

| | | |
|---|---|-------------------------|
|  | Nuclear Regulatory Commission Exhibit # - NRC000008-00-BD01 Docket # - 05200016 Identified: 01/26/2012 | |
| | Admitted: 01/26/2012 Rejected: | Withdrawn: Stricken: |

NRC000008
 Filed 10/21/2011
NUREG-1555



U.S. NUCLEAR REGULATORY COMMISSION **ENVIRONMENTAL STANDARD REVIEW PLAN**

8.4 ASSESSMENT OF NEED FOR POWER

REVIEW RESPONSIBILITIES

Primary— Organization responsible for the review of need for power information

Secondary— None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's review and assessment of the need for new baseload generating capacity. This review should include an assessment of the timing of the need for the additional capacity.

The scope of the review directed by this plan should include a comparison of baseload capacity with baseload demand, a reserve margin assessment, projected cost of power, a comparison of total capacity in relation to peakload demand, a schedule evaluation, and an ultimate conclusion regarding the need for the electrical-production capability of the proposed facility. As such, it will draw on ESRPs 8.2 and 8.3.

In performing this review, the reviewer may rely on the analysis in the applicant's environmental report (ER) and/or State or regional authorities' or Independent System Operators' (ISOs') analyses concerning the need for power and energy supply alternatives after ensuring that the analysis of the need for power and alternatives is reasonable and meets high quality standards.

The reviewer of ESRP 8.4 should consider that substantial amounts of electricity are now bought and sold in competitive wholesale markets by utilities, non-utility power producers, and power marketers and brokers within and between regions across the country and even between U.S. markets and markets in Canada and Mexico. As a result, the relevant area of analysis for this ESRP is likely to include the relevant utility service area, if the proposed project is expected to primarily serve the demand of a specific utility and service area, and a larger market area comprising trading partners of that utility and others in the regional wholesale market area surrounding and/or abutting the utility or power plant site. This larger area may coincide with the area covered by a regional transmission organization (RTO),

Revision 1 - July 2007

8.4-1

NUREG-1555

USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

This Environmental Standard Review Plan has been prepared to establish guidance for the U.S. Nuclear Regulatory Commission staff responsible for environmental reviews for nuclear power plants. The Environmental Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required.

These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-1555 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of New Reactors, Washington, D.C. 20555-0001.

Requests for single copies of ESRP sections (which may be reproduced) should be made to the U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Reproduction and Distribution Services Section, or by fax to (301) 415-2289, or by email to DISTRIBUTION@nrc.gov. Electronic copies of this section are available through the NRC's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/> or in the NRC's Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under Accession number ML071810034.

independent system operator (ISO), power pool, or North American Electric Reliability Corporation (NERC) regional reliability council, or multiples of these. The reviewer should also consider the fact that distributed and self-generation by customers is increasing as power costs increase and the cost of distributed generating systems decrease. Finally, the reviewer should consider that dramatic improvements in electricity use have occurred recently and are projected to continue due to energy efficiency codes for equipment and appliances as well as buildings. As a result, new customers, on average, may have very different usage rates than previous generations of customers.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to the reviewers for the following ESRPs, as indicated:

- ESRP 8.1. Obtain information and data on the power system context for the proposal.
- ESRPs 8.2.1 and 8.2.2. Obtain data on power and energy requirements and factors affecting growth of demand.
- ESRP 8.3. Obtain data on power supply.
- ESRPs 9.2.1 and 9.2.2. Provide information to assist in the consideration of alternative sources of energy that might provide the baseload generating capacity.
- ESRPs 10.4.1 and 10.4.2. Provide a summary of the benefit-cost balancing dealing with the consequences of not having sufficient baseload capacity or of adding this capacity too soon.

Data and Information Needs

Affected States and/or regions, NERC reliability councils, and regional transmission organizations may prepare need-for-power evaluations for proposed generation and transmission facilities. The NRC will review the evaluation of the proposed facility and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. If the need-for-power evaluation is found acceptable, no additional independent review by NRC is needed and the analysis can be the basis for ESRPs 8.2 through 8.4.

As part of their analyses, States and/or regional authorities would normally collect data for the need for power. These data may be supplemented by information sources such as the Energy Information Administration, FERC, NERC and member reliability councils, and others.

If an analysis meeting the preceding criteria is not available or satisfactory, the following data or information should be obtained and/or prepared by NRC staff for review of the applicant's need-for-power analysis:

- projected baseload demand from the present to 3 years after initial commercial operation of all proposed units. Prepare a table showing baseload demands, baseload capacities, and resulting deficit or surplus (see Table 8.4-1 for an example) and a table showing peakload responsibilities, accredited generating capacities, and resulting reserve margin (see Table 8.4-2 for an example). Reliability assessments prepared by each NERC reliability council should be used as a starting point.
- reserve margin criteria for the service area. Briefly describe the reserve margin deemed desirable by the staff based on its evaluation of the applicant's analysis and supplementary sources of information including the requirements of the regional reliability council and regional transmission operator at a minimum.
- the applicant's calculated reserve margins extending from the present to the first 3 years after initial operation of all proposed units. Merchant plants may not have reserve requirements similar to those for regulated utilities, however, wholesale power suppliers are increasingly required to provide RTOs, ISOs, or reliability coordinators with assurances of reliability. (Merchant plants are not dedicated to a specific customer or load but sell solely to wholesale markets instead.)
- historical data on installed and actual reserve margins at the time of summer and winter peak hourly demand for the 15 years preceding the date of application
- the relationship between reserve margin (expressed as percent) and system reliability level (expressed as 1 day's outage in 10 years, 5 years, etc.) or other industry accepted measure.

