STATE OF CALIFORNIA
ENERGY RESOURCES CONSERVATION AND
DEVELOPMENT COMMISSION

MASTER

POWER PLANT PERFORMANCE ANALYSIS
AND
GUIDELINES STUDY
APPENDIX I

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BY
SYSTEM DEVELOPMENT CORPORATION
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**POWER PLANT
PERFORMANCE ANALYSIS
AND
GUIDELINES STUDY**

**APPENDIX I
RECOMMENDED GUIDELINE FOR
SITING POWER PLANTS**

TPE 16.5-A.I

June 1978

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CALIFORNIA ENERGY COMMISSION

GUIDELINE

Revised June 1978
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POWER PLANT

RELIABILITY & EFFICIENCY

GUIDELINE

CEC GUIDELINE

This initial guideline is issued to describe and make available to the public methods acceptable to the California Energy Commission staff of implementing specific parts of the Commission's regulations and provide guidance to applicants desiring to site new power plants in the State of California. This guideline is not a substitute for regulations and compliance with it is not required. Methods and approaches different from those set out in the guideline will be acceptable if they provide a basis for the findings requisite to the acceptance of an NOI and/or AFC submittal, by the Commission.

Comments and suggestions for improvements in the initial guideline are encouraged. The initial guideline will be reviewed, as appropriate, to accommodate comments and to reflect new information or experience. Comments on the initial guideline should be addressed to Mr. A.J. Mihanovich of the California Energy Commission.

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POWER PLANT RELIABILITY AND EFFICIENCY GUIDELINE

1.0 INTRODUCTION

The Warren-Alquist Act, Legislation AB 1575 of the California Legislature, establishes the framework for siting new power plants in the State of California. It mandated the formation of the California Energy Resources Conservation and Development Commission (CERCDC) as the government body with sole authority to ensure compliance with the intent of the Act. The Act requires the submission of the need of new additional generating capacity and provides the applicant with a staged procedure to be followed in the siting of newly proposed facilities.

In exercising its mandate and meeting the intent of the Act, the Commission has identified the contents of the major submittals it shall require before approving the application, to site a new power plant in California. This guideline, titled "Power Plant Reliability and Efficiency Guideline" is issued by the Commission to apprise applicants for new capacity with the key issues that require resolution between the Commission and the applicant.

It is anticipated that this guideline shall complement existing power plant standards. Compliance with applicable regulations (NRC, EPA, OSHA, etc.) and codes (ASME, etc.) are required. This guideline does not supersede nor take precedence over these and other existing industry standards.

This guideline outlines the key issues and implementation procedure for acceptable applicant submittals. This guideline defines the requirements and makes recommendations. The requirements are indicated by the verb "shall"; the recommendations by the verb "should". Individual applicants, when complying with the requirements, may propose alternates to the recommendations. These alternates need not be consistent with the recommendations of this guideline. Justification for these alternates will be re-

viewed by the Commission staff and their acceptability will be determined on a case-by-case basis during individual AFC submittal reviews.

This guideline, its requirements and recommendations, are applicable to all thermal power plants that are proposed to be built to meet projected demand. A thermal power plant means any stationary or floating electrical generating facility using any source of thermal energy, with a generating capacity of 50 megawatts or more, and any facilities appurtenant thereto.

This initial guideline is issued in two parts, as shown in Exhibit 1. The first part, Part A, is to be used for assessing the attainability and optimality of levels of reliability and efficiency for new power plants. This is required to provide assurance to the Commission that levels of reliability and efficiency proposed for the new facility are cost-effective.

The analysis to assess the cost-effectiveness of the reliability and efficiency levels proposed for a new facility shall be based upon the applicant's costs of bringing a new power plant on-line, and operating, maintaining and managing it to achieve the proposed reliability and efficiency levels, through the useful life of the new plant.

The uncertainties involved in such an analysis shall be specifically discussed by the applicant to assure the commission of awareness, on his part, of future technical, environmental, socio-economic and socio-political issues and his best estimate of their effect on plant life cycle costs.

