acuity, contrast sensitivity, visual perimetry and target detection, identification, and designation. Research efforts included the development of an interactive flight simulation capability for the evaluation of laser OCM on aircrew performance within the context of mission relevant scenarios for air base attack operations. Developed first approved protocol for direct intraocular laser exposure in humans to support research efforts.

The 4th Space Warning Squadron (4 SWS), Mobile, Survivability Improvement Program. Sponsored by the Defense Weapons Systems Agency, Strategic Command and Control Division (DWSA/NASC) this program improved the survivability of the Air Force Space Command, 21st Space Wing, 4 SWS during deployed ballistic missile warning operations. The program included analysis of exploitable identifying signatures for all operational phases and deployment locations across both the strategic and tactical conflict engagement spectrum to develop a comprehensive multispectral deceptive program. Responsibilities included task leadership for signature analysis and deceptive technique development for visual, thermal, radar, electronic, acoustic, and olfactory signature reduction.

ACE and SHAPE Alternate War Headquarters Deceptive Practices Programs. Provided technical analysis and test planning support to the Defense Nuclear Agency for both the Allied Command Europe (ACE), and the Supreme Headquarters Allied Program in Europe (SHAPE) Alternate War Headquarters Deceptive Practices Programs (ACE AWHQ/DPP, and SHAPE AWHQ/DPP). Developed and provided various CCD concepts, technologies and techniques for AWHQs (both existing and interim) and supported subsequent field testing for HQ AFCENT at the NATO Camouflage of Mobile Command and Control Elements (CAMCOE Phase II and III) exercises to evaluate CCD effectiveness.

Project CABLE. Project Manager. In conjunction with WL/AARI, ASC/YQ, and AL/CFH established a Memorandum of Understanding with the German Military Defense, Forschungsinstitut fur Optik (FGAN-FfO), and Industrieanlagen - Betribsgesellschaft (IABG/WVT), Military Installations and Image Processing to conduct the Joint German-US Project CABLE, (Camouflage of Air Bases, example Leipheim) to implement and field test various CCD measures designed to defeat airborne infrared acquisition systems. Developed program test plan for CCD treatments, data acquisition and analysis, sensor and imagery analysis, pilot pre-brief, interview and questionnaire. Developed and implemented visual/thermal decoys and masking patterns for field-test and conducted subsequent laboratory analysis and experimentation with field imagery.

Multispectral Smoke Obscuration Modeling. Project Manager. Developed a Silicon Graphics based flight simulation capability for the Aeronautical Systems Center, Integrated Engineering/Technology Management Directorate, Crew Systems Branch (ASC/EN) to research Infrared Smoke Obscuration Requirements for the denial of air to ground target acquisition. Conducted research program using simulated LANTIRN imagery to evaluate target acquisition as a function of airborne obscurant density using an equivalent contrast reduction technique.

Additional research efforts on SIDEF with significant support roles include:

Concept I Demonstration. Human factors lead in the development and implementation of image extraction algorithms for evaluating the performance of computer vision systems for image recognition and Automatic Target Cueing (ATC) using synthetic aperture radar (SAR) imagery. In support of the Strategic Relocatable Target (SRT) Program developed a Signal Detection Theory paradigm to evaluate man-machine system performance for real-time air-to-ground SRT acquisition using the Strategic Avionics Battle-management Evaluation Research (SABER) simulator.

Advanced Target Acquisition System (ATAS) Conceptual Studies. Assisted Strategic Air Command (SAC) in establishing system performance requirements for ATAS deployment concepts and configurations, and evaluate ATAS performance with flight simulation experimentation for various SAC missions.

Radar Warning Receiver Human Factors Study. Designed and conducted research to evaluate human performance, situation awareness and workload for an integrated vs. stand-alone radar warning receiver in the B1-B defense management system configuration.

Strategic Mission Analysis. Developed a B-1 relocatable target mission, conceptual control and display concepts, and supported simulation studies to evaluate human-system performance.

Automatic Map Cueing Evaluation. Conducted B1-B OSO task analysis, mission decomposition and development, and conduct experiments to evaluate new Automatic Map Cueing system.

Phase II Color Research. Designed and tested man-machine interface (MMI) concepts and advanced defensive display color formats for the B1-B Defensive System Officer's displays.

Additional research has included support to the Aeronautical Systems Center (ASC/XR) Specialized Short Term Development Planning Support contract. Support was provided to the Human Systems Division (HSC/XR):

a) In visual requirements analysis and future technology assessment for the ***Tactical Night Vision Program***, and the ***Night Vision Goggles Requirements Analysis and Technology Assessment Program***. Contributions included requirements analysis, technology assessment, mission analysis and trade studies for future night vision goggle and integrated helmet mounted display/sight systems for night low level visual navigation, targeting and weapon delivery.

b) In visual requirements analysis for the ***Close Air Support/Battlefield Air Interdiction and Reconnaissance Night Attack Sensor System Program***. Contributions included determining Tactical Air Command vision requirements for fixed and head-steered navigation, targeting and information (NTI) systems (both HMD and NVG targeting) to support Army operations with 24-hour CAS, BAI, and RECCE missions for the F-16.

Past efforts also included a compartmentalized program for the design, research and development for advanced sensor and display technology applications combining sensor fusion, real-time physiologic image processing, and multispectral hybrid display applications.

Systems Research Laboratories (1985-1989)

Concurrent program manager for the Optical Countermeasures (OCM) and the Camouflage, Concealment and Deception (CCD) programs at the Armstrong Aerospace Medical Research Laboratory (AAMRL) under the Human Engineering Support contract. While managing these two programs grew the full-time technical support staff from one to seven individuals. Management responsibilities included budget control, proposal development and directing a team of human factors and engineering personnel. Research responsibilities included problem definition, preparation and review of experimental protocols, conducting experiments, resource control and allocation, and documentation of results.

OCM research assessed visual performance for various aircraft and weapons systems to develop effective deployment and defense strategies for various optical countermeasure techniques. Direct interocular exposure to various threat lasers dominated the research programs. These included: dynamic target acquisition and visual tracking performance, measures of transient visual field losses, the effects of windscreens and personnel protective visors, spectral analysis of various optical media, quantification of beam profiles and scatter effects, and measures of spatial contrast sensitivity in the presence of structured exposures as a function of wavelength, target contrast, and adaptation level. Developed a review concerning metrics of eye safety with respect the thermal, photoacoustic, and photochemical hazards involved in laser exposure.

CCD research involved the development and evaluation of camouflage, concealment and deception related practices. This included active and passive aircraft visual signature reduction, air base luminance and chrominance tonedown strategies, the use of 2-D silhouette decoys, and

deceptive 2-D masking and shape disruptive patterning analysis. Research efforts also included developing a physiologically based vision model to predict detection thresholds of arbitrary space-time separable stimuli using a 4-D foveated space/spatial-frequency Gabor pyramid representation. Developed a new methodology for the derivation of optimal masking patterns and camouflage design based on psychophysical theories of visual system processing of pattern information.

University of Alabama at Birmingham Medical School (1984-1985)

Visual Neurophysiologist, Vision Science Research Center. Conducted detailed measures of spatial modulation transfer functions of physiologically identified neurons in the lateral geniculate nucleus (LGN) of Galago crassicaudatus, a prosimian primate. Difference-of-Gaussians modeling of center-surround organization for single-cell spatial contrast sensitivity functions was used to test current models of spatial receptive-field organization and to derive parameters specifying receptive-field spatial and sensitivity attributes for analysis. The results demonstrated fundamental differences in the spatial organization of the W, X, and Y LGN cell classes which mediate the relay of visual information to primary visual cortex. A comparison with other visual processing and physiologic response characteristics provided a better understanding of spatial processing in the primary visual pathway.

