# ENGINEERING ASSESSMENT

# FACILITY DESIGN

Testimony of Erin Bright and Steve Baker

## SUMMARY OF CONCLUSIONS

The California Energy Commission staff concludes that the design, construction, and eventual closure of the Beacon Solar Energy Project and its linear facilities would likely comply with applicable engineering laws, ordinances, regulations, and standards. The proposed conditions of certification, below, would ensure compliance with these laws, ordinances, regulations, and standards.

## INTRODUCTION

Facility design encompasses the civil, structural, mechanical, and electrical engineering design of the Beacon Solar Energy Project. The purpose of this analysis is to:

- verify that the laws, ordinances, regulations, and standards (LORS) that apply to the engineering design and construction of the project have been identified;
- verify that both the project and its ancillary facilities are sufficiently described, including proposed design criteria and analysis methods, in order to provide reasonable assurance that the project will be designed and constructed in accordance with all applicable engineering LORS, in a manner that also ensures the public health and safety;
- determine whether special design features should be considered during final design to address conditions unique to the site which could influence public health and safety; and
- describe the design review and construction inspection process and establish the conditions of certification used to monitor and ensure compliance with the engineering LORS, in addition to any special design requirements.

Subjects discussed in this analysis include:

- identification of the engineering LORS that apply to facility design;
- evaluation of the applicant's proposed design criteria, including identification of criteria essential to public health and safety;
- proposed modifications and additions to the application for certification (AFC) necessary for compliance with applicable engineering LORS; and
- conditions of certification proposed by staff to ensure that the project will be designed and constructed to ensure public health and safety and comply with all applicable engineering LORS.

## LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

Lists of LORS applicable to each engineering discipline (civil, structural, mechanical, and electrical) are described in the AFC (BS 2008a, AFC § 5.7.1.3, Table 5.7-1). Key LORS are listed in **FACILITY DESIGN Table 1** below.

**FACILITY DESIGN Table 1**
**Key Engineering Laws, Ordinances, Regulations, and Standards (LORS)**

| Applicable LORS | Description |
|---|---|
| **Federal** | Title 29 Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health standards |
| **State** | 2007 California Building Standards Code (CBSC) (also known as Title 24, California Code of Regulations) |
| **Local** | Kern County General Plan<br>Kern County Zoning Ordinance |
| **General** | American National Standards Institute (ANSI)<br>American Society of Mechanical Engineers (ASME)<br>American Welding Society (AWS)<br>American Society for Testing and Materials (ASTM) |

## SETTING

The Beacon Solar Energy Project (Beacon), a 250 MW solar thermal power plant facility utilizing a parabolic trough design with oil based heat transfer fluid, would be built on a 2,012-acre section in eastern Kern County. The site lies in Seismic Risk Zone 4. For more information on the site and related project description, please see the **Project Description** section of this document. Additional engineering design details are contained in the AFC (Appendices C and D).

## ASSESSMENT OF IMPACTS AND DISCUSSION OF MITIGATION

The purpose of this analysis is to ensure that the project would be built to applicable engineering codes and ensure public health and life safety. This analysis further verifies that applicable engineering LORS have been identified and that the project and its ancillary facilities have been described in adequate detail. It also evaluates the applicant's proposed design criteria, describes the design review and construction inspection process, and establishes conditions of certification that would monitor and ensure compliance with engineering LORS and any other special design requirements. These conditions allow both the California Energy Commission (Energy Commission) compliance project manager (CPM) and the applicant to adopt a compliance monitoring scheme that will verify compliance with these LORS.

## SITE PREPARATION AND DEVELOPMENT

Staff has evaluated the proposed design criteria for grading, flood protection, erosion control, site drainage, and site access, in addition to the criteria for designing and constructing linear support facilities such as electric transmission interconnections. The applicant proposes the use of accepted industry standards (see Beacon AFC, Appendices C and D, for representative lists of applicable industry standards), design practices, and construction methods in preparing and developing the site. Staff concludes that this project, including its linear facilities, would most likely comply with all applicable site preparation LORS and proposes conditions of certification (see below and the **Geology and Paleontology** section of this document) to ensure that compliance.

## MAJOR STRUCTURES, SYSTEMS, AND EQUIPMENT

Major structures, systems, and equipment are structures and their associated components or equipment that are necessary for power production; costly or time consuming to repair or replace; used for the storage, containment, or handling of hazardous or toxic materials; or capable of becoming potential health and safety hazards if not constructed according to applicable engineering LORS. Major structures and equipment are identified in the proposed Condition of Certification **GEN-2,** below.

Beacon shall be designed and constructed to the 2007 California Building Standards Code (CBSC), also known as Title 24, California Code of Regulations, which encompasses the California Building Code (CBC), California Building Standards Administrative Code, California Electrical Code, California Mechanical Code, California Plumbing Code, California Energy Code, California Fire Code, California Code for Building Conservation, California Reference Standards Code, and other applicable codes and standards in effect when the design and construction of the project actually begin. If the initial designs are submitted to the chief building official (CBO) for review and approval after the update to the 2007 CBSC takes effect, the 2007 CBSC provisions shall be replaced with the updated provisions.

Certain structures in a power plant may be required, under the CBC, to undergo dynamic lateral force (structural) analysis; others may be designed using the simpler static analysis procedure. In order to ensure that structures are analyzed according to their appropriate lateral force procedure, staff has included Condition of Certification **STRUC-1**, below, which, in part, requires the project CBO's review and approval of the owner's proposed lateral force procedures before construction begins.

## PROJECT QUALITY PROCEDURES

The project's AFC (BS 2008a, AFC § 3.7.4, Appendix 2C) describes a quality control program intended to inspire confidence that its systems and components will be designed, fabricated, stored, transported, installed, and tested in accordance with all appropriate power plant technical codes and standards. Compliance with design requirements will be verified through specific inspections, audits, and testing. Implementation of this quality assurance/quality control (QA/QC) program will ensure that Beacon is actually designed, procured, fabricated, and installed as described in this analysis.

## COMPLIANCE MONITORING

Under Section 104.1 in Appendix Chapter 1 of the CBC, the CBO is authorized and directed to enforce all provisions of the CBC. The Energy Commission itself serves as the building official and has the responsibility to enforce the code for all of the energy facilities it certifies. In addition, the Energy Commission has the power to interpret the CBC and adopt and enforce both rules and supplemental regulations that clarify application of the CBC's provisions.

The Energy Commission's design review and construction inspection process conforms to CBC requirements and ensures that all facility design conditions of certification are met. As provided by section 103.3 in Appendix Chapter 1 of the CBC, the Energy Commission appoints experts to perform design review and construction inspections and act as delegate CBOs on behalf of the Energy Commission. These delegates typically include the local building official and/or independent consultants hired to provide technical expertise that is not provided by the local official alone. The applicant, through permit fees provided by the CBC, section 108 in Appendix Chapter 1, pays the cost of these reviews and inspections. While building permits in addition to Energy Commission certification are not required for this project, the applicant, consistent with CBC section 108, pays in lieu of CBC permit fees to cover the costs of these reviews and inspections.

Engineering and compliance staff will invite Kern County or a third-party engineering consultant to act as CBO for this project. When an entity has been assigned CBO duties, Energy Commission staff will complete a memorandum of understanding (MOU) with that entity to outline both its roles and responsibilities and those of its subcontractors and delegates.

Staff has developed proposed conditions of certification to ensure public health and safety and compliance with engineering design LORS. Some of these conditions address the roles, responsibilities, and qualifications of the engineers who will design and build the proposed project (Conditions of Certification **GEN-1** through **GEN-8**). These engineers must be registered in California and sign and stamp every submittal of design plans, calculations, and specifications submitted to the CBO. These conditions require that every element of the project's construction (subject to CBO review and approval) be approved by the CBO before it is performed. They also require that qualified special inspectors perform or oversee special inspections required by all applicable LORS.

While the Energy Commission and delegate CBO have the authority to allow some flexibility in scheduling construction activities, these conditions are written so that no element of construction (of permanent facilities subject to CBO review and approval) that could be difficult to reverse or correct can proceed without prior CBO approval. Elements of construction that are not difficult to reverse may proceed without approval of the plans. The applicant bears the responsibility to fully modify construction elements in order to comply with all design changes resulting from the CBO's subsequent plan review and approval process.

## FACILITY CLOSURE

The removal of a facility from service (decommissioning) when it reaches the end of its useful life ranges from “mothballing” to the removal of all equipment and appurtenant facilities and subsequent restoration of the site. Future conditions that could affect decommissioning are largely unknown at this time.

In order to ensure that decommissioning will be completed in a manner that is environmentally sound, safe, and protects the public health and safety, the applicant shall submit a decommissioning plan to the Energy Commission for review and approval before the project’s decommissioning begins. The plan shall include a discussion of:

- proposed decommissioning activities for the project and all appurtenant facilities that were constructed as part of the project;
- all applicable LORS and local/regional plans and proof of adherence to those applicable LORS and local/regional plans;
- the activities necessary to restore the site if the plan requires removal of all equipment and appurtenant facilities; and
- decommissioning alternatives other than complete site restoration.

Satisfying the above requirements should serve as adequate protection, even in the unlikely event that the project is abandoned. Staff has proposed general conditions (see **General Conditions**) to ensure that these measures are included in the Facility Closure Plan.

## AGENCY AND PUBLIC COMMENTS

No agency or public comments were received regarding Facility Design.

## CONCLUSIONS AND RECOMMENDATIONS

1. The laws, ordinances, regulations, and standards (LORS) identified in the AFC and supporting documents directly apply to the project.

2. Staff has evaluated the proposed engineering LORS, design criteria, and design methods in the record, and concludes that the design, construction, and eventual closure of the project will likely comply with applicable engineering LORS.

3. The proposed conditions of certification will ensure that Beacon is designed and constructed in accordance with applicable engineering LORS. This will be accomplished through design review, plan checking, and field inspections that will be performed by the CBO or other Energy Commission delegate. Staff will audit the CBO to ensure satisfactory performance.

4. Though future conditions that could affect decommissioning are largely unknown at this time, it can reasonably be concluded that if the project owner submits a

decommissioning plan as required in the **General Conditions** section of this document prior to decommissioning, decommissioning procedures will comply with all applicable engineering LORS.

Energy Commission staff recommends that:

1. The proposed conditions of certification be adopted to ensure that the project is designed and constructed in a manner that protects the public health and safety and complies with all applicable engineering LORS;

2. The project be designed and built to the 2007 CBSC (or successor standards, if in effect when initial project engineering designs are submitted for review); and

3. The CBO reviews the final designs, checks plans, and performs field inspections during construction. Energy Commission staff shall audit and monitor the CBO to ensure satisfactory performance.

## CONDITIONS OF CERTIFICATION

**GEN-1** The project owner shall design, construct, and inspect the project in accordance with the 2007 California Building Standards Code (CBSC), also known as Title 24, California Code of Regulations, which encompasses the California Building Code (CBC), California Administrative Code, California Electrical Code, California Mechanical Code, California Plumbing Code, California Energy Code, California Fire Code, California Code for Building Conservation, California Reference Standards Code, and all other applicable engineering laws, ordinances, regulations and standards (LORS) in effect at the time initial design plans are submitted to the chief building official (CBO) for review and approval (the CBSC in effect is the edition that has been adopted by the California Building Standards Commission and published at least 180 days previously). The project owner shall ensure that all the provisions of the above applicable codes are enforced during the construction, addition, alteration, moving, demolition, repair, or maintenance of the completed facility (2007 CBC, Appendix Chapter 1, § 101.2, Scope). All transmission facilities (lines, switchyards, switching stations, and substations) are covered in the conditions of certification in the **Transmission System Engineering** section of this document.

In the event that the initial engineering designs are submitted to the CBO when the successor to the 2007 CBSC is in effect, the 2007 CBSC provisions shall be replaced with the applicable successor provisions. Where, in any specific case, different sections of the code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

The project owner shall ensure that all contracts with contractors, subcontractors, and suppliers clearly specify that all work performed and materials supplied comply with the codes listed above.

**Verification:** Within 30 days following receipt of the certificate of occupancy, the project owner shall submit to the compliance project manager (CPM) a statement of verification, signed by the responsible design engineer, attesting that all designs, construction, installation, and inspection requirements of the applicable LORS and the Energy Commission's decision have been met in the area of facility design. The project owner shall provide the CPM a copy of the certificate of occupancy within 30 days of receipt from the CBO (2007 CBC, Appendix Chapter 1, § 110, Certificate of Occupancy).

Once the certificate of occupancy has been issued, the project owner shall inform the CPM at least 30 days prior to any construction, addition, alteration, moving, demolition, repair, or maintenance to be performed on any portion(s) of the completed facility that requires CBO approval for compliance with the above codes. The CPM will then determine if the CBO needs to approve the work.

**GEN-2** Before submitting the initial engineering designs for CBO review, the project owner shall furnish the CPM and the CBO with a schedule of facility design submittals, master drawing, and master specifications lists. The schedule shall contain a list of proposed submittal packages of designs, calculations, and specifications for major structures and equipment. To facilitate audits by Energy Commission staff, the project owner shall provide specific packages to the CPM upon request.

**Verification:** At least 60 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of rough grading, the project owner shall submit to the CBO and to the CPM the schedule, the master drawing, and master specifications lists of documents to be submitted to the CBO for review and approval. These documents shall be the pertinent design documents for the major structures and equipment listed in **FACILITY DESIGN Table 2,** below. Major structures and equipment shall be added to or deleted from the table only with CPM approval. The project owner shall provide schedule updates in the monthly compliance report.

**FACILITY DESIGN Table 2**
**Major Structures and Equipment List**

| Equipment/System | Quantity (Plant) |
|---|---|
| Steam Turbine Generator Foundation and Connections | 1 |
| Start-up Boilers Foundations and Connections | 2 |
| GSU Transformer Foundation and Connections | 1 |
| Unit Auxiliary Transformers Foundations and Connections | 2 |
| SUS Transformers Foundations and Connections | 4 |
| Gas Storage Area Foundation and Connections | 1 |
| Cooling Tower Foundation and Connections | 1 |
| Raw & Fire Water Storage Tank Foundation and Connections | 1 |
| Firewater Pump House Foundation and Connections | 1 |
| Process Water Storage Tank Foundation and Connections | 1 |
| Process Water Pump Skid Foundation and Connections | 4 |
| Demineralized Water Storage Tank Foundation and Connections | 1 |
| Demineralized Water Pump Skid Foundation and Connections | 1 |
| Demineralized Water Treatment Facility Foundation and Connections | 1 |
| Water Treatment Building Foundation and Connections | 1 |
| Control and Administration Building Foundation and Connections | 1 |
| Feed Water Pumps Foundations and Connections | 3 |
| Condensate Pumps Foundations and Connections | 3 |
| Economizers Foundations and Connections | 4 |
| Reheaters Foundations and Connections | 9 |
| Evaporators Foundations and Connections | 9 |
| Superheaters Foundations and Connections | 5 |
| Expansion Storage Tanks Foundations and Connections | 6 |
| HTF Freeze Protection Heat Exchangers Foundations and Connections | 2 |
| HTF Circulation Pumps Foundations and Connections | 6 |
| Steam Blowdown Tank Foundation and Connections | 1 |
| Circulating Water Pumps Foundation and Connections | 1 |
| Neutralization Storage Tank Foundation and Connections | 1 |
| Solar Field Reflectors and Receivers Foundations and Connections | 1 Lot |

**GEN-3** The project owner shall make payments to the CBO for design review, plan checks, and construction inspections, based upon a reasonable fee schedule to be negotiated between the project owner and the CBO. These fees may be consistent with the fees listed in the 2007 CBC (2007 CBC, Appendix Chapter 1, § 108, Fees; Chapter 1, Section 108.4, Permits, Fees, Applications and Inspections), adjusted for inflation and other appropriate adjustments; may be based on the value of the facilities reviewed; may be based on hourly rates; or may be otherwise agreed upon by the project owner and the CBO.

**Verification:** The project owner shall make the required payments to the CBO in accordance with the agreement between the project owner and the CBO. The project owner shall send a copy of the CBO's receipt of payment to the CPM in the next monthly compliance report indicating that applicable fees have been paid.

**GEN-4** Prior to the start of rough grading, the project owner shall assign a California-registered architect, structural engineer, or civil engineer, as the resident engineer in charge of the project (2007 California Administrative Code, § 4-209, Designation of Responsibilities). All transmission facilities (lines, switchyards, switching stations, and substations) are addressed in the conditions of certification in the **Transmission System Engineering** section of this document.

The resident engineer may delegate responsibility for portions of the project to other registered engineers. Registered mechanical and electrical engineers may be delegated responsibility for mechanical and electrical portions of the project, respectively. A project may be divided into parts, provided that each part is clearly defined as a distinct unit. Separate assignments of general responsibility may be made for each designated part.

The resident engineer shall:

1. Monitor progress of construction work requiring CBO design review and inspection to ensure compliance with LORS;

2. Ensure that construction of all facilities subject to CBO design review and inspection conforms in every material respect to applicable LORS, these conditions of certification, approved plans, and specifications;

3. Prepare documents to initiate changes in approved drawings and specifications when either directed by the project owner or as required by the conditions of the project;

4. Be responsible for providing project inspectors and testing agencies with complete and up-to-date sets of stamped drawings, plans, specifications, and any other required documents;

5. Be responsible for the timely submittal of construction progress reports to the CBO from the project inspectors, the contractor, and other engineers who have been delegated responsibility for portions of the project; and

6. Be responsible for notifying the CBO of corrective action or the disposition of items noted on laboratory reports or other tests when they do not conform to approved plans and specifications.

The resident engineer shall have the authority to halt construction and to require changes or remedial work if the work does not meet requirements.

If the resident engineer or the delegated engineers are reassigned or replaced, the project owner shall submit the name, qualifications and

registration number of the newly assigned engineer to the CBO for review and approval. The project owner shall notify the CPM of the CBO's approval of the new engineer.

**Verification:** At least 30 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of rough grading, the project owner shall submit to the CBO for review and approval, the resume and registration number of the resident engineer and any other delegated engineers assigned to the project. The project owner shall notify the CPM of the CBO's approvals of the resident engineer and other delegated engineer(s) within five days of the approval.

If the resident engineer or the delegated engineer(s) is subsequently reassigned or replaced, the project owner has five days to submit the resume and registration number of the newly assigned engineer to the CBO for review and approval. The project owner shall notify the CPM of the CBO's approval of the new engineer within five days of the approval.

**GEN-5** Prior to the start of rough grading, the project owner shall assign at least one of each of the following California registered engineers to the project: a civil engineer; a soils, geotechnical, or civil engineer experienced and knowledgeable in the practice of soils engineering; and an engineering geologist. Prior to the start of construction, the project owner shall assign at least one of each of the following California registered engineers to the project: a design engineer who is either a structural engineer or a civil engineer fully competent and proficient in the design of power plant structures and equipment supports; a mechanical engineer; and an electrical engineer. (California Business and Professions Code section 6704 et seq., and sections 6730, 6731 and 6736 require state registration to practice as a civil engineer or structural engineer in California.) All transmission facilities (lines, switchyards, switching stations, and substations) are handled in the conditions of certification in the **Transmission System Engineering** section of this document.

The tasks performed by the civil, mechanical, electrical, or design engineers may be divided between two or more engineers, as long as each engineer is responsible for a particular segment of the project (for example, proposed earthwork, civil structures, power plant structures, equipment support). No segment of the project shall have more than one responsible engineer. The transmission line may be the responsibility of a separate California registered electrical engineer.

The project owner shall submit, to the CBO for review and approval, the names, qualifications, and registration numbers of all responsible engineers assigned to the project (2007 CBC, Appendix Chapter 1, § 104, Duties and Powers of Building Official).

If any one of the designated responsible engineers is subsequently reassigned or replaced, the project owner shall submit the name,

qualifications, and registration number of the newly assigned responsible engineer to the CBO for review and approval. The project owner shall notify the CPM of the CBO's approval of the new engineer.

A. The civil engineer shall:

1. Review the foundation investigations, geotechnical, or soils reports prepared by the soils engineer, the geotechnical engineer, or by a civil engineer experienced and knowledgeable in the practice of soils engineering;

2. Design (or be responsible for the design of), stamp, and sign all plans, calculations, and specifications for proposed site work, civil works, and related facilities requiring design review and inspection by the CBO. At a minimum, these include: grading; site preparation; excavation; compaction; and construction of secondary containment, foundations, erosion and sedimentation control structures, drainage facilities, underground utilities, culverts, site access roads and sanitary sewer systems; and

3. Provide consultation to the resident engineer during the construction phase of the project and recommend changes in the design of the civil works facilities and changes to the construction procedures.

B. The soils engineer, geotechnical engineer, or civil engineer experienced and knowledgeable in the practice of soils engineering, shall:

1. Review all the engineering geology reports;

2. Prepare the foundation investigations, geotechnical or soils reports containing field exploration reports, laboratory tests, and engineering analysis detailing the nature and extent of the soils that could be susceptible to liquefaction, rapid settlement, or collapse when saturated under load (2007 CBC, Appendix J, § J104.3, Soils Report; Chapter 18, § 1802.2, Foundation and Soils Investigations);

3. Be present, as required, during site grading and earthwork to provide consultation and monitor compliance with requirements set forth in the 2007 CBC, Appendix J, section J105, Inspections, and the 2007 California Administrative Code, section 4-211, Observation and Inspection of Construction (depending on the site conditions, this may be the responsibility of either the soils engineer, the engineering geologist, or both); and

4. Recommend field changes to the civil engineer and resident engineer.

This engineer shall be authorized to halt earthwork and to require changes if site conditions are unsafe or do not conform to the predicted conditions used as the basis for design of earthwork or foundations (2007 CBC, Appendix Chapter 1, § 114, Stop Orders).

C. The engineering geologist shall:

1. Review all the engineering geology reports and prepare a final soils grading report; and

2. Be present, as required, during site grading and earthwork to provide consultation and monitor compliance with the requirements set forth in the 2007 California Administrative Code, section 4-211, Observation and Inspection of Construction (depending on the site conditions, this may be the responsibility of either the soils engineer, the engineering geologist, or both).

D. The design engineer shall:

1. Be directly responsible for the design of the proposed structures and equipment supports;

2. Provide consultation to the resident engineer during design and construction of the project;

3. Monitor construction progress to ensure compliance with engineering LORS;

4. Evaluate and recommend necessary changes in design; and

5. Prepare and sign all major building plans, specifications, and calculations.

E. The mechanical engineer shall be responsible for, and sign and stamp a statement with, each mechanical submittal to the CBO, stating that the proposed final design plans, specifications, and calculations conform to all of the mechanical engineering design requirements set forth in the Energy Commission's decision.

F. The electrical engineer shall:

1. Be responsible for the electrical design of the project; and

2. Sign and stamp electrical design drawings, plans, specifications, and calculations.

**Verification:** At least 30 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of rough grading, the project owner shall submit to the CBO for review and approval, resumes and registration numbers of the responsible civil engineer, soils (geotechnical) engineer, and engineering geologist assigned to the project.

At least 30 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of construction, the project owner shall submit to the CBO for review and approval, resumes and registration numbers of the responsible design engineer, mechanical engineer, and electrical engineer assigned to the project.

The project owner shall notify the CPM of the CBO's approvals of the responsible engineers within five days of the approval.

If the designated responsible engineer is subsequently reassigned or replaced, the project owner has five days in which to submit the resume and registration number of the newly assigned engineer to the CBO for review and approval. The project owner shall notify the CPM of the CBO's approval of the new engineer within five days of the approval.

**GEN-6** Prior to the start of an activity requiring special inspection, the project owner shall assign to the project qualified and certified special inspector(s) who shall be responsible for the special inspections required by the 2007 CBC, Chapter 17, Section 1704, Special Inspections; Chapter 17A, Section 1704A, Special Inspections; and Appendix Chapter 1, Section 109, Inspections. All transmission facilities (lines, switchyards, switching stations, and substations) are handled in conditions of certification in the **Transmission System Engineering** section of this document.

A certified weld inspector, certified by the American Welding Society (AWS), and/or American Society of Mechanical Engineers (ASME) as applicable, shall inspect welding performed on site requiring special inspection (including structural, piping, tanks, and pressure vessels).

The special inspector shall:

1. Be a qualified person who shall demonstrate competence, to the satisfaction of the CBO, for inspection of the particular type of construction requiring special or continuous inspection;

2. Observe the work assigned for conformance with the approved design drawings and specifications;

3. Furnish inspection reports to the CBO and resident engineer. All discrepancies shall be brought to the immediate attention of the resident engineer for correction, then, if uncorrected, to the CBO and the CPM for corrective action (2007 CBC, Chapter 17, § 1704.1.2, Report Requirements); and

4. Submit a final signed report to the resident engineer, CBO, and CPM, stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved plans, specifications, and other provisions of the applicable edition of the CBC.

**Verification:** At least 15 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of an activity requiring special inspection, the project owner shall submit to the CBO for review and approval, with a copy to the CPM, the name(s) and qualifications of the certified weld inspector(s) or other certified special inspector(s) assigned to the project to perform one or more of the duties set forth above. The project owner shall also submit to the CPM a copy of the CBO's approval of the qualifications of all special inspectors in the next monthly compliance report.

If the special inspector is subsequently reassigned or replaced, the project owner has five days in which to submit the name and qualifications of the newly assigned special inspector to the CBO for approval. The project owner shall notify the CPM of the CBO's approval of the newly assigned inspector within five days of the approval.

**GEN-7** If any discrepancy in design and/or construction is discovered in any engineering work that has undergone CBO design review and approval, the project owner shall document the discrepancy and recommend required corrective actions (2007 CBC, Appendix Chapter 1, § 109.6, Approval Required; Chapter 17, § 1704.1.2, Report Requirements). The discrepancy documentation shall be submitted to the CBO for review and approval. The discrepancy documentation shall reference this condition of certification and, if appropriate, applicable sections of the CBC and/or other LORS.

**Verification:** The project owner shall transmit a copy of the CBO's approval of any corrective action taken to resolve a discrepancy to the CPM in the next monthly compliance report. If any corrective action is disapproved, the project owner shall advise the CPM, within five days, of the reason for disapproval and the revised corrective action to obtain CBO's approval.

**GEN-8** The project owner shall obtain the CBO's final approval of all completed work that has undergone CBO design review and approval. The project owner shall request the CBO to inspect the completed structure and review the submitted documents. The project owner shall notify the CPM after obtaining the CBO's final approval. The project owner shall retain one set of approved engineering plans, specifications, and calculations (including all approved changes) at the project site or at an alternative site approved by the CPM during the operating life of the project (2007 CBC, Appendix Chapter 1, § 106.3.1, Approval of Construction Documents). Electronic copies of the approved plans, specifications, calculations, and marked-up as-builts shall be provided to the CBO for retention by the CPM.

**Verification:** Within 15 days of the completion of any work, the project owner shall submit to the CBO, with a copy to the CPM, in the next monthly compliance report, (a) a written notice that the completed work is ready for final inspection, and (b) a signed statement that the work conforms to the final approved plans. After storing the final approved engineering plans, specifications, and calculations described above, the project owner shall submit to the CPM a letter stating both that the above documents have been stored and the storage location of those documents.

Within 90 days of the completion of construction, the project owner shall provide to the CBO three sets of electronic copies of the above documents at the project owner's expense. These are to be provided in the form of "read only" files (Adobe .pdf 6.0), with restricted (password-protected) printing privileges, on archive quality compact discs.

**CIVIL-1** The project owner shall submit to the CBO for review and approval the following:

1. Design of the proposed drainage structures and the grading plan;

2. An erosion and sedimentation control plan;

3. Related calculations and specifications, signed and stamped by the responsible civil engineer; and

4. Soils, geotechnical, or foundation investigation reports required by the 2007 CBC, Appendix J, section J104.3, Soils Report, and Chapter 18, section 1802.2, Foundation and Soils Investigation.

**Verification:** At least 15 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of site grading the project owner shall submit the documents described above to the CBO for design review and approval. In the next monthly compliance report following the CBO's approval, the project owner shall submit a written statement certifying that the documents have been approved by the CBO.

**CIVIL-2** The resident engineer shall, if appropriate, stop all earthwork and construction in the affected areas when the responsible soils engineer, geotechnical engineer, or the civil engineer experienced and knowledgeable in the practice of soils engineering identifies unforeseen adverse soil or geologic conditions. The project owner shall submit modified plans, specifications, and calculations to the CBO based on these new conditions. The project owner shall obtain approval from the CBO before resuming earthwork and construction in the affected area (2007 CBC, Appendix Chapter 1, § 114, Stop Work Orders).

**Verification:** The project owner shall notify the CPM within 24 hours when earthwork and construction is stopped as a result of unforeseen adverse geologic/soil conditions. Within 24 hours of the CBO's approval to resume earthwork and construction in the affected areas, the project owner shall provide to the CPM a copy of the CBO's approval.

**CIVIL-3** The project owner shall perform inspections in accordance with the 2007 CBC, Appendix Chapter 1, section 109, Inspections, and Chapter 17, section 1704, Special Inspections. All plant site-grading operations, for which a grading permit is required, shall be subject to inspection by the CBO.

If, in the course of inspection, it is discovered that the work is not being performed in accordance with the approved plans, the discrepancies shall be reported immediately to the resident engineer, the CBO, and the CPM (2007 CBC, Chapter 17, § 1704.1.2, Report Requirements). The project owner shall prepare a written report, with copies to the CBO and the CPM, detailing all discrepancies, non-compliance items, and the proposed corrective action.

**Verification:** Within five days of the discovery of any discrepancies, the resident engineer shall transmit to the CBO and the CPM a non-conformance report (NCR), and the proposed corrective action for review and approval. Within five days of resolution of the NCR, the project owner shall submit the details of the corrective action to the CBO and the CPM. A list of NCRs, for the reporting month, shall also be included in the following monthly compliance report.

**CIVIL-4** After completion of finished grading and erosion and sedimentation control and drainage work, the project owner shall obtain the CBO's approval of the final grading plans (including final changes) for the erosion and sedimentation

control work. The civil engineer shall state that the work within his/her area of responsibility was done in accordance with the final approved plans (2007 CBC, Chapter 17, § 1703.2, Written Approval).

**Verification:** Within 30 days (or within a project owner- and CBO-approved alternative time frame) of the completion of the erosion and sediment control mitigation and drainage work, the project owner shall submit to the CBO, for review and approval, the final grading plans (including final changes) and the responsible civil engineer's signed statement that the installation of the facilities and all erosion control measures were completed in accordance with the final approved combined grading plans and that the facilities are adequate for their intended purposes, along with a copy of the transmittal letter to the CPM. The project owner shall submit a copy of the CBO's approval to the CPM in the next monthly compliance report.

**STRUC-1** Prior to the start of any increment of construction of any major structure or component listed in **FACILITY DESIGN Table 2** of Condition of Certification **GEN 2**, above, the project owner shall submit to the CBO for design review and approval the proposed lateral force procedures for project structures and the applicable designs, plans, and drawings for project structures. Proposed lateral force procedures, designs, plans, and drawings shall be those for the following items (from **Table 2**, above):

1. Major project structures;

2. Major foundations, equipment supports, and anchorage; and

3. Large field-fabricated tanks.

Construction of any structure or component shall not begin until the CBO has approved the lateral force procedures to be employed in designing that structure or component.

The project owner shall:

1. Obtain approval from the CBO of lateral force procedures proposed for project structures;

2. Obtain approval from the CBO for the final design plans, specifications, calculations, soils reports, and applicable quality control procedures. If there are conflicting requirements, the more stringent shall govern (for example, highest loads, or lowest allowable stresses shall govern). All plans, calculations, and specifications for foundations that support structures shall be filed concurrently with the structure plans, calculations, and specifications (2007 CBC, Appendix Chapter 1, § 109.6, Approval Required);

3. Submit to the CBO the required number of copies of the structural plans, specifications, calculations, and other required documents of the designated major structures prior to the start of on-site fabrication and

installation of each structure, equipment support, or foundation (2007 California Administrative Code, § 4-210, Plans, Specifications, Computations and Other Data);

4. Ensure that the final plans, calculations, and specifications clearly reflect the inclusion of approved criteria, assumptions, and methods used to develop the design. The final designs, plans, calculations, and specifications shall be signed and stamped by the responsible design engineer (2007 CBC, Appendix Chapter 1, § 106.3.4, Design Professional in Responsible Charge); and

5. Submit to the CBO the responsible design engineer's signed statement that the final design plans conform to applicable LORS (2007 CBC, Appendix Chapter 1, § 106.3.4, Design Professional in Responsible Charge).

**Verification:** At least 60 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of any increment of construction of any structure or component listed in **FACILITY DESIGN Table 2** of Condition of Certification **GEN-2**, above, the project owner shall submit to the CBO the above final design plans, specifications and calculations, with a copy of the transmittal letter to the CPM.

The project owner shall submit to the CPM, in the next monthly compliance report, a copy of a statement from the CBO that the proposed structural plans, specifications, and calculations have been approved and comply with the requirements set forth in applicable engineering LORS.

**STRUC-2** The project owner shall submit to the CBO the required number of sets of the following documents related to work that has undergone CBO design review and approval:

1. Concrete cylinder strength test reports (including date of testing, date sample taken, design concrete strength, tested cylinder strength, age of test, type and size of sample, location and quantity of concrete placement from which sample was taken, and mix design designation and parameters);

2. Concrete pour sign-off sheets;

3. Bolt torque inspection reports (including location of test, date, bolt size, and recorded torques);

4. Field weld inspection reports (including type of weld, location of weld, inspection of non-destructive testing procedure and results, welder qualifications, certifications, qualified procedure description or number (ref: AWS); and

5. Reports covering other structural activities requiring special inspections shall be in accordance with the 2007 CBC, Chapter 17, section 1704, Special Inspections, and section 1709.1, Structural Observations.

**Verification:** If a discrepancy is discovered in any of the above data, the project owner shall, within five days, prepare and submit an NCR describing the nature of the discrepancies and the proposed corrective action to the CBO, with a copy of the transmittal letter to the CPM (2007 CBC, Chapter 17, § 1704.1.2, Report Requirements). The NCR shall reference the condition(s) of certification and the applicable CBC chapter and section. Within five days of resolution of the NCR, the project owner shall submit a copy of the corrective action to the CBO and the CPM.

The project owner shall transmit a copy of the CBO's approval or disapproval of the corrective action to the CPM within 15 days. If disapproved, the project owner shall advise the CPM, within five days, the reason for disapproval, and the revised corrective action necessary to obtain the CBO's approval.

**STRUC-3** The project owner shall submit to the CBO design changes to the final plans required by the 2007 CBC, including the revised drawings, specifications, calculations, and a complete description of, and supporting rationale for, the proposed changes, and shall give to the CBO prior notice of the intended filing (2007 CBC, Appendix Chapter 1, § 106.1, Submittal Documents; § 106.4, Amended Construction Documents; 2007 California Administrative Code, § 4-215, Changes in Approved Drawings and Specifications).

**Verification:** On a schedule suitable to the CBO, the project owner shall notify the CBO of the intended filing of design changes and shall submit the required number of sets of revised drawings and the required number of copies of the other above-mentioned documents to the CBO, with a copy of the transmittal letter to the CPM. The project owner shall notify the CPM, via the monthly compliance report, when the CBO has approved the revised plans.

**STRUC-4** Tanks and vessels containing quantities of toxic or hazardous materials exceeding amounts specified in the 2007 CBC, Chapter 3, Table 307.1(2), shall, at a minimum, be designed to comply with the requirements of that chapter.

**Verification:** At least 30 days (or within a project owner- and CBO-approved alternate time frame) prior to the start of installation of the tanks or vessels containing the above specified quantities of toxic or hazardous materials, the project owner shall submit to the CBO for design review and approval final design plans, specifications, and calculations, including a copy of the signed and stamped engineer's certification.

The project owner shall send copies of the CBO approvals of plan checks to the CPM in the following monthly compliance report. The project owner shall also transmit a copy of the CBO's inspection approvals to the CPM in the monthly compliance report following completion of any inspection.

**MECH-1** The project owner shall submit, for CBO design review and approval, the proposed final design, specifications and calculations for each plant major piping and plumbing system listed in **FACILITY DESIGN Table 2**, Condition of Certification **GEN-2**, above. Physical layout drawings and drawings not related to code compliance and life safety need not be submitted. The submittal shall also include the applicable QA/QC procedures. Upon

completion of construction of any such major piping or plumbing system, the project owner shall request the CBO's inspection approval of that construction (2007 CBC, Appendix Chapter 1, § 106.1, Submittal Documents; § 109.5, Inspection Requests; § 109.6, Approval Required; 2007 California Plumbing Code, § 301.1.1, Approvals).

The responsible mechanical engineer shall stamp and sign all plans, drawings, and calculations for the major piping and plumbing systems, subject to CBO design review and approval, and submit a signed statement to the CBO when the proposed piping and plumbing systems have been designed, fabricated, and installed in accordance with all of the applicable laws, ordinances, regulations, and industry standards (2007 CBC, Appendix Chapter 1, § 106.3.4, Design Professional in Responsible Charge), which may include, but are not limited to:

- American National Standards Institute (ANSI) B31.1 (Power Piping Code);
- ANSI B31.2 (Fuel Gas Piping Code);
- ANSI B31.3 (Chemical Plant and Petroleum Refinery Piping Code);
- ANSI B31.8 (Gas Transmission and Distribution Piping Code);
- Title 24, California Code of Regulations, Part 5 (California Plumbing Code);
- Title 24, California Code of Regulations, Part 6 (California Energy Code, for building energy conservation systems and temperature control and ventilation systems);
- Title 24, California Code of Regulations, Part 2 (California Building Code); and
- San Luis Obispo County codes.

The CBO may deputize inspectors to carry out the functions of the code enforcement agency (2007 CBC, Appendix Chapter 1, § 103.3, Deputies).

**Verification:** At least 30 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of any increment of major piping or plumbing construction listed in **FACILITY DESIGN Table 2**, Condition of Certification **GEN-2,** above, the project owner shall submit to the CBO for design review and approval the final plans, specifications, and calculations, including a copy of the signed and stamped statement from the responsible mechanical engineer certifying compliance with applicable LORS, and shall send the CPM a copy of the transmittal letter in the next monthly compliance report.

The project owner shall transmit to the CPM, in the monthly compliance report following completion of any inspection, a copy of the transmittal letter conveying the CBO's inspection approvals.

**MECH-2** For all pressure vessels installed in the plant, the project owner shall submit to the CBO and California Occupational Safety and Health Administration (Cal/OSHA), prior to operation, the code certification papers and other

documents required by applicable LORS. Upon completion of the installation of any pressure vessel, the project owner shall request the appropriate CBO and/or Cal/OSHA inspection of that installation (2007 CBC, Appendix Chapter 1, § 109.5, Inspection Requests).

The project owner shall:

1. Ensure that all boilers and fired and unfired pressure vessels are designed, fabricated, and installed in accordance with the appropriate section of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, or other applicable code. Vendor certification, with identification of applicable code, shall be submitted for prefabricated vessels and tanks; and

2. Have the responsible design engineer submit a statement to the CBO that the proposed final design plans, specifications, and calculations conform to all of the requirements set forth in the appropriate ASME Boiler and Pressure Vessel Code or other applicable codes.

**Verification:** At least 30 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of on-site fabrication or installation of any pressure vessel, the project owner shall submit to the CBO for design review and approval, the above-listed documents, including a copy of the signed and stamped engineer's certification, with a copy of the transmittal letter to the CPM.

The project owner shall transmit to the CPM, in the monthly compliance report following completion of any inspection, a copy of the transmittal letter conveying the CBO's and/or Cal/OSHA inspection approvals.

**MECH-3** The project owner shall submit to the CBO for design review and approval the design plans, specifications, calculations, and quality control procedures for any heating, ventilating, air conditioning (HVAC), or refrigeration system. Packaged HVAC systems, where used, shall be identified with the appropriate manufacturer's data sheets.

The project owner shall design and install all HVAC and refrigeration systems within buildings and related structures in accordance with the CBC and other applicable codes. Upon completion of any increment of construction, the project owner shall request the CBO's inspection and approval of that construction. The final plans, specifications, and calculations shall include approved criteria, assumptions, and methods used to develop the design. In addition, the responsible mechanical engineer shall sign and stamp all plans, drawings, and calculations and submit a signed statement to the CBO that the proposed final design plans, specifications, and calculations conform with the applicable LORS (2007 CBC, Appendix Chapter 1, § 109.3.7, Energy Efficiency Inspections; § 106.3.4, Design Professionals in Responsible Charge).

**Verification:** At least 30 days (or within a project owner- and CBO-approved alternative time frame) prior to the start of construction of any HVAC or refrigeration system, the project owner shall submit to the CBO the required HVAC and refrigeration

calculations, plans, and specifications, including a copy of the signed and stamped statement from the responsible mechanical engineer certifying compliance with the CBC and other applicable codes, with a copy of the transmittal letter to the CPM.

**ELEC-1** Prior to the start of any increment of electrical construction for all electrical equipment and systems 480 Volts or higher (see a representative list, below), with the exception of underground duct work and any physical layout drawings and drawings not related to code compliance and life safety, the project owner shall submit, for CBO design review and approval, the proposed final design, specifications, and calculations (2007 CBC, Appendix Chapter 1, § 106.1, Submittal Documents). Upon approval, the above-listed plans, together with design changes and design change notices, shall remain on the site or at another accessible location for the operating life of the project. The project owner shall request that the CBO inspect the installation to ensure compliance with the requirements of applicable LORS (2007 CBC, Appendix Chapter 1, § 109.6, Approval Required; § 109.5, Inspection Requests). All transmission facilities (lines, switchyards, switching stations, and substations) are handled in conditions of certification in the **Transmission System Engineering** section of this document.

A. Final plant design plans shall include:

1. one-line diagrams for the 13.8 kV, 4.16 kV, and 480 V systems; and
2. system grounding drawings.

B. Final plant calculations must establish:

1. short-circuit ratings of plant equipment;
2. ampacity of feeder cables;
3. voltage drop in feeder cables;
4. system grounding requirements;
5. coordination study calculations for fuses, circuit breakers, and protective relay settings for the 13.8 kV, 4.16 kV, and 480 V systems;
6. system grounding requirements; and
7. lighting energy calculations.

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

1. Receipt or delay of major electrical equipment;
2. Testing or energization of major electrical equipment; and

3. A signed statement by the registered electrical engineer certifying that the proposed final design plans and specifications conform to requirements set forth in the Energy Commission decision.

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

## REFERENCES

BS 2008a - FPL Energy/M. O'Sullivan (tn 45646). Application for Certification, dated 03/13/08. Submitted to CEC/Docket Unit on 03/14/08.

# GEOLOGY AND PALEONTOLOGY

Testimony of Dal Hunter, Ph.D., C.E.G.

## SUMMARY OF CONCLUSIONS

The proposed Beacon Solar Energy Project (BSEP) is located in a geologically active area of the northwestern Mojave Desert Geomorphic Province, east-central Kern County in Southeastern California. Because of its geologic setting, the site could be subject to intense levels of earthquake-related ground shaking. Due to its close proximity to the western and central traces of the Garlock Fault there is some potential for ground rupture in the site vicinity. The effects of strong ground shaking would need to be mitigated, to the extent practical, through structural designs required by the California Building Code (CBC 2007) and the project geotechnical report. The CBC (2007) requires that structures be designed to resist seismic stresses from ground acceleration. Subsidence due to historical ground water pumping in the Fremont Valley and/or dilation due to pull-apart faulting between the western and central strands of the Garlock Fault have resulted in formation of localized tension cracks and surface fissuring along stress planes parallel to the Garlock Fault system. A geotechnical investigation has been performed and presents standard engineering design recommendations for mitigation of seismic shaking and site soil conditions. Further investigation in the area of the proposed power block is needed to verify the absence of faults, tension cracking, and subsurface fissuring. Likewise, a geologist experienced in recognition and examination of faults and fissures should be available during trenching performed for construction of the ancillary facilities, particularly the natural gas pipeline, to document any potential near surface soil anomalies and facilitate any appropriate changes in design. The additional fault/fissure evaluation is detailed in proposed Condition of Certification **GEO-1**.

There are no known viable geologic or mineralogical resources at the proposed BSEP site. Regionally, paleontological resources have been documented within Quaternary older alluvium, similar to deposits that underlie the site, but no significant fossils were found during field explorations at the plant site. Potential impacts would also be mitigated through worker training and monitoring by qualified paleontologists, as required by proposed Conditions of Certification **PAL-1** through **PAL-7**.

Based on its independent research and review, the California Energy Commission believes that the potential is low for significant adverse impacts to the proposed project from geologic hazards during its design life and to potential geologic, mineralogic, and paleontological resources from the construction, operation, and closure of the proposed project and its proposed ancillary and linear facilities. It is staff's opinion that the BSEP could be designed and constructed in accordance with all applicable laws, ordinances, regulations, and standards and in a manner that would both protect environmental quality and assure public safety, to the extent practical.

## INTRODUCTION

In this section, California Energy Commission (Energy Commission) staff discusses the potential impacts of geologic hazards on the proposed BSEP site as well as the

potential to affect geologic, mineralogic, and paleontological resources. Staff's objective is to ensure that there would be no consequential adverse impacts to significant geological and paleontological resources during the project construction, operation, and closure and that operation of the plant would not expose occupants to high-probability geologic hazards. A brief geological and paleontological overview is provided. The section concludes with staff's proposed monitoring and mitigation measures for geologic hazards and geologic, mineralogic, and palentologic resources, with the proposed Conditions of Certification.

## LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

Applicable laws, ordinances, regulations, and standards (LORS) are listed in the application for certification (AFC) (BS 2008a). The following briefly describes the current LORS for both geologic hazards and resources and mineralogic and paleontological resources.

**Geology and Paleontology Table 1**
**Laws, Ordinances, Regulations, and Standards (LORS)**

| Applicable Law | Description |
|---|---|
| **Federal** | The proposed BSEP is not located on federal land. There are no federal LORS for geologic hazards and resources for this site. |
| **State** | |
| California Building Code (CBC), 2007 | The CBC (2007) includes a series of standards that are used in project investigation, design, and construction (including grading and erosion control). |
| Alquist-Priolo Earthquake Fault Zoning Act, Public Resources Code (PRC), section 2621–2630 | Mitigates against surface fault rupture of known active faults beneath occupied structures. Requires disclosure to potential buyers of existing real estate and a 50-foot setback for new occupied buildings. Portions of the site and proposed ancillary facilities are located within designated Alquist-Priolo Fault Zones. The proposed site layout places occupied structures outside of the 50-foot setback zone. |
| The Seismic Hazards Mapping Act, PRC Section 2690–2699 | Areas are identified that are subject to the effects of strong ground shaking, such as liquefaction, landslides, tsunamis, and seiches. |
| PRC, Chapter 1.7, sections 5097.5 and 30244 | Regulates removal of paleontological resources from state lands, defines unauthorized removal of fossil resources as a misdemeanor, and requires mitigation of disturbed sites. |
| Warren-Alquist Act, PRC, sections 25527 and 25550.5(i) | The Warren-Alquist Act requires the Energy Commission to "give the greatest consideration to the need for protecting areas of critical environmental concern, including, but not limited to, unique and irreplaceable scientific, scenic, and educational wildlife habitats; unique historical, archaeological, and cultural sites…" With respect to paleontological resources, the Energy Commission relies on guidelines from the Society for Vertebrate Paleontology, indicated below. |

| Applicable Law | Description |
|---|---|
| California Environmental Quality Act (CEQA), PRC sections 15000 et seq., Appendix G | Mandates that public and private entities identify the potential impacts on the environment during proposed activities. Appendix G outlines the requirements for compliance with CEQA and provides a definition of significant impacts on a fossil site. |
| Society for Vertebrate Paleontology (SVP), 1995 | The "Measures for Assessment and Mitigation of Adverse Impacts to Non-Renewable Paleontological Resources: Standard Procedures" is a set of procedures and standards for assessing and mitigating impacts to vertebrate paleontological resources. The measures were adopted in October 1995 by the SVP, a national organization of professional scientists. |
| **Local** | |
| Kern County Grading Code, (Ord. 17.28.040, 2008) | Kern County grading permit is required for earth moving activities in excess of 50 cubic yards. |
| Kern County Floodplain Management Ordinance, (Ord. 17.48.140, 2008) | A Kern County development permit is required prior to construction or development within an area of special flood hazards, areas of flood related erosion hazards, or areas of potential mudslides. |

## SETTING

The proposed BSEP would be constructed on 2,012 acres of privately-owned vacant land within a 2,317-acre parcel east of State Route 14 approximately 4 miles north-northwest of California City in Kern County, California. With the exception of active drainages, the site was cleared and graded during the mid-1900's for agriculture which continued until the mid-1980's. The site is partially fenced and hosts approximately 14 disused irrigation wells. A shallow ephemeral drainage crosses the site from southwest to northeast near its center and serves to convey infrequent runoff from catchment areas south and southwest of the site to the fluvially isolated playa of Koehn Lake approximately 5 miles to the east-northeast.

The proposed BSEP would be a primary power generating facility capable of producing 250 MW of electricity from a parabolic trough linear receiver solar array. The high flash point fluid, which would circulate within the closed-loop linear receiver array, would be used to generate steam which would drive the electricity generating turbine system. A propane-fired boiler system would be used to maintain system circulation during the night and periods of heavy cloud cover, and would provide power during system startup each morning. Ancillary facilities associated with the solar array would include re-routing an existing above-ground electrical transmission line, connecting to the existing Los Angeles Department of Water and Power electrical grid, to a location along the proposed north fence line, connection to existing water supply well(s) on the

property for process water, a cooling tower, an onsite septic system, a control building, paved and unpaved roads, and various smaller outbuildings to house maintenance and security personnel and equipment. Other water sources are now being considered, one from new wells around Koehn Lake would require a 7- to 9-mile-long pipeline. A second alternate source, the Rosamond Waste Water Treatment Plant, would require a 40±-mile-long pipeline (DB 2009r).

## REGIONAL SETTING

The proposed BSEP would to be located in the Koehn Lake sub-basin of Fremont Valley, an enclosed drainage basin in the northwest corner of the Mojave Desert Geomorphic Province in eastern Kern County, California. The Mojave Desert is a broad interior region of isolated mountain ranges which separate vast expanses of desert plains and interior drainage basins and occupies approximately 25,000 square miles in southeastern California and portions of Nevada, Utah, and Arizona. In California, its overall topography is dominated by southeast to northwest trending faulting with a secondary east to west trending alignment which is correlateable to Transverse Range faulting. The proposed BSEP site is located near the northwest boundary of the Mojave Desert Geomorphic Province where it terminates against the Garlock Fault. North of Fremont Valley, the Garlock fault defines the northern boundary of the Mojave Desert province where it meets the southern end of the Basin and Range province. In Fremont Valley, the Garlock Fault defines the northwest border of the Mojave Desert province, separating it from the southern end of the Sierra Nevada Geomorphic Province. Further south a portion of the Garlock Fault and the San Andreas Fault define an abrupt topographic transition between the Mojave Desert province and the Transverse Range Geomorphic Province.

## PROJECT SITE DESCRIPTION

The proposed BSEP site is located on vacant land east of California State Route 14 approximately four miles north-northwest of California City and 15 miles north of Mojave in eastern Kern County, California. The site is located in an enclosed drainage basin within Fremont Valley in the northwest portion of the Mojave Desert Geomorphic Province. Drainage within the enclosed basin occurs along ephemeral streams which flow toward the normally dry lakebed of Koehn Lake approximately 5 miles northeast of the site. The site is located on partially cleared and graded land formerly used for agricultural crops including alfalfa. The property is partially fenced and approximately 14 disused irrigation wells are present on the site. Access is obtained from a gravel road leading east from SR-14 past several abandoned farm structures and across the north to south trending Union Pacific Railroad tracks. The site is relatively flat with elevations ranging from approximately 2,220 feet in the south to 2,025 feet at the northern boundary. A prominent change in topography, formed by the northeast to southwest trending scarp of the Western Garlock Fault strand, is present in the southeast portion of the site. The dry and moderately vegetated braided channel of Pine Tree Creek carries runoff from infrequent rainfall events from south-southwest to north-northeast across the center of the site toward Koehn Lake. An oval, paved automotive test track facility is located immediately east of the northeast quarter of the site.

Due to its location near the junction of three geomorphic provinces, the proposed BSEP site is in close proximity to several active and potentially active faults related to regional

strike-slip faulting and extensional tectonics. The California Geological Survey (CGS) assigns type classifications to faults according to their historic and projected potential for future activity. Type A faults have slip-rates of ≥5 mm per year and are capable of producing an earthquake of magnitude 7.0 or greater. Type B faults have slip-rates of 2 to 5 mm per year and are capable of producing an earthquake of magnitude 6.5 to 7.0. Type A and B faults within 70 miles of the site are listed in **Geology and Paleontology Table 2**, along with the orientation, type, sense of movement, and distance from the project site.

The fault characteristics information listed was derived from Blake, (2000), CGS, (2002 a and b), USGS (2006), and McGill and Sieh (1993). The CGS does not currently recognize the central strand of the Garlock Fault, but most recent studies indicate it is the only segment of the Garlock Fault which shows Holocene movement. The western segment may be undergoing a seismic creep (Pampeyan, Holzer, and Clark, 1988). Staff has assigned the central segment classification Type A based of its reported slip rate of 5 to 7 mm per year (McGill and Sieh, 1993), and potential to produce a magnitude 7.0 or greater earthquake (McGill and Rockwell, 1998). If the western and eastern segments of the Garlock Fault have the slip rates and maximum magnitudes assigned them by the CGS (2002), they too could be considered to be Type A faults.

**Geology and Paleontology Table 2**
**Active Faults Relative to the Proposed BSEP Site**

| Fault Name | Distance From Site (miles) | Maximum Earthquake Magnitude (Mw) | Estimated Peak Site Acceleration (g) | Movement and Strike | Slip Rate mm/yr | Fault Type |
|---|---|---|---|---|---|---|
| Garlock - West Strand (Also known as the Cantil Fault) | 0.0 | 7.3 | 0.705 | Left-Lateral Strike Slip (East) | 6.0 | B |
| Garlock – Central Strand (Includes El Paso Fault) | 0.9 | 7.3 | 0.705 | Left-Lateral Strike Slip (Northeast) | 5 - 11 | A |
| Garlock - East Strand | 62 | 7.5 | 0.691 | Left-Lateral Strike Slip (Northeast) | 7.0 | B |
| Owl Lake | 68.5 | 6.5 | 0.046 | Left-Lateral Strike Slip | 2.0 | B |
| Lenwood-Lockhart-Old Woman Springs | 14.3 | 7.5 | 0.260 | Right-Lateral Strike Slip (Northwest) | 0.6 | B |
| Southern Sierra Nevada | 18.3 | 7.3 | 0.237 | Normal (North to Northeast) | 0.1 | B |
| White Wolf | 22.1 | 7.3 | 0.205 | Left-Lateral Reverse/Oblique Slip (South) | 2.0 | B |
| Gravel Hills-Harper Lake | 31.4 | 7.1 | 0.116 | Right-Lateral Strike Slip (Northwest) | 0.6 | B |
| Helendale-South Lockhart | 31.6 | 7.3 | 0.128 | Right-Lateral Strike Slip (Northwest) | 0.6 | B |
| Little Lake | 34.7 | 6.9 | 0.097 | Right-Lateral Strike Slip (Northwest) | 0.7 | B |
| Blackwater | 36.5 | 7.1 | 0.104 | Right-Lateral Strike Slip (Northwest) | 0.6 | B |

| Fault Name | Distance From Site (miles) | Maximum Earthquake Magnitude (Mw) | Estimated Peak Site Acceleration (g) | Movement and Strike | Slip Rate mm/yr | Fault Type |
|---|---|---|---|---|---|---|
| San Andreas (Entire M-1a) | 46.4 | 8.0 | 0.138 | Right-Lateral Strike Slip (Northwest) | 34.0 | A |
| San Andreas (Mojave M-1c-3) | 46.4 | 7.4 | 0.101 | Right-Lateral Strike Slip (Northwest) | 30.0 | A |
| San Andreas (Cholame-Mojave) | 46.4 | 7.8 | 0.125 | Right-Lateral Strike Slip (Northwest) | 34.0 | A |
| San Andreas (Carrizo) | 47.4 | 7.4 | 0.099 | Right-Lateral Strike Slip (Northwest) | 34.0 | A |
| Tank Canyon | 49.2 | 6.4 | 0.069 | Normal (Northwest) | 1.0 | B |
| Pleito Thrust | 53.6 | 7.0 | 0.089 | Reverse (Northeast) | 2.0 | B |
| Sierra Madre (San Fernando) | 60.5 | 6.7 | 0.069 | Reverse (North) | 2.0 | B |
| Panamint Valley | 60.9 | 7.4 | 0.082 | Right-Lateral Normal Oblique Slip (Northwest) | 2.5 | A |
| San Gabriel | 61.1 | 7.2 | 0.073 | Right-Lateral Strike Slip (Northwest) | 1.0 | B |
| Sierra Madre | 62.0 | 7.2 | 0.088 | Reverse (West) | 2.0 | B |

The deepest well drilled in the site vicinity ends in alluvium at approximately 4,920 feet below surface. Gravity modeling suggests the valley is filled with sediments to a depth of approximately 10,500 feet and seismic reflection profiles suggest the basin alluvial fill may be as much as 13,000 feet deep (McGill and Rockwell, 1998). Valley fill deposits within enclosed desert basins tend to vary greatly in thickness, composition, and lateral distribution because they are generally deposited rapidly during short-lived runoff events of variable magnitude. This makes basin-wide correlation of deposits from individual runoff events an impractical if not impossible task and basin fill deposits are generally only referred to by their relative age if it can be determined by fossil, geomorphic, or other means.

The surface areas of the proposed plant site, which were disturbed by agricultural activities, are characterized by fine to coarse sand and subangular to subrounded fine to coarse gravel cover which may be the result of wind erosion of the fine-grained silt component. Subsurface investigation by Kleinfelder (2008) indicates the near surface formation is composed of sand and silt dominated layers with a minor clay component in scattered locations.

Ground water depth in the area is 304 to 487 feet below ground surface (Kleinfelder, 2007). The end of local irrigation in the mid-1980's probably slowed or stopped ground water overdraft in the Fremont Valley. Therefore, ground water levels in the valley may be slowly rising as annual recharge replenishes the aquifer(s) beneath the site.

## ASSESSMENT OF IMPACTS AND DISCUSSION OF MITIGATION

This section considers two types of impacts. The first is geologic hazards, which could impact the proper functioning of the proposed facility and create life/safety concerns. The second is the potential impacts the proposed facility could have on existing geologic, mineralogic, and paleontological resources in the area.

## METHOD AND THRESHOLD FOR DETERMINING SIGNIFICANCE

No federal LORS concerning geologic hazards and geologic and mineralogic resources apply to this proposed project. The California Building Standards Code (CBSC) and CBC (2007) provide geotechnical and geological investigation and design guidelines, which engineers must follow when designing a facility. As a result, the criteria used to assess the significance of a geologic hazard include evaluating each hazard's potential impact on the design and construction of the proposed facility. Geologic hazards include faulting and seismicity, liquefaction, dynamic compaction, hydrocompaction, subsidence, expansive soils, landslides, tsunamis, and seiches.

The California Environmental Quality Act (CEQA) guidelines, Appendix G, provide a checklist of questions that lead agencies typically address.

- Section (V) (c) includes guidelines that determine if a project will either directly or indirectly destroy a unique paleontological resource or site or a unique geological feature.
- Sections (VI) (a), (b), (c), (d), and (e) focus on whether or not the project would expose persons or structures to geologic hazards.
- Sections (X) (a) and (b) concern the project's effects on mineral resources.

Staff has reviewed geologic and mineral resource maps for the surrounding area, as well as site-specific information provided by the applicant, to determine if geologic and mineralogic resources exist in the area and to determine if operations could adversely affect geologic and mineralogic resources.

Staff reviewed existing paleontological information and requested records searches from the San Bernardino County Museum and the Natural History Museum of Los Angeles County for the site area. Site-specific information generated by the applicant for the BSEP was also reviewed. All research was conducted in accordance with accepted assessment protocol (SVP 1995) to determine whether any known paleontological resources exist in the general area. If present or likely to be present, Conditions of Certification, which outline required procedures to mitigate impacts to potential resources, are proposed as part of the project's approval.

## DIRECT/INDIRECT IMPACTS AND MITIGATION

Ground shaking and fissuring due to subsidence settlement represent the main geologic hazards at this site. These potential hazards can be effectively mitigated through facility design by incorporating recommendations contained in the project geotechnical report. Further investigation of the power block site is necessary to verify subsurface fissuring

which could affect foundation stability is not present in that area. Proposed Conditions of Certification **GEO-1**, **GEN-1, GEN-5,** and **CIVIL-1** in the **Facility Design** section should also mitigate these impacts to a less than significant level.

The proposed BSEP site is not located within an established Mineral Resource Zone (MRZ) and no economically viable mineral deposits are known to be present. A test pit, which was excavated to explore the potential for clay montmorillonite production, is present near SR-14 and the UPRR tracks near the northwest corner of the site but no montmorillonite production is known to have occurred (CGS, 1999).

No important paleontological resources were observed on the proposed BSEP site during the paleontological field survey conducted for the AFC (BS 2008a). The site near-surface formation is composed to an unknown and probably variable depth by unconsolidated Holocene flood plain and fan deposits. Given their recent age (<10,000 years), these deposits are unlikely to contain significant paleontological resources. Older Quaternary alluvium of Pleistocene age which underlies the Holocene deposits is known to contain significant fossil resources, primarily terrestrial vertebrates. Likewise, lakebed deposits which range in age from recent to Pleistocene have potential to contain significant fossil resources, particularly as they increase in age with depth.

Overall, staff considers the probability that paleontological resources will be encountered during site construction activities to be low. However, if construction includes significant amounts of grading or deep foundation excavation and utility trenching, the potential for exposure of paleontological resources will increase with depth of the excavations. This assessment is based on SVP criteria and the paleontological report appended to the AFC (BS 2008a). Proposed Conditions of Certification **PAL-1** to **PAL-7** are designed to mitigate paleontological resource impacts, as discussed above, to less than significant levels. These conditions essentially require a worker education program in conjunction with the monitoring of earthwork activities by a qualified professional paleontologist (a paleontological resource specialist, or PRS).

The proposed Conditions of Certification allow the Energy Commission's compliance project manager (CPM) and the applicant to adopt a compliance monitoring scheme ensuring compliance with LORS applicable to geologic hazards and the protection of geologic, mineralogic, and paleontological resources.

Based on the information below, it is staff's opinion that the potential for significant adverse, direct or indirect impacts to the project, from geologic hazards, and to potential geologic, mineralogic, and paleontological resources, from the proposed project, is low.

## GEOLOGICAL HAZARDS

The AFC provides documentation of potential geologic hazards at the proposed BSEP plant site, including site-specific subsurface information (Kleinfelder, 2008). Review of the AFC, coupled with staff's independent research, indicates that the potential for geologic hazards to impact the proposed plant site during its practical design life would be low if recommendations for mitigation of seismic shaking and subsidence are followed. Geologic hazards related to seismic shaking and subsidence are addressed in the project geotechnical report per CBC (2007) requirements (Kleinfelder, 2008). As a

proposed Condition of Certification (**GEO-1**), staff recommends that examination of the near surface formation in the power block area be conducted during construction to verify the absence of splay faults or fissures which could affect the integrity of foundations. Likewise, a geologist experienced in recognition and examination of faults and fissures should be available during trenching performed during construction of the ancillary facilities, particularly the natural gas pipeline, to document any potential near surface soil anomalies and facilitate any appropriate changes in design.

Staff's independent research included the review of available geologic maps, reports, and related data of the BSEP plant site. Geological information was available from the CGS, California Division of Mines and Geology (CDMG, now know as CGS), the U.S. Geological Survey (USGS), the American Geophysical Union, the Geologic Society of America, and other organizations.