The life cycle cost of the new plant addition and its planned operation shall be borne by the consumer base during the plant life cycle in accordance with the prevailing allowable applicant rates-of-

Exhibit 1

Power Plant Reliability & Efficiency Guideline

return. The consumer base is comprised of residential, commercial and industrial customers. As their mix changes or the consumer base expands with time, the contribution of each individual consumer to the plant costs are expected to change. For the purpose of this guideline, the proposed reliability and efficiency levels of the new plant shall be cost-effective if the costs of addition of the new plant and its planned operation, result in reduced or minimized individual consumer costs.

An analysis based upon (I) plant life cycle costs, (II) the uncertainties in the utility environment of the future, and (III) the effect of new plant addition and operation on the cost to an individual consumer shall be acceptable to the Commission in its evaluation of the applicant submittal for new generating capacity.

The second part, Part B, identifies specific actions or efforts required by the applicant to achieve the established cost-effective levels. This guideline is required to provide assurance to the Commission that specific actions will be taken by the applicant to ensure that the levels of reliability and efficiency proposed, will be achieved in accordance with the cost estimates and cost accounts of Part A.

It is the intent of this guideline that the establishment and subsequent justification of the most cost-effective reliability and efficiency levels or ranges and the utility plan of action to achieve the levels or ranges proposed, by the applicant, be expressed in and be measured by four indices. The four recommended reliability and efficiency indices at the level of an individual electric power generating unit are Capacity Factor, Operating Availability, Equivalent Availability and Heat Rate. They are defined and calculated as follows, in accordance with Appendix II:

- Capacity Factor is expressed as percentage and calculated as the ratio of the net electrical

generation during a pre-established period of time, to the maximum possible generation (based upon the unit design electrical rating) during the same time period (period hours).

- Operating Availability is expressed as a percentage and calculated as the ratio of the unit operating time (service hours) plus stand-by time (reserve shutdown hours), to the total calendar time for the period (period hours).
- Equivalent Availability is the "equivalent" percentage of the period hours for which a unit is available to generate at full power. It is computed by subtracting from the total hours in the period, the number of hours of full power outages and the "equivalent" number of full power outage hours contributed by partial outages, and dividing the result by the total calendar time in the period (period hours).
- Heat Rate is defined as the amount of fuel energy, measured in BTU's, required to generate one Kwh (net) of electricity.

The purpose of this guideline is to provide a standard agenda for the applicant and the Commission, for assessing the attainability and optimality of levels or ranges of reliability and efficiency proposed by the applicant for implementation in the NOI/AFC stage of the facility siting process. This is accomplished, in part, in the guideline by:

- Identifying Commission review and acceptance criteria
- Identifying key issues to be addressed by the applicant
- Identifying methods for use by the applicant for acceptable responses to the guidelines.

This guideline identifies, in part, the key issues to be addressed by an applicant in each application for siting new capacity. It is not the intention of this guideline to require applicants for new additional generating capacity to repeatedly submit identical information in support of alternate applications. In instances where information identical to that submitted by the same applicant in support of a previous application, is used to support a current application, it is recommended that the applicant refer to the previous submittal. The applicant must have previously stated, in anticipation of the future repeated use of one or more submittals being made, in support of a current application, his intention of doing so and obtained commission approval. A previous submittal may be referenced, in support of a current application if:

intent of the Warren-Alquist act.

- it was made by the same applicant,
- it was previously accepted by the commission in support of the previous application, regardless of whether the previous application was approved or not.
- it addresses a single key issue
- it is a separable document in the previous application.
- it be applicable, in full, to the current application.

This guideline does not include any criteria or recommendations on the procedure applicants may follow to obtain commission approval to refer to previous submittals or the manner in which the acceptability and applicability of previous submittals, to current applications, will be determined.

