STATE OF CALIFORNIA

Energy Resources Conservation And Development Commission

In the Matter of:
The Application for Certification for the Calico Solar Power Project Licensing Case

Docket No. 08-AFC-13

PREPARED DIRECT TESTIMONY OF DAVID A. KRAUSS, Ph.D.
Senior Managing Scientist, Exponent

and

GENEVIEVE M. HECKMAN, Ph.D.
Senior Scientist, Exponent

August 16, 2010

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PREPARED DIRECT TESTIMONY

OF

David A. Krauss, Ph.D.

Senior Managing Scientist, Exponent

and

Genevieve M. Heckman

Senior Scientist, Exponent

Q.1 Please state your name and occupation?

A.1 Our names are David A. Krauss, Ph.D. and Genevieve M. Heckman, Ph.D. Dr. Krauss is a Senior Managing Scientist with Exponent; Dr. Heckman is a Senior Scientist with Exponent. Exponent is a multidisciplinary organization of scientists, physicians, engineers, and regulatory consultants that performs in-depth investigations in more than 90 technical disciplines. Exponent evaluates complex human health and environmental issues, assesses risks related to exposure to certain environmental conditions, and analyzes failures and accidents to determine their causes and to understand how to prevent them. We also evaluate complex human health and environmental issues to find cost-effective solutions.

Q.2 What is your particular area of expertise?

A.2 We have both obtained Ph.D.'s in neuroscience and have specialized knowledge in human perception and cognition, reaction time, attention, the effects of lighting conditions on vision, and how stress affects behavior. We assess risk associated with and investigate human factors in a wide array of scenarios. A copy of our respective *curriculum vitae* are attached hereto as Exhibits "A" and "B."

Q.3 Have you the studied the impact of glare and glint in your area of expertise?

A.3 Yes. This is typically done to determine the impact, if any, that glare or glint may have on a particular environment or has had on an accident.

Q4 Is there a body of professional literature that discusses and analyzes the effect of glint and glare?

A.4 Yes. There is an extensive body of literature that deals with both the effects of vehicle operators encountering bright lights during operation and the more physiological studies that deal with the changes to the retina when the retina is bombarded with bright light under various states of light adaptation.

Q.5. What have you been asked to do in relation to the Calico Solar Project?

A.5 We were asked to review and have reviewed the Staff Assessment and Supplemental Staff Assessment, Part II, on Traffic and Safety, as it relates to glare and glint, the associated study referenced in Appendix A, and to render an opinion as to the adequacy of the study and conclusions contained therein.

Q.6 After reviewing these materials, did you develop an understanding about the nature and purpose of the Calico Solar Project?

A.6 Yes, we did. As we understand it, this is relatively large solar energy project to be located in the Mojave Desert near Barstow. The proposed Project is to include 34,000 SunCatchers – 40 foot tall, 25-kilowatt-electrical (kWe) solar dishes developed by Stirling Energy Systems. [Supplemental Staff Assessment, Part II ("SSA Part II") at C.11-4];

Q.7 What is your opinion of the adequacy of the Supplemental Staff Assessment and associated study and the conclusions contained therein?

A.6 The Supplemental Staff Assessment, Part II, specifically makes a number of findings, three of which we focus on:

1. the SunCatchers could pose a significant risk to BNSF engineers and train crews, to include but not limited to temporary flash blindness, which would adversely impact the ability to see train signal lights [SSA Part II at C-11-19];

2. train signal lights are significant to the operational safety of the crews and trains [SSA Part II at C-11-19]; and

3. any escaping or itinerant glint and glare that may affect the railroad engineer's ability to clearly and accurately see signals is mitigable through shielding, LED lights, or other means designed to increase the contrast and intensity of the signal light [SSA Part II at C-11-19].

Q.8 What is your opinion of the adequacy of the first finding – the SunCatchers could pose a significant risk to BNSF engineers and train crews, to include but not limited to temporary flash blindness, which would adversely impact the ability to see train signal lights?

A.8 There is sufficient material in the SSA Part II, in particular the study attached as Appendix A ("Daytime Intrusive Brightness Analysis of Stirling Engine Solar Systems, by James Jewell, et al., (hereafter the "Jewell Report") that supports this finding. Although requested, we have not seen and there is not adequate time to review the underlying data associated with the Jewell Report. However, the Jewell Report states that the authors calculated the amount of light that is both captured by and escapes from a single SunCatcher. Based on their calculations, which at this point we assume to be accurate, they found that "significant glare impacts (temporary flash blindness) would occur to any receptor within 223 feet of any SunCatcher unit." [SSA Part II, Appendix A at A-8] Accordingly, the Jewell Report establishes that at least 223 feet must be maintained between any receptor and any SunCatcher. [See Jewell Report at SSA Part II, Appendix A at A-10 ("At any distance less than 223 feet from the SunCatcher units, construction and operational workers will experience hazardous levels of irradiance.").] The proposed Project, however, does not envision a single SunCatcher; it calls for 34, 000 SunCatchers. Moreover, the Jewell Report is a static evaluation – both the SunCatcher and the receptor are stationary. Here, we have a dynamic situation – we know the engineer will be in a moving train that is not traveling in a straight line. The Jewell Report does not analyze, calculate or measure the impact of thousands of SunCatchers specifically on a train engineer moving over tracks within the Right-of-Way (RoW). The adverse impact, therefore, may be greater than that stated in the Jewell Report.