## Faulting and Seismicity

Energy Commission staff reviewed numerous CDMG and USGS publications as well as informational websites in order to gather data on the location, recency, and type of faulting in the project area. Type A and B faults within 70 miles of the BSEP site are listed in Table 1. Type A faults have slip-rates of $\geq$5 mm per year and are capable of producing an earthquake of magnitude 7.0 or greater. Type B faults have slip-rates of 2 to 5 mm per year and are capable of producing an earthquake of magnitude 6.5 to 7.0. The fault type, potential magnitude, and distance from the BSEP site are summarized in **Geology and Paleontology Table 2**.

Type C and otherwise undifferentiated faults which are more than 20 miles from the site are not discussed here because they are unlikely to undergo movement or generate seismicity which could affect the project.

Although 20 Type A and B faults and fault segments were identified within 70 miles of the site, the closest and most likely to impact operation of the BSEP are the central and western segments of the Garlock Fault System. The Garlock Fault is one of the major fault systems in southern California, marking the geographic boundary between the Mojave Desert geomorphic province and, in the project area, the southern end of the Sierra Nevada geomorphic province and, further north, the Basin and Range geomorphic province. Overall, the fault system is defined as an approximately 155 mile long arcuate left lateral strike slip system extending from the San Andreas Fault at the Transverse Ranges in the south, northeast and then east to the Avawatz Mountains at the southern end of Death Valley (McGill and Sieh, 1993).

The U.S. Geological Survey and other organizations recognize three separate segments along the Garlock Fault System as they are defined by geographic setting and apparent seismic activity. These are the western, central, and eastern Garlock Fault segments. The western segment extends northeast from the San Andreas Fault at the base of the Transverse Ranges to a point just north of the project area on the eastern side of Koehn Lake. Within Fremont Valley, the Garlock Fault offsets to the west across the width of the valley to form the southwestern end of the central segment. This means much of the Fremont Valley, including the BSEP site and Koehn Lake, lies in an approximately 2-mile-wide, down-to-the-north block formed by the extensional step-over between the western and central segments (McGill and Rockwell, 1998). The central

segment originates on the west side of Fremont Valley and arcs northeast approximately 65 miles to a splayed en-echelon hinge zone at the southern end of the Quail Mountains which defines the northeastern end of the central fault segment. South of the Quail Mountains the Garlock Fault bends 15 degrees to the east and the eastern segment strikes nearly east-west for 34 miles to terminate at the southern end of Death Valley (McGill and Rockwell, 2003).

Although the fault has not produced any large historic earthquakes, geomorphic and stratigraphic evidence indicates it has done so in the past and approximately 30 to 40 miles of left lateral offset has been documented along the fault since its activation during the late Miocene approximately 7 million years (My) ago (Dawson, McGill, and Rockwell, 2003). The most recent documented fault movement occurred along the Central Garlock Fault segment northwest of the project site between approximately 200 to 550 years before present (McGill and Rockwell, 1998). Although the western segment forms a prominent scarp across the southeast portion of the site, no Holocene movement has been documented on the western segment of the Garlock fault.

Holocene movement has been demonstrated on the central segment of the Garlock fault (Dawson, McGill, and Rockwell, 2003, and McGill and Sieh, 1991). In the area of Koehn Lake, approximately 5 miles north of the site, at least 5 and possibly as many as 8 surface ruptures have been recorded on the central Garlock fault in the last 5,000 years. The average recurrence rate is apparently irregular but is believed to be in the range of 700 to 1,200 years (McGill and Rockwell, 1998).

The Alquist-Priolo Act of 1973 and subsequent California state law (California Code of Regulations 2001) require that all occupied structures be set back 50 feet or more from the surface trace of an active fault. The western segment of the Garlock Fault is traceable across the southeast portion of the site, forming a topographic rise from southwest to northeast. Therefore, occupied structures will require set backs of at least 50 feet from the surface trace of the fault. Trenching should be performed beneath or near the footprint of any proposed occupied structure to demonstrate no fault splay or subsurface fissure underlies the building.

Based on previous drilling and on the soil profile generated for this site by the geotechnical investigation, the site soil class is assumed to be seismic Class D. The estimated peak horizontal ground acceleration for the power plant is 0.85 times the acceleration of gravity (0.85g) for bedrock acceleration based on 2 percent probability of exceedence in 50 years under 2007 CBC criteria. For a Class D site, the soils profile amplifies the acceleration of the ground surface to 1.94g (USGS 2008).

## Liquefaction

Liquefaction is a condition in which a saturated cohesionless soil may lose shear strength because of sudden increase in pore water pressure caused by an earthquake. However, the potential for liquefaction of strata deeper than approximately 40 feet below surface is considered negligible due to the increased confining pressure and because geologic strata at this depth are generally too compact to liquefy. The reported deep ground water table of greater than 300 feet would indicate no potential

for liquefaction and standard penetration testing (blowcounts) reported in the project-specific geotechnical report (Kleinfelder, 2008) indicate strata beneath the site are generally too dense to liquefy.

## Lateral Spreading

Lateral spreading of the ground surface can occur within liquefiable beds during seismic events. Lateral spreading generally requires an abrupt change in slope—that is, a nearby steep hillside or deeply eroded stream bank, etc.—but can also occur on gentle slopes such as are present at the project site. Other factors such as distance from the epicenter, magnitude of the seismic event, and thickness and depth of liquefiable layers also affect the amount of lateral spreading. Because the BSEP site is not subject to liquefaction, the potential for lateral spreading of the site surface during seismic events is negligible.

## Dynamic Compaction

Dynamic compaction of soils results when relatively unconsolidated granular materials experience vibration associated with seismic events. The vibration causes a decrease in soil volume, as the soil grains tend to rearrange into a more dense state (an increase is soil density). The decrease in volume can result in settlement of overlying structural improvements. Site specific geotechnical investigation indicates the alluvial deposits in the site subsurface are generally too dense to allow significant dynamic compaction (Kleinfelder, 2008).

## Hydrocompaction

Hydrocompaction (also known as hydro-collapse) is generally limited to young soils that were deposited rapidly in a saturated state, most commonly by a flash flood. The soils dry quickly, leaving an unconsolidated, low density deposit with a high percentage of voids. Foundations built on these types of compressible materials can settle excessively, particularly when landscaping irrigation dissolves the weak cementation that is preventing the immediate collapse of the soil structure. Site specific geotechnical investigation indicates the subsurface alluvial deposits which underlie the site are generally too dense to experience significant hydrocompaction (Kleinfelder, 2008).

## Subsidence

Regional ground subsidence is typically caused by petroleum or ground water withdrawal that increases the effective unit weight of the soil profile, which in turn increases the effective stress on the deeper soils. This results in consolidation or settlement of the underlying soils. The nearest known petroleum or gas fields are located in the Great Valley roughly 60 miles west of the project site on the western side of the southern Sierra Nevada Geomorphic Province (California Department of Conservation [CDC] 2001). Site water supply will be provided by pumping from existing wells at the site but is not expected to rival historic pumping levels. Therefore, subsidence due to petroleum, natural gas, or future ground water production is considered very unlikely.

Local subsidence or settlement may occur when areas containing compressible soils are subjected to foundation loads. Site-specific geotechnical investigation indicates the

alluvial deposits which underlie the site are generally compacted to a medium-dense to very dense consistency and therefore are considered unlikely to support site-wide subsidence due to foundation loading. Deep foundations (drilled shafts) or mat foundations may be necessary to limit settlement of heavily loaded structures (Kleinfelder, 2008).

Tension cracking due to either historic ground water withdrawals, lateral extension between the western and central segments of the Garlock Fault, or possibly a combination of the two forces has resulted in formation of near-surface tension cracking and fissures in the site area in the past (Pampeyan, Holzer, and Clark, 1988; and BS 2008a). Near surface fissuring related to the Garlock Fault has also been documented near the eastern end of the Central Segment (Zellmer, Roquemore, and Blackerby, 1985). In the site area surface fissures appear to form when runoff from storm events causes erosion along the plane of tension cracks. Surface fissures can grow to several yards in width and depth and have caused historic damage to roads, power lines, and buried pipelines (Pampeyan, Holzer, and Clark, 1988). Additional examination of the near surface formation in the power block area should be conducted during construction to verify near surface soil stability and the absence of faults, tension cracks, or fissures which could fail and affect the integrity of power block structures (refer to proposed Condition of Certification **GEO-1**). A geologist experienced in recognition and examination of faults and fissures should be available during trenching performed for construction of the ancillary facilities, particularly the natural gas pipeline, to document any potential near surface soil anomalies and facilitate any appropriate changes in design (refer to proposed **GEO-1**).

## Expansive Soils

Soil expansion occurs when clay-rich soils with an affinity for water exist in place at a moisture content below their plastic limit. The addition of moisture from irrigation, precipitation, capillary tension, water line breaks, etc. causes the clay soils to absorb water molecules into their structure, which in turn causes an increase in the overall volume of the soil. This increase in volume can correspond to excessive movement (heave) of overlying structural improvements. The silts and silty sand which form most of the site subsurface are not considered to be expansive.

## Landslides

The BSEP site under consideration slopes gently to the east-northeast at a gradient of less than 1 percent. Due to the low site gradient and the absence of topographically high ground in the site vicinity there is no potential for landslide impacts to the proposed project.

## Flooding

The Federal Emergency Management Agency (FEMA) has identified the majority of the BSEP site and ancillary facilities areas as lying in Unshaded Zone C, or “Areas of Minimal Flooding.” However, the zone along Pine Tree Creek which passes through the site from southwest to the northeast toward Koehn Lake is classified Zone A, “Areas of 100 year flood, base flood elevation and flood hazard not determined” (FEMA 1986).

## Tsunamis and Seiches

The proposed BSEP project and associated linear facilities are not located near any significant surface water bodies and therefore there is no potential for impacts due to tsunamis and seiches.

# GEOLOGIC, MINERALOGIC AND PALEONTOLOGICAL RESOURCES

Energy Commission staff has reviewed applicable geologic maps, reports, and on-line resources for this area (Blake 2000; Bryant 2000a and 2000b; CDMG 2003, 1999, 1998, 1994, 1990, 1986, 1965, and 1962; CGS 1999; Morton and Troxel 1962). Staff did not identify any geological or mineralogical resources at the proposed energy facility location.

Energy Commission staff reviewed the paleontological resources assessment in Section 5.9 and Appendix H of the AFC (ENSR 2008). Staff has also reviewed paleontological literature and records searches conducted by the San Bernardino County Museum (Scott 2008) and the Natural History Museum of Los Angeles County (McCleod 2008). No paleontological resources have been documented on the proposed BSEP plant site.

Although Quaternary alluvial and lakebed deposits, like those which underlie the project site, are known to contain a wide variety of vertebrate fossils, none have been identified at the site or within a 1-mile radius of the site. There is some potential to encounter significant vertebrate fossils if drilled shaft foundations are required to support heavily loaded structures. Any fossil brought to the surface by drilling operations would be badly disturbed and out of context as well. Given the relatively small diameter of the shaft boring (typically 18 to 48 inches), and the general scarcity of significant fossils, the chances of intersecting strata bearing significant fossils would seem remote.

This assessment is based on SVP criteria, the paleontological report appended to the AFC (BS 2008a), and the independent paleontological assessment of McLeod (2008). Proposed Conditions of Certification **PAL-1** to **PAL-7** are designed to mitigate paleontological resource impacts, as discussed above, to less than significant levels. These conditions essentially require a worker education program in conjunction with the monitoring of earthwork activities by a qualified professional paleontologist (a paleontological resource specialist, or PRS).

The proposed conditions of certification allow the Energy Commission's compliance project manager (CPM) and the applicant to adopt a compliance monitoring scheme ensuring compliance with LORS applicable to geologic hazards and the protection of geologic, mineralogic, and paleontological resources.

## Construction Impacts and Mitigation

The design-level geotechnical investigation, required for the project by the CBC (2007) and proposed Condition of Certification **GEN-1**, should provide standard engineering design recommendations for mitigation of earthquake ground shaking and excessive settlement (see **Proposed Conditions of Certification, Facility Design**). Proposed Condition of Certification **GEO-1** is intended to verify that fault splays and fissures do

not underlie the major structural components of the proposed project and that any such features are identified along project linears so that appropriate design precautions can be taken.

As noted above, no viable geologic or mineralogic resources are known to exist in the vicinity of the BSEP construction site. No paleontological resources have been identified at the site although older alluvium and lakebed deposits beneath the site are considered to have a high sensitivity for paleontological impacts. Construction of the proposed project will include grading, foundation excavation, and utility trenching. Based on the soils profile, SVP assessment criteria, and the depth of the potentially fossiliferous geologic units, staff considers the probability of encountering paleontological resources to be low unless drilled shaft foundation borings, or other excavations, reach greater than 25 feet below existing ground surface. Given the small diameter of the foundation borings (24 inches), and the general scarcity of significant fossils, the chances of intersecting fossil bearing strata would seem remote. The need for other excavations to extend to depths of 25 feet or more is unlikely.

Proposed Conditions of Certification **PAL-1 to PAL-7** are designed to mitigate any paleontological resource impacts, as discussed above, to a less than significant level. Essentially, Conditions of Certification **PAL-1 to PAL-7** require a worker education program in conjunction with monitoring of earthwork activities by qualified professional paleontologists (paleontological resource specialist, or PRS). Earthwork is halted any time potential fossils are recognized by either the paleontologist or the worker. When properly implemented, the Conditions of Certification yield a net gain to the science of paleontology since fossils that would not otherwise have been discovered can be collected, identified, studied, and properly curated. A paleontological resource specialist is retained, for the project by the applicant, to produce a monitoring and mitigation plan, conduct the worker training, and provide the monitoring. During the monitoring, the PRS can and often does petition the Energy Commission for a change in the monitoring protocol. Most commonly, this is a request for lesser monitoring after sufficient monitoring has been performed to ascertain that there is little change of finding significant fossils. In other cases, the PRS can propose increased monitoring due to unexpected fossil discoveries or in response to repeated out-of-compliance incidents by the earthwork contractor.

Based upon the literature and archives search, field surveys, and compliance documentation for the BSEP, the applicant has proposed monitoring and mitigation measures to be followed during the construction of the project. Energy Commission staff believes that the facility can be designed and constructed to minimize the effect of geologic hazards and impacts to potential paleontological resources at the site during project design life.

## Operation Impacts and Mitigation

Operation of the proposed solar generating facility should not have any adverse impact on geologic, mineralogic, or paleontological resources.

## CUMULATIVE IMPACTS AND MITIGATION

The proposed BSEP is situated in a seismically active geologic environment. Strong ground shaking potential must be mitigated through foundation and structural design as required by the CBC (2007). Compressible soils and areas within and near building footprints which may undergo subsidence due to tension cracking and fissuring must be mitigated in accordance with a design-level project geotechnical investigation and proposed Conditions of Certification **GEO-1**, **GEN-1, GEN-5, and CIVIL-1** under **Facility Design**. Paleontological resources have been documented in the general area of the project and in sediments similar to those that are present on the site. However, to date, none have been found during field studies of the BSEP site. The potential impacts to paleontological resources due to construction activities would be mitigated as required by proposed Conditions of Certification **PAL-1 to PAL-7**.

Staff believes that the potential for significant adverse impacts to the proposed project from geologic hazards, during the project's design life, is low, and that the potential for cumulative impacts to geologic, mineralogic, and paleontological resources is very low.

Based upon the literature and archives search, field surveys, and compliance documentation for the planned BSEP project, the applicant proposes monitoring and mitigation measures for construction of the BSEP, and staff agrees with the applicant that the project can be designed and constructed to minimize the effects of geologic hazards at the site and that impacts to fossils encountered during construction would be mitigated to levels of insignificance.

The proposed conditions of certification allow the Energy Commission CPM and the applicant to adopt a compliance monitoring scheme ensuring compliance with applicable LORS for geologic hazards and geologic, mineralogic, and paleontological resources.

## FACILITY CLOSURE

Facility closure activities are not expected to impact geologic, paleontological, or mineralogic resources since no such resources are known to exist at the project location. In addition, the decommissioning and closure of the project should not negatively affect geologic, mineralogic, or paleontological resources since the majority of the ground disturbed during plant decommissioning and closure would have been already disturbed, and mitigated as required, during construction and operation of the project.

## RESPONSE TO AGENCY AND PUBLIC COMMENTS

Staff has not received any agency or public comments regarding geologic hazards, mineral resources, or paleontology at this time.

## CONCLUSIONS

The applicant will easily be able to comply with applicable LORS, provided that the proposed Conditions of Certification are adopted and followed. The design and

construction of the project should have no adverse impact with respect to geologic, mineralogic, and paleontological resources. Staff proposes to ensure compliance with applicable LORS through the adoption of the proposed conditions of certification listed below.

## PROPOSED CONDITIONS OF CERTIFICATION

General conditions of certification with respect to engineering geology are proposed under Conditions of Certification **GEO-1**, below, and **GEN-1, GEN-5, and CIVIL-1** in the **Facility Design** section. Proposed paleontological conditions of certification follow. It is staff's opinion that the likelihood of encountering paleontological resources is low at the plant site. Staff will consider reducing monitoring intensity, at the recommendation of the project paleontological resource specialist, following examination of sufficient, representative deep excavations.

**GEO-1** The project owner shall have all trenching for underground utilities located within 500 feet of a known active or potentially active fault examined by a licensed geologist. The faults to be examined are:

- Garlock Fault East
- Garlock Fault West
- Randsburg-Mojave Fault
- Muroc Fault.

In addition, the foundation excavations for occupied structures, the turbine-generators, and steam generator shall be similarly examined. The purpose of the examination will be to verify the absence or presence of splay or fissures related to the major fault systems in the areas described. Fissures and/or fault splays, if present, may require mitigation in accordance with supplementary recommendations from the project geotechnical and structural engineers.

**Verification:** The geologist shall submit, to the CPM, appropriate, brief field reports describing and documenting his/her findings and interpretation. Any recommendations for mitigation developed by the geologist, geotechnical or structural engineers must also be submitted for review.

**PAL-1** The project owner shall provide the compliance project manager (CPM) with the resume and qualifications of its paleontological resource specialist (PRS) for review and approval. If the approved PRS is replaced prior to completion of project mitigation and submittal of the Paleontological Resources Report, the project owner shall obtain CPM approval of the replacement PRS. The project owner shall keep resumes on file for qualified paleontological resource monitors (PRMs). If a PRM is replaced, the resume of the replacement PRM shall also be provided to the CPM.

The PRS resume shall include the names and phone numbers of references. The resume shall also demonstrate to the satisfaction of the CPM the appropriate education and experience to accomplish the required paleontological resource tasks.

As determined by the CPM, the PRS shall meet the minimum qualifications for a vertebrate paleontologist as described in the Society of Vertebrate Paleontology (SVP) guidelines of 1995. The experience of the PRS shall include the following:

1. Institutional affiliations, appropriate credentials, and college degree;

2. Ability to recognize and collect fossils in the field;

3. Local geological and biostratigraphic expertise;

4. Proficiency in identifying vertebrate and invertebrate fossils; and

5. At least three years of paleontological resource mitigation and field experience in California and at least one year of experience leading paleontological resource mitigation and field activities.

The project owner shall ensure that the PRS obtains qualified paleontological resource monitors to monitor as he or she deems necessary on the project. Paleontological resource monitors (PRMs) shall have the equivalent of the following qualifications:

- BS or BA degree in geology or paleontology and one year of experience monitoring in California; or
- AS or AA in geology, paleontology, or biology and four years' experience monitoring in California; or
- Enrollment in upper division classes pursuing a degree in the fields of geology or paleontology and two years of monitoring experience in California.

**Verification:**

1. At least 60 days prior to the start of ground disturbance, the project owner shall submit a resume and statement of availability of its designated PRS for on-site work.

2. At least 20 days prior to ground disturbance, the PRS or project owner shall provide a letter with resumes naming anticipated monitors for the project, stating that the identified monitors meet the minimum qualifications for paleontological resource monitoring required by the condition. If additional monitors are obtained during the project, the PRS shall provide additional letters and resumes to the CPM. The letter shall be provided to the CPM no later than one week prior to the monitor's beginning on-site duties.

3. Prior to the termination or release of a PRS, the project owner shall submit the resume of the proposed new PRS to the CPM for review and approval.

**PAL-2** The project owner shall provide to the PRS and the CPM, for approval, maps and drawings showing the footprint of the power plant, construction lay-down areas, and all related facilities. Maps shall identify all areas of the project where ground disturbance is anticipated. If the PRS requests enlargements or strip maps for linear facility routes, the project owner shall provide copies to the PRS and CPM. The site grading plan and plan and profile drawings for the utility lines would be acceptable for this purpose. The plan drawings should show the location, depth, and extent of all ground disturbances and be at a scale between 1 inch = 40 feet and 1 inch = 100 feet. If the footprint of the project or its linear facilities changes, the project owner shall provide maps and drawings reflecting those changes to the PRS and CPM.

If construction of the project proceeds in phases, maps and drawings may be submitted prior to the start of each phase. A letter identifying the proposed schedule of each project phase shall be provided to the PRS and CPM. Before work commences on affected phases, the project owner shall notify the PRS and CPM of any construction phase scheduling changes.

At a minimum, the project owner shall ensure that the PRS or PRM consults weekly with the project superintendent or construction field manager to confirm area(s) to be worked the following week and until ground disturbance is completed.

**Verification:**

1. At least 30 days prior to the start of ground disturbance, the project owner shall provide the maps and drawings to the PRS and CPM.

2. If there are changes to the footprint of the project, revised maps and drawings shall be provided to the PRS and CPM at least 15 days prior to the start of ground disturbance.

3. If there are changes to the scheduling of the construction phases, the project owner shall submit a letter to the CPM within 5 days of identifying the changes.

**PAL-3** The project owner shall ensure that the PRS prepares, and the project owner submits to the CPM for review and approval, a paleontological resources monitoring and mitigation plan (PRMMP) to identify general and specific measures to minimize potential impacts to significant paleontological resources. Approval of the PRMMP by the CPM shall occur prior to any ground disturbance. The PRMMP shall function as the formal guide for monitoring, collecting, and sampling activities and may be modified with CPM approval. This document shall be used as the basis of discussion when on-site decisions or changes are proposed. Copies of the PRMMP shall reside with the PRS, each monitor, the project owner's on-site manager, and the CPM.

The PRMMP shall be developed in accordance with the guidelines of the Society of Vertebrate Paleontology (SVP 1995) and shall include, but not be limited, to the following:

1. Assurance that the performance and sequence of project-related tasks, such as any literature searches, pre-construction surveys, worker environmental training, fieldwork, flagging or staking, construction monitoring, mapping and data recovery, fossil preparation and collection, identification and inventory, preparation of final reports, and transmittal of materials for curation will be performed according to PRMMP procedures;

2. Identification of the person(s) expected to assist with each of the tasks identified within the PRMMP and the Conditions of Certification;

3. A thorough discussion of the anticipated geologic units expected to be encountered, the location and depth of the units relative to the project when known, and the known sensitivity of those units based on the occurrence of fossils either in that unit or in correlative units;

4. An explanation of why, how, and how much sampling is expected to take place and in what units. Include descriptions of different sampling procedures that shall be used for fine-grained and coarse-grained units;

5. A discussion of the locations of where the monitoring of project construction activities is deemed necessary, and a proposed plan for monitoring and sampling;

6. A discussion of procedures to be followed in the event of a significant fossil discovery, halting construction, resuming construction, and how notifications will be performed;

7. A discussion of equipment and supplies necessary for collection of fossil materials and any specialized equipment needed to prepare, remove, load, transport, and analyze large-sized fossils or extensive fossil deposits;

8. Procedures for inventory, preparation, and delivery for curation into a retrievable storage collection in a public repository or museum, which meet the Society of Vertebrate Paleontology's standards and requirements for the curation of paleontological resources;

9. Identification of the institution that has agreed to receive data and fossil materials collected, requirements or specifications for materials delivered for curation and how they will be met, and the name and phone number of the contact person at the institution; and

10. A copy of the paleontological Conditions of Certification.

**Verification:** At least 30 days prior to ground disturbance, the project owner shall provide a copy of the PRMMP to the CPM. The PRMMP shall include an affidavit of authorship by the PRS and acceptance of the PRMMP by the project owner evidenced by a signature.

**PAL-4** Prior to ground disturbance and for the duration of construction activities involving ground disturbance, the project owner and the PRS shall prepare and conduct weekly CPM-approved training for the following workers: project managers, construction supervisors, foremen, and general workers involved with or who operate ground-disturbing equipment or tools. Workers shall not excavate in sensitive units prior to receiving CPM-approved worker training. Worker training shall consist of an initial in-person PRS training during the project kick off for those mentioned above. Following initial training, a CPM-approved video or in-person training may be used for new employees. The training program may be combined with other training programs prepared for cultural and biological resources, hazardous materials, or other areas of interest or concern. No ground disturbance shall occur prior to CPM approval of the Worker Environmental Awareness Program (WEAP), unless specifically approved by the CPM.

The WEAP shall address the possibility of encountering paleontological resources in the field, the sensitivity and importance of these resources, and legal obligations to preserve and protect those resources.

The training shall include:

1. A discussion of applicable laws and penalties under the law;
2. Good quality photographs or physical examples of vertebrate fossils for project sites containing units of high paleontological sensitivity;
3. Information that the PRS or PRM has the authority to halt or redirect construction in the event of a discovery or unanticipated impact to a paleontological resource;
4. Instruction that employees are to halt or redirect work in the vicinity of a find and to contact their supervisor and the PRS or PRM;
5. An informational brochure that identifies reporting procedures in the event of a discovery;
6. A WEAP certification of completion form signed by each worker indicating that he/she has received the training; and
7. A sticker that shall be placed on hard hats indicating that environmental training has been completed.

**Verification:**

1. At least 30 days prior to ground disturbance, the project owner shall submit the proposed WEAP, including the brochure, with the set of reporting procedures for workers to follow.

2. At least 30 days prior to ground disturbance, the project owner shall submit the script and final video to the CPM for approval if the project owner is planning to use a video for interim training.

3. If the owner requests an alternate paleontological trainer, the resume and qualifications of the trainer shall be submitted to the CPM for review and approval prior to installation of an alternate trainer. Alternate trainers shall not conduct training prior to CPM authorization.

4. In the monthly compliance report (MCR), the project owner shall provide copies of the WEAP certification of completion forms with the names of those trained and the trainer or type of training (in-person or video) offered that month. The MCR shall also include a running total of all persons who have completed the training to date.

**PAL-5** The project owner shall ensure that the PRS and PRM(s) monitor consistent with the PRMMP all construction-related grading, excavation, trenching, and augering in areas where potential fossil-bearing materials have been identified, both at the site and along any constructed linear facilities associated with the project. In the event that the PRS determines full-time monitoring is not necessary in locations that were identified as potentially fossil bearing in the PRMMP, the project owner shall notify and seek the concurrence of the CPM.

The project owner shall ensure that the PRS and PRM(s) have the authority to halt or redirect construction if paleontological resources are encountered. The project owner shall ensure that there is no interference with monitoring activities unless directed by the PRS. Monitoring activities shall be conducted as follows:

1. Any change of monitoring from the accepted schedule in the PRMMP shall be proposed in a letter or email from the PRS and the project owner to the CPM prior to the change in monitoring and will be included in the monthly compliance report. The letter or email shall include the justification for the change in monitoring and be submitted to the CPM for review and approval.

2. The project owner shall ensure that the PRM(s) keep a daily monitoring log of paleontological resource activities. The PRS may informally discuss paleontological resource monitoring and mitigation activities with the CPM at any time.

3. The project owner shall ensure that the PRS notifies the CPM within 24 hours of the occurrence of any incidents of non-compliance with any

paleontological resources Conditions of Certification. The PRS shall recommend corrective action to resolve the issues or achieve compliance with the Conditions of Certification.

4. For any significant paleontological resources encountered, either the project owner or the PRS shall notify the CPM within 24 hours, or Monday morning in the case of a weekend event, where construction has been halted because of a paleontological find.

The project owner shall ensure that the PRS prepares a summary of monitoring and other paleontological activities placed in the monthly compliance reports. The summary will include the name(s) of PRS or PRM(s) active during the month; general descriptions of training and monitored construction activities; and general locations of excavations, grading, and other activities. A section of the report shall include the geologic units or subunits encountered, descriptions of samplings within each unit, and a list of identified fossils. A final section of the report will address any issues or concerns about the project relating to paleontological monitoring, including any incidents of non-compliance or any changes to the monitoring plan that have been approved by the CPM. If no monitoring took place during the month, the report shall include an explanation in the summary as to why monitoring was not conducted.

**Verification:** The project owner shall ensure that the PRS submits the summary of monitoring and paleontological activities in the MCR. When feasible, the CPM shall be notified 10 days in advance of any proposed changes in monitoring different from the plan identified in the PRMMP. If there is any unforeseen change in monitoring, the notice shall be given as soon as possible prior to implementation of the change.

**PAL-6** The project owner, through the designated PRS, shall ensure that all components of the PRMMP are adequately performed including collection of fossil materials, preparation of fossil materials for analysis, analysis of fossils, identification and inventory of fossils, the preparation of fossils for curation, and the delivery for curation of all significant paleontological resource materials encountered and collected during project construction.

**Verification:** The project owner shall maintain in his/her compliance file copies of signed contracts or agreements with the designated PRS and other qualified research specialists. The project owner shall maintain these files for a period of three years after project completion and approval of the CPM-approved paleontological resource report (see Condition of Certification **PAL-7**). The project owner shall be responsible for paying any curation fees charged by the museum for fossils collected and curated as a result of paleontological mitigation. A copy of the letter of transmittal submitting the fossils to the curating institution shall be provided to the CPM.

**PAL-7** The project owner shall ensure preparation of a Paleontological Resources Report (PRR) by the designated PRS. The PRR shall be prepared following

completion of the ground-disturbing activities. The PRR shall include an analysis of the collected fossil materials and related information and submit it to the CPM for review and approval.

The report shall include, but is not limited to, a description and inventory of recovered fossil materials; a map showing the location of paleontological resources encountered; determinations of sensitivity and significance; and a statement by the PRS that project impacts to paleontological resources have been mitigated below the level of significance.

**Verification:** Within 90 days after completion of ground-disturbing activities, including landscaping, the project owner shall submit the PRR under confidential cover to the CPM.

# Certification of Completion
# Worker Environmental Awareness Program
# Beacon Solar Energy Project (08-AFC-2)

This is to certify these individuals have completed a mandatory California Energy Commission-approved Worker Environmental Awareness Program (WEAP). The WEAP includes pertinent information on cultural, paleontological, and biological resources for all personnel (that is, construction supervisors, crews, and plant operators) working on site or at related facilities. By signing below, the participant indicates that he/she understands and shall abide by the guidelines set forth in the program materials. Include this completed form in the Monthly Compliance Report.

| No. | Employee Name | Title/Company | Signature |
|---|---|---|---|
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Cultural Trainer: _____ Signature:_____ Date: ___/___/____

PaleoTrainer: _____ Signature:_____ Date: ___/___/____

Biological Trainer: _____Signature:_____ Date:___/___/__

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# POWER PLANT EFFICIENCY

Testimony of Shahab Khoshmashrab

## SUMMARY OF CONCLUSIONS

The Beacon Solar Energy Project (BSEP), if constructed and operated as proposed, would generate 250 megawatts (MW) (nominal net output) of electricity. The BSEP would be a solar thermal power plant proposed on an approximately 2,012-acre site in eastern Kern County, California. The project would use the concentrated parabolic trough solar thermal technology to produce electrical power using a steam turbine generator fed from a solar steam generator. The BSEP would use solar energy to generate most of its capacity. Fossil fuel would be used only to reduce startup time and to keep the temperature of the heat transfer fluid above its relatively high freezing point. Propane would be used during startup to generate approximately 25 MW of electricity for 30-60 minutes per day for an estimated total of 4,500 megawatt hours (MWH) per year. Once the plant commences generation of electricity for delivery to the electrical grid, the use of the propane-fired auxiliary boilers ceases and they are held in stand-by mode until auxiliary heat is again required for startup or heat transfer fluid freeze protection. Compared to the project's expected overall production rate of approximately 600,000 MWH per year, and compared to a typical fossil fuel-fired power plant of equal capacity, the amount of the annual power production from fossil fuel is insignificant.

The project would decrease reliance on fossil fuel, and would increase reliance on renewable energy resources. It would not create significant adverse effects on fossil fuel energy supplies or resources, would not require additional sources of energy supply, and would not consume fossil fuel energy in a wasteful of inefficient manner. No efficiency standards apply to this project. Staff therefore concludes that this project would present no significant adverse impacts on fossil fuel energy resources.

The BSEP, if constructed and operated as proposed, would occupy approximately five acres per MW of power output, a figure about half that of some other solar power technologies.

## INTRODUCTION

## FOSSIL FUEL USE EFFICIENCY

One of the responsibilities of the California Energy Commission (Energy Commission) is to make findings on whether the energy use by a power plant, including the proposed BSEP, would result in significant adverse impacts on the environment, as defined in the California Environmental Quality Act (CEQA). If the Energy Commission finds that the BSEP's energy consumption creates a significant adverse impact, it must further determine if feasible mitigation measures could eliminate or minimize that impact. In this analysis, staff addresses the inefficient and unnecessary consumption of energy.

In order to support the Energy Commission's findings, this analysis will:

- examine whether the facility would likely present any adverse impacts upon energy resources;
- examine whether these adverse impacts are significant; and if so,
- examine whether feasible mitigation measures or alternatives could eliminate those adverse impacts or reduce them to a level of insignificance.

## SOLAR LAND USE EFFICIENCY

Solar thermal power plants typically consume much less fossil fuel (usually in the form of natural gas) than other types of thermal power plants. Therefore, common measures of power plant efficiency such as those described above are less meaningful. Solar power plants do occupy vast tracts of land, so the focus for these types of facilities shifts from fuel efficiency to land use efficiency. To analyze the land use efficiency of a solar facility staff utilizes the following approach.

Solar thermal power plants convert the sun's energy into electricity in three basic steps:

- Mirrors and/or collectors capture the sun's rays.
- This solar energy is converted into heat.
- This heat is converted into electricity, typically in a heat engine such as a steam turbine generator or a Stirling Engine-powered generator.

The effectiveness of each of these steps depends on the specific technology employed; the product of these three steps determines the power plant's overall solar efficiency. The greater the project's solar efficiency, the less land the plant must occupy to produce a given power output.

The most significant environmental impacts caused by solar power plants result from occupying large expanses of land. Even in a desert environment, disturbing and shading hundreds or thousands of acres of land can impact environmental resources. The extent of these impacts is likely in direct proportion to the number of acres affected. For this reason, staff will evaluate the land use efficiency of proposed solar power plant projects. This efficiency will be expressed in terms of power produced, or MW per acre, and in terms of energy produced, or MW-hours per acre-year. Specifically:

- Power-based solar land use efficiency is calculated by dividing the maximum net power output in MW by the total number of acres impacted by the power plant, including roads and electrical switchyards and substations.
- Energy-based solar land use efficiency is calculated by dividing the annual net electrical energy production in MW-hours per year by the total number of acres impacted by the power plant. Since different solar technologies consume differing quantities of fossil fuel for morning warm-up, cloudy weather output leveling and heat transfer fluid freeze protection (and some consume no fossil fuel at all), this effect will be accounted for. Specifically, fossil fuel consumption will be backed out by reducing the plant's net energy output by the amount of energy that could have been produced by consuming the project's annual fuel consumption in a modern

combined cycle power plant. (See **Efficiency Appendix A**, immediately following.) This reduced energy output will then be divided by acres impacted.

## LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

No federal, state, or local/county laws, ordinances, regulations, and standards (LORS) apply to the efficiency of this project.

## SETTING

The applicant proposes to build and operate the BSEP, a solar thermal power plant producing a total of 250 MW (nominal net output) and employing the concentrated parabolic trough solar thermal technology. The project would consist of arrays of parabolic mirrors, solar steam generator heat exchangers, one steam turbine generator, and a wet cooling tower (BS 2008a, AFC §§1.1, 2.1, 2.5).

The project's power cycle would be based on a steam cycle (also known as the Rankine cycle) (BS 2008a, AFC §2.5.2).The solar steam generator heat exchangers would receive heated heat transfer fluid from the solar thermal equipment comprised of arrays of parabolic mirrors that collect energy from the sun. The heated heat transfer fluid would be used to generate steam in the heat exchangers. This steam would then expand through the steam turbine generator to produce electrical power.

The project would utilize two auxiliary boilers fueled by propane to reduce startup time and to keep the temperature of the heat transfer fluid above its relatively high freezing point (54 degrees Fahrenheit [°F]). Except during startup, the project would not use fossil fuel to generate electricity.

## ASSESSMENT OF IMPACTS — FOSSIL FUEL ENERGY USE

## METHOD AND THRESHOLD FOR DETERMINING THE SIGNIFICANCE OF FOSSIL FUEL ENERGY RESOURCES

CEQA guidelines state that the environmental analysis "…shall describe feasible measures which could minimize significant adverse impacts, including where relevant, inefficient and unnecessary consumption of energy" (Title 14 CCR §15126.4[a][1]). Appendix F of the guidelines further suggests consideration of such factors as the project's energy requirements and energy use efficiency; its effects on local and regional energy supplies and energy resources; its requirements for additional energy supply capacity; its compliance with existing energy standards; and any alternatives that could reduce the wasteful, inefficient, and unnecessary consumption of energy (Title 14, CCR §15000 et seq., Appendix F).

The inefficient and unnecessary consumption of energy, in the form of non-renewable fuels such as natural gas, propane and oil, constitutes an adverse environmental impact. An adverse impact can be considered significant if it results in:

- adverse effects on local and regional energy supplies and energy resources;
- a requirement for additional energy supply capacity;
- noncompliance with existing energy standards; or
- the wasteful, inefficient, and unnecessary consumption of fuel or energy.

## PROJECT ENERGY REQUIREMENTS AND ENERGY USE EFFICIENCY

The BSEP would consume insignificant amounts of fossil fuel for power generation. It would consume fossil fuel only to reduce startup time and to keep the temperature of the heat transfer fluid above its relatively high freezing point.

The project would burn propane at a nominal rate of approximately 410,000 gallons per year (DB 2009r, §2.2.1). Compared to a typical fossil fuel-fired power plant of equal capacity, and compared to the relatively considerable resources of fossil fuel in California (see below in **ADVERSE EFFECTS ON ENERGY SUPPLIES AND RESOURCES**), this rate is not significant. Propane is a relatively efficient form of fossil fuel, more efficient than natural gas and fuel oil.

The applicant estimates an average overall steam cycle efficiency of 35% for the BSEP (BS 2008a, AFC Figure 2-7). There are currently no legal or industry standards for measuring the efficiency of solar thermal power plants (CEC 2008d). Therefore, staff compares the steam cycle efficiency of the BSEP to the average efficiency of the typical modern steam turbines currently available in the market. The efficiency figures for these turbines range from 35% to 40%. The project's thermal efficiency of 35% is comparable to this industry figure.

Therefore, staff considers the impact of the project's fuel consumption on energy supplies and energy efficiency to be less than significant.

## ADVERSE EFFECTS ON ENERGY SUPPLIES AND RESOURCES

The applicant has described its sources of propane for the project (DB 2009r AFC §§2.2.1, BS 2009b). According to Suburban Propane and Paxair, two area suppliers, sufficient supplies of propane are expected to be available to the BSEP. Propane is normally created as a by-product of petroleum refining and from natural gas production. Petroleum products and natural gas (with California's access to natural gas resources from the Rocky Mountains, Canada and the southwest) represent considerable energy resources in California. Propane supplies in California amount to approximately 630 million gallons per year only from refineries. This is only about 60% of California's total propane supply. Compared to this figure, the 410,000 gallons per year needed for the BSEP is not significant. Therefore, it appears highly unlikely that the project would create a substantial increase in fossil fuel demand.

## ADDITIONAL ENERGY SUPPLY REQUIREMENTS

There appears to be little likelihood that the BSEP would require additional supply (see above in **ADVERSE EFFECTS ON ENERGY SUPPLIES AND RESOURCES**).

## COMPLIANCE WITH ENERGY STANDARDS

No standards apply to the efficiency of the BSEP or other non-cogeneration projects.

## ALTERNATIVES TO REDUCE WASTEFUL, INEFFICIENT, AND UNNECESSARY ENERGY CONSUMPTION

Staff evaluates the project alternatives to determine if alternatives exist that could reduce the project's fuel use. The evaluation of alternatives to the project (that could reduce wasteful, inefficient, or unnecessary energy consumption) requires the examination of the project's energy consumption. Even though staff does not believe the project's fuel consumption would be significant, staff evaluates alternatives that could reduce or eliminate the use of fossil fuel.

## Efficiency of Alternatives to the Project

The BSEP's objectives include the generation of electricity using the concentrated parabolic trough solar thermal technology (BS 2008a, AFC §2.2).

### Alternative Generating Technologies

Alternative generating technologies for the BSEP are considered in the AFC (BS 2008a, AFC §§1.3, 4.6) and the section of this document entitled **Project Alternatives**. For purposes of this analysis, staff has evaluated fossil fuel use by other solar based technologies to compare efficiency.

Employing the photovoltaic (PV) technology would result in no consumption of fossil fuel (propane). From an energy resources perspective, the PV technology would be a viable alternative to the parabolic trough technology selected by the applicant. However, due to the BSEP's relatively low demand for fossil fuel, this alternative is only suggestive.

Given the project objectives, location, air pollution control requirements, and the commercial availability of the above technologies, staff agrees with the applicant that from an energy efficiency perspective the selected solar thermal technology is a feasible selection.

Staff, therefore, believes that the BSEP would not constitute a significant adverse impact on fossil fuel energy resources compared to feasible alternatives.

### Alternatives to the Use of Propane for Freeze Protection

Propane would be used to fire two auxiliary boilers to create steam for the purpose of heat transfer fluid freeze protection, and for startup. Although propane would be used only for these purposes and the quantities of propane expected for the BSEP would not likely constitute a significant impact on energy resources, staff suggests that the applicant consider exploring the following alternatives in order to reduce or eliminate the use of fossil fuel.

One alternative is thermal storage of heat for heat transfer fluid freeze protection. In this technology, freeze protection is routinely accomplished by circulating heat transfer fluid at a very low rate through the solar field using hot heat transfer fluid from the storage tank as a source. This results in consumption of smaller amounts of propane (or natural gas) as compared to a technology that lacks thermal storage. This storage technology is being proposed by a potential solar power plant project expected to be proposed in Kern County, California, by Solar Mellenium, LLC.—Sage Canyon Solar Power Plant.

Another alternative is what is being employed in AUSRA's Compact Linear Fresnel Reflector technology. In this technology, the sun's thermal energy is directly used to heat water within a series of specially coated stainless steel pipes to produce saturated steam. This steam is then used by the steam turbine to generate electricity. This eliminates the need for a heat transfer fluid. Throughout much of the year, no fuel is needed to keep the water temperature above its freezing point, because of the lower freezing temperature of water (32 °F) as compared to that of the heat transfer fluid chosen for the BSEP (54 °F).

## ASSESSMENT OF IMPACTS — SOLAR LAND USE

The solar insolation falling on the earth's surface can be regarded as an energy resource. Since this energy is inexhaustible, its consumption does not present the concerns inherent in fossil fuel consumption. What is of concern, however, is the extent of land area required to capture this solar energy and convert it to electricity. Setting aside hundreds or thousands of acres of land for solar power generation removes it from alternative uses. Constructing buildings and solar collector foundations can disturb environmental resources.

To evaluate the BSEP, staff tabulates the land use efficiency of the project (described above) and compares it to similar measures for other solar power plant projects that have passed through, or are passing through, the Energy Commission's siting process.

## METHOD AND THRESHOLD FOR DETERMINING THE SIGNIFICANCE OF SOLAR LAND USE ENERGY RESOURCES

Energy Commission staff proposes to compare the land use of a solar power plant project to that of other solar projects in the Energy Commission's siting process. It has not been determined how great a difference in land use would constitute a significant difference; staff proposes to compare the five solar projects currently in the process.

As this is written, there are currently five solar power plant projects in the Energy Commission siting process. These projects' power and energy output, and the extent of the land occupied by them, are summarized in **Efficiency Table 1**, below. The solar land use efficiency for a typical fossil fuel-fired (natural gas-fired) combined cycle power plant is shown only for comparison. (There are no propane-fired combined cycle power plants to use for comparison. It is noted that propane is more efficient than natural gas.)

## ADVERSE EFFECTS ON LAND USE

While the Energy Commission customarily requires full mitigation for such impacts, such mitigation is generally regarded as less effective in protecting resources than avoiding the impact entirely. A solar power project that occupies twice as much land as another project holds the potential to produce twice the environmental impacts.

## PROJECT LAND USE

The BSEP would produce power at the rate of 250 MW net, and would generate energy at the rate of 600,000 MW-hours net per year, while occupying approximately 1,321 acres (the portion of the 2,012-acre site encompassing the solar field, the power block, the evaporation ponds, and the administration buildings[1]) (BS 2008a, AFC §§2.3, Figure 2-4). Staff calculates power-based land use efficiency thus:

**Power-based efficiency**: 250 MW ÷ 1,321 acres = **0.19 MW/acre** or **5.3 acres/MW**

Staff calculates energy-based land use efficiency thus:

**Energy-based efficiency**: 600,000 MWh/year ÷ 1,321 acres = **454 MWh/acre-year**

As seen in **Efficiency Table 1**, the BSEP, employing the linear parabolic trough technology, is roughly twice as efficient in use of land as the Ivanpah SEGS project, which employs BrightSource power tower technology, the Stirling Energy Systems Solar One project, and the Stirling Energy Systems Solar Two project; and is roughly 32% less efficient than the Carrizo Energy Solar Farm project in use of land, which employs the AUSRA Compact Linear Fresnel Reflector technology.

**Efficiency Table 1 — Solar Land Use Efficiency**

| Project | Generating Capacity (MW net) | Annual Energy Production (MWh net) | Annual Fuel Consumption (MMBtu LHV) | Footprint (Acres) | Land Use Efficiency (Power-Based) (MW/acre) | Land Use Efficiency (Energy – Based) (MWh/acre-year) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Total | Solar Only[2] |
| Beacon Solar (08-AFC-2) | 250 | 600,000 | 36,000 | 1,321 | 0.19 | 454 | 450 |
| Carrizo Energy (07-AFC-8) | 177 | 375,000 | 0 | 640 | 0.28 | 586 | 586 |
| Ivanpah SEGS (07-AFC-5) | 400 | 960,000 | 432,432 | 3,744 | 0.11 | 256 | 238 |
| SES Solar One (08-AFC-13) | 850 | 1,840,000 | 0 | 8,200 | 0.11 | 224 | 224 |
| SES Solar Two (08-AFC-5) | 750 | 1,620,000 | 0 | 6,500 | 0.12 | 249 | 249 |
| Avenal Energy (08-AFC-1)[3] | 600 | 3,023,388 | 24,792,786 | 25 | 24.0 | 120,936 | N/A |

[1] 1,266 + 55 = 1,321
Solar field plus power block = 1,266 acres

Staff's estimate of the footprint encompassing the evaporation ponds and administration buildings = 55 acres (DB 2009r, AFC Figure 3). The remainder of the 2,012 acres is for purposes other than power generation or power plant operation.

[2] Net energy output is reduced by natural gas-fired combined cycle proxy energy output; see **Efficiency Appendix A**.

[3] Example natural gas-fired combined cycle plant.

## ALTERNATIVES TO REDUCE SOLAR LAND USE IMPACTS

Building and operating a typical fossil fuel-fired combined cycle power plant would yield much greater land use efficiency than any solar power plant; see **Efficiency Table 1**. However, this would not achieve the basic project objective, to generate electricity from the renewable energy of the sun.

Building a solar power plant employing a different technology, such as the BrightSource power tower technology of the Ivanpah SEGS project or the Stirling Engine technology of the SES Solar projects, would almost halve the solar land use efficiency of the BSEP. Employing the AUSRA Compact Linear Fresnel Reflector technology would increase the land use efficiency. The AUSRA technology, however, is relatively new while the the concentrated parabolic trough solar thermal technology proposed to be employed in the BSEP has been employed for over 20 years at the nearby Solar Electric Generating System facilities in the Mojave Desert (BS 2008a, AFC §§1.3, 2.5.3.1).

### Alternative Heat Rejection System

The applicant proposes to employ a wet cooling system (an evaporative cooling tower) as the means for rejecting power cycle heat from the steam turbine (BS 2008a, AFC §§1.1, 1.3, 2.5.1, 2.5.2). An alternative heat rejection system would utilize an air-cooled condenser.

The local climate in the project area is characterized by high temperatures and low relative humidity (low wet-bulb temperature). In low temperatures and high relative humidity (low dry-bulb temperature), the air-cooled condenser performs slighly more efficiently than the evaporative cooling tower. In high temperatures and low relative humidity, typical of the project area, the evaporative cooling tower performs slightly more efficiently than the air-cooled condenser. However, such an improvement may be less significant compared to the adverse environmental impacts of wet cooling over dry cooling, such as those identified in the **Soil and Water Resources** section of this document.

## CUMULATIVE IMPACTS

There are no nearby power plant projects or other projects consuming large amounts of fossil fuel that hold the potential for cumulative energy consumption impacts when aggregated with the project.

Staff believes that the construction and operation of the project would not create indirect impacts (in the form of additional fuel consumption) that would not have otherwise occurred without this project. Because the BSEP would consume significantly less fossil fuel than a typical fossil fuel-fired power plant, it should compete favorably in the California power market and replace fossil fuel burning power plants. The project would therefore cause a positive impact on the cumulative amount of fossil fuel consumed for power generation.

## NOTEWORTHY PUBLIC BENEFITS

The BSEP would employ an advanced solar thermal technology. Solar energy is renewable and unlimited. The project would have a less than significant adverse impact on nonrenewable energy resources. Consequently, the project would help in reducing California's dependence on fossil fuel-fired power plants.

## PUBLIC AND AGENCY COMMENTS

Staff did not receive any public or agency comments in the area of Power Plant Efficiency.

## APPLICANT COMMENTS

Staff received the following comment from the applicant. Below is also staff's response to this comment.

Comment: It was noted in the PSA that the project boilers would be used only at startup. The applicant requests clarification that the boilers would also be used to keep the temperature of the heat transfer fluid above its freezing point.

Staff's Response: Staff has noted, in several places in the PSA, that the boilers would be used at startup as well as to keep the fluid temperature above its freezing point. No change is necessary.

## CONCLUSIONS AND RECOMMENDATIONS

## FOSSIL FUEL ENERGY USE

The BSEP, if constructed and operated as proposed, would use solar energy to generate most of its capacity, consuming insignificant amounts of fossil fuel for power production. Although propane would be used only to reduce startup time and to keep the temperature of the heat transfer fluid above its relatively high freezing point, staff suggests that the applicant consider exploring alternatives that can reduce or eliminate the use of fossil fuel, such as the thermal storage technology proposed by Solar Mellenium or replacing the heat transfer fluid with water as in AUSRA's Compact Linear Fresnel Reflector technology.

The project would decrease reliance on fossil fuel, and would increase reliance on renewable energy resources. It would not create significant adverse effects on energy supplies or resources, would not require additional sources of energy supply, and would not consume energy in a wasteful or inefficient manner. No energy standards apply to this project. Staff therefore concludes that this project would present no significant adverse impacts on energy resources.

No cumulative impacts on energy resources are likely. Facility closure would not likely present significant impacts on electric system efficiency.

## LAND USE

The BSEP, if constructed and operated as proposed, would occupy approximately five acres per MW of power output, a figure about half that of some other solar power technologies. Employing a more land-intensive solar technology, such as the BrightSource power tower technology or Stirling Engine technology, would almost halve the land use efficiency. Staff believes the BSEP represents one of the most land use-efficient solar technologies currently available.

## PROPOSED CONDITIONS OF CERTIFICATION

No conditions of certification are proposed.

## REFERENCES


BS 2008a – FPL Energy/M. O'Sullivan (tn 45646). Submittal of the Application for Certification for the Beacon Solar Energy Project, dated 03/13/08. Submitted to CEC/Docket Unit on 03/14/08.

BS 2009b—Applicant's Responses to Air Quality Questions from July 1, 2009 Workshop. Submitted to Docket Unit on 7/21/09.

CEC 2008d – Report of Conversation between Steve Baker (CEC staff, Power Plant Siting Division) and Golam Kibrya (CEC staff, Energy Resource and Development Division). February 22, 2008.

DB 2009r – Downey Brand/S. Rowlands (tn 52116). Applicant Project Design Refinements, dated 6/22/09. Submitted to CEC/Docket Unit on 6/22/09.

TSF 2008 – Conditional Use Permit for the Topaz Solar Farm. Submitted to San Luis Obsispo County on July 18, 2008.

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# Efficiency Appendix A
## Solar Power Plant Efficiency Calculation
## Gas-Fired Proxy

In calculating the efficiency of a solar power plant, it is desired to subtract the effect of natural gas burned for morning startup, cloudy weather augmentation and Therminol freeze protection. As a proxy, we will use an average efficiency based on several recent baseload combined cycle power plant projects in the Energy Commission siting process. Baseload combined cycles were chosen because their intended dispatch most nearly mirrors the intended dispatch of solar plants, that is, operate at full load in a position high on the dispatch authority's loading order.

The most recent such projects are:

Colusa Generating Station (06-AFC-9)
- Nominal 660 MW 2-on-1 Combined Cycle with GE Frame 7FA CGTs
- Air cooled condenser, evaporative inlet air cooling
- Efficiency with duct burners on: 666.3 MW @ 52.5% LHV
- Efficiency with duct burners off: 519.4 MW @ 55.3% LHV
- Efficiency (average of these two): **53.9% LHV**

San Gabriel Generating Station (07-AFC-2)
- Nominal 696 MW 2-on-1 Combined Cycle with Siemens 5000F CGTs
- Air cooled condenser, evaporative inlet air cooling
- Efficiency with duct burners on: 695.8 MW @ 52.1% LHV
- Efficiency with duct burners off: 556.9 MW @ 55.1% LHV
- Efficiency (average of these two): **53.6% LHV**

KRCD Community Power Plant (07-AFC-7)
- Nominal 565 MW 2-on-1 Combined Cycle with GE or Siemens F-class CGTs
- Evaporative cooling, evaporative or fogging inlet air cooling
- Efficiency with GE CGTs: 497 MW @ 54.6% LHV
- Efficiency with Siemens CGTs: 565 MW @ 56.1% LHV
- Efficiency (average of these two): **55.4% LHV**

Avenal Energy (08-AFC-1)
- Nominal 600 MW 2-on-1 Combined Cycle with GE Frame 7FA CGTs
- Air cooled condenser, inlet air chillers
- Efficiency with duct burners on: 600.0 MW @ 50.5% LHV
- Efficiency with duct burners off: 506.5 MW @ 53.4% LHV
- Efficiency (average of these two): **52.0% LHV**

Average of these four power plants: **53.7% LHV**

# POWER PLANT RELIABILITY

Testimony of Shahab Khoshmashrab

## SUMMARY OF CONCLUSIONS

The applicant predicts an equivalent availability factor of 96 percent, which staff believes is achievable. (The availability factor of a power plant is the percentage of time it is available to generate power; both planned and unplanned outages subtract from this availability.) Based on a review of the proposal, with the exception of the source of water supply currently selected by the applicant (see the **Soil and Water Resources** section of this document), staff concludes that the Beacon Solar Energy Project (BSEP) would be built and would operate in a manner consistent with industry norms for reliable operation. No conditions of certification are proposed.

## INTRODUCTION

In this analysis, California Energy Commission (Energy Commission) staff addresses the reliability issues of the BSEP project to determine if the power plant is likely to be built in accordance with typical industry norms for reliable power generation. Staff uses this norm as a benchmark because it ensures that the resulting project would not be likely to degrade the overall reliability of the electric system it serves (see the "Setting" subsection, below).

The scope of this power plant reliability analysis covers:

- equipment availability;
- plant maintainability;
- fuel and water availability; and
- power plant reliability in relation to natural hazards.

Staff examined the project design criteria to determine if the project is likely to be built in accordance with typical industry norms for reliable power generation. While the applicant has predicted an equivalent availability factor of 96 percent for the BSEP (see below), staff uses typical industry norms as the benchmark, rather than the applicant's projection, to evaluate the project's reliability.

## LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

No federal, state, or local/county laws, ordinances, regulations, or standards (LORS) apply to the reliability of this project.

## SETTING

In the restructured competitive electric power industry, the responsibility for maintaining system reliability falls largely to the state's control area operators, such as the California Independent System Operator (California ISO), that purchase, dispatch, and sell electric

power throughout the state. Determining how the California ISO and other control area operators would ensure system reliability has been an ongoing effort. Protocols have been developed and put in place that allow sufficient reliability to be maintained under the competitive market system. “Must-run” power purchase agreements and “participating generator” agreements are two mechanisms that have been employed to ensure an adequate supply of reliable power.

In September 2005, California AB 380 (Núñez, Chapter 367, Statutes of 2005) became law. This modification to the Public Utilities Code requires the California Public Utilities Commission to consult with the California ISO to establish resource adequacy requirements for all load-serving entities (basically, publicly and privately owned utility companies). These requirements include maintaining a minimum reserve margin (extra generating capacity to serve in times of equipment failure or unexpected demand) and maintaining sufficient local generating resources to satisfy the load-serving entity’s peak demand and operating reserve requirements.

In order to fulfill this mandate, the California ISO has begun to establish specific criteria for each load-serving entity under its jurisdiction. These criteria guide each load-serving entity in deciding how much generating capacity and ancillary services to build or purchase, after which the load-serving entity issues power purchase agreements to satisfy these needs.

The California ISO’s mechanisms to ensure adequate power plant reliability apparently were devised under the assumption that the individual power plants that compete to sell power into the system will each exhibit a level of reliability similar to that of power plants of past decades. However, there has been valid cause to believe that, under free market competition, financial pressures on power plant owners to minimize capital outlays and maintenance expenditures may act to reduce the reliability of many power plants, both existing and newly constructed (McGraw-Hill 1994). It is possible that, if significant numbers of power plants were to exhibit individual reliability sufficiently lower than this historical level, the assumptions used by California ISO to ensure system reliability would prove invalid, with potentially disappointing results. Accordingly, staff has recommended that power plant owners continue to build and operate their projects to the level of reliability to which all in the industry are accustomed.

As part of its plan to provide needed reliability, the applicant proposes to operate the 250-megawatt (MW) (net power output) BSEP, a solar thermal power plant facility employing advanced solar power technology. This project, using renewable solar energy, would provide dependable power to the grid, generally during the hours of peak power consumption by the interconnecting utility(s). This project would help serve the need for renewable energy in California, as all its generated electricity would be produced by a reliable source of energy that is available during the hot summer afternoons, when power is needed most.

The project is expected to achieve an equivalent availability factor in the range of 96 percent. The project is anticipated to operate at an annual capacity factor of approximately 26.5 percent (BS 2008a, AFC §2.5.2).

## ASSESSMENT OF IMPACTS

## METHOD FOR DETERMINING RELIABILITY

The Energy Commission must make findings as to how a project is designed, sited, and operated in order to ensure its safe and reliable operation (Title 20, CCR §1752[c]). Staff takes the approach that a project is acceptable if it does not degrade the reliability of the utility system to which it is connected. This is likely the case if a project is at least as reliable as other power plants on that system.

The availability factor of a power plant is the percentage of time it is available to generate power; both planned and unplanned outages subtract from this availability. Measures of power plant reliability are based upon both the plant's actual ability to generate power when it is considered to be available and upon starting failures and unplanned (or forced) outages. For practical purposes, reliability can be considered a combination of these two industry measures, making a reliable power plant one that is available when called upon to operate. Throughout its intended 30-year life, the BSEP is expected to operate reliably (BS 2008a, AFC §2.5.3). Power plant systems must be able to operate for extended periods without shutting down for maintenance or repairs. Achieving this reliability requires adequate levels of equipment availability, plant maintainability with scheduled maintenance outages, fuel and water availability, and resistance to natural hazards. Staff examines these factors for a project and compares them to industry norms. If the factors compare favorably for this project, staff will then conclude that the BSEP would be as reliable as other power plants on the electric system and would not degrade system reliability.

## EQUIPMENT AVAILABILITY

Equipment availability would be ensured by adoption of appropriate quality assurance/quality control (QA/QC) programs during the design, procurement, construction, and operation of the plant and by providing for the adequate maintenance and repair of the equipment and systems discussed below.

### Quality Control Program

The applicant describes a QA/QC program (BS 2008a, AFC §2.5.3) that is typical of the power industry. Equipment would be purchased from qualified suppliers based on technical and commercial evaluations. Suppliers' personnel, production capability, past performance, QA programs, and quality history would be evaluated. The project owner would perform receipt inspections, test components, and administer independent testing contracts. Staff expects that implementation of this program would result in standard reliability of design and construction. To ensure this implementation, staff has proposed appropriate conditions of certification in the section of this document entitled **Facility Design**.

## PLANT MAINTAINABILITY

### Equipment Redundancy

The project, as proposed in the AFC, would be able to operate only when the sun is shining. Maintenance or repairs could be done when the plant is shut down at night.

This would help to enhance the project's reliability. Also, the applicant proposes to provide redundant pieces of equipment for those that are most likely to require service or repair. This redundancy would allow service or repair to be done during sunny days when the plant is in operation, if required.

Major plant systems are designed with adequate redundancy to ensure their continued operation if equipment fails.

### Maintenance Program

Equipment manufacturers provide maintenance recommendations for their products, and the applicant would base the project's maintenance program on those recommendations (BS 2008a, AFC §2.5). The program would encompass both preventive and predictive maintenance techniques. Maintenance outages would probably be planned for periods of low electricity demand. Staff expects that the project would be adequately maintained to ensure an acceptable level of reliability.

## FUEL AND WATER AVAILABILITY

The long-term availability of fuel and of water for cooling or process use is necessary to ensure the reliability of any power plant. The need for reliable sources of fuel and water is obvious; lacking long-term availability of either source, the service life of the plant could be curtailed, threatening both the power supply and the economic viability of the plant.

### Fuel Availability

The BSEP would consume insignificant amounts of propane for power generation. The sole consumption of propane would be to reduce startup time and to keep the temperature of the heat transfer fluid above its freezing point.

Propane would be delivered to the BSEP site by trucks and would be stored onsite. According to Suburban Propane and Paxair, two area suppliers, sufficient supplies of propane are expected to be available to the BSEP (BS 2009b). Staff believes that there will be adequate fuel supply to meet the project's needs.

### Water Supply Reliability

The BSEP has proposed to use well water for domestic and industrial water needs, including steam cycle makeup, mirror washing, service water and fire protection water. According to the **Soil and Water Resources** section of this document, the proposed use of onsite groundwater for power plant cooling is in conflict with the State Water Board and Energy Commission policies. Therefore, staff cannot conclude that this source of water supply is a reliable source of water for the project.

Rosamond Community Services District (RCSD) has proposed, and has submitted a letter expressing its willingness, to provide the BSEP with 1,456 acre-feet per year of Title 22 tertiary treated reclaimed water during the life of the BSEP (RCSD 2009a). The quantity and quality of this water appear to be adequate for the BSEP. Therefore, staff considers this to be a reliable alternative.

Also, the City of California City has recently proposed, and has submitted a letter expressing its willingness, to provide the BSEP with treated wastewater in adequate quantities for the project's water needs (CofC 2009c). Therefore, staff considers this to be a reliable alternative.

For further discussion of water supply, see the **Soil and Water Resources** section of this document.

## POWER PLANT RELIABILITY IN RELATION TO NATURAL HAZARDS

Natural forces can threaten the reliable operation of a power plant. Tsunamis (tidal waves) and seiches (waves in inland bodies of water) are not likely to present hazards for this project, but seismic shaking (earthquakes) and flooding could present credible threats to the project's reliable operation (BS 2008a, AFC §§1.2, 2.5.6.6).

### Seismic Shaking

The site lies within Seismic Zone 4 (BS 2008a, AFC §1.2); see the "Faulting and Seismicity" portion of the **Geology and Paleontology** section of this document. The project will be designed and constructed to the latest applicable LORS (BS 2008a, AFC Appendix C). Compliance with current seismic design LORS represents an upgrading of performance during seismic shaking compared to older facilities since these LORS have been continually upgraded. Because it would be built to the latest seismic design LORS, this project would likely perform at least as well as, and perhaps better than, existing plants in the electric power system. Staff has proposed conditions of certification to ensure this; see the section of this document entitled **Facility Design**. In light of the general historical performance of California power plants and the electrical system in seismic events, staff has no special concerns with the power plant's functional reliability during earthquakes.