EDUCATIONAL EXPERIENCE

National Eye Institute Postdoctoral Fellow (1982-1984)

University of Alabama Medical School at Birmingham, Vision Science Research Center. Developed technologies and instrumentation necessary to conduct intracellular recording with horseradish peroxidase (HRP) staining techniques. Developed and implemented procedures for manufacturing and beveling glass capillary micropipettes, extracellular and intracellular recording techniques and instrumentation, physiological classification of neuronal response properties, iontophoresis of HRP, histological processing and histochemical staining of brain tissue, and morphological reconstruction of neurons. These inclusive techniques allowed the recovery of the complete detailed morphology of individual neurons in the Superior Colliculus of the tree shrew after physiological classification in the temporal and spatial domains using computer driven stimuli. These structure-function studies allowed a direct comparison between the information processing capacities of individual neurons and their specific morphological structure. Analysis examined relationships between physiologic response properties, cellular morphology, and connectivity.

Postdoctoral Research Associate, Visual Neurophysiology (1981-1982)

University of Alabama Medical School at Birmingham, Department of Physiological Optics. In a collaborative effort with Vanderbilt University Departments of Cell Biology and Psychology examined the receptive-field organization of relay cells in the lateral geniculate nucleus (LGN) of both normal and monocularly deprived Galago, a prosimian primate.

The studies in normal Galago demonstrated that W, X, and Y relay cells are segregated by LGN laminae in accordance with cell size distributions. Additionally, cells histologically localized to the interlaminar zones (ILZs) of the LGN exhibit W-cell response properties; a new finding consistent with the similar morphology and anatomical connections that ILZs share with W-cell LGN laminae across mammalian species. This significant discovery strongly supports

the conclusions that: a) both the ILZs and koniocellular layers in the Galago LGN convey W-like visual information from retina to cortex, and, b) in higher primates the W-cell pathway is preserved in the LGN intercalated layers, and that the full compliment of W, X, and Y pathways participate in the encoding and transmission of visual information from retina to cortex.

Provided the first report of the effects of monocular deprivation on the physiological response properties of relay cells in the LGN of a primate. Comparison of physiologically identified relay cells histologically localized to deprived vs. non-deprived LGN laminae revealed no alteration in the distribution of functional properties of any cell class despite a reduction in cell size of the deprived LGN laminae. This result disallowed previous models of deprivation induced amblyopia based on a direct competition between X and Y retinal afferents for post-synaptic targets within the main layers of the LGN. Proposed a new model of developmental amblyopia in primates that resulted from cortical changes due to reduced input from the deprived LGN laminae rather than to a selective loss of input from a particular functional cell class.

Graduate Research Fellow, Biopsychology Program (1978-1980)

Syracuse University, Department of Psychology. Doctoral Thesis: "Psychophysical Determinants of Temporal Processing in the Human Fovea." Measured foveal temporal processing characteristics using a combination of the Two-Pulse paradigm and Stiles' two color increment threshold technique. The results demonstrated that, in the temporal domain, the fovea behaves as a low-pass filter at absolute threshold independent of stimulus size. In the light adapted state, low-pass filter characteristics are observed provided stimulus size is within the limits of intensity-area reciprocity. Beyond these limits, foveal filter characteristics are band-pass and exhibit a progressively increasing low frequency attenuation (greater inhibitory effects) either as a function of increasing stimulus size or background luminance. Additionally, the results demonstrated the necessity for temporal processing models to accurately account for temporal probability summation effects.

Graduate Research Fellow, Physiological Psychology Program (1977-1978)

Syracuse University, Department of Psychology, Visual Psychophysics Laboratory. Investigated monoptic and dichoptic contributions to temporal brightness enhancement, demonstrating that the Broca-Sulzer effect originates before the combination of the individual monocular pathways at the cortical level. Also, isolated and characterized the contributions of sustained and transient mechanisms to brightness enhancement effects utilizing a unique spatio-temporal stimulus paradigm to produce and control selective transient adaptation.

Characterized brightness and darkness sensations in the human fovea using multidimensional and suprathreshold scaling techniques. Discovered and characterized asymmetries between brightness and darkness percepts in terms of sensation magnitude, flash durations producing maximal sensation, and in the minimal luminance changes necessary for brightness and darkness enhancement effects to be produced. Demonstrated that brightness and darkness sensations are generated by separate neuronal systems.

Graduate Research Associate (1976-1977)

Syracuse University, School of Engineering, Institute for Sensory Research, and Department of Psychology, Visual Psychophysics Laboratory. Investigated contextual determinants of

perceived length illusions using absolute magnitude estimation. Demonstrated that when all visual cues to context are eliminated, including contextual reference cues based on the limits of the visual field, the Horizontal-Vertical Illusion does not exist. Additionally, investigated methodological determinants of the Law of Size Constancy by scaling perceived line length as a function of viewing distance. Perceived length obeys the Law of Size Constancy when viewing distance is varied within sessions, whereas, across sessions perceived length increases as an inverse function of viewing distance.

Undergraduate Research Assistant (1974-1976)

Syracuse University, Department of Psychology. Supported National Eye Institute grant research "Mechanisms of Visual Sensitivity". Investigated spatial dependence of rod-cone interactions measured on scotopically equated adapting fields using the Crawford early light and dark adaptation paradigm. Temporal profiles of size dependent rod-cone interactions during transient light adaptation were characterized. Additionally investigated spectral sensitivity of Stiles π–mechanisms to incremental and decremental stimuli, suprathreshold two-pulse interaction, adaptive independence of the Stiles π_0 mechanism, blue cone spatial and temporal integration, and perceptual correlates of on- and off- center pathways.

REPRESENTATIVE PUBLICATIONS, PRESENTATIONS, AND REPORTS

Note: Over 150 references deleted due to classification issues.

1) Irvin, G.E., Irvin, J.G., Riccio, G.E., McDonald, P.V. and Skelly, J.J. *Advanced Human-Systems Technology for Uninhabited Aerial Vehicle (UAV) Ground Control Segments (GCS).* Laboratory Report. U.S. Air Force Research Laboratory, Human Effectiveness Directorate, Crew Systems Interface Division (AFRL/HECP). AFRL-HE-WP-TR-2000-0068, January 2000.

2) Irvin, G.E. *Technology Transfer and Applications from Industry-Academe Alliance*. Invited presentation Distributed Real-Time Sensors Program, Syracuse University, Computer Science Scalable Concurrent Programming Laboratory, October 20, 1999.

3) Irvin, G.E. *Spectral Mapping: A Perceptual Components Approach to Exploitation of Multispectral Imagery*. American Society for Photogrammetery & Remote Sensing and Resource Technology Institute (ASPRS-RTI), Tampa, FL, April, 1998.

4) McDonald, P.V., Riccio, G.E., Irvin, G.E. & Bloomberg, J.J. *Multimodal Perception of Multicriterion Control of Nested Systems: II. Constraints on Crew Members During Space Vehicle Abort, Entry and Landing*. National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, NASA TP-1998-3703v2, April, 1998.

5) Ramer, D.P., Irvin, G.E., Heaton, H.H. & Malek, D.A. *Multispectral Aerosol Obscurant Effects on Synthetic Aperture Radar Target Acquisition Study*. Proceedings of the Smoke/Obscurants Symposium XIX: Vol.1. U.S. Army Chemical Research, Development and Engineering Center, ERDEC-TR-223, STC TR-3123, April, 1997

6) Irvin, G.E., Aleva, D.L., Gaska, J.P. & Jacobson, L.D. *Human Performance Aiding for Tactical Decision Aids and Mission Performance Aids: A Model of Human Visual Performance for the Weather Impact Decision Aid (WIDA) Electro-Optical Simulation (ACT/EOS).* Armstrong Laboratory, Crew Systems Directorate, Human Engineering Division, Systems Integration Branch, AL/CFHI, AL/CF-TR-1996-0121, March 1996.