Q.9 What is your opinion of the adequacy of the second finding – train signal lights are significant to the operational safety of the crews and trains?

A.9 This finding is supported by the SSA and the Jewell Report. Moreover, we have spoken with several personnel from BNSF in order to gain a better perspective of the importance of train signals to BNSF and the actual operators. Based on our discussions, it is clear that being able clearly to see train signals from an appropriate distance given the train's speed (varying between approximately 60-75 mph) and to respond accordingly is critical to the safety of the train and its crew. At these speeds, and depending upon the grade, it is our understanding that it can take over a mile of track to stop a train.

Q.10 What is your opinion of the adequacy of the third finding – any escaping or itinerant glint and glare that may affect the railroad engineer's ability to clearly and accurately see signals is mitigable through shielding, LED lights, or other means designed to increase the contrast and intensity of the signal light?

A.10 There is no scientific basis for this finding. No study has been performed that addresses these issues. According to the SSA, Part II at C.11-32, "Staff determined that measures exist, if needed, to ensure that BNSF railway engineers will be able to correctly perceive the color of the signal. Those procedures involves hooding and increasing the intensity of the lights." There is no analysis or data that supports this finding. The Jewell Report makes no mention of shielding, LED lights or other measures to increase the contrast and intensity of signal lights. While various mitigation measures <u>may</u> be helpful to reduce the impact of the glint and glare from the SunCatchers, to date no site-specific studies have been done to verify which measures, if any, would be able to mitigate the hazards identified in the above two findings. To reiterate, the Jewell Report is a static analysis of a single SunCatcher and a single receptor. Here, we have a dynamic situation and, to date, there has been no study or analysis to evaluate an engineer's ability to see a signal under such conditions.

Q.11 In your opinion, what needs to be done to properly assess the impact of glint and glare from the SunCatchers?

A.11 In addition to modeling the impact from a single SunCatcher, to fully evaluate this dynamic situation, the following factors, among others, need to be analyzed, measured and/or calculated:

1. The engineer's vantage point changes with respect to the location of SunCatchers in his visual field and the number of SunCatchers in his visual field as the engineer travels along the RoW;

2. The magnitude of glare may be affected by the geometry of the track, the changes in elevation, and the direction of travel;
3. The pattern of glare may have a differential effect on engineers depending on the time of day;
4. The pattern of glare may have a differential effect on engineers depending on the time of year;
5. There also may exist a level of glare that engineers may experience as a result of the SunCatchers that does not rise to a level that would induce the temporary flash blindness measured by the Jewell Report, but nonetheless causes discomfort that makes it difficult to focus in the direction of the SunCatchers;
6. While mitigation measures, including high contrast LED lights or black shielding, were suggested to enhance the conspicuity of railroad signals, the ability for engineers to perceive these signals out of a potentially bright, dynamically changing background has not been assessed to understand any possible discomfort or delays in detection that might arise out of the signal being viewed against a field of SunCatchers;
7. The perceived glint (high-contrast flicker) in the engineers' peripheral visual field may cause engineers involuntarily to orient their eyes and attention away from where they would otherwise be focusing their vision;
8. The size of the SunCatchers (up to 40 feet tall) may cause visual obstructions, independent of glare, that prevent engineers from perceiving job-critical information;

9. Light reflecting off the SunCatchers may result in a phenomenon known as a "phantom signal" whereby unlit signals appear to be illuminated because of abundant light striking them at low angles;
10. Since the trains are moving through the RoW, the distance traveled during expected look-away times as a result of the SunCatchers' presence should be calculated and the consequences of such travel should be assessed;
11. The effects of viewing multiple, indeed thousands, of SunCatchers simultaneously, rather than just one, must be analyzed to understand any cumulative glare effects that may arise;
12. The effects of viewing multiple SunCatchers simultaneously, for the entire period of time that the engineer is passing through the RoW, must be analyzed to understand any cumulative glare effects that may arise over time.

Q.12 The SSA Part II refers to "temporary flash blindness," (see, e.g., SSA Part II at C.11-19). Is this the only condition that could impair a train engineer's ability to see a signal and react in a timely manner?

A.12 No. In addition to temporary flash blindness, the Jewell Report refers to veiling reflections and/or distracting glare. [See SSA Part II, Appendix A at A-7.] Again, while the Jewell Report appears to account for temporary flash blindness from a single SunCatcher with a single receptor at a fixed point, it does not measure or otherwise account for the situation we have here, which involves multiple SunCatchers (i.e., thousands) at different elevations and different angles in a dynamic, moving scenario. This needs to be fully analyzed before one can render an opinion as to whether or not the 223-foot setback necessary for a single SunCatcher is sufficient for multiple SunCatchers.