### Flooding

The project site elevation ranges from approximately 2,050 to 2,260 feet above mean sea level. According to the Federal Emergency Management Agency, a portion of the site lies within the 100-year flood plain (BS 2008a, AFC §§2.5.6.6, 5.17.2.9). In the PSA, staff concluded that the diversion channel intending to reroute flood flows around the project site, as proposed by the applicant in the AFC, did not seem adequate for anticipated flows. Recently, the applicant has proposed to design and build a new diversion channel to relocate two linear miles of Pine Creek Wash in order to control storm water flow in and around the project site (DB 2009r, §2.1.1). This proposal, if built, would eliminate staff's concerns with power plant reliability due to flooding. For further discussion, see **Soil and Water Resources** and **Geology and Paleontology**.

## COMPARISON WITH EXISTING FACILITIES

The North American Electric Reliability Corporation (NERC) maintains industry statistics for availability factors (as well as other related reliability data). The NERC regularly polls North American utility companies on their project reliability through its Generating Availability Data System and periodically summarizes and publishes those statistics on the Internet at <http://www.nerc.com>. Because no statistics are available for solar power plants, staff compares the project's availability factor to the average availability

factor of fossil fuel-fired units. Also because the project's total net power output would be 250 MW, staff uses the NERC statistics for 200–299 MW units. The NERC reported an availability factor of 86.01 percent as the generating unit average for the years 2002 through 2006 for fossil fuel units of 200-299 MW (NERC 2007).

The concentrated parabolic trough solar thermal technology is not new. This technology has been employed for over 20 years at the nearby Solar Electric Generating System facilities in the Mojave Desert (BS 2008a, AFC §§1.3, 2.5.3.1). Staff believes that the parabolic trough technology is likely to exhibit the projected reliability.

The project would use multi-pressure condensing steam turbine technology. Steam turbines incorporating this technology have been on the market for many years now and are expected to exhibit typically high availability. Also, because solar-generated steam is cleaner than burnt fossil fuel, the BSEP steam cycle units would likely require less frequent maintenance than units that burn fossil fuel. Therefore, the applicant's expectation of an annual availability factor of 96 percent (BS 2008a, AFC §2.5.2) appears reasonable when compared with the NERC figures throughout North America (see above). In fact, these machines might well be expected to outperform the fleet of various turbines (mostly older and smaller) that make up NERC statistics. Additionally, the project, as proposed, would be able to operate only when the sun is shining. Maintenance or repairs could be done when the plant is shut down at night.

The applicant's estimate of plant availability, therefore, appears to be realistic. Stated procedures for assuring the design, procurement, and construction of a reliable power plant appear to be consistent with industry norms, and staff believes they are likely to ultimately produce an adequately reliable plant.

## NOTEWORTHY PROJECT BENEFITS

This project would help serve the need for renewable energy in California, as most of the electricity generated would be produced by a reliable source of energy that is available during the hot summer afternoons, when power is needed most.

## PUBLIC AND AGENCY COMMENTS

Staff did not receive any public or agency comments in the area of Power Plant Reliability.

## CONCLUSION

The applicant predicts an equivalent availability factor of 96 percent, which staff believes is achievable. Based on a review of the proposal, with the exception of the source of water supply currently selected by the applicant (see the **Soil and Water Resources** section of this document), staff concludes that the plant would be built and operated in a manner consistent with industry norms for reliable operation. No conditions of certification are proposed.

## PROPOSED CONDITIONS OF CERTIFICATION

No conditions of certification are proposed.

## REFERENCES


BS 2008a—FPL Energy/M. O'Sullivan (tn 45646). Submittal of the Application for Certification for the Beacon Solar Energy Project, dated 03/13/08. Submitted to CEC/Docket Unit on 03/14/08.

BS 2009b—Applicant's Responses to Air Quality Questions from July 1, 2009 Workshop. Submitted to Docket Unit on 7/21/09.

CofC 2009c—City of California/M. Bevins (tn 52865). City of California's Proposal to Provide Treated Wastewater to Beacon Solar, dated 8/13/09. Submitted to CEC/Docket Unit on 8/13/09.

DB 2009r—Downey Brand/S. Rowlands (tn 52116). Applicant Project Design Refinements, dated 6/22/09. Submitted to CEC/Docket Unit on 6/22/09.

McGraw-Hill 1994—McGraw-Hill Energy Information Services Group. 1994. *Operational Experience in Competitive Electric Generation*. Executive Report.

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PUB 2009a—Member of the Public/J. Musick (tn 52860). Mineral and Water Rights Reservation Arciero and Rudnick. Submitted to CEC/Docket Unit on 08/12/09.

RCSD 2009a—Rosamond Community Services District (tn 52318). Tertiary Water Service Letter of Intent for the Beacon Solar Energy Project, dated 8/14/09. Submitted to CEC/Docket Unit on 8/31/09.

# TRANSMISSION SYSTEM ENGINEERING

Testimony of Sudath Arachchige and Mark Hesters

## SUMMARY OF CONCLUSIONS

The proposed Beacon Solar Energy Project (BSEP) outlet lines and termination are acceptable and would comply with all applicable laws, ordinances, regulations, and standards (LORS). The analysis of project transmission lines and equipment, both from the power plant up to the point of interconnection with the existing transmission network as well as upgrades beyond the interconnection that are attributable to the project have been evaluated by staff.

- The modification of the existing Barren Ridge switch yard would occur within the fence line of the existing Los Angeles Department of Water and Power (LADWP) switchyard and would not trigger CEQA (California Environmental Quality Act).
- The applicant should request a Facility Study (FS) to be performed by the LADWP to determine the cost estimates and work scope for interconnection facilities and the transmission network upgrades of the LADWP system.

## INTRODUCTION

## STAFF ANALYSIS

This transmission system engineering (TSE) analysis examines whether this project's proposed interconnection conforms to all LORS required for safe and reliable electric power transmission. Additionally, under CEQA, the Energy Commission must conduct an environmental review of the "whole of the action," which may include facilities not licensed by the Energy Commission (Title 14, California Code of Regulations §15378). The Energy Commission must therefore identify the system impacts and necessary new or modified transmission facilities downstream of the proposed interconnection that are required for interconnection and that represent the whole of the action.

Commission staff relies upon the responsible interconnecting authority for analysis of impacts on the transmission grid, as well as for the identification and approval of new or modified facilities required downstream from the proposed interconnection for mitigation purposes.

## LADWP'S ROLE

LADWP is responsible for ensuring electric system reliability in its service territory for proposed transmission modifications. For the BSEP project, LADWP performed the System Impact Study used to determine whether or not the proposed transmission modifications conform to reliability standards. Because the BSEP project would be connected to the LADWP controlled Municipal utility grid via the Barren Ridge 230kV switching station, the LADWP's role is to review and approve the SIS and its conclusions.

## LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

- California Public Utilities Commission (CPUC) General Order 95 (GO-95), *Rules for Overhead Electric Line Construction*, sets forth uniform requirements for the construction of overhead lines. Compliance with this order ensures both adequate service and the safety of both the public and the people who build, maintain, and operate overhead electric lines.
- CPUC General Order 128 (GO-128), *Rules for Construction of Underground Electric Supply and Communications Systems*, sets forth uniform requirements and minimum standards for underground supply systems to ensure adequate service and the safety of both the public and the people who build, maintain, and operate underground electric lines.
- The National Electric Safety Code, 1999, provides electrical, mechanical, civil, and structural requirements for overhead electric line construction and operation.
- The combined NERC/WECC (North American Electric Reliability Corporation/Western Electricity Coordinating Council) planning standards provide system performance standards for assessing the reliability of the interconnected transmission system. These standards require continuity of service as their first priority and the preservation of interconnected operation as their second. Some aspects of NERC/WECC standards are either more stringent or more specific than the either agency's standards alone. These standards are designed to ensure that transmission systems can withstand both forced and maintenance outage system contingencies while operating reliably within equipment and electric system thermal, voltage, and stability limits. These standards include reliability criteria for system adequacy and security, system modeling data requirements, system protection and control, and system restoration. Analysis of the WECC system is based to a large degree on Section I.A of WECC standards, *NERC and WECC Planning Standards with Table I and WECC Disturbance-Performance Table,* and on Section I.D, *NERC and WECC Standards for Voltage Support and Reactive Power.* These standards require that power flows and stability simulations verify defined performance levels. Performance levels are defined by specifying allowable variations in thermal loading, voltage and frequency, and loss of load that may occur during various disturbances. Performance levels range from no significant adverse effects inside and outside a system area during a minor disturbance (such as the loss of load from a single transmission element) to a catastrophic loss level designed to prevent system cascading and the subsequent blackout of islanded areas and millions of consumers during a major transmission disturbance (such as the loss of multiple 500-kV lines along a common right-of- way, and/or of multiple large generators). While the controlled loss of generation or system separation is permitted under certain specific circumstances, this sort of major uncontrolled loss is not permitted (WECC, 2002).
- NERC's reliability standards for North America's electric transmission system spell out the national policies, standards, principles, and guidelines that ensure the adequacy and security of the nation's transmission system. These reliability standards provide for system performance levels under both normal and contingency conditions. While these standards are similar to the combined NERC/WECC standards, certain aspects of the combined standards are either more

stringent or more specific than the NERC performance standards alone. NERC's reliability standards apply to both interconnected system operations and to individual service areas (NERC, 2006).

- LADWP planning standards also provide the standards and guidelines that ensure the adequacy, security, and reliability of the state's member grid facilities. These standards also incorporate the combined NERC/WECC and NERC standards. These standards are also similar to the NERC/WECC or NERC standards for transmission system contingency performance. However, the LADWP standards also provide additional requirements that are not found in either the WECC/NERC or NERC standards. The LADWP standards apply to all participating transmission owners interconnecting to the LADWP controlled grid. They also apply to non-member facilities that impact the LADWP grid through their interconnections with adjacent control grids (LADWP, SIS).

## PROJECT DESCRIPTION

The proposed BSEP site is located approximately one mile to the north of LADWP's Barren Ridge 230kV switching station site and will consist of a 250MW steam turbine generator. The steam for the prime mover will be created by utilizing collected solar energy, through a heat-exchanger. The proposed generating plant will consist of one 330 MVA Steam turbine generating unit for a total net output of 250MW. The project's planned operational date is summer of 2011.The generator auxiliary load would be 30MW, resulting in a maximum net output of 250 MW at an 85 percent power factor. Generating unit would be connected to the low side of its dedicated 18/230 kV generator step-up (GSU) transformer through 18kV, 1200-ampere SF6 circuit breakers. The step-up transformer for the steam turbine generating unit would be rated at 18/230 kV and 200/266/332 megavolt ampere (MVA) at 55 centigrade. The 230-kV side of step-up transformer would be connected through 1200A, SF6 circuit breaker to the existing Barren Ridge switching station via the selected 230kV transmission line options. The applicant has proposed to utilize the existing bus work within the breaker-and- a-half Barren Ridge switching station to interconnect the BSEP plant. The modification of the existing Barren Ridge switch yard would consist of two new 3000A, 230kV circuit breakers, 230-115 kV capacitor controlled voltage transformers and four 230kV, 3000 A disconnect switches. (BSEP project, 2008b section 2.0 pages 2-29 to 2-32 and Figure 2-4,2-10,2-15, 2-16).

## SWITCHYARD AND INTERCONNECTION FACILITIES

The project will interconnect to the LADWP owned Barren Ridge switching station as the primary point of interconnection.

- The Barren Ridge interconnection would require approximately 3.5 miles of overhead 230kV transmission line, approximately 1.6 miles of which would be within the plant site boundary. The line would exit a pull off structure within a new project switchyard in the plant side power block and head northerly. It will follow the project access road for approximately 1.2 miles on monopole steel concrete

structures, turning southwest to cross the existing Union Pacific (UP) rail line and SR- 14. After crossing SR-14 the line will continue in a southwesterly direction for approximately 0.3 mile until it reaches the Barren Ridge switching station.

The proposed 230kV overhead single circuit would be built with 795 kcmil per phase ACSR conductors and routed through the 230kV, 36 new steel/concrete mono-poles to interconnect plant to the existing Barren Ridge substation. The proposed overhead generator tie line is rated to carry the full capacity of the BSEP project. The 230kV poles are expected to average about 79 feet in height, with a span length expected to average approximately 500 feet. (BSEP project, 2008b section 2.0 pages 2.29, 2.32 and Figure 2-4, 2-10).The proposed transmission line is the first point of interconnection and will be permitted by the CEC, and a general level of environmental review is required for the Energy Commission's CEQA process.

## ASSESSMENT OF IMPACTS AND DISCUSSION OF MITIGATION

The proposed BSEP project would deliver energy to the 230kV LADWP grid; hence LADWP municipal utility is responsible for ensuring grid reliability. This entity determines the transmission system impacts of the proposed project and any mitigation measures needed to ensure system conformance with utility reliability criteria, NERC planning standards, WECC reliability criteria. System impact and facilities studies are used to determine the impacts of the proposed project on the transmission grid. Staff relies on these studies and any review conducted by the LADWP to determine the effect of the project on the transmission grid and to identify any necessary downstream facilities or indirect project impacts required to bring the transmission network into compliance with applicable reliability standards. System impact and facilities studies analyze the grid both with and without the proposed project, under conditions specified in the planning standards and reliability criteria. The standards and criteria define the assumptions used in the study and establish the thresholds through which grid reliability is determined. The studies analyze the impact of the project for the proposed first year of operation, and are based on a forecast of loads, generation, and transmission. Load forecasts are developed by the interconnected utility. Generation and transmission forecasts are established by an interconnection queue. The studies focus on thermal overloads, voltage deviations, system stability (excessive oscillations in generators and transmission system, voltage collapse, loss of loads, or cascading outages), and short circuit duties. If the studies show that the interconnection of the project causes the grid to be out of compliance with reliability standards, then the study will identify mitigation alternatives or ways in which the grid could be brought into compliance with reliability standards.

When a project connects to the LADWP-controlled grid, both the studies and mitigation alternatives must be reviewed and approved by the LADWP. If the interconnecting utility determines that the only feasible mitigation includes transmission modifications or additions requiring CEQA review, the Energy Commission must analyze those modifications or additions according to CEQA requirements.

## Scope of the LADWP system study

The LADWP performed an Interconnection System Impact Study (SIS) of the Beacon Solar Energy Project (BSEP), as requested by Florida Power & Light Company (FPL) Energy, LLC. The study included power flow, sensitivity, and short circuit studies, and transient and post-transient analyses (LADWP, 2008a, system impact study). The study modeled the proposed project for a net output of 250 MW. The base case system representation includes all the proposed upgrades in the LADWP area and any generator and transmission interconnection requests that are currently in LADWP's interconnection application queue ahead of the project. These conditions reflect the most critical expected loading condition for the transmission system in LADWP's area. In addition, the bulk power study evaluated conditions with dispatch of generation outside of the LAWDP service territory and electrical system in a manner that maximized loadings in the LADWP Main System area. The detailed study assumptions are described in the study. The power flow studies were conducted with and without BSEP connected to LADWP's grid at the Barren Ridge, using 2011 heavy summer peak and 2011 light autumn base cases. The power flow study assessed the project's impact on thermal loading of the transmission lines and equipment. Transient and post-transient studies were conducted for BSEP project using the 2011 heavy summer peak base case to determine whether the project would create instability in the system following certain selected outages. Short circuit studies were conducted to determine if BSEP would overstress existing substation facilities.

### LADWP Power Flow Study Results

#### *Heavy Summer Conditions:*

Steady-state analysis of both primary and alternate point of interconnection cases reveals no thermal overload in the pre and post project system, except for the loss of both Rinaldi-Tarzana lines (N-2), which results in the overload of the Northridge-Tarzana line. However, this overload is resolved with partial load shed at Tarzana as an interim mitigation procedure. In addition, to address a long-term solution for this overload, LADWP is planning to upgrade the conductor of the impacted line with higher capacity.

#### *Light Autumn Conditions:*

No steady-state violations and no thermal overloads were found for all contingencies in the Pre and Post project system with either the primary point of interconnection or the alternate point of interconnection.

### LADWP Transient Study Results

The Transient study was conducted for the critical single and double contingencies affecting the area listed in the page 8 of the LADWP SIS. The three-phase faults with normal clearing are studied for single contingencies; single -line-to-ground faults with delayed clearing are studied for double contingencies. All outage cases were evaluated with the assumption that existing Special Protection Schemes (SPS) or Remedial Action Schemes (RAS) would operate as designed where required. Transient stability study indicates there would be no system performance issues caused by the BSEP project for primary point of interconnection.

### LADWP Post-Transient Study Results

NERC/WECC planning standards require that the system maintain post-transient voltage stability when either critical path transfers or area loads increase by 5 percent for category ”B” contingencies, and 2.5 percent for category ”C” contingencies. Post-transient studies conducted for similar or larger generators in the area concluded that voltage remains stable under both N-1 and N-2 contingencies. All outage cases were evaluated with the assumption that existing SPS or RAS would operate as designed where required. The studies determined that the system remained stable under both single and double contingency outage conditions and the addition of the BSEP project for primary point of interconnection.

### LADWP Short Circuit Study Results

Short circuit studies were performed to determine the degree to which the addition of BSEP project increases fault duties at LADWP’s substations, adjacent utility substations, and the other 230-kV, and 500-kV busses within the study area. The busses at which faults were simulated, the maximum three-phase and single-line-to-ground fault currents at these busses both with and without the project, and information on the breaker duties at each location are summarized in the Short Circuit Study Results tables (3 Phase to Ground and Single Line to Ground) of the System Impact Study Report (BSEP, 2008b, SIS, tables 3 to 10, Pages 16 to 19). The BSEP interconnection increases both three-phase and single-phase duties at several stations along the Inyo-Rinaldi line. These increased duties do not exceed the planned interrupting duty of 15KA of all Barren Ridge switching station circuit breakers. At the point of interconnection, two circuit breakers and four disconnect switches are required at the positions E31 and E32 of the Barren Ridge switching station. The continuous rating of the new circuit breakers and disconnect switches should be 3000A at the 230kV nominal voltage. The interruptible rating of the breakers should match with the existing level of 15kA.

The applicant should request a Facility Study to be performed by the LADWP to determine the cost estimates and work scope for interconnection facilities and the transmission network upgrades of the LADWP system.

## COMPLIANCE WITH LORS

The study indicates that the project interconnection would comply with NERC/WECC planning standards and LADWP reliability criteria. The applicant will design, build, and operate the proposed 230-kV overhead single circuits.

Staff concludes that, assuming the proposed conditions of certification are met, the project would likely meet the requirements and standards of all applicable LORS.

## RESPONSE TO AGENCY AND PUBLIC COMMENTS

No agency or public comments related to the TSE discipline have been received.

## CONCLUSIONS AND RECOMMENDATIONS

The proposed Beacon Solar Energy Project (BSEP) outlet lines and termination are acceptable and would comply with all applicable laws, ordinances, regulations, and standards (LORS). The analysis of project transmission lines and equipment, both from the power plant up to the point of interconnection with the existing transmission network as well as upgrades beyond the interconnection that are attributable to the project have been evaluated by staff.

- The modification of the existing Barren Ridge switch yard would occur within the fence line of the existing Los Angeles Department of Water and Power (LADWP) switchyard and would not trigger CEQA (California Environmental Quality Act).
- The applicant should request a Facility Study to be performed by the LADWP to determine the cost estimates and work scope for interconnection facilities and the transmission network upgrades of the LADWP system.

### RECOMMENDATIONS

If the Energy Commission approves this project, staff recommends that the following conditions of certification be met to ensure both system reliability and conformance with LORS.

## CONDITIONS OF CERTIFICATION FOR TSE

**TSE-1** The project owner shall furnish to the Compliance Project Manager (CPM) and to the Chief Building Official (CBO) a schedule of transmission facility design submittals, a Master Drawing List, a Master Specifications List, and a Major Equipment and Structure List. The schedule shall contain a description and list of proposed submittal packages for design, calculations, and specifications for major structures and equipment. To facilitate audits by Energy Commission staff, the project owner shall provide designated packages to the CPM when requested.

**Verification**: At least 60 days prior to the start of construction (or a lesser number of days mutually agreed to by the project owner and the CBO), the project owner shall submit the schedule, a Master Drawing List, and a Master Specifications List to the

CBO and to the CPM. The schedule shall contain a description and list of proposed submittal packages for design, calculations, and specifications for major structures and equipment (see a list of major equipment in **Table 1: Major Equipment List** below). Additions and deletions shall be made to the table only with CPM and CBO approval. The project owner shall provide schedule updates in the Monthly Compliance Report.

**TRANSMISSION SYSTEM ENGINEERING Table 1**
**Major Equipment List**

| |
|---|
| Breakers |
| Step-Up Transformer |
| Switchyard |
| Busses |
| Surge Arrestors |
| Disconnects |
| Take Off Facilities |
| Electrical Control Building |
| Switchyard Control Building |
| Transmission Pole/Tower |
| Grounding System |

**TSE-2** Prior to the start of construction, the project owner shall assign an electrical engineer and at least one of each of the following to the project: A) a civil engineer; B) a geotechnical engineer or a civil engineer experienced and knowledgeable in the practice of soils engineering; C) a design engineer who is either a structural engineer or a civil engineer fully competent and proficient in the design of power plant structures and equipment supports; or D) a mechanical engineer. (Business and Professions Code Sections 6704 et seq, require state registration to practice as a civil engineer or structural engineer in California.

The tasks performed by the civil, mechanical, electrical, or design engineers may be divided between two or more engineers, as long as each engineer is responsible for a particular segment of the project (e.g., proposed earthwork, civil structures, power plant structures, equipment support). No segment of the project shall have more than one responsible engineer. The transmission line may be the responsibility of a separate California-registered electrical engineer. The civil, geotechnical or civil, and design engineer assigned in conformance with Facility Design condition **GEN-5**, may be responsible for design and review of the TSE facilities.

The project owner shall submit to the CBO for review and approval, the names, qualifications, and registration numbers of all engineers assigned to the project. If any one of the designated engineers is subsequently reassigned or replaced, the project owner shall submit the name, qualifications, and registration number of the newly assigned engineer to the CBO for review and approval. The project owner shall notify the CPM of the CBO's approval of the new engineer. This engineer shall be authorized to halt

earthwork and to require changes if site conditions are unsafe or do not conform with predicted conditions used as a basis for design of earthwork or foundations.

The electrical engineer shall:

1. Be responsible for the electrical design of the power plant switchyard, outlet and termination facilities; and

2. Sign and stamp electrical design drawings, plans, specifications, and calculations.

**Verification:** At least 30 days prior to the start of rough grading (or a lesser number of days mutually agreed to by the project owner and the CBO), the project owner shall submit to the CBO for review and approval, the names, qualifications, and registration numbers of all the responsible engineers assigned to the project. The project owner shall notify the CPM of the CBO's approvals of the engineers within five days of the approval.

If the designated responsible engineer is subsequently reassigned or replaced, the project owner has five days in which to submit the name, qualifications, and registration number of the newly assigned engineer to the CBO for review and approval. The project owner shall notify the CPM of the CBO's approval of the new engineer within five days of the approval.

**TSE-3** If any discrepancy in design and/or construction is discovered in any engineering work that has undergone CBO design review and approval, the project owner shall document the discrepancy and recommend corrective action (California Building Code, 1998, Chapter 1, Section 108.4, Approval Required; Chapter 17, Section 1701.3, Duties and Responsibilities of the Special Inspector; Appendix Chapter 33, Section 3317.7, Notification of Noncompliance). The discrepancy documentation shall become a controlled document and shall be submitted to the CBO for review and approval and shall reference this condition of certification.

**Verification:** The project owner shall submit a copy of the CBO's approval or disapproval of any corrective action taken to resolve a discrepancy to the CPM within 15 days of receipt. If disapproved, the project owner shall advise the CPM, within five days, the reason for disapproval, and the revised corrective action required obtaining the CBO's approval.

**TSE-4** For the power plant switchyard, outlet line, and termination, the project owner shall not begin any increment of construction until plans for that increment have been approved by the CBO. These plans, together with design changes and design change notices, shall remain on the site for one year after completion of construction. The project owner shall request that the CBO

inspect the installation to ensure compliance with the requirements of applicable LORS. The following activities shall be reported in the Monthly Compliance Report:

1. Receipt or delay of major electrical equipment;

2. Testing or energization of major electrical equipment; and

3. The number of electrical drawings approved, submitted for approval, and still to be submitted.

**Verification:** At least 30 days prior to the start of each increment of construction (or a lesser number of days mutually agreed to by the project owner and the CBO), the project owner shall submit to the CBO for review and approval the final design plans, specifications, and calculations for equipment and systems of the power plant switchyard, outlet line, and termination, including a copy of the signed and stamped statement from the responsible electrical engineer attesting to compliance with the applicable LORS, and send the CPM a copy of the transmittal letter in the next Monthly Compliance Report.

**TSE-5** The project owner shall ensure that the design, construction, and operation of the proposed transmission facilities will conform to all applicable LORS, including the requirements listed below. The project owner shall submit the required number of copies of the design drawings and calculations as determined by the CBO.

1. The BSEP project will be interconnected to the LADWP grid via 230kV, 795kcmil ACSR overhead conductors, single circuit generator tie line.

2. The power plant outlet line shall meet or exceed the electrical, mechanical, civil, and structural requirements of CPUC General Order 95 and General Order 98 or National Electric Safety Code (NESC), Title 8 of the California Code and Regulations (Title 8), Articles 35, 36, and 37 of the “High Voltage Electric Safety Orders”, National Electric Code (NEC), and related industry standards.

3. Breakers and busses in the power plant switchyard and other switchyards, where applicable, shall be sized to comply with a short-circuit analysis.

4. Outlet line crossings and line parallels with transmission and distribution facilities shall be coordinated with the transmission line owner and comply with the owner’s standards.

5. The project conductors shall be sized to accommodate the full output from the project.

6. Termination facilities shall comply with applicable LADWP Utility interconnection standards.

7. The project owner shall provide to the CPM:
    a. The final Detailed Facility Study (DFS) including a description of facility upgrades, operational mitigation measures, and/or Special Protection System (SPS) sequencing and timing if applicable,
    b. Executed project owner and LADWP Facility Interconnection Agreement.

**Verification:** At least 60 days prior to the start of construction of transmission facilities (or a lessor number of days mutually agree to by the project owner and CBO), the project owner shall submit to the CBO for approval:

1. Design drawings, specifications, and calculations conforming with CPUC General Order 95 and General Order 98 or NESC; Title 8, California Code of Regulations, Articles 35, 36, and 37 of the "High Voltage Electric Safety Orders"; NEC; applicable interconnection standards, and related industry standards for the poles/towers, foundations, anchor bolts, conductors, grounding systems, and major switchyard equipment.

2. For each element of the transmission facilities identified above, the submittal package to the CBO shall contain the design criteria, a discussion of the calculation method(s), a sample calculation based on "worst-case conditions,"[1] and a statement signed and sealed by the registered engineer in responsible charge, or other acceptable alternative verification, that the transmission element(s) will conform with CPUC General Order 95 or NESC; Title 8, California Code of Regulations, Articles 35, 36 and 37 of the "High Voltage Electric Safety Orders"; NEC; applicable interconnection standards, and related industry standards.

3. Electrical one-line diagrams signed and sealed by the registered professional electrical engineer in responsible charge, a route map, and an engineering description of equipment and the configurations covered by requirements **TSE-5** 1) through 5) above.

4. The final Detailed Facility Study, including a description of facility upgrades, operational mitigation measures, and/or SPS sequencing and timing if applicable, shall be provided concurrently to the CPM.

**TSE-6** The project owner shall provide the following Notice to the LADWP prior to synchronizing the facility with the LADWP transmission system:

1. At least one week prior to synchronizing the facility with the grid for testing, provide the LADWP a letter stating the proposed date of synchronization; and

2. At least one business day prior to synchronizing the facility with the grid for testing, provide telephone notification to the LADWP Outage Coordination Department.

[1] Worst-case conditions for the foundations would include for instance, a dead-end or angle pole.

**Verification:** The project owner shall provide copies of the LADWP letter to the CPM when it is sent to the LADWP one week prior to initial synchronization with the grid. A report of the conversation with the LADWP shall be provided electronically to the CPM one day before synchronizing the facility with the LADWP transmission system for the first time.

**TSE-7** The project owner shall be responsible for the inspection of the transmission facilities during and after project construction, and any subsequent CPM and CBO approved changes thereto, to ensure conformance with CPUC GO-95 or NESC; Title 8, CCR, Articles 35, 36 and 37 of the "High Voltage Electric Safety Orders"; applicable interconnection standards; NEC; and related industry standards. In case of non-conformance, the project owner shall inform the CPM and CBO in writing, within 10 days of discovering such non-conformance and describe the corrective actions to be taken.

**Verification:** Within 60 days after first synchronization of the project, the project owner shall transmit to the CPM and CBO:

1. "As built" engineering description(s) and one-line drawings of the electrical portion of the facilities signed and sealed by the registered electrical engineer in responsible charge. A statement attesting to conformance with CPUC GO-95 or NESC; Title 8, California Code of Regulations, Articles 35, 36 and 37 of the "High Voltage Electric Safety Orders"; applicable interconnection standards; NEC; and related industry standards, and these conditions shall be provided concurrently.

2. An "as built" engineering description of the mechanical, structural, and civil portion of the transmission facilities signed and sealed by the registered engineer in responsible charge or acceptable alternative verification. "As built" drawings of the electrical, mechanical, structural, and civil portion of the transmission facilities shall be maintained at the power plant and made available, if requested, for CPM audit as set forth in the "Compliance Monitoring Plan."

3. A summary of inspections of the completed transmission facilities, and identification of any nonconforming work and corrective actions taken, signed and sealed by the registered engineer in charge

## REFERENCES

California ISO (California Independent System Operator). 1998a. Cal-ISO Tariff Scheduling Protocol. Posted April 1998, Amendments 1,4,5,6, and 7 incorporated.

California ISO (California Independent System Operator). 1998b. Cal-ISO Dispatch Protocol. Posted April 1998.

California ISO (California Independent System Operator). 2002a. Cal-ISO Grid Planning Standards. February 2002.

BSEP (Beacon Solar Energy Project). 2008a. Los Angeles Department of Water and Power (System Impact Study) submitted to the California Energy Commission.

BSEP (Beacon Solar Energy Project). 2007b. Beacon Solar, LLC, BSEP Application for Certification. Submitted to the California Energy Commission.

NERC/WECC (North American Reliability Council/Western Electricity Coordinating Council). 2002. NERC/WECC Planning Standards. August 2002.

## DEFINITION OF TERMS

AAC — All aluminum conductor

ACSR — Aluminum conductor steel-reinforced

ACSS — Aluminum conductor steel-supported

Ampacity — Current-carrying capacity, expressed in amperes, of a conductor at specified ambient conditions, at which damage to the conductor is nonexistent or deemed acceptable based on economic, safety, and reliability considerations.

Ampere — The unit of current flowing in a conductor.

Bundled — Two wires, 18 inches apart.

Bus — Conductors that serve as a common connection for two or more circuits.

Conductor — The part of the transmission line (the wire) that carries the current.

Congestion management – A scheduling protocol, which provides that dispatched generation and transmission loading (imports) will not violate criteria.

Emergency overload – See “Single Contingency.” This is also called an L-1.

Kcmil or KCM – Thousand circular mil. A unit of the conductor’s cross sectional area When divided by 1,273, the area in square inches is obtained.

Kilovolt (kV) — A unit of potential difference, or voltage, between two conductors of a circuit, or between a conductor and the ground.

Loop — An electrical cul de sac. A transmission configuration that interrupts an existing circuit, diverts it to another connection, and returns it back to the interrupted circuit, thus forming a loop or cul de sac.

Megavar — One megavolt ampere reactive.

Megavars — Mega-volt-Ampere-Reactive. One million Volt-Ampere-Reactive. Reactive power is generally associated with the reactive nature of motor loads that must be fed by generation units in the system.

Megavolt ampere (MVA) – A unit of apparent power. It equals the product of the line voltage in kilovolts, current in amperes, and the square root of 3, divided by 1,000.

Megawatt (MW) – A unit of power equivalent to 1,341 horsepower.

Normal operation/normal overload – The condition arrived at when all customers receive the power they are entitled to, without interruption and at steady voltage, and with no element of the transmission system loaded beyond its continuous rating.

N-1 condition – See “single contingency.”

Outlet – Transmission facilities (circuit, transformer, circuit breaker, etc.) linking generation facilities to the main grid.

Power flow analysis – A forward-looking computer simulation of essentially all generation and transmission system facilities that identifies overloaded circuits, transformers, and other equipment and system voltage levels.

Reactive power – Generally associated with the reactive nature of motor loads that must be fed by generation units in the system. An adequate supply of reactive power is required to maintain voltage levels in the system.

Remedial action scheme (RAS) – An automatic control provision, which, for instance, will trip a selected generating unit upon a circuit overload.

SF6 (sulfur hexafluoride) – An insulating medium.

Single contingency – Also known as “emergency” or “N-1 condition,” the occurrence when one major transmission element (circuit, transformer, circuit breaker, etc.) or one generator is out of service.

Solid dielectric cable – Copper or aluminum conductors that are insulated by solid polyethylene type insulation and covered by a metallic shield and outer polyethylene jacket.

Switchyard An integral part of a power plant and used as an outlet for one or more electric generators.

Thermal rating – See “ampacity.”

TSE Transmission system engineering.

Tap A transmission configuration creating an interconnection through a sort single circuit to a small or medium sized load or a generator. The new single circuit line is inserted into an existing circuit by utilizing breakers at existing terminals of the circuit, rather than installing breakers at the interconnection in a new switchyard.

Undercrossing – A transmission configuration where a transmission line crosses below the conductors of another transmission line, generally at 90 degrees.

Underbuild A transmission or distribution configuration where a transmission or distribution circuit is attached to a transmission tower or pole below (under) the principle transmission line conductors.

# ALTERNATIVES

Testimony of Eric K. Solorio, Michael N. DiFilippo and John S. Maulbetsch

## SUMMARY OF CONCLUSIONS

Staff has concluded that, as proposed, the Beacon Solar Energy Project (BSEP) will have significant adverse impacts to biological resources, cultural resources, and visual resources. The project can avoid and or reduce some of these significant environmental impacts, and utilize water resources in a manner consistent with state policies by implementing any one of staff's proposed project alternatives, including utilizing tertiary treated wastewater for power plant cooling or incorporating an air cooled condenser ("dry cooling").

Although staff concluded the "no project' alternative is not a reasonable alternative to the proposed project, staff concluded there are at least four feasible project alternatives that are reasonable alternatives to the proposed BSEP. Each of the four alternatives is a reasonable alternative to the proposed BSEP because each alternative could reduce the BSEP's consumption of potable water by up to 97%. The first alternative would utilize the proven technology of dry cooling which does not require the use of water in the cooling process. The second alternative would utilize tertiary treated wastewater obtained from the Rosamond Community Services District. The third alternative would utilize tertiary treated wastewater from the city of California City. The fourth alternative would utilize photovoltaic (PV) solar panels for power generation, as PV panels do not require a cooling system or the related water use.

Both PV panels and dry cooling have the added benefit of not only eliminating 97% of the water use but also eliminating the need for evaporation ponds which are a source of concern to staff, the California Department of Fish and Game and the United States Fish and Wildlife Service (see the **Biological Resources** section for discussion of evaporation ponds). Staff has concluded that utilizing either PV technology or tertiary treated wastewater or dry cooling could avoid and or reduce the proposed project's significant environmental impacts. Staff's conclusion is that each of the separate alternatives is reasonable, technically feasible and economically feasible to incorporate.

## INTRODUCTION

In this section staff evaluated potential alternatives to the construction and operation of the proposed Beacon Solar Energy Project (BSEP). Staff conducted the alternatives analysis in accordance with state environmental laws by providing an analysis of reasonable alternatives that are capable of reducing or avoiding any adverse impacts of the proposed project. Staff also evaluated project alternatives that would utilize non-potable water for power plant cooling.

This Alternatives analysis and the Final Staff Assessment, as a whole, are produced as part of the evidentiary record which is considered by the Energy Commission when the Commission decides whether or not to approve the proposed BSEP or require modifications to the proposal. The decision making process takes into account various

laws, ordinances, regulations, standards, state resource conservation policies, Commission policies, the *California Environmental Quality Act (CEQA), and the Warren-Alquist Act (Public Resources Code Section 25500 et seq.).*

## DETERMINING THE SCOPE OF THE ALTERNATIVES ANALYSIS

The Guidelines for Implementation of the California Environmental Quality Act, Title 14, California Code of Regulations, section 15126.6(a) and(b), provide direction for scoping the alternatives analysis by requiring an evaluation of alternatives based upon the comparative merits of "a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project"; "…even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly".

"The fact that an alternative may be more expensive or less profitable is not sufficient to show that the alternative is financially infeasible. What is required is evidence that the additional costs or lost profitability are sufficiently severe as to render it impractical to proceed with the project." (*Citizens of Goleta Valley v. Board of Supervisors*, 197 Cal.App.3d at p. 1181, 243 Cal.Rptr. 339, italics added.)

The range of alternatives required to be evaluated is governed by the "rule of reason" which requires consideration only of those alternatives necessary to permit a reasoned choice. Potentially feasible alternatives are selected and discussed to foster informed decision making and public participation. The *California Environmental Quality Act* (CEQA) guidelines state that an environmental document does not have to consider an alternative where the effect cannot be reasonably ascertained and whose implementation is remote and speculative (Cal. Code Regs., tit. 14, §15126.6[f][3]). To prepare the alternatives analysis, staff used the methodology summarized below:

- Establish the basic project objectives to use as screening criteria for project alternatives.
- Identify the proposed project's significant adverse environmental impacts.
- Identify different types of alternatives to the project that could avoid or lessen the projects significant impacts, such as:
    - Sources of non-potable water for use in power plant cooling and processes.
    - Alternative project sites.
    - Alternative energy generation technologies.
    - Alternative equipment and processes that can be incorporated into the proposed project.
    - The "No Project" alternative.

- Evaluate and determine whether any of the alternatives would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the environmental impacts of the proposed project.
- Summarize which alternatives, if any, can feasibly avoid or reduce the proposed project's environmental impacts.

## Sources of Non-Potable Water as Alternative to Using Fresh Water

In scoping the Alternatives analysis, staff also considered the project's need to comply with several Laws, Ordinances, Regulations and Standards (LORS), specifically, Article X, Section 2 of the California Constitution and California Water Code Section 13551. Staff also considered the need for the BSEP to comply with several state policies, specifically, State Water Resources Control Board (SWRCB) Resolution No. 75-58, and Resolution No. 09-11, and the 2003 Integrated Energy Policy Report (IEPR). Both, the LORS and the state policies address the importance of avoiding the use of fresh water for industrial processes (including power plant cooling) when sources of "non-potable" water is reasonably available. As such, this Alternatives analysis also evaluates the feasibility of the BSEP using non-potable water for power plant cooling.

## BASIC OBJECTIVES OF THE PROJECT

After reviewing the BSEP Application for Certification (08-AFC-2), staff has determined the four basic objectives of the Beacon Solar Energy Project (BSEP) to be as follows:

1. To construct, operate and maintain an efficient, economic, reliable, safe and environmentally sound solar-powered generating facility that will help achieve: (i) the State of California's renewable energy objectives mandated by Senate Bill 1078 (California Renewable Portfolio Standard Program) and accelerated by Senate Bill 107, (ii) Assembly Bill 32 (California Global Warming Solutions Act of 2006), and (iii) other local mandates adopted by the State's municipal electric utilities to meet the requirements for the long term, wholesale purchase of renewable electric energy for distribution to their customers.

2. To develop a site with an excellent solar resource.

3. To develop a previously disturbed site with close proximity to transmission infrastructure in order to minimize environmental impacts.

4. To interconnect directly to the Los Angeles Department of Water and Power (LADWP) electrical transmission system.

Staff eliminated applicant's fifth project objective as described on page 2-2, in the Application for Certification, "*To develop a site with available water resources to allow wet cooling in order to optimize power generation efficiency and reduce Project cost.*" Staff eliminated this project objective as a screening criterion because the ground water at the project site is potable and therefore the objective to use potable water for power plant cooling, especially in a desert environment, is inconsistent with state policies, as generally described in the table below:

**Alternatives Table 1**
**Laws, Ordinances, Regulations, and Standards (LORS), and State Water Use Policies Affecting Power Plants**

| LORS | Purpose |
|---|---|
| California Constitution, Article X, Section 2 | This section **requires that the water resources of the State be put to beneficial use to the fullest extent possible** and states that the waste, unreasonable use or unreasonable method of use of water is prohibited. |
| California Water Code Section 13551 | Requires the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such water is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare. |
| State Water Resources Control Board (SWRCB) Resolution No. 09-11 | State Water Resources Control Board Resolution 09-11 **encourages and promotes use of recycled water to replace the use of potable water for non-potable purposes**. The policy supports the sustainable use of surface water and groundwater and encourages the use of recycled water where this water is not being put to other beneficial uses. The policy provides for a streamlined permitting process for recycled water use with local Regional Water Quality Control Boards. |
| Warren-Alquist, State Energy Resources Conservation and Development Act, California Public Resources Code 25008 | "**It is further the policy of the state and the intent of the Legislature to promote all feasible means of…water conservation…**" |

## POTENTIALLY SIGNIFICANT ENVIRONMENTAL IMPACTS OF THE PROJECT

In analyzing the Beacon Solar Energy Project (BSEP) staff identified potentially significant adverse impacts to biological resources, cultural resources and visual resources. This analysis evaluates the feasibility of incorporating potential alternatives that can avoid and or lessen impacts to some of these resource areas.

If the BSEP is approved as currently proposed, staff estimates that construction and operation of the project would consume more than 50,000 acre feet of high quality fresh water, equating to more than 20 billion gallons, during the 30-year life of the project. The water would be pumped from on-site wells, drawing approximately 8,080 acre feet during construction and an additional 1,400 acre/feet per year for operations, from an aquifer already in overdraft condition. The aquifer has taken approximately 25 years to recharge half of the level of drawdown that occurred at the project site, from prior intensive agriculture activities that ceased in the mid 1980s (BS 2008a, p. 1-10). Staff's independent analysis indicates that approximately 70% of this "recharge" is actually due to water migrating within the basin and not necessarily due to new inflow from precipitation. See the **SOIL AND WATER RESOURCES** section. The BSEP would reduce the annual rate of groundwater recharge (BS 2008a, p. 1-11).

Impacts to biological resources, from the proposed BSEP project would result from mass grading more than 7 million cubic yards of soil covering more than 2,000 acres. The grading activities include removal of approximately 430 acres of vegetation that provides cover, foraging, and breeding habitat for wildlife. Impacts to biological resources also include the loss of approximately 60 acres of desert wash scrub habitat and 16.0 acres of jurisdictional waters of the state. Additionally, the construction of 6 acres of evaporation ponds to receive highly concentrated brine discharge could have a significant adverse impact on migratory birds, water fowl and wildlife as well as potentially increase predation of protected species. Please see the **BIOLOGICAL RESOURCES** section.

Staff also concluded that because there are known cultural resources on site, the mass grading of more than 7 million cubic yards of soil would have significant direct impacts on surface and subsurface prehistoric archaeological resources. Please see the **CULTURAL RESOURCES** section.

The introduction of the project would change the existing physical setting of the Fremont Valley floor from a moderately disturbed desert floor landscape to a highly human-altered landscape. This change principally would be caused by two square miles of the project site being covered with parabolic trough solar collectors. In addition, the introduction of the radiance from the parabolic trough arrays during operation would be prominent from elevated locations. Staff concluded the project would cause significant adverse impacts to visual resources from two sensitive view points. These significant adverse impacts would be unmitigatable. Please see the **VISUAL RESOURCES** section.

## IDENTIFY, SCREEN AND EVALUATE PROJECT ALTERNATIVES

The range of project alternatives considered in this analysis includes an alternative site, an alternative generation technology, alternative water treatment equipment, and sources of tertiary treated wastewater for power plant cooling.

## ALTERNATIVE PROJECT SITES

The applicant provided a general discussion (BS 2008a, pp. 4.5-7) of alternative ***areas*** to site the proposed project. Although the proposed BSEP site is previously disturbed and in close proximity to transmission lines, the proposed site is bisected by designated waters of the state (Pine Tree Creek) which applicant proposes to relocate one-half mile to the east. An alternative site that has been previously disturbed by agriculture activities and does not contain any waters of the state, could potentially avoid impacts to several environmental resource areas.

### Antelope Area

Staff conducted a windshield survey of the Antelope area which generally consists of previously disturbed lands. As shown on **Alternatives Figure 1**, the Antelope area has reasonable access to infrastructure. There appears to be potential project sites surrounding the Neenach substation. Staff concluded that the area south of Rosamond Boulevard appears to be absent of any waters of the state and/or waters of the US.

However, the majority of large parcels appear to be designated as “farmlands of statewide importance” by the Farmland Mapping and Monitoring Program (FMMP). The FMMP produces maps and statistical data used for analyzing impacts on California’s agricultural resources. Agricultural land is rated according to soil quality and irrigation status; the best quality land is called Prime Farmland. The maps are updated every two years with the use of a computer mapping system, aerial imagery, public review, and field reconnaissance. Because this alternative would create a different type of impact to limited farmland resources, staff concludes a similar 2,000 acre project sited in the immediate Antelope area is not a viable alternative site to the proposed project.

## ALTERNATIVE ELECTRICITY GENERATION TECHNOLOGIES

The second component of the Alternatives analysis is to consider project alternatives to the proposed electricity generation technology. Staff considered fossil fuel based energy generation such as simple-cycle and combined-cycle, natural gas-fired power plants but ruled them out as alternatives because of their more significant impacts to air quality and failure to meet most of the project objectives. Because staff considers five alternatives to be a “reasonable range” of project alternatives, staff therefore limited its analysis of alternative generating technologies to photovoltaic technology because the use of PV solar panels would meet most of the project objectives.

### Photovoltaic Technologies (PV)

Photovoltaic technologies (PV) are considered the primary competitor with solar thermal technologies because both applications convert solar energy into electricity. The reliability of PV technology is equivalent to that of solar thermal technology due to the same dependence on solar incidence necessary to allow the collection of solar radiation. In considering PV technology as an alternative to the BSEP, staff finds cost advantages and environmental advantages of utilizing PV applications compared to solar trough thermal technology.

Although both PV applications and the proposed BSEP would have similar impacts to land resources and vegetation that provides cover, foraging and breeding habitat for wildlife, staff concludes that a PV application could avoid substantial impacts to biological resources and cultural resources that could otherwise result from the proposed BSEP. These impacts can be avoided because PV applications do not require power plant cooling systems and related evaporation ponds to discharge spent cooling water to, as reflected in the BSEP proposal. Because PV applications can avoid using evaporation ponds, the use of PV technology can also avoid significant impacts to cultural and biological resources associated with the excavation and operation of these ponds. Please see **Biological Resources** and **Cultural Resources** sections.

The proposed BSEP would require approximately 1,400 acre feet of potable water annually for use in a wet cooling system. The only water consumption that PV applications require would be for biannual washing of the PV panels which is far less than the need to regularly wash the solar troughs proposed by the BSEP (BCV 2009a and BS 2008a, Figure 2-13).

### Economic Feasibility of Photovoltaic (PV) Technology on a “Cost per Watt” Basis

Due to the increasing market demand for solar technology applications, there has been substantial progress in reducing the cost per watt of PV technologies, to the point where PV technology is affordable, scalable and has a low environmental impact on a life-cycle basis. There are two cost components that make PV technology cost competitive with solar thermal technology. The first component is the installed cost per watt. Staff identified a utility scale PV project being developed by Sempra Generation, a subsidiary of San Diego-based Sempra Energy. The project is a 10 MW plant recently constructed in Boulder City, Nevada. According to Michael Allman, President of Sempra Generation, PV technology is more cost effective than solar thermal trough technology. Mr. Allman states "*We looked at both concentrated solar power and photovoltaic and it was our belief that photovoltaic was the least expensive electricity to develop from solar power.*" (BCV 2009a). Staff also contacted the company Applied Materials, an international manufacturer of equipment that manufactures thin film PV solar panels (CEC 2009j). Steve Stokowski, Solar Sales Manager of Applied Materials, estimated the installed cost of thin film PV technology at approximately $3.90 per watt. This cost appears to be equivalent to the BSEP project cost (BS 2008a). Based on these two market reference points, staff concludes that the cost of PV technology is equivalent to the installed cost per watt of solar trough thermal technology, as proposed by BSEP.

The second cost advantage of PV is the significantly reduced operating costs. Solar thermal electricity generating facilities have far greater staffing requirements than PV electricity generating facilities. The proposed BSEP facility would require 66 full time workers to operate and maintain the facility compared with a PV facility that can operate with a staff of 13 people (1 Person per 20 MW) (BS 2008a, BCV 2009a, and CEC 2009i). The lower operating costs of PV applications results in more free cash available for debt servicing, which is a key determinate (debt service coverage ratio) for lenders when considering project financing. Staff finds there are cost advantages from utilizing PV technology in place of solar thermal technology, as proposed by BSEP. Because PV technologies have a less than or equivalent cost per watt to develop, as compared with solar thermal technologies, and PV technologies have much lower operating costs, staff concludes that PV technology is an economically feasible alternative to solar thermal technology.

### Market Based Approach to Economic Feasibility of Photovoltaic (PV) Technology

Staff next applied a market based approach to determine if the broader market of energy generators (developers) considered PV technology to be cost competitive with solar thermal technology. Staff researched the US Department of Interior, Bureau of Land Management (BLM) website at http://www.blm.gov/ca/st/en/prog/energy/solar.html and found a list (BLM Applications Table) of utility scale PV projects proposed to be developed by the private sector (BLM 2009a). The scope of these PV projects can be described as 23 projects covering more than 150,000 acres with capacity to produce more than 14,500 megawatts of electricity.

In addition to the projects proposed to be developed on BLM lands, staff researched PV projects at the Solar Energy Industries Association at http://www.seia.org. Staff found that the parent company of BSEP, Florida Power & Light (FPL) has several PV projects under development in Florida (SEIA 2009a). Considering the breadth of proposed PV

projects on BLM lands, and applicant's PV projects in Florida, the overall market (and applicant) has determined that PV technology is economically viable and competitive with solar thermal technology.

Staff concludes that generating 250 MW of electricity using PV technology has cost advantages, financing advantages, reduces potable water consumption by up to 97 percent, could avoid significant impacts to cultural resources by avoiding the need for excavation of evaporation ponds, and could avoid impacts to biological resources by eliminating the need for excavation of evaporation ponds that can be toxic to wildlife. Staff finds PV technology to be economically feasible and a reasonable alternative to the proposed BSEP.

## ALTERNATIVE COOLING TECHNOLOGY; AND SOURCES OF NON-POTABLE WATER

The project proponent, Beacon Solar LLC, a subsidiary of NextEra Energy Resources, has proposed a wet cooling system using *potable* water, on the basis that using non-potable water or dry cooling technology would "…create a significant cost disadvantage..." and rejects these reasonable alternatives as being "…economically unsound" (BS 2008a, pp. 1-4, 4-15). Currently, the proposed BSEP is the only solar thermal project engaged in the Energy Commission's licensing process that has proposed to use potable water for wet cooling. Because installing a water line to convey recycled water or constructing a dry cooling system are both logistically and technically feasible as demonstrated by their respective industries over the past 30 years, staff focuses the remainder of this analysis on the economic feasibility of using *non-potable* water for wet cooling or in the alternative using dry cooling technology.

### Air Cooled Condenser (ACC) Also Known As "Dry Cooling"

In a power plant application, a "dry cooling" system can be used in place of a "wet cooling" system to accomplish power plant cooling needs. The similarities are that both cooling systems utilize fans to cool the steam that drives the main turbine. The difference between wet cooling and dry cooling is: a wet cooling tower applies water to the outside of the condenser while simultaneously using fans to evaporate the water. This evaporation provides approximately a 5% to 7% more efficient cooling process (see **Appendix B**). The efficiency "loss" associated with using a dry cooling system, as compared to a wet cooling system, is the basis for applicant's assertion that dry cooling is not economically feasible.

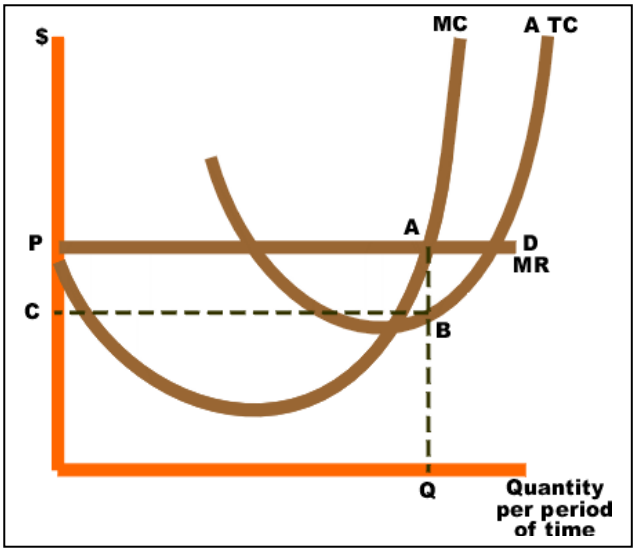
In order to offset the efficiency loss of using dry cooling, the applicant proposed expanding the solar field and related equipment by approximately 12%. Staff finds this approach to be practical and implementable. See **Alternatives Figure 3** that illustrates an expanded solar field. In **APPENDIX A**, staff established capital equipment costs and annual operating costs for the BSEP to utilize a dry cooling system with an expanded solar field. In **APPENDIX B,** staff independently verified the dry cooling alternative, as it was presented in the AFC. However, when considering the economic feasibility of dry cooling with an expanded solar field, staff concludes that the AFC did not account for the additional revenues that would be generated by the increased capacity derived from the expanded solar field.

## Applying the Marginal Cost – Marginal Revenue Model to Profit Maximization

In **APPENDIX B** staff analyzed the average hourly and monthly ambient temperatures to determine when the efficiency losses occur under the dry cooling scenario. Those losses are primarily restricted to the hottest times of the year, from May through September. Next staff calculated the additional power generated during times when the efficiency loss was ***not*** a factor, generally from October through April. During these "off season" times, the project benefitted from the expanded solar field by utilizing the idle capacity in the power plant and related infrastructure. Staff found that utilizing this idle capacity generated a significant amount of additional revenues.

Expanding the solar field comports with the general business practice[1] of increasing production (solar field capacity and related output) as long as marginal costs are less than marginal revenues. Profit maximization is reached when marginal costs equal marginal revenues, as illustrated by point "A" in the diagram[2] below. Applying the profit maximization model, it is apparent that the proposed BSEP (which uses wet cooling) has not optimized its production and related revenues. This becomes evident when considering that with dry cooling and an expanded solar field, the BSEP would generate 4% more energy than the proposed wet cooled project; would slightly exceed the internal rate of return for the wet cooled project; and would generate more than an additional $65 million in net revenues, as compared to the proposed wet cooled project.

**Marginal Cost – Marginal Revenue Diagram**




[1] Since total profit increases when marginal profit is positive and total profit decreases when marginal profit is negative, it must reach a maximum where marginal profit is zero - or where marginal cost equals marginal revenue. This is because the producer has collected positive profit up until the intersection of MR and MC (where zero profit is collected and any further production will result in negative marginal profit, because MC will be larger than MR). The intersection of marginal revenue (MR) with marginal cost (MC) is shown in the diagram as point A. If the industry is competitive (as is assumed in the diagram), the firm faces a demand curve (D) that is identical to its Marginal Revenue curve (MR), and this is a horizontal line at a price determined by industry supply and demand. Average total costs are represented by curve ATC. Total economic profits are represented by area P,A,B,C. The optimum quantity is ("Q").

[2] The diagram illustrates the mathematical relationship between marginal costs, marginal revenues and the resulting profit maximization. However, the diagram does NOT represent the exact linear functions of the BSEP costs, revenues and profit maximization.

## Brackish Water

**Appendix A** describes alternative equipment and process configurations that would use brackish water from the vicinity of Koehn Dry Lake. **Appendix A** also evaluates the cost of using an air cooled condenser (ACC), also known as “dry cooling” technology. Although adding an additional cost to the project, each of the alternatives discussed in **Appendix A** would potentially provide a means for the BSEP to comply with LORS and state policies regarding the use of high quality fresh water.

## Rosamond Community Services District (RCSD)

The Rosamond Community Services District (RCSD) has submitted to staff, a Letter of Intent to provide the BSEP with tertiary-treated water for BSEP’s planned process needs (RCSD 2009d). The District’s wastewater treatment plant produces enough effluent to meet the annual quantity of water demanded by the proposed BSEP cooling tower. All of the effluent is currently being disposed of in evaporation ponds. The RCSD is currently constructing wastewater treatment plant upgrades that include a tertiary level treatment facility. Upon completion of phases I and II, the wastewater treatment plant will have sufficient capacity to provide the tertiary-treated quality of water that is suitable for the proposed BSEP. The wastewater treatment plant upgrades will be completed prior to the planned operation of the BSEP.

In order for the RCSD to supply water to the proposed BSEP a 40-mile pipeline would be constructed, using public rights-of-way which have been selected by the RCSD, and are identified on the Kern County General Plan. See “Western Alternative”, **Alternatives Figure 2**. The RCSD has previously engaged in a separate and unrelated effort to provide tertiary-treated wastewater to Edwards Air Force Base (EAFB) by installing a 10-mile pipeline. EAFB completed an environmental review and approved installation of the pipeline which will have excess capacity that can also be used to deliver water for 10 miles of the total distance to the BSEP (EAFB 2009a). See “Eastern Alternative”, **Alternatives Figure 2.** In this overall FSA, staff has analyzed the environmental impacts of installing the pipeline along the Western Alternative route and identified mitigation measures to reduce any potential environmental impacts to less than significant.

Staff supports and recommends the RCSD project alternative because it would facilitate compliance with state water policy, effectively bring new water (which is otherwise being evaporated) into the Koehn sub-basin, and implementing this alternative would directly increase the project’s positive economic impact on the local community of Rosamond, California.

## California City as a Source of Tertiary-Treated Wastewater

California City has also submitted a proposal to staff that would supply BSEP with tertiary-treated water for its planned process needs (CofC 2009c). California City has a different dynamic than the Rosamond Community Services District, in that California City has a tertiary treatment plant in operation but does not have the household sewer connections to generate the tertiary-treated effluent. As a result, California City’s

proposal is based largely upon the cost to connect the existing residents to the system and install a pipeline to the BSEP site. In summary, although California City requires a 15-mile pipeline as compared to RCSD's 40-mile pipeline (or 30-mile pipeline if the EAFB line is built first), the costs of the two alternatives are equivalent.

Staff is concerned that California City's proposal also includes a "return line" that would allow the BSEP to pump an undetermined amount of high quality, fresh groundwater and sell it to California City. See **Alternatives Figure 4**. As currently proposed, staff does not support this proposal because pumping an undetermined amount of groundwater from the BSEP site has the potential to significantly impact groundwater wells near the BSEP site. However, if as a Condition of Certification BSEP is prohibited from pumping site groundwater to sell or trade, then staff would support the California City recycled water pipeline alternative, as a feasible measure for the BSEP to comply with state water policy. California City Council has approved this modified alternative which excludes any purchase of groundwater from BSEP but still provides the BSEP with recycled wastewater to use for power plant cooling.

Staff has considered the potential environmental impacts arising from California City providing tertiary treated waste water to the BSEP and staff has recommended mitigation measures to reduce such impacts to less than significant levels, if the alternative is adopted. However, staff did not evaluate the environmental impacts associated with BSEP pumping an undetermined amount of high quality, fresh groundwater to sell to California City.

On June 25, 2009 the California City Council voted 5-0 to support RCSD's proposal to provide recycled water to the BSEP (CofC 2009b). California City has been fully supportive of the proposed Beacon Solar Energy Project and has submitted their proposal to provide recycled water, solely as a back-up plan to the RCSD proposal. The representatives of California City have stated in a public workshop and letters to staff that it is their preference for the BSEP to utilize water from RCSD rather than from California City because it effectively brings new water into the basin. Staff agrees that implementation of the RCSD alternative would allow California City the flexibility to use their reclaimed water for other beneficial purposes in the basin while allowing BSEP to make use of RCSD's tertiary-treated water that is otherwise being evaporated.

## Profit Based Approach to Determine Economic Feasibility of Project Alternatives

Staff begins by considering a legal standard for establishing economic feasibility under CEQA. "The fact that an alternative may be more expensive or less profitable is not sufficient to show that the alternative is financially infeasible. What is required is evidence that the additional costs or lost profitability are sufficiently severe as to render it impractical to proceed with the project." (*Citizens of Goleta Valley v. Board of Supervisors*, 197 Cal.App.3d at p. 1181, 243 Cal.Rptr. 339.)

### Solar Energy Industry Benchmark for Profitability – Internal Rate of Return (IRR)

Staff's approach to evaluate the economic feasibility of each alternative began with first establishing reasonable benchmarks for the expected rate of return on investment, also known as the internal rate of return (IRR). Staff first considered the company eSolar, a

developer who plans to build large scale solar thermal power plants. eSolar is considered a solid market reference point because they have entered into power purchase agreements to sell their electricity in New Mexico and California. The company has signed a 20-year contract to provide Southern California Edison (SCE) the energy from a 245 megawatt solar thermal power plant. That project is nearly identical in size to the proposed 250 megawatt BSEP. According to Bill Gross, Chief Executive of eSolar, internal rates of return are expected to fall within the range of 11% to 14% for a "wet cooled" plant (GW 2009a) (GB 2009a). Considering that eSolar is developing projects of smaller scale and larger scale than the proposed BSEP staff concludes eSolar is a fair representative of the marketplace.

Staff next considered the international solar development company, Abengoa Solar. Abengoa has recently filed an Application for Certification with the Energy Commission to develop the Mojave Solar 1 project (09-AFC-5). The Mojave Solar 1 project is the same scale (250 MW) and utilizes the same solar trough technology as the BSEP. In their Application for Certification, Abengoa establishes their internal rate of return as 8%. Staff considers Abengoa to be a fair representative of the marketplace.

Although eSolar "expects" to generate an 11% to 14% internal rate of return (IRR), eSolar submitted a formal comment letter to staff emphasizing that this is an expectation and not a commitment (GB 2009a). Comparatively, Abengoa as a successful developer of solar energy projects has a much more competitive IRR of 8%. Staff believes that a median, industry benchmark for profitability will likely fall somewhere between the most competitive companies such as Abengoa Solar and the upper end of profitability such as the target rate of 14%, identified by eSolar. Staff therefore concludes that economic feasibility for solar energy power plants appears to be achieving an internal rate of return (annualized net profit margin) 11% or more.

### Applying the Industry IRR Benchmark to Beacon Solar Energy Project

The next step in staff's analysis was to establish BSEP's internal rate of return (IRR) under different scenarios that accounted for the cost of each alternative. Staff therefore requested the baseline project cost data and revenue data from the BSEP proponent. The data was submitted to staff under an application for confidentiality which was granted by the Commission's Executive Director (DB 2009l). Staff then generated a feasibility study to estimate costs for several alternatives that each would utilize non-potable, brackish water from the general vicinity of Koehn Dry Lake. The feasibility study also evaluates the marginal cost of using dry cooling technology, see "ACC 40F ITD", **APPENDIX A**. Staff also conducted a detailed review of applicant's dry cooling and hybrid cooling study, see **APPENDIX B**. Additionally, staff obtained preliminary engineering and cost estimates for the Rosamond Community Services District's (RCSD) alternative and the California City alternative, as described above.