7) Irvin, G.E., Gaska, J.P. & Jacobson, L.D. *Human Performance Model (HPM): A General Model of Human Visual Discrimination Developed to Predict Human-System Performance for use in Tactical Decision Aids and Mission Performance Aids*. Phillips Laboratory, Directorate of Geophysics, Air Force Material Command, Hanscom AFB, MA, PL-TR-95-2092, December 1995.

8) Irvin, G.E. Invited Panelist, Symposium Synopsis Discussion Panel. Sixth Annual Camouflage, Concealment and Deception Symposium, Revolutionizing CCD for the Next Century, American Defense Preparedness Association, Combat Survivability Division, U.S. Navy Fleet Combat Training Center Atlantic, Virginia Beach, VA., September, 1995.

9) Watts, K., Hogan, G. & Irvin, G.E. *Fourth Space Warning Squadron Survivability Improvement Program: Phase II Survivability Exercise Report* (U). Defense Weapons Systems Agency, Strategic Command and Control Division (DWSA/NASC), Technical Report DNA-TR-95-66, June 1995.

10) Irvin, G.E. & Riccio, G.E. *User-Centered Approach to Strategic Alliances for Technology Transfer from the Federal Laboratories*. Invited presentation at the NTTC Forum on Commercialization of Disability Technologies: Overseeing the Commercialization and Marketing Gaps. Sponsored by the National Technology Transfer Center, American Chemical Society, Washington, DC, and April 1995.

11) Irvin, G.E. & Heaton, H.H. *Human Performance Evaluation of the Effects of Multispectral Aerosol Obscurants on Synthetic Aperture Radar Target Acquisition and Designation*. Invited presentation at U.S. Army, Edgewood Research, Development and Engineering Center, Research and Technology, Modeling and Simulation Team (SCBRD/RTM), Aberdeen Proving Ground, MD, April 1995.

12) Doyal, J.A., Irvin, G.E. & Ramer, D.P. *Operator Cursor Positioning Performance on Navigational Update and Target Positioning Tasks: Evaluation of Gain Functions for the B-2 Radar-Embedded Cursor System* (U). Armstrong Laboratory, Crew Systems Directorate, Human Engineering Division, Crew Systems Integration Branch, AL/CFHI, AL/CF-TR-1995-0106, April 1995.

13) Doyal, J.A., Irvin, G.E. & Ramer, D.P. *Evaluation of Gain Functions for the B-2 Radar-Embedded Cursor System*. Air Force Systems Command, B-2 Systems Program Office, IFC Integrated Product Team, Cockpit Integration Group, ASC/YSDS, 79 pp., January 1995.

14) Irvin, G.E. *Federal Technology Transfer for the Development of Assistive Technologies*. Invited presentation at the Improvement of Assistive Technology Devices for Home Care of Persons with Physical Impairments Conference, Sponsored by the Medical College of Wisconsin, Office of Research and Technology, and, Center for Biomedical Engineering and Biomathematics, Milwaukee, WI, June 1994.

15) Stengle, J.D., Heaton, H.H., Finch, S., Hopper, J., Irvin, G.E., Irvin, J.G., et. al. *Systems Engineering Design and Technical Analysis for Strategic Avionics Crew Station Design Evaluation Facility (SACDEF)* Armstrong Laboratory, Crew Systems Directorate, Human Engineering Division, Crew Systems Integration Branch, AL/CFHI-TR-1994-0074, May, 1994.

16) Irvin, G.E. *Toward a New Methodology for the Development of Assistive Technologies*. Invited presentation at the Forum on Technology Transfer and People with Disabilities,

Sponsored by the National Technology Transfer Center, American Chemical Society, Washington, DC, March 1994.

17) Irvin, G.E., Wilson, D.L., Gaska, J.P. and Jacobson, L.D. *Human Performance Modeling and Analysis Program for Mission Planning Aids*. Weather Impact Decision Aids (WIDA) for Operation of Electro-Optical and Radio Frequency Systems, Requirements and Technical Interchange Meeting, Las Vegas, NE, March 1994.

18) Irvin, G.E. *Quantitative Methodologies for the Development and Evaluation of Camouflage Systems*. Visiting Scientists Invitational Colloquium, Headquarters U.S. Army, Belvoir Research, Development and Engineering Center, Night Vision and Electronic Sensors Directorate, Visionics and Image Signal Processing Division (AMSEL-RD-NV-D), Ft. Belvoir, VA, March 1994.

19) Irvin, G.E., Casagrande, V.A., Norton, T.T. *Center-Surround Relationships of Magnocellular, Parvocellular and Koniocellular Relay Cells in Primate Lateral Geniculate Nucleus*. Visual Neuroscience, 10, 363-373, 1993.

20) Irvin, G.E. *Technology Transfer for Developmental Disabilities*. Invited presentation to the Ohio Developmental Disabilities Planning Council, Columbus, OH, December 1993.

21) Irvin, G.E. *The Assistive Technologies Group Technology Transfer Initiative*. Forum on Technology Transfer for Developmental Disabilities. Sponsored by the Assistive Technologies Group at Wright State University, Dayton, OH, December 1993.

22) Irvin, G.E. & Wilson, D.L. *Texture Image Processing System for the Development and Evaluation of Multispectral Spatial Patterning*. Fourth Annual Camouflage, Concealment and Deception Symposium, CCD for Joint/Combined Contingency Operations, American Defense Preparedness Association, Combat Survivability Division, Eglin AFB, FL., October, 1993.

23) Irvin, G.E. *Ohio Consortium for the Development of Assistive Technologies*. Presentation by the Assistive Technologies Group to Federal Laboratory Consortium for Technology Transfer and Air Force Armstrong Laboratory. Dayton, OH, September, 1993.

24) Wilson, D.L. & Irvin, G.E. *Human Performance Modeling of Target Detection, Identification, and Recognition Ranges for Application in Tactical Decision Aids*. Fourth Annual Ground Target Modeling and Validation Conference, U.S. Army Tank-Automotive Research, Development and Engineering Center, and, U.S. Army Belvoir Research, Development and Engineering Center. Warren, MI, August 1993.

25) Irvin, G.E. *The Future Threat from Precision Guided Weapons and Strategies for Defeat by Advanced Optical Modulation Techniques*. Laser Countermeasures Program IPR, Defense Nuclear Agency and Aeronautical Systems Division, Air Base Operability and Survivability Branch (ASC/YQ), Eglin Air Force Base, August, 1993.

26) Irvin G.E. *Vision Research in the Department of Defense*. Visiting Scholars Program Invitational. Vision Science Research Center, School of Optometry Department of Physiological Optics, University of Alabama at Birmingham, AL, April, 1993.

27) Irvin G.E., Doyal J.A. & Koch R.D. *Experimental Approach to the Evaluation of Radar Obscurant Requirements for Effective Disruption of Air-to-Ground Target Acquisition*. Proceedings of the Smoke/Obscurants Symposium XVII: Early Entry Survivability. U.S. Army

Chemical and Biological Defense Agency, Edgewood Research, Development and Engineering Center, Research and Technology Directorate, Vol. 1, pp. 171-183, 1993.

28) Irvin G.E., Jacobson L.D. & Gaska J.P. *Human Performance Modeling to Improve Tactical Decision Aid Ranging Algorithm Predictions*. Electro-Optical Tactical Decision Aid Conference, Las Vegas, NE., March, 1993.

29) Irvin, G.E. *Joint Camouflage, Concealment and Deception (JCCD) Joint Test and Evaluation Program Test Design*. Office of the Secretary of Defense, Under Secretary of Defense, Acquisition, (OSD USD(A)), Weapons Systems Assessment, Special Test and Evaluation Program (WSA/STEP), 126 pp., September 1992.