Moreover, veiling effects and/or distracting glare are clearly noted in the Jewell Report as phenomena that are expected to occur as a result of light emitted from the SunCatcher. As the Jewell Report notes, it is well known that veiling reflections and/or distracting glare impact receptors "[b]eyond the distance that may cause temporary flash blindness [i.e., beyond 223 feet] and “may cause nuisance distraction or veil other objects (e.g., signal indicators for train operators) in the visual field." [SSA Part II, Appendix A at A-7.] In short, even with a single SunCatcher, the veiling reflection and/or distracting glare from the single SunCatcher may cause a disturbance in the train engineer's visual field such that the engineer cannot see the signal. The SSA Part II does not even mention these phenomena or otherwise attempt to account for them. The Jewell Report recognizes these phenomena but has done nothing to measure or quantify their impact. Moreover, as with temporary flash blindness, the Jewell report fails to account for, analyze, or measure the cumulative effect of thousands of SunCatchers on veiling reflections and/or distracting glare at different heights and angles in a dynamic, moving scenario.

Q.13 Have you reviewed TRANS-7 in the SSA Part II and do you have an opinion regarding whether it will adequately address the significant safety issues regarding the impact of glint and glare on train operators?

A.13 Yes. There is a discussion of TRANS-7 at C.11-19 and the actual proposed Condition of Certification is set forth at C.11-36-39 and is divided into two parts, "Signal Light Modifications," and "General Location, Operating, and Reporting Procedures." During the discussion on C.11-19, Staff notes that glare and glint is "mitigable" and that TRANS-7 is "designed to reduce to less than significant the operational impacts of the SunCatchers ... to BNSF Railway and AMTRAK crews and passengers." The scientific analysis performed in the Jewell Report is insufficient to support this conclusion or the separate or collective potential, and as yet untested, mitigation measures suggested therein. For example, the Signal Light Modifications section assumes without any analysis or study that signals can be modified by affixing shields and/or utilizing what is referred to as "current LED signal technology." Without more information there is simply no basis for this assumption. The Jewell Report itself has no such reference to signal light modification, shielding, or "current LED signal technology." The General Location, Operating, and Reporting Procedures section sets forth numerous requirements regarding offset tracking procedures and stow positions. While there is reference to offset tracking and stow positions in the Jewell Report (e.g., the reference to modifying offset tracking from 10 degrees to 25 degrees [SSA Part II, Appendix A-11]), there is no accompanying calculation to establish the sufficiency of this proposed offset. Additionally, the Jewell Report is based on a single SunCatcher and a single receptor; it does not take into account the dynamic situation here. With thousands of SunCatchers at different elevations and a train moving along a curved track for several miles, the view of the engineer and the angle between the engineer and the respective SunCatchers will change constantly. This has not been quantified or otherwise taken into account. Not until the full effects of the SunCatchers' field are studied and determined, is one able to propose, evaluate, and select potential mitigation measures.

Q.14 Did you prepare any demonstratives to illustrate some of these concepts?

A.14 Yes.

Q.15 Please explain how these relate to the present discussion.

A.15 Exhibits 1-2 demonstrate an important concept in visual search – that is, that the background against which a target (in this case, the upward tilted line) is viewed has a significant and measurable impact on the ease with which that target is located. Exhibit 3 illustrates the "phantom signal" phenomenon, in which direct external illumination can hinder a driver or operator's ability to discern whether a signal light is illuminated. Finally, Exhibit 4 depicts a simple demonstration of the spatial summation of light.

I swear under penalty of perjury that this testimony is true and correct to the best of my knowledge and belief.

Dated: August 16, 2010

David A. Krauss, Ph.D.

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Professional Profile

Dr. David A. Krauss is a Senior Managing Scientist in Exponent's Human Factors practice. Dr. Krauss has specialized knowledge in human perception and cognition, reaction time, attention, the effects of lighting conditions on vision, and how stress affects behavior. He uses this experience to investigate human factors in a wide array of scenarios such as automobile accidents, industrial and occupational accidents, structure fires, and slip-and-fall incidents. Dr. Krauss has investigated accidents associated with industrial safety, motor vehicles, and consumer products, among others.

Dr. Krauss' analysis methods include programming custom image-processing software to quantify visibility and conspicuity for many applications, including product development and recreating accident scenarios. He has also developed, published, and implemented a method to accurately capture and display digital photographs of low-visibility or nighttime accident scenes. Additionally, he performs quantitative injury and risk analyses using large-scale incident and injury data from various sources including the Consumer Product Safety Commission (CPSC), Centers for Disease Control (CDC), Food and Drug Administration (FDA), and manufacturer trade associations.

As part of his consulting practice, Dr. Krauss oversees human-subject testing to assess product usability and to gather user opinions for various products. He incorporates elements of anthropometry, visual assessments, psychophysics, questionnaires, and observational techniques to conduct comprehensive evaluations of a variety of consumer and industrial products.

Dr. Krauss' doctoral dissertation addressed human visual perception and reading. His familiarity with the cognitive-psychology literature has been applied to the development of warnings, instructions, and safety information for various products as well as to the assessment of the role of warnings in accidents.