In **CONFIDENTIAL APPENDIX C,** staff provides a detailed project cost analysis of the various alternatives. The analysis utilizes the confidential revenue model submitted by applicant to staff. Staff created three separate revenue models reflecting the marginal project costs of the RCSD alternative, California City alternative and the Dry Cooling alternative, respectively. In the case of dry cooling, staff added the additional revenue from expanding the solar field, as proposed in the AFC. In all three scenarios, the

revenue models show that BSEP would surpass the benchmark internal rate of return (IRR) of 11%. Additionally, the applicant's revenue model shows that even without expanding the solar field, the BSEP would still meet or exceed the benchmark IRR. Due to the confidential nature of the revenue models, **CONFIDENTIAL APPENDIX C** will be presented to the Commission during an "in camera" hearing (closed door session) that will be part of the formal hearings on the BSEP (08-AFC-2) case.

It is also worth noting that a "residual value" of the BSEP was missing from the BSEP revenue model which would yield an IRR that is more than staff's estimate, therefore staff's estimate is conservative. The residual value component would reflect what the power plant was worth at the end of the 30 years. Because the revenue model assumes a cost for annual maintenance, the power plant would be fully maintained and operating at the end of 30 years (revenue model) and long after the debt financing was repaid. Therefore it could be sold for a lump sum or held for its continuing cash flow. The residual value is a significant factor that should have been included in the revenue model when establishing the complete project cash flow (DB 2009l). It follows that staff's estimate of value is understated and the project would likely reach an IRR above staff's estimate.

### Market Based Approach to Economic Feasibility

Staff also took a broader approach to establish economic feasibility based upon the overall market (supply side) – solar power plant, development industry in California. Staff defined the market by solar thermal projects with capacity of 50 megawatts or more, constructed within the last 10 years in California or proposed to be built in California. **Alternatives Table 2** below provides a brief description of solar thermal projects being considered for certification by the Energy Commission. Each project proposes to use a cooling system that complies with state water policy and avoids adverse impacts to fresh water resources. Some of the projects listed below are identical in size to the BSEP. They are also proposed to be built in the same general area (climate) and therefore would have similar if not identical efficiency losses from using dry cooling. Although the nominal megawatt (MW) rating may appear larger for the Palen and Blythe projects, respectively, each project is actually divided into separate 250 MW power plants using the same technology as the BSEP.

**Alternatives Table 2**
**Solar Thermal Projects with Cooling Systems Consistent with State Policy**

| Project | Capacity | Generation Technology | Cooling System |
|---|---|---|---|
| Ridgecrest Solar Power Project (09-AFC-9) | 250 MW | Solar parabolic trough | Dry cooling (air-cooled condenser) |
| Blythe Solar Power Project (09-AFC-6) | 1 GW (1,000 MW) | Solar parabolic trough | Dry cooling (air-cooled condenser) |
| Palen Solar Power Project (09-AFC-7) | 500 MW | Solar parabolic trough | Dry cooling (air-cooled condenser) |
| Carrizo Energy Solar Farm (07-AFC-8) | 177 MW | Compact Linear Fresnel Reflector solar thermal technology | Dry cooling (air-cooled condenser) |
| Ivanpah Solar Electric Generating System | 400 MW | Power tower solar thermal technology | Dry cooling (air-cooled condenser) |
| San Joaquin Solar 1&2 Hybrid Project (08-AFC-12) | 106 MW | Solar parabolic trough/biomass | Wet cooling using reclaimed water |
| Palmdale Hybrid Power Project (08-AFC-9) | 570 MW | Solar parabolic trough and natural gas-fired combined cycle | Wet cooling using reclaimed water |
| Victorville 2 Hybrid Power Project (07-AFC-1) **APPROVED** | 563 MW | Solar parabolic trough and natural gas-fired combined cycle | Wet cooling using reclaimed water |

Staff also considered the company BrightSource Energy ("BrightSource"), as a market referent. BrightSource was considered for several reasons: 1.) they currently propose to develop the Ivanpah Solar Electric Generation System ("Ivanpah") which is a solar thermal project in a similar desert environment and Ivanpah will use dry cooling, 2.) BrightSource has entered into the world's largest power purchase agreement to sell Southern California Edison 1,300 megawatts of electricity from BrightSource's solar thermal projects (GW 2009 B), and 3.) the Ivanpah project consists of three power plants, two of which are 100 megawatts each and one that is 200 megawatts. These three plants are each smaller than the proposed BSEP project and therefore demonstrate the economic feasibility of dry cooling, on a scale smaller than the proposed BSEP.

BrightSource has demonstrated by its development proposals to supply SCE with 1,300 megawatts, that dry cooling is economically feasible (CEC 2009k). BrightSource also acknowledges that the efficiency loss of using dry cooling in place of wet cooling is "marginal" and therefore does not render a project infeasible (CEM 2009 A). More so, the proposed BSEP appears to be twice as efficient, on a megawatt per acre basis, than Ivanpah, see **Efficiency Table 1** in the **EFFICIENCY** section of this FSA.

Considering the facts above, staff concludes that solar thermal energy generators in the overall marketplace have established the economic feasibility of both: using dry cooling technology or in the alternative - reclaimed water in a wet cooling system. The economic feasibility of dry cooling technology is further demonstrated by the proposed use in smaller projects; projects of the same size; and projects using identical solar trough technology in the same desert environment, as compared to the proposed BSEP.

## THE “NO PROJECT” ALTERNATIVE

CEQA Guidelines and Energy Commission regulations require consideration of the “No Project” alternative. The CEQA Guidelines state that “the purpose of describing and analyzing a No Project Alternative is to allow decision makers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project” (Cal. Code Regs., tit. 14 §15126.6[i]). Toward that end, the “No Project” analysis considers “existing conditions” and “what would be reasonably expected to occur in the foreseeable future if the project were not approved…” (§15126.6[e][2]).

In short, the site-specific and direct impacts associated with the power plant would not occur at this site if the project does not go forward. Selection of the “No Project” alternative would render all concerns about project impact moot. The “No Project” alternative would preclude any construction or operation and, thus, grading of the site or installation of new foundations, piping, or utility connections.

If the project were not built, off-takers of the renewable energy from BSEP would not benefit from the annual, solar power this project would provide. A primary benefit of the BSEP is that it would help achieve: the State of California objectives mandated by SB 1078 (California Renewable Portfolio Standard Program), and AB 32 (California Global Warming Solutions Act of 2006).

If the proposed project was not constructed then during peak demand periods, potential off-takers of the solar power may have to rely on existing, inefficient, older natural gas-fired power plants which are known to consume more fuel and emit more air pollutants per kilowatt-hour generated than the proposed BSEP.

In light of the California Renewable Portfolio Standard Program and the California Global Warming Solutions Act of 2006, in the absence of the proposed Beacon Solar Energy Project, other power plants with unknown technologies would likely be constructed in the region to supply the market demand for energy. As such, staff has concluded the “No Project” alternative would not be a reasonable alternative or a feasible alternative to the proposed project.

## AGENCY AND PUBLIC COMMENTS

### COMMENT

**California Department of Fish and Game**

In their June 19, 2008 comment letter on BSEP, the CDFG recommended avoiding impacts to state waters and requested that the applicant evaluate alternative site layouts that would avoid the desert washes (DFG 2008b).

### STAFF RESPONSE

Staff believes the applicant need not locate the entire project on one side of the desert wash nor straddle the wash with the entire project utilizing one 250 megawatt (MW) power block. Instead applicant could avoid Pine Tree Creek entirely by constructing two half scale facilities: a 125 MW plant on each side of the desert wash (still achieving the desired 250 MW). Such a modification to the layout could provide increased efficiencies in land use while avoiding impacts to state waters. The efficiencies could be gained by

avoiding the substantial excavation costs of filling the existing 2-mile long channel and constructing a new longer diversion channel. Further cost savings could be realized by avoiding the requirement to provide mitigation lands, endowment funds and a management plan.

**COMMENT**
**Scott Galati, Galati | Blek LLP, Legal Counsel for eSolar**
In a letter dated June 4, 2009, Mr. Galati, on behalf of eSolar, commented on staff's Preliminary Staff Assessment (PSA). The PSA cited public statements made by Bill Gross, CEO of eSolar. The PSA cited Mr. Gross as stating internal rates of return (IRR) ***will be*** between 11% and 14%. Mr. Galati clarifies that Mr. Gross said the "internal rates of return were ***expected*** to be between 11 to 14 percent".

**STAFF RESPONSE**
Staff has made the correction which is reflected on pages 6-11 and 6-12, herein.

**COMMENT**
**Scott Galati, Galati | Blek LLP, Legal Counsel for eSolar**
In a letter dated June 4, 2009, Mr. Galati, on behalf of eSolar, commented on staff's Preliminary Staff Assessment (PSA). Mr. Galati states "*First, eSolar believes it is unreasonable to apply broad statements made by one company concerning its business strategy and how it calculates internal rates of return to other industry participants. Second, it is important to note that the rates of return noted by Mr. Gross were based upon wet cooling. Last the internal rates of return for any project must be balanced by the risk management strategy adopted by each industry participant. These risks are different for every project and are largely related to transmission interconnection, ability to access capital, financing costs, expectations of rates of return by company shareholders, risks of successful permitting, and the specific risks of a power purchase agreement. We believe it is imprudent for the CEC staff to dictate the reasonable internal rates of return on any applicant…" "We strongly urge the CEC to refrain from comparing internal rates of return between companies or technologies*".

**STAFF RESPONSE**
Staff respectfully disagrees with Mr. Galati's interpretation of a permitting Agency's responsibility to evaluate the economic feasibility of project alternatives that can avoid or lessen a project's environmental impacts in accordance with CEQA, and or allow the project to comply with state LORS and water use policies. An Agency ***may not*** simply accept at face value the project proponent's assertion regarding economic feasibility. (*Sierra Club v. County of Napa*, 121 Cal.App.4th at p. 1504, 19 Cal.Rptr.3d 1; see also *Laurel Heights*, p. 404, 253 Cal.Rptr. 426, 764 P.2d 278 [courts will not "countenance blind trust by the public"].)

Because staff must evaluate the economic feasibility of alternatives, staff must consider "[t]he fact that an alternative may be more expensive or less profitable is not sufficient to show that the alternative is financially infeasible. *What is required is evidence* that the additional costs or lost profitability are sufficiently severe as to render it impractical to

proceed with the project." (*Citizens of Goleta Valley v. Board of Supervisors*, 197 Cal.App.3d at p. 1181, 243 Cal.Rptr. 339). Staff must therefore gather evidence of profitability, as established in the marketplace, to determine whether it is “practical to proceed with the project”.

Regarding “the unreasonableness…of applying how one company calculates an internal rate of return to another company”, staff replies that the method of calculating an internal rate of return (IRR) is not unique to any one company because an IRR is always calculated by the same equation*, as illustrated below:

$$\mathrm{NPV} = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n} = 0$$

***Given a collection of pairs (time, cash flow) involved in a project, the internal rate of return follows from the net present value as a function of the rate of return. A rate of return for which this function is zero is an internal rate of return. Given the (period, cash flow) pairs (n, Cn) where n is a positive integer, the total number of periods N, and the net present value NPV, the internal rate of return is given by r.**

Regarding Mr. Galati’s description of various project risk factors being indicative of differing internal rates of return, staff replies that staff’s analysis began with a comparison of similar projects in the same industry (renewable energy) and more so in the same subsector (solar thermal energy). Staff then assumed that no project will be built unless all of the risks are fully mitigated to acceptable levels, as established by the financial markets. Therefore working under the assumption that projects in the same industry subsector are required to mitigate risks to the same levels in order to obtain debt financing from the same financial markets, the internal rates of return between these projects are absolutely comparable. In other words, a financial institution is not likely to fund a project that does not have a transmission interconnection or a power purchase agreement, regardless of the projected IRR or risk management strategy. As such, project risks will be mitigated to acceptable levels before the project is constructed. Therefore, the risk factors noted by Mr. Galati are only applicable to a developer in the ***permitting stage*** where less than 2% of the total project funding will be spent. The market forces require all developers to implement appropriate “risk management strategies” in the planning phase as well as the development phase, in order to arrive at the same point – project risks mitigated to acceptable levels, as determined by the financial debt markets, not necessarily by private investors projected IRRs.

Regarding Mr. Galati’s comment that “…it is imprudent for the CEC staff to dictate the reasonable internal rates of return on any applicant…”. Neither staff nor the Energy Commission is dictating profit margins to developers. By a close reading of the FSA it is apparent that staff has identified industry benchmarks to assess whether the project developer will “**meet or exceed**” the “**minimum**” profit threshold staff identified as the industry median level of profitability. Staff applied this threshold as screening criteria, in

order to determine whether or not “it is impractical to proceed with the project". Such an approach is supported by CEQA case law, as discussed in *Citizens of Goleta Valley v. Board of Supervisors*. Moreover, an Agency may not simply accept at face value the project proponent’s assertion regarding economic feasibility (*Sierra Club v. County of Napa*).

**COMMENT**
**California Unions for Reliable Energy (“CURE”)**
On April 30, 2009, as an Intervener in the BSEP (08-AFC-2) case, CURE, submitted written comments on the Preliminary Staff Assessment (PSA). The comments relevant to the Alternatives analysis were various arguments and calculations of internal rates of return supporting the use of dry cooling.

**STAFF RESPONSE**
Because the revenue models are confidential staff will not attempt to provide any calculations here, in response to the comments. More importantly, staff agrees with CURE’s comments that in fact dry cooling is economically feasible, as discussed in this **Alternatives** section.

## CONCLUSIONS

## ALTERNATIVE SITES

After evaluating the alternative project siting areas proposed by applicant, staff concludes the Antelope alternative site area would likely cause a significant impact to prime agricultural lands and thus in order to avoid impacting waters of the state the project proponent would create a much more significant impact to farmland resources, on an overall acreage basis. Staff therefore concludes this particular alternative site area is not a feasible alternative to the proposed BSEP.

## ALTERNATIVE ELECTRICAL GENERATION TECHNOLOGIES

After evaluating the alternative electrical generation technologies and applying the screening criteria, staff has determined photovoltaic technology (PV) is a feasible alternative generation technology for the proposed BSEP because PV technology can reduce consumption of high quality fresh water by up to 97 percent, as compared with the proposed BSEP. The use of PV technology could also avoid the need to excavate evaporation ponds which could impact cultural resources. The evaporation ponds associated with the proposed BSEP also pose a threat to wildlife due to the toxicity of the wastewater and other factors. Staff concludes that utilizing PV solar panel technology could avoid or lessen certain environmental impacts from the proposed BSEP.

## ALTERNATIVE COOLING TECHNOLOGY – AIR COOLED CONDENSER (“DRY COOLING”)

Staff concludes that utilizing a dry cooling system is a feasible project alternative to the proposed BSEP. Staff has reached this conclusion because the dry cooling alternative “…would feasibly attain most of the basic objectives of the project [and] would avoid or substantially lessen any of the significant effects of the project…even if these

alternatives would…be more costly", Title 14, California Code of Regulations, section 15126.6(a)(b). In fact, staff has concluded that utilizing dry cooling with an expanded solar field actually provides a slightly higher profit margin, as compared to the proposed wet cooled project. Staff also finds that even without expanding the solar field, the BSEP would still meet or exceed the benchmark internal rate of return.

## SOURCES OF NON-POTABLE WATER FOR POWER PLANT COOLING

Staff concludes that using tertiary treated wastewater from either the Rosamond Community Services District (RCSD) or California City (with staff's condition) are both feasible project alternatives that would also increase the positive economic impact on the local communities. Staff supports and recommends the RCSD project alternative because it would facilitate compliance with state water policy. Staff also agrees with California City's assessment that the RCSD project alternative should be the preferred alternative because it effectively brings new water (which is otherwise being evaporated) into the sub-basin.

## REFERENCES


BCV 2009a – Boulder City View (tn 50615). Article El Dorado Energy Solar, Sempra Generation Boulder City View, dated 03/19/09. Submitted to CEC/Docket Unit on 03/20/09.

BLM 2009a – Bureau of Land Management (tn 50618). BLM Project Application Table (PV only). Submitted to CEC/Docket Unit on 03/20/09.

BS 2008a - FPL Energy/M. O'Sullivan (tn 45646). Application for Certification, dated 03/13/08. Submitted to CEC/Docket Unit on 03/14/08.

BS 2008c - Beacon Solar, LLC/G. Palo (tn 45972). AFC Volume 3 - Data Adequacy Supplement, dated 04/18/08. Submitted to CEC/Docket Unit on 04/21/08.

CEC 2008uu – California Energy Commission/E. Solorio (tn 49203). Report of Conversation about CEC Data Request Regarding Alternative Site Layouts, dated 11/24/08. Submitted to CEC/Docket Unit on 12/02/08.

CEC 2009i – California Energy Commission/E. Solorio (tn 50617). Record of Conversation Regarding Ownership of Transmission lines and Operating Costs for Photovoltaic Power Plants, dated 02/25/09. Submitted to CEC/Docket Unit on 03/20/09.

CEC 2009j – California Energy Commission/E. Solorio (tn 50553). PV – Installed Cost Per Watt, dated on 03/16/09. Submitted to CEC/Docket Unit on 03/18/09.

CEC 2009k – California Energy Commission/E. Solorio (tn 50653). Report of Conversation Regarding Dry Cooling Systems as a Component of BrightSource Energy's Project Proposals, dated 03/23/09. Submitted to CEC/Docket Unit on 03/25/09.

CEM 2009a – California Energy Markets (tn 50555). CEM 2009 A, dated 02/06/09. Submitted to CEC/Docket Unit on 3/18/09.

CofC 2009b – City of California/M. Bevins (tn 52168). City of California Proposal to Provide Treated Wastewater to Beacon Solar, dated 6/26/09. Submitted to CEC/Docket Unit on 6/26/09.

CofC 2009c – City of California/M. Bevins (tn 52865). City of California Water Supply Proposal, dated 8/13/09. Submitted to CEC/Docket Unit on 8/13/09.

DB 2009l – Downey Brand/S. Rowlands (tn 50354). Application for Confidential – Resubmission of Revenue Data, dated 03/02/09. Submitted to CEC/Docket Unit on 03/02/09.

DB 2009m – Downey Brand, LLP (tn 50634). Status Report #4, dated 03/02/09. Submitted to CEC/Docket Unit on 03/02/09.

DFG 2008b - Department of Fish and Game/ W. Loudermilk (tn 46814). Letter in Response to Request for Agency Participation, dated 06/19/08. Submitted to CEC/Docket Unit on 06/30/08.

EAFB 2009a – Edwards Air Force Base/K. Dyas (tn 52940). Edwards AFB Form 813 – Rosamond CSD, dated 8/21/09. Submitted to CEC/Docket Unit on 8/24/09.

GB 2009a – Galati Blek LLP/M. Mills (tn 51827). Comments on Beacon Preliminary Staff Assessment, dated 6/4/09. Submitted to CEC/Docket Unit on 6/4/09.

GW 2009a – Green Wombat (tn 50559). Woody 2009 A, dated 02/27/09. Submitted to CEC/Docket Unit on 03/18/09.

GW 2009b – Green Wombat (tn 50561). Woody 2009 B, dated 02/27/09. Submitted to CEC/Docket Unit on 03/18/09.

RCSD 2009d – Rosamond Community Services District/J. Stewart (tn 53088). Revised Rosamond CSD Letter of Intent, dated 8/14/09. Submitted to CEC/Docket Unit on 9/1/09.

SB 2009a – Sacramento Bee (tn 50619). Energy Production Takes Toll on Birds, dated 03/20/09. Submitted to CEC/Docket Unit on 03/20/09.

SEIA 2009a – Solar Energy Industries Association (tn 50616). SEIA Major Solar Project, dated 03/10/09. Submitted to CEC/Docket Unit on 03/20/09.

WP 2009a – Worley Parsons (tn 49597). Dry Cooling Evaluation, dated 02/01/08. Submitted to CEC/Docket Unit 01/05/09.

# APPENDIX A
# FEASIBILITY STUDY OF WATER SUPPLIES AND COOLING SYSTEMS

Testimony of Michael N. DiFilippo

## WATER SUPPLY & COOLING

The Beacon Solar Energy Project (BSEP) would utilize onsite groundwater for all plant needs including cooling and steam generator feedwater as well as potable uses. Cooling will be provided by a mechanical draft cooling tower. Plant wastewater (from all sources) would be sent to evaporation ponds for final disposal. No backup cooling water supply is planned for by the applicant although they offer to use future tertiary treated effluent from California City if it becomes available.

Staff has compared the environmental and economic merits of the proposed project with an alternate water supply and one cooling alternative as follows:

## PROPOSED PROJECT

All BSEP water needs (including potable needs) will be met by groundwater pumped from wells on the plant site. There are 12 existing water supply wells that were previously used for farming at the site - four wells would be used to supply water for the project (two operating and two backup). The applicant projects water use as follows:

| Water Use | | | |
|---|---|---|---|
| Water Use | Annualized Average Rate[1], gpm | Peak Rate[2], gpm | Estimated Annual Use, Acre Feet |
| Plant Operation | 990 | 4,054 | 1,599 |
| Potable Water | 5 | 5 | 8 |

1. The estimated groundwater usage in gallons per minute is based on an average daily consumption.
2. The peak rate is the instantaneous maximum for summer usage.

Water uses would include cooling tower makeup, closed cooling system makeup, steam generator makeup, mirror washing, plant wash down (housekeeping and maintenance), dilution water for chemical feed systems, etc. Well water would also be used for potable uses - drinking, showers, sinks, and toilets. Well water would be stored on site in the Raw Water Tank. Most of the water would be treated using ion exchange (SAC-SBA) and stored in the Process Water Tank. Process water would be used for cooling tower makeup. A portion of the process water would be treated further for steam generator makeup and mirror washing utilizing portable demineralizers (these are regenerated offsite and generate no wastewater). Wastewater sources include cooling tower blowdown, steam generator blowdown, plant drains, water treatment waste streams, etc. Cooling tower blowdown and SAC-SBA neutralized wastewater would be sent to three 8.3 acre evaporation ponds. Steam generator blowdown and plant drains would be recycled to the cooling tower. The applicant claims that the ponds are sized to accommodate all solids residue generated throughout the life of the plant.

The treatment process selected by BSEP was driven by the PM10 requirements placed on the cooling tower (by the AQMD). The total dissolved solids (TDS) of the circulating water must be less than 1,600 mg/l to meet the PM10 limit. Also, BSEP plans to operate the cooling tower at 15 cycles of concentration (the ratio of feedwater flow to blowdown flow is 15) to minimize wastewater generation. This also means that the TDS of the makeup water (onsite wells) must be reduced to approximately 100 mg/l. BSEP proposes using SAC-SBA ion exchangers to accomplish this. SAC-SBA vessels contain ion exchange resin specifically designed to remove cations (positive ions) and anions (negative ions) from water. The SAC and SBA vessels have a fixed capacity to remove ions, and therefore, must be removed from service frequently and regenerated. This is accomplished by passing dilute sulfuric acid through the SAC vessel (strong acid cation) and dilute sodium hydroxide through the SBA vessel (strong base anion). Wastewater which can have very high or low pH would require neutralization prior to disposal.

In the applicant's water balance for typical annual conditions, they show a wastewater rate to the evaporation ponds of 471 gpm (Section 2, Figure 2-13). This consists primarily of cooling tower blowdown and wastewater from water treatment. They plan to operate at an annual 26.5% capacity factor (94% capacity factor during daylight periods). Adjusting wastewater flow to a 24-hour operating basis, flow to the evaporation ponds would be 125 gpm (471 gpm x 26.5%). All ponds would have to operate for the entire year to accommodate this flow. Stated another way, the evaporation rate from the ponds would have to be 97 inches per year. Evaporation pan data for this area is about 120 inches per year. Pan data is measure of ambient evaporation rate and is measured with a National Weather Service Class A pan (measuring 48" diameter x 10" deep). Past experience in sizing evaporation ponds (by author) was to adjust the Class A pan data by 40% to 45% for salinity and edge effects. This equates to an adjusted evaporation rate of approximately 66 to 72 inches. As ponds concentrate, high levels of salt inhibit evaporation. Additionally, the size, shape and depth of the pond also reduce evaporation. The ponds as sized are marginal and a fourth pond would likely be required. Also, if water use in the plant is greater than that described in the water balance (Figure 2), additional pond area would be required.

## ALTERNATIVE WATER SUPPLY (BRACKISH WATER) AND TREATMENT PROCESSES

As a means of conserving high quality (potable) onsite groundwater, five treatment alternatives were evaluated utilizing offsite brackish water. Refer to the following table. All the alternatives would utilize well water from a brackish makeup source. The water is considered brackish because State Water Resources Control Board, Resolution 75-58 defines brackish waters as "all waters with a salinity range of 1,000 to 30,000 mg/l" and the water at Koehn Lake fits within those parameters. The aquifer is accessible at the southwest corner of Koehn Lake approximately 5 miles from the project site. It was assumed that four wells would be required to supply BSEP needs. In all of the alternatives well water would be transported to the site via a 12-inch or 14-inch pipeline (depending on water demand).

| Offsite Brackish Water Alternatives | | | | | |
|---|---|---|---|---|---|
| | SAC-SBA | Makeup RO | Recovery RO | Evap/Crys | Evap Ponds |
| Alternative 1 | X | | | | X |
| Alternative 2 | X | | X | | X |
| Alternative 3 | | X | X | | X |
| Alternative 4 | X | | | X | |
| Alternative 5 | | X | X | X | |

All of the processes in the above table are well established commercial technologies.

SAC-SBA in Alternative 1 is the same ion exchange process proposed by BSEP.

Reverse osmosis (RO) would be used in two ways – as makeup treatment or in a wastewater recovery configuration. In alternatives 2 and 5, RO would be used to directly treat cooling tower makeup, steam generator makeup and mirror washing water. In Alternatives 2, 3 and 5, RO would be used to treat cooling tower blowdown to reduce overall wastewater volume either for disposal or as a pretreatment to an evaporator. RO is a technology that utilizes permeable membranes (under relatively high pressure) to repel salt and pass water. Most of the dissolved salts are repelled by the membrane surface (95% to 98% for most ions) allowing only water to pass through. RO must have highly filtered water with modified chemistry (usually pH adjustment) to operate successfully. In the alternatives utilizing RO, the water would be filtered by the use of microfiltration (MF). MF is also a membrane process that is commonly used with RO in difficult industrial or reuse applications.

Evaporator/Crystallizers in Alternatives 4 and 5 would be used to reduce wastewater volume to essentially zero volume. In the evaporator 90% to 95% of the water would be recovered. Brine from the evaporator would be sent to a crystallizer to further recover water. Waste from the crystallizer would be in the form of highly concentrated salt brines that would crystallize to solid form for offsite disposal. In Alternative 5, a recovery RO would be used to pre-concentrate the wastewater stream to the evaporator. Alternatives 4 and 5 would be the only treatment options requiring offsite disposal.

## COMPARATIVE WATER CONSUMTION OF VARIOUS PROCESSES

Refer to the following table for a comparative summary of onsite water versus offsite brackish water for BSEP makeup. The analysis was based on typical summer conditions. Note the evaporation pond sizing for the BSEP proposed treatment. Staff calculated a pond size (utilizing the criteria discussed above) of 43.5 acres versus 25 acres in the BSEP project description.

| Water Treatment Summary<br>*Typical Summer Conditions Basis* | | | | | | |
|---|---|---|---|---|---|---|
| | | Offsite Wells - Koehn Lake Source Water | | | | |
| | BSEP Onsite Wells SAC-SBA | Alternative 1 SAC-SBA | Alternative 2 SAC-SBA Recov RO | Alternative 3 MU RO Recov RO | Alternative 4 SAC-SBA Evap-Crys | Alternative 5 MU-Recov RO Evap-Crys |
| **Water Demand - Instantaneous** | | | | | | |
| Onsite Wells Demand, gpm | 4,038 | 5 | 5 | 5 | 5 | 5 |
| Koehn Lake Water Demand, gpm | N/A | 4,086 | 3,772 | 3,959 | 3,463 | 3,480 |
| Total Wastewater, gpm | 572 | 650 | 565 | 801 | 0 | 0 |
| **Water Demand - Annual Average Conditions** | | | | | | |
| Annual Capacity Factor | 26.5% | 26.5% | 26.5% | 26.5% | 26.5% | 26.5% |
| Onsite Wells Demand, gpm | 1,070 | 5 | 5 | 5 | 5 | 5 |
| Koehn Lake Water Demand, gpm | N/A | 1,083 | 1,000 | 1,049 | 918 | 922 |
| Onsite Wells Demand, AF/yr | 1,726 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 |
| Koehn Lake Water Demand, AF/yr | N/A | 1,747 | 1,612 | 1,692 | 1,480 | 1,488 |
| Total Wastewater, gpm | 152 | 172 | 150 | 212 | 0 | 0 |
| Evap Pond, acres[1] | 43.5 | 49.4 | 42.9 | 60.8 | 0 | 0 |

***Notes.....***
1. BSEP project evap pond was sized based based on staff calculation.

The offsite well field at Koehn Lake would be the same for all of the alternatives (1 through 5). Each well was assumed to be 500 feet deep. The pipeline diameter for Alternatives 1 and 3 is 14 inches and 12 inches for Alternatives 2, 4 and 5. The size differences are a function of water demand for each alternative. For this analysis, the line was sized to operate 24 hours per day at half the water demand rate.

## ALTERNATIVE 1

Alternative 1 utilizes “brackish” water from offsite wells for plant needs, e.g. cooling tower makeup, closed cooling system makeup, steam generator makeup, mirror washing, etc. Steam generator blowdown and plant drains would be recycled to the cooling tower. It is the same alternative proposed by BSEP. Well water from onsite wells would still be used for potable needs. Plant wastewater would be sent to an evaporation pond for final disposal. The evaporation ponds would be about 15 percent larger than the BSEP ponds because more wastewater would be generated by the SAC-SBA treating brackish water.

## ALTERNATIVE 2

This alternative combines Alternative 1 (SAC-SBA) with a recovery RO to reduce the cooling tower blowdown portion of the wastewater stream. MF would be used as pretreatment for the recovery RO. The evaporation ponds would be slightly smaller than the BSEP ponds.

## ALTERNATIVE 3

In this alternative offsite water would be treated with and RO prior to storage in the Process Water Tank (replacing SAC-SBA). A portion of cooling tower blowdown would also be recovered via RO prior to discharge to evaporation ponds. MF would be used as pretreatment for the makeup and recovery RO. Steam generator blowdown and plant drains would be recycled to the cooling tower. RO permeate would be recovered to the cooling tower. This alternative would generate more wastewater than Alternatives 1 or 2 and would require a significantly larger evaporation pond.

## ALTERNATIVE 4

This alternative combines Alternative 1 (SAC-SBA) with an evaporator/crystallizer and would essentially eliminate a liquid waste stream. There would be no evaporation pond in this alternative. Crystallizer solid waste would require offsite disposal. Steam generator blowdown and plant drains would be recycled to the cooling tower. Cooling tower blowdown and SAC-SBA wastewater would be fed to the evaporator/crystallizer. Distillate from the evaporator/crystallizer would be recovered to the cooling tower.

## ALTERNATIVE 5

This alternative combines Alternative 3 (makeup RO/recovery RO) with an evaporator/crystallizer and would essentially eliminate a liquid waste stream, i.e. there would be no evaporation pond in this alternative. Crystallizer solid waste would require offsite disposal. Steam generator blowdown and plant drains would be recycled to the cooling tower. Cooling tower blowdown and makeup RO wastewater (known as reject) would be fed to the evaporator/crystallizer. Distillate from the evaporator/crystallizer would be recovered to the cooling tower.

## COST ANALYSIS

Refer to the following table for a cost analysis of BSEP onsite wells versus offsite brackish water. From a capital perspective Alternative 1 (SAC-SBA) and Alternative 2 (SAC-SBA with recovery RO) are the least costly of the offsite alternatives (i.e. at this level of evaluation they are too close to call). Alternative 3 is the least costly based on operating costs. Relative to the BSEP treatment, Alternatives 1 or 2 would cost an additional $12.0 to $12.5 million to install. Likewise, Alternative 3 (makeup & recovery RO) would cost $1 million more to operate relative to the BSEP base case. When the installed cost is capitalized (amortized at 7% for 20 years), Alternative 3 is the least costly of the five offsite alternatives. However, its annual cost would exceed BSEP costs by over $2.75 million per year.

Lastly, Alternatives 1, 2 or 3 achieve the goal of using non-potable quality water for project cooling. Given the budget level of analysis, the costs of these alternatives are quite close and should be considered equivalent.

| Water Treatment Summary & Cost Analysis<br>*Typical Summer Conditions Basis* | | | | | | |
|---|---|---|---|---|---|---|
| | | Offsite Wells - Koehn Lake Source Water | | | | |
| | BSEP Onsite Wells SAC-SBA | Alternative 1 SAC-SBA | Alternative 2 SAC-SBA Recov RO | Alternative 3 MU RO Recov RO | Alternative 4 SAC-SBA Evap-Crys | Alternative 5 MU-Recov RO Evap-Crys |
| **Equipment & Evap Pond Installed Cost** | | | | | | |
| SAC-SBA | $20,610,000 | $20,610,000 | $20,610,000 | N/A | $20,610,000 | N/A |
| MU-Recovery RO | N/A | N/A | $3,380,000 | $23,840,000 | N/A | $21,160,000 |
| Evaporator Crystallizer | N/A | N/A | N/A | N/A | $33,750,000 | $36,190,000 |
| Common Tankage & Pumping | $11,140,000 | $11,270,000 | $10,520,000 | $10,970,000 | $9,770,000 | $9,810,000 |
| Water Treatment Subtotal | $31,750,000 | $31,880,000 | $34,510,000 | $34,810,000 | $64,130,000 | $67,160,000 |
| Evaporation Pond | $10,960,000 | $12,460,000 | $10,820,000 | $15,340,000 | N/A | N/A |
| Total Water & Wastewater | $42,710,000 | $44,340,000 | $45,330,000 | $50,150,000 | $64,130,000 | $67,160,000 |
| **Pipeline from Koehn Lake** | | | | | | |
| 4 Wells | N/A | $880,000 | $880,000 | $880,000 | $880,000 | $880,000 |
| Pump Station | N/A | $3,080,000 | $3,000,000 | $3,050,000 | $2,910,000 | $2,910,000 |
| 5 Mile Carbon Steel Pipeline | N/A | $6,970,000 | $5,580,000 | $6,970,000 | $5,580,000 | $5,580,000 |
| Total | N/A | $10,930,000 | $9,460,000 | $10,900,000 | $9,370,000 | $9,370,000 |
| **Total Installed Water Treatment Costs** | $42,710,000 | $55,270,000 | $54,790,000 | $61,050,000 | $73,500,000 | $76,530,000 |
| | Base | $12,560,000 | $12,080,000 | $18,340,000 | $30,790,000 | $33,820,000 |
| **Total Annual Operating Costs** | $1,215,000 | $3,549,000 | $3,453,000 | $2,235,000 | $5,202,000 | $4,215,000 |
| | Base | $2,334,000 | $2,238,000 | $1,020,000 | $3,987,000 | $3,000,000 |
| **Capitalized Equipment Costs[1]** | $4,032,000 | $5,218,000 | $5,172,000 | $5,763,000 | $6,938,000 | $7,224,000 |
| | Base | $1,186,000 | $1,140,000 | $1,731,000 | $2,906,000 | $3,192,000 |
| **Annual Operating & Capital Cost** | $5,247,000 | $8,767,000 | $8,625,000 | $7,998,000 | $12,140,000 | $11,439,000 |
| | Base | $3,520,000 | $3,378,000 | $2,751,000 | $6,893,000 | $6,192,000 |

***Notes.....***
1. Capitalized at 7% per year for 20 years.

## DRY COOLING

BSEP evaluated three Air Cooled Condenser (ACC) dry cooling alternatives (refer to Worley Parsons report “FPLE Beacon Solar Energy Project Dry Cooling Evaluation”, dated February 1, 2008). The report evaluated three inlet temperature differences (ITD) scenarios (35 °F, 40 °F and 45 °F). Each ITD scenario yields a slightly different operating profile. For evaluation purposes, the 40 °F scenario was compared to wet cooling alternatives, i.e. the BSEP base case and Alternative 3 (offsite water, MU/Recovery RO). In the Worley Parsons study, the cost for solar arrays was increased to provide 250 MW (i.e. same as base case).

Refer to the following table. Note that the cooling system (cooling tower) costs remain the same for the base case and Alternative 3. After adjusting the costs for water treatment, the BSEP base case is the lowest estimated capital cost followed by Alternative 3 ($18.3 million difference) and dry cooling ($53.7 million difference). The annual operating costs were calculated by adding power for the wet and dry cooling system to the annual cost for water treatment. Other power costs (outside the cooling loop) were considered equivalent. The dry cooling alternative has the lowest operating costs by $403,000 when compared to the BSEP base case.

## Cooling System Comparison Summary

*Typical Summer Conditions Basis*

| | BSEP Base Case | Alternative 3 Offsite Wells MU/Recov RO | Alternative 6 Dry Cooling ACC 40F ITD |
|---|---|---|---|
| **Cooling System** | | | |
| Cooling Tower Cells | 11 | | N/A |
| ACC Cells | N/A | | 40 |
| **Power Requirements** | | | |
| Fan Power, HP | 250 | | 200 |
| Circ Pump Power, HP | 2509 | | N/A |
| Total Power, HP | 5259 | | 8000 |
| Total Power, kw | 3918 | | 5960 |
| Average Op Capacity | 26.5% | | 26.5% |
| Power, kw-hr/year | 9,096,000 | | 13,836,000 |
| Power Cost, $/year | $1,364,400 | $1,364,400 | $2,075,400 |
| **Cooling System Costs** | | | |
| HTF Pumps | $3,000,000 | | $3,000,000 |
| BFW Pumps | $2,300,000 | | $2,400,000 |
| SG Heat Exchanger | $12,500,000 | | $14,100,000 |
| Additional Solar Arrays[1] (installed) | Base | | $53,000,000 |
| Cooling Tower | $4,275,000 | | N/A |
| CT Basin | $1,500,000 | | N/A |
| Circ Water Pumps | $600,000 | | N/A |
| Surface Condenser | $3,500,000 | | N/A |
| Circ Water Piping | $1,300,000 | | N/A |
| Circ Water Piping Install | $520,000 | | N/A |
| ACC Equipment | N/A | | $36,900,000 |
| ACC Install | N/A | | $11,500,000 |
| Closed Cycle Aux Cooler | N/A | | $450,000 |
| **Total Cooling System Cost** | $29,495,000 | $29,495,000 | $121,350,000 |
| **Water Treatment Costs** | $42,710,000 | $61,050,000 | $4,600,000 |
| **Total System Cost** | $72,205,000 | $90,545,000 | $125,950,000 |
| | Base | $18,340,000 | $53,745,000 |
| **Annual Operating Costs** | | | |
| Water Treatment | $1,215,000 | $2,235,000 | $101,000 |
| Cooling System Power | $1,364,400 | $1,364,400 | $2,075,400 |
| **Total Operating Cost[2]** | $2,579,400 | $3,599,400 | $2,176,400 |
| | Base | $1,020,000 | -$403,000 |
| **Capitalized Equipment Costs[3]** | $6,820,000 | $8,550,000 | $11,890,000 |
| | Base | $1,730,000 | $5,070,000 |
| **Annual Operating & Capital Costs** | $9,399,400 | $12,149,400 | $14,066,400 |
| | Base | $2,750,000 | $4,667,000 |

***Notes.....***

1. Costs extracted from Worley Parsons report, "FPLE - Beacon Solar Energy Project Dry Cooling Evaluation" dated February 1, 2008.
2. Water treatment costs plus cost for cooling system power. All other power costs were assumed to be equivalent.
3. Capitalized at 7% per year for 20 years.

## EFFICIENCY LOSS CALCULATIONS

The Worley Parsons study determined that the net output for the 40 °F ITD ACC would be 7.50% less than that of the base case. The base case would include the BSEP proposed cooling configuration or Alternative 3 (offsite wells with makeup and recovery RO). At high ambient dry bulb temperatures (summer conditions), the ACC cannot cool as efficiently as wet cooling resulting in higher condenser backpressure and reduced turbine output. Refer to the following table for a comparison of annual net output for these alternatives. The difference in generating output is an indirect measure of ACC cooling efficiency relative to wet cooling.

| **Net Output Comparisons** | | | |
|---|---|---|---|
| | BSEP<br>Wet Cooling | Alternative 3<br>Offsite Wells<br>MU/Recov RO | ACC<br>40° F ITD |
| Estimated Annual Output, MW-hr | 602,527 | 602,527 | 557,365 |
| Est Annual Output Difference, MW-hr | Base | Base | 45,162 |
| Pct Difference to Base | Base | Base | -7.50% |

# APPENDIX B
# Review and Analysis of Alternative Cooling Systems

Testimony of John S. Maulbetsch

## BACKGROUND AND OBJECTIVES

The Beacon Solar Power plant is a 250 MWe (net) parabolic trough solar plant to be located in Kern County, California, 4 miles north-northwest of California City, The developers have investigated the use of 7 alternative cooling system designs for meeting the main steam condenser and other auxiliary plant cooling loads. The alternatives include:

- Closed-cycle wet cooling with a surface steam condenser and a mechanical-draft wet cooling tower
- Three sizes of dry cooling each using a forced-draft air-cooled condenser
- Three hybrid (wet/dry) systems each with a different mix of wet and dry cooling using a surface condenser/wet cooling tower for the wet portion and an air-cooled condenser for the dry portion.

The basis for the sizing of the systems and a discussion of the comparative costs, performance and water consumption was reported in the “Dry Cooling Evaluation” report. [1]

This current study was undertaken with the general intent of providing an independent review of the approach, methodology and results of the cooling systems report [1] with the specific objectives of:

1. determining which of the three dry cooling systems appears to be economically preferred alternative among dry cooling systems
2. estimating the differential cost and annual performance of the dry and wet systems
3. estimating the size, configuration and water consumption of a hybrid system capable of providing the most comparable performance to the all wet system

The remainder of the report is organized as follows:

- Review of original cooling system design and selection
- Review effect of cooling system capability on plant performance
- Comparison of dry and wet systems
- Comparison of three alternative dry systems
- Estimating the size, cost and water consumption of the desired hybrid system

## COOLING SYSTEM DESIGN AND SELECTION

All cooling systems were designed in conjunction with an appropriate turbine selection to deliver 280 MWe (gross) and 250 MWe (net) at design conditions.

## WET COOLING

The wet cooling system is a closed-cycle system with a surface steam condenser of the shell-and-tube type and a mechanical-draft, counterflow wet cooling tower.

Ambient Conditions

Site elevation: 2,314 feet (above sea level)
Design wet bulb temperature: 68 °F (1% wet bulb)
Mean coincident dry bulb temperature: 95 °F

Cooling tower specifications:

Circulating water flow: 149,000 gpm ($7.45 \times 10^7$ lb/hr)
Circulating water temperature drop: 20 °F
Approach temperature:[3] 9 °F
Heat load (calculated): $1.49 \times 10^9$ Btu/hr

Condenser specifications:

Circulating water flow: 149,000 gpm ( lb/hr)
Range:[4] 20 °F
Terminal temperature difference (TTD):[5] 5 °F

Design operating point:

Condensing temperature: 102 °F ($T_{cond}$ = wet bulb + approach + range + TTD)
Condensing pressure: 2.1 in Hga

## DRY COOLING

The dry cooling system is a direct dry cooling system with the turbine exhaust steam condensed in the tubes of a forced-draft air-cooled condenser. The tubes are arranged in an A-frame configuration with the inlet steam duct at the top and a condensate collection pipe at the bottom. The outsides (air-sides) of the tubes are finned for enhanced air-side heat transfer.

[3] Approach = Wet bulb temperature – cold water temperature

[4] Range = Circulating water temperature rise in condenser = temperature drop in tower

[5] Terminal temperature difference (TTD) = Condensing temperature – hot water temperature

Ambient Conditions:

Site elevation: 2,314 feet (above sea level)
Design dry bulb temperature: 103.5 °F (0.4% dry bulb)
Mean coincident wet bulb temperature: 66 °F

Three different air-cooled condensers were considered with specified ITD's (Initial Temperature Difference's) of 35, 40 and 45 °F. For a given heat duty, a lower ITD represents a larger and more costly air-cooled condenser that a higher ITD. As noted in the WorleyParsons report (1) a 40 °F is a common selection for ACC's, often (but not always) representing a preferred trade-off between cost and performance. Specifications for the three ACC's are given below in Table 1.

**Table 1: Dry Cooled System Specifications**

| Design Parameters | ACC Alternative Designs | | |
|---|---|---|---|
| | A | B | C |
| **Initial temperature difference (ITD)[6], °F** | **35** | **40** | **45** |
| **Condensing temperature, °F** | **138.5** | **143.5** | **148.5** |
| **Turbine exhaust pressure, in Hga** | **5.67** | **6.44** | **7.30** |
| **Steam flow, lb/hr** | **1,848,207** | **1,884,259** | **1,919,791** |
| **Steam enthalpy, Btu/lb** | **1,045.8** | **1,054.6** | **1,063.6** |
| **Heat load (calc.), Btu/hr** | **$1.74 \times 10^9$** | **$1.78 \times 10^9$** | **$1.82 \times 10^9$** |

## OPERATING PROFILE

An annual operating profile of site conditions (solar insolation, solar field output, thermal input to the power block, and net electrical power generated) is provided in Reference 1 for both a wet cooled and a dry cooled plant design. The dry cooled design uses the intermediate sized ACC (Case B; ITD = 40 °F). While the solar field profile does not represent the real annual variability in solar field output, this "synthetic" profile where all the several solar field efficiencies are held constant, was used in Reference 1 to simplify the analysis. It is considered appropriate since the cooling systems are compared at identical power block input conditions throughout the year and differences in net plant output are attributable solely to differences in cooling system capabilities and their variation with ambient conditions. These profiles will be used as the basis for comparisons in this study for the same reasons and to provide a consistent comparison to the results discussed in Reference 1.

Table 2 lists the site ambient conditions, the solar field output and the power block input for all operating hours of the year.

[6] Initial temperature difference (ITD) = Condensing temperature – ACC air inlet temperature

## Table 2: Site Ambient Conditions and Solar Field Operating Profile

| Day/Hour | | | | Field Insolation | Field Output | Collector Output | Dry Bulb Temperature | Wet Bulb Temperature |
|---|---|---|---|---|---|---|---|---|
| No. | Month | Hour | Hrs/yr | W/m2 | MWth | MWt | F | F |
| 1 | Jan | 7 | 31 | 3.48 | 5.03 | 2.66 | 38.13 | 32.45 |
| 2 | Jan | 8 | 31 | 264 | 381.83 | 202.06 | 41.98 | 34.97 |
| 3 | Jan | 9 | 31 | 518.42 | 749.81 | 396.78 | 45.88 | 37.35 |
| 4 | Jan | 10 | 31 | 655.23 | 947.69 | 501.49 | 49.73 | 39.48 |
| 5 | Jan | 11 | 31 | 692.29 | 1001.29 | 529.86 | 52.81 | 41.16 |
| 6 | Jan | 12 | 31 | 722.55 | 1045.05 | 553.02 | 55.86 | 42.73 |
| 7 | Jan | 13 | 31 | 724.1 | 1047.30 | 554.20 | 58.94 | 44.15 |
| 8 | Jan | 14 | 31 | 716.58 | 1036.42 | 548.45 | 59.37 | 44.46 |
| 9 | Jan | 15 | 31 | 652.65 | 943.96 | 499.52 | 59.79 | 44.75 |
| 10 | Jan | 16 | 31 | 523.32 | 756.90 | 400.53 | 60.23 | 45.06 |
| 11 | Jan | 17 | 31 | 240.35 | 347.63 | 183.96 | 56.67 | 43.26 |
| 12 | Jan | 18 | 31 | 2.94 | 4.25 | 2.25 | 53.11 | 41.28 |
| 13 | Feb | 7 | 28 | 71.04 | 102.75 | 54.37 | 42.14 | 37.09 |
| 14 | Feb | 8 | 28 | 387.36 | 560.26 | 296.47 | 47.27 | 40.36 |
| 15 | Feb | 9 | 28 | 545.36 | 788.78 | 417.40 | 52.42 | 43.31 |
| 16 | Feb | 10 | 28 | 628.79 | 909.45 | 481.26 | 57.54 | 45.83 |
| 17 | Feb | 11 | 28 | 664.61 | 961.25 | 508.67 | 60.43 | 46.97 |
| 18 | Feb | 12 | 28 | 683.75 | 988.94 | 523.32 | 63.32 | 47.91 |
| 19 | Feb | 13 | 28 | 667.86 | 965.95 | 511.16 | 66.21 | 48.68 |
| 20 | Feb | 14 | 28 | 677.11 | 979.33 | 518.24 | 66.98 | 48.91 |
| 21 | Feb | 15 | 28 | 645.64 | 933.82 | 494.15 | 67.72 | 49.08 |
| 22 | Feb | 16 | 28 | 581.07 | 840.43 | 444.73 | 68.5 | 49.29 |
| 23 | Feb | 17 | 28 | 426.14 | 616.34 | 326.16 | 64.34 | 47.62 |
| 24 | Feb | 18 | 28 | 83.86 | 121.29 | 64.18 | 60.16 | 45.68 |
| 25 | Mar | 6 | 31 | 11.84 | 17.12 | 9.06 | 49.02 | 40.09 |
| 26 | Mar | 7 | 31 | 272.52 | 394.16 | 208.58 | 48.83 | 39.96 |
| 27 | Mar | 8 | 31 | 557.16 | 805.84 | 426.43 | 53.01 | 42.31 |
| 28 | Mar | 9 | 31 | 691.71 | 1000.45 | 529.41 | 57.24 | 44.46 |
| 29 | Mar | 10 | 31 | 737 | 1065.95 | 564.08 | 61.42 | 46.3 |
| 30 | Mar | 11 | 31 | 780.35 | 1128.65 | 597.26 | 63.94 | 47.26 |
| 31 | Mar | 12 | 31 | 768.19 | 1111.07 | 587.95 | 66.46 | 48.06 |
| 32 | Mar | 13 | 31 | 769.16 | 1112.47 | 588.69 | 68.98 | 48.78 |
| 33 | Mar | 14 | 31 | 744.13 | 1076.27 | 569.54 | 69.32 | 48.87 |
| 34 | Mar | 15 | 31 | 701.32 | 1014.35 | 536.77 | 69.59 | 48.97 |
| 35 | Mar | 16 | 31 | 624.19 | 902.79 | 477.74 | 69.93 | 49.05 |
| 36 | Mar | 17 | 31 | 510.52 | 738.39 | 390.74 | 67.07 | 48.12 |
| 37 | Mar | 18 | 31 | 204.84 | 296.27 | 156.78 | 64.22 | 47.1 |
| 38 | Mar | 19 | 31 | 0.71 | 1.03 | 0.54 | 61.32 | 45.87 |
| 39 | Apr | 6 | 30 | 155.03 | 224.23 | 118.66 | 54.93 | 45.08 |
| 40 | Apr | 7 | 30 | 510.9 | 738.94 | 391.03 | 55.38 | 45.43 |
| 41 | Apr | 8 | 30 | 681.33 | 985.44 | 521.47 | 59.68 | 47.36 |
| 42 | Apr | 9 | 30 | 797.87 | 1153.99 | 610.67 | 63.93 | 48.95 |
| 43 | Apr | 10 | 30 | 846.7 | 1224.62 | 648.04 | 68.23 | 50.15 |
| 44 | Apr | 11 | 30 | 871.17 | 1260.01 | 666.77 | 70.83 | 50.97 |
| 45 | Apr | 12 | 30 | 890.3 | 1287.68 | 681.41 | 73.38 | 51.64 |
| 46 | Apr | 13 | 30 | 846.13 | 1223.79 | 647.60 | 75.99 | 52.18 |
| 47 | Apr | 14 | 30 | 833.77 | 1205.92 | 638.14 | 76.39 | 52.32 |
| 48 | Apr | 15 | 30 | 814.17 | 1177.57 | 623.14 | 76.77 | 52.47 |
| 49 | Apr | 16 | 30 | 721.77 | 1043.93 | 552.42 | 77.18 | 52.62 |
| 50 | Apr | 17 | 30 | 653.43 | 945.08 | 500.12 | 74.4 | 51.91 |
| 51 | Apr | 18 | 30 | 429.07 | 620.58 | 328.40 | 71.62 | 50.99 |
| 52 | Apr | 19 | 30 | 37.07 | 53.62 | 28.37 | 68.79 | 49.99 |
| 53 | May | 5 | 31 | 15.16 | 21.93 | 11.60 | 58.85 | 48.9 |
| 54 | May | 6 | 31 | 296.74 | 429.19 | 227.12 | 60.86 | 50.2 |
| 55 | May | 7 | 31 | 549.94 | 795.40 | 420.91 | 64.84 | 52.18 |
| 56 | May | 8 | 31 | 676 | 977.73 | 517.39 | 69.88 | 54.21 |
| 57 | May | 9 | 31 | 735.74 | 1064.13 | 563.11 | 74.03 | 56.07 |
| 58 | May | 10 | 31 | 769.97 | 1113.64 | 589.31 | 77.71 | 57.01 |
| 59 | May | 11 | 31 | 805.97 | 1165.71 | 616.87 | 81.27 | 57.99 |
| 60 | May | 12 | 31 | 829.45 | 1199.67 | 634.84 | 83.64 | 58.19 |
| 61 | May | 13 | 31 | 822.61 | 1189.78 | 629.60 | 85.3 | 58.61 |
| 62 | May | 14 | 31 | 801.68 | 1159.50 | 613.58 | 86.52 | 58.38 |
| 63 | May | 15 | 31 | 756.32 | 1093.90 | 578.87 | 87.06 | 57.65 |
| 64 | May | 16 | 31 | 716.55 | 1036.38 | 548.43 | 86.42 | 57.61 |
| 65 | May | 17 | 31 | 642.87 | 929.81 | 492.03 | 84.19 | 56.68 |
| 66 | May | 18 | 31 | 457.06 | 661.07 | 349.82 | 81.41 | 55.95 |
| 67 | May | 19 | 31 | 108.35 | 156.71 | 82.93 | 77.35 | 54.62 |

| Day/Hour | | | | Field Insolation | Field Output | Collector Output | Dry Bulb Temperature | Wet Bulb Temperature |
|---|---|---|---|---|---|---|---|---|
| No. | Month | Hour | Hrs/yr | W/m2 | MWth | MWt | F | F |
| 68 | June | 5 | 30 | 40.57 | 58.68 | 31.05 | 72.1 | 55.33 |
| 69 | June | 6 | 30 | 408.7 | 591.12 | 312.81 | 73.21 | 55.94 |
| 70 | June | 7 | 30 | 642.3 | 928.99 | 491.60 | 74.29 | 56.58 |
| 71 | June | 8 | 30 | 749.87 | 1084.57 | 573.93 | 78.46 | 58.09 |
| 72 | June | 9 | 30 | 812.17 | 1174.68 | 621.61 | 82.66 | 59.38 |
| 73 | June | 10 | 30 | 837.43 | 1211.21 | 640.94 | 86.83 | 60.26 |
| 74 | June | 11 | 30 | 853.83 | 1234.93 | 653.50 | 89.31 | 60.95 |
| 75 | June | 12 | 30 | 859.43 | 1243.03 | 657.78 | 91.72 | 61.54 |
| 76 | June | 13 | 30 | 826.47 | 1195.36 | 632.56 | 94.2 | 62.02 |
| 77 | June | 14 | 30 | 842.2 | 1218.11 | 644.60 | 94.9 | 62.33 |
| 78 | June | 15 | 30 | 776.63 | 1123.27 | 594.41 | 95.58 | 62.63 |
| 79 | June | 16 | 30 | 747.53 | 1081.18 | 572.14 | 96.28 | 62.93 |
| 80 | June | 17 | 30 | 670.3 | 969.48 | 513.03 | 93.58 | 62.15 |
| 81 | June | 18 | 30 | 528.07 | 763.77 | 404.17 | 90.89 | 61.27 |
| 82 | June | 19 | 30 | 216.97 | 313.81 | 166.06 | 88.15 | 60.28 |
| 83 | July | 5 | 31 | 13.06 | 18.89 | 10.00 | 77.33 | 59.36 |
| 84 | July | 6 | 31 | 297.23 | 429.90 | 227.49 | 78.4 | 60.13 |
| 85 | July | 7 | 31 | 543.13 | 785.55 | 415.70 | 79.44 | 60.83 |
| 86 | July | 8 | 31 | 667.13 | 964.90 | 510.60 | 83.56 | 62.4 |
| 87 | July | 9 | 31 | 731.77 | 1058.39 | 560.08 | 87.64 | 63.67 |
| 88 | July | 10 | 31 | 782.48 | 1131.73 | 598.89 | 91.75 | 64.68 |
| 89 | July | 11 | 31 | 798.35 | 1154.69 | 611.03 | 94.61 | 65.65 |
| 90 | July | 12 | 31 | 806.58 | 1166.59 | 617.33 | 97.39 | 66.42 |
| 91 | July | 13 | 31 | 821.32 | 1187.91 | 628.61 | 100.24 | 67.17 |
| 92 | July | 14 | 31 | 801.81 | 1159.69 | 613.68 | 101.14 | 67.42 |
| 93 | July | 15 | 31 | 798.94 | 1155.54 | 611.49 | 102.07 | 67.64 |
| 94 | July | 16 | 31 | 749.29 | 1083.73 | 573.48 | 102.97 | 67.87 |
| 95 | July | 17 | 31 | 658.84 | 952.91 | 504.26 | 100.45 | 66.9 |
| 96 | July | 18 | 31 | 519.06 | 750.74 | 397.27 | 97.98 | 65.93 |
| 97 | July | 19 | 31 | 197.13 | 285.12 | 150.88 | 95.41 | 64.84 |
| 98 | Aug | 6 | 31 | 179.39 | 259.46 | 137.30 | 75.58 | 60 |
| 99 | Aug | 7 | 31 | 504.65 | 729.90 | 386.24 | 75.8 | 60.21 |
| 100 | Aug | 8 | 31 | 669.32 | 968.07 | 512.28 | 80.15 | 62.15 |
| 101 | Aug | 9 | 31 | 745.94 | 1078.88 | 570.92 | 84.53 | 63.82 |
| 102 | Aug | 10 | 31 | 809.35 | 1170.60 | 619.45 | 88.88 | 65.21 |
| 103 | Aug | 11 | 31 | 806.87 | 1167.01 | 617.55 | 91.49 | 65.82 |
| 104 | Aug | 12 | 31 | 828.9 | 1198.87 | 634.42 | 94.06 | 66.19 |
| 105 | Aug | 13 | 31 | 799.23 | 1155.96 | 611.71 | 96.67 | 66.51 |
| 106 | Aug | 14 | 31 | 784.87 | 1135.19 | 600.72 | 97.25 | 66.42 |
| 107 | Aug | 15 | 31 | 743.32 | 1075.09 | 568.92 | 97.85 | 66.45 |
| 108 | Aug | 16 | 31 | 663.42 | 959.53 | 507.76 | 98.43 | 66.33 |
| 109 | Aug | 17 | 31 | 569.52 | 823.72 | 435.89 | 96.23 | 65.49 |
| 110 | Aug | 18 | 31 | 403.45 | 583.53 | 308.79 | 93.98 | 64.56 |
| 111 | Aug | 19 | 31 | 73.61 | 106.47 | 56.34 | 91.74 | 63.62 |
| 112 | Sep | 6 | 30 | 81.27 | 117.54 | 62.20 | 65.82 | 54.5 |
| 113 | Sep | 7 | 30 | 487 | 704.37 | 372.74 | 69.02 | 56 |
| 114 | Sep | 8 | 30 | 683.77 | 988.97 | 523.34 | 74.17 | 57.97 |
| 115 | Sep | 9 | 30 | 785.43 | 1136.00 | 601.15 | 78.97 | 59.42 |
| 116 | Sep | 10 | 30 | 848.47 | 1227.18 | 649.39 | 83.09 | 60.99 |
| 117 | Sep | 11 | 30 | 850 | 1229.39 | 650.57 | 86.85 | 61.83 |
| 118 | Sep | 12 | 30 | 851.53 | 1231.60 | 651.74 | 89.76 | 62.49 |
| 119 | Sep | 13 | 30 | 819.9 | 1185.86 | 627.53 | 91.69 | 63.18 |
| 120 | Sep | 14 | 30 | 776.93 | 1123.71 | 594.64 | 92.81 | 63.73 |
| 121 | Sep | 15 | 30 | 734.17 | 1061.86 | 561.91 | 93 | 63.93 |
| 122 | Sep | 16 | 30 | 603.9 | 873.45 | 462.21 | 92.23 | 63.13 |
| 123 | Sep | 17 | 30 | 517.67 | 748.73 | 396.21 | 90.16 | 62.66 |
| 124 | Sep | 18 | 30 | 237.8 | 343.94 | 182.01 | 87.07 | 61.72 |
| 125 | Sep | 19 | 30 | 2.33 | 3.37 | 1.78 | 83.99 | 60.67 |
| 126 | Oct | 6 | 31 | 9.29 | 13.44 | 7.11 | 58.37 | 46.48 |
| 127 | Oct | 7 | 31 | 324.84 | 469.83 | 248.62 | 58.13 | 46.41 |
| 128 | Oct | 8 | 31 | 580.65 | 839.82 | 444.41 | 62.81 | 48.92 |
| 129 | Oct | 9 | 31 | 703.65 | 1017.72 | 538.55 | 67.49 | 51.13 |
| 130 | Oct | 10 | 31 | 763.13 | 1103.75 | 584.08 | 72.17 | 53.06 |
| 131 | Oct | 11 | 31 | 806.71 | 1166.78 | 617.43 | 74.99 | 54.07 |
| 132 | Oct | 12 | 31 | 776.52 | 1123.11 | 594.33 | 77.77 | 54.94 |
| 133 | Oct | 13 | 31 | 752.9 | 1088.95 | 576.25 | 80.58 | 55.67 |
| 134 | Oct | 14 | 31 | 756.71 | 1094.46 | 579.16 | 80.99 | 55.74 |
| 135 | Oct | 15 | 31 | 699.06 | 1011.08 | 535.04 | 81.4 | 55.74 |
| 136 | Oct | 16 | 31 | 596.45 | 862.67 | 456.51 | 81.81 | 55.81 |
| 137 | Oct | 17 | 31 | 343.26 | 496.47 | 262.72 | 78.12 | 54.43 |

| Day/Hour | | | | Field Insolation | Field Output | Collector Output | Dry Bulb Temperature | Wet Bulb Temperature |
|---|---|---|---|---|---|---|---|---|
| No. | Month | Hour | Hrs/yr | W/m2 | MWth | MWt | F | F |
| 139 | Nov | 7 | 30 | 118.5 | 171.39 | 90.70 | 45.77 | 38.29 |
| 140 | Nov | 8 | 30 | 496 | 717.39 | 379.62 | 50.17 | 41.02 |
| 141 | Nov | 9 | 30 | 672.53 | 972.71 | 514.73 | 54.56 | 43.5 |
| 142 | Nov | 10 | 30 | 739.03 | 1068.89 | 565.63 | 58.96 | 45.74 |
| 143 | Nov | 11 | 30 | 779.3 | 1127.13 | 596.45 | 62.18 | 47.2 |
| 144 | Nov | 12 | 30 | 775 | 1120.92 | 593.16 | 65.47 | 48.52 |
| 145 | Nov | 13 | 30 | 731.53 | 1058.04 | 559.89 | 68.69 | 49.63 |
| 146 | Nov | 14 | 30 | 668 | 966.16 | 511.27 | 69.03 | 49.8 |
| 147 | Nov | 15 | 30 | 567.33 | 820.55 | 434.22 | 69.36 | 50 |
| 148 | Nov | 16 | 30 | 461.37 | 667.30 | 353.12 | 69.7 | 50.17 |
| 149 | Nov | 17 | 30 | 107.33 | 155.24 | 82.15 | 65.73 | 48.25 |
| 150 | Dec | 7 | 31 | 24.26 | 35.09 | 18.57 | 41.12 | 34.84 |
| 151 | Dec | 8 | 31 | 347.81 | 503.05 | 266.20 | 44.05 | 36.78 |
| 152 | Dec | 9 | 31 | 550.81 | 796.66 | 421.57 | 46.99 | 38.59 |
| 153 | Dec | 10 | 31 | 650 | 940.12 | 497.49 | 49.92 | 40.33 |
| 154 | Dec | 11 | 31 | 690 | 997.98 | 528.11 | 52.8 | 41.82 |
| 155 | Dec | 12 | 31 | 682.52 | 987.16 | 522.38 | 55.74 | 43.22 |
| 156 | Dec | 13 | 31 | 681.48 | 985.65 | 521.58 | 58.62 | 44.43 |
| 157 | Dec | 14 | 31 | 661.06 | 956.12 | 505.96 | 58.84 | 44.5 |
| 158 | Dec | 15 | 31 | 568.1 | 821.67 | 434.81 | 59 | 44.52 |
| 159 | Dec | 16 | 31 | 409.23 | 591.89 | 313.21 | 59.23 | 44.59 |
| 160 | Dec | 17 | 31 | 109.32 | 158.11 | 83.67 | 56.5 | 43.22 |

## ANALYSIS OF WET SYSTEM PERFORMANCE

To infer the effect of cooling system performance on plant efficiency and output it is necessary to understand the effect of steam flow and turbine exhaust pressure on turbine performance. The steam flow is determined primarily by the thermal energy delivered to the power block. The turbine exhaust pressure is determined by the steam flow, steam inlet conditions and the ambient conditions as they affect the cooling system performance.

