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**STATE OF CALIFORNIA
ENERGY RESOURCES CONSERVATION
AND DEVELOPMENT COMMISSION**

In the Matter of:

Docket No. 00-AFC-14C

Petition to Amend The
EL SEGUNDO ENERGY CENTER PROJECT

ENERGY COMMISSION STAFF'S REBUTTAL TESTIMONY

Staff received the applicant's written testimony, filed on October 12, 2015. (TN 206334). Based on a review of the applicant's testimony, staff's rebuttal is necessary to respond to issues first raised in applicant's opening testimony, and is evidence upon which the Committee can base its decision.

Several contested issues remain in the following technical areas: Air Quality, Biological Resources, Cultural Resources, Hazardous Materials, and Compliance Conditions. Biological Resources and Cultural Resources were not included in applicant's opening testimony, but staff believes issues may remain with these two technical areas, and will identify them in the Prehearing Conference Statement to be filed on October 19, 2015. Staff notes that testimony regarding all areas has been docketed by staff in the Final Staff Assessment Combined Parts A and B ("combined FSA"), supported by declarations attached to staff's opening testimony, and by the applicant in their opening testimony. At the time of this filing, no testimony or rebuttal has been filed by Intervenors. Staff has new evidence to introduce in its rebuttal testimony to

respond to the applicant's opening testimony which will supplement the record, and reserves the right to submit additional evidence at such time as it becomes necessary.

The following staff witness is identified and his declaration and statement of qualifications is attached here to sponsor rebuttal testimony to the issue first raised in applicant's opening testimony concerning air quality impacts of clutch technology:

- Installation of Clutch Technology – Matthew Layton, P.E.

The positions and arguments of both staff and applicant have been set forth and are ready to proceed to hearing. Staff does not agree with the applicant's position in the technical areas listed above for reasons already set forth in the combined FSA and other filed documents, and will present our arguments at the evidentiary hearing.

DATED: October 16, 2015

Respectfully submitted,

Original signed by _____
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STAFF’S REBUTTAL TESTIMONY

Staff’s rebuttal testimony comprises responses, figures, changes to conditions of certification, and a proposed additional condition of certification. Changes to the conditions of certification from the combined FSA appear in single ~~strike through~~, with new text **bold and underlined**.

AIR QUALITY & COMPLIANCE IMPACTS OF CLUTCH TECHNOLOGY

Rebuttal Testimony of Matthew Layton, P.E., and Wenjun Qian, Ph.D.

Comment: The applicant’s testimony addresses the following four sub-topics, and proposes a new compliance Condition of Certification CONTINGENCY-3:

- Air Quality Impacts of Clutch Technology, Gary Rubenstein, Sierra Research
- Physical Ability to Accommodate Clutch Technology Given Project Size & Design, Steve Rose, NRG Energy, Inc.
- Drawbacks Associated with the Use of Clutches at ESPFM, Scott Valentino, NRG Energy, Inc.
- Proposed New Condition of Certification, CONTINGENCY-3, Scott Valentino, NRG Energy, Inc.

Staff’s Rebuttal – Air Quality Impacts of Clutch Technology: Staff agrees with the applicant’s testimony that the clutch is technically feasible on a variety of combustion turbines, and appears on a number of California combustion turbines. And, like the applicant, we cannot find any information on if and when they are used¹ in California. In other words, feasibility does not address the questions of need, function, or economics.

Applicant’s opening testimony discusses potential impacts and benefits from synchronous condenser operation afforded from the availability of an installed clutch. The testimony recognizes that these effects are speculative at best, but then suggests that the use of the clutch technology would, “[R]esult in a small increase in air and GHG emissions due to the additional rotating mass associated with this technology [equipment].” (Applicant’s Written Testimony, pg.1, TN 206334). Staff agrees that there would be an effect, but disagrees that applicant can

¹ We note that the generators for legacy steam boiler units Huntington Beach 3 are 4 are now operating as synchronous condensers. The shafts to the steam turbine were permanently disconnected, new equipment was added to ramp up, sync and control the synchronous condenser operations, and some form of a contract is in place to pay for the services provided.