The key issues and implementation procedures provided in this guideline will be subject to continuous review by the Commission staff with the aim of providing greater flexibility to the applicant in meeting the requirements of this guideline, and the stated and implied

POWER PLANT RELIABILITY AND EFFICIENCY GUIDELINE

- PART A -

ESTABLISHING MOST COST-EFFECTIVE LEVELS OR RANGES OF RELIABILITY AND EFFICIENCY

2.1 DISCUSSION

Section 21100, Division 15, State of California Public Resources Code requires, in part, that any person who plans to accommodate the electric power demand forecast with additional (new) electric generating capacity shall provide information to the California Energy Resources Conservation and Development Commission on the site, the number of units, type of energy source and the maximum generating capacity proposed for each unit. The Commission shall, in evaluating the adequacy of the proposed plan, ensure that the maximum levels of reliability and efficiency which are technically and economically feasible for the operation of the new facility (unit), at the particular site, within the electrical supply system, are met.

This guideline lists the key issues that need to be addressed by any person planning to accommodate the electric power demand forecast with additional (new) electric generating capability. These issues need be considered to justify the cost-effectiveness of proposed levels or ranges of reliability and efficiency. This justification, addressing the key issues, is generally acceptable to the California Energy Resources Conservation and Development Commission.

The establishment of the most cost-effective reliability and efficiency levels or ranges requires the evaluation of the impact, on the power generation

and distribution system of the new unit; the three primary considerations are (I) its projected utilization, (II) the planned levels or ranges of reliability and efficiency, and (III) the total monies allocated/available. Exhibit 2 illustrates a recommended procedure for establishing cost-effective levels of Reliability and Efficiency. As shown in the exhibit a relationship is required to be established between the system cost-effectiveness and new unit posed reliability and efficiency levels.

While the goal is to supply the energy demand in California, a supplier has some influence in shaping energy demand or in modifying it. The exercising of this influence is defined as load management. The ideal case would be for a supplier to modify the expected electrical demand profile to eliminate short-term increases in average load and periodic peak loads. In practice, however, this is not always possible and generally an increase in the periodic load and the average load occurs with time, which the supplier is able to reduce but not eliminate in its entirety. The resultant net increase in the average load and the periodic peak load with time, is the demand the supplier must meet in a safe, reliable, efficient and cost-effective manner.

the applicant should develop and define alternate supply scenarios to meet the projected energy demand profile. The supply scenarios should describe the new generation capacity requirements, the fuel

Exhibit 2

Establishing Cost Effective Levels of Reliability and Efficiency

to be used, the number of unit(s), the size of each unit and the site location.

The applicant shall assess the impact of implementing each scenario on the cost-effectiveness of the system. For the purpose of this guideline a supply scenario is defined to be most cost-effective if its implementation results in a reduced or minimized increase in cost to the individual consumer. The final option that shall be chosen to be implemented shall be the one with the lowest possible cost to the individual consumer. This lowest possible cost shall be consistent with the current allowable rate-of-return. The objective shall be to rank the alternative scenarios in order of increasing cost to the consumer. The "validity of the projected impact of the new facility on the system", in the environment of applicable regulations, and the "Optimization of plant considerations", are the key issues that require resolution to assess the cost-effectiveness of proposed reliability and efficiency levels or ranges of new plant(s).

A discussion of the key issues along with the topics that should be addressed by the applicant are listed in Section 2.2.

2.2 KEY ISSUES & REGULATORY POSITION

Key issues that require resolution between the applicant and the commission are identified below. These key issues comprise the topics that shall be addressed by the applicant in the justification of the required new, additional capacity. The justification shall substantiate the establishment of the relationship between system cost-effectiveness and plant reliability and efficiency and shall provide a definition of the cost-effective reliability and efficiency levels for applicant actions described in Part B of this guideline.

The following discussion lists the key issues that an applicant should address in substantiating that the proposed

reliability and efficiency levels for the new facility (unit) are cost-effective. The Commission shall, in approving the submittal, assess the validity of the relationships developed, and the optimization of the proposed reliability and efficiency levels. The Commission shall base their approval upon the key issues addressed in the application. The key issues to be addressed by the applicant and assessed by the Commission are:

- 1) Validity of the projected impact of the new facility on the system,
- 2) Optimality of the balance obtained between facility considerations.

These key issues shall be addressed for each plant/fuel type by the applicant. Typical topics comprising each key issue, that shall be acceptable to the Commission are listed for each key issue. All topics are equally applicable to each plant/fuel type. The applicant should identify and substantiate the key issue topics for each plant proposed for siting.