These relationships are estimated from the information provided in Appendices H (for the wet-cooled plant) and G (for the dry cooled plant) in Reference 1.

## TURBINE CHARACTERISTICS---WET COOLING DESIGN

Appendix H tabulates the net turbine output for each month and hour of day during that month. The net turbine output is the output available for export from the plant and is equal; to the gross turbine output minus the auxiliary load which is consumed in the plant. The plant auxiliary load is approximated based on the following assumptions: (2)

Auxiliary load at design plant output: 30 MWe
Auxiliary load at 25% design output: 15 MWe

The variation in auxiliary power is estimated with a linear relationship established by these two points.

Auxiliary power (MW) = 10. + 0.2 x % Design Load

Gross output, which is required to generate the basic turbine performance curves, is calculated as the net output plus the auxiliary load.

The wet cooling system rejects 1.49 x $10^9$ Btu/hr (436.6 $MW_{th}$) at design conditions at a net electrical output of 250 MW (280 MW gross output) implying a power input to the power block at design conditions of 2.45 x $10^9$ Btu/hr (716.6$MW_{th}$). Therefore, at the design turbine exhaust pressure of 2.1 in Hga, the steam cycle efficiency (gross) is 39.1%. (= 280 MWe/716.6 MWth). The corresponding net cycle efficiency is 34.9% which agrees well with the tabulated value of 34.7% in Table 5 of the WorleyParsons report. (1)

It will be assumed that the steam flow to the HP turbine inlet is proportional to the thermal input to the power block. Therefore, for each of the 160 operating conditions listed in Table 2, the steam flow as a percentage of the design steam flow can be determined.

The heat rejected at each condition is determined by the difference between the thermal input to the power block and the gross electrical generation. The circulating water flow is held constant. Therefore, to a reasonable approximation, the operating range and TTD are scaled from the design values to the operating point values proportionally to the heat rejected by the cooling system. Finally, using the CTI Toolkit [Ref. 3] published by the Cooling Technology Institute (CTI), the off-design condensing temperatures and pressures are calculable for each operating point.

Figure 1 (attached) displays the calculated efficiency for all the operating points vs. steam flow expressed as a percentage of the design steam flow. The slight variation in efficiency at a given steam flow is a result of the variation in turbine exhaust pressure resulting from the variation in ambient wet bulb temperature and its effect on the performance of the cooling tower. Figure 2 (attached) displays the effect of turbine exhaust pressure at constant steam flow. Each curve represents a narrow range of steam flow and illustrates the fall-off in efficiency with increasing turbine exhaust pressure. The family of curves indicates the fall-off in efficiency at constant exhaust pressure as the steam flow is reduced. The slight mismatch in the shape of the curves and their relative positions are due to slight imprecision in the tabulated data and the resulting effect on the curve fits.

## TURBINE CHARACTERISTICS---DRY COOLING DESIGN

A similar analysis can be applied to the plant and turbine performance for a dry cooled design equipped with an ACC sized for a 40 °F ITD. However, this condition requires some additional explanation.

The ACC, when sized for the selected turbine and the required plant output, has the design specifications given in Table 1 under Case B and a heat duty of 1.74 x $10^9$ Btu/hr or 520.6 $MW_{th}$. This combined with a turbine/generator output of 280 MW (gross) requires a thermal input to the power block of 800.6 $MW_{th}$ and would yield a gross efficiency of 35.% and a corresponding net efficiency of 31.2%. This agrees well with the net efficiency of 31.1% tabulated in Table 5 of the WorleyParsons report. (1)

However, the "Summary" page at the beginning of Appendix H where the comparative performance of the dry cooled plant is presented lists a gross output of 251.7 $MW_e$, a net output of 223.4 $MW_e$ and a corresponding net efficiency of 31.3% (35.3% gross efficiency). This implies a thermal input to the power block of 713.7 $MW_{th}$ corresponding to within 0.4% of that calculated for the system with a wet cooling system. Therefore, the comparative performance tabulated in Appendix H is based on a thermal input from the base solar field originally sized for the plant equipped with a wet cooling system.

This apparent internal inconsistency is acknowledged in the text of p. 8 (1) where the comparative cooling system performance analyses are discussed. The report notes that

> ***"the FPLE[7] requirement that the facility should have 250 net MW regardless of the heat rejection system".***

and that, therefore,

> ***"it has been assumed (emphasis added) that there is sufficient solar thermal energy available from the field to generate the necessary steam flow for the alternate cooling system to meet 250 net MW".***

and further,

> ***"Because of the requirement to meet 250 net MW at the design point, the performance table below shows equal plant output for all the cooling options at this operating condition. The performance item that then distinguishes the cooling options is the steam cycle efficiency so that a lower efficiency translates to increased solar thermal energy needed for the steam cycle".***

Therefore, to meet the performance objectives as tabulated in Table 5 (1), an expanded solar field capable of delivering 800.6 MWth (or approximately 12% more input power than the 714 MWth available from the base field) is required.

The initial comparison of plant performance with dry cooling to plant performance with wet cooling will be made assuming the base field input of 714 MWth in order to be consistent with and comparable to the results tabulated in Appendix H or the WorleyParsons report with the following system design point.

| | |
|---|---|
| Design gross output: | 251.7 $MW_e$ |
| Design net output: | 223.4 $MW_e$ |
| Design thermal input: | 713.7 $MW_{th}$ |
| Design efficiency (gross): | 35.3% |
| Design efficiency (net): | 31.3% |

An important difference between the operation of dry cooled plants and wet cooled plants occurs at low turbine exhaust pressures. Wet cooled plants can operate at low turbine exhaust pressures as low as 0.5 to 1. in Hga. Dry cooled plants are normally

[7] FPL Energy

controlled to maintain the turbine exhaust pressure above 2. in Hga. This is a result of the fact that large ACC's are subject to some amount of air in-leakage which must be removed with air removal equipment such as air ejectors. At backpressures below 2 in Hga the air in-leakage becomes large and difficult to handle. Therefore, at conditions where the turbine exhaust pressure would fall below 2. in Hga (low steam flow and/or low ambient temperatures) some of the ACC fans are operated at half speed or shut down entirely to maintain the backpressure at 2. in Hga.

The ability to operate at low turbine exhaust pressures gives the wet cooled plants and additional efficiency advantage as shown in Figure 2. Also, as seen in that figure, the curves bend over and approach a maximum efficiency for any given steam flow as the backpressure drops below 1 in Hga.

The efficiency curves for the dry cooled turbine are shown in two parts. For turbine backpressures above 2 in Hga, Figure 3 (attached) shows cycle efficiency vs. turbine exhaust pressure for several narrow ranges of steam flow. Figure 4 (attached) shows the cycle efficiency vs. % of design steam flow for turbine exhaust pressure controlled to 2 in Hga.

## COMPARISON OF WET AND DRY COOLED PLANTS

Figure 5 (attached) displays the comparative cycle efficiency between the wet cooled plant and the dry cooled plant. Three points are noteworthy. First, the turbine used with wet cooling is consistently more efficient over the entire range of operating conditions than the turbine used with dry cooling. Second, the variation (spread in the plotted points) at the higher flow rates is substantially greater for the dry cooled turbine than for the wet cooled turbine. This results from the greater variation in backpressure with ambient conditions for a dry cooled plant than for a wet cooled plant. This occurs because the seasonal and diurnal variation in dry bulb temperature is greater than the concurrent variation in wet bulb temperature with a correspondingly greater variation in turbine exhaust pressure. Finally, the increasing difference in cycle efficiencies at the lower flow rates is related to the reduction in condenser range and TTD at the lower heat duties which benefits the wet system and the decrease in Q/ITD at the lower back pressures which hurts the dry system.

Figure 6 (attached) displays the comparative net output for the two plants. The abscissa on this plot is divided into months. Within each month, the individual points are the output for a particular hour of an <u>average day</u> for that month. The points are for only those hours of the day during which the output of the solar field is sufficient to operate the plants…typically from early morning to late afternoon.

On the basis of this comparison which assumes the use of an ACC with a 40°F ITD and a constant solar field size and a synthetic solar field output model, the wet cooled plant delivers just over 8% more net electrical output than does the dry cooled plant. The annual net output totals (725,745 MWh for the wet cooled plant; 671,226 MWh for the dry cooled plant) are not representative of realistic operation because of the "synthetic" solar field output, but the ratios are indicative of the effect of the relative performance of the alternative cooling systems.

## ADDITIONAL COMPARISONS

Two further comparisons are relevant. These are:

1. the effect of different size ACC's on plant performance.
2. the effect of expanding the solar field to meet the required net output of 250 $MW_e$ at design conditions on the annual output.

## EFFECT OF DIFFERENT SIZE ACC'S:

The choice of a larger (lower ITD) or smaller (higher ITD) ACC will affect the plant performance both at the design point and throughout the year by changing the turbine exhaust pressure achieved for any given combination of steam flow and ambient temperature.

The performance differences relative to the dry cooled plant with a 40°F ACC are estimated for both a larger (35°F ITD) and a smaller (45°F ITD) ACC. An important assumption made in this comparison is that the same turbine characteristics are used in all three cases. While this need not be the case in practice, it is consistent with other published studies on this subject and is also all that can be done in this study with the information available. It is not believed that it would have a significant effect on the comparisons.

The determination of efficiency for the 40°F ITD unit was straightforward since both the thermal input to the power block and the net power output were known from Appendix G (1). For the other two ACC's, the calculation is an iterative one since the thermal input is known but the power output and the heat duty on the ACC are not. The calculation begins with the assumption that the cycle efficiency and hence the heat duty on the ACC are the same as for the 40°F ITD case. For that assumed heat duty and the known ACC capability (Q/ITD) of the selected ACC, the ITD, condensing temperature, and condensing pressure can be calculated for each point. Assuming, as noted above, that the turbine characteristics are the same as for the 40°F ITD case, a cycle efficiency, net power output and ACC heat duty can be determined, all of which will differ from the 40°F ITD case. The calculations are then repeated using the new value for the ACC heat duty, and the process is repeated until the results converge. The final results of cycle efficiency and net output for each of the ACC's are shown for each operating hour of the year in Figure 7 (Cycle efficiency) and Figure 8 (Net output).

Figure 7 (attached) shows the cycle efficiencies for the three cases. Figure 8 (attached) displays the comparable net output profiles.

As can be seen the differences are quite small. The ordinate scale in Figure 8 (attached) is expanded compared to the similar plot in Figure 6 (attached) in order to make the differences even slightly visible. The more relevant comparison is among the total annual net outputs which are tabulated in Table 3.

**Table 3: Comparative Annual Output with Different ACC's**

| Cooling System | Wet Cooled | Dry Cooled | | |
|---|---|---|---|---|
| ITD | | 35 | 40 | 45 |
| Annual Output, MWh | 725,000 | 667,000 | 665,000 | 664,000 |
| % of Wet Cooled Plant | Base | 92. | 91.7 | 91.6 |
| Reduced Output | Base | 58,000 | 60,000 | 61,000 |

## EFFECT OF EXPANDED SOLAR FIELD

A suggested approach to compensating for the reduced cycle efficiency and plant output with dry cooling is to expand the solar field and some of the plant components to provide increased thermal input to the power block and increased steam flow to the turbine. The following considerations are relevant to making an appropriate comparison.

As noted previously, the existing (base) solar field in combination with a 40°F ITD ACC produces a gross plant output of 251.7 $MW_e$, a net plant output of 223.4 $MW_e$ at the design ambient temperature of 103.5°F. This corresponds to a gross cycle efficiency of 35.3% and a net plant efficiency of 31.3% implying a thermal input to the power block of 714. $MW_{th}$. This further implies a heat duty to the ACC of 462 $MW_{th}$ (1.58 x $10^9$ Btu/hr) which is less than the 1.78 x $10^9$ Btu per hour heat duty for which the 40°F ITD ACC was designed. Therefore the backpressure is well below the design value even at the design ambient temperature.

In comparison to the same solar field input to a thermal block equipped with the wet cooling system, the net output at design is reduced by 10.6% and the annual net output by 7.5%. However, these analyses are based on the performance of an ACC sized by the supplier for the full design heat duty of 1.78 x $10^9$ Btu/hr (See Table 1) or 520.6 $MW_{th}$ at a turbine backpressure of 6.44 in Hga at an ambient temperature of 103.5°F. A heat balance on the power block for this operating point requires a thermal input from the solar field of 800.6 $MW_{th}$ or a 12% increase over the base solar field input of 715. $MW_{th}$.

Figure 9 (attached) shows the hourly plant net output with a solar field expanded by 12% compared to the base case determined previously and plotted in Figure 6. It should be noted that for several conditions, the net output exceeds the net design output. This results from the fact that the annual profile used in Appendix G (1) and in this study, includes periods of high insolation coincident with ambient temperatures well below the design level of 103.5°F. The increased capacity is then available to provide added plant output throughout the year.

Figure 10 (attached) shows the net output of the expanded solar field with the dry-cooled plant compared to the base solar field with the wet-cooled plant originally plotted in Figure 6. It is seen that the dry cooled plant output exceeds the wet cooled plant output in this comparison for nearly the entire year. They would be equal at the design point, but the design condition is never reached in this annual profile.

The assumed field expansion used in the WorleyParsons (1) report was a solar field cost increase of 13% which agrees well with the calculated 12% increase in thermal input necessary to meet the design requirements. (Table 3 of Reference 1).

Table 4 summarizes the annual net energy production in MWh for the several cases discussed.

**Table 4: Comparison of Net Annual Outputs from Alternate Systems**

| System | Annual Net Output | Difference from Base, wet | % Difference |
|---|---|---|---|
| | MWH | MWh | % |
| Base field, wet cooled | 725,436 | 0 | 0.0% |
| Base field, dry cooled | 665,460 | -59,976 | -8.3% |
| 12% expanded, dry cooling | 755,512 | 30,076 | 4.1% |

## HYBRID COOLING

An alternative to either an all-wet or an all-dry cooling system is the hybrid system consisting of an air-cooled condenser operating in parallel with a conventional surface steam condenser paired with a wet cooling tower. The plant would operate using the dry portion alone for periods of low solar insolation or low ambient temperatures during which a sufficiently low turbine exhaust pressure can be maintained. At higher insolation levels or higher ambient temperatures, if the turbine exhaust pressure rises above desired levels, the wet system fans and circulating water pumps are turned on and a portion of the steam flow and heat duty diverts to the surface condenser. The system will equilibrate at a lower turbine exhaust pressure with the steam flow divided between the wet and dry portions of the cooling system in the proportion where both reach the same condensing pressure.

The design approach taken in the WorleyParsons report (1) was the following:

1. Three ACC's of different sizes were selected to carry the cooling loads consistent with plant net electrical outputs of 250, 200 and 150 MWe respectively while maintaining a turbine exhaust pressure of 2.97 in Hga at an ambient temperature of 71°F.

2. For each ACC, a wet cooling system was sized to have the cooling capability which, in conjunction with the corresponding ACC, would meet the plant cooling requirements consistent with a net electrical output of 250 MWe maintaining a turbine exhaust pressure of 5.1 in Hga at the design ambient conditions of an ambient temperature of 103.5°F and an ambient wet bulb temperature of 68°F.

The basis for the choice of the design criteria of backpressure and ambient conditions was not discussed in the report (1). However, based on the stated criteria, the operating points for the wet and dry portions and for the integrated hybrid cooling system are listed in Tables 5, 6 and 7.

**Table 5: ACC Design Specifications**

| Quantity | Case | | |
|---|---|---|---|
| | "250 MW" | "200 MW" | "150 MW" |
| Tamb, F | 71 | 71 | 71 |
| Steam flow, lb/hr | 1,672,843 | 1,272,761 | 1,084,459 |
| Steam enthalpy, Btu/lb | 1,010 | 1,010 | 1,010 |
| Condensate enthalpy, Btu/lb | 83 | 83 | 83 |
| Exhaust pressure, in Hga | 2.97 | 2.97 | 2.97 |
| Tcond, F | 114.70 | 114.70 | 114.70 |
| ITD, F | 43.70 | 43.70 | 43.70 |
| Heat duty, Btu/hr | 1.551E+09 | 1.180E+09 | 1.006E+09 |
| Q/ITD | 3.55E+07 | 2.70E+07 | 2.30E+07 |

**Table 6: Wet System Design Specifications**

| Quantity | Case | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| WBT, F | 68 | 68 | 68 |
| Water flow, gpm | 41,768 | 63,811 | 74,039 |
| HWT, F | 110 | 110 | 110 |
| CWT, F | 85 | 85 | 85 |
| TTD, F | 24.5 | 24.5 | 24.5 |
| Approach, F | 17 | 17 | 17 |
| Tcond, F | 134.5 | 134.5 | 134.5 |
| Exhaust pressure, in Hga | 5.10 | 5.10 | 5.10 |
| Heat duty, Btu/hr | 5.221E+08 | 7.976E+08 | 9.255E+08 |

**Table 7: Hybrid Cooling System Design Specifications**

| Quantity | Case | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Dry heat duty, Btu/hr | 1.134E+09 | 8.583E+08 | 7.304E+08 |
| Wet heat duty, Btu/hr | 5.221E+08 | 7.976E+08 | 9.255E+08 |
| Total, Btu/hr | 1.656E+09 | 1.656E+09 | 1.656E+09 |
| Qrej, MWth | 485.2 | 485.2 | 485.2 |
| Gross output, Mwe | 280.0 | 280.0 | 280.0 |
| Power block input, MWth | 765.2 | 765.2 | 765.2 |
| Implied efficiency | 36.59% | 36.59% | 36.59% |
| Net output, Mwe | 250 | 250 | 250 |
| Net efficiency | 32.67% | 32.67% | 32.67% |

The values for the hybrid system at design conditions can be used, as previously in the case of the all-dry system, to evaluate plant cycle efficiency. The total heat rejected is $1.656 \times 10^9$ Btu/hr (~MWh) for a gross electrical output of 280 MWe. This requires a thermal input to the power block of 765.2 MWth and implies a gross efficiency or 36.6% and a net efficiency of 32.7%. Two points are noteworthy:

1. The net efficiency compares well with that tabulated in Table 5 of the Worley Parsons report (1)

2. The thermal input for the solar field of 765.2 MWth (for Case 1) is approximately 7.2% greater than that from the base solar field at design conditions of 714. MWth. This corresponds well to the 7.6% increase in solar field cost indicated in Table 3 of the Worley Parsons report (1).

   The steam flow at design conditions for 280 MWe gross output is $1.78 \times 10^6$ lb/hr. The steam turbine to be used in conjunction with a hybrid cooling system will be similar in design and performance characteristics to the turbine used with dry cooling, since it must operate at elevated turbine exhaust pressures above 5. in Hga. Therefore, the turbine curves will be assumed to be the same as those of the turbine used in the dry cooling analysis. The cycle efficiency as a function of steam flow (expressed as a percentage of the design steam flow) and exhaust pressure will be the same as shown in Figures 3 and 4.

   The determination of the operating point and net power output for each of the 160 conditions used in Appendices G and H proceeds as follows:

   First, the turbine exhaust pressure achievable with the ACC alone is calculated using the same approach used in the previous section but using the ACC sized for the “250 MW” hybrid system. Since the operation of an ACC is controlled to maintain the condensing pressure at or above 2. in Hga, all conditions for which the ACC alone achieves a condensing pressure of 2. in Hga or lower, are “all dry” operating points with a condensing pressure of 2. in Hga. The cycle efficiency for these conditions is determined with the correlation shown in Figure 4 with the “% flow” calculated as the ratio of the actual thermal input to the design thermal input of 765.2 MWth. Of the 160 operating conditions, 67 result in all dry operation and are distributed throughout the year at times of low insolation and low ambient temperature. The points are plotted in Figure 11 (attached) as the thermal input to the power block vs. the ambient temperature for all points where the dry section alone achieves a condensing pressure of 2. in Hga or lower.. A rough boundary shows the combination of thermal input and ambient temperature below which no wet cooling is required to maintain 2 in Hga.

For the remaining points, some degree of wet cooling can be used to reduce the turbine exhaust pressure and increase the cycle efficiency. The split of the heat load between the dry and wet parts of the hybrid cooling system and the resulting turbine exhaust pressure, cycle efficiency and net plant output is determined through an iterative calculation as follows:

1. For a given condition, specified by the thermal input to the power block, the ambient temperature and the ambient wet bulb temperature and an <u>assumed</u> cycle efficiency,

the total heat load to the cooling system is determined. (The design value of the cycle efficiency is used as a starting point)

2. A split in the heat duty between the wet and dry sections is assumed. (The design value of the split is used as a starting point.)

3. A condensing pressure is then calculated for both the wet and dry sections individually.

   a. For the dry section…the ITD is determined assuming that Q/ITD is constant at the design value (See Table 5) for condensing pressures above 3.5 in Hga. For condensing pressures between 3.5 in Hga and 2. in Hga, a correction is applied to the Q/ITD. The ITD is calculated for the assumed heat duty and the condensing temperature is the sum of the ITD and the ambient temperature.

   b. For the wet section…the range, the TTD are scaled from the design values by the ratio of the heat duty to the design heat duty. The approach temperature is determined using the CTI Workbook (3) assuming tower and fill characteristics established using the design specifications. The condensing temperature is calculated from the sum of the wet bulb temperature, range, TTD and approach.

4. In general, the condensing pressures calculated for the two sections will differ. The split between the wet and dry heat duties is then adjusted until they are equal. This establishes the operating backpressure for the assumed total heat load. The calculated turbine exhaust pressure is used to calculate a new cycle efficiency.

5. The calculation is repeated using the new cycle efficiency and the iterations continued until the condensing pressure and the cycle efficiency converge, usually after two or three iterations.

If the resulting condensing pressure is 2. in Hga or lower, it is assumed that the wet cooling tower capability will be reduced by shutting off fans or reducing the circulating water flow until the pressure is raised to 2. in Hga for proper operation of the dry section ACC. The same adjustment could be made by modulating the dry portion but, in the interest of water conservation, the ACC will be maintained at full capability whenever possible. For these points, the condensing pressure is assumed to be 2. in Hga and the cycle efficiency is calculated on that basis using the correlation from Figure 4.

For all other points, the calculation proceeds to establish a balanced operating point where the condensing pressures in both the wet and dry sections are the same at which the cycle efficiency and net plant output are determined.

## CONCLUSION AND SUMMARY OF COMPARISONS

Figure 12 (attached) shows the comparison of the plant output profiles for the wet cooled plant and the hybrid cooled plant with an expanded solar field. Table 5 summarizes the annual output for all systems analyzed including the hybrid system. The 0.4% output shortfall compared to the wet system is within the level of precision possible with the information available to this study and the performance of the two systems is essentially identical.

**Table 5: Comparison of Annual Net Output from Plant with Alternative Cooling Systems**

| System | Annual Net Output | Difference from Base, wet | % Difference |
|---|---|---|---|
| | MWH | MWh | % |
| Base field, wet cooled | 725,436 | 0 | 0.0% |
| Base field, dry cooled | 665,460 | -59,976 | -8.3% |
| 12% expanded, dry cooling | 755,512 | 30,076 | 4.1% |
| 7% expanded, hybrid cooling | 722,000 | -3,000 | -0.4% |

## APPENDIX B, REFERENCES

FPLE – Beacon Solar Energy Project: Dry Cooling Evaluation, Prepared by WorleyParsons Group, Inc., Report No. FPLS-0-LI-450-0001 Rev B, February, 1, 2008.

Personal communication, J. Foster, July, 2009

CTI ToolKit, Cooling Technology Institute,

# CONFIDENTIAL APPENDIX C

1. Revenue Model for Dry Cooling
   **(Intentionally Omitted)**

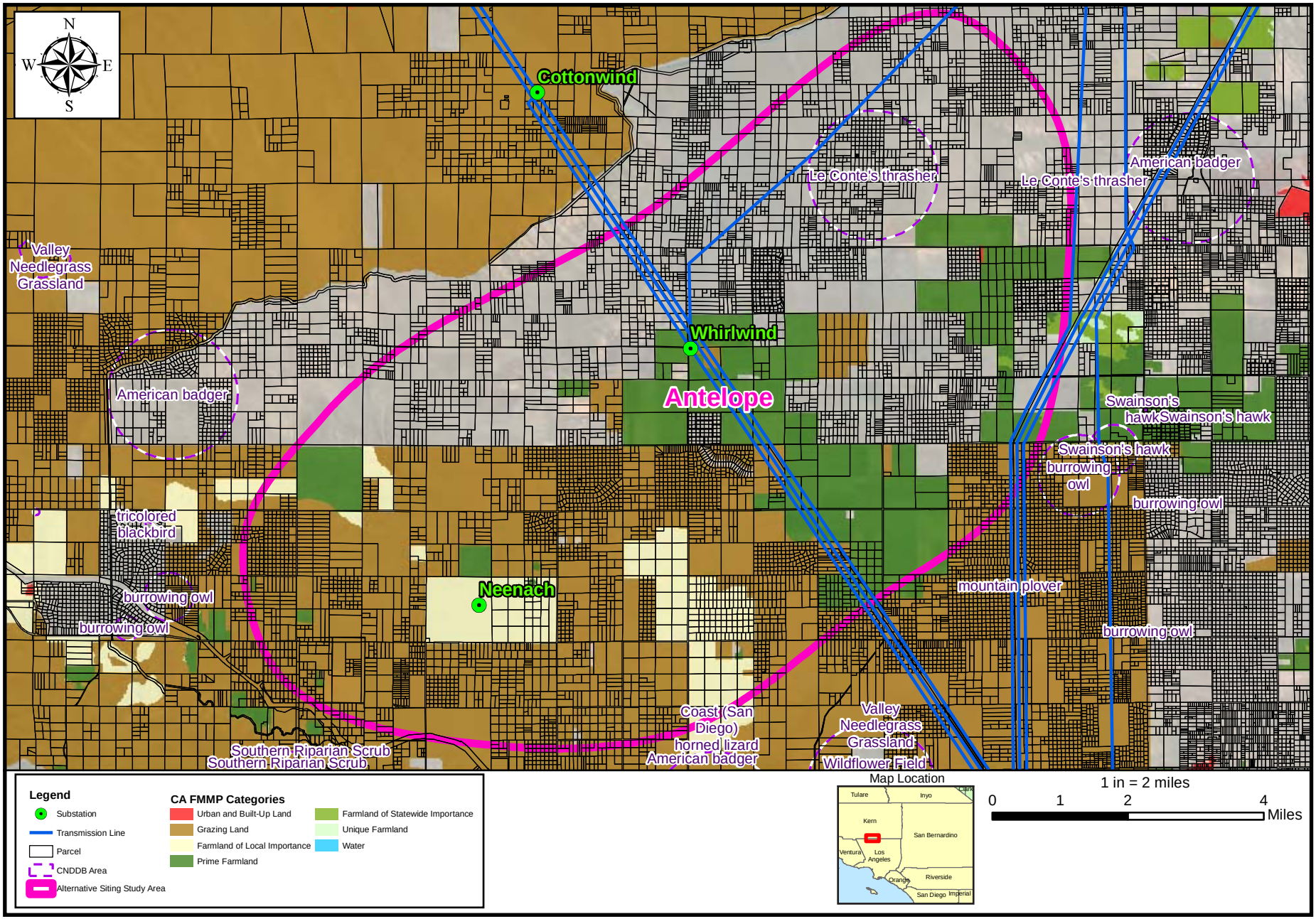
2. Revenue Model for Rosamond Community Services District Alternative
   **(Intentionally Omitted)**

3. Revenue Model for California City Alternative
   **(Intentionally Omitted)**

4. Confidential Appendix C, Figure 1 – Revenue and Internal Rate of Return (IRR) Summary Chart
   **(Intentionally Omitted)**

# ALTERNATIVES - FIGURE 1

Beacon Solar Energy Project - Antelope Site Alternative



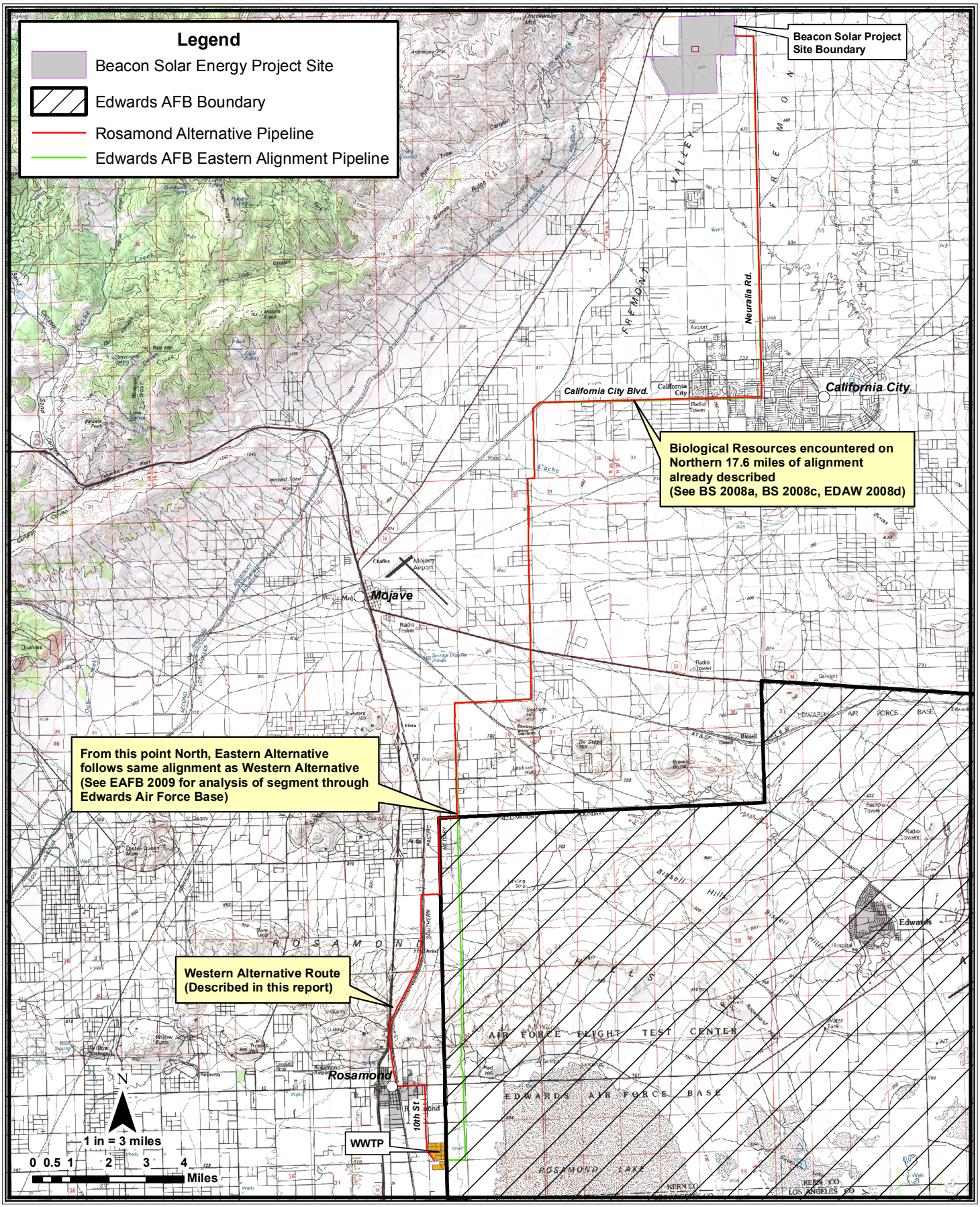





SOURCE: Pg. 6 of NER 2009a

**ALTERNATIVES - FIGURE 2**

Beacon Solar Energy Project - Vicinity Map

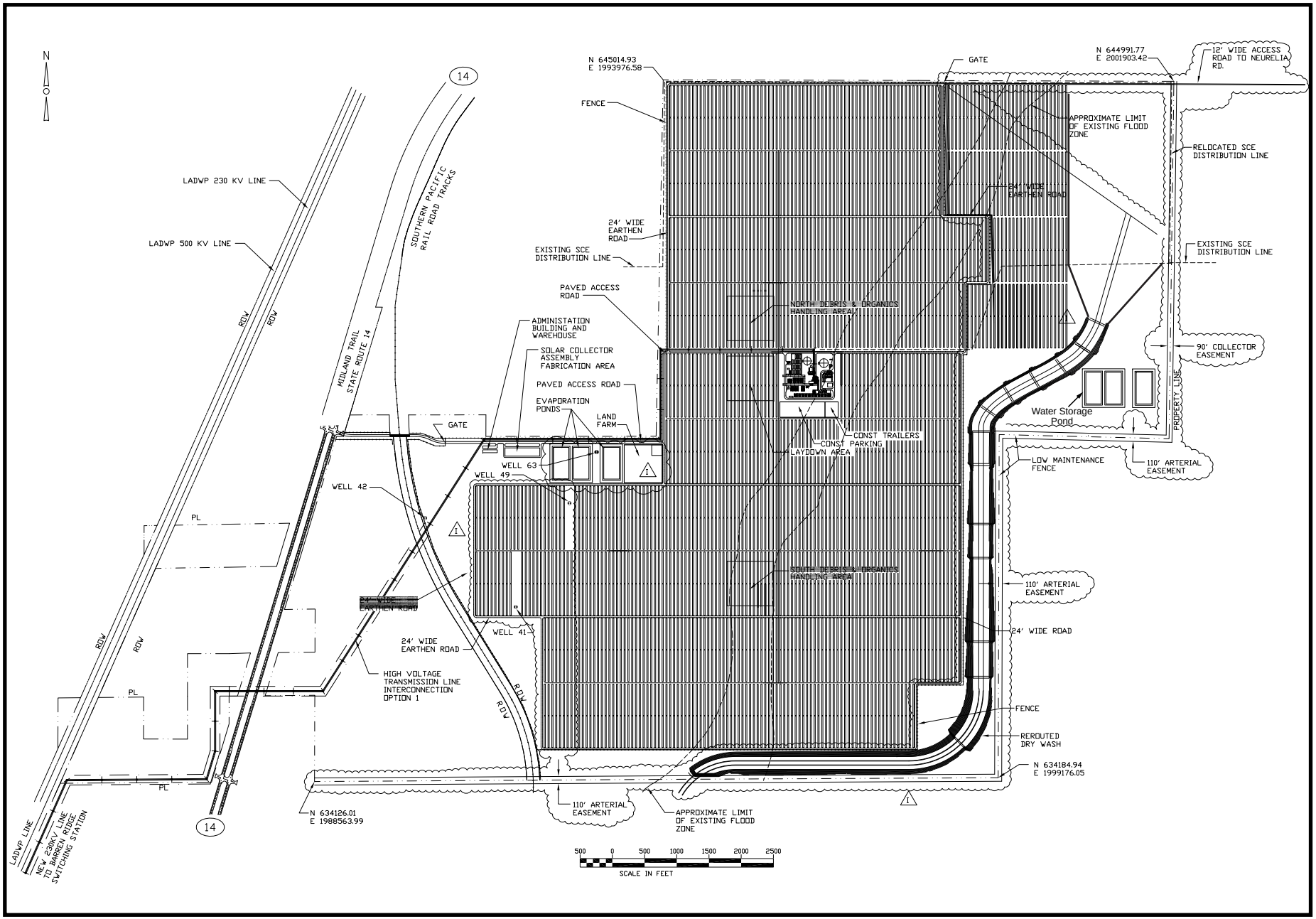



**CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009**

SOURCE: California Energy Commission - TOPO Map - 7. 5 minute USGS quadrangles: Rosamond, Soledad Mtn, Bissell, Sanborn and Mohave NE

**ALTERNATIVES - FIGURE 3**

Beacon Solar Energy Project - General Arrangement Site Plan as Modified by CEC Staff



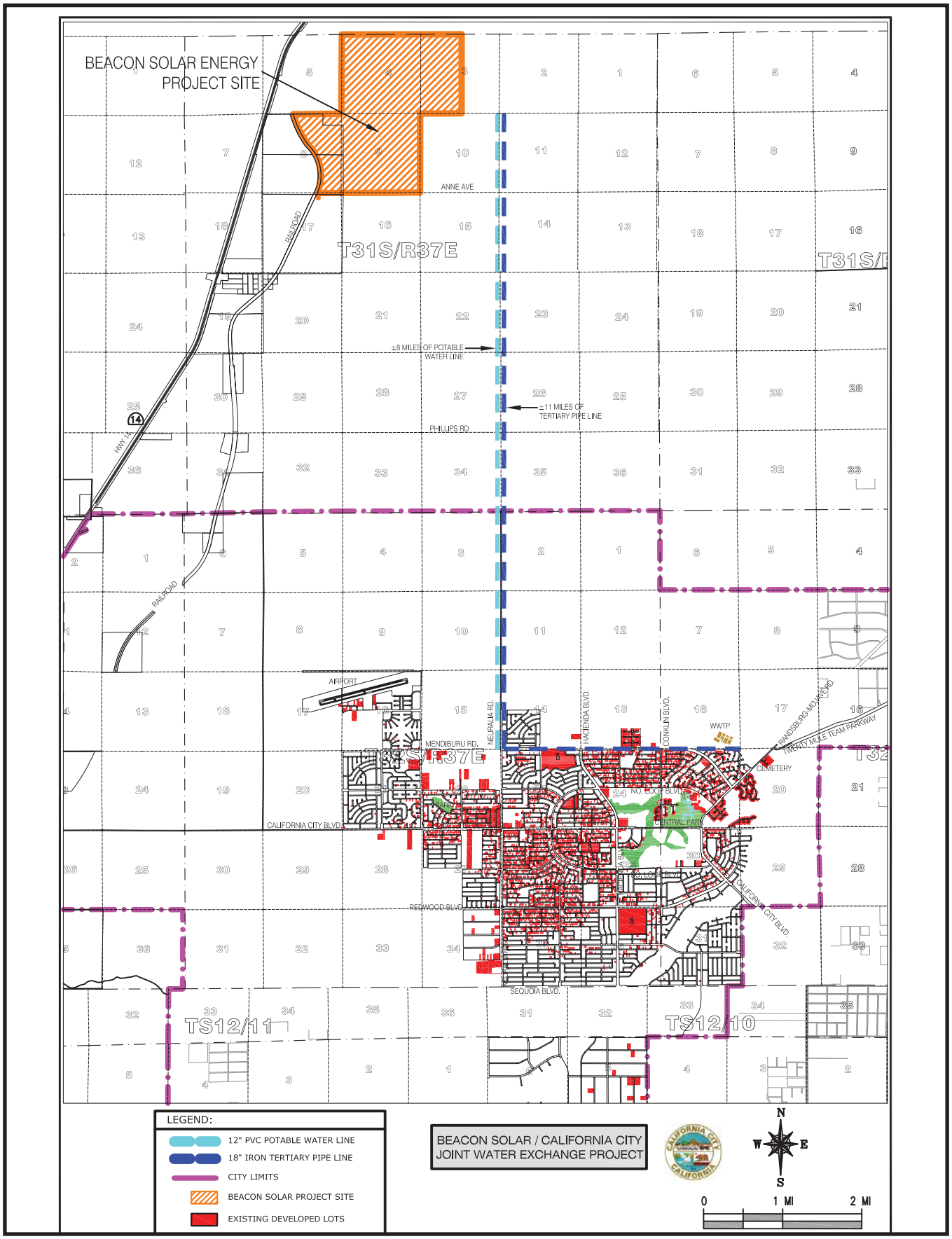



**CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009**

SOURCE: Staff has modified Applicant's Site Plan submitted in 2009 Applicant Project Design Refinements

**ALTERNATIVES - FIGURE 4**

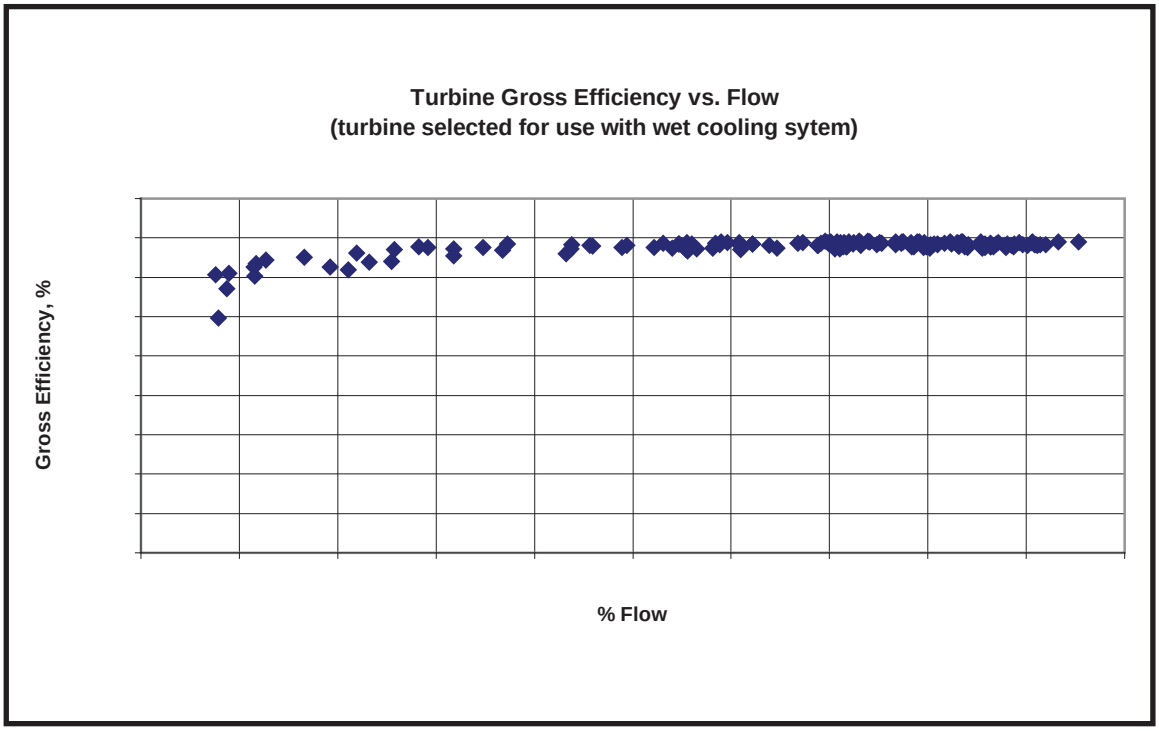
Beacon Solar Energy Project - California City Alternative



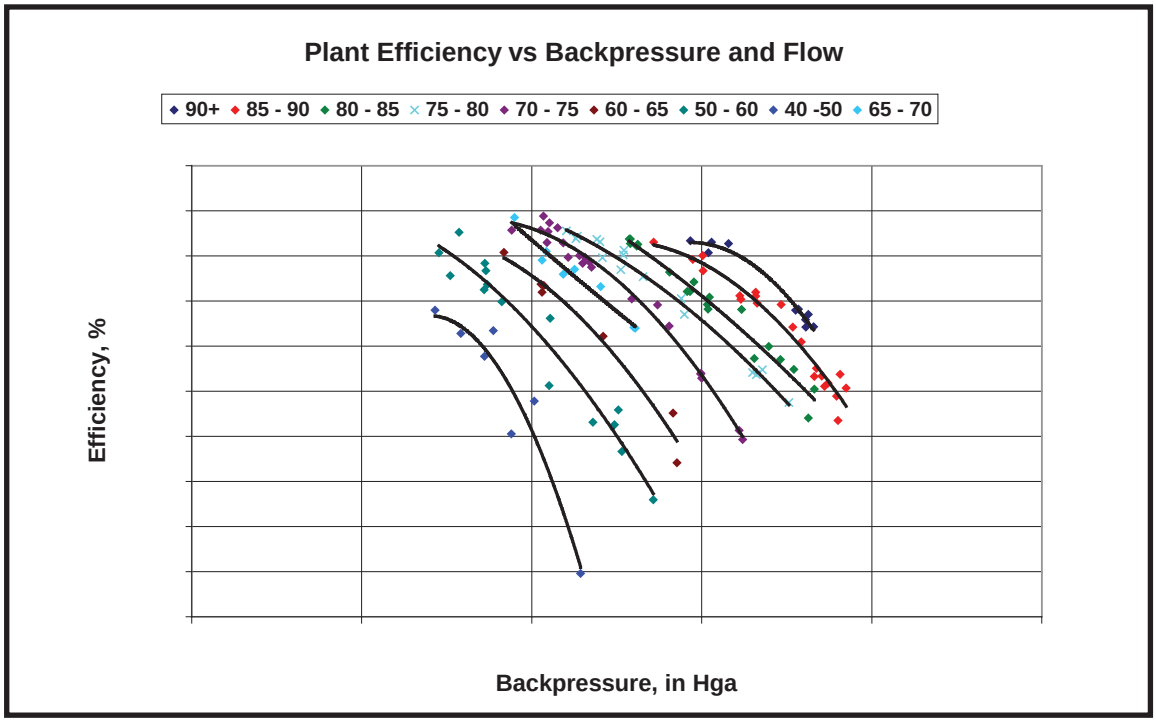

**CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009**

SOURCE: City of California City, Public Works Department

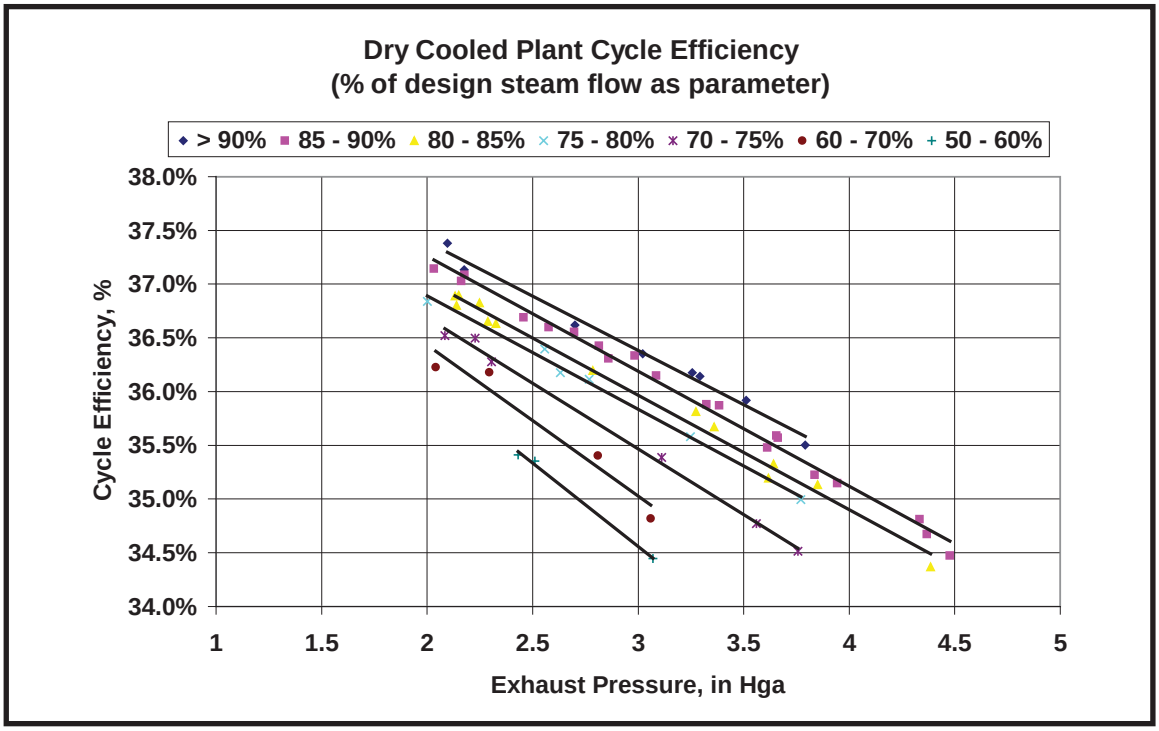
Variations in Gross Cycle Efficiency vs. Steam Flow (wet cooled turbine)



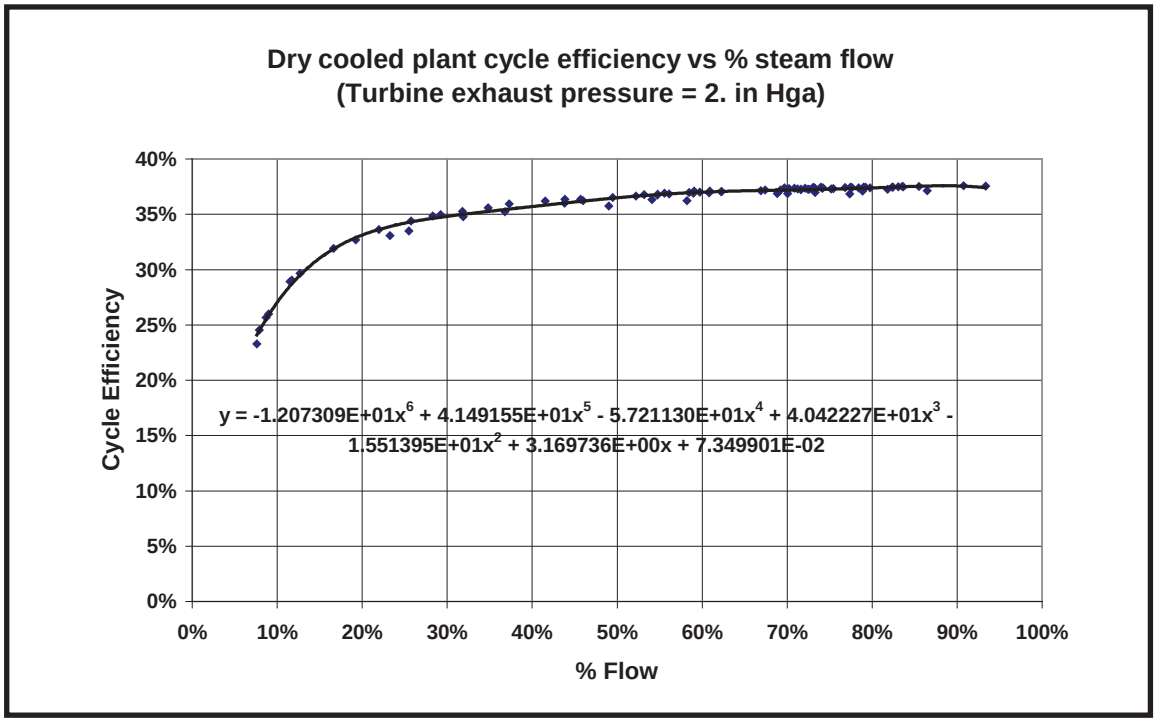

Variations in Gross Cycle Efficiency vs. Turbine Exhaust Pressure
(for different steam flow rates)



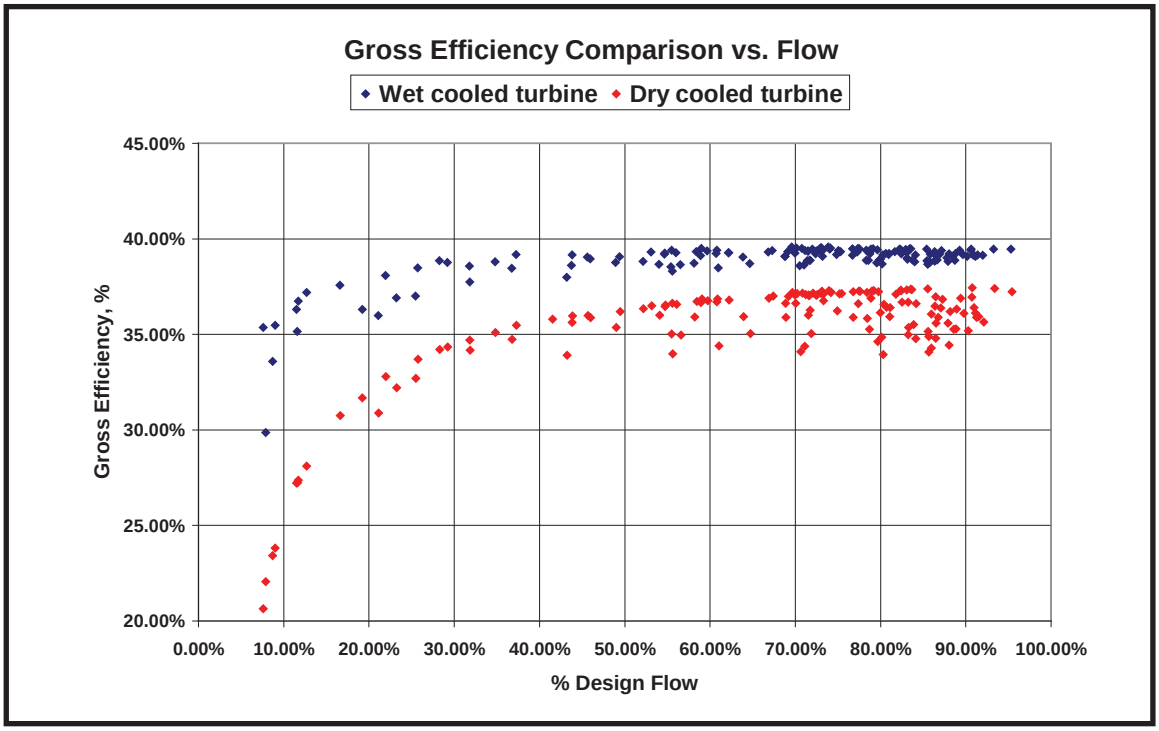
Dry Cooling Turbine Efficiency vs. Backpressure (flow as parameter)



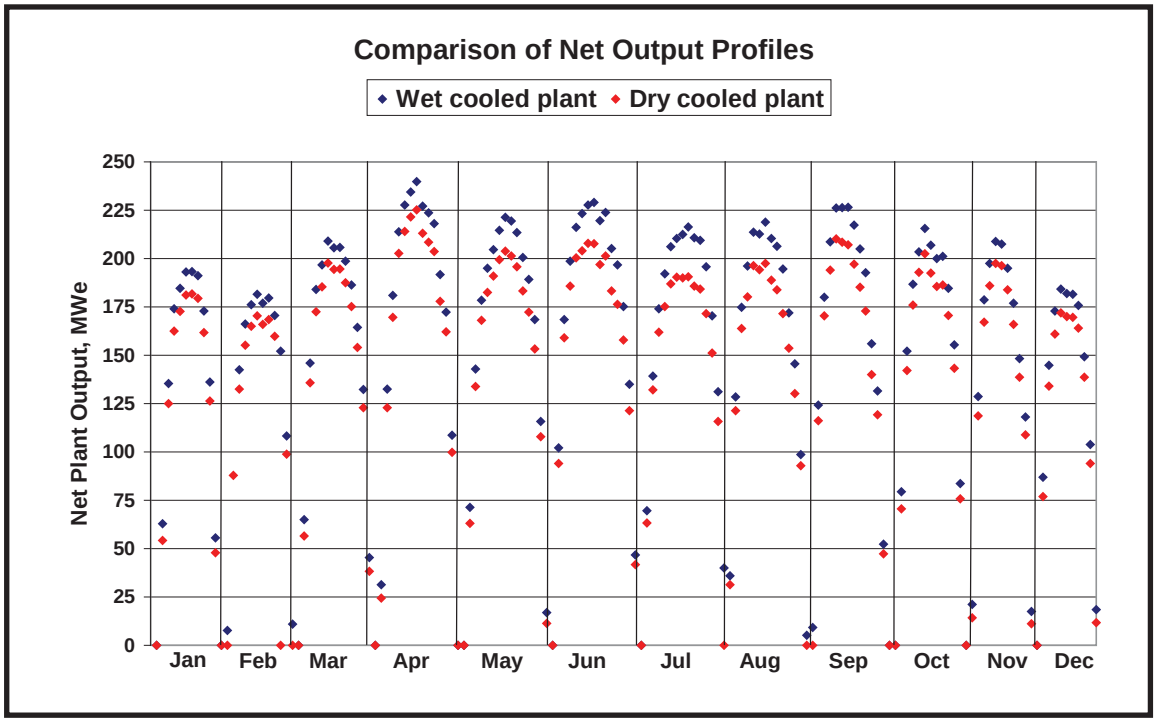

Dry Cooling Turbine Efficiency vs. Steam Flow (Backpressure of 2. in Hga)



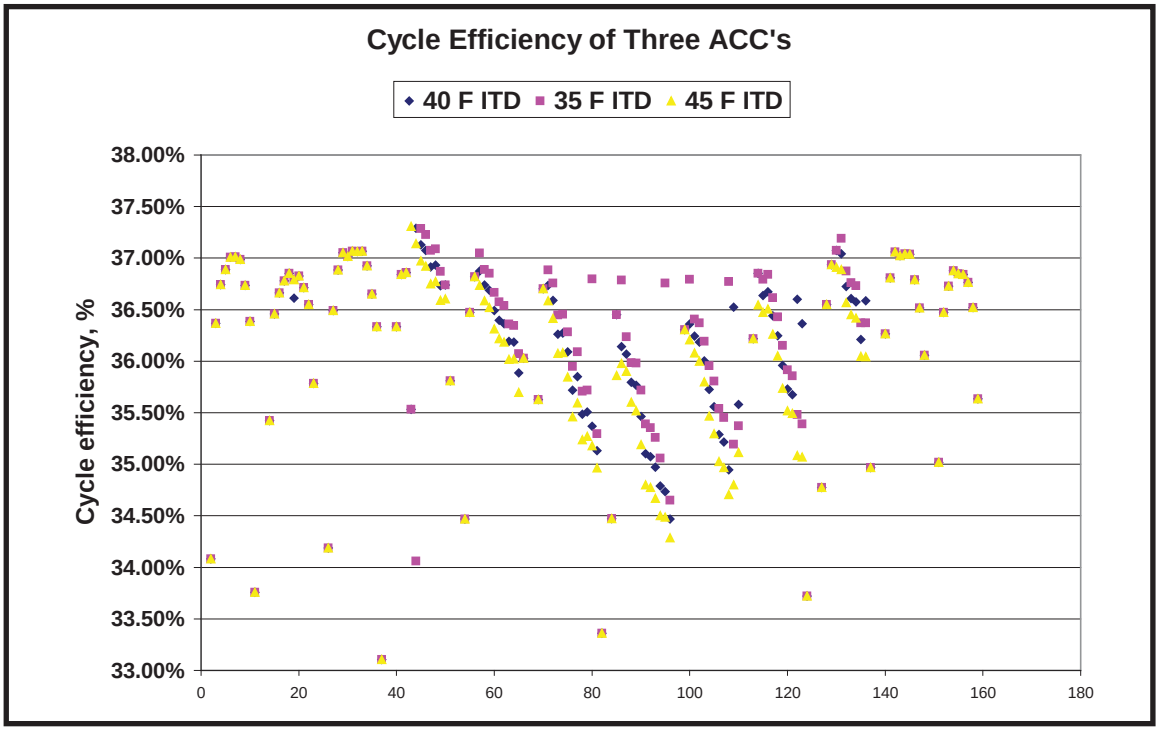
Cycle Efficiency Comparison of Wet and Dry Cooled Plants



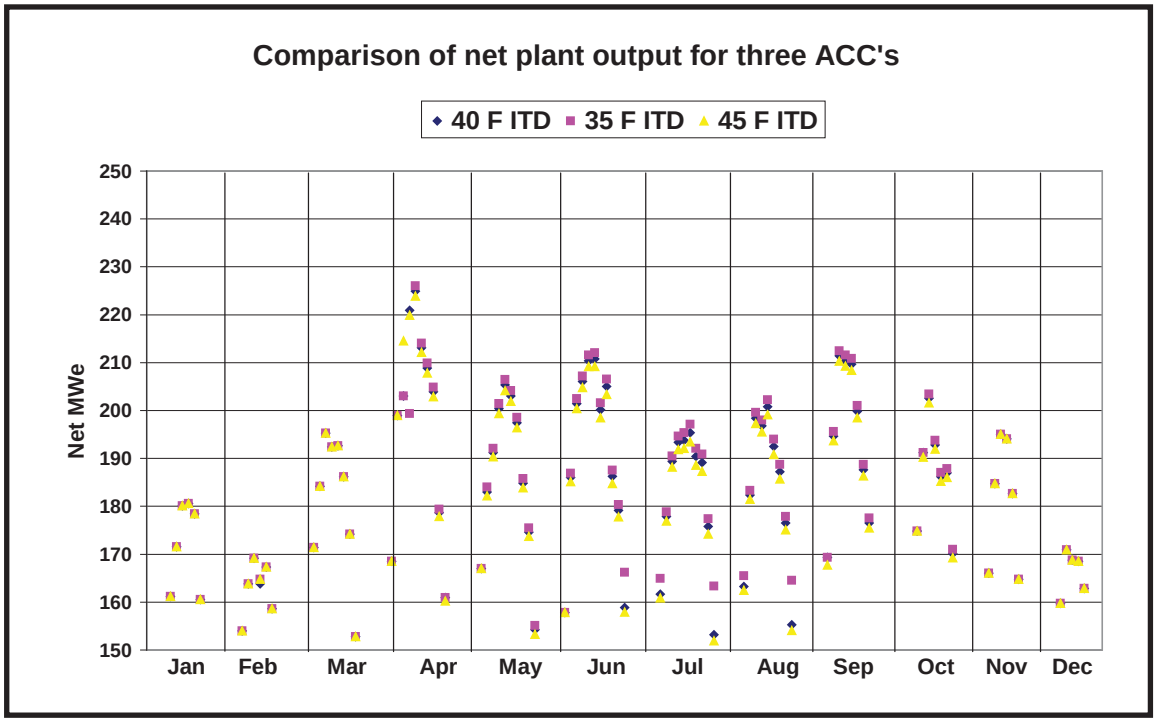

Net Output Comparison of Wet and Dry Cooled Plants



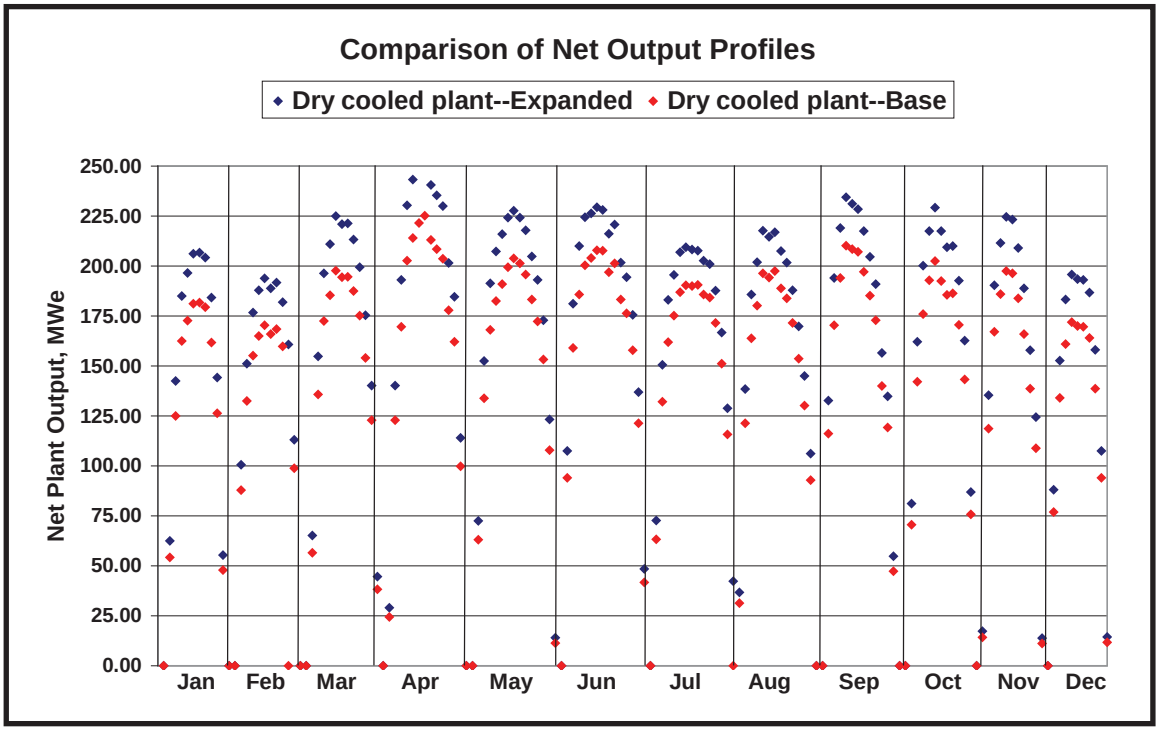
Comparison of Cycle Efficiencies for Three ACC's