30) Irvin, G.E. and Dowler, M.G. *Modeling Requirements for Human Performance Evaluation Metrics for Airborne Tactical Decision Aids: Pyramidal Representations, and, Adaptive Luminance and Contrast Gain Control*. Invited Presentation, Wright Laboratory, Avionics Directorate, (WL/AARI), Dayton, OH, September, 1992.

31) Irvin, G.E. *Multimedia Information Analysis Procedures for a New Fiducial Aimpoint Scoring Methodology to Support Air-to-Ground Multispectral Target Acquisition Field Testing using the Global Positioning Systems (GPS) based Tactical Air Combat Training System (TACTS)*. Invited Presentation at Headquarters, Joint Camouflage, Concealment and Deception Joint Test and Evaluation Program (JCCD), Vicksburg, MS, September, 1992.

32) Irvin, G.E., Gaska, J.P. and Jacobson, L.D. *Joint Space/Spatial Frequency Representation Architectures to Support Prediction of Airborne Visual Detection, Identification and Recognition Ranges of Complex Target Classes in Complex Backgrounds*. Invited Presentation at Phillips Laboratory, Geophysics Directorate, Atmospheric Sciences Division (PL/PGA), May, 1992.

33) Irvin, G.E., Dowler, M.G. *Physiological-Based Computational Approach to Camouflage and Masking Patterns*. Automatic Object Recognition II, Psychophysics for Easier Pattern Recognition, SPIE Symposium on Optical Engineering and Photonics in Aerospace Sensing, Vol. 1700, pp. 481-488, April, 1992.

34) Irvin, G.E. *Program Test Design Architecture for the Fixed Facility Joint Camouflage, Concealment and Deception Joint Test and Evaluation Program*. Joint Test and Evaluation Working Group Meeting, Reno, NV, February, 1992.

35) Donohue, T.R., Irvin, G.E., Doyal, J.A. & Dowler, M.G. *Creek Shadow Camouflage, Concealment and Deception (CCD) Demonstration Final Report: Experimental Results and Complete Data Bases of Pilot Questionnaires, Radar Bomb Scoring and Head-Up Display Imagery and Voice Analysis*. Armstrong Laboratory, Crew Systems Directorate, Human Engineering Division, Crew Systems Integration Branch, AL/CFHI, CCD-ILR-92:01, 1992. (UNCLASSIFIED).

36) Irvin, G.E. *Second Generation Camouflage, Concealment and Deception Approaches*. American Defense Preparedness Association, Combat Survivability Division Symposium on Camouflage, Concealment and Deception, A Combat Multiplier. US Marine Corps Station, Quantico, VA., November 1991.

37) Irvin, G.E. *Visual Detection Simulator: A Physiologically Based Computational Approach to Human Visual Threshold Prediction*. Invited presentation at USAF Human Systems Division

Armstrong Laboratory Advisory Group Conference on Applied Spatial Vision Models for Target Detection and Recognition. San Antonio, TX., March 1991.

38) Irvin, G.E., Keep, G.F., Dowler, M.G. *2-Dimensional Aircraft Decoys Based on Perspective Rendition: Overview and Experimental Results*. Aerospace Medical Association, Cincinnati, OH., May 1991.

39) Keep, G.F., Donohue, T.R., Irvin, G.E. & Dowler, M.D. *Development and Evaluation of a Two-Dimensional KC-135/AWACS Decoy: Laboratory Evaluations and CREEK SHADOW Field Testing*. Headquarters Strategic Air Command, HQ SAC/XOBS, 27pp., January, 1991.

40) Irvin, G.E. *Visual Perception Factors Related to Pilot Target Acquisition in the Presence of Camouflage, Concealment and Deception Techniques*. Eighth Joint Test and Evaluation CCD Working Group, USAF Air Base Operability Office, Eglin AFB, FL., January, 1991.

41) Irvin, G.E., Doyal, J.A., Keep, G.F. & Dowler, M.G. *The Evaluation of 2-Dimensional Silhouette Decoys of KC-135 Aircraft Using Computer Based Flight Simulation*. Armstrong Laboratory, Crew Systems Directorate, Human Engineering Division, Crew Systems Integration Branch, AL/CFHI, CCD-ILR-91:03, 1991 (UNCLASSIFIED).

42) Irvin, G.E., Donohue, T.R. & Dowler, M.G. *Evaluation and Specification of Chromaticity Coordinants for an Effective Concrete False Operating Surface (FOS) (U)*. Armstrong Laboratory, Crew Systems Directorate, Human Engineering Division, Crew Systems Integration Branch, AL/CFHI, CCD-ILR-91:01, 1991 (UNCLASSIFIED).

43) Irvin, G.E., Dowler, M.G. *The Effects of Continuous-Wave Laser Countermeasures and Laser Protective Visors on Simulated Terrain Following and Targeting Accuracy (U)*. Proceedings of the Ocular Hazards in Flight and Remedial Measures Symposium, Advisory Group for Aerospace Research and Development, London, U.K. Oct, 1990. (Secret).

44) Irvin, G.E., Urban, K.E. & Dowler, M.G. *Psychophysical Evaluation of Personnel Protective Visors: Acuity, color discrimination and contrast sensitivity (U)*. Armstrong Aerospace Medical Research Laboratory, Human Systems Division, Air Force Systems Command. OCM-ILR-89:02, 1989, (Secret).

45) Irvin, G.E., Urban, K.E., Spravka, J.J. & Kang, R.N. *The Effects of Pulsed and Continuous Wave Optical Countermeasures on Target Detection Performance (U)*. Armstrong Aerospace Medical Research Laboratory, Human Systems Division, Air Force Systems Command. OCM-ILR-89:01, 1989, (Secret).

46) Norton, T.T., Casagrande, V.A., Irvin, G.E. & Sesma, M.A. *Contrast sensitivity functions of W-, X- and Y-like relay cells in lateral geniculate nucleus of Bush Baby (Galago crassicaudatus)*. J. Neurophysiology, 59:6, 1639-1656, 1988.

47) Irvin, G.E. & Kuyk, T.K. *Camouflage Concealment and Deception Guidelines Manual (U)*. Prepared by ICON Consultants and Systems Research Laboratories for Armstrong Aerospace Medical Research Laboratory, Human Systems Division, Air Force Systems Command. 222 pp., 1988, (UNCLASSIFIED).

48) Irvin, G.E., Kang, R.N., Spravka, J.J. & O'Neal, M.R. *Correlational Investigation of Contrast Sensitivity and Visual Acuity in the Detection of Approaching Aircraft*. Aviation, Space and Environmental Medicine, 59:4, 463, 1988.

49) Irvin, G.E. *Overview of Current and Future Research Efforts of the Camouflage, Concealment and Deception Program at Armstrong Aerospace Medical Research Laboratory*. Joint Service Camouflage, Concealment and Deception Research Technical Coordinating Meeting, Invited Presentation, Naval Civil Engineering Laboratory, Port Hueneme, CA, October, 1987.

50) Irvin, G.E. & Kang, R.N. *Perimetry Measures of Transient Visual Field Loss in the Presence of Foveal Laser Exposures in Humans (U)*. Sixth DoD Conference on Directed Energy Weapons: Vulnerability, Survivability and Effects. Joint Technical Coordinating Group on Aircraft Survivability. National Bureau of Standards, Gaithersburg, MD, May 1987, (Secret).

51) Irvin, G.E., Norton, T.T., Sesma, M.A. & Casagrande, V.A. *W-like Response Properties of Interlaminar Zone Cells in the Lateral Geniculate Nucleus of a Primate (Galago Crassicaudatus)*. Brain Research, 362, 254-270, 1986.