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of the staff's assessment of the need for power are based on the relevant requirements of the following:

- 10 CFR 51, Appendix A(4), with respect to discussion of the no-action alternative in NRC environmental impact statements (EISs)
- 10 CFR 51.71(d) with respect to analysis of alternatives and to weighing the costs and benefits of the proposed action and reasonable alternatives
- 10 CFR 51.75(b) and (c) with respect to applications for early site permits and combined licenses, respectively.

Regulatory positions and specific criteria necessary to meet the regulations identified above are as follows:

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), with respect to the need for new capacity.

Technical Rationale

The technical rationale for evaluating the applicant's assessment of the need for power is discussed in the following paragraphs:

The Atomic Energy Act states that licenses for a nuclear power plant can only be issued when the plant will serve a useful purpose proportional to the quantities of special nuclear material or source material to be utilized. A demonstration of the need for electricity from the proposed plant is necessary to satisfy the "useful purpose" requirement.

NRC's regulations implementing the National Environmental Policy Act (NEPA) in 10 CFR 51 include Appendix A, containing the format for presentation of material in EISs. Section 4 of Appendix A specifically requires that the no-action alternative be discussed in an NRC EIS. ESRP 8.4 will assist in this analysis.

NRC's regulations implementing NEPA also include 10 CFR 51.71, which specifies the content requirements for draft EISs. It is stated in 10 CFR 51.71(d) that a draft EIS is to include "a preliminary analysis which considers and balances the environmental and other effects of the proposed action and the alternatives available for reducing or avoiding adverse environmental and other effects." In addition to providing input for analysis of the no-action alternative, the review conducted under ESRP 8.4 will aid this analysis by providing as input to ESRP 9.1 information to assist in the consideration of alternative sources of electric energy.

It is stated in 10 CFR 51.71(e) that a draft EIS is to include a preliminary recommendation respecting the proposed action "reached after weighing the costs and benefits of the proposed action and considering reasonable alternatives." The review conducted under ESRP 8.4 will aid this determination by evaluating the need for power and the potential benefits of the proposed action and the alternatives.

III. REVIEW PROCEDURES

If an independent review of need for power is to be conducted by NRC staff in lieu of using a review prepared by affected States and/or regions or other independent third-party, the procedures discussed below should be followed. These procedures also may be used by the reviewer as an aid in evaluating forecasts prepared by others. The procedures assume a traditional utility. Industry best practice may evolve in response to deregulation of the utility industry. The reviewer should be aware of, and use, industry best practice where possible. In this context, best practice is defined by methods used by leading consultants in the field, the Energy Information Administration (EIA), federal power marketing administrations such as the Bonneville Power Administration and including the Tennessee Valley Authority, and leading state and regional power planning organizations, such as California, New York, and Wisconsin and the Northwest Power and Conservation Council. Current best practice includes development of resource supply curves that rank from low to high prospective supply options (including energy efficiency as a supply option) on the basis of cost (typically net present value) with respective potential quantities of energy and power (see Northwest Power and Conservation Council power plans

for a detailed description). Supply curves should facilitate staff comparison of supply options because some resources are inherently limited in terms of capacity and may, therefore, not be adequate substitutes for large central baseload generating plants.

(1) Calculate baseload demand as that portion of forecasted kilowatt-hour (kWh) sales occurring at loads equal to or less than average load.

(a) Forecasted growth in the relevant region(s) as a range:

- The forecasted growth rates of kWh sales in this analysis should include at least the applicant's mid-range, high, low, 75th percentile, and 25th percentile forecasts, and the forecast ranges developed by the affected State and/or region or NRC staff (ESRP 8.2.1).
- If the range of reasonable forecasts developed or adopted by the staff (the 25th percentile to 75th percentile range) encompasses the applicant's forecasts of the 25th to 75th percentile range, perform the analysis using the NRC range.
- If the range of relevant regional forecasts developed or adopted by the NRC staff is encompassed by in the applicant's 25th percentile to 75th percentile range, perform the analysis using the applicant's range.
- If the two ranges partially overlap or one is lower, use the lower of the two ranges.

(b) In any case, analyze

- reasons for differences between the applicant's forecast and the forecast developed or adopted by the staff
- the implications for baseload demand of the extreme value forecasts.

(2) Analyze the power supply data (e.g., capacity factors, variable costs, and redesignations) and estimate the baseload capacity of the system using the evaluation of ESRP 8.3.

(3) Compare the supply of baseload capacity with the demand for baseload capacity for the first 3 years of commercial operation of all proposed units.

(4) Identify the reserve margin^(a) requirements currently in acceptance for the service area and identify the organization responsible for establishing this requirement.

(a) Reserves are defined in this ESRP as the difference between accredited net generating capacity and peakload responsibility; the reserve margin is this difference divided by the peakload responsibility.