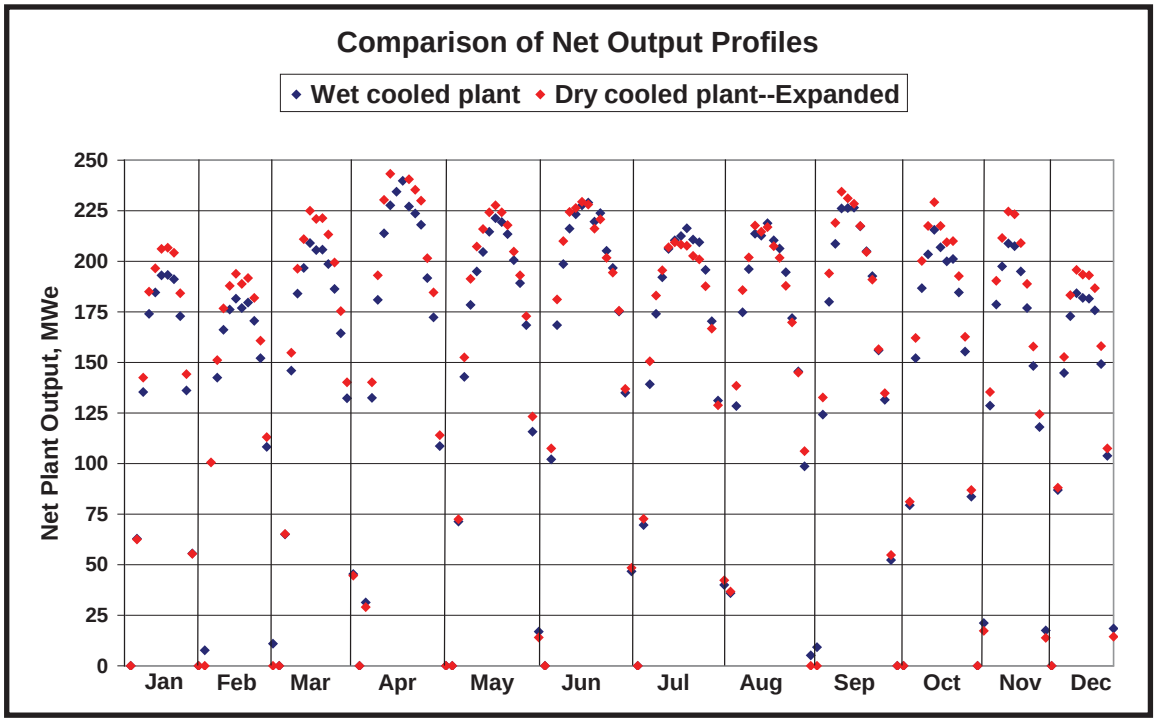

Comparison of Plant Net Output Profiles for Three ACC's



Expanded Field Performance

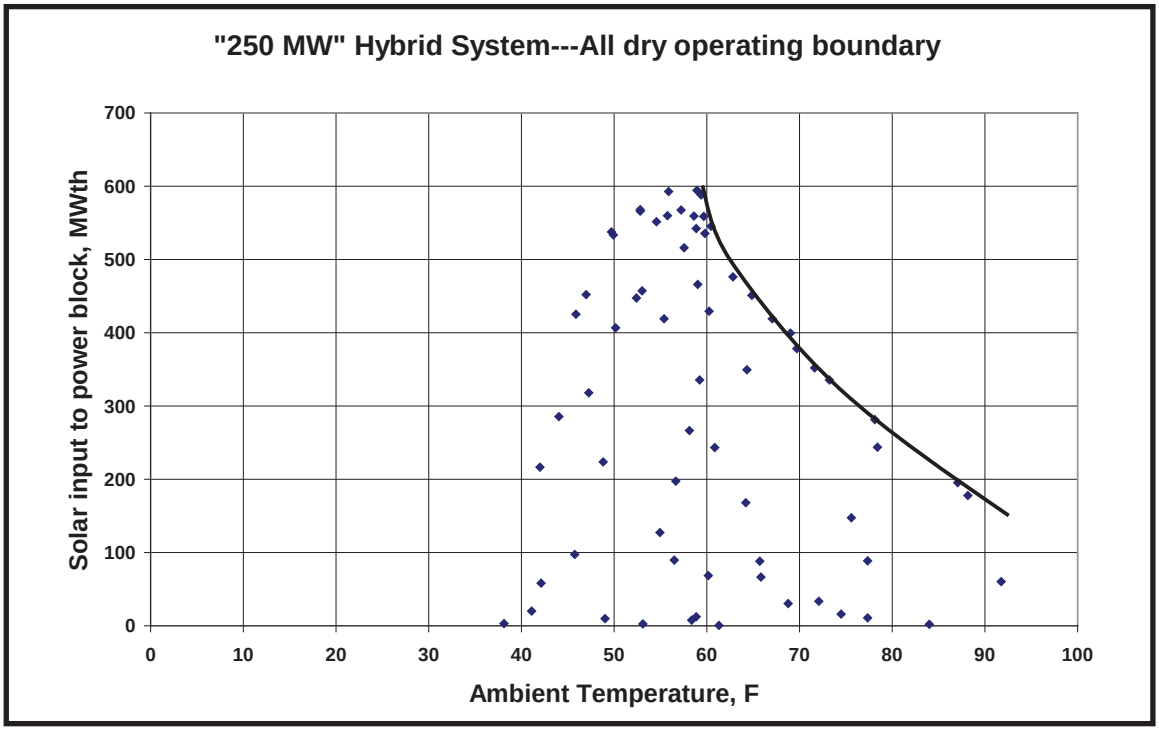



Expanded Field Performance (12% Expansion)

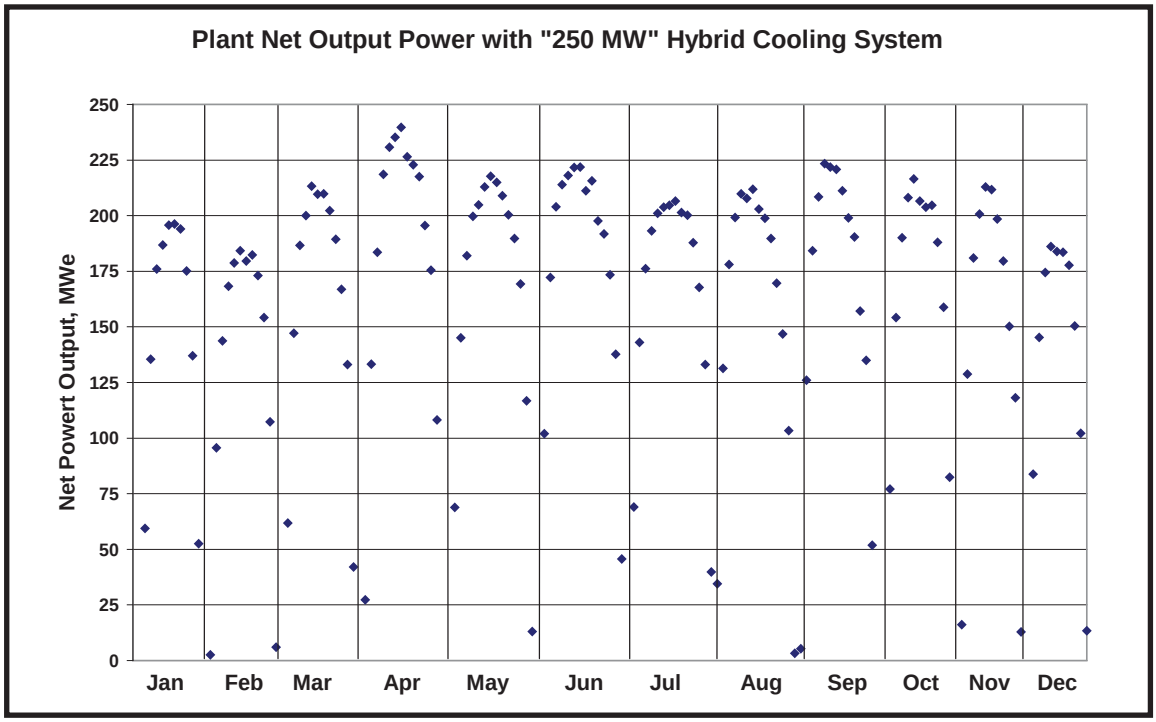



**CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMETAL PROTECTION DIVISION, SEPTEMBER 2009**
SOURCE: APPENDIX B Maulbetsch 8-30-09

"All Dry" Operation Conditions With Boundary

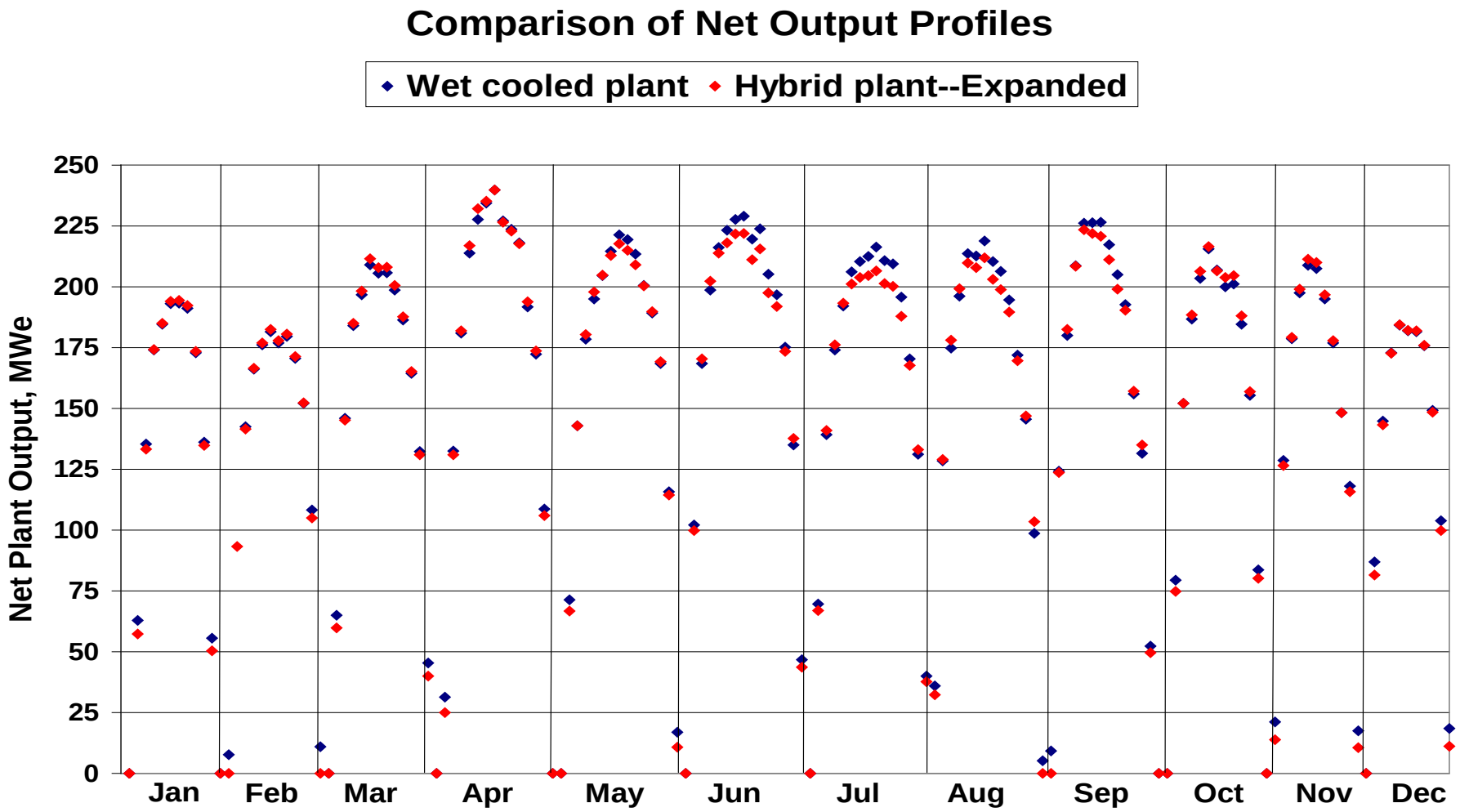



Annual Operating Profile for Plant with "250 MW" Hybrid System



**APPENDIX B - FIGURE 13**

Beacon Solar Energy Project - Comparison of Output Profiles Wet vs. Hybrid








SOURCE: APPENDIX B Maulbetsch 8-30-09

# GENERAL CONDITIONS
# INCLUDING
# COMPLIANCE MONITORING AND CLOSURE PLAN

Testimony of Steve Munro

## INTRODUCTION

The project's General Compliance Conditions of Certification, including Compliance Monitoring and Closure Plan (Compliance Plan) have been established as required by Public Resources Code section 25532. The plan provides a means for assuring that the facility is constructed, operated and closed in compliance with public health and safety, environmental and other applicable regulations, guidelines, and conditions adopted or established by the California Energy Commission and specified in the written decision on the Application for Certification or otherwise required by law.

The Compliance Plan is composed of elements that:

- set forth the duties and responsibilities of the Compliance Project Manager (CPM), the project owner, delegate agencies, and others;
- set forth the requirements for handling confidential records and maintaining the compliance record;
- state procedures for settling disputes and making post-certification changes;
- state the requirements for periodic compliance reports and other administrative procedures that are necessary to verify the compliance status for all Energy Commission approved conditions of certification;
- establish requirements for facility closure plans; and
- specify conditions of certification for each technical area containing the measures required to mitigate any and all potential adverse project impacts associated with construction, operation and closure below a level of significance. Each specific condition of certification also includes a verification provision that describes the method of assuring that the condition has been satisfied.

## DEFINITIONS

The following terms and definitions are used to establish when Conditions of Certification are implemented.

## PRE-CONSTRUCTION SITE MOBILIZATION

Site mobilization is limited preconstruction activities at the site to allow for the installation of fencing, construction trailers, construction trailer utilities, and construction trailer parking at the site. Limited ground disturbance, grading, and trenching associated with the above mentioned pre-construction activities is considered part of site mobilization. Walking, driving or parking a passenger vehicle, pickup truck and light vehicles is allowable during site mobilization.

## CONSTRUCTION

Onsite work to install permanent equipment or structures for any facility.

### Ground Disturbance

Construction-related ground disturbance refers to activities that result in the removal of top soil or vegetation at the site beyond site mobilization needs, and for access roads and linear facilities.

### Grading, Boring, and Trenching

Construction-related grading, boring, and trenching refers to activities that result in subsurface soil work at the site and for access roads and linear facilities, e.g., alteration of the topographical features such as leveling, removal of hills or high spots, moving of soil from one area to another, and removal of soil.

Notwithstanding the definitions of ground disturbance, grading, boring and trenching above, construction does **not** include the following:

1. the installation of environmental monitoring equipment;
2. a soil or geological investigation;
3. a topographical survey;
4. any other study or investigation to determine the environmental acceptability or feasibility of the use of the site for any particular facility; and
5. any work to provide access to the site for any of the purposes specified in "Construction" 1, 2, 3, or 4 above.

## START OF COMMERCIAL OPERATION

For compliance monitoring purposes, "commercial operation" begins after the completion of start-up and commissioning, when the power plant has reached reliable steady-state production of electricity at the rated capacity. At the start of commercial operation, plant control is usually transferred from the construction manager to the plant operations manager.

## COMPLIANCE PROJECT MANAGER RESPONSIBILITIES

The Compliance Project Manager (CPM) shall oversee the compliance monitoring and is responsible for:

1. Ensuring that the design, construction, operation, and closure of the project facilities are in compliance with the terms and conditions of the Energy Commission Decision
2. Resolving complaints
3. Processing post-certification changes to the conditions of certification, project description (petition to amend), and ownership or operational control (petition for change of ownership) (See instructions for filing petitions)

4. Documenting and tracking compliance filings

5. Ensuring that compliance files are maintained and accessible

The CPM is the contact person for the Energy Commission and will consult with appropriate responsible agencies, Energy Commission, and staff when handling disputes, complaints, and amendments.

All project compliance submittals are submitted to the CPM for processing. Where a submittal required by a condition of certification requires CPM approval, the approval will involve all appropriate Energy Commission staff and management. All submittals must include searchable electronic versions (pdf or word files).

## PRE-CONSTRUCTION AND PRE-OPERATION COMPLIANCE MEETING

The CPM usually schedules pre-construction and pre-operation compliance meetings prior to the projected start-dates of construction, plant operation, or both. The purpose of these meetings is to assemble both the Energy Commission's and project owner's technical staff to review the status of all pre-construction or pre-operation requirements, contained in the Energy Commission's conditions of certification. This is to confirm that all applicable conditions of certification have been met, or if they have not been met, to ensure that the proper action is taken. In addition, these meetings ensure, to the extent possible, that Energy Commission conditions will not delay the construction and operation of the plant due to oversight and to preclude any last minute, unforeseen issues from arising. Pre-construction meetings held during the certification process must be publicly noticed unless they are confined to administrative issues and processes.

## ENERGY COMMISSION RECORD

The Energy Commission shall maintain the following documents and information as a public record, in either the Compliance file or Dockets file, for the life of the project (or other period as required):

- All documents demonstrating compliance with any legal requirements relating to the construction and operation of the facility;
- All monthly and annual compliance reports filed by the project owner;
- All complaints of noncompliance filed with the Energy Commission; and
- All petitions for project or condition of certification changes and the resulting staff or Energy Commission action.

## PROJECT OWNER RESPONSIBILITIES

The project owner is responsible for ensuring that the compliance conditions of certification and all other conditions of certification that appear in the Commission Decision are satisfied. The compliance conditions regarding post-certification changes specify measures that the project owner must take when requesting changes in the project design, conditions of certification, or ownership. Failure to comply with any of the conditions of certification or the compliance conditions may result in reopening of the

case and revocation of Energy Commission certification; an administrative fine; or other action as appropriate. A summary of the Compliance Conditions of Certification is included as **Compliance Table 1** at the conclusion of this section.

## COMPLIANCE CONDITIONS OF CERTIFICATION

### Unrestricted Access (COMPLIANCE-1)

The CPM, responsible Energy Commission staff, and delegated agencies or consultants shall be guaranteed and granted unrestricted access to the power plant site, related facilities, project-related staff, and the records maintained on-site, for the purpose of conducting audits, surveys, inspections, or general site visits. Although the CPM will normally schedule site visits on dates and times agreeable to the project owner, the CPM reserves the right to make unannounced visits at any time.

### Compliance Record (COMPLIANCE-2)

The project owner shall maintain project files on-site or at an alternative site approved by the CPM for the life of the project, unless a lesser period of time is specified by the conditions of certification. The files shall contain copies of all “as-built” drawings, documents submitted as verification for conditions, and other project-related documents.

Energy Commission staff and delegate agencies shall, upon request to the project owner, be given unrestricted access to the files maintained pursuant to this condition.

### Compliance Verification Submittals (COMPLIANCE-3)

Each condition of certification is followed by a means of verification. The verification describes the Energy Commission’s procedure(s) to ensure post-certification compliance with adopted conditions. The verification procedures, unlike the conditions, may be modified as necessary by the CPM.

Verification of compliance with the conditions of certification can be accomplished by the following:

1. Monthly and/or annual compliance reports, filed by the project owner or authorized agent, reporting on work done and providing pertinent documentation, as required by the specific conditions of certification;

2. Appropriate letters from delegate agencies verifying compliance;

3. Energy Commission staff audits of project records; and/or

4. Energy Commission staff inspections of work, or other evidence that the requirements are satisfied.

Verification lead times associated with start of construction may require the project owner to file submittals during the certification process, particularly if construction is planned to commence shortly after certification.

A cover letter from the project owner or authorized agent is required for all compliance submittals and correspondence pertaining to compliance matters. **The cover letter subject line shall identify the project by AFC number, the appropriate condition(s) of certification by condition number(s), and a brief description of the subject of the submittal**. The project owner shall also identify those submittals **not** required by a condition of certification with a statement such as: "This submittal is for information only and is not required by a specific condition of certification." When submitting supplementary or corrected information, the project owner shall reference the date of the previous submittal and CEC submittal number.

The project owner is responsible for the delivery and content of all verification submittals to the CPM, whether such condition was satisfied by work performed by the project owner or an agent of the project owner.

All hardcopy submittals shall be addressed as follows:

**Compliance Project Manager**
**(08-AFC-2C)**
**California Energy Commission**
**1516 Ninth Street (MS-2000)**
**Sacramento, CA 95814**

Those submittals shall be accompanied by a searchable electronic copy, on a CD or by e-mail, as agreed upon by the CPM.

If the project owner desires Energy Commission staff action by a specific date, that request shall be made in the submittal cover letter and shall include a detailed explanation of the effects on the project if that date is not met.

## Pre-Construction Matrix and Tasks Prior to Start of Construction (COMPLIANCE-4)

Prior to commencing construction, a compliance matrix addressing only those conditions that must be fulfilled before the start of construction shall be submitted by the project owner to the CPM. This matrix will be included with the project owner's first compliance submittal or prior to the first pre-construction meeting, whichever comes first. It will be submitted in the same format as the compliance matrix described below.

Construction shall not commence until the pre-construction matrix is submitted, all pre-construction conditions have been complied with, and the CPM has issued a letter to the project owner authorizing construction. Various lead times for submittal of compliance verification documents to the CPM for conditions of certification are established to allow sufficient staff time to review and comment and, if necessary, allow the project owner to revise the submittal in a timely manner. This will ensure that project construction may proceed according to schedule.

Failure to submit compliance documents within the specified lead-time may result in delays in authorization to commence various stages of project development.

If the project owner anticipates commencing project construction as soon as the project is certified, it may be necessary for the project owner to file compliance submittals prior

to project certification. Compliance submittals should be completed in advance where the necessary lead time for a required compliance event extends beyond the date anticipated for start of construction. The project owner must understand that the submittal of compliance documents prior to project certification is at the owner's own risk. Any approval by Energy Commission staff is subject to change, based upon the Commission Decision.

## Compliance Reporting

There are two different compliance reports that the project owner must submit to assist the CPM in tracking activities and monitoring compliance with the terms and conditions of the Energy Commission Decision. During construction, the project owner or authorized agent will submit Monthly Compliance Reports. During operation, an Annual Compliance Report must be submitted. These reports, and the requirement for an accompanying compliance matrix, are described below. The majority of the conditions of certification require that compliance submittals be submitted to the CPM in the monthly or annual compliance reports.

## Compliance Matrix (COMPLIANCE-5)

A compliance matrix shall be submitted by the project owner to the CPM along with each monthly and annual compliance report. The compliance matrix is intended to provide the CPM with the current status of all conditions of certification in a spreadsheet format. The compliance matrix must identify:

1. the technical area;
2. the condition number;
3. a brief description of the verification action or submittal required by the condition;
4. the date the submittal is required (e.g., 60 days prior to construction, after final inspection, etc.);
5. the expected or actual submittal date;
6. the date a submittal or action was approved by the Chief Building Official (CBO), CPM, or delegate agency, if applicable; and
7. the compliance status of each condition, e.g., "not started," "in progress" or "completed" (include the date).
8. if the condition was amended, the date of the amendment.

Satisfied conditions shall be placed at the end of the matrix.

## Monthly Compliance Report (COMPLIANCE-6)

The first Monthly Compliance Report is due one month following the Energy Commission business meeting date upon which the project was approved, unless otherwise agreed to by the CPM. The first Monthly Compliance Report shall include the

AFC number and an initial list of dates for each of the events identified on the **Key Events List. The Key Events List Form is found at the end of this section.**

During pre-construction and construction of the project, the project owner or authorized agent shall submit an original and an electronic searchable version of the Monthly Compliance Report within 10 working days after the end of each reporting month. Monthly Compliance Reports shall be clearly identified for the month being reported. The reports shall contain, at a minimum:

1. A summary of the current project construction status, a revised/updated schedule if there are significant delays, and an explanation of any significant changes to the schedule;

2. Documents required by specific conditions to be submitted along with the Monthly Compliance Report. Each of these items must be identified in the transmittal letter, as well as the conditions they satisfy and submitted as attachments to the Monthly Compliance Report;

3. An initial, and thereafter updated, compliance matrix showing the status of all conditions of certification (fully satisfied conditions do not need to be included in the matrix after they have been reported as completed);

4. A list of conditions that have been satisfied during the reporting period, and a description or reference to the actions that satisfied the condition;

5. A list of any submittal deadlines that were missed, accompanied by an explanation and an estimate of when the information will be provided;

6. A cumulative listing of any approved changes to conditions of certification;

7. A listing of any filings submitted to, or permits issued by, other governmental agencies during the month;

8. A projection of project compliance activities scheduled during the next two months. The project owner shall notify the CPM as soon as any changes are made to the project construction schedule that would affect compliance with conditions of certification;

9. A listing of the month's additions to the on-site compliance file; and

10. A listing of complaints, notices of violation, official warnings, and citations received during the month, a description of the resolution of the resolved actions, and the status of any unresolved actions.

All sections, exhibits, or addendums shall be separated by tabbed dividers or as acceptable by the CPM.

## Annual Compliance Report (COMPLIANCE-7)

After construction is complete, the project owner shall submit Annual Compliance Reports instead of Monthly Compliance Reports. The reports are for each year of

commercial operation and are due to the CPM each year at a date agreed to by the CPM. Annual Compliance Reports shall be submitted over the life of the project unless otherwise specified by the CPM. Each Annual Compliance Report shall include the AFC number, identify the reporting period and shall contain the following:

1. An updated compliance matrix showing the status of all conditions of certification (fully satisfied conditions do not need to be included in the matrix after they have been reported as completed);

2. A summary of the current project operating status and an explanation of any significant changes to facility operations during the year;

3. Documents required by specific conditions to be submitted along with the Annual Compliance Report. Each of these items must be identified in the transmittal letter, with the condition it satisfies, and submitted as attachments to the Annual Compliance Report;

4. A cumulative listing of all post-certification changes approved by the Energy Commission or cleared by the CPM;

5. An explanation for any submittal deadlines that were missed, accompanied by an estimate of when the information will be provided;

6. A listing of filings submitted to, or permits issued by, other governmental agencies during the year;

7. A projection of project compliance activities scheduled during the next year;

8. A listing of the year's additions to the on-site compliance file;

9. An evaluation of the on-site contingency plan for unplanned facility closure, including any suggestions necessary for bringing the plan up to date [see Compliance Conditions for Facility Closure addressed later in this section]; and

10. A listing of complaints, notices of violation, official warnings, and citations received during the year, a description of the resolution of any resolved matters, and the status of any unresolved matters.

## Confidential Information (COMPLIANCE-8)

Any information that the project owner deems confidential shall be submitted to the Energy Commission's Dockets Unit with an application for confidentiality pursuant to Title 20, California Code of Regulations, section 2505(a). Any information that is determined to be confidential shall be kept confidential as provided for in Title 20, California Code of Regulations, section 2501 et. seq.

## Annual Energy Facility Compliance Fee (COMPLIANCE-9)

Pursuant to the provisions of Section 25806(b) of the Public Resources Code, the project owner is required to pay an annual compliance fee, which is adjusted annually. The amount of the fee for FY2007-2008 was $17,676. The initial payment is due on the date the Energy Commission adopts the final decision. You will be notified of the

amount due. All subsequent payments are due by July 1 of each year in which the facility retains its certification. The payment instrument shall be made payable to the California Energy Commission and mailed to: Accounting Office MS-02, California Energy Commission, 1516 9th St., Sacramento, CA 95814.

## Reporting of Complaints, Notices, and Citations (COMPLIANCE-10)

Prior to the start of construction, the project owner must send a letter to property owners living within one mile of the project notifying them of a telephone number to contact project representatives with questions, complaints or concerns. If the telephone is not staffed 24 hours per day, it shall include automatic answering with date and time stamp recording. All recorded complaints shall be responded to within 24 hours. The telephone number shall be posted at the project site and made easily visible to passersby during construction and operation. The telephone number shall be provided to the CPM who will post it on the Energy Commission's web page at:
http://www.energy.ca.gov/sitingcases/power_plants_contacts.html

Any changes to the telephone number shall be submitted immediately to the CPM, who will update the web page.

In addition to the monthly and annual compliance reporting requirements described above, the project owner shall report and provide copies to the CPM of all complaint forms, including noise and lighting complaints, notices of violation, notices of fines, official warnings, and citations, within 10 days of receipt. Complaints shall be logged and numbered. Noise complaints shall be recorded on the form provided in the **NOISE** conditions of certification. All other complaints shall be recorded on the complaint form (Attachment A).

# FACILITY CLOSURE

At some point in the future, the project will cease operation and close down. At that time, it will be necessary to ensure that the closure occurs in such a way that public health and safety and the environment are protected from adverse impacts. Although the project setting for this project does not appear, at this time, to present any special or unusual closure problems, it is impossible to foresee what the situation will be in 30 years or more when the project ceases operation. Therefore, provisions must be made that provide the flexibility to deal with the specific situation and project setting that exist at the time of closure. Laws, Ordinances, Regulations and Standards (LORS) pertaining to facility closure are identified in the sections dealing with each technical area. Facility closure will be consistent with LORS in effect at the time of closure.

There are at least three circumstances in which a facility closure can take place: planned closure, unplanned temporary closure and unplanned permanent closure**.**

## CLOSURE DEFINITIONS

### Planned Closure

A planned closure occurs when the facility is closed in an anticipated, orderly manner, at the end of its useful economic or mechanical life, or due to gradual obsolescence.

## Unplanned Temporary Closure

An unplanned temporary closure occurs when the facility is closed suddenly and/or unexpectedly, on a short-term basis, due to unforeseen circumstances such as a natural disaster or an emergency.

## Unplanned Permanent Closure

An unplanned permanent closure occurs if the project owner closes the facility suddenly and/or unexpectedly, on a permanent basis. This includes unplanned closure where the owner implements the on-site contingency plan. It can also include unplanned closure where the project owner fails to implement the contingency plan, and the project is essentially abandoned.

# COMPLIANCE CONDITIONS FOR FACILITY CLOSURE

## Planned Closure (COMPLIANCE-11)

In order to ensure that a planned facility closure does not create adverse impacts, a closure process that provides for careful consideration of available options and applicable laws, ordinances, regulations, standards, and local/regional plans in existence at the time of closure, will be undertaken. To ensure adequate review of a planned project closure, the project owner shall submit a proposed facility closure plan to the Energy Commission for review and approval at least 12 months (or other period of time agreed to by the CPM) prior to commencement of closure activities. The project owner shall file 120 copies (or other number of copies agreed upon by the CPM) of a proposed facility closure plan with the Energy Commission.

The plan shall:

1. identify and discuss any impacts and mitigation to address significant adverse impacts associated with proposed closure activities and to address facilities, equipment, or other project related remnants that will remain at the site;

2. identify a schedule of activities for closure of the power plant site, transmission line corridor, and all other appurtenant facilities constructed as part of the project;

3. identify any facilities or equipment intended to remain on site after closure, the reason, and any future use; and

4. address conformance of the plan with all applicable laws, ordinances, regulations, standards, and local/regional plans in existence at the time of facility closure, and applicable conditions of certification.

Prior to submittal of the proposed facility closure plan, a meeting shall be held between the project owner and the Energy Commission CPM for the purpose of discussing the specific contents of the plan.

In the event that there are significant issues associated with the proposed facility closure plan's approval, or the desires of local officials or interested parties are inconsistent with the plan, the CPM shall hold one or more workshops and/or the Energy Commission may hold public hearings as part of its approval procedure.

As necessary, prior to or during the closure plan process, the project owner shall take appropriate steps to eliminate any immediate threats to public health and safety and the environment, but shall not commence any other closure activities until the Energy Commission approves the facility closure plan.

## Unplanned Temporary Closure/On-Site Contingency Plan (COMPLIANCE-12)

In order to ensure that public health and safety and the environment are protected in the event of an unplanned temporary facility closure, it is essential to have an on-site contingency plan in place. The on-site contingency plan will help to ensure that all necessary steps to mitigate public health and safety impacts and environmental impacts are taken in a timely manner.

The project owner shall submit an on-site contingency plan for CPM review and approval. The plan shall be submitted no less than 60 days (or other time agreed to by the CPM) prior to commencement of commercial operation. The approved plan must be in place prior to commercial operation of the facility and shall be kept at the site at all times.

The project owner, in consultation with the CPM, will update the on-site contingency plan as necessary. The CPM may require revisions to the on-site contingency plan over the life of the project. In the annual compliance reports submitted to the Energy Commission, the project owner will review the on-site contingency plan, and recommend changes to bring the plan up to date. Any changes to the plan must be approved by the CPM.

The on-site contingency plan shall provide for taking immediate steps to secure the facility from trespassing or encroachment. In addition, for closures of more than 90 days, unless other arrangements are agreed to by the CPM, the plan shall provide for removal of hazardous materials and hazardous wastes, draining of all chemicals from storage tanks and other equipment, and the safe shutdown of all equipment. (Also see specific conditions of certification for the technical areas of Hazardous Materials Management and Waste Management.)

In addition, consistent with requirements under unplanned permanent closure addressed below, the nature and extent of insurance coverage, and major equipment warranties must also be included in the on-site contingency plan. In addition, the status of the insurance coverage and major equipment warranties must be updated in the annual compliance reports.

In the event of an unplanned temporary closure, the project owner shall notify the CPM, as well as other responsible agencies, by telephone, fax, or e-mail, within 24 hours and shall take all necessary steps to implement the on-site contingency plan. The project owner shall keep the CPM informed of the circumstances and expected duration of the closure.

If the CPM determines that an unplanned temporary closure is likely to be permanent, or for a duration of more than 12 months, a closure plan consistent with the

requirements for a planned closure shall be developed and submitted to the CPM within 90 days of the CPM's determination (or other period of time agreed to by the CPM).

## Unplanned Permanent Closure/On-Site Contingency Plan (COMPLIANCE-13)

The on-site contingency plan required for unplanned temporary closure shall also cover unplanned permanent facility closure. All of the requirements specified for unplanned temporary closure shall also apply to unplanned permanent closure.

In addition, the on-site contingency plan shall address how the project owner will ensure that all required closure steps will be successfully undertaken in the event of abandonment.

In the event of an unplanned permanent closure, the project owner shall notify the CPM, as well as other responsible agencies, by telephone, fax, or e-mail, within 24 hours and shall take all necessary steps to implement the on-site contingency plan. The project owner shall keep the CPM informed of the status of all closure activities.

A closure plan, consistent with the requirements for a planned closure, shall be developed and submitted to the CPM within 90 days of the permanent closure or another period of time agreed to by the CPM.

## Post Certification Changes to the Energy Commission Decision: Amendments, Ownership Changes, Staff Approved Project Modifications and Verification Changes (COMPLIANCE-14)

The project owner must petition the Energy Commission pursuant to Title 20, California Code of Regulations, section 1769, in order to modify the project (including linear facilities) design, operation or performance requirements, and to transfer ownership or operational control of the facility. **It is the responsibility of the project owner to contact the CPM to determine if a proposed project change should be considered a project modification pursuant to section 1769.** Implementation of a project modification without first securing Energy Commission, or Energy Commission staff approval, may result in enforcement action that could result in civil penalties in accordance with section 25534 of the Public Resources Code.

A petition is required for **amendments** and for staff approved project modifications, as specified below. Both shall be filed as a "Petition to Amend." Staff will determine if the change is significant or less than significant. For verification changes, a letter from the project owner is sufficient. In all cases, the petition or letter requesting a change should be submitted to the CPM, who will file it with the Energy Commission's Dockets Unit in accordance with Title 20, California Code of Regulations, section 1209.

The criteria that determine which type of approval and the process that applies are explained below. They reflect the provisions of Section 1769 at the time this condition was drafted. If the Commission's rules regarding amendments are amended, the rules in effect at the time an amendment is requested shall apply.

### Amendment

The project owner shall petition the Energy Commission, pursuant to Title 20, California Code of Regulations, Section 1769(a), when proposing modifications to the project (including linear facilities) design, operation, or performance requirements. If a proposed modification results in deletion or change of a condition of certification, or makes changes that would cause the project not to comply with any applicable laws, ordinances, regulations or standards, the petition will be processed as a formal amendment to the final decision, which requires public notice and review of the Energy Commission staff analysis, and approval by the full Commission. The petition shall be in the form of a legal brief and fulfill the requirements of Section 1769(a). Upon request, the CPM will provide you with a sample petition to use as a template.

### Change of Ownership

Change of ownership or operational control also requires that the project owner file a petition pursuant to section 1769 (b). This process requires public notice and approval by the full Commission. The petition shall be in the form of a legal brief and fulfill the requirements of Section 1769(b). Upon request, the CPM will provide you with a sample petition to use as a template.

### Staff Approved Project Modification

Modifications that do not result in deletions or changes to conditions of certification, and that are compliant with laws, ordinances, regulations and standards may be authorized by the CPM as a Staff Approved Project Modification pursuant to section 1769(a) (2). This process usually requires minimal time to complete, and it requires a 14-day public review of the Notice of Staff Approved Project Modification that includes staff's intention to approve the modification unless substantive objections are filed. These requests must also be submitted in the form of a "petition to amend" as described above.

### Verification Change

A verification may be modified by the CPM without requesting an amendment to the decision if the change does not conflict with the conditions of certification and provides an effective alternate means of verification.

## CBO DELEGATION AND AGENCY COOPERATION

In performing construction and operation monitoring of the project, Energy Commission staff acts as, and has the authority of, the Chief Building Official (CBO). Energy Commission staff may delegate CBO responsibility to either an independent third party contractor or the local building official. Energy Commission staff retains CBO authority when selecting a delegate CBO, including enforcing and interpreting state and local codes, and use of discretion, as necessary, in implementing the various codes and standards.

Energy Commission staff may also seek the cooperation of state, regional and local agencies that have an interest in environmental protection when conducting project monitoring.

## ENFORCEMENT

The Energy Commission's legal authority to enforce the terms and conditions of its Decision is specified in Public Resources Code sections 25534 and 25900. The Energy Commission may amend or revoke the certification for any facility, and may impose a civil penalty for any significant failure to comply with the terms or conditions of the Energy Commission Decision. The specific action and amount of any fines the Energy Commission may impose would take into account the specific circumstances of the incident(s). This would include such factors as the previous compliance history, whether the cause of the incident involves willful disregard of LORS, oversight, unforeseeable events, and other factors the Energy Commission may consider.

## NONCOMPLIANCE COMPLAINT PROCEDURES

Any person or agency may file a complaint alleging noncompliance with the conditions of certification. Such a complaint will be subject to review by the Energy Commission pursuant to Title 20, California Code of Regulations, section 1237, but in many instances the noncompliance can be resolved by using the informal dispute resolution process. Both the informal and formal complaint procedure, as described in current State law and regulations, are described below. They shall be followed unless superseded by future law or regulations.

The Energy Commission has established a toll free compliance telephone number of **1-800-858-0784** for the public to contact the Energy Commission about power plant construction or operation-related questions, complaints or concerns.

### Informal Dispute Resolution Process

The following procedure is designed to informally resolve disputes concerning the interpretation of compliance with the requirements of this compliance plan. The project owner, the Energy Commission, or any other party, including members of the public, may initiate an informal dispute resolution process. Disputes may pertain to actions or decisions made by any party, including the Energy Commission's delegate agents.

This process may precede the more formal complaint and investigation procedure specified in Title 20, California Code of Regulations, section 1237, but is not intended to be a substitute for, or prerequisite to it. This informal procedure may not be used to change the terms and conditions of certification as approved by the Energy Commission, although the agreed upon resolution may result in a project owner, or in some cases the Energy Commission staff, proposing an amendment.

The process encourages all parties involved in a dispute to discuss the matter and to reach an agreement resolving the dispute. If a dispute cannot be resolved, then the matter must be brought before the full Energy Commission for consideration via the complaint and investigation procedure.

## Request for Informal Investigation

Any individual, group, or agency may request the Energy Commission to conduct an informal investigation of alleged noncompliance with the Energy Commission's terms and conditions of certification. All requests for informal investigations shall be made to the designated CPM.

Upon receipt of a request for informal investigation, the CPM shall promptly notify the project owner of the allegation by telephone and letter. All known and relevant information of the alleged noncompliance shall be provided to the project owner and to the Energy Commission staff. The CPM will evaluate the request and the information to determine if further investigation is necessary. If the CPM finds that further investigation is necessary, the project owner will be asked to promptly investigate the matter. Within seven working days of the CPM's request, provide a written report to the CPM of the results of the investigation, including corrective measures proposed or undertaken. Depending on the urgency of the noncompliance matter, the CPM may conduct a site visit and/or request the project owner to also provide an initial verbal report, within 48 hours.

## Request for Informal Meeting

In the event that either the party requesting an investigation or the Energy Commission staff is not satisfied with the project owner's report, investigation of the event, or corrective measures proposed or undertaken, either party may submit a written request to the CPM for a meeting with the project owner. Such request shall be made within 14 days of the project owner's filing of its written report. Upon receipt of such a request, the CPM shall:

1. immediately schedule a meeting with the requesting party and the project owner, to be held at a mutually convenient time and place;

2. secure the attendance of appropriate Energy Commission staff and staff of any other agencies with expertise in the subject area of concern, as necessary;

3. conduct such meeting in an informal and objective manner so as to encourage the voluntary settlement of the dispute in a fair and equitable manner;

4. After the conclusion of such a meeting, promptly prepare and distribute copies to all in attendance and to the project file, a summary memorandum that fairly and accurately identifies the positions of all parties and any understandings reached. If an agreement has not been reached, the CPM shall inform the complainant of the formal complaint process and requirements provided under Title 20, California Code of Regulations, section 1230 et seq.

## Formal Dispute Resolution Procedure-Complaints and Investigations

Any person may file a complaint with the Energy Commission's Dockets Unit alleging noncompliance with a Commission decision adopted pursuant to Public Resources Code section 25500. Requirements for complaint filings and a description of how complaints are processed are in Title 20, California Code of Regulations, section 1237.

# KEY EVENTS LIST

PROJECT: _____

DOCKET #: _____

COMPLIANCE PROJECT MANAGER: _____

| EVENT DESCRIPTION | DATE |
|---|---|
| Certification Date | |
| Obtain Site Control | |
| Online Date | |
| **POWER PLANT SITE ACTIVITIES** | |
| Start Site Mobilization | |
| Start Ground Disturbance | |
| Start Grading | |
| Start Construction | |
| Begin Pouring Major Foundation Concrete | |
| Begin Installation of Major Equipment | |
| Completion of Installation of Major Equipment | |
| First Combustion of Gas Turbine | |
| Obtain Building Occupation Permit | |
| Start Commercial Operation | |
| Complete All Construction | |
| **TRANSMISSION LINE ACTIVITIES** | |
| Start T/L Construction | |
| Synchronization with Grid and Interconnection | |
| Complete T/L Construction | |
| **FUEL SUPPLY LINE ACTIVITIES** | |
| Start Gas Pipeline Construction and Interconnection | |
| Complete Gas Pipeline Construction | |
| **WATER SUPPLY LINE ACTIVITIES** | |
| Start Water Supply Line Construction | |
| Complete Water Supply Line Construction | |

**COMPLIANCE TABLE 1**
**SUMMARY of COMPLIANCE CONDITIONS OF CERTIFICATION**

| CONDITION NUMBER | SUBJECT | DESCRIPTION |
|---|---|---|
| COMPLIANCE-1 | Unrestricted Access | The project owner shall grant Energy Commission staff and delegate agencies or consultants unrestricted access to the power plant site. |
| COMPLIANCE-2 | Compliance Record | The project owner shall maintain project files on-site. Energy Commission staff and delegate agencies shall be given unrestricted access to the files. |
| COMPLIANCE-3 | Compliance Verification Submittals | The project owner is responsible for the delivery and content of all verification submittals to the CPM, whether such condition was satisfied by work performed or the project owner or his agent. |
| COMPLIANCE-4 | Pre-construction Matrix and Tasks Prior to Start of Construction | Construction shall not commence until the all of the following activities/submittals have been completed:<br>▪ property owners living within one mile of the project have been notified of a telephone number to contact for questions, complaints or concerns,<br>▪ a pre-construction matrix has been submitted identifying only those conditions that must be fulfilled before the start of construction,<br>▪ all pre-construction conditions have been complied with,<br>▪ the CPM has issued a letter to the project owner authorizing construction. |
| COMPLIANCE-5 | Compliance Matrix | The project owner shall submit a compliance matrix (in a spreadsheet format) with each monthly and annual compliance report which includes the status of all compliance conditions of certification. |
| COMPLIANCE-6 | Monthly Compliance Report including a Key Events List | During construction, the project owner shall submit Monthly Compliance Reports (MCRs) which include specific information. The first MCR is due the month following the Energy Commission business meeting date on which the project was approved and shall include an initial list of dates for each of the events identified on the Key Events List. |
| COMPLIANCE-7 | Annual Compliance Reports | After construction ends and throughout the life of the project, the project owner shall submit Annual Compliance Reports instead of Monthly Compliance Reports. |

| CONDITION NUMBER | SUBJECT | DESCRIPTION |
|---|---|---|
| COMPLIANCE-8 | Confidential Information | Any information the project owner deems confidential shall be submitted to the Energy Commission's Dockets Unit with a request for confidentiality. |
| COMPLIANCE-9 | Annual fees | Payment of Annual Energy Facility Compliance Fee |
| COMPLIANCE-10 | Reporting of Complaints, Notices and Citations | Within 10 days of receipt, the project owner shall report to the CPM, all notices, complaints, and citations. |
| COMPLIANCE-11 | Planned Facility Closure | The project owner shall submit a closure plan to the CPM at least 12 months prior to commencement of a planned closure. |
| COMPLIANCE-12 | Unplanned Temporary Facility Closure | To ensure that public health and safety and the environment are protected in the event of an unplanned temporary closure, the project owner shall submit an on-site contingency plan no less than 60 days prior to commencement of commercial operation. |
| COMPLIANCE-13 | Unplanned Permanent Facility Closure | To ensure that public health and safety and the environment are protected in the event of an unplanned permanent closure, the project owner shall submit an on-site contingency plan no less than 60 days prior to commencement of commercial operation. |
| COMPLIANCE-14 | Post-certification changes to the Decision | The project owner must petition the Energy Commission to delete or change a condition of certification, modify the project design or operational requirements and/or transfer ownership of operational control of the facility. |

**ATTACHMENT A**

COMPLAINT REPORT/RESOLUTION FORM

| |
|---|
| PROJECT NAME:<br>AFC Number: |
| **COMPLAINT LOG NUMBER** _____<br>Complainant's name and address:<br><br>Phone number: _____ |
| Date and time complaint received:<br>Indicate if by telephone or in writing (attach copy if written):<br>Date of first occurrence: |
| Description of complaint (including dates, frequency, and duration): |
| Findings of investigation by plant personnel:<br><br>Indicate if complaint relates to violation of a CEC requirement:<br>Date complainant contacted to discuss findings: _____ |
| Description of corrective measures taken or other complaint resolution:<br><br>Indicate if complainant agrees with proposed resolution:<br>If not, explain:<br><br>Other relevant information: |
| If corrective action necessary, date completed: _____<br>Date first letter sent to complainant: _____(copy attached)<br>Date final letter sent to complainant: _____(copy attached) |
| This information is certified to be correct.<br>Plant Manager's Signature: _____ Date: |

(Attach additional pages and supporting documentation, as required.)

# PREPARATION TEAM

**DECLARATION OF**
**Eric K. Solorio**

I, Eric Solorio, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division, as a Project Manager (Planner II).

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

3. I prepared the staff testimony on the **Executive Summary** and helped prepare staff testimony on the **Alternatives** section of the Final Staff Assessment for the **Beacon Solar Energy Project** (08-AFC-2) based on my independent analysis of the Application for Certification 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:_____ Signed:_____

At: Sacramento, California

# ERIC SOLORIO

## SUMMARY

I'm currently a project manager for the California Energy Commission. I have seven years of experience managing business operations for real estate development companies and three years of experience with economic development through international trade and foreign direct investment. I have a working knowledge of the California Environmental Quality Act. My strengths are in business development, strategic planning, team building, economic analysis, and raising private equity. I'm experienced with managing diverse groups of people to accomplish common objectives.

## PROFESSIONAL EXPERIENCE

### Presentation Skills

- Organize and participate in public workshops to facilitate public participation in the environmental review of large-scale real estate development projects, up to 4,000 acres in size.
- Organize and participate in international trade and investment, "business to business" workshops.
- Organize and participate in international trade and investment, business development seminars.
- Make presentations to foreign delegations and dignitaries to solicit "foreign direct investment" into California business ventures.
- Assist with implementing protocol for receiving foreign trade delegations visiting California.

### Technical Skills

- Review and analyze Application(s) for Certification submitted to the California Energy Commission for proposed, utility-scale thermal power plant development.
- Manage the development of comprehensive environmental impact reports, in accordance with the California Environmental Quality Act, the Warren Alquist Act, the federal Clean Air Act and the federal Clean Water Act.
- Develop and maintain financial models for various business types: real estate development, resource development (forestry) and international trade (technology transfers).
- Work with the following software applications: Access, Excel, PowerPoint, Project and Word.

### Legislation and Policy Analysis

- Review and analyze proposed legislation that could affect international trade and investment in California, and draft official Agency opinions.

### Writing

- I've written weekly reports to the Governor's office (two years), business plans, letters, memos and environmental impact reports.

## EMPLOYMENT HISTORY

| | | |
|---|---|---|
| **October 2008 – Present** | **Project Manager** | California Energy Commission; Siting, Transmission and Environmental Protection Division |
| **May 1999 – April 2008** | **Owner / Manager** | Various Real Estate Development Partnerships in California |
| **Sept. 2001 – Nov. 2002** | **Owner / Manager** | Technology Transfer Services |
| **Nov. 1999 – August 2001** | **Special Assistant to Deputy Secretary** | California Trade and Commerce Agency, International Trade and Investment Division |

## EDUCATION

**California State University at Sacramento**
Major: International Business
Minor: Economics

**DECLARATION OF**
**MATTHEW S. LAYTON**

I, Matthew S. Layton, declare as follows:

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

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

3. I helped prepare the greenhouse gas analysis in the Air Quality section for the Beacon Solar Energy Project Final Staff Assessment based on my independent analysis of the Application for Certification 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:_____ Signed:_____

At: Sacramento, California

# MATTHEW S. LAYTON

## Experience Summary

Twenty five years of experience in the electric power generation field, including regulatory compliance and modification; research and development; licensing of nuclear, coal-fired, peaking and combined cycle power plants; and engineering and policy analysis of regulatory issues.

## Education

B.S., Applied Mechanics, University of California, San Diego.

Registered Professional Engineer - Mechanical, California.

## Experience

**1987-present** – Senior Mechanical Engineer, Systems Assessment and Facilities Siting Division, California Energy Commission. Review and evaluate 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 Heath; and
- Transmission Line Safety and Nuisance.

Prepared Commission demonstration project process; contributed to the Energy Technology Status, Energy Development, and Electricity Reports; Project Manager for demonstration projects; evaluated demonstration test plans, procedures, data and reports; disseminated test results; and managed research and development contracts.

**1983-1986** -- Control Systems Engineer, Bechtel Power Corporation. Managed a multi-disciplined effort to environmentally qualify client's safety related nuclear plant equipment. Performed analyses, calculations and reviews against vendor test reports, NRC guidelines and plant normal and postulated accident conditions. Initiated purchase orders for testing and formulated test objectives and test plans. Developed and implemented plant equipment maintenance and surveillance program based on test results, vendor recommendations and industry operating experiences. Trained client in environmental qualification engineering analysis and equipment maintenance program. Prepared client for NRC audits and presentation.

**1981-1983** -- Engineer, GA Technologies, Inc. Supervised design and procurement of full-scale test assembly used to evaluate design changes to operating reactor graphite core assembly. Conducted experiment to determine the relationship of graphite oxidation rate to water concentration, temperature, and helium pressure. Environmentally qualified essential and safety related nuclear power plant equipment to comply with NRC guidelines.

# DECLARATION OF
## Testimony of William Walters, P.E.

I**, William Walters,** declare as follows:

1. I am presently employed by Aspen Environmental Group, a contractor to the California Energy Commission, Systems Assessment and Facilities Siting Division, as a senior associate in engineering and physical sciences.

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 **Air Quality** and **Visual Resources (Visible Plume Modeling Analysis)**, for the **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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: July 27, 2009 Signed: _____

At: Agoura Hills, California

**WILLIAM WALTERS, P.E.**
**Air Quality Specialist**

**ACADEMIC BACKGROUND**
B.S., Chemical Engineering, 1985, Cornell University

## PROFESSIONAL EXPERIENCE

Mr. Walters has over 20 years of technical and project management experience in environmental compliance work, including environmental impact reports, emissions inventories, source permitting, energy and pollution control research RCRA/CERCLA site assessment and closure, site inspection, and source monitoring,.

### Aspen Environmental Group 2000 to present

Responsible as lead technical and/or project manager of environmental projects. Specific responsibilities and projects include the following:

- **Engineering and Environmental Technical Assistance to Conduct Application for Certification Review for the California Energy Commission:**
  - Preparation and project management of the air quality section of the Staff Assessment and/or Initial Study and the visual plume assessment for the following California Energy Commission (CEC) licensing projects: Hanford Energy Park; United Golden Gate, Phase I; Huntington Beach Modernization Project (including Expert Witness Testimony); Woodland Generating Station 2; Ocotillo Energy Project, Phase I; Magnolia Power Project; Colusa Power Project; Inland Empire Energy Center; Rio Linda/Elverta Power Plant Project; Roseville Energy Center; Henrietta Peaker Project; Tracy Peaking Power Plant Project (including Expert Witness Testimony); Avenal Energy Project; San Joaquin Valley Energy Center (including expert witness testimony); Salton Sea Unit 6 Project (including expert witness testimony); Modesto Irrigation District Electric Generation Station (including expert witness testimony); Walnut Energy Center (including expert witness testimony); Riverside Energy Resource Center (including expert witness testimony); Pastoria Energy Facility Expansion; Panoche Energy Center; Starwood Power Plant; and Riverside Energy Resource Center Units 3 and 4 Project (in progress).
  - Preparation and project management of the visual plume assessment for the following California Energy Commission (Energy Commission) licensing projects: Metcalf Energy Center Power Project (including Expert Witness Testimony); Contra Costa Power Plant Project (including Expert Witness Testimony); Mountainview Power Project; Potrero Power Plant Project; El Segundo Modernization Project; Morro Bay Power Plant Project; Valero Cogeneration Project; East Altamont Energy Center (including expert witness testimony); Russell City Energy Center; SMUD Cosumnes Power Plant Project (including expert witness testimony); Pico Power Project; Blythe Energy Project Phase II; City of Vernon Malburg Generating Station; San Francisco Electric Reliability Project; Los Esteros Critical Energy Facility Phase II; Roseville Energy Park; City of Vernon Power Plant; South Bay Replacement Project; Walnut Creek Energy Park; Sun Valley Energy Project; Highgrove Power Plant; Colusa Generating Station; Russell City Energy Center; Avenal Energy Project; Carlsbad Energy Center; Community Power Project; Panoche Energy Center; San Gabriel Generating Station; Sentinel Energy Project; and Victorville 2 Hybrid Power Project.
  - Assistance in the aircraft safety review of thermal plume turbulence for the Riverside Energy Resources Center; Russell City Energy Center Amendment (including expert witness testimony); Eastshore Energy Power Plant (including expert witness testimony); Carlsbad Energy Center (in progress), Riverside Energy Resource Center Units 3 and 4 Project; Victorville 2 Hybrid Power Project; and the Blythe Energy Power

Plant and Blythe Energy Project Phase II (including expert witness testimony) siting cases. Assistance in the aircraft safety review of thermal and visual plumes of the operating Blythe Energy Power Plant. Preparation of a white paper on methods for the determination of vertical plume velocity determination for aircraft safety analyses.

- Preparation and instruction of a visual water vapor plume modeling methodology class for the CEC.
- Preparation and project management of the public health section of the Initial Study for the Woodland Generating Station 2 Energy Commission licensing project.
- Preparation of project amendment or project compliance assessments, for air quality or visual plume impacts, for several licensed power plants, including: Metcalf Energy Center; Pastoria Power Plant; Elk Hills Power Plant; Henrietta Peaker Project; Tracy Peaker Project; Magnolia Power Project; Delta Energy Center; SMUD Cosumnes Power Plant; Walnut Energy Center; San Joaquin Valley Energy Center; City of Vernon Malburg Generating Station; Otay Mesa Power Plant; Los Esteros Critical Energy Facility; Pico Power Project; Riverside Energy Resource Center; Blythe Energy Project Phase II; Inland Empire Energy Center; Salton Sea Unit 6 Project; and Starwood Power-Midway Peaking Power Plant.
- Preparation of the air quality section of the staff paper "A Preliminary Environmental Profile of California's Imported Electricity" for the Energy Commission and presentation of the findings before the Commission.
- Preparation of the draft staff paper "Natural Gas Quality: Power Turbine Performance During Heat Content Surge", and presentation of the preliminary findings at the California Air Resources Board Compressed Natural Gas Workshop and a SoCalGas Technical Advisory Committee meeting.
- Preparation of the staff paper "Emission Offsets Availability Issues" and preparation and presentation of the Emission Offsets Constraints Workshop Summary paper for the Energy Commission.
- Preparation of information request and data analysis to update the Energy Commission's Cost of Generation Model capital and operating cost factors for combined and simple cycle gas turbine projects. Additionally, performed a review of the presentation for the revised model as part of the CEC's 2007 Integrated Energy Policy Report workshops, and attended the workshop and answering Commissioner questions on the data collection and data analysis.

- For the **Los Angeles Department of Water and Power (LADWP)**:
  - Preparation of the Air Quality Inventory for the LADWP River Supply Pipeline Project EIR.
  - Project management and preparation of the Air Quality Section for the LADWP Valley Generating Station Stack Removal IS/MND support project.
- For the **U.S. Army Corps of Engineers (Corps)**:
  - Preparation of the Air Quality Section and General Conformity Analysis for the Matilija Dam Ecosystem Restoration Project EIS/R for the Corps.
  - Preparation of emission inventory and General Conformity Analysis of the Murrieta Creek Flood Control Project and the Joint Red Flag exercise to be conducted in the Nevada Test and Training Range.
  - Emission inventory for the construction activities forecast for the San Jose/Old San Jose Creeks Ecosystem Restoration project for the Corps.

- Other Projects:
  - Preparation of the Air Quality Section of the LAUSD New School Construction Program EIR and provided traffic trip and VMT calculation support for the Traffic and Transportation Section.

- Preparation of the draft staff paper "Natural Gas Quality: Power Turbine Performance During Heat Content Surge", and presentation of the preliminary findings at the California Air Resources Board Compressed Natural Gas Workshop and a SoCalGas Technical Advisory Committee meeting.
- Preparation of the Air Quality Section of the Environmental Information Document in support of the Coastal Consistency Determinations for the suspension of operation requests for undeveloped units and leases off the Central California Coast.
- Preparation of comments on the Air Quality, Alternatives, Marine Traffic, Public Safety, and Noise section of the Cabrillo Port Liquefied Natural Gas Deepwater Port Draft EIS/EIR for the City of Oxnard.
- Preparation of the emission estimates used in the Air Quality Sections for the DWR Tehachapi Second Afterbay Project Initial Study and EIR.

## Camp Dresser & McKee, Inc. 1998 to 2000

Mr. Walters was responsible as lead technical and/or project manager of environmental projects. Specific responsibilities and projects include the following:

- Preparation of emission inventories and dispersion modeling for criteria and air toxic pollutants for the Los Angeles International Airport Master Plan (LAXMP) EIS/EIR.
- Project Manager/Technical lead for the completion of air permit applications and air compliance audits for two Desa International fireplace accessory manufacturing facilities located in Santa Ana, California.
- Project manager/technical lead for the completion of Risk Management Plans (RMPs) for four J.R. Simplot food processing facilities in Oregon, Idaho, and Washington and the Consolidated Reprographics facility located in Irvine, California.

## Planning Consultants Research 1997 to 1998

Mr. Walters was responsible as lead technical and/or project manager of environmental projects. Specific responsibilities and projects include the following:

- Project Manager for a stationary source emission audit of the entire Los Angeles International Airport complex for Los Angeles World Airports (LAWA) in support of the LAXMP.
- Review of the Emission Dispersion Modeling System (EDMS) and preparation of a report with findings to the Federal Aviation Administration for LAWA in support of the LAXMP.
- Project manager for the ambient air monitoring and deposition monitoring studies performed for LAWA in support of the LAXMP, including the selection of the monitoring sites and specialty subcontractor, and review of all monitoring data.

## Aspen Environmental Group/Clean Air Solutions 1995 to 1996

Mr. Walters was responsible as lead technical and/or project manager of environmental projects. Specific responsibilities and projects include the following:

- Manager of the Portland, Oregon, office of Clean Air Solutions from March 1995 to December 1995, with responsibilities including Project Management, Business Development, and Administration.
- Control technology assessment, engineering support and Notice of Intent to construct preparation for J.R. Simplot's Hermiston, Oregon, food processing facility. Review and revision of an Air Contaminant Discharge Permit application, Title V permit application, and PSD modeling analysis for J.R. Simplot's Hermiston facility.

- Air quality compliance report including an air emission inventory, regulation and permit compliance determination, and recommendations for compliance for Lumber Tech, Inc.'s Lebanon, Oregon, wood products facility.

## Fluor Daniel, Inc. 1990 to 1995 and 1996 to 1997

Mr. Walters was responsible as lead technical or project manager for major environmental projects for both government and private clients. His projects included:

- Prepared several air permit applications for the ARCO Los Angeles Refinery Polypropylene Plant Project; Phase I environmental assessments for properties located in Southern California; and a site investigation and RCRA closure plan for a hazardous waste storage site in Vernon, California.
- Project manager of the Anaconda Smelter site for the U.S. Environmental Protection Agency's (EPA) Alternative Remedial Contract System (ARCS) project during the conclusion of technical activities and project closeout. Prepared a cost recovery report for the project.
- Performed environmental analysis for the Bonneville Power Authority, including air pollution BACT analysis, wastewater analysis, and evaluation of secondary environmental effects of electric power producing technologies.