Academic Credentials and Professional Honors

Ph.D., Psychology/Cognitive Neuroscience, University of California, Los Angeles, 2003
M.A., Psychology/Cognitive Neuroscience, University of California, Los Angeles, 2000
B.S., Biopsychology and Cognitive Science, University of Michigan, 1998

Pauley Graduate Fellowship, University of California, Los Angeles (1998)
Undergraduate honors, University of Michigan (1994)

Licenses and Certifications

OSHA-Qualified General Industry Safety Trainer; Certified Forklift Operator

Exhibit A Krauss-Heckman

Publications

Khan F, Arndt S, Krauss D. Understanding the relationship between safety climate and warning compliance in occupational settings. Proceedings, 14th Annual International Conference on Industrial Engineering: Theory, Applications and Practice, Anaheim, CA, 2009.

Polk TA, Lacey HP, Nelson JK, Demiralp E, Newman LI, Krauss D, Raheja A, Farah MJ. The development of abstract letter representations for reading: Evidence for the role of context. Cognitive Neuropsychology 2009; 26(1):70–90.

Kubose T, Krauss D. Methodological considerations for using the English XL tribometer for post-hoc slip-and-fall evaluations. Proceedings, 52nd Annual Meeting of the Human Factors and Ergonomics Society, Santa Monica, CA, 2008.

Krauss D, Arndt S, Lakhiani S, Khan F. Additional considerations when applying the "Safety Engineering Hierarchy" in industrial work settings. Proceedings, 13th Annual International Conference on Industrial Engineering: Theory, Applications and Practice, Las Vegas, NV, 2008.

Arndt S, Krauss D, Weaver B. A previously unidentified failure mode for ladder-climbing fall-protection systems. Proceedings, American Society of Safety Engineers Professional Development Conference and Exposition, Las Vegas, NV, 2008.

Arndt S, Young D, Krauss D. Human factors issues in trucking—What does a qualified expert need to know? Trucking Law Seminar, Phoenix, AZ, April 17, 2008.

Krauss D, Lieberman D, Grossman H, Ray R, Scher I. An evaluation of perceptual experience of skiers using quantitative image processing. Journal of ASTM International 2008; 5(4).

Kuzel M, Krauss D, Moralde M, Kubose T. Comparison of subjective ratings of slipperiness to the measured slip resistance of real-world walking surfaces. International Conference on Slips, Trips and Falls, From Research to Practice, 2007.

Krauss DA, Kuzel MJ, Cassidy P, Goodman J. A review of technologies for studying visual perception under low-illumination conditions. Proceedings, 50th Annual Meeting of the Human Factors and Ergonomics Society, Santa Monica, CA, 2006.

Arndt SR, Wood CT, Delahunt PB, Wall CT, Krauss DA. Who's in the back seat? A study of driver inattention. Proceedings, 50th Annual Meeting of the Human Factors and Ergonomics Society, Santa Monica, CA, 2006.

Krauss DA, Kuzel MJ, Arndt SR, Delahunt PB. Validation of digital image representations of low-illumination scenes. SAE Paper 2006-01-1288, Society for Automotive Engineers, Inc., 2006.

Young D, Huntley-Fenner G, Trachtman D, Krauss D. Human performance issues in auditory collision-avoidance systems. Proceedings, 10^{th} Annual International Conference on Industrial Engineering—Theory, Applications and Practice, pp. 64–68, Clearwater, FL, 2005.

Al-Tarawneh IS, Cohen WJ, Trachtman D, Bishu RR, Krauss DA. The effect of hands-free cellular telephone conversation complexity on choice response time in a detection task. Proceedings, 48^{th} Annual Meeting of the Human Factors and Ergonomics Society, Santa Monica, CA, 2004.

Krauss DA. Mechanisms of letter perception. Doctoral Dissertation, Department of Psychology, University of California, Los Angeles, June 2003.

Presentations and Posters

Clausner TC, Fox JR, Krauss DA. Comprehension and production of graphs that metaphorically express linguistic semantic event structure. 8^{th} International Cognitive Linguistics Conference, La Rioja, Spain, 2003.

Krauss DA, Engel SA. Effects of stimulus crowding in human extrastriate cortex. Meeting of the Society for Neuroscience, San Diego, CA, 2001.

Krauss DA, Engel SA. Differential effects of crowding on feature detection and letter recognition. Meeting of the Cognitive Neuroscience Society, New York, NY, 2001.

Krauss DA, Engel SA. Perceptual learning in color classification. Meeting of the Association for Research in Vision and Ophthalmology, Fort Lauderdale, FL, 2000.

Polk TA, Krauss D, Nelson J, Pond H, Raheja A, Farah MJ. The development of abstract letter identities: Evidence for a contextual hypothesis. Annual Meeting of the Psychonomics Society, 1998.

Project Experience

Evaluated the visibility of pedestrians, tractor-trailer combinations, and other parked vehicles on roadways under various reduced-lighting conditions.

Analyzed the performance capabilities, including perception-response time, for drivers and pedestrians under a variety of lighting and traffic conditions.