1) Validity of the Projected Impact of New Facility on the System: The addition to an existing electrical generation and supply system of a new facility changes the total installed capacity available to produce energy to meet consumer demand. Bringing new capacity into commercial operation within the prevailing rate structure, safety and environmental regulations, and state-of-the-art of design, construction, operations and maintenance of power plants mandates a re-evaluation of the applicant's current system. These evaluations shall consist of financial analyses, the proximity of load center and growth patterns, energy distribution sources, transportation of fuel and system dispatch philosophies, and alternate supply concepts. The decision to bring a new unit into commercial operation, to meet customer demand, thus, requires an assessment of the impact the new facility is expected to have on the existing electrical power generation and supply system. In substantiating the definition of the impact

of the proposed new plant on the power generation system, the applicant should address the following topics:

- Impact on meeting energy demand,
- impact on interchange and purchase agreements,
- impact on the existing generation system,
- impact on generation financing,
- impact on regulations.

The Commission shall accept the substantiation of the expected impact of the new facility on the system which includes the above topics.

2) Optimality of the Balance Obtained Between Plant Considerations: The energy demand on the new unit is defined by the energy requirements on the generation system, the proximity of load centers and the available energy distribution network. The ability of the new facility to meet the demand imposed upon it, is a function of the established reliability and efficiency levels proposed, as tempered by the cost involved in achieving these proposed levels. For the proposed facility, the applicant is required to strike a balance between 1) the energy demand on the unit, 2) the levels and ranges of reliability and efficiency and 3) fiscal considerations to achieve proposed levels. In substantiating the cost-effectiveness of the proposed facility the applicant should address the following topics:

- Facility Utilization
- Reliability and Efficiency Ranges and Levels
- Cost Accounts

The Commission shall accept the substantiation of the optimality of the balance obtained between facility considerations, which includes the above topics.

POWER PLANT RELIABILITY AND EFFICIENCY GUIDELINE

- PART B -

APPLICANT ACTIONS TO ENSURE THE ACHIEVEMENT OF ESTABLISHED RELIABILITY & EFFICIENCY LEVELS & RANGES

3.1 DISCUSSION

Section 21100, Division 15, State of California Public Resources Code requires, in part, that any person who plans to accommodate the electric power demand forecast with additional (new) electric generating capacity shall provide information to the California Energy Resources Conservation & Development Commission on the actions that will be implemented to achieve the reliability and efficiency indices levels proposed for each unit. The Commission shall, in evaluating the adequacy of the proposed action plan, ensure that the proposed cost-effective levels or ranges of reliability and efficiency which are technically and economically feasible for the operation of the new facility (unit), at the particular site, are met.

This guideline lists the key issues that need to be addressed by the applicant, planning to accommodate the electric power demand forecast with additional (new) electric generating capability, in the proposed action plan. These issues need be considered to justify that proposed levels or ranges of reliability and efficiency shall be achieved cost-effectively. This justification, addressing the key issues, is generally acceptable to the California Energy Resources Conservation & Development Commission.

The key issues and implementation procedures provided in this guideline will be subject to continuous review by the Commission staff with the aim of providing greater flexibility to the applicant in meeting the requirements of this guideline, and the objectives of the Warren-Alquist Act.

The applicant should substantiate that the proposed facility (unit) shall achieve required reliability and efficiency levels. These levels shall be established by the applicant and be in accord with the new facility cost accounts based upon the future proposed rate structure. The levels shall be those required to meet the supply scenario determined as the most cost-effective to meet the projected demand profile. The substantiation shall comprise actions by the applicant. Implementation of these actions shall ensure that the required reliability and efficiency levels will be achieved in a most cost-effective manner.

The Commission shall, in approving the submittal, assess the adequacy of the actions that are proposed to be implemented. The objective shall be to ensure that the facility will safely and reliably attain the reliability and efficiency levels or ranges established as the most cost-effective for the facility.

The utility submittal will, thus, require justification. Key issues that need to be resolved between the applicant and the Commission to provide the Commission with justification of proposed applicant actions have been identified and are listed in Section 3.2.