conclude that there would in fact be a slight increase in GHG emissions across the system and on average. The system effects of the deployment of this technology at a given power plant are only realized when:

- there is a need for location specific ancillary/grid support services;
- the plant is not needed for (a) energy or (b) ancillary services other than voltage support, if provision of these services requires the plant to be operating and producing energy. When needed for energy or spinning reserve, the generator and engine are connected and the plant is producing energy and providing voltage support; the fact that it *can* provide the latter without generating energy is irrelevant at that point in time; and,
- the synchronous condenser is needed for voltage support but the energy and capacity not provided by the plant are provided by a plant *that is more efficient/lower emitting than the local plant that it replaces*. Reliance on a synchronous condenser to provide the needed voltage support would require replacing the energy it would have provided. While the replacement energy might be cleaner (e.g., from a renewable generator), it might not, depending on load-levels, time of day, etc.

Staff’s Rebuttal – Physical Ability to Accommodate Clutch Technology: Staff agrees with applicant’s testimony that the ESEC peakers could be configured to allow contemporaneous or future clutch installation. However, the cost of achieving any potential benefits beyond changes in criteria air and GHG emissions such as local voltage support and reactive power, depends upon the costs of deploying the technology. The costs associated with configuring the ESEC peakers with a clutch would include:

- the clutch and components would require foundations, and an extra long shaft if not installed during project construction;
- the clutch and components would have to be purchased, and stored if not installed during project construction; and
- the clutch and components would have to be installed, and maintained.

Staff’s Rebuttal – Drawbacks Associated with Use of Clutch Technology at ESPFM:

Because megavars (MVars) do not “travel well,” the scale of the benefits from deploying the technology depend upon the need for voltage support in the plant’s geographic area (whatever

area for which the plant can provide voltage support), the time profile of that need (e.g., emissions savings only arise when the plant would not otherwise be operating), and the extent to which the plant contributes to satisfying that need (a function of where the plant is located and the configuration of the transmission system and set of generators available). The California ISO (CAISO) is the agency primarily responsible for determining the need for voltage support in the balancing authority area, as well as the impact and effectiveness of existing or proposed resources in its provision. In comments at the California Public Utilities Commission (CPUC) on the need for, and impact of installing synchronous condenser technology at the Amended Carlsbad Energy Center Project site, CAISO stated:

*“The Alternate Proposed Decision includes language directing SDG&E to study the addition of synchronous condenser technology, commonly referred to as a “clutch,” at the Carlsbad Energy Center facility. In response to the Alternate Proposed Decision, the CAISO analyzed both peak forecast and lower load level scenarios to test whether the addition of synchronous condenser technology could enable a reduction in the amount of gas-fired generation (and associated emissions) that the Carlsbad Energy Center would otherwise be expected to produce. In recent years, the CAISO has approved significant upgrades to the Southern California transmission system to address reactive power needs and will continue to update and evaluate the adequacy of these solutions in future planning studies. The CAISO targeted these upgrades at locations that were both highly electrically efficient and feasible at times of peak system loading with some locations having expansion capabilities for even more reactive support should it become necessary. Due to the specific circumstances of localized voltage stability, the thermal limitations in the area, and the development of better-situated synchronous condensers in the area, the CAISO has not been able to confirm that the synchronous condenser technology at Carlsbad would enable any material reduction in gas-fired generation output. Assuming that the transmission system upgrades and Commission-authorized procurement are realized in a timely manner, synchronous condenser technology at the Carlsbad Energy Center may not provide material emission reduction benefits [emphasis added]. Therefore, based on a preliminary analysis, the CAISO has not been able to identify significant benefits to the installation of synchronous condenser technology at the Carlsbad Energy Center.”*²

It may be most efficient, as described by the CAISO and as seen in activities in the Southern California Edison and San Diego Gas & Electric utilities highlighted in applicant’s opening testimony, to install stand-alone synchronous generators or other voltage support components at a time when and at very specific location where they are needed. This may be a moving target as

² *Comments of the California Independent System Operator Corporation on Alternative Proposed Decision*, filed in California Public Utilities Commission proceeding A.14-07-009, April 27, 2015.

the electricity power system evolves to 33% and then >50% renewables. Determining relative costs of achieving these benefits compared to other measures (ranging from developing stand-alone synchronous generators, distributed generation, demand-side measures, to increasing transportation fuel efficiency) involve consideration of a multitude of other factors.