Created representative low-light photographs to use as demonstrative exhibits using recently developed and validated software and photography techniques.

Used the English XL tribometer to evaluate slip resistance on various flooring surfaces and correlated these measurements with pedestrian expectations of surface traction.

Programmed custom software in Matlab® to assess the visibility of terrain on a ski mountain under a variety of lighting conditions. These measurements were correlated with skier and snowboarder subjective ratings to understand perceptual biases to aid in predicting potentially hazardous visibility conditions.

Assisted companies with development and revision of product warnings and instructions for a wide range of products including those used in home, occupational, recreational, and agricultural settings.

Academic Appointments

- Lecturer, University of California, Los Angeles Department of Psychology
- Instructor, University of California, Los Angeles Extension

Peer Reviewer

- Human Factors and Ergonomics Society
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Professional Profile

Dr. Genevieve Heckman is a Senior Scientist in Exponent's Human Factors practice. Dr. Heckman has specialized expertise in human perception and cognition, reaction time, and decision-making, as well as lighting and illumination, inattention and distraction, and the effects of training and experience on performance. Dr. Heckman uses her knowledge of fundamental human sensory and cognitive processes to evaluate human factors and human performance issues in a wide variety of scenarios including trips, slips, and falls; motor vehicle and pedestrian accidents; occupational and industrial accidents; on-product warnings and safety information; child safety and hazards; and the use and misuse of consumer products. She has experience conducting visibility and conspicuity analyses; evaluating optical radiation hazards in industrial settings; and assessing the factors influencing driver and pedestrian behavior, reaction time, performance in sports and recreation, and compliance with warnings and instructions. In her work, Dr. Heckman uses a variety of analysis methods, including human subjects testing, quantitative injury and risk analyses, and use of image-processing techniques to quantify visibility, conspicuity, and discriminability under diverse viewing conditions.

Prior to joining Exponent, Dr. Heckman completed a Ph.D. in psychology, with specialization in cognitive neuroscience, at the University of California, Los Angeles. Her work during that time used a combination of behavioral, neuroimaging, and mathematical techniques to study human perception of color and lighting, the effects of experience on perceptual capabilities, and optimal experimental design in fMRI experiments. Her graduate work was supported by awards from the University of California, the National Institutes of Health, and the National Science Foundation.

Academic Credentials and Professional Honors

Ph.D., Psychology/Cognitive Neuroscience, University of California, Los Angeles, 2007
M.A., Psychology/Cognitive Neuroscience, University of California, Los Angeles, 2004
B.A., Psychology, Wake Forest University, 2002

Hobson Dissertation Year Fellow, University of California, Los Angeles, 2006; National Science Foundation Graduate Research Fellow, University of California, Los Angeles, 2003–2006; Phi Beta Kappa Honor Society, Wake Forest University, 2002

Exhibit B Krauss-Heckman

Publications

Heckman GM, Jackson GW, Keefer RE, Ray R, Harley EM, Young DE. Mechanisms of automatic transmission console shift selection and driver egress. Society of Automotive Engineers 2009 World Congress, April 2009. Paper judged to be among the most outstanding SAE Technical Papers of 2009 and thus further published in the SAE International Journal of Engines, Volume 2, September 15, 2009.

Harley EM, Trachtman D, Heckman GM, Young DE. Driver gear-shifting behaviors and errors. Proceedings, Human Factors and Ergonomics Society, 52nd Annual Meeting, New York, NY, 2008.

Heckman GM, Bouvier SE, Carr VA, Harley EM, Cardinal KS, Engel SA. Nonlinearities in rapid event-related fMRI explained by stimulus scaling. Neuroimage 2007; 34:651–660.

Heckman GM, Muday JA, Schirillo JA. Chromatic shadow compatibility and cone-excitation ratios. Journal of the Optical Society of America A 2005; 22:401–415.

Presentations and Published Abstracts

Heckman GM. Mechanisms of learning in a color detection task. Invited talk given at the Smith-Kettlewell Eye Research Institute Colloquim Series, San Francisco, CA, November 2006.

Heckman GM, Engel SA. Perceptual learning of contrast detection is color selective. Poster session presented at the annual meeting of the Vision Sciences Society, Sarasota, FL, May 2006.

Harley EM, Bouvier SE, Heckman GM, Engel SA. Figure-ground effects in V1 measured with functional MRI. Poster session presented at the annual meeting of the Vision Sciences Society, Sarasota, FL, May 2006.

Heckman GM, Cardinal KS, Harley EM, Bouvier SE, Carr VA, Engel SA. Characterizing contrast response functions measured with rapid event-related fMRI. Poster session presented at the annual meeting of the Vision Sciences Society, Sarasota, FL, May 2005.

Cardinal KS, Harley EM, Heckman GM, Bouvier SE, Carr VA, Engel SA. Comparison of contrast response functions measured with rapid and spaced event-related fMRI. Poster session presented at the annual meeting of the Society for Neuroscience, San Diego, CA, October 2004.