52) Irvin, G.E., Norton, T.T. & Casagrande, V.A. *Receptive-field Properties Derived from Spatial Contrast Sensitivity Measurements of Primate Lateral Geniculate Nucleus Cells*. Invest. Ophthal. and Vis. Sci. Suppl., 27, 1986.

53) Casagrande, V.A. Irvin, G.E., Norton, T.T., Sesma, M.A. & Petry, H.M. *Difference of Gaussian Model of Contrast Sensitivity Functions from W-, X- and Y-like Cells in Primate Lateral Geniculate Nucleus*. Investigative Ophthal. and Visual Science, 27, 1986.

54) Irvin, G.E. *New Concepts of Neural Organization from Intracellular Injection of Neurons: Morphological Organization of Physiologically Identified Neurons in the Superior Colliculus*. Invited Lecture, Southeastern Regional Neuroscience Symposium, Birmingham, AL. 1985.

55) Irvin, G.E. & Norton, T.T. *Structure Function Relationships of Visual Neurons in the Tree Shrew Superior Colliculus*. Southeast Regional Nerve Net Symposium, Invited Lecture, C.V. Whitney Laboratories, St. Augustine, FL., Mar, 1984.

56) Sesma, M.A., Irvin, G.E., Kuyk, T.K., Norton, T.T. & Casagrande, V.A. *Effects of Monocular Deprivation on the Lateral Geniculate Nucleus in a Primate*. Proc. National Academy of Science, 18, 2255-2259, 1984.

57) Irvin, G.E. *The Primate Superior Colliculus; the Functional Implications of our Current Understanding of Anatomy, Physiology, and Psychophysics*. Invited Lectures (two), Current Topics in Optometry and Visual Science, Vision Science Research Center, School of Optometry Medical Center, University of Alabama in Birmingham, May, 1984.

58) Irvin, G.E. *Neurophysiological, Anatomical, and Psychophysical Basis of On- and Off-center Mechanisms in the Mammalian Visual System and their Implications for Current Theoretical Models of Visual Information Processing*. Invited Lecture, Current Topics in Optometry and Visual Science, Vision Science Research Center, School of Optometry, The Medical Center, University of Alabama in Birmingham, April, 1984.

59) Irvin, G.E., Norton, T.T., Sesma, M.A. & Casagrande, V.A. *W-like Receptive Field Properties of Interlaminar Cells in Primate Lateral Geniculate Nucleus*. Society for Neuroscience, 10, 297, 1984.

60) Irvin, G.E. *Relationships Between Visual Information Processing Characteristics of Individual Neurons and Cellular Morphologies Derived from Intracellular Horseradish Peroxidase Staining Techniques*. Invitational Lecture Series, Departments of Cell Biology and

Psychology, and, Departments of Electrical and Biomedical Engineering, Vanderbilt University, Nashville, TN, March 1984.

61) Irvin, G.E., Norton, T.T. & Kuyk, T.K. *Morphology of Physiologically Identified Neurons in the Superior Colliculus of the Tree Shrew*. Invest. Ophthal. and Vis. Sci. Suppl., 24, 224, 1983.

62) Irvin, G.E., Sesma, M.A., Kuyk, T.K., Norton, T.T. & Casagrande, V.A. *Visual Response Latencies and Contrast Sensitivity Functions in Primate Lateral Geniculate Nucleus after Monocular Deprivation*. Soc. Neurosci. 9, 25, 1983.

63) Irvin, G.E. *Mechanisms of Color Vision in Tupia Glis; the Basis of Dichromacy*. Invited Lecture, Department of Physiological Optics, School of Optometry Medical School, University of Alabama at Birmingham, AL, April, 1982.

64) Irvin, G.E., Sturr, J.F. & Kobus, D.A. *Foveal Two-Pulse Summation Characteristics*. Investigative Ophthalmology and Visual Science, 22, 123, 1982.

65) Irvin, G.E. *Psychophysical Determinants of Temporal Processing in the Human Fovea*. Doctoral Dissertation in BioPsychology, Syracuse University, 189 pp., October, 1981.

66) Irvin, G.E. *Psychophysical Basis for Statistical Signal-to-Noise Measures of the Efficiency of Central Visual Mechanisms*. Invited Lecture, Visual Psychophysics Lab, Dept. of Psychology, Syracuse University, September, 1981.

67) Irvin, G.E. *Psychophysical Correlates of ON- and OFF-center pathways*. Invited Lecture, Department of Physiological Optics, School of Optometry/The Medical School, University of Alabama at Birmingham, AL, June, 1981.

68) Irvin, G.E. & Verrillo, R.T. *Absolute Magnitude Estimation of Line Length as a Function of Contrast, Line Orientation, and Viewing Distance*. Eastern Psychological Association, Hartford, CT, April 1980.

69) White, T.W., Irvin, G.E. & Williams, M.C. Asymmetry in the Brightness and Darkness Broca-Sulzer Effects. Vision Research, 20, 723-726, 1980.

70) Irvin, G.E. *Isolating the Contribution of Sustained and Transient Visual Mechanisms to Subjective Brightness using a Spatio-temporal Adaptation Paradigm*. Invited Lecture, Visual Psychophysics Laboratory, Department of Psychology, Syracuse University, March, 1980.

71) Irvin, G.E. *An Anatomical Investigation into the Possible Existence of Differential Projections from the Parvocellular Laminae of Lateral Geniculate Nucleus to Striate Cortex in Macaque Monkey*. Doctoral Thesis Proposition, Manuscript #1, 35 pp., July, 1979.

72) Irvin, G.E. & Verrillo, R.T. *Size Constancy and the Absolute Magnitude Estimation of Line Length*. Sensory Processes, 3, 275-285, 1979.

73) Verrillo, R.T. & Irvin, G.E. *Absolute Magnitude Estimation of Line Length as a Function of Orientation and Contrast Polarity*. Sensory Processes, 3, 261-274, 1979.

74) Irvin, G.E., White, T.W., Williams, M.C. & Sturr, J.F. *The Brightness and Darkness of Brief Changes in Luminance*. J. Optical Society America, 69, 1486-1487, 1979.

75) Gaska, J.P., Sturr, J.F. & Irvin, G.E. *Small Adapting Fields Favor Rod-Cone Interaction During Early Light Adaptation*. J. Opt. Soc. Am., 69, 1453, 1979.

76) Irvin, G.E. *The Segregation of On- and Off-Center Responses in the Mammalian Visual Pathway*. Invited Lecture, Anatomy of Sensory Systems, School of Engineering, Institute for Sensory Research, Syracuse University, October, 1978.

77) White, T.W., Irvin G.E. & Williams M.C. *Evidence Supporting a Retinal Interpretation of the Broca-Sulzer Effect*. Investigative Ophthalmology and Visual Science, 18, 131, 1978.

DECLARATION OF
Shahab Khoshmashrab

I, **Shahab Koshmashrab**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Senior Mechanical Engineer .**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I prepared the supplemental staff testimonies on **Overriding Consideerations - Thermal Energy Storage** and **Natural Gas Consumption**, for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: June 19, 2014

Signed: Shahab Khoshmashrab

At: Sacramento, California

Shahab Khoshmashrab
Senior Mechanical Engineer

Experience Summary

Eighteen years experience in the mechanical, civil, structural, and manufacturing engineering fields involving engineering and manufacturing of various mechanical components and building structures. This experience includes QA/QC, construction/licensing of electric generating power plants, analysis of noise pollution, and engineering and policy analysis of thermal power plant regulatory issues.

Education

- California State University, Sacramento-- Bachelor of Science, Mechanical Engineering
- Registered Professional Engineer (Mechanical), California License No. M 32883, Exp. 9/30/2014

Professional Experience

2001-Current—Senior Mechanical Engineer – Siting, Transmission, and Environmental Protection Division – California Energy Commission

- Perform analysis of generating capacity, system reliability and safety, energy efficiency, noise and vibration, jurisdictional determination, and the mechanical, civil, electrical, and structural aspects of power plants during licensing, construction, and operation.