Further, as the system evolves certain assets will become stranded to the degree that they can offer fewer services to the grid, or that local reliability area of the grid needs fewer services. Adding features to a peaking unit may appear efficient, but could result in a more expensive, multipurpose facility, that is a stranded asset nonetheless.

We understand that there are LMS100 CTGs (the GE CTG proposed for the ACECP) in the Los Angeles Department of Water & Power fleet that are or could be configured with clutches. The Energy Commission was not a party to the decision to install the clutches, and thus staff do not know why, how or whether they are used to maintain the system reliability.

Staff is aware of four CalPeak peaking plants in California with clutches installed that would allow the generators to disconnect from their combustion turbines and operate temporarily as synchronous condenser. The Pratt & Whitney, Model FT8 (DLN), Twin-Pac industrial aeroderivative combustion turbine generator packages come with a clutch already configured and installed. We note that in the approximately 15 years since these peaking plants have been operating, they have never been asked to do so, nor have they operated in that configuration. CalPeak also just purchased the 97 MW Malaga plant from Kings River Conservation District. It is reported that two clutches were delivered with the original turbines, and are being stored onsite. It is reported that the project design included space for the clutches but that the clutches are not currently installed.

Staff's Rebuttal – Applicant's Proposed CONTINGENCY-3: Clutches were not proposed in this petition, and therefore were not reviewed. And, as CONTINGENCY-3 acknowledges, the petition and its review by the staff have not resulted in a determination of a local current need for voltage support and reactive power at this location, absent MW and MWhrs. The determination of the need for MVars would be no different than the consideration of needed capacity or real power. And, determining whether or not MVars are needed at a location would be outside the Energy Commission's power plant siting jurisdiction.

Regarding Condition of Certification CONTINGENCY-3 proposed by the project owner in its opening testimony, we are concerned that given the paucity of analysis of the clutch technology, the environmental impacts proposed in the first criterion are unclear. Further, we are not certain if reference to Condition (3) being waived is for the entire Condition of Certification CONTINGENCY-3, or just the third criterion. Lastly, staff believes the proposed condition does not allow for spacing and clearances to be designed into the project and then at some later date, perhaps years from start of commercial operation, for clutch installation. The proposed condition CONTINGENCY-3 seems to limit the decision on clutch to its viability today – therefore, it is not a contingency condition. Staff does not agree with CONTINGENCY-3 as proposed in applicant’s testimony and offers the following edits to make it a contingency condition.

CONTINGENCY-3: The project owner shall include design clearances for the potential installation of the clutch technology on the project’s Trent 60 units.

The project owner shall install the clutch components that facilitates dispatch as synchronous condensers in the design and construction of the Trent 60 units if all of the following criteria are met ~~prior to the start of construction~~:

- (1) It is physically and technically feasible to install clutch technology on the Trent 60 units ~~without modifying the environmental impacts characteristics of the project~~;
- (2) clutches are available as warranted components of the Trent Power Trains; and
- (3) a contract that allows Project Owner to recoup the costs of installing clutches and obtain compensation for providing reactive power has been entered into and approved by the California Public Utilities Commission (CPUC).

~~Condition (3)~~ **Criteria (3)** above can be waived by the Project Owner, should Project Owner decide to install clutches in anticipation of such equipment being valued by CAISO or an offtaker.

Verification: At least one hundred and twenty (120) days prior to start of **project** construction, **the** project owner shall submit to the CPM a Clutch Feasibility Report (CFR) that reports of ~~Project Owner’s decision of whether to include clutches in~~ the final design of Trent Units **that accommodates the potential installation of the clutch technology.** The CFR shall address all three criteria and explain whether or not each criteria are **currently** met or not. The CPM shall approve the report unless the CPM finds the conclusions in the CFR unsupported by substantial evidence.

At least one hundred and twenty (120) days prior to start of installation of the clutch technology, the project owner shall submit to the CPM a CFR that reports of project owner’s decision to install the clutch technology on project’s Trent 60 units. The CFR shall address all three criteria and explain how criteria are met. The CPM

shall approve the report unless the CPM finds the conclusions in the CFR unsupported by substantial evidence.