- (a) Determine if the reserve margin requirements at the time the proposed units are scheduled to begin operation are different from the current reserve margin requirements.
 - (b) Contact the appropriate regional reliability council, other regional bodies, power pools, and FERC to compare this reserve margin requirement with requirements recommended by these organizations.
- (5) Calculate the region's accredited generating capacity (i.e., total installed capacity plus nonfirm purchases and less nonfirm sales) for the period extending from 1 year preceding commercial operation of the proposed first unit to the 3rd year of commercial operation of the proposed last unit.
- (6) Calculate peakload^(a) responsibility based on the growth rates for peakload demand calculated for ESRP 8.2.1.
- (7) For reviews requiring additional staff analysis, calculate peakload responsibility based on forecasted growth rates for peakload demand.
- (a) Determine these by contrasting the applicant's projected range of growth rates for system peakload with the range of growth rates developed or adopted by the staff for the system peak.

The same rules for comparison apply as for annual kWh sales:

- If the range of reasonable forecasts developed or adopted by the staff encompasses the applicant's forecast, the reviewer should perform the analysis using the developed or adopted forecast.
 - If the range of forecasts falls below the applicant's forecast(s), the reviewer should use the staff forecasts.
- (8) For each estimate of peakload responsibility^(b) and for each year under consideration, calculate reserve margin as

$$\text{Reserve Margin} = \frac{\text{Accredited Generating Capacity} - \text{Peakload Responsibility}}{\text{Peakload Responsibility}}$$

Based on the reserve margins and the projections for baseload demand, determine the timespan representing the probable dates when plant capacity will initially be needed.

-
- (a) For each growth rate used, calculate system peakload for the relevant years and adjust for firm purchases and sales and interruptible contracts to obtain peakload responsibility.
 - (b) Peakload responsibility is defined as system load plus firm sales and less firm purchases.

- (9) Prepare an analysis of the costs and benefits of not having sufficient and timely capacity additions and also the costs and benefits of adding capacity too soon.
- (a) For these purposes, assume the applicant's proposed date of commercial operation of all proposed units and consider the effects of the load materializing 3 years earlier than this date and 3 years later than this date.
- (b) The 6-year timespan may be shifted if conditions specific to the service area suggest this to be appropriate.

Treatment of this subject should include, at a minimum, participation by the socioeconomic and benefit-cost reviewers.

- (10) If a need-for-power analysis conducted by or for one or more relevant regions affected by the proposed plant concludes there is a need for new generating capacity, that finding should be given great weight provided that the analysis was systematic, comprehensive, subject to confirmation, and responsive to forecast uncertainty. This source may be the most appropriate if the proposed plant is not planned to serve a traditional utility load or as a retail power supplier in a specific region, but is expected to provide power as a merchant plant to a regional wholesale power market. In this case, the analysis of the relevant market should include an assessment of competitors to the proposed plant.

If no such analysis is available, determine whether the projected peakload responsibility plus the reserve requirement exceeds the total accredited generating capacity and, absent special circumstances, these findings justify the conclusion that new capacity is warranted.

Although this criterion does not show a need for baseload capacity, it does demonstrate a need for new capacity that is independent of type. This criterion, coupled with an affirmative indication that there is a need for baseload capacity, justifies a baseload addition within the timespan determined by the reviewer's forecast analysis.

- (11) If these criteria cannot be met, it may still be possible that the proposed facility will be needed on some other basis. The analysis should be summarized in a table similar to Table 8.4-3. Additional considerations include the following:
- the relevant region's need to diversify sources of energy (e.g., using a mix of nuclear fuel and coal for baseload generation)
 - the potential to reduce the average cost of electricity to consumers
 - the nationwide need to reduce reliance on imported petroleum

- the case of a significant benefit-cost advantage being associated with plant operation before system demand for the plant capacity develops. (This will require the reviewer's benefit-cost evaluation of the consequences of not having sufficient baseload capacity or of adding this capacity too soon.)

If none of the above criteria can be satisfied, it may be concluded that there is no need for additional baseload generating capability on the scale represented by the applicant's proposal during the timespan considered.

IV. EVALUATION FINDINGS

This section of the environmental impact statement should be planned to document the following: (1) public disclosure of the applicant's forecast of need for the proposed project, (2) a presentation of the staff's analysis of the applicant's forecast, and (3) a presentation of the staff's conclusion of whether additional capacity is needed within the timespan developed by the staff.

The following information should be included in the EIS:

- a table showing baseload demands, baseload capacities, and resulting deficit or surplus (see Table 8.4-1 for an example)
- a table showing peakload responsibilities, accredited generating capacities, and resulting reserve margin (see Table 8.4-2 for an example)
- a brief description of the reserve margin deemed desirable by the staff based on its evaluation of the applicant's analysis and supplementary sources of information
- the staff's conclusion as to whether additional capacity (represented by the proposed plant) is needed within the timespan developed by the staff
- a tabulation of costs and benefits associated with bringing the proposed plant online as scheduled, but not having the electrical demand materialize as projected.

V. IMPLEMENTATION

The method described in this ESRP should be used by the staff in evaluating conformance with NRC requirements, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the requirements.

VI. REFERENCES

10 CFR 51, Appendix A(4), "Purpose and need for action."

10 CFR 51.71, “Draft environmental impact statement—contents.”

10 CFR 51.75, “Draft environmental impact statement—construction permit, early site permit, or combined license.”

Atomic Energy Act of 1954, as amended, 42 USC 2011 et seq.

U.S. Nuclear Regulatory Commission (NRC). 1976. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Rev. 2, Washington, D.C.