3.2 KEY ISSUES & REGULATORY POSITION

Key issues that require resolution between the applicant and the Commission have been identified. These key issues comprise the topics that shall be addressed by the applicant in the proposed action plan to be implemented for the new facility. This action plan shall substantiate the ability

Exhibit 3

Achieving Established Reliability and Efficiency Levels

of the applicant to achieve the reliability and efficiency levels established as most cost-effective, based upon system considerations, for the new facility.

The following discussion lists the key issues that an applicant should address in substantiating that the new facility shall achieve the required reliability and efficiency levels. The Commission shall, in approving the submittal, assess the adequacy of the actions that the applicant is proposing to implement. The Commission shall base their approval upon the key issues addressed by the application. Those key issues, to be addressed by the applicant and assessed by the Commission, are:

- 1) Adequacy of plant design
- 2) Quality of plant construction
- 3) Effectiveness of procurement
- 4) Emphasis of personnel training/retraining
- 5) Assurance of maintenance effectiveness
- 6) Organization and plant management

These key issues shall be addressed for each plant/fuel type by the applicant. Typical topics comprising a key issue, that shall be acceptable to the Commission are listed for each key issue. As not all topics are equally applicable to each plant/fuel type, the applicant should identify and substantiate specific key issue topics applicable to the plant/fuel proposed for siting in California.

1) Adequacy of Plant Design: The design of a power plant plays a major role in helping meet the goal of generating power in a reliable and efficient manner. Continuous performance of systems and components necessary for reliable and safe unit operation is a prerequisite of high unit availability. Safety, maximum reliability and top system efficiency re-

quire proper operation and maintenance. Achieving the established reliability and efficiency levels shall, thus, be a prime concern of the applicant's engineers and designers. In substantiating that the proposed design shall successfully achieve the reliability and efficiency levels or ranges established for the plant, the applicant should describe his plan to address the the following topics:

- Fuel: Flexibility and availability
- Essential Systems/Components: Redundancy and conservatism
- Plant Operability: Flexibility and Simplicity
- Plant Maintainability: Accessibility, Human engineering
- Specifications: Performance, acceptance, testing, start-up, operation and maintenance
- Environmental Preservation/Pollution (air, water) Control
- Control: Design review procedures and documentation
- Compliance: Regulations and Standards/Codes
- Plant Safety: Control Systems/Alarms/Trips/Diagnostics
- Design: Standardization, Useful Life, Maturization Period, Design Review

The Commission shall accept the substantiation of adequate provision in the design of the new power plant, to meet the established reliability and efficiency levels, which includes the above topics.

2) Quality of Power Plant Construction: For the purposes of this guideline plant construction includes the work involved in site preparation, plant building construction, installation of components/systems and their preoperational testing. Quality construction

will eliminate the down-time attributable to inadequate workmanship, unchecked components, etc. The benefit, thus, of higher quality construction are improving operational availability by minimizing outage time and improving operational efficiency by proper installation and testing. In substantiating that the proposed construction shall successfully achieve the reliability and efficiency levels established for the plant, the applicant should address the following topics:

- Essential Components/Systems: Storage, Installation and Calibration
- Plant Operation: Pre-operational Testing
- Control: Construction Planning and Scheduling
- Compliance: Regulations and Codes
- Safety: Quality Assurance

The Commission shall accept substantiation of quality of construction which includes a discussion of the above topics.

3) Effectiveness of Procurement: For the purposes of this guideline, procurement is defined to include the tasks involved in purchasing required goods and services, and execution of contracts. Purchasing specifies the material, services, supplies and equipment that comprise the power plant and determine its future availability to generate power. Emphasis must, then, necessarily be directed towards significant systems and components. Contracts are agreements between the applicant and chosen suppliers to warrant, guarantee and establish their liability for the reliability, efficiency and safety of their product. Effective procurement strikes a balance between competitive bidding and reliability and efficiency requirements. Achieving the established reliability and efficiency levels shall, thus, be a major thrust of procurement. In substantiating the effectiveness of the procurement, the applicant should address, the following topics:

- Essential Systems/Components: Reliability and efficiency goals
- Specifications: Performance, testing, storage, operation, and maintenance
- Quality Assurance: Warranty, guarantee, liability
- Request for Quotation: Supplier prequalification, bid assessments and trade-offs
- Proposal Evaluation: Procurement and life cycle price
- Compliance with Laws, regulations and standards

The Commission shall accept the substantiation of effectiveness of procurement which includes the above topics.