- As the Facility Design Unit's lead, or senior, review and manage the work of technical staff (other engineers) and contractors; ensure project deadlines are met; and ensure that projects propose and implement the most energy efficient technologies to satisfy project objectives while protecting the environment;

- Independently review and evaluate Applications for Certification to ensure compliance of power plants and related facilities with applicable laws, ordinances, regulations, and standards and California Environmental Quality Act, or CEQA;

- Prepare and recommend to the Siting Committee, conditions of certification (including mitigation measures) under which power plants should be licensed, constructed and operated;

- Present oral and written expert testimonies in support of analysis at evidentiary hearings held before the Siting Committee and the public; and

- Assist the California Energy Commission in policy making related to power generation.

1998-2001—Structural Engineer – Rankin & Rankin

Engineered concrete foundations, structural steel and sheet metal of various building structures including energy related structures such as fuel islands. Performed energy analysis/calculations of such structures and produced both structural plans and detailed shop drawings using AutoCAD.

1995-1998—Manufacturing Engineer – Carpenter Advanced Technologies

Managed manufacturing projects of various mechanical components used in high tech medical and engineering equipment. Directed inspection of first articles. Wrote and implemented QA/QC procedures and occupational safety procedures. Conducted developmental research of the most advanced manufacturing machines and processes including writing of formal reports. Developed project cost analysis. Developed/improved manufacturing processes.

DECLARATION OF
Andrea Koch

I, **Andrea Koch**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as an **Environmental Planner II.**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I prepared the supplemental staff testimony on **Traffic and Transportation** for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)** based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 6/20/14

Signed: Andrea Koch

At: Sacramento, California

ANDREA KOCH

PROFESSIONAL EXPERIENCE

CALIFORNIA ENERGY COMMISSION, December 2009 – Present

Siting, Transmission, and Environmental Protection Division, Sacramento, California

Environmental Planner II- Perform environmental review of power plant applications.

- Review power plant applications for traffic and transportation and land use impacts.
- Write environmental analysis documents.

CITY OF SACRAMENTO, June 2007 – July 2009

Planning Department, Long-Range Planning Division, Sacramento, California

Assistant Planner- Performed long-range city planning for Sacramento.

- Coordinated review of the Draft 2030 General Plan, a comprehensive citywide land use plan.
- Prepared Ben Ali and Hagginwood neighborhood plans. Worked with City staff and community members to identify strategies for resolving neighborhood issues, such as infrastructure deficiencies.
- Reviewed 70 development applications, analyzing their consistency with City policy and providing written feedback to applicants.

COUNTY OF SANTA CRUZ, June 2005 – June 2007

Planning Department, Environmental Planning Division, Santa Cruz, California

Resource Planner II- Performed resource planning for Santa Cruz County.

- Reviewed development permit applications to ensure their consistency with regulations for creeks, wetlands, grading, geologic hazards, erosion control, and sensitive plant and animal species.
- Wrote staff reports analyzing development proposals and providing recommendations to the Environmental Planning Division Manager.
- Performed an average of 5 weekly pre-construction meetings and final inspections at project sites to ensure that development was consistent with County regulations and required mitigations.
- Regularly assisted the public with resource planning questions, both in-person and over the phone.

COUNTY OF MONTEREY, November 2004 – June 2005

Planning Department, Marina, California

Assistant Planner- Performed current planning for Monterey County.

- Reviewed development permit applications for consistency with County regulations.
- Prepared and presented staff reports for development applications. Reports provided recommendations to the Zoning Administrator.
- Assisted the public with zoning questions, both in-person and over the phone.

EDUCATION

California Polytechnic State University, San Luis Obispo, California

- Master of City and Regional Planning, Concentration in Environmental Planning, 2004

University of California, Davis

- Bachelor of Science in Wildlife, Fish, & Conservation Biology, Concentration in Conservation Biology, 2002
- Graduated with High Honors and a Department Citation

DECLARATION OF
Geoff Lesh

I, **Geoff Lesh**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Senior Mechanical Engineer.**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I helped prepare the supplemental staff testimony on **Biological Resources**, for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 6/18/2014

At: Sacramento, California

Signed: Geoff Lesh

Geoffrey Lesh, PE

WORK HISTORY

California Energy Commission Senior Mechanical Engineer 2002 - Current

- Analyze siting permit applications for gas-fired and solar-thermal power plants in the technical areas of hazardous materials management, fire safety, security, and worker safety plans
- Provide written and oral expert witness testimony at commission hearings on power plant fire protection plans, risk assessments, and adequacy of local fire departments
- Recommend mitigations as needed
- Inspect power plants during construction and operational phases
- Investigate accident, fire, and hazardous materials incidents at power plants

Self-Employed Independent Investor 2000 - 2002

- Wrote market analysis computer software

Read-Rite Corp Wafer Engineering Manager 1994 - 2000

- Designed and developed wafer manufacturing processes for computer data storage systems. Managed team of engineers and technicians responsible for developing wet and dry chemical processes for manufacturing, including process and safety documentation
- Managed process and equipment selection for manufacturing processes
- Processes included vacuum processed metals and ceramics, grinding-polishing, plating, etching, encapsulation, process troubleshooting, and SPC reporting

Dastek Corp (Komag Joint Venture Start-up) Wafer Engineering Manager 1992 - 1994

- Developed wafer processes for new-technology recording head for hard disk drives
- Managed team of engineers and technicians
- This position included start-up of wafer fab, including line layout, purchase, installation, and startup of new process equipment, etc.

Komag, Inc Alloy Development Manager 1989 - 1992

- Developed new vacuum-deposited recording alloys
- Responsible for planning and carrying-out tests, designing experiments, analyzing results, managing test lab conducting materials characterizations
- Extensive process modeling, experiment design and data analysis

Verbatim Corp (Kodak) Process Development Manager 1983 – 1989

- Mechanical/materials engineering for computer disk manufacturing, including product, process, and equipment including metal-ceramic-plastic processes for optical disk development
- Production processes included metal plating, metal evaporation, reactive sputtering, laser-based photolithography, injection molding
- Steering Committee Member, Center for Magnetic Recording Research, UC San Diego
- Steering Committee Member, Institute for Information Storage Technology, Santa Clara University

IBM Corp Mechanical/Process Engineer 1977 - 1983

- Product development for photocopiers, semiconductors, and computer data tape-storage systems

EDUCATION

Stanford University, Master of Science Degree	Materials Science and Engineering
UC-Berkeley, Bachelor of Science Degree (Double Major)	Mechanical Engineering, Materials Science and Engineering
University of Santa Clara, Graduate Certificate	Magnetic Recording Engineering

PROFESSIONAL LICENSES and CERTIFICATIONS

Registered Professional Engineer, California (PE)	Mechanical #M32576 Fire Protection #FP1827 Metallurgical #MT1940
Certified Safety Professional (CSP)	Board of Certified Safety Professionals
Certified Fire Protection Specialist (CFPS)	Certified Fire Protection Specialist Board of NFPA
Certified Fire and Explosion Investigator (CFEI)	Board of National Association of Fire Investigators

OSHA 40-hr HAZWOPER Hazardous Materials Incident Training

PROFESSIONAL ASSOCIATIONS

American Society of Safety Engineers – Professional Member
Society of Fire Protection Engineers – Professional Member
National Fire Protection Association – Member
National Association of Fire Investigators – Member

PUBLICATIONS

All-Solid Lithium Electrodes with Mixed-Conductor Matrix, J. Electrocchem. Soc. 128, 725 (1981).
Proc. Symp. on Lithium Batteries, H.V. Venkatasetty, Ed., Electrochem Soc (1981), p. 467.