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Environmental Standard Review Plan are covered by the requirements of 10 CFR Part 51, and were approved by the Office of Management and Budget, approval number 3150-0021.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

Table 8.4-1. Baseload Demand, Capacity, and Capacity Surplus (Deficit)

| | Year | | | |
|-----------------------------|------|------|------|----|
| | 2000 | 2005 | 2010 | -- |
| Baseload Demand by Scenario | | | | |
| High | | | | |
| 25th Percentile | | | | |
| Midrange | | | | |
| 75th Percentile | | | | |
| Low | | | | |
| Baseload Capacity | | | | |
| Surplus (Deficit) | | | | |
| High | | | | |
| 25th Percentile | | | | |
| Midrange | | | | |
| 75th Percentile | | | | |
| Low | | | | |

Table 8.4-2. Peakload Responsibilities, Generating Capacities, and Reserve Margin

| Year | Accredited Generating Capacity (MW) | System Peakload Responsibility (MW) | | | Reserve Margin (% of Peakload Responsibility) | | |
|---|--|--|----------------------|--------------------------------|--|----------------------|--------------------------------|
| | | 25th Percentile Forecast | Midrange Forecast | 75th Percentile Forecast | 25th Percentile Forecast | Midrange Forecast | 75th Percentile Forecast |
| 2000 | | | | | | | |
| 2005 ^(a) | | | | | | | |
| 2010 | | | | | | | |
| 2015 | | | | | | | |
| ... | | | | | | | |
| (a) year unit is expected to come online. | | | | | | | |

Table 8.4-3. Example of Summary Page of Staff Assessment of Need for Power

| Forecast Demand Year = | Net Needed Baseline Capacity | Net Capacity Needed for Peak Power | Net Capacity Needed for Source Diversity | Reduction in Average Cost of Power | Amount and Type of Fossil Fuel Displaced | Net Benefit of Early Availability |
|---------------------------------------|---|---|---|---|---|--|
| High | | | | | | |
| 25th Percentile | | | | | | |
| Midrange | | | | | | |
| 75th Percentile | | | | | | |
| Low | | | | | | |
| | | | | | | |
| Net Benefit If 3 Years Earlier | | | | | | |
| | | | | | | |
| Net Benefit If 3 Years Later | | | | | | |
| | | | | | | |



U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

9.2.1 ALTERNATIVES NOT REQUIRING NEW GENERATING CAPACITY

REVIEW RESPONSIBILITIES

Primary— Office responsible for the review of energy alternative information

Secondary—None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's review and assessment of the economic and technical feasibility of (1) supplying the electrical energy from the proposed plant without constructing new generating capacity, or (2) initiating energy conservation measures that would avoid the need for the plant. The scope of the review directed by this plan should include consideration of (1) power purchases from other utilities or power generators and reactivation or extended service life of plants within the power system in combinations that should provide a supply alternative to the proposed project and (2) the potential for energy conservation or demand management measures that would be equivalent to the output of the proposed project. Energy sources selected by this review should be compared with the proposed project by the reviewer for ESRP 9.2.3. This ESRP is not applicable to applications for an early site permits (ESPs) that do not include an analysis of energy alternatives.

In performing this review, the reviewer should use the assessment of the need for power prepared by the reviewer of ESRP 8.4.

The term "relevant service area" is used in this ESRP to indicate any region to be served by the proposed facility, whether or not it corresponds to a traditional utility service area. Relevant service area is a situation-specific concept, and it must be defined on a case-by-case basis. Applicants may be power generators rather than a utility; therefore, analysis of existing and projected capacity and alternatives must be sufficiently flexible to accommodate differences in the applicant types and regulatory environments. The concept of "relevant region" is also introduced here to mean an area for which electricity demand forecasts are estimated, such as the Northeast Power Coordinating Council region,

Revision 1 - July 2007

9.2.1-1

NUREG-1555

USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

This Environmental Standard Review Plan has been prepared to establish guidance for the U.S. Nuclear Regulatory Commission staff responsible for environmental reviews for nuclear power plants. The Environmental Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required.

These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-1555 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of New Reactors, Washington, D.C. 20555-0001.

Requests for single copies of ESRP sections (which may be reproduced) should be made to the U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Reproduction and Distribution Services Section, or by fax to (301) 415-2289, or by email to DISTRIBUTION@nrc.gov. Electronic copies of this section are available through the NRC's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/> or in the NRC's Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under Accession number ML071830296.

that would usually include the relevant service area, but may not if the applicant intends to sell power to a wider geographic area such as the Eastern United States.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to the reviewers for the following ESRPs, as indicated:

- ESRP 3.7. Obtain a description of the power transmission system from the reviewer for ESRP 3.7.
- ESRPs 8.1 through 8.4. Obtain a description of the power system, factors associated with the power demand and supply, and an assessment of the need for power. **An assessment of the need for power is not required for ESP applications unless the applicant elects to cover need for power in its application.**
- ESRPs 9.2.3 and 10.4.3. Provide an assessment of whether any alternatives considered under ESRP 9.2.1 are both feasible and competitive for supplying the electrical generating capacity proposed in the application.

Data and Information Needs

The following data and information should be obtained:

- A listing of the plants in the relevant service area scheduled for retirement during the period extending from date of application through the 6th year of commercial operation of the proposed project, including existing nuclear power plants within the relevant region that are near the end of their license and are candidates for license renewal. Power plants available for reactivation should also be considered.
- A description of the power system, factors associated with the power demand and supply, and an assessment of the need for power.
- The potential for energy conservation within the relevant service area (from ESRP 8.2.2).