4) Emphasis of Personnel Staffing/Training: People manage, operate and maintain a power plant. The experience and knowledge of the managers, operators and maintenance personnel influence the productivity of the plant. The effectiveness of outage management increases the availability and minimize the outage time. Safety, maximum reliability and top system efficiency require proper operation and maintenance. Achieving the established reliability and efficiency levels shall, thus, require a staff familiar with managing, operating and maintaining a power plant. In substantiating that the plant staff is capable of running a safe, reliable and efficient plant, the applicant should address the following topics:

- Staffing: Policies and Procedures
- Training Program: Requirements Formulation and Administration
- Personnel Performance: Evaluation and Certification
- Review: Personnel Proficiency and Program Updates

The Commission shall accept the substantiation of adequate emphasis on the personnel training/retraining, to meet the

established reliability and efficiency levels, which include a discussion of the above topics.

5) Assurance of Maintenance Effectiveness:

A majority of plant management actions and decisions related to plant performance predominantly result in some form of maintenance action or activity. To assure that the resulting maintenance will be effective in achieving the established cost-effective reliability and efficiency levels, it is necessary to consider the resources available, procedures to acquire and document information, alternative maintenance strategies and effectiveness of maintenance scheduling. In substantiating that the proposed maintenance is effective, the applicant should address the following topics:

- Maintenance Program: Requirements, planning and scheduling
- Parts: Spares strategy
- Personnel Qualifications
- Essential Components/Systems: Specifications and manufacturers recommendations
- Test Programs: Equipment
- Information: Storage and retrieval
- Control: Quality assurance

The Commission shall accept the substantiation of maintenance effectiveness, which includes the above topics.

6) Organization and Plant Management:

Generation of power in a reliable and efficient manner is dependent upon the management and organization structure of the personnel responsible for operating and maintaining the plant. The organization is required to be both functional and outage oriented. The former is required to run the plant on a day-by-day basis while the latter is responsible for the execution of outage prevention and restoration in a timely and efficient manner. The capability of personnel and the organization establishes the atmosphere in which a team of knowledge-

able individuals can perform these duties. In substantiating that the management personnel and organizational structure is responsive to operating a safe, reliable and efficient plant, the applicant should address the following:

- Organization: Functions, responsibilities, authority, reporting and review
- Policies: Staffing, training, information management
- Procedures: Requirements, review and updates
- Responsibility: Duties, special assignments and audits
- Plant Maintenance: Forced and scheduled
- Control: O/M activities, outages
- Compliance with regulations
- Support: External organizations responsibilities

The Commission shall accept the substantiation of the plant management personnel and organizational structure on the basis of a discussion which includes the above topics.

4.0 RECOMMENDED IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the Commission plans for using this guideline. Except in the cases in which the applicant proposes an acceptable alternative method for complying with the specified objectives of this guideline the method(s) described herein will be used in the evaluation of submittals for siting new power plants.

It is recommended that a staged approach be used in implementing the Reliability and Efficiency guideline. It is not the intention of this guideline that all required substantiation be provided on the initial day of guideline implementation. It is recognized that the applicant may not have the necessary documentation to fully substantiate the detail to which each key issue is required to be addressed. It is

recommended that a staged plan of implementation of the guideline requirements, be developed by each utility and be approved by the Commission. The applicant shall, as a minimum, provide either a sample of each document or a description of planned activities to demonstrate that all essential issues affecting plant safety, reliability and efficiency will be addressed, at the beginning of the siting process.

It is anticipated that this guideline shall complement existing power plant standards. Compliance with applicable regulations, (Nuclear Regulatory Agency, Environmental Protection Agency, Office of Safety and Health Administration, etc.) and codes (American Society of Mechanical Engineers, American National Standard Institute, etc.) are required. This guideline does not supersede or take precedence over these and other existing industry standards.