Heckman GM, Engel SA. Spatial frequency modulates color selectivity of adaptation to contrast patterns. Poster session presented at the annual meeting of the Vision Sciences Society, Sarasota, FL, May 2003.

Schirillo JA, Heckman GM, Barra T. A chromatic test of shadow compatibility and equal cone excitation ratios. Poster session presented at the annual meeting for the Vision Sciences Society, Sarasota, FL, May 2003.

Peer Reviewer

- Human Factors and Ergonomics Society

Professional Affiliations

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- Vision Sciences Society

Visual Search:
Find the upward tilted purple line

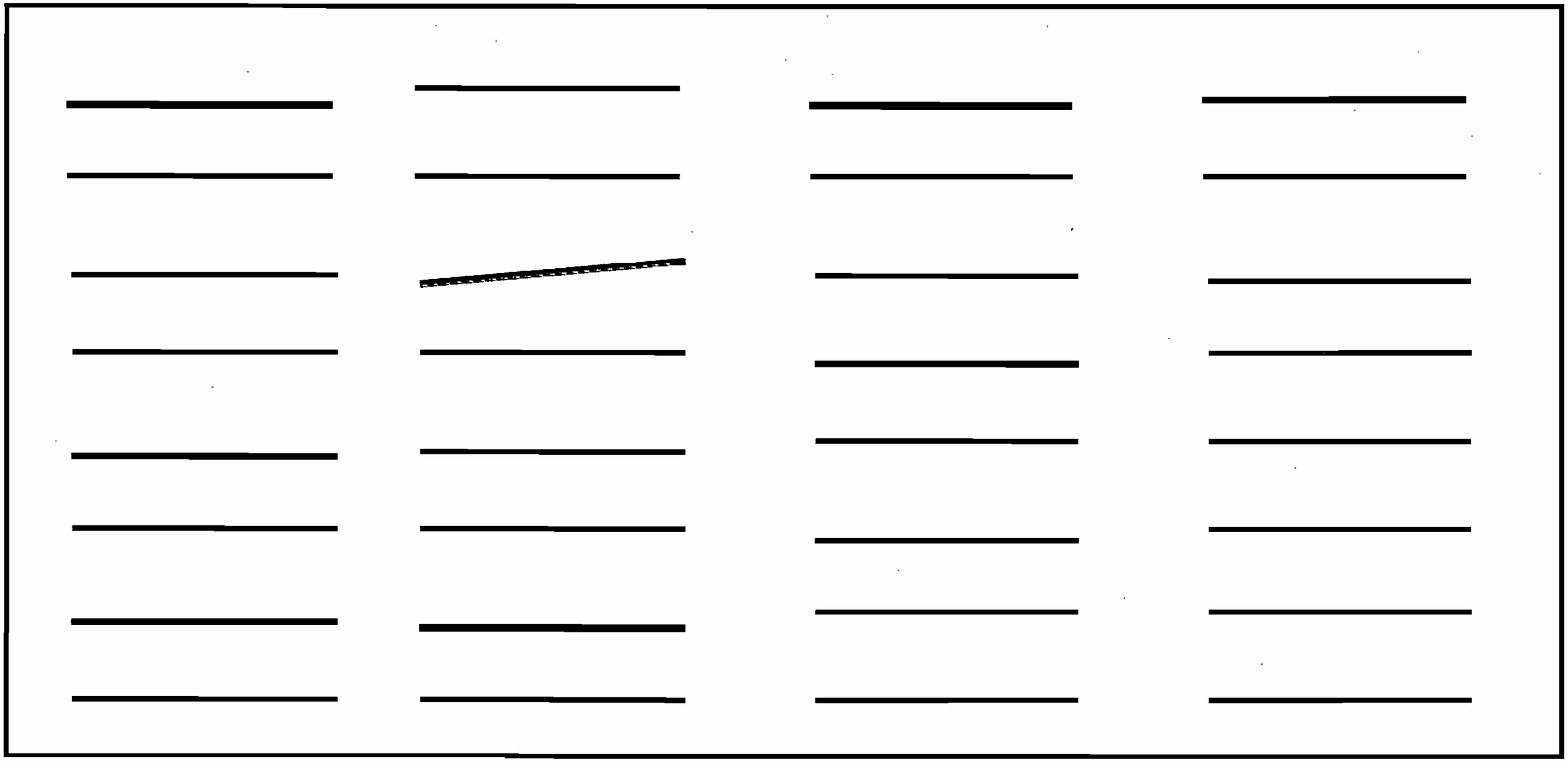


Exhibit 1 Krauss-Heckman

Visual Search:
Find the same upward tilted purple line

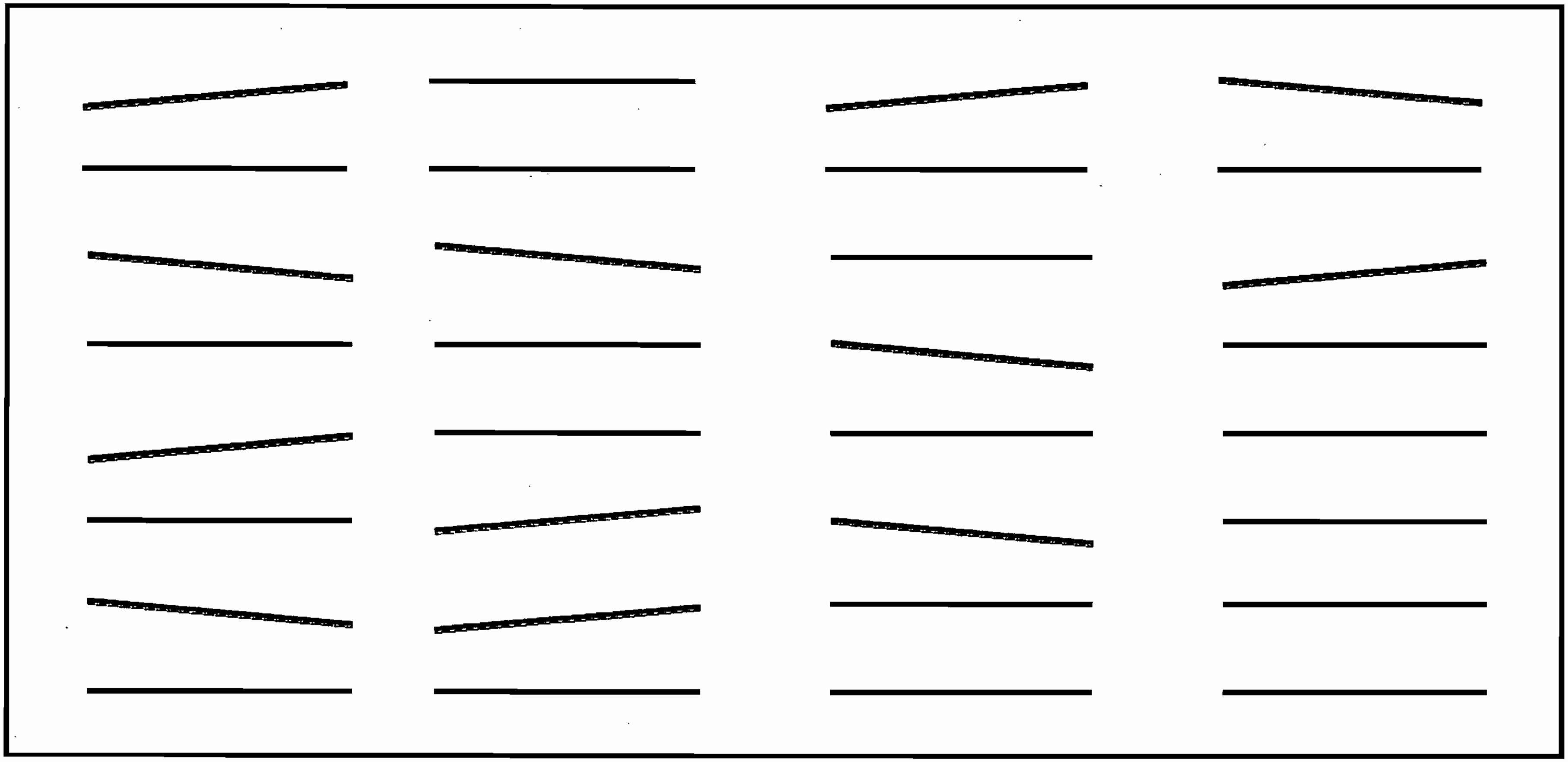


Exhibit 2 Krauss-Heckman

“Phantom Signals”

Excess of direct external illumination on a signal makes it difficult to discern which signal is illuminated.