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of alternatives not requiring new generating capacity are based on the relevant requirements of the following:

- **10 CFR 51.71(d)** and 10 CFR 51, Appendix A to Subpart A, with respect to including analysis of alternatives to the proposed action in the EIS.

Regulatory positions and specific criteria necessary to meet the regulations as identified above are as follows:

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), with respect to the analysis of alternatives to adding new generating capacity.

Technical Rationale

The technical rationale for evaluating the applicant's alternatives not requiring new generating capacity is discussed in the following paragraph:

The consideration of alternatives is the heart of an NRC EIS (10 CFR 51, Appendix A). The review conducted under this ESRP contributes to the consideration of alternatives by addressing alternatives that do not involve the addition of power generation capacity. The results of this review should be considered in the assessment of alternative energy sources and systems conducted under ESRP 9.2.3.

III. REVIEW PROCEDURES

The analysis includes two separate evaluations: the first of power purchases and reactivation and the second of energy efficiency. Projections by Federal, State, regional, local, and affected Native American tribal agencies energy planners may be the most useful source of capacity and demand information available. The reviewer should consult current NRC policies regarding these evaluations for alternative analyses.

The extent of this analysis should be determined by the amount and cost of capacity available through combinations of purchases of power and reactivating or extending the service life of plants within the relevant regional system. To make this determination, the reviewer should conduct a brief initial analysis following the procedures in the following subsections to identify the probable amount of electrical generating capacity available.

Power Purchases

The reviewer should determine if excess generating capacity (capacity beyond reserve margin requirements) will be available for extended periods of time from other sources. The time period to be considered for determining this availability should cover a 6-year period starting with the expected first year of commercial operation of the proposed project. Excess generating capacity of these utilities and/or systems should be summed and compared with the capacity need established by the reviewer of ESRP 8.4.

If sufficient excess capacity has been identified to warrant continuation of this review, the reviewer should do the following:

- (1) Determine if adequate transmission line interties exist for the efficient transfer of this power.
- (2) Determine the administrative structure of the current generating supply system in the relevant regional grid and the applicant's relationship to this structure in terms of current and projected power supply. Full account should be taken of nondiscriminatory access rules as promulgated by the Federal Energy Regulatory Commission (FERC).
- (3) Consult with the reviewer for ESRP 3.7 to identify existing transmission lines and corridors within the region.
- (4) If transmission lines and interties are not available, make general estimates of the costs^(a) to construct and maintain such lines and estimates of the environmental impacts associated with their construction and maintenance.

Plant Reactivation or Extended Service Life

To review the relevant regional (e.g., power pool, power marketing area, major utility service area) inventory of the available generating plants, the reviewer should do the following:

- (1) Identify plants now deactivated but potentially operable.
- (2) Identify plants scheduled for retirement during the period extending from the date of application through the 6th year of commercial operation of the proposed project.

In considering alternatives, the reviewer should be guided by FERC practice to define relevant markets as those utilities and power generators directly interconnected to the applicant (first-tier markets). For each first-tier market, FERC considers all utilities interconnected to the first-tier utility and all utilities interconnected to the applicant as competitors in that relevant market. Thus, the competitors usually are assumed to include the second-tier utilities that can reach the market by virtue of the applicant's open-access transmission tariff. FERC admits that the open-access rule (61 *Federal Register* 21540) may lead to consideration of an area broader in scope than the first-tier and second-tier markets currently considered. However, evidence of transmission constraints may circumscribe the scope of the relevant market. FERC permits applicants and intervenors to argue that the market is broader or narrower than that offered by second-tier utilities. The argument must be more than open access and involves transmission constraints and cumulative transmission costs.

(a) The cost analyses should be made on the basis of data available in references or that can readily be supplied by the applicant. Costs should include environmental compliance costs.

When sufficient capacity is identified to warrant further analysis,^(a) the reviewer should review the estimate of the environmental and operating costs associated with the use of these plants. Factors to be considered in preparing these cost estimates should include the

- capital costs needed to reactivate retired plants and to upgrade existing plants, when necessary, to comply with current standards
- operating costs, including costs associated with meeting current environmental standards (these costs should be adjusted to account for reduced availability factors where applicable)
- environmental costs, including the environmental impacts associated with alternative-energy sources.

Conservation (Energy Efficiency)

The reviewer's analysis of conservation (increased energy efficiency) as an alternative to construction of the proposed plant should be based on the analysis and evaluation of conservation and substitution received from the reviewer for ESRP 8.2.2. Except for unusual circumstances, no additional review should be required to complete this portion of this ESRP, since the reviewers for ESRP 8.2.2 and 8.4, in the process of analyzing and evaluating the need for the plant, should make a determination that conservation is or is not a practical alternative to the proposed plant. The reviewer should consult with and assist the reviewer for ESRP 8.2.2 in analyzing the effects of conservation on the need for the plant and to prepare data for inclusion in this section of the EIS. **The reviewer does not need to analyze the potential for conservation if the applicant is proposing to build a merchant plant to sell electric power on the open market and did not address the potential for conservation in the ER (Exelon Generation Co., LLC 2005).**

The reviewer should review the relevant regional (e.g., power pool, power marketing area, major utility service area) summation of the total amount of alternative electrical generating capacity available through a combination of purchased power and the reactivation and extended service life of plants within the regional system. If this combined capacity is insufficient to meet the capacity needs through the 6th year of commercial operation of the proposed project, the reviewer may conclude that this alternative is not feasible. Where sufficient capacity is available, the reviewer should consider whether there are any factors unique to the relevant regional system that could prevent the reactivation or extended service life of existing units or the purchase of power from other systems.