PATENTS

Method of Preparing Thermo-Magneto-Optic Recording Elements, US Patent# 4,892,634, (assigned to Eastman Kodak Co.)

DECLARATION OF
Jacquelyn Record

I, **Jacquelyn Record**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a**n Air Resources Engineer.**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I prepared the supplemental staff testimony on **Natural Gas**, for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: June 18, 2014

Signed: Jacquelyn L. Record

At: Sacramento, California

(916) 654-3846 work
jleyva@energy.ca.gov

Jacquelyn Leyva Record

Experience

March '09 – Present **CA Energy Commission** **Sacramento, CA**

Air Resources Engineer

- Currently authoring staff assessment analyses for the technical area of air quality for the Engineering and Siting Division permitting power plant projects over 50 MW in the state of CA. Worked on renewable ARRA funding projects along with natural gas power projects.
- Reviewing emission compliance reports
- Authored staff analyses for project amendments
- Trained in CEQA and NEPA analysis, along with AERMOD air modeling.

August '08 – March '09 **ERRG, Inc.** **Martinez, CA**

Engineering Assistant

- Assisted with both technical and field duties for a variety of environmental investigations.
- Assisted on an environmental site assessment, preliminary assessments (PA), site inspections, and remedial investigations feasibility studies.
- Field duties performed include groundwater sampling and air sampling

June '07 – March '08 **Tetra Tech EC, Inc** **Santa Ana, CA**

Engineering Assistant Intern

- Working on various Department of Defense projects in environmental engineering.
- Helped assist in 5 year review of remediation approaches.
- Helping assist with a commercial project creating a water reuse/recycle treatment plant.

June '05 – September '05 **SF Regional Water Board** **Oakland, CA**

Contract Work – Special Project

- Wrote a memorandum regarding total petroleum hydrocarbons showing up as false positives in submitted quarterly monitoring reports for NPDES FUEL permit.
- Researched various EPA methods of testing for VOC, and Fuel constituents in water.
- Communicated with consultants from Weiss Associates and state funded laboratories to come to a conclusion for memorandum.
- Site inspections, site reports.

Education

2003-June 2008 University of California Irvine Irvine, CA

- B.S., Chemical Engineering
- MAES (Mexican American Engineers and Scientists) - Vice Chair 2004-2005
- CAMP summer science program participant 2003

June 1999 – September 2003 Las Lomas High School Walnut Creek, CA

- High School Diploma
- Life time member of CSF (California Scholarship Federation).

DECLARATION OF
Christine Stora

I, **Christine Stora**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Compliance Project Manager.**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I prepared the supplemental staff testimony on **Project Description**, for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 6/18/14

Signed: Christine Stora

At: Sacramento, California

CHRISTINE R. STORA

EXPERIENCE SUMMARY

Over nine years of project and staff management experience related to the development of energy projects in North America and other international locations. Technical focus on NEPA, and CEQA compliance, planning, permitting, and compliance monitoring.

PROFESSIONAL EXPERIENCE AND EDUCATION

CALIFORNIA ENERGY COMMISSION COMPLIANCE PROJECT MANAGER
06/2010 to Present

Manages power plant compliance for licensed power plants in California including solar, geothermal, and natural gas. Duties include oversight of power plant construction and ensuring that the conditions of certification are being met throughout construction, operation, and decommissioning of various power plants in California. Reviews petitions to amend existing licenses and gives recommendations to the Commission for approval or denial of requests. Coordinate with Commission technical staff, Certified Building Officers, other regulatory agencies, developers, contractors, and the public to ensure power projects are in compliance with all applicable conditions of certification and LORS. Working knowledge of CEQA, NEPA, and the Warren-Alquist Act.

Construction Compliance Project Manager for the following projects:

- Calpine's Los Esteros 2 Power Plant conversion of the simple-cycle power plant (Los Esteros I) to a combined-cycle with a total output of 320 MW located in north San Jose CA.
- GenOn's Marsh Landing Generating Station 760 MW simple-cycle power plant located in Antioch CA.
- Northern California Power Authority's Lodi Energy Center 255 MW combined-cycle power plant located in Lodi CA.
- Turlock Irrigation District's Almond 2 Power Plant 174 MW simple-cycle peaker located in Modesto CA.
- Calpine's Sutter Energy Center Grimes Pipeline, a 2.8 mile natural gas pipeline.

Amendment Project Manager:

Responsible for all Commission Amendments from 06/2010 to 4/2011. Duties included developing the Amendment Procedures Guidance Document for Compliance Project Managers at the Commission. Coordinate with technical staff, project owners and make recommendations to the Commission regarding changes.

Amendment Highlights:

- CE Obsidian Energy, LLC, Black Rock 1, 2, and 3 Geothermal Power Project amendment to increase generating capacity to 215 MW as a multi-flash, single-generator facility.

- Calpine's Sutter Energy Center (540 MW) amendment to install the 2.8 mile, 6 inch, Grimes natural gas pipeline.
- Turlock Irrigation District's Walnut Energy Center (250 MW) amendment to change annual water usage.
- Sacramento Municipal Utility District's (SMUD's) Consumnes Power Project (500 MW) amendment to inject digester gas from the Sacramento Regional Wastewater Treatment Plant into the natural gas supply line serving the CPP.

Operational Compliance Project Manager on various projects located throughout the state of California.

URS CORPORATION RENEWABLE ENERGY PROJECT AND STAFF MANAGER 11/2003 to 5/2010

Managed the Renewable Energy Group in the URS Sacramento office consisting of: Environmental Scientists, Real Estate Specialists, Marketing Staff and Biologists. As a Project Manager, I provided environmental planning services for international renewable energy clients through sitting, permitting, construction, and post construction, environmental monitoring and compliance. I coordinated multiple disciplines for NEPA and CEQA compliance documents (EISs/EIRs) and other environmental reports related to renewable energy development. I coordinated field surveys as the lead field technician (surveys included avian mortality studies for wind energy developments, wetland delineations, burrowing owl surveys, meteorological siting investigations, geotechnical investigations, and other technical disciplines). I also contributed to marketing and research efforts for the URS renewable energy marketing sector including attending conferences such as the annual Wind Power Conference held by the American Wind Energy Association (AWEA).

Professional awards and certifications include:

- URS Team Award for a Wind Energy Environmental Planning for a team I managed (February 2010)
- URS Monthly Outstanding Achievement Award for Marketing Efforts in the Renewable Energy Sector (December 2008)
- Individual Outstanding Achievement Award in Project Management (2007)
- URS Project Manager Certification (November 2007)

Assignment Highlights

Deputy Project Manager, Searchlight Wind Project, Searchlight, NV, Bureau of Land Management. Duke's Searchlight Wind Project is a 370 MW project consisting of up to 161 wind turbine generators. Provided wind energy planning services including the development of the Plan of Development, Environmental Assessment, and the EIS for the Searchlight Wind Power Project. Managed budget, schedule and technical staff in several URS offices for this effort.

Deputy Project Manager, Sacramento Municipal Utility District (SMUD) Solano Wind Project. November 2003 to March 2010. Responsible for overseeing budgets and schedule for all task orders. Monitored subcontractors and technical staff in a verity of efforts ranging from EIR preparation, biological field surveys, meteorological investigations, land acquisitions and other program activities. Proposal Manager for multiple efforts for this client. Developed program management plans and tracked tasks in MS Project. Managed task orders and staff. Contributed to strategic planning with client. Provided technical guidance and oversight to renewable energy technical staff.