The CPM shall approve the CFR(s) or return ~~it~~ **them** with comments within thirty (30) days of receipt.

If returned by the CPM with comments, project owner shall respond within thirty (30) days with a revised CFR for approval by the CPM.

AIR QUALITY

Rebuttal Testimony of Wenjun Qian, Ph.D., P.E.

Comment: The applicant's testimony proposes to revise the verification language for AQ-33 for compliance demonstration of the 2.0 ppmv volatile organic compound (VOC) emission limit for Units 5 and 7. The applicant states that the South Coast Air Quality Management District (SCAQMD) does not have an approved method for monitoring VOC concentrations in a continuous emission monitoring system (CEMS). Instead, compliance is demonstrated by periodic compliance tests performed using SCAQMD Modified Method 25.3. Accordingly, the applicant proposes to revise the verification language for AQ-33 so that test results, instead of CEMS records, would be required to be submitted to demonstrate compliance with this condition.

Staff's Rebuttal: Staff agrees with the proposed change to use source testing for VOC compliance. However, the applicant's change includes reference to the incorrect Conditions of Certification, AQ-72 and AQ-73, for testing requirements. AQ-72 and AQ-73 apply to the proposed Units 9 through 12. The VOC source testing requirements for Units 5 and 7 were specified in AQ-7. Staff believes that AQ-7 should be referred to for the VOC source test requirements for these units. Staff would also like to correct the abbreviation of oxygen in the combined FSA from "O2" to "O₂" in AQ-33. Therefore, staff proposes the following changes to Condition of Certification AQ-33:

AQ-33: The 2.0 ppmv VOC emission limit is averaged over 60 minutes at 15 percent ~~02~~ **O₂**, dry basis.

Verification: The project owner shall submit ~~CEMS records~~ **source test results (see AQ-7)** demonstrating compliance with this condition as part of the Quarterly Operational Report required in AQ-SC8.

COMPLIANCE – CONTINGENCY CONDITIONS OF CERTIFICATION

Rebuttal Testimony of Roger E. Johnson

Comment: The applicant’s testimony agrees with staff that the demolition of Units 3 and 4 and associated facilities such as the once-through cooling facilities is a core part of the Petition to Amend (PTA), and presents suggested revisions to proposed Conditions of Certification CONTINGENCY-1 and CONTINGENCY-2.

Applicant’s testimony for CONTINGENCY-1 asserts that the verification requirement timeframe should be adjusted such that the condition of certification is revised to reflect the timeframe from a draft plan to a final plan after agency review. Applicant recognizes the value of CONTINGENCY-1 to coordinate the timing and ensure the compliance of these complex and interrelated activities, but asserts that 30 days to respond to agency comments and to prepare a final Demolition, Removal, and Remediation Plan (DRRP) could be problematic depending on the scope of comments received.

Applicant’s testimony for CONTINGENCY-2 asserts that the condition of certification should be revised to link demolition of Units 3 and 4 with the start of construction of the project and changes described in the PTA.

Staff’s Rebuttal – CONTINGENCY-1: Staff agrees that additional time may be needed and proposes changing the timeframe to 60 days. Staff does not agree with the applicant’s proposal to leave the date open-ended, which is inconsistent with the timing and intent of CONTINGENCY-2. Staff rejects applicant’s position that demolition of Units 3 and 4 is tied to the construction of the project proposed in the PTA such that demolition of Units 3 and 4 places a date certain for the start of construction for the new project. Staff believes the applicant is capable of finding a source of capital to accomplish the demolition separate from obtaining capital for the new project.

Staff’s Rebuttal – CONTINGENCY-2: Staff rejects the applicant’s proposal to modify CONTINGENCY-2 to require a Delayed Construction Management Plan (DCMP) to maintain the property in a stable manner that is compliant with all applicable laws if the project does not commence construction within one year of approval of the final Demolition, Removal and Remediation Plan (DRPP). A DCMP is needed soon after Unit 4 is retired. A DCMP would be

of questionable value 2 ½ years after the units are retired. Staff's proposed CONTINGENCY-2 provides for the demolition of Units 3 and 4 in a manner that allows the applicant to prepare the plan, obtain the approvals and financing, and accomplish the demolition in a reasonable timeframe. With the site ready for construction, the approved project could be selected as a contingency (emergency) project needed for system reliability and quickly move to construction.