## Jacobs Engineering Group 1988 to 1990

Mr. Walters was responsible for a wide range of air pollution regulatory and testing projects, including the following:

- Project manager of air toxic emission inventory reports prepared for U.S. Borax's boron mining and refining facility and the Naval Aviation Depot (N. Island Naval Base, San Diego, California).
- Prepared air permit applications and regulatory correspondence for several facilities including the U.S. Department of Energy's Feed Material Production Center uranium processing facility in Fernald, Ohio; Evaluation of a sludge dewatering process at Unocal's Wilmington, California, Refinery; and United Airlines blade repair facility at the San Francisco Airport.
- Characterized and quantified air emissions for offshore oil and gas development activities associated with Federal oil and gas Lease Sale 95, offshore southern California, for the U.S. Minerals Management Service.

### CERTIFICATIONS

- Chemical Engineer, California License 5973
- CARB, Fundamentals of Enforcement Seminar
- EPA Methods 1-8, 17; Training Seminar

### AWARDS

- California Energy Commission Outstanding Performance Award 2001

# DECLARATION OF
## Carolyn A. Chainey-Davis

I**, Carolyn A. Chainey-Davis,** declare as follows:

1. I am presently under contract with Aspen Environmental Group to provide environmental technical assistance to the California Energy Commission. Under Contract No. 700-05-002, I am serving as a Biological Resource Specialist (Associate level) to provide Peak Workload Support for the Energy Facility Siting Program and for the Energy Planning Program.

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 **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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: September 10, 2009 Signed: _____

At: Nevada City, California

## Carolyn Chainey-Davis, botanist

Ms. Chainey-Davis is a botanist specializing in the flora of California, with emphasis on cismontane California and the Great Basin and Mojave Desert regions. Ms. Chainey-Davis has nearly 20 years experience conducting biological inventories and impact assessments, rare plant and noxious weed surveys, large-scale vegetation mapping, wetland delineations, large-scale watershed assessments, designing and implementing mitigation, monitoring, and restoration plans. Her field experience includes a diverse group of clients and projects from large transmission and hydro relicensing projects to small, local urban and residential development projects, local, state and federal agencies, resource conservation organizations, landfill and mine reclamation projects, and many more. She led Garcia and Associates (GANDA) botanical studies for the PG&E Stanislaus River, Upper North Fork Feather River, Pit River, Bucks Lake and Poe hydro-relicensing projects, Transmission Separation project, Lower Owens River riparian monitoring, and hundreds of other large and small projects around the state.

Ms. Davis is past President of the California Native Plant Society, Nevada and Placer County Chapter and is a co-author of the recently published field guide "*Wildflowers of Nevada and Placer Counties*", published by the California Native Plant Society. Ms. Davis completed her wetland training at Portland State University and is certified for conducting wetland delineations based on the U.S. Army Corps of Engineers Wetland Delineation Manual. Ms. Chainey-Davis is skilled in the use of Trimble GeoExplorer series Global Positioning (GPS) equipment. As a botanist, she apprenticed for several years under some of the state's leading botanists, vegetation and wetland ecologists, including Robert Holland. Ms. Davis' continuing education includes several annual intensive botanical workshops through the U.C. Berkeley Jepson Herbarium, including identification workshops in the genus *Carex*, and the plant families Poaceae, Asteraceae, Apiaceae, and Boraginaceae, Polygonaceae, and Bryophytes.

## A Sampling of Project Experience

**Project:** **Lower Owens River Monitoring Program**
**Client:** **Ecosystem Sciences**
Designed long-term monitoring program for collecting and analyzing data on riparian habitat and key wildlife habitat characteristics on 62 miles of the Lower Owens River. Directed field efforts to collect baseline data at 350 sites. Future monitoring, conducted after the initiation of appropriate flow and land management practices, will be compared against the baseline to determine if changes resulting from proposed restoration efforts (augmented stream flows) are consistent with the LORP goals and objectives.

**Project:** **Open ended Contract for Biological Services**
**Client:** **Southern California Edison (SCE)**
Led botanical studies (vegetation mapping, habitat asssessments, etc.) in support of various SCE construction and relicensing projects in the central and southern Sierras, Sierra east slope and Great Basin region, and the eastern edge of the San Joaquin Valley.

**Project:** **Stanislaus River Hydroelectric Project Relicensing Studies**
**Client:** **Pacific Gas and Electric Company, Technical and Ecological Services**
Led field efforts to conduct floristically-based botanical studies for the Federal Energy Regulatory Commission relicensing of four hydroelectric and transmission line projects located on the Stanislaus River, Stanislaus National Forest. Riparian and watershed vegetation mapping and sampling, special-status plant surveys, noxious weed mapping, and identify and map culturally significant Native American botanical resources for local tribes in support of the Federal Energy Regulatory Commission relicensing process. Prepared draft and final reports.

**182 Grove Street Nevada City, CA 95959 [ph] 530.478.1963 [cell] 530.205.6218 bighair60@att.net**

**Project:** **Kern River Natural Gas Pipeline**
**Client:** **Garcia and Associates**
Led Garcia and Associates botanical staff and conducted floristically-based special status plant surveys for the Daggett and Goodsprings segments of the interstate pipeline.

**Project:** **Owens Lake Dust Control Project**
**Client:** **CH2M Hill**
Conducted two years of floristically-based special status plant surveys and wetland delineations for the Los Angeles Department of Water and Power Owens Lake Dust Control mitigation project.

**Project:** **Pit River Hydroelectric Project Relicensing Studies**
**Client:** **Pacific Gas and Electric Company, Technical and Ecological Services**
Led field efforts to conduct floristically-based special status plant surveys, noxious weed surveys, upland habitat mapping, and riparian vegetation classification and mapping for PG&E's Pit 3, 4, and 5 hydroelectric project in Shasta County in support of the Federal Energy Regulatory Commission relicensing process. Prepared draft and final reports.

**Project:** **Upper North Fork Feather River and Poe Hydroelectric Projects, Lake Almanor Habitat Management Plan**
**Client:** **Pacific Gas and Electric Company, Technical and Ecological Services**
Led field efforts to conduct floristic surveys for special-status plant species and noxious weeds on the Upper North Fork Feather River (Plumas and Lassen National Forests) and Poe Project Included GIS-based riparian and upland vegetation mapping in support the Federal Energy Commission relicensing process. Prepared draft and final reports. Also conducted detailed mapping of the wet meadows around Lake Almanor and prepared a long-term habitat managment plan for meadow resources and willow flycatcher habitat.

**Project:** **Transmission Separation Project**
**Client:** **Foster Wheeler Environmental Corporation**
Led field efforts to conduct floristically-based special-status plant surveys and noxious weed surveys in the spring and summer of 2000 for Foster Wheeler Environmental Corporation for the PG&E Transmission Separation Project. GANDA botanists conducted surveys on selected transmission line segments and their associated access roads on USDA Forest Service (USFS) lands in the Plumas, Shasta-Trinity, Tahoe, and Eldorado National Forests, created GIS-based vegetation and noxious weed maps, and analyzed potential threats to special-status plant populations. Prepared draft and final reports.

**Project:** **Nevada and Placer County projects – large and small subdivisions, infrastructure development, etc.**
**Client:** **Susan Sanders Biological Consulting and Beedy Environmental Consulting**
Conducted biological inventory and impact analyses and prepared mitigation plans for over 100 large and small subdivisions and infrastructure development projects in Nevada and Placer County. Lead writer and botanist. All projects included vegetation mapping, habitat assessments, floristic surveys, and mitigation planning. Prepared detailed habitat management plans and recreation/ trail plans for over a thousand acres of open space.

**Project:** **Bear Valley Meadow Restoration**
**Client:** **American Rivers**
Sample design and long-range monitoring design and protocol for a large-scale meadow restoration project in Placer County. Included detailed vegetation mapping, conducting baseline inventory, and preparing report on sample design and results of baseline monitoring.

**Project:** **Dog Ranch-Salmon Creek Conservation Project**
**Client:** **Robert Holland/Geobotanical Phenominology**
Conducted endangered species surveys and documented over 300 occurrences of special status plants (using Trimble data dictionary and population sampling protocol) for a proposed conservation easement/land swap on a 400+ acre ranch in Humboldt County on the Samoa Peninsula.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**Project:** **Field Guide to *Epilobium* in the Sierra Nevada, Tahoe National Forest**
**Client:** **U.S.D.A. Forest Service, Tahoe and Inyo National Forests (Open-ended Contract)**
Conducted surveys for rare *Epilobiums* at seven sites in the Tahoe and Inyo National Forests and prepared a field guide to all *Epilobiums* in the Sierra Nevada with illustrations and keys to identification. The field guide was geared to USFS field crews and volunteers. The goal was to produce a 'field-friendly' guide to a group of plants notoriously difficult to identify in the field. Research included a herbaria review.

**Project:** **Shirttail Creek Conservation Easement**
**Client:** **Beedy Environmental Consulting for Conservation Biology Institute**
Conducted biological inventory and conservation assessment for 800-acre property on Shirttail Creek in the American River watershed using protocol developed by The Nature Conservancy for conservation planning. Lead writer and botanist.

**Project:** **Natural Heritage 2020 Nevada County Watershed Assessment**
**Client:** **County of Nevada and Sierra Business Council**
Lead botanist for a countywide watershed and ecosystem assessment. A two-year process funded by the Sierra Business Council and the County of Nevada to create a GIS database and biotic inventory of the county's natural habitats and wildlife resources, including an assessment of vegetation, special status and invasive for 98 sub-watershed basins in the county. Duties included verifying the accuracy of more than 40 countywide GIS data themes, including information on the extent and distribution of major vegetation cover types, agriculture, development, and infrastructure. Assessed the extent and quality of each of the county's ecosystem types and their suitability or occurrence potential for special-status plants and animals. Mapped, photo-logged, described and collected GPS coordinates for small-patch or sensitive vegetation communities encountered, such as fens, ephemeral or perennial wetlands, marshes, vernal pools, serpentine and gabbro habitats, etc.

**Project:** **Special Status Plant Surveys and Habitat Mapping for Rock Creek/Cresta Hydroelectric**
**Client:** **Pacific Gas and Electric Company, Technical and Ecological Services**
Conducted floristically-based special status plant surveys and habitat mapping for PG&E's Rock Creek-Cresta hydroelectric facility project area, including transmission lines and associated project facilities and roads. The hydro facility is located on the North Fork of the Feather River near Oroville; the associated transmission line extends 72 miles south and traverses portions of Plumas, Butte, Yuba and Sutter counties.

**Project:** **Travis Air Force Base Vernal Pool Study**
**Client:** **CH2M Hill**
Conducted floristically-based special status plant surveys, wetland delineation and habitat-ranking of natural and artificially-created pools at Travis Air Force Base in Fairfield.

**Project:** **Beale Air Force Base Best Slough Mitigation**
**Client:** **CH2M Hill**
Conducted floristically-based special status plant surveys, and wetland delineation of vernal pools and other seasonal wetlands at the Best Slough Super Fund site at Beale Air Force Base in Yuba County.

**Project:** **Osborne Hill Open Space Habitat Management Plan**
**Client:** **Susan Sanders Biological Consulting**
Prepared a detailed, goal-driven long-range habitat management plan for 250 acres of open space for a residential development in Nevada County. Included guidelines for forest management to promote old-growth conditions, fules management specifications, habitat management specifications, and designs and implementation plan for recreational trails, educational signage, and formation of an independent non-profit land trust to manage the open space. Prepared similar plans for several other residential developments in Nevada County.

**Project:** **Ragsdale Creek Setback Study**
**Client:** **Susan Sanders Biological Consulting & County of Nevada**
Identified, described, and mapped important biological resources on an urban stream in Nevada County and recommended appropriate development setbacks to avoid/minimize impacts, assessed potential impacts to the creek as a result of adjacent development, and recommended mitigation measures to reduce impacts. Coordinated with County GIS Department in production of map of sensitive resources, and presented results of study to citizen advisory committee.


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# DECLARATION OF
## Richard L Anderson

I**, Richard L Anderson,** declare as follows:

1. I am presently under contract with Aspen Environmental Group to provide environmental technical assistance to the California Energy Commission. Under Contract No. 700-05-002, I am serving as a Biological Resource Specialist and Project Manager to provide Peak Workload Support for the Energy Facility Siting Program and for the Energy Planning Program.

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 **Rosemond Water Pipeline Alternative Route** for the **Beacon Solar Energy Project** based on my independent analysis of the route, 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: September 10, 2009 Signed: _____

At: Davis, California

# RICHARD L. ANDERSON

2850 Layton Dr.
Davis, CA 95616
530.758.4672
Danderson@cal.net

## EDUCATION

| | |
|---|---|
| 1976 | B.S. Biological Sciences, University of California at Davis |

## EXPERIENCE

| | |
|---|---|
| March 2005 - Present | Biological Resources, water Resources and soil resources consulting related to energy production. |
| March 2001 – March 2005 | Energy Facilities Siting Planner lll---Supervised the Biology, Water, and Soil Resources Unit of the Systems Assessment and Facilities Siting Division of the California Energy Commission. Responsible for biology, water, and soil staff and related products regarding energy planning, policy, and siting. |
| August 1979 - March 2001 | Planner l and Planner ll---Staff Biologist, California Energy Commission<br><br>Develop and review planning and policy objectives for California's energy facility siting program. Work on interdisciplinary teams responsible for review and preparation of Environmental Impact Reports, environmental planning projects, and locational analyses. Provide expert testimony in the area of biological resources. Act as project manager and contract manager for field research. Organize and direct workshops. Survey existing and proposed energy facility sites. Coordinate biological resource issue evaluation and mitigation planning with Federal, State; and local agencies and other interested parties. Managed several complex multi-year research projects. |
| October 1977-<br>July 1979 | Environmental Specialist ll, California State Water Resources Control Board<br>Responsible for environmental documents produced in the Division of Water Right's application unit. Analyzed and evaluated impacts of direct diversion and/or water storage (reservoir) on the environment. Coordinated and communicated with other State, Federal and local agencies, and the general public. Trained new employees. |

| | |
|---|---|
| PROFESSIONAL AFFILIATIONS/ CERTIFICATION | Raptor Research Foundation<br>The Wildlife Society---Certified Wildlife Biologist, TWS<br>American Ornithological Union<br>Coopers Society<br>American Field Ornithologists<br>Swainson's Hawk Technical Advisory Committee<br>International Erosion Control Association<br>National Wind Coordinating Committee |
| PUBLICATIONS | Author of numerous staff biological and water resources testimonies for the California Energy Commission of energy projects throughout the state including desert projects to marine biology and water quality issues associated with once-through cooling power plants. Author of numerous environmental assessments for water diversion and impoundment projects. Author of numerous reports and papers regarding conservation of T&E species, wind energy/bird interactions, and standard metrics and methods for monitoring bird interactions with wind turbines/utility structures. |

# DECLARATION OF
## Susan D. Sanders

I**, Susan D. Sanders,** declare as follows:

1. I am presently under contract with Aspen Environmental Group to provide environmental technical assistance to the California Energy Commission. Under Contract No. 700-05-002, I am serving as a Biological Resource Specialist and Project Manager to provide Peak Workload Support for the Energy Facility Siting Program and for the Energy Planning Program.

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 **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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: September 24, 2009 Signed: _____

At: Nevada City, California

# *Susan Sanders Biological Consulting*

*12213 Half Moon Way*
*Nevada City, California 95959*
*Phone: (530) 477-7415 Fax: (530) 477-7580*
*ssanders55@comcast.net*

## RESUME OF SUSAN SANDERS

### EDUCATION

| | | |
|---|---|---|
| Ph.D. | Zoology | University of California, Davis (1983) |
| M.A. | Zoology | University of California, Davis (1979) |
| B.A. | Zoology | University of California, Berkeley (1976) |

**REGULATORY COMPLIANCE EXPERTISE** in coordination with state, federal, and local agencies in the environmental review process for projects regulated by the California Environmental Quality Act, National Environmental Policy Act, Federal and State Endangered Species Acts, National Fish & Wildlife Coordination Act, Clean Water Act, and California Coastal Act. Also experienced in providing technical support and agency coordination for license and permit applications.

**TECHNICAL EXPERTISE** in surveys for threatened and endangered wildlife species; biological inventories; preparation of Biological Assessments; habitat management plans; raptor surveys; wildlife habitat assessment; mitigation monitoring; expert testimony; constraints analysis; sensitive species research.

### CONSULTING EXPERIENCE (1982 - 2009)

### CALIFORNIA ENERGY COMMISSION TECHNICAL ASSISTANCE (2005 – 2009)

**Siting Work**: Reviewed Applications for Certification; prepared Data Adequacy Forms, Data Requests, Preliminary and Final Staff Assessments; participated in PSA Workshops and provided testimony at Evidentiary Hearings; organized and conducted issue resolution workshops and interagency conference calls to resolve complex and controversial biological resource issues; coordinated extensively with local, state and federal agencies, including California Department of Fish and Game, U.S. Fish and Wildlife Service, Regional Water Quality Control Board, U.S. Army Corps of Engineers, and Bureau of Land Management. Projects include:

- **Beacon Solar Energy Project** - Beacon Solar LLC (08-AFC-2)
- **Orange Grove Energy** - J Power USA (08-AFC-4)
- **Ivanpah Solar Electric Generating System -**BrightSource (07-AFC-5)
- **MMC Chula Vista Expansion** - MMC Energy Inc. (07-AFC-4)
- **Eastshore Energy Center** - Eastshore Energy, LLC / Tierra Energy (07-AFC-5)
- **Pastoria Phase 2 Expansion Project** - simple cycle addition - Calpine (05-AFC-1)
- **San Francisco Reliability Project** - City of SF (04-AFC-1)

**Avian Specialist for Renewable Energy Issues**: Since 2005 provided Energy Commission staff with technical expertise as an avian specialist on wildlife interactions with wind turbines and other utility structures. Activities/publications include the following:

- **Wind-Wildlife Guidelines:** Co-authored *California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development in California* published by the Energy Commission in September 2007; helped organize and coordinate this statewide effort to develop science-based protocols for pre-and post-construction monitoring methods to

assess the effects of wind energy development on birds and bats. Worked closely with siting, PIER, and legal staff from Energy Commission and California Department of Fish and Game; coordinated the efforts of an eight-member Science Advisory Committee, helped organize and conduct public workshops, worked with wind energy developers, non-governmental organizations, and other stakeholders on this collaborative effort. <www.energy.ca.gov/windguidelines/index.>

- **Guidelines Implementation:** Working with CDFG and Energy Commission staff since 2007 on training for and implementation of the *Guidelines*. Conduct monthly interagency conference calls, helped organize and conduct two training workshops for CDFG, worked with CDFG headquarters and regional staff to develop a draft white paper: *Recommended Compensatory Mitigation Approaches for Reducing Unavoidable Impacts to Biological Resources from Wind Energy Development*. Co-author or on-line *Frequently Asked Questions about the Guidelines* <www.dfg.ca.gov/habcon/energy/wind>

- **Renewable Energy Research for PIER:** Prepared: *A Roadmap for PIER Research on Methods to Assess and Mitigate Impacts of Wind Energy Development on Birds and Bats in California* (Sanders and Spiegel 2008). This roadmap summarizes the current state of knowledge on the impacts of wind energy on birds and bats, and describes research that will improve the biological assessment, mitigation, and monitoring of wind energy projects in California. Currently working with PIER staff to oversee disbursement of $2.25 million in grant money to address Terrestrial resources Energy Research (PON 08-003) and to monitor and manage this research. Continuing work to develop an annotated bibliography of publications relating to research on wildlife interactions with wind turbines. </www.energy.ca.gov/publications/search>

## CONSULTING PROJECTS WITH CEQA/NEPA COMPLIANCE

***Commerical/Industrial/Linear Projects***. Prepared biological resource sections of Environmental Impact Reports/Statements, Initial Studies, and Environmental Assessments for hundreds of commercial, industrial, and residential developments, water projects, transportation and other linear projects throughout California. Conducted wildlife and plant community surveys, habitat assessments, agency coordination, data analysis and report preparation. Secured permits for 1600 Streambed Alteration Agreements from California Department of Fish and Game, Section 404 Permits from U.S. Army Corps of Engineers, and 401 Permits from Regional Water Quality Control Board. Some representative projects involving linear facilities include:

- Western Area Power Administration North Area Right of Way Maintenance Project;
- Pacific Bell Route 101 Fiber Optic Cable, Kern County;
- Laguna Creek Interceptor and Sewer Alignment Constraints Study, Sacramento County;
- Roseville Water Facilities Project, City of Roseville, Placer County;
- South Branch 60 kV Pole Line Project, Roseville, Placer County;
- Smith-Moulton Pipeline Project, Nevada County;
- Lower Laguna Drainage Master Plan, Sacramento County;
- Natomas Ditch Abandonment and Pipeline Construction Project, Sacramento County;
- Tuolumne River Wildlife Studies for FERC License, Tuolumne County;
- Calabazas Creek Flood Control Project, Santa Clara County.

***Transportation Projects***. Prepared Caltrans Natural Environment Study Reports, Biological Assessments, Categorical Exemption/Exclusions, Preliminary Environmental Study Forms, and other documentation for over 50 projects, including bridge replacements, interchange modifications, seismic retrofits, road widenings, emergency storm damage repairs, and other transportation projects in Caltrans Districts 1, 2, 3, 4, 5, 6, and 10. Involved extensive coordination

with federal agencies (Federal Highway Administration, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers) state (California Department of Fish and Game, Regional Quality Control Board, State Lands Commission, Coastal Commission), and cities and counties. Some representative projects include:

- SR 101/Prado Rd. Interchange Improvement Project, San Luis Obispo County;
- I-580/Isabel Avenue Interchange Project, Livermore, Alameda County;
- Route 99/Route 120 East Interchange Project, Manteca, San Joaquin County;
- Route 1 Improvement Project, Sand City to Seaside, Monterey County;
- Northeast Area Transportation Plan, Constraints Analysis, Sacramento;
- Route 92 Widening, Half Moon Bay, San Mateo County;
- Route 99/Hammer Lane Interchange Improvements, Stockton, San Joaquin County;
- La Gonda Way/Paraiso Drive Bridge Seismic Retrofit, Danville, Contra Costa County;
- HOV Lane Construction, US 50, Sunrise to El Dorado Blvd., Sact/El Dorado Co;
- Emergency Storm Damage Repair, Routes 49 and 89, Sierra and Nevada Counties;
- Interstate 5 - Benjamin Holt/Hammer Lane Interchange project, San Joaquin County;
- State Route 113/Interstate 5 Connector Study, Woodland, Yolo County, California;
- State Route 50/Folsom Interchange Improvement Project, Sacramento County.

***Compliance Monitoring.*** Supervised the design and ongoing monitoring of wetland and sensitive species mitigation projects, including riparian revegetation, vernal pool creation, and mitigation banking. Some projects involved preparation of a Habitat Mitigation and Monitoring Plan, and long-term monitoring efforts (five years plus), as well as preparation of annual reports, and coordination with US Army Corps of Engineers, US Fish and Wildlife Service, California Department of Fish and Game, California Department of Transportation, Regional Water Quality Control Board, and the US Environmental Protection Agency. Projects include:

- State Route 99/Calvine Interchange Vernal Pool Vegetation and Fairy Shrimp Mitigation Monitoring, Sacramento County;
- Roseville Sanitary Landfill Riparian Revegetation Project, Roseville, Placer County;
- Burrowing Owl Mitigation Monitoring, Meadowview, Sacramento County;
- Wilbur Avenue Overhead Project, Habitat Restoration for Lange's Metalmark Butterfly, Antioch, Contra Costa County;
- Swainson's Hawk Nest Monitoring, Garden Highway, Sacramento, Sacramento County;
- Sierra College Boulevard Riparian Revegetation Monitoring, Roseville, Placer County;
- Potrero Hills Landfill Bird Deterrence Monitoring, Solano County;
- State Route 50/Folsom Boulevard Improvement Project, Beach Lakes Mitigation Bank;
- Niblick Bridge Riparian Revegetation and Mitigation Monitoring, San Luis Obispo County;
- Humboldt Lily Mitigation Monitoring, Eskaton Village, Nevada County
- Dark Horse Mitigation Monitoring, Nevada County.

***Federal Land Exchanges*:** Prepared Biological Assessments/Evaluations for USDA Forest Service land exchanges in the Plumas National Forest, including the 11,000-acre Soper-Wheeler Company land exchange, a two-year project requiring management of eight employees and several subconsultants for surveys of rare plants, California spotted owls, northern goshawks, California red-legged frogs, and other sensitive species. Other projects include the Crites Mineral Fraction Land Exchange and the Saunders Land Exchange, Plumas National Forest.

***Litigation Support/Expert Witness.*** Provided technical assistance to project attorneys, prepared declarations, and expert testimony for the following litigation:

- El Portal Road Improvement Project (Sierra Club *et al. vs*. National Park Service);
- Merced River Plan (Sierra Club *et al. vs.* National Park Service);
- Lower American River Instream Flows. (Friends of the American River v. EBMUD);
- Putah Creek Instream Flows. (Putah Creek Council V. Solano Irrigation District et al.).

## PUBLICATIONS

**Sanders, S. D. and L. Spiegel**. 2008. *A Roadmap for PIER Research on Methods to Assess and Mitigate Impacts of Wind Energy Development on Birds and Bats in California.* Consultant Report, Prepared for the California Energy Commission. CEC-500-2008-076 October 2008

**California Energy Commission and California Department of Fish and Game.** 2007. *California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development.* Commission Final Report. California Energy Commission, Renewables Committee, and Energy Facilities Siting Division, and California Department of Fish and Game, Resources Management and Policy Division. Prepared by D. Anderson, S. Flint, S. Sanders, and D. Sterner. CEC700-2007-008-CMF.September 2007.

**Beedy, E. C., S. D. Sanders, and D. A. Bloom**. 1991. *Breeding status, distribution, and habitat associations of the tricolored blackbird* (*Agelaius tricolor*), 1850-1989. June 21, 1991. Jones & Stokes Associates (JSA 88-187.) Sacramento, CA. Prepared for USFWS, Sacramento, CA.

**Flett, M. A. and S. D. Sanders**. 1987. *Ecology of a Sierra Nevada population of Willow Flycatchers*. Western Birds. 18:37-42.

**Fowler, C., B. Valentine, S. Sanders, and M. Stafford.** 1991. *Habitat Suitability Index Model: Willow Flycatcher* (*Empidonax traillii*). USDA Forest Service, Tahoe National Forest.

**Harris, J. D., S. D. Sanders, and M. A. Flett**. 1987. Willow Flycatcher surveys in the Sierra Nevada. Western Birds. 18:27-36.

**Sanders, S. D. and M. A. Flett**. 1989. *The ecology of a Sierra Nevada population of Willow Flycatchers (Empidonax traillii), 1986 and 1987*. California Management Branch Administrative Report No. 89-3, California Department of Fish and Game.

**Sanders, S. D.** 1983. *Foraging Ecology of a Sierra Nevada population of Douglas Tree Squirrels* (*Tamiasciurus douglasii*). Ph.D. Dissertation, University of California, Davis

**DECLARATION OF**
**Amanda Blosser**

I, Amanda Blosser, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting Office of the Energy Facilities Siting Division as a Cultural Resources Specialist (Planner II).

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

3. I have contributed to the Cultural Resources Section for the Beacon Solar Energy Project Final Staff Assessment and based on my independent analysis of the Application for Certification and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge agree with the staff conclusions and I am willing to testify in support of these conclusions.

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:_____ Signed:_____

At: Sacramento, California

# Amanda Blosser

Planner II, California Energy Commission
1516 9th Street
Sacramento, CA 95814
916.654.4884
Ablosser@state.energy.ca.gov

**Summary of Qualifications**

Ten years experience in the field of historic preservation and cultural resource management. Expertise includes survey of architectural and engineering resources, assessment of effects on historic resources, and preparation of local and state landmark applications.

**Professional Experience**

California Energy Commission, Planner II, Environmental Office-Facilities Siting, May 2008-present.

Perform technical analysis for complex facility siting cases and planning studies in the area of cultural resources for Applications of Certification and Small Power Plant Exemptions.

California Office of Historic Preservation, Staff Historian II/, Project Review Unit, November 2005- present.

Major responsibilities include reviewing and providing comment, both from an academic and regulatory perspective, on project impacts to cultural resources, assessment of adequacy of reports prepared for review, recommending revisions to submission, and prepare agreement documents to resolve adverse affects to cultural resources, assists federal agencies in completing compliance with National Historic Preservation Act.

JRP Historical Consulting Services, Staff Historian II/Architectural Historian II, October 16, 2001- present.

Major responsibilities include inventory and evaluation of historic resources, preparation of environmental documents and other reports regarding compliance with state and federal environmental regulations and policies, undertaking site specific and general historical research, writing and compiling physical descriptions and integrity assessments of historic resources for historic property surveys, prescribing mitigation measures for historic resources as necessary and completing mitigation measures, assisting or training other staff in historical research methods and techniques. Other work related experience includes client and review agency coordination, project management, approaches, project budgets and schedules, proposals for projects, managing multiple projects and staff members, interaction with clients and various federal, state, and local agencies and the public.

Independent Architectural Historian and Preservation Planner, August 15, 1999-September 15, 2001.

Projects while an independent contractor encompassed preparation of small inventory and evaluation and historic architecture survey reports for city planning organizations and other municipal agencies, preparation of National Register of Historic Places nomination forms,

# Amanda Blosser

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preparation of Federal Tax Credit applications, and authoring land use histories. Additional project work included participating in design guideline recommendations for historic resources during master planning process.

Student Intern, Colonial Williamsburg, Architectural History and Material Conservation Departments, January 21, 1999-April 15, 1999.
Responsibilities included completion of research tasks for staff, undertaking paint analysis, conservation of objects, and preparation of written documentation. All work was undertaken under supervision of Architectural Historians and furniture conservators.

Ft. Davis National Historic Site, Student Architectural Conservator, June 15, 1998-August 15, 1998.
Responsibilities included preparation of written and photographic documentation, conducting condition assessments, undertaking plaster and paint stabilization and consolidation for historic structures within the Ft. Davis National Historic site. All work was undertaken in conjunction with additional architectural conservators and student architectural conservators.

Teaching Assistant, Texas Tech University, Architecture History, January 21, 1998 - May 15, 1998.

**Education**

Bachelor of Arts in Art History, University of Texas, Austin, 1995.
Undergraduate Deans' Research Scholarship Recipient, 1995.

Master of Science in Architecture, Historic Preservation, Texas Tech University, 1999.
Thesis: *Paint Analysis at Colonial Williamsburg, An Evolution of Technique*.

Los Rios Community College, GIS Applications certificate, currently enrolled.

**Professional Memberships and Community Activities**

Vice-President, Northern California Chapter of the Society of Architectural Historians.

Presenter, "Restoring Wood Windows," September 2005, 2006, 2007 at various locations.

Presenter, "Researching Your Historic Property," *Fainted Ladies Restoration Seminar*, October 16, 2004.

Society of Architectural Historians.

California Garden and Landscape History Society.

# DECLARATION OF
**Beverly E. Bastian**

I, **Beverly E. Bastian**, 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**.

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

3. I prepared the staff testimony on **Cultural Resources,** for the Beacon Solar Energy Project, based on my independent analysis of the Application for Certification and supplements hereto, 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: September 10, 2009 Signed: _____

At: Sacramento, California

**Beverly E. Bastian**
1516 Ninth Street MS 40
Sacramento, CA 95814-5504
(916) 654-4840 email: bbastian@energy.state.ca.us

| Education | Field | Degree | Year |
|---|---|---|---|
| University of California, Davis | Anthropology | B.A | 1967 |
| University of California, Davis | Anthropology | M.A | 1969 |
| Tulane University | Anthropology | A.B.D. | 1975 |
| University of Mississippi | American History | (courses only) | 1989 |
| University of California, Santa Barbara | Public (American) History and Historic Preservation | A.B.D. | 1996 |

## Experience

*State of California, California Energy Commission* *2005 to present*
*Planner II, Siting, Transmission, and Environmental Protection Division, Environmental Office, Biological and Cultural Unit*
All tasks related to the production of the cultural resources sections of CEQA-equivalent (California Environmental Quality Act) documents for the environmental review of proposed 50-MW+ power plants in California, including: Evaluating data in applications; writing data requests to applicants and doing independent research to compile an inventory of and evaluate the historical/cultural significance of cultural resources subject to significant impacts from proposed projects; providing and receiving information in public hearings on applications; analyzing all pertinent data; writing Staff Assessments of impacts; identifying California Register of Historical Resources-eligible cultural resources; developing mitigation measures to reduce to insignificant any impacts to Register-eligible cultural resources; providing expert testimony on my analyses and recommendations in public hearings; and reviewing compliance with mitigation measures during the construction, operation, and decommissioning of certified power plants. Additional tasks include: providing prefiling assistance to applicants; coordinating environmental review of power plant projects with cultural resources specialists in sister state agencies and in federal agencies; supervising and reviewing the work of Commission cultural resources consultants; reviewing the CEQA documents of sister state agencies; and developing internal procedures and guidelines to improve cultural resources review of applications.

*State of California, Department of Parks and Recreation* *2001 to 2005*
*Historian II, Cultural Resources Division, Cultural Resources Support Unit*
Major and complex historical and historic architectural investigations and studies dealing with the significance, integrity, and management of historic buildings, structures, and landscapes in California's state parks; participation in interdisciplinary teams and project assignments; preparation of technical reports and correspondence; inventorying and evaluating historic properties; coordinating the statewide registration of historical properties; assessing the eligibility of historic properties to the National Register of Historic Places and the California Register of Historical Resources; reviewing environmental documents and providing technical analyses of major Departmental projects to determine impacts to cultural resources under State and federal laws; identifying resource issues and constraints; establishing allowable use and development guidelines; developing approaches to protect, enhance, and perpetuate cultural resources under relevant State and federal laws, regulations, and standards; proposing and developing programs, policies, and budgets to meet Department's historic preservation missions.

*Department of Social Sciences, American River College* *2000 to 2002*
*Instructor (part-time), American History*
Creation and presentation of classroom lectures, selection of assigned texts and readings, creation and administration of quizzes and examinations, assignment and supervision of student research papers, student consultation in office hours, grading of all quizzes, tests, and papers, and assigning final student grades. These research, organizing, and teaching skills demonstrate ability to organize information, to speak effectively to the public, and to train and direct other personnel.

*Department of Sociology and Anthropology, University of Mississippi* *1987 to 1989*
*Archaeologist, Center for Archaeological Research*
All tasks for the completion of the historical archaeological part of an archaeological survey and testing program final report related to a U. S. Army Corps of Engineers erosion control project in twelve north-central Mississippi counties, including: Coordinating the activities of a field crew and the research of historians working in archives; setting up an artifact database using survey data to generate statistical summaries for discovered historical archaeological sites; gathering historical settlement and land-use data for twelve counties; conducting a special statistical analysis and synthesis of historical data only, focusing on pre-and post-Civil War land tenure and agricultural production for plantations in two counties where soil fertility contrasted; synthesizing data from all sources, collaborating on the final cultural resources management report with archaeologists specializing in prehistory and survey and sampling methodology; presenting findings at the annual meeting of the Society for Historical Archaeology in 1989.

*Gilbert Commonwealth, Inc.* *1984 to 1987*
*Historical Archaeologist and Project Manager, Environmental Unit*
All tasks as Principal Investigator for six major historical archaeological and/or historical architectural cultural resources management projects done under contract to federal, state, and local governments, including: Writing winning proposals for these projects; negotiating and managing project budgets; gathering/supervising the gathering of historical, oral historical, and archaeological data; analyzing/supervising the analysis of gathered data; and writing/supervising the writing of reports of findings, along with the creation of maps, illustrations, and data tables for these reports; serving as the historian and historical preservationist on several multidisciplinary teams tasked with siting the routes for several major power lines in east Texas.

*Tennessee Valley Authority (personal services contract)* *1979 to 1981, 1983-1984*
*Historical Archaeologist (self-employed)*
All tasks as Principal Investigator for various cultural resources management projects in areas affected by TVA construction, the most significant of which were: the complete excavation of and report on seven nineteenth-century log-cabin sites in Cedar Creek Reservoir in northwestern Alabama; and all historical research, the field work, and the report for the underwater remote-sensing reconnaissance and underwater videotaping of sunken Civil War cargo boats and gunboats at Johnsonville, Tennessee, in the western part of the Tennessee River.

*Other Archaeological Projects* *1966 to 1981*

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**Professional Societies**
Register of Professional Archaeologists, #10683
Society for Historical Archaeology
California Council for the Promotion of History
Vernacular Architecture Forum
Society for California Archeology

# DECLARATION OF
**Michael D. McGuirt**

I, **Michael D. McGuirt**, 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**.

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

3. I prepared the staff testimony on **Cultural Resources,** for the Beacon Solar Energy project, based on my independent analysis of the Application for Certification 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 issues 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: September 2, 2009 Signed: _____

At: Sacramento, California

# MICHAEL D. MCGUIRT, MA, RPA

## OBJECTIVE

To participate in the consultations that guide the management of heritage resources in native, public, and private trusts, to foster public support for heritage resource conservation through archaeological research and public outreach, and to contribute to the formulation of historic preservation policy.

## EDUCATION

MASTER OF ARTS in Anthropology ◦ The University of Texas at Austin May 1996

Area concentration in the North American Southwest. Technical concentrations in geoarchaeology, palynology, and ceramic analysis.

BACHELOR OF ARTS in Anthropology and Archaeological Studies ◦ The University of Texas at Austin December 1990

Area concentrations in Mesoamerica and the Andes. Technical concentration in lithic analysis.

## PROFESSIONAL EMPLOYMENT

ENERGY PLANNER II ◦ California Energy Commission, Sacramento, California November 2007 to November 2008

Develop environmental impact analyses of the potential effects that the construction and operation of proposed thermal power plants may have on significant cultural resources. Apply applicable Federal, State, and local statutes and regulations, as they relate to the consideration of cultural resources. Design and execute cultural resource impact analyses that are appropriate to the specific regulatory context for each proposed project. Gather and evaluate information on projects and on cultural resources in project areas. Develop and maintain agency and public relationships to acquire the most useful data and to elicit input in the development of California Energy Commission conditions of certification. Succinctly convey, orally in different public forums and in different written technical formats, the results of cultural resource impact analyses and proposed conditions of certifications meant to mitigate adverse impacts to significant cultural resources. Periodic reviews of licensees' actions to ensure compliance with extant conditions of certification. Oversight of consultants' who are preparing cultural resource impact analyses preservation program.

SENIOR STATE ARCHAEOLOGIST ◦ Office of Historic Preservation, California Department of Parks and Recreation (California State Parks), Sacramento, California December 2004 to December 2005

Out-of-class assignment supervising the Project Review Unit for the California State Historic Preservation Officer (SHPO) in the California Office of Historic Preservation (OHP). As the Acting Chief of Project Review, I managed and trained a staff of eight professionals and one clerical assistant to conduct, on behalf of the SHPO, the review of all Federal agency actions in the State of California under 36 CFR Part 800. 36 CFR Part 800 is the Advisory Council on Historic Preservation's implementing regulation for Section 106 of the National Historic Preservation Act of 1966, and the primary Federal historic preservation program.

ASSOCIATE STATE ARCHAEOLOGIST ◦ Office of Historic Preservation, California Department of Parks and Recreation (California State Parks), Sacramento, California May 2001 to November 2007

Project Review Unit archaeologist for the California State Historic Preservation Officer (SHPO). Consulted under 36 CFR Part 800 on the adequacy of federal agency efforts to comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470f). Served as SHPO contact person for informal federal agency consultation and formal initiation of Section 106 consultation (36 CFR § 800.3). Reviewed documentation of and provide comment on federal agency determinations and

findings (36 CFR §§ 800.4 and 800.5). Negotiated, drafted, and reviewed memoranda of agreement and treatment plans to resolve adverse effects to historic properties (36 CFR § 800.6). Negotiated, drafted, and reviewed program alternatives and management plans (36 CFR § 800.14). Administered federal agency efforts to comply with previously executed agreement documents. Developed and delivered public and professional presentations and workshops on the Section 106 regulatory process in California and the role of the SHPO in Section 106 consultation. Helped create initiatives through the National Park Service's Certified Local Government (CLG) program to encourage the development of local community archaeological site preservation plans. Evaluated and recommended proposals for CLG grants and helped administer resultant grants. Reviewed and provided comment on National Register of Historic Places (National Register) property nominations, and prepared and presented staff reports on the nominations to the State Historical Resources Commission. Member of committee to revise the Comprehensive Statewide Historic Preservation Plan for California, and author of the archaeology section of the plan. The Office of Historic
Preservation's (OHP) liaison to the Society for California Archaeology (June 2002 to September 2009).

ARCHAEOLOGICAL CONSULTANT ◦ Kaniakapūpū Project, O`ahu, Hawai`i ◦ Department of Anthropology, University of Hawai`i at Mānoa, Honolulu, Hawai`i June 2000

Recorded exposed architectural elements and directed test excavations to reconstruct building sequences of Native Hawaiian stone architecture. Advised on the interpretation of archaeological stratigraphy and on the field application of archaeological mapping methods and techniques.

ENVIRONMENTAL SPECIALIST III ◦ Jones & Stokes, Sacramento, California February 1999 to May 2001

Designed, conducted, and managed short- and long-term archaeological projects in California, Nevada, and New Mexico to comply with Sections 106 and 110 of the NHPA. Prepared proposals. Assisted with client contract negotiations. Conducted archaeological record searches and archival research. Directed Phase I pedestrian inventory surveys and test excavations for Phase II evaluations. Analyzed material culture assemblages. Prepared technical reports and regulatory compliance documents including National Register property and district evaluations, and monitoring and discovery plans. Represented clients in consultations with federal and state agencies, and coordinated and managed clients' compliance with federal cultural resource regulations and the cultural resource regulations of California, Nevada, and New Mexico.

ARCHAEOLOGICAL TECHNICIAN ◦ B.O.A.S., Inc., Seattle, Washington August 1998 to October 1998

Assisted with data recovery excavations on a short-term cultural resource management contract.

ASSISTANT ANTHROPOLOGIST ◦ Bernice Pauahi Bishop Museum, Honolulu, Hawai`i August 1996 to June 1998

Assisted with archaeological project design, preparation of proposals, and client contract negotiations, directed Phase I pedestrian inventory surveys, test excavations for Phase I subsurface inventory surveys, test excavations for property evaluations, and data recovery excavations, and assisted with preparation of technical reports on short-term cultural resource management contracts. Analyzed field records, prepared site reports and synthetic report chapters, and analyzed and prepared reports on lithic assemblages for Phases I–III of a long-term federal highway project (Interstate Route H–3). Conducted research in Hawaiian archaeology, and delivered public and professional presentations of that research. Advised on the integration of geoarchaeological methods and techniques into cultural resource management field efforts, and on geoarchaeological interpretations of extant field records, and designed and conducted geoarchaeological components of fieldwork for short–term cultural resource management contracts.

FIELD DIRECTOR ◦ Chersonesos Project, Ukraine, Eastern Europe ◦ Institute of Classical Archaeology, University of Texas at Austin, Austin, Texas May 1996 to July 1996

Assisted in archaeological project design. Directed a geoarchaeological reconnaissance, a pedestrian inventory survey, archaeological mapping, test excavations, and data recovery excavations in the National Preserve of Tauric Chersonesos. Conducted on-site project presentations for the United States Ambassador to Ukraine, and Ukrainian and Russian archaeological scholars. Assisted in the preparation and implementation of archaeological site preservation plans. Taught archaeological field methods and techniques to graduate students. Prepared portion of requisite field report for Crimean Archaeological Council, Simferopol.

ASSISTANT FIELD DIRECTOR ◦ Chersonesos Project, Ukraine, Eastern Europe ◦ Institute of Classical Archaeology, University of Texas at Austin, Austin, Texas May 1995 to July 1995

Assisted in the direction of data recovery excavations in the National Preserve of Tauric Chersonesos. Taught archaeological field methods and techniques to graduate students. Advised on the interpretation of archaeological stratigraphy.

ARCHEOLOGIST I ◦ Archeology Survey Team ◦ Texas Parks and Wildlife Department, Austin, Texas December 1994 to May 1995

Assisted in the direction of pedestrian inventory surveys, the preparation of cultural resource management plans, and the preparation of state site forms and reports of investigations. Advised on the integration of
global positioning system (GPS) technology and the field methods of archaeological survey.

RESEARCH ASSISTANT ◦ Colha Project, Belize, Central America ◦ Department of Anthropology, University of Texas at Austin, Austin, Texas July 1994 to August 1994

Conducted an extensive ground survey to correct the published base map for the Maya site of Colha. Assisted in mapping of surface architectural ruins. Directed a test excavation crew. Assisted in the preparation of the field report.

ARCHAEOLOGIST ◦ Lower Colorado River Authority, Austin, Texas February 1994 to December 1994

Designed and implemented trial mitigation plans for archaeological sites threatened by fluvial and lacustrine erosion. Assisted in pedestrian inventory surveys and test excavations, the preparation of state site forms, the development of the agency's database of its archaeological site inventory, and public education initiatives that included site tours for primary and secondary students, and workshops for primary and secondary teachers.

## COLLEGIATE EXPERIENCE

TEACHING ASSISTANT ◦ Archaeological Analysis ◦ Department of Anthropology, University of Texas at Austin, Austin, Texas August 1993 to December 1993

Presented undergraduate lectures on archaeological method and theory. Wrote and graded examinations. Advised students.

TEACHING ASSISTANT ◦ Archaeological Field School, New Mexico ◦ Department of Anthropology, University of Texas at Austin, Austin, Texas May 1993 to July 1993

Taught archaeological field methods and techniques to undergraduate and graduate students.

PROJECT ARCHAEOLOGIST ◦ WS Ranch Project, New Mexico ◦ Department of Anthropology, University of Texas at Austin, Austin, Texas May 1992 to July 1992, May 1993 to July 1993

Designed and prepared proposals for two field seasons. Addressed New Mexico State Historic Preservation Office and United States Forest Service comments on the proposals. Directed test excavations and data recovery excavations for two field seasons. Conducted geoarchaeological, palynological, and material culture analyses. Prepared a report of the research.

VOLUNTEER LITHIC ANALYST ◦ WS Ranch Project, New Mexico ◦ Department of Anthropology, University of Texas at Austin September 1991 to December 1991

Analyzed lithic tool collections from San Francisco and Three Circle phase Mogollon sites on the Gila National Forest.

VOLUNTEER ARCHAEOLOGICAL TECHNICIAN ◦ WS Ranch Project, New Mexico ◦ Department of Anthropology, University of Texas at Austin June 1991

Assisted in test excavations for the Phase II evaluations of San Francisco and Three Circle phase Mogollon sites on the Gila National Forest in advance of the development of an interpretative trail.

VOLUNTEER LITHIC ANALYST ◦ WS Ranch Project, New Mexico ◦ Department of Anthropology, University of Texas at Austin September 1990 to December 1990

Analyzed a lithic tool collection from a Three Circle to Tularosa phase Mogollon site on the Gila National Forest and submitted a report of the analysis.

ARCHAEOLOGICAL TECHNICIAN ◦ Archaeological Research, Inc., Austin, Texas July 1990

Assisted in a Phase I pedestrian inventory survey on the Sitgreaves National Forest, Arizona in advance of a timber sale.

ARCHAEOLOGICAL TECHNICIAN ◦ New World Consultants, Inc., Albuquerque, New Mexico June 1990

Assisted in a Phase I pedestrian inventory survey on the Gila National Forest, New Mexico in advance of a timber sale.

UNDERGRADUATE PARTICIPANT ◦ Archaeological Field School, New Mexico ◦ Department of Anthropology, University of Texas at Austin May 1990 to July 1990

Laid out mapping control networks and assisted in test excavations on a Reserve phase Mogollon site and a Three Circle to Tularosa phase Mogollon site, and assisted in a pedestrian inventory survey of the upper San Francisco River Valley on the Gila National Forest.

## TECHNICAL KNOWLEDGE AND SKILLS

### CULTURAL RESOURCE AND ENVIRONMENTAL LAW

Expert knowledge of Section 106 of the National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470f), as amended, and the regulation that implements Section 106 (36 CFR Part 800). Thorough knowledge of Section 110 of the NHPA and the U.S. Army Corps of Engineers' Appendix C to 33 CFR Part 325. Working knowledge of the Native American Graves Protection and Repatriation Act of 1990, the National Environmental Policy Act of 1969, the Archaeological Resource Protection Act of 1979, the California Environmental Quality Act of 1970, and cultural resource statutes, regulations, and guidelines for the states of California, Hawai`i, Nevada, New Mexico, and Texas.

### GEOARCHAEOLOGY

Specialty in geoarchaeology with emphases on processual and historical geomorphology, paleoecology, stratigraphy, pedology, and sedimentology. Strong ability to reconstruct the depositional history and paleoenvironment of archaeological resources at multiple areal scales. Design and implement geoarchaeological data collection strategies. Analyze and interpret resultant data. Analyze and interpret geoarchaeological data from extant field records. Expertise used to provide superior contexts for material

culture assemblages and architecture at sites in Hawai`i, Ukraine, and New Mexico.

### Mapping and Spatial Analysis

Five years of professional land surveying experience prior to 1988. Thorough knowledge of principles and techniques of land surveying, of a wide variety of optical instruments, of GPS receivers, and of the integration and manipulation of positional and attribute data from multiple sources in drafting and GIS applications. Expertise used to develop archaeological mapping and GIS programs for projects in California, Ukraine, Belize, Hawai`i, New Mexico, and Texas.

### Archaeological Survey and Excavation

Archeological survey and excavation experience on sites that represent a wide range of cultures, time periods, and environments. Survey experience in California on nineteenth and twentieth century Karuk sites and late nineteenth to early twentieth century Euroamerican mining sites, in Nevada on Pre-Archaic, Archaic, and Protohistoric Native American sites and mid-nineteenth to early twentieth century railroad, mining, emigrant trail, and homestead sites with European, Euroamerican, and Asian components, in northeastern and southern Texas on Paleoindian, Archaic, Caddoan, and early nineteenth to early twentieth century Euroamerican sites, in western New Mexico and eastern Arizona on Archaic and Mogollon sites, on the Na Pali Coast of Kaua`i, Hawai`i on precontact Native Hawaiian sites and in the southern Crimea, Ukraine on Neolithic, Bronze Age, Greek, Roman, Byzantine, and nineteenth century Russian sites.

Excavation experience in California on late nineteenth to early twentieth century Euroamerican mining sites, early twentieth century Euroamerican homesteads, and a Feather River site with Maidu and Euroamerican components, in western New Mexico on Early Pithouse period, Three Circle, Reserve, and Tularosa phase Mogollon sites, in eastern Belize on the Middle Preclassic to Postclassic Maya site of Colha, on O`ahu, Hawai`i on early postcontact to early twentieth century sites with Native Hawaiian, Chinese, Japanese, European, and Euroamerican components in downtown Honolulu, on the East Loch of Pearl Harbor, and in Nu`uanu Valley, in Washington on an Olcott phase Native American site, and in the southern Crimea, Ukraine on Hellenistic Greek and Roman sites.

Experience in the excavation of adobe and stone architecture, house pits or pithouses, former sites of wooden and grass structures, ancient roadways, hearths, refuse pits, storage pits, and extramural surfaces.

### Material Analyses

Experience with a wide range of prehistoric and historic material culture. Analyzed and reported on lithic assemblages from Hawai`i and New Mexico, ceramic assemblages from Ukraine and New Mexico, sediments from Hawai`i, Ukraine, and New Mexico, and fossil pollen from New Mexico. Ability to identify and date archaeological site assemblages with late eighteenth to early twentieth century architectural materials, bottle glass, tin cans, and American, British, Chinese, and Japanese ceramics.

### Computer Literacy

Experience with diverse word processing, spreadsheet, database, drafting, graphics, data processing, and GIS applications on PC (Windows XP) and MacIntosh platforms in networked environments. Word processing applications used include Microsoft Word and WordPerfect. Spreadsheet applications used include Microsoft Excel. Database applications used include Microsoft Access, Quattro Pro, FoxPro, and MinArk. Drafting applications used include AutoCAD and Surfer. Graphics applications used include CorelDraw. Data processing applications used include PathFinder, SurveyLink, and GeoLink. GIS applications used include ArcView.

## Recent Professional Development

### Cultural Resource and Environmental Law

*ACHP - FHWA Advanced Seminar: Reaching Successful Outcomes in Section 106 Review* ◦ Vancouver, Washington ◦ Advisory Council on Historic Preservation, Don Klima and Carol Legard; Federal Highway Administration, Mary Ann Naber October 2007

*NEPA Compliance and Cultural Resources* ◦ Portland, Oregon ◦ National Preservation Institute, Joe Trnka October 2007

*Section 106: How to Negotiate and Write Agreements* ◦ Sacramento, California ◦ National Preservation Institute, Claudia Nissley November 2004

*Consultation with Indian Tribes on Cultural Resource Issues* ◦ Sacramento, California ◦ National Preservation Institute, Thomas F. King and Reba Fuller September 2003

*Section 106: How to Negotiate and Write Agreements* ◦ The Presidio, San Francisco, California ◦ National Preservation Institute, Thomas F. King May 2002

*Introduction to CEQA* ◦ Sacramento, California ◦ University of California, Davis, Continuing and Professional Education, Ken Bogdan and Terry Rivasplata July 2000

### Technical Archaeology

*Introduction to Historic Site Survey, Preliminary Evaluation, and Artifact ID* ◦ West Sacramento, California ◦ California Department of Transportation and California Department of Parks and Recreation, Glenn Farris, Larry Felton, Julia Huddleson, Anmarie Medin, Pete Schulz, Judy Tordoff, and Kimberly Wooten September 2006

*Principles of Geoarchaeology for Transportation Projects* (Course No. 100246). Sacramento, California ◦ California Department of Transportation, Graham Dalldorf, Glenn Gmoser, Jack Meyer, Stephen Norwick, Adrian Praetzellis, and William Silva October 2006

### Information Technology and Cultural Resource Management

*GIS: Practical Applications for Cultural Resource Projects* ◦ Sacramento, California ◦ National Preservation Institute, Deidre McCarthy September 2006

### State Government

*Introduction to California State Parks* ◦ Asilomar, Monterey County, California ◦ California Department of Parks and Recreation and Monterey Peninsula College December 2001

## Publications, Reports, Papers, and Workshops

Darcangelo, Jennifer, John Sharp, Michael D. McGuirt, Andrea Galvin, and Clarence Caesar

2004 *Section 106 for Experienced Practitioners: Consulting with the California SHPO (GEV4111).* Course taught on 8 September in Oakland to California Department of Transportation cultural resources personnel and private sector cultural resource consultants (8 hours).

Darcangelo, Jennifer, John Sharp, Michael D. McGuirt, and Andrea Galvin

2005 *How to Consult with the California SHPO.* Workshop presented on 23 April at the 39th Annual Meeting of the Society for California Archaeology, Sacramento, California (6 hours).

1999a *Cultural Resource Inventory Report for Williams Communications, Inc. Fiber Optic Cable System Installation Project, Wendover, Nevada to the California State Line*. Volume 1: Draft Report. July. (JSA 98-358.) Sacramento, California. Prepared for Williams Communications, Inc., Tulsa, Oklahoma.

1999b *Cultural Resources Report for the Williams Communications, Inc. Interstate 80 Fiber Optic Cable System Installation Project*. Volume I. September. (JSA 98-358.) Submitted to Williams Communications, Inc., Tulsa, Oklahoma. On file with the State Historic Preservation Office, Carson City, Nevada.

1999c *Archaeological Site Avoidance and Monitoring Plans for Williams Communications' Fiber Optic Cable Installation In the Union Pacific Railroad Right-of-Way, Doña Ana County to Hidalgo County, New Mexico*. October. (JSA98-379.) Sacramento, California. Prepared for Williams Communications, Inc., Tulsa, Oklahoma.

2001 *Final Phase II Cultural Resource Evaluation for the Kramer Mining District, Edwards AFB, Kern and San Bernardino Counties, California*. Volume I. November. Sacramento, California. On file with the Base Historic Preservation Officer, Edwards AFB, California.

Lebo, Susan A. and Michael D. McGuirt

1997 *Geoarchaeology at 800 Nuuanu: Archaeological Inventory Survey of Site 50-80-14-5496 (TMK1-7-02:02), Honolulu, Hawai`i*. Department of Anthropology, Bishop Museum, Honolulu. (100 pp.) Submitted to Bank of Hawaii, Honolulu. On file with the State Historic Preservation Division, Honolulu.

1998a *Assessments of Stone Architecture: a Case Study from North Hālawa Valley, O`ahu*. Paper presented at the 11th Annual Hawaiian Archaeology Conference of the Society for Hawaiian Archaeology, Kailua-Kona, Hawai`i.

1998b Pili *Grass, Wood Frame, Brick, and Concrete: Archaeology at 800 Nuuanu*. Department of Anthropology, Bishop Museum, Honolulu. (142 pp.) Submitted to Bank of Hawaii, Honolulu. On file with the State Historic Preservation Division, Honolulu.

Lennstrom, Heidi A., P. Christiaan Klieger, Michael D. McGuirt, and Susan A. Lebo

1997 *Archaeological Reconnaissance of Pouhala Marsh, `Ewa District, O`ahu*. Department of Anthropology, Bishop Museum, Honolulu. (14 pp.) Submitted to Ducks Unlimited, Inc., Rancho Cordova, California. On file with the State Historic Preservation Division, Honolulu.

McGuirt, Michael D.

1996 *The Geoarchaeology and Palynology of an Early Formative Pithouse Village in West-Central New Mexico*. Unpublished M.A. thesis, Department of Anthropology, University of Texas at Austin.

1998 50-80-10-2010, 50-80-10-2016, 50-80-10-2088, and 50-80-10-2134. In *Activities and Settlement in an Upper Valley: Data Recovery and Monitoring Archaeology in North Hālawa Valley, O`ahu*, vols. 2a and 2b, edited by Department of Anthropology, Bishop Museum, pp. 1–3, 1–44, 1–5, and 1–46. Department of Anthropology, Bishop Museum, Honolulu. Submitted to State of Hawaii, Department of Transportation, Honolulu. On file with the State Historic Preservation Division, Honolulu.

2002 Committee Reports, OHP Liaison. *SCA Newsletter* 36(3):4–5.

2004 Committee Reports, OHP Liaison. *SCA Newsletter* 38(2): 7, 38(3):6–8.

2006 Preservation Archaeology. In *California Statewide Historic Preservation Plan: 2006–2010*, edited by Marie Nelson, pp. 8–15. California Department of Parks and Recreation's Office of Historic Preservation, Sacramento. Submitted to the National Park Service, Washington, D.C. On file at the California Office of Historic Preservation, Sacramento.

2008 Dealing with Multi-element Cultural Resources under Section 106. In *Historic Properties Are More Than Meets the Eye: Dealing with Historical Archaeological Resources under the Regulatory*

*Context of Section 106 and CEQA*. Session presented on 25 April at the *33rd Annual California Preservation Conference* of the California Preservation Foundation in Napa, California, moderated by Michelle Messinger and Michael D. McGuirt (1 1/2 hours).

McGuirt, Michael D. and Leigh Ann Garcia

1991 Lithic Stew at Apache Creek: the 1990 Chipped Stone Artifact Collection from LA 2949. In *An Analysis of Lithic Artifacts Recovered During the 1990 Test Excavations at the Apache Creek Site (LA 2949), Gila National Forest, West Central New Mexico*, edited by James A. Neely and Jay R. Peck, pp. 13–61. Department of Anthropology, University of Texas at Austin. Submitted to United States Forest Service. On file at the Gila National Forest Office, Silver City, New Mexico.

McGuirt, Michael D. and Leslie H. Hartzell

1997 50-80-10-2139 and 50-80-10-2459. In *Imu, Adzes, and Upland Agriculture: Inventory Survey Archaeology in North Hālawa Valley, O`ahu*, vols. 2c and 2d, edited by Department of Anthropology, Bishop Museum, pp. 1–17 and 1–5. Department of Anthropology, Bishop Museum, Honolulu. Submitted to State of Hawaii, Department of Transportation, Honolulu. On file with the State Historic Preservation Division, Honolulu.

1998 Chapter 1: Introduction. In *Activities and Settlement in an Upper Valley: Data Recovery and Monitoring Archaeology in North Hālawa Valley, O`ahu*, vol. 1, edited by Department of Anthropology, Bishop Museum, pp. 1–14. Department of Anthropology, Bishop Museum, Honolulu. Submitted to State of Hawaii, Department of Transportation, Honolulu. On file with the State Historic Preservation Division, Honolulu.

McGuirt, Michael D. and Margaret Howard

1995 Prehistoric Background. In *Archeological Survey of Tyler State Park, Smith County, Texas*, edited by Margaret Howard, pp. 16–31. Texas Parks and Wildlife Department, Austin. On file with the Texas Historical Commission, Austin, Texas Antiquities Committee Permit No. 1484.

McGuirt, Michael D. and Shannon P. MacPherron

1998 50-80-10-2137 . In *Activities and Settlement in an Upper Valley: Data Recovery and Monitoring Archaeology in North Hālawa Valley, O`ahu*, vol. 2b, edited by Department of Anthropology, Bishop Museum, pp. 1–86. Department of Anthropology, Bishop Museum, Honolulu. Submitted to State of Hawaii, Department of Transportation, Honolulu. On file with the State Historic Preservation Division, Honolulu.

McGuirt, Michael D. and Deborah I. Olszewski

1997 50-80-10-2256. In *Imu, Adzes, and Upland Agriculture: Inventory Survey Archaeology in North Hālawa Valley, O`ahu*, vol. 2d, edited by Department of Anthropology, Bishop Museum, pp. 1–9. Department of Anthropology, Bishop Museum, Honolulu. Submitted to State of Hawaii, Department of Transportation, Honolulu. On file with the State Historic Preservation Division, Honolulu.

Mikesell, Stephen, Michael McGuirt, and Trish Fernandez

2007 Introduction to the White Papers in State Historical Resources Commission Archaeology Committee White Papers. *SCA Newsletter* 41(1):18–21.

Sharp, John, Michael D. McGuirt, Jennifer Darcangelo, and Andrea Galvin

2004 *How to Consult with the California SHPO*. Workshop presented on 18 March at the 38th Annual Meeting of the Society for California Archaeology, Riverside, California (4 hours).

## Professional and Honorary Associations

Register of Professional Archaeologists
Society for American Archaeology
Society for California Archaeology
Honor Society of Phi Kappa Phi

## References and Writing Samples

Available upon request.

# DECLARATION OF
## Geoffrey Lesh

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

1. I am presently employed by the California Energy Commission in the **Engineering Office** of 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 helped prepare the staff testimony on the **Hazardous Materials Management Section and the Worker Safety and Fire Protection Section** for the **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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:_____ Signed:_____

At: Sacramento, California

**Geoffrey Lesh, P.E.**
**Mechanical Engineer**

## WORK HISTORY

California Energy Commission  Mechanical Engineer  2002 - Current
• Review and analyze applicants' plans for safe management of hazardous materials, fire prevention, and worker safety.

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 and data analysis.

Verbatim Corp  (Kodak)  Process Development Manager  1983 - 1989
• Mechanical engineering for computer disk manufacturing, including product, process, and equipment including metal-ceramic-plastic processes for optical disk development.
• Production processes included 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, University of Santa Clara*

IBM Corp  Mechanical/Process Engineer  1977 - 1983
• Product development for photocopiers and computer 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 |
| Registered Professional Engineer, California | Mechanical #M32576<br>Metallurgical #MT1940 |

## 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 Pat# 4,892,634 (assigned to Eastman Kodak Co.)

# DECLARATION OF
## Rick Tyler

I, **Rick A. Tyler**, declare as follows:

1. I am presently employed by the California Energy Commission in the Siting Office of the Energy Facilities Siting Division as a Senior Mechanical Engineer**.**

2. A copy of my professional qualifications and experience were included in the FSA, and is incorporated by reference herein.