The reviewer should ensure that cost data associated with this alternative, including purchases of power, transmission line costs, capital/operating costs and environmental compliance costs of reactivated and extended service life plants, are available and can be compared with the costs of the proposed project.

(a) The reviewer may want to consider the plant-availability factor at this point. The expected availability factors through the 6th year of commercial operation of the proposed project should be used for this analysis.

These cost data should be used by the reviewer for ESRP 9.2.3. Where sufficient electrical generating capacity is available to meet the need established by the reviewers for ESRP Chapter 8.0, and the costs of the alternative are reasonable when compared to costs of the proposed project, the reviewer of ESRP 9.2.1 should provide this assessment to the reviewer of ESRP 9.2.3. However, when costs of this alternative are significantly greater than costs of the proposed project, the reviewer, after consulting with the reviewers for ESRP 10.4, may conclude that the alternative is not practical.

When the reviewer has determined that the alternatives of conservation, power plant reactivation and life extension, and power import have been adequately described and explored, this information should be included in the environmental impact statement (EIS) and communicated to the reviewer of ESRP 9.2.3 for analysis of alternatives.

IV. EVALUATION FINDINGS

The depth and extent of the input to the EIS should be governed by the analyses required to draw the final conclusion for this section. The input should include the basis for rejecting or accepting the alternative and supporting data such as (1) the amount of (or lack of) excess generating capacity available for purchase, (2) the plants within the regional system, if any, available for reactivation or extended service life and their operating costs and availability factors, and (3) the effects of conservation on reducing the need for electrical generating capacity. Alternatives that are found to be competitive should be reported to the reviewer of ESRP 9.2.3. A competitive alternative is one that is feasible and compares favorably with the proposed project in terms of environmental and health impacts. If the proposed project is intended to supply baseload power, a competitive alternative would also need to be capable of supplying baseload power. A competitive alternative could be composed of combinations of individual alternatives.

The characteristics of the alternatives should be described in sufficient detail that a decision can be reached regarding environmental impacts. The NRC staff evaluation supports concluding statements of the following type to be included in the EIS:

The staff reviewed the available information and concluded that the issues have been covered in sufficient detail for staff analysis of alternatives not requiring new generating capacity.

V. IMPLEMENTATION

The method described in this ESRP should be used by the staff in evaluating conformance with NRC requirements, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the requirements.

VI. REFERENCES

Electric Utilities (Federal Power Act); Promoting Wholesale Competition Through Open-Access Nondiscriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities; Final Rule and Proposed Rule. 61 *Federal Register* 21540-21738 (May 10, 1996).

10 CFR 51, Appendix A, "Format for Presentation of Material in Environmental Impact Statements."

U.S. Nuclear Regulatory Commission (NRC). 1976. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Rev. 2, Washington, D.C.

Exelon Generation Company, LLC (Early Site Permit for Clinton ESP site), CLI-05-29 (2005).

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Environmental Standard Review Plan are covered by the requirements of 10 CFR Part 51, and were approved by the Office of Management and Budget, approval number 3150-0021.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.



U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

9.2.2 ALTERNATIVES REQUIRING NEW GENERATING CAPACITY

REVIEW RESPONSIBILITIES

Primary— Organization responsible for the review of energy alternative information

Secondary—None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's identification and review of alternative sources of energy that could reasonably be expected to meet the demand from both a load and economic standpoint for additional generating capacity determined for the proposed project. Energy sources selected by this review will be compared with the proposed project by the reviewer for ESRP 9.2.3. The scope of the review directed by this plan will be governed by consideration of national policy, by site- and region-specific factors, and by the extent to which the energy sources may be considered as commercially exploitable. Within this scope, the reviewer should determine the current and projected status of (1) alternatives not yet commercially available, (2) fossil fuels, taking into account national policy regarding their use as fuels, and (3) alternatives uniquely available within the region (e.g., hydropower and geothermal).

In performing this review, the reviewer may rely on the analysis in the applicant's environmental report (ER) and/or State or regional authorities' analyses. The reviewer should ensure that the analysis of the need for power and alternatives is reasonable and meets high quality standards.

The term "relevant service area" is used in this ESRP to indicate any region to be served by the proposed facility, whether or not it corresponds to a traditional utility service area. Relevant service area is a situation-specific concept, and it must be defined on a case-by-case basis. Applicants may be power generators rather than a utility; therefore, analysis of existing and projected capacity and alternatives must be sufficiently flexible to accommodate differences in the applicant types and regulatory environments. The concept of "relevant region" is also introduced here to mean an area for which

Revision 1 - July 2007

9.2.2-1

NUREG-1555

USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

This Environmental Standard Review Plan has been prepared to establish guidance for the U.S. Nuclear Regulatory Commission staff responsible for environmental reviews for nuclear power plants. The Environmental Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required.

These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-1555 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of New Reactors, Washington, D.C. 20555-0001.