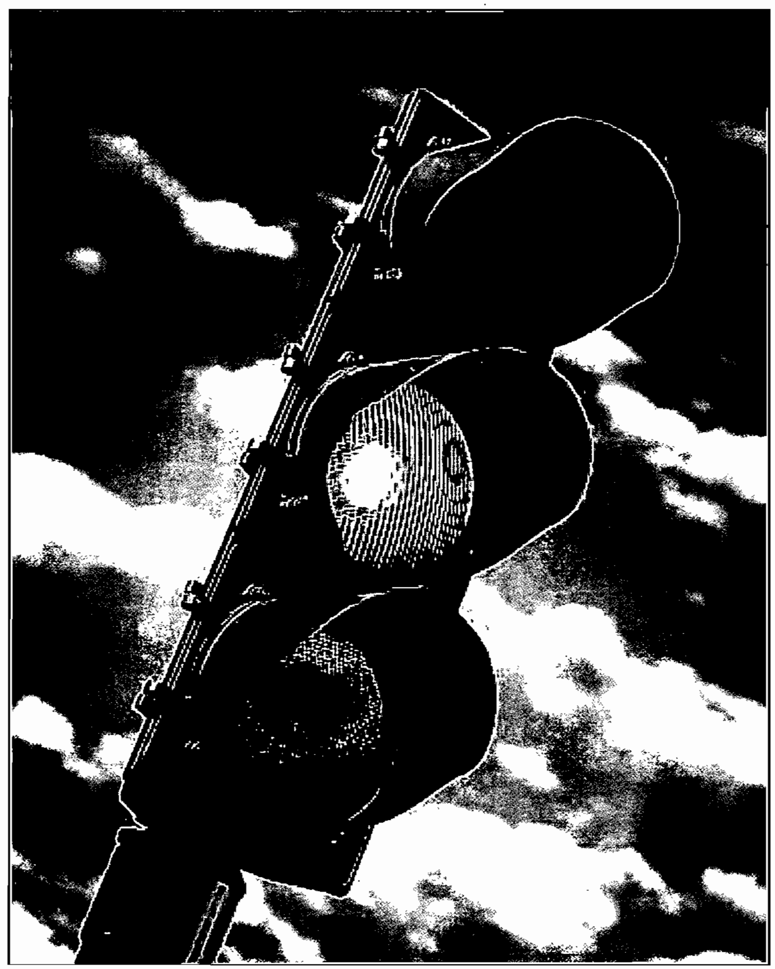
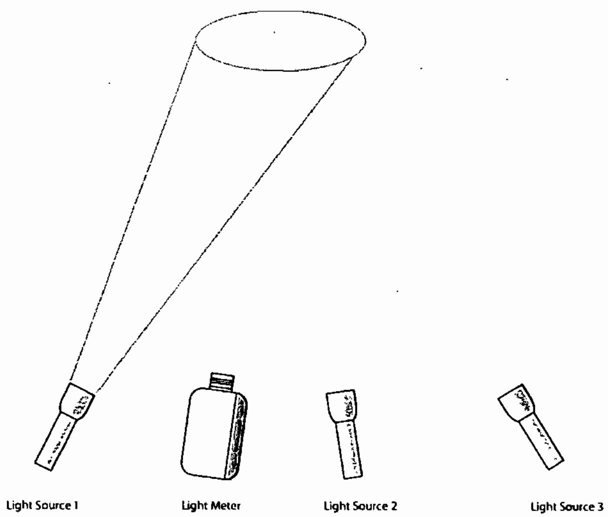
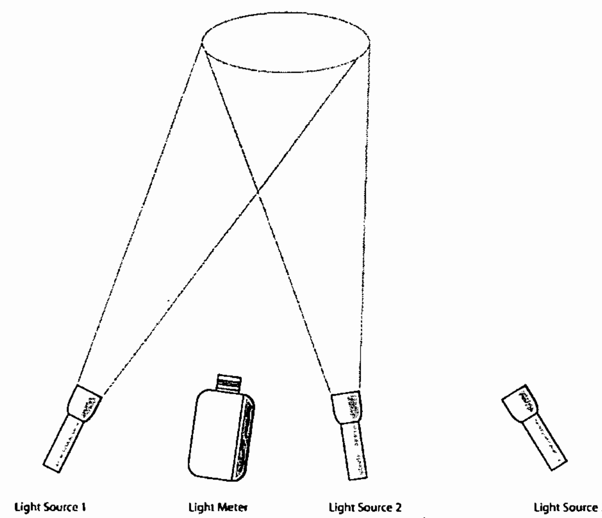


Exhibit 3 Krauss-Heckman

Spatial Summation of Light





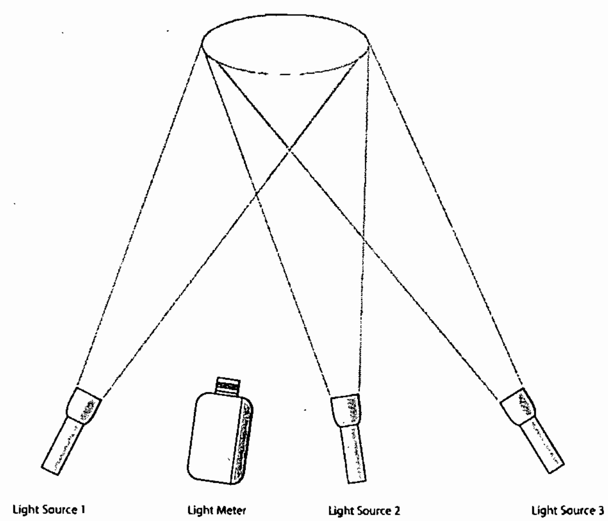


Exhibit 4 Krauss-Heckman

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
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APPLICATION FOR CERTIFICATION

For the CALICO SOLAR (Formerly SES Solar One)

Docket No. 08-AFC-13

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(Revised 8/9/10)

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DECLARATION OF SERVICE

I, Harriet Vletas, declare that on August 17, 2010, I served and filed copies of the attached Prepared Direct Testimony of David A. Krauss, Ph.D and Genevieve M. Heckman, Ph.D. dated August 16, 2010. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at:
[www.energy.ca.govlsitingcaseslsolarone].

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

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FOR SERVICE TO ALL OTHER PARTIES:

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

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AND

FOR FILING WITH THE ENERGY COMMISSION:

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

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CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 08-AFC-13
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
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I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Harriet Vletas
HARRIET VLETAS

*indicates change

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