3. I supervised the preparation of Staff Testimony on Hazardous Materials Management, Worker Safety / Fire Protection and Public Health for the Beacon Energy Project based on my independent analysis of the Application for Certification and any 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: September 10, 2009 Signed:_____

At: Sacramento, California

**RESUME**

RICK A. TYLER

Senior Mechanical Engineer

CALIFORNIA ENERGY COMMISSION

EXPERIENCE

Oct. 2001- Oct 2004 (Part Time)

**Corporate President, Chairman, and CEO** Professional Engineers in California Government (PECG) 2002, **Section Director** 2003-2004, 2008-2009 PECG Board of Directors

**As President / CEO** of the Professional Engineers in California Government, I served as the Chairman of the Board and Chief Executive Officer of this 13,000 member organization representing engineers employed by the State of California. In this capacity I was 1) the primary interface between the Corporate Board and the consultant organization that conducted most of the day to day business of the organization 2) the Chairman responsible for conducting quarterly board meetings and 3) responsible for ensuring that the member stake holders received good value for their investment. During my tenure on the corporate board we obtained the best contract negotiated in more than 20 years. This was achieved during a period of extreme economic constraints for, our employer, the State of California. I believe that this achievement was the direct result of my focus on the organization's primary mission and my success in keeping the organization on task.

**As Section Director** I represented the interests of the stakeholders in one of the 17 local sections represented on the PECG Board. This experience gave me a keen understanding of corporate board dynamics and how interactions between individual directors having conflicting priorities affects board function.

My experiences on the PECG Board of Directors provided me with a clear understanding of corporate board structure, function, and leadership as well as extensive knowledge of labor relations functions. It also provided me with a first hand understanding of the need for a clear vision and strong corporate governance which I provided during my tenure.

June 2000- Present (Full Time)

California Energy Commission – **Senior Mechanical Engineer (energy facility permitting)** Systems Assessment and Facilities Siting Division

Responsible for planning, organizing and directing the work of the Facility Safety Unit within the Systems Assessment and Facilities Siting Division's, Engineering Office. This unit evaluates the adequacy of proposed and ongoing safety management practices associated with hazardous material handling, worker safety and fire protection at very large conventional and alternative/renewable energy power facilities certified by the California Energy Commission. Responsible for quality and timeliness of all work conducted by employees and contractors performing work for this unit, including engineering analysis, products such as expert witness testimonies, compliance verifications, and conducting accident evaluations and investigations.

| | |
|---|---|
| Jan. 1998-<br>June 2000<br>(Full Time) | California Energy Commission - **Associate Mechanical Engineer (energy facility siting)** Energy Facility Siting and Environmental Protection Division<br><br>Responsible for review of Applications for Certification (applications for permits) for large power plants including the review of handling practices associated with the use of hazardous and acutely hazardous materials, loss prevention, safety management practices, design of engineered equipment and safety systems associated with equipment involving hazardous materials use, evaluation of the potential for impacts associated with accidental releases and preparation and presentation of expert witness testimony and conditions of certification. Review of compliance submittals regarding conditions of certifications for hazardous materials handling, including Risk Management Plans Process Safety Management. |
| April 1985-<br>Jan. 1998<br>(Full Time) | California Energy Commission - **Health and Safety Program Specialist (energy facility siting)** ; Energy Facility Siting and Environmental Protection Division.<br><br>Responsible for review of Public Health Risk Assessments, air quality, noise, industrial safety, and hazardous materials handling of Environmental Impact Reports on large power generating and waste to energy facilities, evaluation of health effects data related to toxic substances, development of recommendations regarding safe levels of exposure, effectiveness of measures to control criteria and non-criteria pollutants, emission factors, multimedia exposure models. Preparation of testimony providing Staff's position regarding public health, noise, industrial safety, hazardous materials handling, and air quality issues associated with proposed power plants. Advise Commissioners, Management, other Staff and the public regarding issues related to health risk assessment of hazardous materials handling. Present expert witness testimony at regulatory hearings. |
| Nov. 1977-<br>April 1985<br>(Full Time) | California Air Resources Board – **Mechanical Engineer (regulatory compliance)** last four years at Associate level<br><br>Responsible for testing to determine pollution emission levels at major industrial facilities; including planning, supervision of field personnel, report preparation and case development for litigation; evaluate, select and acceptance-test instruments prior to purchase; design of instrumentation systems and oversight of their repair and maintenance; conduct inspections of industrial facilities to determine compliance with applicable pollution control regulations; improved quality assurance measures; selected and programmed a computer system to automate data collection and reduction; developed regulatory procedures and the instrument system necessary to certify and audit independent testing companies; prepared regulatory proposals and other presentations to classes at professional symposia and directly to the Air Resources Board at public hearings. As a representative, of the State I coordinated efforts with federal, local, and industrial representatives. |
| EDUCATION | **B.S., Mechanical Engineering**, California State University, Sacramento. |
| KNOWLEDGE OF | Knowledge of; corporate governance, Roberts Rules of Order, corporate |

organization, structure and bylaws, business plan development, management supervision, organizational failure, contract management, process safety management, CEQA, statistics, instrumentation, technical writing, toxicology, risk assessment, loss prevention, environmental chemistry, hazardous materials management, technical management of chemical process safety, noise measurement, regulations and framework of toxic substances control and workplace safety, and presentation expert witness testimony.

## PUBLICATIONS, PROFESSIONAL PRESINTATIONS, AND ACCOMPLISHMENTS

Authored staff reports published by the California Air Resource Board and presented papers regarding continuous emission monitoring at symposiums

Authored a paper entitled "A Comprehensive Approach to Health Risk Assessment", presented at the New York Conference on Solid Waste Management and Materials Policy.

Authored a paper entitled "Risk Assessment A Tool For Decision Makers" at the Association of Environmental Professionals AEP Conference on Public Policy and Environmental Challenges.

Conducted a seminar at University of California, Los Angeles for the Doctoral programs in Environmental Science and Public Health on the subject of "Health Risk Assessment".

Authored a paper entitled "Uncertainty Analysis -An Essential Component of Health Risk Assessment and Risk Management" presented at the EPA/ORNL expert workshop on Risk Assessment for Municipal Waste Combustion: Deposition, Uncertainty, and Research Needs.

Presented a talk on off-site consequence analysis for extremely hazardous materials releases. Presented at the workshop for administering agencies conducted by the City of Los Angeles Fire Department.

Evaluated, provided analysis and testimony regarding public health and hazardous materials management issues associated with the permitting of more than 20 major power plants throughout California.

Developed Departmental policy, prepared policy documents, regulations, staff instruction, and other guidance documents and reference materials for use in evaluation of public health and hazardous materials management aspects of proposed power plants.

Project Manager, overseeing contract work totaling more than $500,000.

# DECLARATION OF
**James Adams**

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

1. I am presently employed by the California Energy Commission in the Environmental Office of 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 staff testimony on Land Use for the Final Staff Assessment for the Beacon Solar Energy Project (08-AFC-2), based on my independent analysis of the Application for Certification and supplements hereto, 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 issues 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: _____ Signed: _____

At: Sacramento, California

**James S. Adams, M.A.**
**Environmental Protection Office**
**California Energy Commission**
**1516 Ninth Street**
**Sacramento, CA 95814-5504**
**PH (916) 653-0702, FAX (916) 651-8868**
**jadams@energy.state.ca.us**

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, traffic and transportation, land use and visual resources. Work on special projects as requested.

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 Surfrider Foundation before the California Public Utilities Commission regarding decommissioning issues concerning Humboldt Bay, Diablo Canyon and San Onofre nuclear reactors.

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--
present 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
## Erin Bright

I**, Erin Bright,** declare as follows:

1. I am presently employed by the California Energy Commission in the **Engineering Office** of 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 staff testimony on **Facility Design** and **Noise and Vibration** for the **Beacon Solar Energy Project** based on my independent analysis of the Application, 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 issues 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: July 28, 2009 Signed: _____

At: Sacramento, California

**Erin Bright**
Mechanical Engineer

## Experience Summary

One year of experience in the electric power generation field, including analysis of noise pollution, construction/licensing of electric generating power plants, and engineering and policy analysis of thermal power plant regulatory issues. One year of experience in the alternative energy field, including analysis of alternative fuel production and use.

## Education

- University of California, Davis--Bachelor of Science, Mechanical Engineering and Materials Science
- University of California, Davis Extension Program--Renewable Energy Systems

## Professional Experience

**2007 to Present**-- Mechanical Engineer, Energy Facilities Siting Division - California Energy Commission

Performed analysis of generating capacity, reliability, efficiency, noise, and the mechanical, civil/structural and geotechnical engineering aspects of power plant siting cases.

**2006 to 2007**--Energy Analyst, Fuels & Transportation Division - California Energy Commission

Performed analysis of use potential and environmental effects of emerging non-petroleum fuels, including compressed natural gas, biomass, hydrogen and electricity, in heavy and light duty transportation vehicles. Contributor to Energy Commission's alternative fuels plan.

# DECLARATION OF
**Steve Baker**

I, Steve Baker, declare as follows:

1. I am presently employed by the California Energy Commission in the Engineering Office of 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 assisted in the preparation of the staff testimony on **Noise and Vibration**, and supervised preparation of the staff testimony on **Power Plant Efficiency, Power Plant Reliability, Facility Design** and **Geology and Paleontology**, for the Beacon Solar Energy Project based on my independent analysis of the Application for Certification 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 issues 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:_____ Signed:_____

At: Sacramento, California

**STEVE BAKER**, P.E.
Senior Mechanical Engineer

## Experience Summary

Thirty-five years experience in the electric power generation field, including mechanical design, QA/QC, construction/startup and business development/licensing of nuclear, coal-fired, hydroelectric, geothermal and windpower plants; and engineering and policy analysis of thermal power plant regulatory issues.

## Education

- California State University, Long Beach--Master of Business Administration
- California State Polytechnic University, Pomona--Bachelor of Science, Mechanical Engineering
- Registered Professional Engineer (Mechanical), California —
  No. M27737 expires 6/30/2010

## Professional Experience

**1990 to Present**--Senior Mechanical Engineer, Facilities Siting Division - California Energy Commission

Technical lead person for the analysis of generating capacity, reliability, efficiency, noise, geology, paleontology and the mechanical, civil/structural and geotechnical engineering aspects of power plant siting cases. Key contributor to Commission's investigation into market impediments to the deployment of advanced high-efficiency generating technologies.

**1987 to 1990**--Generation Systems/Facility Design Unit Supervisor, Siting & Environmental Division - California Energy Commission

Responsible for supervising the analysis of generating capacity, reliability, efficiency, safety, and mechanical, civil/structural, and geotechnical engineering aspects of power plant siting cases.

**1981-1986**--Operations Manager, Alternate Energy - Santa Fe Pacific Realty Corporation

Participated in and supervised identification, evaluation and feasibility analysis, licensing and permitting of hydroelectric, geothermal, windpower and biomass power projects.

**1974-1981**--Mechanical Engineer, Quality Engineer - Bechtel Power Corporation and Bechtel National, Inc.

Wrote equipment specifications, drew flow diagrams and P&ID's, performed system design and safety analysis for nuclear power plants and nuclear fuel processing plant. Wrote and implemented QA/QC procedures for nuclear power plant. Participated in construction/startup of large coal-fired power plant.

# DECLARATION OF

Dr.Obed Odoemelam

I, **Obed Odoemelam** declare as follows:

1. I am presently employed by the California Energy Commission in the Facilities Siting, Transmission, and Environmental protection Division as a Staff Toxicologist.

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 **Public Health** for the Beacon Solar Energy Project based on my independent analysis of the Application for Certification 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:_____ Signed:_____

At: Sacramento, California

# DECLARATION OF

Dr.Obed Odoemelam

I, **Obed Odoemelam** declare as follows:

1. I am presently employed by the California Energy Commission in the Facilities Siting, Transmission, and Environmental Protection Division as a Staff Toxicologist.

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 **Transmission Line safety and Nuisance** for Beacon Solar Energy Project based on my independent analysis of the Application for Certification 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:_____ Signed:_____

At: Sacramento, California

**RESUME**

DR. OBED ODOEMELAM

EDUCATION:

1979-1981 University of California, Davis, California. Ph.D., Ecotoxicology

1976-1978 University of Wisconsin, Eau Claire, Wisconsin. M.S., Biology.

1972-1976 University of Wisconsin, Eau Claire, Wisconsin. B.S., Biology

EXPERIENCE:

1989
The Present: California Energy Commission. Staff Toxicologist.

Responsible for the technical oversight of staffs from all Divisions in the Commission as well as outside consultants or University researchers who manage or conduct multi-disciplinary research in support of Commission programs. Research is in the following program areas: Energy conservation-related indoor pollution, power plant-related outdoor pollution, power plant-related waste management, alternative fuels-related health effects, waste water treatment, and the health effects of electromagnetic fields. Serve as scientific adviser to Commissioners and Commission staff on issues related to energy conservation. Serve on statewide advisory panels on issues related to multiple chemical sensitivity, ventilation standards, electromagnetic field regulation, health risk assessment, and outdoor pollution control technology. Testify as an expert witness at Commission hearings and before the California legislature on health issues related to energy development and conservation. Review research proposals and findings for policy implications, interact with federal and state agencies and industry on the establishment of exposure limits for environmental pollutants, and prepare reports for publication.

1985-1989 California Energy Commission.

Responsible for assessing the potential impacts of criteria and noncriteria pollutants and hazardous wastes associated with the construction, operation and decommissioning of specific power plant projects. Testified before the Commission in the power plant certification process, and interacted with federal and state agencies on the establishment of environmental limits for air and water pollutants.

1983-1985 California Department of Food and Agriculture.

Environmental Health Specialist.

Evaluated pesticide registration data regarding the health and environmental effects of agricultural chemicals. Prepared reports for public information in connection with the eradication of specific agricultural pests in California.

# DECLARATION OF
**Marie McLean**

I**,** Marie McLean, declare as follows:

1. I am presently employed by the California Energy Commission in the Environmental Office of 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 staff testimony on Socioeconomics for the Final Staff Assessment for the Beacon Solar Energy Project (08-AFC-2), based on my independent analysis of the Application for Certification and supplements hereto, 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 issues 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: _____ Signed: _____

At: Sacramento, California

# MARIE McLEAN

## QUALIFICATIONS SUMMARY

Twenty years experience in the field of environmental research, analysis, and planning, with specific emphasis on the economics of water, energy, and land use and its social, visual, and cultural ramifications. Specific projects involved (1) assessing economic costs and benefits of water delivery contracts and energy sales; (2) conducting and presenting visual analyses of historic and other local, state, and federal resources; (3) preparing local, state, and federal resource assessment forms; (4) determining and communicating benefits and costs of proposed development projects (housing, energy, and water) on the social and economic life of communities in which they are located; and (5) as member of local design review, historic preservation, and housing boards, recommended programs and policies and monitored their implementation.

## RECENT PROFESSIONAL EXPERIENCE

California Energy Commission, Planner II, Environmental Office-Facilities Siting, January 2008—present.

Conduct technical analyses for complex facility siting cases and planning studies in the area of socioeconomics and visual resources.

Electricity Oversight Board; June 1, 2007—December 31, 2008.

Developed, conducted, and presented economic studies on energy markets and transmission projects; California Independent System Operator (CAISO) market redesign and technology upgrade program; and investigated, analyzed, and reported the effects of existing and proposed energy programs on supply, demand, and rates.

California Department of Water Resources, State Water Project Analysis Office, June 2001—July 31, 2007.

Developed and implemented complex analyses of the social, economic, and financial ramifications of contracted and proposed water deliveries and transfers and changes to valuation methods for selling energy in deregulated markets. Researched, identified, and reported on market activities in energy and water and their economic effects on ratepayers.

## EDUCATION

Bachelor of Arts, Economics, California State University, Sacramento, 1983

# DECLARATION OF
**Casey Weaver**

I**,** Casey Weaver declare as follows:

1. I am presently employed by the California Energy Commission in the Soil and Water and Resources Unit of the Siting, Transmission and Environmental Protection Division as an Engineering Geologist.

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 SOIL AND WATER SECTION, for the BEACON SOLAR ENERGY PROJECT based on my independent analysis of the Application for Certification and supplements hereto, 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: September 11, 2009 Signed: Casey Weaver

At: Sacramento, California

**CASEY W. WEAVER, RG, CEG**

## SUMMARY OF EXPERIENCE:

Certified Engineering Geologist with over 20 years of environmental and geotechnical consulting experience. Experience includes remedial investigations and feasibility studies (RI/FS), groundwater investigations, corrective action plans, landfill studies (SWATs, siting, closure), preliminary environmental site assessments (PESA, Phase I), regulatory compliance (RCRA/CERCLA), geotechnical investigation/evaluation, geologic hazard evaluations, active fault evaluations, seismic studies, landslide evaluation/repair, foundation suitability studies, personnel management and business development.

## EDUCATION:

B.S. Geology, Humboldt State University, Arcata, CA, 1981
University of California, Davis Extension Courses

## REGISTRATIONS/LICENCES/CERTIFICATIONS:

Certified Engineering Geologist, California
Registered Geologist, California, Oregon, Arizona
Registered Environmental Assessor
OSHA 1910.120 Hazardous Waste Operations and Emergency Response - 40hr
OSHA 1910.120 Hazardous Waste Operations and Emergency Response -Supervising Operations at Hazardous Waste Sites.

## PROFESSIONAL HISTORY:

2008 to Present **Engineering Geologist**
*California Energy Commission, Sacramento, CA*

Duties within the Water and Soils Unit of the Environmental Office in the Facilities Siting Division include review and evaluation of applications for certification of thermal power plants within the state of California. The focus of the work is on sensitive project sites that may have issues involving groundwater and surface water resources, soil erosion, flooding potential, water quality and plant-derived waste generation and disposal. In addition, evaluate construction, operation and maintenance of the facilities and conduct investigations to determine if violations of the program's regulations, the Energy Commission's conditions of certification, or the California Environmental Quality Act (CEQA) have occurred.

2001 to 2008 **Engineering Geologist**

*State Water Resources Control Board, Headquarters, Sacramento, CA*

With the UST Enforcement Unit, under direction from the State Attorney General's Office, conducted inspections of UST systems to evaluate compliance with 1998 upgrade requirements. This work culminated in the largest settlement of its kind in the nation's history. In addition, conducted surveillance of unlawful discharges from remediation systems and conducted investigations of UST Fund fraud cases.

With the USTCF Technical Review Unit, evaluated the technical elements of USTCF claims.

With the Division of Financial Assistance, assisted with the development of program policy for the Agricultural Water Quality Grant Program ($46 million) and the Integrated Water Quality Grant Program ($380 million), participated in stakeholder workshops, contributed to multijurisdictional work groups for program development and implementation.

With the Office of Enforcement, conducted investigations of operator misconduct, wrote enforcement investigation reports and prepared disciplinary letters.

1998 to 2001 **Senior Engineering Geologist**
*BSK & Associates, Rancho Cordova, CA*

Designed and directed hydrogeologic investigations for use with environmental remediation projects. Supervised field personnel installing groundwater monitoring wells, conducting aquifer tests & SVE pilot tests, reviewed reports and workplans, and conducted business development.

Conducted review of Alquist-Priolo active fault hazard reports as county geologist for Kern County.

1993 to 1998 **Senior Geologist, Geoscience Team Leader and RI/FS Task Leader**
*LAW Engineering and Environmental Services, Inc., Sacramento, CA*

As Geoscience Team Leader, responsible for career development, training and personnel management of ten employees. This group consisted of 3 senior-level geologists, 4 project level geologists and scientists, 2 junior level geologists and 1 technician.

As RI/FS Task Leader, responsible for the development of cost estimates/budgets, preparation of Work Plans and Sampling and Analysis Plans, management of field activities, data collection and documentation associated with the investigation of 15 Installation Restoration Program sites at Beale Air Force Base awarded under several Delivery Orders with combined project budgets of $18 million. Also responsible for aerial photographic interpretations associated with a basewide (23,000 acres),

Preliminary Assessment, and preparation of a basewide Hydrogeologic Evaluation Report.

1990 to 1993

**Senior Project Manger/General Manager**
*Earthtec, Ltd., Roseville, CA*

Management of Environmental Department, business development, preparation of cost estimates and proposals, client and regulatory agency interface, supervision and training, report writing, technical review, budget management, and quality control. Initiated and supported the development of company's wetland and wildlife departments. Typical projects included preliminary sire assessments, soil vapor studies, detailed hydrogeologic evaluations, waste plume delineations, and development of remediation alternatives associated with landfills, service stations, bulk oil facilities and other potentially contaminated sites.

1981 to 1990

**Project Geologist**
*SHN Group, Inc. Eureka, CA*

Managed project work directed toward solving environmental issues at variably contaminated sites and provided geotechnical information for land development and construction. Responsibilities included development of cost estimates/budgets, planned and supervised field operations, collected and interpreted subsurface information, evaluated areas traversed by Alquist-Priolo Special Studies Zones and sites subject to slope stability hazards. Typical projects included geotechnical evaluations and geologic hazard studies for major subdivisions, hospitals, schools, lumber companies, run-of-the-river hydroelectric projects, underground storage tank sites, and solid waste landfills.

1979 to 1981

**Geologist/Seismologic Technician**
*Woodward-Clyde Consultants, San Francisco, CA*

Designed and operated a laboratory model to study surface effects of thrust faulting in connection with seismic evaluation studies for the PG&E Humboldt Bay nuclear reactor. In addition, installed and operated field seismographs in the Humboldt Bay region.

# DECLARATION OF
**Vince C. Geronimo, PE**

I, Vince Geronimo, declare as follows:

1. I am presently employed by the California Energy Commission in the Environmental Office of the Energy Facilities Siting Division as a Soil & Water Resources Specialist.

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 Soil & Water Resources, for the Beacon Solar Energy Project based on my independent analysis of the Application for Certification and supplements hereto, 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: October 14, 2009 Signed: _____

At: Sacramento, California

# Vince C. Geronimo, PE, CFM

Associate Principal

Vince Geronimo is a registered California Professional Civil Engineer with 14 years of experience in the field of civil, environmental, and water resources engineering. Mr. Geronimo specializes in the planning, design, and implementation of flood mitigation projects that integrate ecosystem restoration. As part of PWA's fluvial team Mr. Geronimo provides technical QA/QC review of hydrologic and hydraulic analyses. Mr. Geronimo manages PWA's IDIQ contract with FEMA Region IX. For the California Energy Commission, Mr. Geronimo has conducted CEQA analysis, recommended mitigation measures, and contributed to Staff Assessments on four siting cases. Mr. Geronimo has conducted various environmental compliance reviews for more than 20 energy facilities. His education and project experience includes wastewater treatment facility design, water transmission and storage analysis, economic analysis, sediment and erosion control planning, stream and wetland restoration, and design of hydraulic structures. As a Certified Floodplain Manager and an engineer, Mr. Geronimo is knowledgeable of methods, to employ, that help reduce flood losses and protect and enhance the natural resources and functions of floodplains.

| | | |
|---|---|---|
| **Education** | M.S., 2004 | Civil Engineering, Water Resources Emphasis,<br>University of Colorado - Denver, Colorado |
| | B.S., 1995 | Civil Engineering, Environmental Emphasis,<br>Southern Illinois University - Edwardsville, Illinois |
| **Professional Registration** | 2001<br>2006 | Professional Engineer, State of Colorado, 35224<br>Civil Engineer, State of California, 70165 |
| **Certifications** | 2002 | Certified Floodplain Manager, Certificate No. US-02-00543, Association of State Floodplain Managers |
| **Memberships** | | American Society of Civil Engineers<br>Environmental & Water Resources Institute of ASCE-Sacramento (Treasurer)<br>Association of State Floodplain Managers<br>Floodplain Managers Association |

**Selected Project Experience**

**Beacon Solar Energy Plant**; Kern County, CA 2005 -Present. PWA Project Manager provided environmental review for the California Energy Commission of a proposed solar energy plant in the Mojave desert. The environmental review focused on the stormwater, BMPs, and flood related impacts. Mr. Geronimo conducted hydrologic, hydraulic, and geomorphic analyses to assess the project plan to divert an existing dry wash through a constructed earthen diversion channel. Mr. Geronimo provided environmental review of the Storm Water Pollution Prevention Plan and the Drainage Erosion and Sediment Control Plan (DESCP). Mr. Geronimo authored the stormwater and flood related portions of the Preliminary Staff Assessment which included an engineer's evaluation of the project in a separate appendix.

**GWF Tracy**; Tracy, CA 2008 – Present. PWA Project Manager provided environmental review of a proposed combined-cycle power plant in the City of Tracy for the California Energy Commission. The environmental review focused on the impacts to soil and water use. Mr. Geronimo specifically reviewed the project's proposed stormwater related facilities, BMPs, the septic facility, and water use to evaluate potential soil and water impacts. Mr. Geronimo conducted an assessment of the availability of recycled water and provided oversight for the Soil and Water Section of the Preliminary Staff Assessment.

**Compliance Reviews**; Throughout California. 2006 – Present. PWA Project Manager responsible for compliance reviews for the California Energy Commission. Mr. Geronimo is a technical reviewer for Soil & Water and Waste compliance submittals. Mr. Geronimo reviews Storm Pollution Prevention Plans (SWPPPs), Drainage Erosion and Sediment Control Plans (DESCP), water use, monthly/annual compliance reports, and flood related compliance submittals to determine if the Project remains in compliance with the Conditions of Certification specified in the Energy Commission's licensing decision.

**Selected Project Experience**
(Continued)

**San Francisco Electric Reliability Plant**; San Francisco, CA 2005 -Present. PWA Assistant Project Manager provided environmental review of a proposed power plant in San Francisco for the California Energy Commission. The environmental review was focused on the impacts to soil and water use. Mr. Geronimo specifically reviewed potential flooding, water reclamation and re-use, tertiary wastewater treatment facility, water quality impacts related soil erosion, and the Storm Water Pollution Prevention Plan and storm water best management practices.

**Inland Empire Energy Center**; Romoland, CA 2005. PWA Assistant Project Manager provided environmental review of a proposed power plant in Romoland for the California Energy Commission. The environmental review was focused on the impacts to soil and water use. Specific analyses included assessing potential flooding, water quality impacts related soil erosion, and the Storm Water Pollution Prevention Plan and storm water BMPs.

**South Bay Salt Ponds Restoration Project,** For the California State Coastal Conservancy, 2004 – 2008. PWA Task Manager for the riverine analysis of the Guadalupe River/Alviso Slough system. The analysis supported the EIR/S documentation for the South Bay Salt Pond Restoration Project NEPA/CEQA environmental review processes. The analysis combined a steady-state HEC-RAS model and an unsteady UNET model to test a combination of flooding scenarios related to the project alternatives that reduce offline storage and improve conveyance. The South Bay project is approximately 15,000 acres and will restore and enhance wetland habitats, improve public access and reduce flood hazards.

**Independent QA/QC Review**; FEMA Region IX, 2005 - 2008, PWA Project Manager responsible for developing the QA/QC procedures and checklist to provide independent review of three FEMA Flood Insurance Restudies within Monterey County, Siskiyou County, and Placer County. The independent technical review was conducted in accordance with the established policy principles and procedures in the *Guidelines and Specifications for Flood Hazard Mapping Partners*. The technical review included: Topographic Data, Hydrologic Data, Hydraulic Data, Floodplain Mapping (Revised Areas), as well as secondary checks of the data submitted as part of the TSDN for each re-study.

**Flood Insurance Re-Studies**; **FEMA Region IX**, 2007 - Present, PWA Project Manager responsible for managing a Marin County (Ross Valley) and a Santa Cruz County (Watsonville) Flood Insurance Re-study of several creeks in the study areas. The re-studies include: field survey, topographic mapping, hydrologic and hydraulic modeling, flood hazard assessment, and floodplain mapping.

**Newhall Ranch Development**, Valencia, CA, 2006-2008. For Newhall Land and Farming Company. Led the hydraulic assessment and conceptual civil design for improving five tributaries of the Santa Clara River that will be subject to hydromodification. Mr. Geronimo developed a suite of channel stabilization and bank stabilization application methods and design criteria to achieve stable channel morphology in response to reductions in sediment delivery and increases in flow.

**Contra Costa Clean Water Program Hydrograph Modification Management Plan –** Project Engineer, 2006-2007; for Contra Costa Clean Water program. Mr. Geronimo was part of the consultant team to assist the Contra Costa Clean Water Program in developing a Hydrograph Modification Management Plan (HMP). The HMP will include standards and performance criteria for hydrograph modification management by new development projects. Mr. Geronimo was involved in developing engineering concepts and practical civil design for Integrated Maintenance Practices (IMP).

**Lake Sonoma Water Diversion**; Sonoma County, CA 2005, PWA Project Manager to study feasibility of diverting water from Lake Sonoma, to the Russian River. The purpose of the analysis was for an EIR scoping process. Mr. Geronimo performed a reconnaissance level, engineering evaluation and provided an approximate cost to deliver 26,000 acre-feet of water from Lake Sonoma to the Russian River. The summary cost estimate included: facilities cost, approximate electrical demand engineering costs as percentage of facilities cost.

# DECLARATION OF
**John L. Fio**

I, John L. Fio, declare as follows:

1. I am presently a consultant to the California Energy Commission for the Siting Office of the Energy Facilities Siting Division as a Hydrogeologic Consultant through Aspen Environmental Group**.**

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 **Soil and Water Resources** for the Beacon Solar Energy Project based on my independent analysis of the Application for Certification and the 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: September 17, 2009 Signed:_____

At: Davis, California

# JOHN L. FIO

## QUALIFICATIONS

John L. Fio has almost 25 years of problem-solving experience. Mr. Fio analyzes groundwater systems, quantifies chemical transport in the subsurface, and evaluates groundwater surface-water interactions. He is a recognized expert on hydrologic and water quality issues. Mr. Fio develops and employs numerical models for site, water district, and basin-wide investigations; calculates extraction effects on groundwater levels, stream flow, and lake levels; establishes water quality monitoring programs; designs water management plans; evaluates groundwater quality effects of wastewater and recycled water disposal to land; develops and implements Geographic Information System (GIS) databases; and determines water sources using chemical and age-dating techniques.

## PROFESSIONAL EXPERIENCE

*January, 1998 – present*

Principal Hydrologist, HydroFocus, Inc. *Davis, CA*

California Energy Commission (2008-2009): As part of several proposed power plant permitting reviews (CPV Sentinel, Beacon, and Carizzo), project applicants developed groundwater-flow models to simulate groundwater level changes in response to pumping from power plant extraction wells. Mr. Fio reviewed model construction, assumptions, parameters, calibration, sensitivities, results, and validity. When appropriate, he also employed the models to complete analyses to identify model uncertainty and help develop mitigation and project Conditions of Certification. His written reports are integrated as part of Staff's Preliminary and Final Assessments. Additionally, John provided hydrogeologic assessments to interpret model results and describe basin conditions.

Grasslands Bypass EIR/EIS (1999 and 2008): The Grasslands Drainage Area includes 97,400 acres of farmland approximately located between the California Aqueduct on the west and San Joaquin River on the east. In 1999 and again in 2008, Mr. Fio utilized groundwater-flow and geochemical models to simulate changes in salt and selenium distributions in soil under different water- and land-management alternatives as part of NEPA/CEQA compliance documentation.

San Luis Drainage Feature Evaluation (2005-2007): John Fio completed groundwater hydraulic and soil and water quality assessments for drainage-water management alternatives. As a principal of HydroFocus, Inc., he was part of the URS team that received a commendation from the U.S. Bureau of Reclamation for outstanding performance in the successful completion and certification of the NEPA/CEQA Environmental Impact Report and Environmental Impact Statement.

Alexander Valley Resort AB-610 Water Supply Assessment (2008): The proposed Alexander Valley Resort is located in Cloverdale, California. John Fio completed the SB-610 water supply assessment as required by CEQA for the City of Cloverdale, who is both the public water supplier and the lead agency for the project. Because the City of Cloverdale did not have an adopted Urban Water Management Plan, other data sources,

reports, and soil moisture budget modeling were required to determine the total available water supplies during normal, single dry, and multiple dry years for a 20-year projection. The analysis determined whether supplies met the estimated water demand associated with the proposed project and future residential and non-residential water uses.

Additional relevant data and modeling analyses include:

- Groundwater-flow, solute-transport, and water-quality impacts from wastewater disposal to land: sanitary districts and municipalities located in San Joaquin and Contra Costa Counties, California.
- Quantitative hydrogeochemical assessment of contaminant transport near Menlo Park, California. Development of groundwater-flow and solute-transport models to quantify hydrocarbon transport beneath industrial facility near San Francisco Bay.
- Groundwater recharge and subsurface storage, Merced County, California. Developed and implemented regional groundwater-flow model to assess groundwater recharge and pumping projects.
- Depletion of subsurface flow to the North Platte River, Wyoming and Nebraska. Data analysis and modeling of stream aquifer interactions in support of interstate water rights conflict.

*1995 to 1997*

Senior Project Hydrologist, Hydrologic Consultants, Inc. *Sacramento, CA*

Project experience in the evaluation of groundwater flow, water quality, and solute transport. Consulting assignments included the following:

- Developed relationships to describe geologic controls and load-flow relationships for Santa Ynez River drainage system. The relationships were part of a network of interacting reservoir operations, surface-water, and groundwater-flow and transport models.
- Evaluation of groundwater-flow paths beneath South San Francisco Bay. The groundwater-flow system was quantified using a groundwater-flow model to assess system response to pumping centers located east and west of the Bay.
- Coordination with the California Regional Water Quality Control Board on the remediation of a VOC plume in Mountain View, California.
- Assess the response of groundwater levels, streamflow, and spring discharge to groundwater pumpage in the Mammoth Basin, California.
- Quantifying stream flow depletions owing to increased consumption and groundwater pumping.

*1990 to 1995*

Research Grade Hydraulic Engineer, U.S. Geological Survey Sacramento, CA

- Geohydrologic and groundwater quality investigations in the western San Joaquin Valley, California.
- Directed the development of a regional Geographic Information System database for the South San Francisco and Peninsula Area, California.
- Supervised data collection and development of databases, data analyses, and report writing.

- Constructed groundwater flow models for parts of the western San Joaquin Valley and South San Francisco Bay areas, California.
- Interacted with private and public cooperators and funding agencies.

*1987 to 1990*

Civil Engineer, U.S. Geological Survey *Sacramento, CA*

- Conducted field-scale investigations of on-farm drainage systems.
- Developed groundwater-flow model of tile drainage system. Assessed flow paths and salt transport in shallow flow-system. Quantified regional groundwater-flow paths intercepted by on-farm drainage systems.
- Integrated particle-tracking models with groundwater-flow model results to assess advective transport of salts and selenium.

*1985 to 1987*

Hydrologist, U.S. Geological Survey *Sacramento, CA*

- Designed and conducted sorption experiments and incorporated results into a solute transport model.
- Assessed the distribution of salts and selenium in unsaturated and saturated soil profiles.
- Developed analytical method to estimate organic selenium concentrations in soil extracts.

*1983 to 1984*

Research Assistant, University of California *Davis, CA*

- Conducted an assessment of methods used to analyze for selenium in soil extracts, aqueous samples, and animal tissues.
- Implemented experiments to assess arsenic volatilization from soils.
- Conducted laboratory analyses to estimate the buffering capacity of soils in response to acidic deposition.

## ACADEMIC BACKGROUND

Master of Science, 1987, Civil Engineering, University of California at Davis
Bachelor of Science, 1984, Soil and Water Science, University of California at Davis

## PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers
Association of Groundwater Scientists and Engineers
California Groundwater Resources Association
Citation for Outstanding Performance, University of California, Davis (1981).

# DECLARATION OF
## DAVID FLORES

I, **David Flores** declare as follows:

1. I am presently employed by the California Energy Commission in the Siting, Transmission and Environmental Protection Division as a **Planner 2**.

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

3. I prepared the staff testimony on **Traffic and Transportation** for the Beacon Solar Energy Project based on my independent analysis of the Application for Certification 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: July 28, 2009 Signed: _____

At: Sacramento, California

# DAVID FLORES

## WORK EXPERIENCE

Sept. 1998 to Present — **Planner 2.** California Energy Commission, Energy Facilities Siting and Protection Division.

- Provide technical analysis of proposed energy planning, conservation, and development programs on land use, visual and traffic and transportation resources. Specific tasks include: the analysis of potential impacts; identification of suitable mitigation measures; preparation of testimony; participate in public workshops; present sworn testimony during evidentiary hearings, and project monitoring to ensure compliance with local, state and federal environmental laws and regulations.

March 29,1988 to September 12, 1998 — **Senior Planner.** County of Yolo Planning and Public Works Department

Senior Planner - Current and Advanced Planning (Resources Management and Planning)

Responsibilities included the following:

- Administered the establishment of Planning schedules and timeframe completion schedules; Administration and staff support to Planning Commission and Board of Supervisors; Staff support and liaison to citizen's committees. Preparation of Environmental documents (Negative Declarations, preparation of Environmental Impact Reports and Categorical Exemptions) in accordance with State and Federal Regulations.

June 1, 1976 to March 25, 1988 — **Manager of Resources** Citizens Utilities Company of California

Responsibilities included the following:

- Coordinated, planned and developed semi-annual and annual construction and operating and maintenance budgets for all Northern California operations.
- Assisted in the development of rate and fee schedules before the California Public Utilities Commission for all Northern California Operations.
- Direct five employees and twenty-five employees in the outlying operations.
- Extensive experience in specification writing, project planning and scheduling, construction management, and site supervision

## EDUCATION

California State University @ Sacramento
University of California @Davis
Major: Environmental Studies
Minor: Business Administration

# DECLARATION OF
## Michael N DiFilippo

I**, Michael N DiFilippo** declare as follows:

1. I am presently employed **as a consultant for** the California Energy Commission in the Energy Facilities Siting Division as a **water treatment consultant**.

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 **Alternatives**, for the **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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: September 21, 2009

Signed:

At: Berkeley, California

# DECLARATION OF
## Michael N DiFilippo

I**, Michael N DiFilippo** declare as follows:

1. I am presently employed **as a consultant to** the California Energy Commission for the Energy Facilities Siting Division as a **water treatment consultant through Aspen Environmental Group**.

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 **Soil and Water Resources**, for the **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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: September 18, 2009

Signed:

At: Berkeley, California

# Resume

Michael N DiFilippo

2803 Woolsey Street
Berkeley, CA 94705
510-655-6629
510-406-6629 (cell phone)
510-653-5874 (fax)
mndconslt@aol.com

Mr. DiFilippo is a chemical engineer with 38 years of experience in environmental and industrial projects involving water and wastewater treatment, water reuse and process optimization. He has also managed a number of consulting operations, multi-disciplinary organizations and design teams. For the past fourteen years, his consulting practice has been focused on the use and reuse of degraded water for the power industry.

Mr. DiFilippo has managed large projects involving: use of reclaimed water in power plants, zero-liquid discharge (ZLD), petrochemical process water and wastewater, geothermal fluids, metal finishing wastewater, electronics industry ultrapure water, irrigation and municipal wastewater reclamation, seawater desalinization and treatment facility design. In most of these projects, process improvements were made to existing or planned facilities to minimize the use of raw materials, reduce waste production and improve overall efficiency.

Before starting his own practice, Mr. DiFilippo worked for Southern California Edison for nine years in new plant design and CH2M Hill for ten years as a project manager and regional technical manager. He also worked for RCC (a water and wastewater equipment manufacturer) and a several small consulting firms.

Mr. DiFilippo prepared a guidance document for the Electric Power Research Institute (EPRI) on the use of degraded water (e.g. reclaimed water) for power plant cooling. He also updated the Institute's standards for cooling tower chemistry. The revised standards will enable power plant developers to more realistically evaluate "challenging" water sources.

For the Los Angeles Department of Water and Power (LADWP), Mr. DiFilippo evaluated the use of reclaimed water for the 585 MW Scattergood Generating Station and 220 MW Harbor Generating Station as alternatives to once-through ocean cooling. For Scattergood, secondary treated effluent from the Hyperion Wastewater Plant (adjacent to Scattergood) was evaluated for both one-through cooling as well as makeup to retrofitted cooling towers. The project involved evaluating existing infrastructure, locations for tie-in points, and conceptual-level cost estimates. A similar study was done for the Harbor Generating Station. Wastewater from the Carson Treatment plant was evaluated for once-through cooling and Title 22 water from West Basin Water District was evaluated for cooling tower makeup.

Mr. DiFilippo is currently working water treatment improvements for the 1100 MW Mountainview Power Plant (owned and operated by Southern California Edison). He has been involved in numerous studies to improve zero discharge system and cooling system performance.

Mr. DiFilippo recently participated in three power plant projects – all were slated to use reclaimed municipal effluent for cooling water. The projects involved detailed evaluations of constituents of concern that typically pose problems in cooling systems, i.e. sparingly soluble salts, suspended solids, BOD, ammonia, etc. Water usage, cycles of concentration, materials of construction, biological control, scale and deposition controls and corrosion controls were assessed for each project.

For the 1,800 MW San Juan Generating Station in New Mexico, Mr. DiFilippo assessed the use of non-traditional sources waters for boiler feed water, $SO_2$ scrubber make-up, cooling tower make-up and plant service water. The plant is coal fired power plant and is operated as a ZLD facility. Saline produced water (generated by oil and gas production) was evaluated to supply 10 to 12 percent of the plant's water needs. The TDS of the water ranged from 3,000 to 20,000 mg/l with an average concentration of 12,000 mg/l. Off-the-shelf technologies were evaluated to treat the water – this would enable PNM to act quickly to install a treatment plant if deemed feasible. Treatment alternatives included precipitation softening, ion exchange, high-pH RO and evaporators.

For two coal-fired power plants in Texas, Mr. DiFilippo evaluated water use and reuse to minimize wastewater generation to their respective cooling lakes. The projects involved developing detailed water balances, the identification of water reuse opportunities and the design and procurement of a wastewater treatment system.

For four different projects, Mr. DiFilippo evaluated the treatment of oil-field wastewater (produced water) as the owners' process consultant. Oil-field wastewater can be very saline (TDS up to 25,000 mg/l) with significant levels of scale-forming constituents, oil, organic compounds, boron, ammonia, silica, strontium and barium. The water can also have high levels of bacteria. Each project planned to treat the water for reuse or discharge to the environment. Some critical discharge parameters presented technical hurdles, e.g. boron, ammonia, BTEX, etc. A number of treatment technologies were evaluated – PACT process (biological process), precipitation softening, ultrafiltration, reverse osmosis, evaporation, etc.

Mr. DiFilippo managed numerous studies and designs for the Southern California Edison Company. Also, he developed a number of computer-based models to predict the performance of water treatment equipment, cooling-system water consumption, ZLD treatment alternatives, evaporation pond performance, water quality impacts during plant start-up, etc. Studies and designs covered boiler feedwater, cooling water treatment and ZLD wastewater and recycle treatment systems. A partial list of projects includes:

- 700 Megawatt (MW) Long Beach Combined Cycle Generating Station – split stream softener/dealkalizer for boiler feedwater treatment and wastewater neutralization.
- 900 MW Coolwater Combined Cycle Generating Station – ZLD design – boiler feedwater treatment, makeup and side-stream cooling water treatment, water reuse and final-disposal evaporation ponds.
- 50 MW Coolwater Solar I Generating Station – ZLD design – one-of-a-kind boiler feedwater treatment.

- 450 MW Coolwater Coal Gasification Plant – ZLD design – wastewater reuse and treatment.
- 2200 MW San Onofre Nuclear Generating Station – cycle make-up and steam generator blowdown treatment and reuse.

Mr. DiFilippo received a B.S. degree in Chemical Engineering from California State University at Long Beach in 1971.

# DECLARATION OF
**Mark R. Hamblin**

I, Mark R. Hamblin declare as follows:

I am presently employed by the California Energy Commission in the Environmental Protection Office of the Siting, Transmission, Environmental Protection Division as a Planner II.

My professional qualifications and experience were included in the FSA, and are incorporated by reference herein.

I prepared the additional staff testimony for the Visual Resources section for the proposed Beacon Solar Energy Project based on my independent analysis of the Application for Certification and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

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

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: July 16, 2009 Signed: _____

At: Sacramento, California

# MARK R. HAMBLIN

## Summary

Public administrator/land use planner with 15 years experience addressing land use development matters of concern to citizens and government leaders. Expertise in interpreting public policy pertaining to land use and environmental assessment. Demonstrated ability in working with individuals, and on teams involved in the development permitting process.

## Professional Experience

**California Energy Commission**, Sacramento, CA.
Planner II November 2000 to present.
Prepares an independent technical analysis in the area(s) of land use, traffic & transportation, and visual resources to inform interested persons and to make recommendations to the Energy Commission regarding the consequences of a natural gas fired power generation plant proposal; reviews information provided by the applicant and other sources to assess the environmental effects of a proposal as required by the California Environmental Quality Act (CEQA), and the California Energy Commission siting regulations; evaluates project in accordance with federal, state and local laws, ordinances, regulations, standards (LORS); coordinates proposal with federal, state and local agencies; conducts field studies; oversees technical consultant(s); participates in public workshop(s) on proposal; presents sworn testimony during evidentiary hearings; implements compliance monitoring programs for projects approved by the Energy Commission to ensure that power plants are constructed and operated according to the conditions of certification of their license.

**Yolo County Planning and Public Works Department**, Woodland, CA.
Associate Planner June 1992 to October 2000.
Advised and assisted individuals in the processing of land use requests (general plan amendments, conditional use permits, subdivision maps, etc.); reviewed information provided by the applicant and other sources for consistency with the state zoning and planning law, the county General Plan, the county government code, and the requirements of the CEQA; collected and analyzed information pertaining to a land use request and presented it in a staff report for consideration by the county planning commission and/or county board of supervisors; board of supervisors liaison, and planning department staff person to citizen and inter-agency committees (county airport advisory committee, county habitat conservation plan steering committee, and community general plan citizen advisory committee(s); drafted zoning ordinances and regulations; prepared environmental assessment documents in accordance with CEQA and NEPA (National Environmental Protection Act); hired and supervised consultants; executed county zoning administrator duties; conducted zone code enforcement; reviewed building plans for issuance of permits; answered questions at the public counter, or on the telephone regarding land use issues and development proposals in the County.

**Yolo County Community Development Agency**, Woodland, CA.
Assistant Planner January 1991 to June 1992.
Advised and assisted individuals in the processing of land use requests; reviewed information provided by the applicant and other sources for consistency with the county

General Plan, the state and county government code, and the requirements of CEQA; collected and analyzed information pertaining to a land use request and presented it in a staff report for consideration by the county planning commission; drafted zoning ordinances; prepared environmental assessment documents in accordance to the CEQA; supervised consultants; conducted zone code enforcement; reviewed building plans for issuance of permits; answered questions at the public counter, or on the telephone regarding land use and development in the County.

**Tulare County Planning and Development Department**, Visalia, CA.
Planning Technician II March 1988 to January 1990.
Advised and assisted individuals in the processing of land use requests, specifically special-use permits, variances, parcel and subdivision maps; reviewed information provided by the applicant and other sources for consistency with the county General Plan, the state and county government code, and the requirements of CEQA; collected and evaluated information for presentation in a staff report on the proposed land use request for consideration by the county zoning administrator, site plan review committee, or planning commission; prepared environmental assessment documents in accordance with CEQA; conducted zone code enforcement; reviewed building plans for issuance of permits; answered questions at the public counter, or on the telephone regarding land use and development in the County.

## Education

**University of California, Davis Extension**. Coursework in California Land Use Planning and the California Environmental Quality Act 1988 to 1995.
**Cosumnes River College**. Coursework in Television and Radio Broadcasting1990 to 1991.
**California State University, Bakersfield**. Master of Public Administration; August 1988. Concentration in Public Policy. Coursework in Business Administration and Political Science.
**California State University, Sacramento**. Bachelor of Science in Public Administration; May 1984. Concentration in Human Resources Management.
**Porterville College**. Associate in Arts Social Science; May 1982. Coursework in Administration of Justice.

## Awards

2001 Superior Accomplishment Award - Recognition of outstanding performance and contribution as a Team Member of the “21 Day, 4, 6, and 12 Month Processes Team.” California Energy Commission.

2001 Superior Accomplishment Award - Recognition of outstanding performance and contribution as a Team Member of the “Expedited 4 Month AFC/SPPE Team,”
California Energy Commission.

# DECLARATION OF
## Ellen Townsend-Hough

I, **Ellen Townsend-Hough** declare as follows:

1. I am presently employed by the California Energy Commission in the Environmental Siting Office of the Energy Facilities Siting Division as an Associate Mechanical Engineer.

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 Waste Management for the Beacon Solar Energy Project based on my independent analysis of the Application for Certification 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:_____ Signed:_____

At: Sacramento, California

# Ellen Townsend-Hough

## SUMMARY

I am a chemical engineer with 29 years of experience. My strengths are in analyzing and performing complex environmental engineering analyses, in areas such as Waste Management, Hazardous Materials Management, Worker Safety, and Water Resources. I perform inspections work involved in the design and construction of thermal electrical generating power plants. I have a working knowledge of the California Environmental Quality Act. I worked as a policy advisor to a California Energy Commissioner for three years. I am also an US Environmental Protection Agency Environmental Justice trainer.

## PROFESSIONAL EXPERIENCE

### Technical Analysis and Presentation

- Performs mechanical engineering analysis of designs for complex mechanical engineering analysis of designs for systems such as combustion chambers and steam boilers, turbine generators, heat transfer systems, air quality abatement systems, cooling water tower systems, pumps and control systems
- Provide an engineering analysis examining the likelihood of compliance with the design criteria for power plants and also examine site specific potential significant adverse environmental impacts
- Review and analyze compliance submittals in accordance with the California Environmental Quality Act, the Warren Alquist Act, the Federal Clean Air Act and the California and Federal Occupational Health and Safety Acts to assure compliance of projects
- Provides licensing recommendations and function as an expert witness in regulatory hearings.
- Provide public health impact analysis to assess the potential for impacts associated with project related air toxic/non-criteria pollutant emissions.
- Evaluate the potential of public exposure to pollutant emissions during routine operation and during incidents due to accidents or control equipment failure

### Technical Skills

- Establish mitigation that reduces the potential for human exposure to levels which would not result in significant health impact or health risk in any segment of the exposed population.
- Assist with on-site audits and inspection to assure compliance with Commission decisions.
- Review and evaluate the pollution control technology applied to thermal power plants and other industrial energy conversion technologies.
- Work with the following software applications: WORD, Excel, and PowerPoint.

### Policy Advisor

- Provided policy, administrative and technical advice to the Commissioner Robert Pernell. My work with the Commissioner focused on the policy and environmental issues related to the Commission's power plant licensing, research and development and export programs.
- Track and provide research on varied California Energy Commission (CEC) programs. Prepare analysis of economic, environmental and public health impacts of programs, proposals and other Commission business items.
- Represent Commissioner's position in policy arenas and power plant siting discussions.

- Write and review comments articulating commission positions before other regulatory bodies including Air Resources Board, California Public Utilities Commission, and the Coastal Commission.

- Wrote speeches for the Commissioner's presentations.

-

**Writing**

- Write letters, memos, negative declarations, environmental impact reports that require technical evaluation of mechanical engineering and environmental aspects of pollution control systems, environmental impacts, public health issues and worker safety.

## EMPLOYMENT HISTORY

| | | |
|---|---|---|
| 2002-Present | Associate Mechanical Engineer | California Energy Commission (CEC)<br>Sacramento CA |
| 1999-2002 | Advisor to CEC Commissioner | CEC<br>Sacramento CA |
| 1989-1999 | Associate Mechanical Engineer | CEC<br>Sacramento CA |
| 1992-1993 | Managing Partner | EnvironNet<br>Sacramento CA |
| 1988-1989 | Sales Engineering Representative | Honeywell Inc<br>Commerce CA |
| `1987-1988 | Chemical Engineer | Groundwater Technology<br>Torrance CA |
| 1985-1986 | Technical Marketing Engineer | Personal Computer Engineers<br>Los Angeles CA |
| 1985-1985 | Energy Systems Engineer | Southern California Gas Company<br>Anaheim CA |
| 1980-1985 | Design Engineer | Southern California Edison<br>Rosemead CA |
| 1975-1980 | Student Chemical Engineer | Gulf Oil Company<br>Pittsburgh PA |

## EDUCATION

Bachelor of Science, Chemical Engineering
Drexel University, Philadelphia Pennsylvania

Continuing Education

*Hazardous Material Management Certificate, University California Davis*
*Urban Redevelopment and Environmental Law, University of California Berkley*
*Analytical Skills, California Department of Personnel Administration (DPA) Training Center*
*Legislative Process/Bill Analysis, DPA Training Center*
*Federally Certified Environmental Justice Trainer*

***References furnished upon request.***

# DECLARATION OF
## Testimony of Dal Hunter, Ph.D., C.E.G.

I**, Dal Hunter, Ph.D., C.E.G.,** declare as follows:

1. I am presently employed as a subcontractor to Aspen Environmental Group, a contractor to the California Energy Commission, Systems Assessment and Facilities Siting Division, as an engineering geologist.

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 **GEOLOGY AND PALEONTOLOGY** for the proposed **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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: July 27, 2009 Signed:_____

At: Black Eagle Consulting, Inc.
Reno, Nevada

# Robert D. Hunter, Ph.D., C.E.G.
## Engineering Geologist
## Vice President

**Education**

- Ph.D. – Geology – 1989 – University of Nevada, Reno
- M.S. – Geology – 1976 – University of California - Riverside
- B.S. – Earth Science – 1972 – California State University, Fullerton

**Registrations**

- Registered Geologist – California
- Certified Engineering Geologist – California
- Professional Geological Engineer – Nevada

**Experience**

1997 to Present: Black Eagle Consulting, Inc.; Vice President. Dr. Hunter is in charge of all phases of geological, geotechnical, and geochemical projects and is responsible for conducting, coordinating, and supervising geotechnical investigations for public and private sector clients. He has worked on numerous industrial and commercial projects over the last 30 years. Dr. Hunter is very familiar with state and federal design specifications as well as CEQA and NEQA requirements related to geology and paleontology.

Dr. Hunter has also provided geological, geotechnical, and paleontological review and written and oral testimony for California Energy Commission (CEC) power plant projects including:

- El Segundo Power Redevelopment Project (including compliance monitoring)
- Magnolia Power Project (including compliance monitoring)
- Ocotillo Energy Project (Wind Turbines)
- Vernon-Malburg Generating Station
- Inland Empire Energy Center (including compliance monitoring)
- Palomar Energy Project
- Henrietta Peaker Project
- BP Carson Peaker Project
- East Altamont Energy Center
- Avenal Energy Center
- Teayawa Energy Center monitoring
- Walnut Energy Center (including compliance monitoring)
- Riverside Energy Resource Center
- Salton Sea Unit 6 (Geothermal Turbines)
- National Modoc Power Plant
- Pastoria Energy Center
- Walnut Creek Energy Park
- Sun Valley Energy Project
- El Centro Unit 3 Repower Project

- AES Highgrove Project
- South Bay Replacement Project
- Vernon Power Plant
- Bullard Energy Center Project
- Humboldt Bay Repowering Project (including compliance monitoring)
- Victorville Power Project
- Carlsbad Energy Center
- San Gabriel Generating Station
- Orange Grove
- Chula Vista Energy Upgrade
- Carrizo (Solar)
- KRCD Community Power
- Carrizo Power Plant (including compliance monitoring)
- Sentinel Peaker Project
- Canyon Power Plant
- Riverside Acorn SPPE Project
- Beacon Solar Generating Station
- Stirling 2 Solar Project
- Stirling 1 Solar Project
- City of Palmdale
- eSolar1 Solar Generating Project
- Otay Mesa Generating Project (compliance monitoring)
- Montainview Power Plant Project (compliance monitoring)
- Consumes Power Plant (compliance monitoring)
- Sunrise Power Project (compliance monitoring )
- Niland Power Project (compliance monitoring)
- Panoche Power Plant (compliance monitoring)
- Colusa Generating Station (compliance monitoring)
- Starwood Power Plant (compliance monitoring)
- Los Mendanos Power Plant (compliance monitoring)
- Blythe Combined Cycle Plant (compliance monitoring)
- Roseville Energy Plant (compliance monitoring)

Attended Expert Witness Training Sponsored by CEC.

1978 to 1997: SEA, Incorporated; Geotechnical Manager, Engineering Geologist. Dr. Hunter was in charge of all phases of geotechnical projects for SEA, including project coordination and supervision, field exploration, geotechnical analysis, slope stability analysis, soil mechanics, engineering geochemistry, mineral and aggregate evaluations, and report preparation. Numerous investigations were undertaken on military, commercial, industrial, airport, residential, and roadway projects. He worked on many geothermal power plants, providing expertise in foundations design, slope stability, seismic assessment, geothermal hazard evaluation, expansive clay, and settlement problems. Project types included high-rise structures, airports, warehouses, shopping centers, apartments, subdivisions, storage tanks, roadways, mineral and aggregate evaluations, slope stability analyses, and fault studies.

1977 to 1978: Fugro (Ertec) Incorporated Consulting Engineers and Geologists; Staff Engineering Geologist; Long Beach, California.

## Affiliations

- Association of Engineering Geologists

## Publications

- Hunter, 1988, *Lime Induced Heave in Sulfate Bearing Clay Soils*, Journal of Geotechnical Engineering, ASCE, Vol. 14, No. 2, pp. 150-167.

- Hunter, 1989, *Applications of Stable Isotope Geochemistry in Engineering Geology*: Proceedings of the 25th Annual Symposium on Engineering Geology and Geotechnical Engineering.

- Hunter, 1993, *Evaluation of Potential Settlement Problems Related to Salt Dissolution in Foundation Soils*: Proceedings of the 29th Annual Symposium on Engineering Geology and Geotechnical Engineering.

# DECLARATION OF
## SHAHAB KHOSHMASHRAB

I**, SHAHAB KHOSHMASHRAB**, declare as follows:

1. I am presently employed by the California Energy Commission in the **ENGINEERING OFFICE** of the Facilities Siting Division as a **MECHANICAL ENGINEER**.

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

3. I participated in the preparation of the staff testimony on **Power Plant Efficiency** for the **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification 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 issues 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: _____ Signed: _____

At: Sacramento, California

# DECLARATION OF
## SHAHAB KHOSHMASHRAB

I**, SHAHAB KHOSHMASHRAB**, declare as follows:

1. I am presently employed by the California Energy Commission in the **ENGINEERING OFFICE** of the Facilities Siting Division as a **MECHANICAL ENGINEER**.

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

3. I participated in the preparation of the staff testimony on **Power Plant Reliability** for the **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification 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 issues 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: _____ Signed: _____

At: Sacramento, California

**Shahab Khoshmashrab**
Mechanical Engineer

## Experience Summary

Nine 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

## Professional Experience

**2001-2004**--Mechanical Engineer, Systems Assessment and Facilities Siting– California Energy Commission

Performed analysis of generating capacity, reliability, efficiency, noise and vibration, and the mechanical, civil/structural and geotechnical engineering aspects of power plant siting cases.

**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 structural engineering detail drawings.

**1995-1998**--Manufacturing Engineer – Carpenter Advanced Technologies

Managed manufacturing projects of various mechanical components used in high tech medical and engineering equipment. Directed fabrication and 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
## Mark Hesters

I**, Mark Hesters** declare as follows:

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

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 **Transmission System Engineering**, for the **Beacon Solar Energy Project** based on my independent analysis of the Application for Certification and supplements hereto, 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:_____ Signed:_____

At: Sacramento, California

Mark Hesters
Associate Electrical Engineer

Mark Hesters has fourteen years of experience in electric power regulation. He worked in the Engineering Office of the California Energy Commission's Energy Facilities Siting & Environmental Protection Division since 1998 providing analysis of California transmission systems and testimony on transmission systems in several Commission power plant certification processes. Prior to that Mark worked in the CEC's Electricity Analysis Office providing lead analysis on Southern California Edison resource issues and modeling support for all areas of California. He holds a B.S. degree from the University of California at Davis in Environmental Policy Analysis and Planning.

# DECLARATION OF

Sudath Arachchige

I, Sudath Arachchige declare as follows:

I am presently employed by the California Energy Commission in the Transmission System Engineering Office of the Systems Assessments and Facilities Siting Division as an Associate Electrical Engineer.

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

I helped prepare the TSE testimony on 07-31-09 for the Beacon Solar Energy Project based on my independent analysis of the Application for Certification and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.

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

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: 07-31-09 Signed: Sudath Arachchige

At: Sacramento, California

**Sudath Arachchige**
**1916 Ackleton Way**
**Roseville CA 95661-USA Phone 916-786-6468**

**EDUCATION:**
Bachelor of Science in Electrical Engineering at California State University Fullerton

**ATTAINMENTS:**
Member of the Professional Engineers in California Government
Vice President Electrical Engineering Society-California State University Fullerton.

**EXPERIENCE:**

**November-2001 to Present**: - Associate Electrical Engineer, System Assessment and Facilities Siting Division, California Energy Commission.
Conduct and perform planning studies and contingency analysis including power flow, short-circuit, stability, and post-transient analysis to maintain reliable operation of the power system. Investigates and analyzes Grid Planning problems and provides appropriate information to Grid Planning Engineers. Develops automated computer programs and other advance analysis methods for comprehensive evaluation of the operational performance of the transmission system.
Understanding of regulatory and reliability guidelines, WECC and NERC planning and operation criteria, CPUC and FERC requirements. Review technical analyses for WECC/ISO/PTO transmission systems and proposed system additions; provide support and analyses associated with Reliability Must-Run (RMR) contracts and the Local Area Reliability Services (LARS) process; review new generation interconnection studies; provide congestion analyses; and provide support for regulatory filings.

**June-1998 to November-2001**: - Project Electrical Engineer, Design Electrical Engineering Section, Department of Transportation, California.
Electrical Engineering knowledge and skills in the design, construction and maintenance of California state work projects involving all the public work areas; contract administration, construction management, plan checking, field engineering and provide liaison with consultants, developers, and contractors. Plan review in facility constructions, highway lighting, sign lighting, rest area lighting, preparation of project reports, cooperative agreements, review plans for compliance of construction and design guide lines for national electrical code, standards and ordinance. Review process included breaker relay coordination, detail wiring diagrams, layout details, service coordination, load, conductor sizes, derated ampacity, voltage drop calculations, harmonic and flicker determination.

**June-1993 to May-1998**:- Substation Electrical Engineer, City of Anaheim, California.
Performed protective relay system application, design and setting determination in Transmission & Distribution Substation. Understanding of principles of selective

coordination system protection and controls for Electric Utility Equipment. Understanding of Power theory and Analysis of symmetrical components. Ability to review engineering plans, specifications, estimates and computation for Electrical Utility Projects. Practices of Electrical Engineering design, to include application of Electro-mechanical and solid state relays in Electrical Power Systems. Software skills in RNPDC (Fuse Coordination Program), Capacitor bank allocation program, and Load Flow Program. Design projects using CAD, Excel spread sheets including cost estimates, wiring diagrams, material specifications and field coordination.

Performed underground service design 12kV and 4kV duct banks; pole riser; getaway upgrade; voltage drop calculation, ampacity calculation and wiring diagrams. Design and maintence of substations in City Electrical Utility System. Upgrade Station Light and power transformers; upgrade capacitor banks; replacement of 12kV-4kV power circuits; Breakers at Metal Clad Switchgear. Design one-line diagrams; three line diagrams; grounding circuits; schematics; coordination of relay settings; conduit and material list preparation. Calculation of derated ampacity; inrush current, short circuit current and fault current.

**BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA**
**1516 NINTH STREET, SACRAMENTO, CA 95814**
**1-800-822-6228 – WWW.ENERGY.CA.GOV**

APPLICATION FOR CERTIFICATION
For the *BEACON SOLAR ENERGY PROJECT*

Docket No. 08-AFC-2

PROOF OF SERVICE
*(Revised 4/28/09)*

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## DECLARATION OF SERVICE

I, Maria Santourdjian, declare that on October 22, 2009, I served and filed copies of the attached Beacon Solar Energy Project (08-AFC-2) Final Staff Assessment. 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.gov/sitingcases/beacon]**. The document has 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:

**(*Check all that Apply*)**

### FOR SERVICE TO ALL OTHER PARTIES:

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

__x__by personal delivery or by depositing in the United States mail at Sacramento with first-class postage thereon fully prepaid and addressed as provided on the Proof of Service list above to those addresses **NOT** marked "email preferred."

***AND***

### FOR FILING WITH THE ENERGY COMMISSION:

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

***OR***

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

**CALIFORNIA ENERGY COMMISSION**
Attn: Docket No. _____
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512

docket@energy.state.ca.us

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

Original Signed in Dockets
Maria Santourdjian