Staff's Proposed New Condition of Certification – CONTINGENCY-4: Staff proposes a new Condition of Certification CONTINGENCY-4 in acknowledgement of applicant's opening testimony recommendation to require a Delayed Construction Management Plan (DCMP) after Units 3 and 4 are retired at the end of 2015 to ensure that the site is properly managed until demolition starts.

CONTINGENCY-4 The project owner shall submit a Delayed Construction Management Plan (DCMP) to maintain the property in a stable manner that is compliant with all applicable laws. The DCMP, at a minimum, shall:

- **Identify procedures for maintaining Units 3 and 4, including associated structures, retention basins, exhaust stacks and once-through cooling facilities in a stable and idle condition;**
- **Identify the process for handling industrial water and storm water in conformance with the facility's National Pollutant Discharge Elimination System (NPDES) permits at the site;**
- **Require reporting relevant information as to the condition of the Units 3 and 4 facilities in each ESPFM Periodic Compliance Report (PCR) until such time as the CPM issues a Demolition, Removal, and Remediation Plan (DRRP) Notice to Proceed.**

Verification: No later than 60 days after the Commission decision to approve the PTA, (or other CPM-approved mutually agreeable date), the project owner shall submit a draft DCMP to the CPM for review and approval and to the city of El Segundo and other interested agencies, for review and comment. DCMP comments are due to the CPM within 60 days after DCMP submittal, (or other CPM-approved date). No later than 60 days following receipt of agency comments, the project owner shall submit a Final DCMP to the CPM for review and approval.

COMPLIANCE - CONDITIONS OF CERTIFICATION

Rebuttal Testimony of Camille Remy-Obad, and Alvin Greenberg, Ph.D.

Comment: The applicant's testimony discusses Conditions of Certification COM-10, -11, -12 and -13.

Staff's Rebuttal – COM-10: Staff agrees with applicant's testimony. Language added to COM-10 in the combined FSA, to reflect statutory changes to the Warren-Alquist Act requiring an amendment fee for Petitions to Amend, should be removed.

Staff's Rebuttal – COM-11: Staff agrees with applicant's testimony and recommends revising the proposed condition of certification to return to the original 10-day timeframe for the reporting of complaints.

Staff's Rebuttal – COM-12: Staff objects to the applicant's revision of the Emergency Response Site Contingency Plan verification schedule. Instead of staff's proposal to require provision of a comprehensive Emergency Response Site Contingency Plan (Plan) no later than 60 days prior to the start of construction, the applicant proposed that the Plan be submitted not less than 60 days prior to the start of commercial operations.

The effect of applicant's proposed revision would be obvious: it would eliminate the provisions, protections, and coordination provided in the Plan from being available and applicable during demolition and construction activities, a time period that is expected to last 30 months. It is well known and documented in the record (see combined FSA Worker Safety and Fire Protection section pp. 4.14-5 through 4.14-11, TN 205874) that demolition and construction activities are inherently dangerous and risky endeavors that require maximum adherence to LORS and sound safety and health principles. The intent of COM-12 is to ensure that all emergency measures will be contained and coordinated in one central repository within the management command and control structure. Staff believes that COM-12 is not duplicative of other conditions of certification in that a comprehensive Plan required by this condition would be a compilation and coordination of all other emergency response plans to aid management in ensuring effective and timely implementation and response. Staff believes this will not place an undue burden on the

applicant to develop and implement this Plan prior to the start of demolition and construction activities.

Staff agrees with applicant's testimony identifying an inconsistency in the time schedule required in COM-12 and Worker Safety-1. Staff proposes that COM-12 be revised to be consistent with Worker Safety-1 so as to reflect that the Emergency Response Site Contingency Plan be submitted to the CPM for review and approval at least 30 days prior to commencement of demolition activities or site mobilization for construction, whichever occurs first.