Requests for single copies of ESRP sections (which may be reproduced) should be made to the U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Reproduction and Distribution Services Section, or by fax to (301) 415-2289, or by email to DISTRIBUTION@nrc.gov. Electronic copies of this section are available through the NRC's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/> or in the NRC's Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under Accession number ML071830302.

electricity-demand forecasts are done, such as the Northeast Power Coordinating Council region, that would usually include the relevant service area.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to the reviewers for the following ESRPs, as indicated:

- ESRP 8.1 - 8.4. Obtain a description of the power system, factors associated with the power demand and supply, and an assessment of the need for power. **An assessment of the need for power is not required for early site permit (ESP) applications unless the applicant elects to cover need for power in its application.**
- ESRP 9.2.3. For each alternative established as competitive, provide the ESRP 9.2.3 reviewer with a description of the energy source/plant combination. This should include the basis for the ESRP 9.2.2 reviewer's findings and sufficient design/performance data to permit the subsequent comparison of the alternative with the proposed project.

Data and Information Needs

The kinds of data and information needed will be affected by site and regional factors as they concern availability of the alternative energy sources, and the degree of detail should be modified according to the technological status of the alternatives or combinations of alternatives. **If a need for power and alternatives analysis that is reasonable and meets high quality standards is not available**, the following data or information should be obtained:

- For alternatives that have not yet achieved commercial acceptance, U.S. Department of Energy (DOE) research, development, and demonstration/commercialization schedules and projected capability as a source of central station power. Information on many of these technologies is available from DOE's Internet site, currently listed as <http://www.doe.gov/>.
- For nonrenewable fuels (e.g., coal, natural gas, and petroleum fuels), the fuel quality, availability to the applicant, rate of consumption estimates, potential environmental restrictions and impacts, amount of land that would be needed, and U.S. national policy, if any, with respect to new uses of these fuels.
- For renewable fuels (e.g., wind, geothermal, hydroelectric, wood and municipal solid waste, energy crops, and solar), availability to the applicant, quantities needed, potential environmental restrictions and impacts, amount of land that would be needed, amount of the fuel available, **and U.S. national policy, if any, with respect to new uses of these fuels.**

For these alternatives, the reviewer should obtain information on the extent of the resource, environmental restrictions and impacts, licensing or permitting constraints, status of

commercialization, and engineering problems associated with each source (from the ER and consultation with local and national resource agencies). NRC's Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437), as updated and modified, can be used as a source of information.

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of alternatives requiring new generating capacity are based on the relevant requirements of the following:

- 10 CFR 51.71(d) and 10 CFR 51, Appendix A to Subpart A, with respect to the need to discuss alternatives to the proposed action in the EIS.

Regulatory positions and specific criteria necessary to meet the regulations as identified above are as follows:

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), with respect to the analysis of alternatives requiring new generating capacity.

Technical Rationale

The technical rationale for evaluating the applicant's alternatives requiring new generating capacity is discussed in the following paragraph:

The consideration of alternatives is the heart of an NRC EIS (10 CFR 51, Appendix A). The review conducted under this ESRP contributes to the consideration of alternatives by addressing alternatives that involve the addition of power generation capacity. The results of this review are considered in the assessment of alternative energy sources and systems conducted under ESRP 9.2.3.

III. REVIEW PROCEDURES

The reviewer should review the alternative energy sources and combinations of sources available to the applicant, and categorize them as either competitive or noncompetitive with the proposed project. A competitive alternative is one that is feasible and compares favorably with the proposed project in terms of environmental and health impacts. If the proposed project is intended to supply baseload power, a competitive alternative would also need to be capable of supplying baseload power. A competitive alternative could be composed of combinations of individual alternatives.

- (1) For competitive alternatives, the reviewer should ensure that the energy source or system meets the following criteria:

- The energy conversion technology should be developed, proven, and available in the relevant region.^(a)
 - The alternative energy source should provide generating capacity substantially equivalent to the capacity need established by the reviewer of ESRP 8.4.
 - The capacity should be available within the timeframe determined for the proposed project.
 - Use of the energy source is in accord with national policy goals for energy use.
 - Federal, State, or local regulations do not prohibit or restrict the use of the energy source.
 - There are no unusual environmental impacts or exceptional costs associated with the energy source that would make it impractical.
 - The reviewer should ensure that the following energy sources have been considered by the applicant:
 - wind
 - geothermal
 - natural gas
 - hydropower
 - municipal solid wastes
 - biomass
 - coal
 - photovoltaic cells
 - solar thermal power
 - wood waste
 - energy crops
 - other advanced systems (e.g. fuel cells, synthetic fuels, etc.).
 - The reviewer should ensure that all alternative energy sources available have been evaluated using the criteria listed above to determine if the alternatives can be considered competitive with the proposed project.
- (2) For noncompetitive alternatives, the reviewer should ensure that the statements dismissing these alternatives are appropriately referenced, applied to the relevant regional system, and that the reasons for rejecting these alternatives have been provided.

(a) Current reports on specific technologies may be identified from the DOE's program offices' web sites (<http://www.doe.gov>).