Project Manager, Benicia Wind Project, Benicia CA, Silicon Valley Power (SVP). As a municipal utility SVP will be the lead agency for the EIR and other environmental documentation required for this 40 MW wind power project. Responsible for the direction of planning, environmental assessment, and consulting services provided to the client. These services include reviewing the Solano County General Plan and EIR's for surrounding projects in preparation of developing this project, assisting with the procurement, permitting, and installation of meteorological equipment, and contract negotiations.

Wind Contract Review Services, Gargau Wind Project, Rio de Janeiro, Brazil, for WestLB, Engineering Fatal Flaw Analysis. Assisted in engineering fatal flaw analysis. Documents under review included contractual agreements, the power purchase agreement, supply documents, balance of plant documents, and others. Provided project management support, including budget and schedule management for this project.

Project Management Assistance, Airtricity Asset Due Dilligance, USA and Canada, Confidential Client. Provided Project Management Assistance for an international technical team to assess the value and status of Airticity's operations for purchase by a private investing firm. At the time of the acquisition Airtricity was currently operating wind farms with around 210 MW installed capacity with an additional 880 MW to be operational by the end of 2008. Other Airtricity projects across US and Canada totaled more than 5,000 MW and were in an early development stage at the time of this project.

EDUCATION AND HONORS

Bachelor of Science Degree in Environmental Science from Humboldt State University (2003).

Academic honors include Cum Laude Honors Humboldt State University (2003) and Fall Presidential Scholar Humboldt State University (2001).

DECLARATION OF
Carol Watson

I, **Carol Watson**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Planner II, Staff Biologist.**

2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

3. I prepared the supplemental staff testimony on **Biological Resources**, for the **Palen Solar Electric Generating System (PSEGS) (09-AFC-7C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 6-18-2014

Signed: _____

At: Sacramento, California

Carol Watson
Sacramento, CA

WORK EXPERIENCE

California Energy Commission **2/2010 - Present**
Sacramento, CA
Siting Transmission & Environmental Protection Division

As staff biologist, primary duty analysis of power plants over 50MW: solar thermal, photovoltaic (pending litigation), natural gas, and coal technologies. Analyze applications to permit projects, conduct CEQA-certified regulatory program under the Warren-Alquist Act, perform scoping and coordination with resource agencies, the public, "intervenors" to the applicant's process, formulate and recommend mitigation, and defend analysis under oath before Energy Commission Commissioners. Provide compliance oversight for permitted projects during all stages: construction, operation, and closure, and ensure proper implementation of mitigation and resolve biological-related construction issues. Synthesize developing regulations (REAT agency, DRECP Sec. 10 process among others) and relevant legislation to ensure Energy Commission compliance. Coordinate with— and negotiate— solutions with diverse entities as BLM, USWS, Water Quality Control Board, US Army Corps of Engineers, Governor's Office liaisons to the Energy Commission, private interest groups, and solicitors working on behalf of these interests.

Parsons Corporation **10/2004 - 12/2009**
Las Vegas, Nevada

Principal Scientist

Worked in-house with client, Southern Nevada Water Authority. Served as Principal scientist from 11/2008 to 2/2010. Prepared Environmental Species Act Section 7 Permit for the Southern Nevada Water Authority Pipeline Project. Species included desert tortoise and 10 other Mojave and Great Basin aquatic and upland species. Perform general site surveys, spring snail counts, sage grouse telemetry, mist netting for bats, Amargosa toad surveys in Death Valley, Nevada, and assist the Nevada Department of Wildlife with bat telemetry studies.
From 2004-2008 served as project scientist. Duties included mapping riverbank vegetation of the Virgin river, from the lower reach in Nevada through the confluence with Lake Mead. Ground-truthed plant assemblages based on aerial imagery and 3-dimensional (stereoscopic) views of vegetation. Familiar with cadastral and rastral imagery analysis.
From 9/2005-11/2008 served on consultant basis. Prepared EIS/EIR analysis for impacts to peregrine falcon and special status bat species from the Gerald Desmond Bridge Project, in the Port of Long Beach, California.

Enercon **9/2005-11/2007**
Tulsa, Oklahoma

Project Biologist

Fulltime from 7/2008-11/2008, consulting status from 9/2005 to 5/2007. Served as project biologist, performing a range of work from baseline surveys for the Oklahoma Department of Transportation, preparing NEPA documents, preparing and responding to Requests for Proposals and Requests for Qualifications. Representative projects include coordination of environmental studies and preparation of an Environmental Assessment for the Federal Highway Administration, on behalf of Kellogg Engineering, in Rogers County, Oklahoma. Conducted public scoping and agency solicitation, attending county plenary sessions as technical environmental consultant. Prepared an Environmental Information Document for the Environmental Protection Agency for the expansion of the Rural Water District #3 Tacora Water Treatment plant in Rogers County, OK. Conduct protocol surveys for the federally endangered American burying beetle on behalf of clients such as Chesapeake Operating Systems, OKDOT, and Panther Energy Company, surveyed new pipeline routes from Oklahoma

though northern Texas for OG&E.

Representative Project: City of Moreno Valley, Riverside Co., California. Prepared Caltrans' Natural Environment Study for improvements to SR-60 at the Moreno Beach Drive and Nason Street interchanges. Studies included oversight of a jurisdictional delineation of wetlands and waters of the U.S., and coordination with project engineers to determine project boundaries and impacts. Developed mitigation in conformance with the Western Riverside County Multiple Species Habitat Conservation Plan.

BonTerra Consulting **2/2004 – 10/2004**
Pasadena, California

Wildlife Biologist

Draft RFQ/RFP, perform general biological surveys on behalf of public and private sector clients, and prepare CEQA/NEPA documentation. Representative Project: Plum Canyon Development, Los Angeles Co., California: Conducted salvage (pitfall trapping & grubbing salvage) and relocation of sensitive and local populations of reptiles and amphibians. Species handled included Western spadefoot toad, coastal western whiptail, and silvery legless lizard. Coordinated with CDFG regarding species of special concern, drafting relocation plans, and assisted with developing a protocol to simulate and force spring emergence and subsequent relocation of spadefoot toads prior to grubbing.

Sapphos Environmental **12/2000-2/2003**
Pasadena, California

Wildlife Biologist

Responsible for all phases of project management and biological technical work. Responded to and prepared RFP/RFQ, designed and conducted environmental study sufficient to project details (*i.e.* determination and development of appropriate ESA, NEPA, CEQA, Clean Water Act permits); and prepared environmental documentation. Prepared and conducted all public noticing and scoping per regulations, and prepared as technical consultant before the county and city and planning committees of Ventura and Los Angeles.

Representative Project: Ahmanson Ranch, Ventura County, California: Conducted long-term monitoring of a population of California red-legged frog with detailed notes as to location, behavior, and conditions. Assisted permitted biologists in placing passive integrated transponders, or PIT tags, as part of a radio telemetry study designed to aid understanding of habitat use and foraging distances. Assisted with the preparation of a Biological Assessment for an Endangered Species Act Section 7 consultation. Managed the design and creation of enclosed habitat and a captive breeding program. Prepared monthly status reports, and conducted various studies at the Ahmanson Ranch, including San Fernando Valley spineflower introduction studies, seed counts and collections, and oak tree surveys and assessments.

EDUCATION

M.S. Zoology, Eastern Illinois University **2000**
Focus: environmental ecology; population dynamics
Paid Teacher's Assistantship

B.S., Biology, Western Michigan University 1998
Chemistry minor

RELEVANT TRAINING

CPR Certified (2011, Energy Commission)
Desert Tortoise Surveying, Monitoring, and Handling Workshop, (2000)
BLM certified to survey for the flat-tailed horned lizard (2001)
California red-legged frog workshop (2001)
Passed U.S. Fish and Wildlife Service survey exam for El Segundo blue butterfly (2002)
American Burying Beetle Bait-away Surveys and Pitfall Trapping (performed under a permitted biologist' supervision), 2006-2007.