Staff proposes the following:

COM-12: Emergency Response Site Contingency Plan. No less than ~~sixty (60)~~ **thirty (30)** days prior to ~~the start of construction commercial operation to~~ **commencement of demolition activities or site mobilization for construction, whichever occurs first,** (or other CPM-approved date), the project owner shall submit for CPM review and approval, an Emergency Response Site Contingency Plan (Contingency Plan). Subsequently, no less than ~~sixty (60)~~ **thirty (30)** days prior to the start of commercial operation, the project owner shall update (as necessary) and resubmit the Contingency Plan for CPM review and approval.

(All other text of COM-12 remains as proposed in the combined FSA.)

Staff's Rebuttal – COM-13: Staff objects to the applicant's proposed revisions to the Incident Reporting Requirements. Staff maintains that the wording of COM-13 proposed in the combined FSA is protective, appropriate, and necessary without presenting an undue burden on the applicant.

Instead of staff's proposal that certain enumerated incidents be reported to the CPM within one *hour* after it is safe and feasible, the applicant proposes that incidents be reported within one *day* after it is safe and feasible. Further, applicant proposes that certain incidences not be reported at all unless they meet the criterion of being "catastrophic" in nature or pose an actual health and safety impact to workers or the public.

Staff believes that a one hour reporting requirement is not only feasible but reasonable and even lenient in that this requirement includes the provision that the reporting be done only after it is safe and feasible to do so. The reporting need not take very long and can consist of a short phone call, e-mail, or text message. Follow-up with more detailed information can be done at a later time. The allowance for undertaking this reporting only when safe and feasible gives the

power plant owner much flexibility in the timeliness of reports. Staff is clearly not asking that the power plant owner interrupt needed emergency actions to notify the CPM when not feasible to do so. Staff believes that there would be at least some power plant staff available to provide this much needed timely notification to the CPM when the enumerated incidences occur. Staff has found through experience that timely reporting of the enumerated incidences is both necessary and appropriate to ensure safe, effective, and continued provision of electrical power to the citizens of California. The Energy Commission, along with the public and power plant owners, have a vested interest in ensuring that safe reliable power is sent to the grid and not placed at risk of interruption. The loss of a power plant during a crucial power demand period would have considerable impact on the health and safety of the public. Staff has found that in order to ensure reliability and the safe operation of a power plant, timely notification of the incidences enumerated in COM-13 is necessary.

Applicant has also proposed in its testimony that only ill-defined “catastrophic” failures be reported in a timely manner. Staff does not agree that only a catastrophe warrants notification. Staff also does not agree to limit reporting of only actual health and safety impacts to workers or the public. Staff believes it would be problematical to prove actual impacts (unless they were immediate acute impacts) and believes that we are long beyond requiring loss of life before potential impacts to the public or workers are reported.

HAZARDOUS MATERIALS MANAGEMENT

Rebuttal Testimony of Alvin Greenberg, Ph.D.

Comment: The applicant’s testimony discusses the site-specific security plan required by HAZ-5, and asserts that it is not feasible to develop an appropriate site-specific security plan in the proposed timeframe.

Staff’s Rebuttal: Staff agrees with applicant’s proposed Verification schedule to revise HAZ-5 so that this condition of certification would require a site-specific security plan at least 60 days prior to the start of construction, and not 60 days after the Petition to Amend is approved as proposed by staff in the combined FSA.

**DECLARATION OF
Matthew Layton, PE**

I, **Matthew 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 staff testimony on the Impacts of Installing Clutch Technology for the **El Segundo Energy Center Amendment (00-AFC-14C)**, based on my independent analysis of the Petition to Amend and supplements thereto, data from reliable documents and sources, and my professional experience and knowledge.
4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.
5. I am personally familiar with the facts and conclusions related in the testimony and, if called as a witness, could testify competently thereto.

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

Dated: Oct 16, 2015

Signed: Matthew Layton

At: Sacramento, California

MATTHEW S. LAYTON

Experience Summary

Thirty three 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

2009-present – Supervising Mechanical Engineer, Engineering Office, Siting, Transmission and Environmental Protection Division, California Energy Commission.

1987-2009 – Senior Mechanical Engineer, STEP 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 Health; 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.

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.