- (3) For alternative energy sources, the reviewer should evaluate the applicant's or regional authority's analysis of each energy source to determine that it describes the source plant combination in sufficient detail to enable the reviewer of ESRP 9.2.3 to compare the environmental and social costs of this alternative with the proposed project. Specific analytical procedures should depend on the alternative. The reviewer should evaluate the analysis procedure in consultation with the reviewers of ESRP 9.2.3 (for analysis requirements) and ESRP Chapter 2.0 (for environmental descriptions and socioeconomic data).
- (4) For the alternatives considered competitive, the reviewer should ensure that there are suitable sites for an alternative plant and should determine the general characteristics of such a site-plant combination. The results of this analysis should be used by the reviewer of ESRP 9.2.3 in determining the impacts and costs (environmental, health, capital and operating costs, etc.) of the alternative and comparing them with the impacts and costs of the proposed project. Based on an appropriate site (this may include the proposed nuclear plant site) and the energy sources identified, the reviewer should consider the following:
- distance from the fuel sources to the plant, probable transportation means, and mileages for each transportation means
 - average daily fuel requirements based on the installed capacity need determined by the reviewer for ESRP 8.4 and the heat content
 - need for fuel pretreatment (e.g., washing), if any, including the volumes of materials (water) required, the quantities of wastes produced, and means of waste disposal. Also include estimated effects of fuel source preparation on fuel characteristics, quantities of water required, and quantities of wastes produced.
 - in the case of coal or other solids as the preferred alternative to the proposed project, need for combustion-product solid waste disposal, including the quantities of wastes produced and disposal methods and locations for deposition of solid waste
 - need for flue-gas desulfurization, the process to be used, and (on an average daily basis), the raw material inputs and byproduct and/or waste product outputs and means of waste disposal
 - average daily atmospheric releases of carbon dioxide (CO₂) and pollutants of concern regulated under the Clean Air Act (including total suspended particulates [TSP], sulfur oxides [SO_x], and nitrogen oxides [NO_x]).
- (5) For alternatives that have been determined to be competitive, the reviewer should ensure that sufficient data are available to permit the reviewer of ESRP 9.2.3 to compare the environmental impacts and costs of these alternatives with costs of the proposed project.

- (6) For each alternative established as noncompetitive, a brief statement should be prepared describing or identifying the alternative and the basis for the staff's conclusion that it was noncompetitive.

IV. EVALUATION FINDINGS

Input to the environmental impact statement (EIS) review should be directed toward accomplishing the following objectives: (1) public disclosure of the alternative energy sources considered, (2) presentation of the basis for the staff analysis, and (3) presentation of staff conclusions for each alternative energy source considered.

The depth and extent of the input to the EIS should be governed by the alternatives or combination of alternatives that are found to be non-competitive with the proposed project. The characteristics of the alternatives should be described in sufficient detail that a decision can be reached regarding environmental impacts. The NRC staff evaluation should support concluding statements of the following type to be included in the EIS:

The staff reviewed the available information and concluded that the issues have been covered in sufficient detail for staff analysis of alternatives requiring new generating capacity.

V. IMPLEMENTATION

The method described in this ESRP should be used by the staff in evaluating conformance with NRC requirements, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the requirements.

VI. REFERENCES

10 CFR 51, Appendix A, "Format for Presentation of Material in Environmental Impact Statements."

10 CFR 51.45, "Environmental report."

10 CFR 51.71, "Draft environmental impact statement—contents."

Clean Air Act Amendments of 1977, as amended, 41 USC 7401 et seq.

U.S. Nuclear Regulatory Commission (NRC). 1976. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Rev. 2, Washington, D. C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Washington, D.C.

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Environmental Standard Review Plan are covered by the requirements of 10 CFR Part 51, and were approved by the Office of Management and Budget, approval number 3150-0021.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.



U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

9.2.3 ASSESSMENT OF **COMPETITIVE** ALTERNATIVE ENERGY SOURCES AND SYSTEMS

REVIEW RESPONSIBILITIES

Primary—Organization responsible for the review of energy alternative information

Secondary—None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's analysis, evaluation, and comparison of alternative **competitive** means of generating electricity with the proposed project. **A competitive alternative is one that is feasible and compares favorably with the proposed project in terms of environmental and health impacts. If the proposed project is intended to supply baseload power, a competitive alternative would also need to be capable of supplying baseload power. A competitive alternative could be composed of combinations of individual alternatives.** Based on environmental conditions, the reviewer should determine if one or more of the **competitive** alternatives can be expected to (1) provide an appreciable reduction in overall environmental and health impacts, and/or (2) offer solutions to potential adverse impacts predicted for the proposed project for which no mitigation procedure could be identified. When such **competitive**, environmentally preferable alternatives are identified, the reviewer should compare the economic costs of these alternatives with the proposed project to determine if any alternative is preferred (superior) to the proposed project. When superior alternatives are identified, the reviewer should normally recommend to the environmental project manager consideration of (1) adoption of the alternative by the applicant, and (2) denial of the permit or license request.

The scope of the review directed by this plan should be limited to those alternative energy sources and systems that the reviewers of ESRPs 9.2.1 and 9.2.2 have identified as available to the applicant and potentially competitive with the proposed project.

Revision 1 - July 2007

9.2.3-1

NUREG-1555

USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

This Environmental Standard Review Plan has been prepared to establish guidance for the U.S. Nuclear Regulatory Commission staff responsible for environmental reviews for nuclear power plants. The Environmental Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required.

These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-1555 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of New Reactors, Washington, D.C. 20555-0001.

Requests for single copies of ESRP sections (which may be reproduced) should be made to the U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Reproduction and Distribution Services Section, or by fax to (301) 415-2289, or by email to DISTRIBUTION@nrc.gov. Electronic copies of this section are available through the NRC's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/> or in the NRC's Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under Accession number ML071830304.

This review should accomplish the following objectives: (1) description of the competitive alternative energy sources and systems that were considered and the results of the staff's analysis of these alternatives, (2) presentation of the basis for the staff's analysis, and (3) presentation of the staff's conclusions and recommendations.

The analysis of the alternatives is a two-step process: (1) comparing the environmental and health impacts of the competitive alternatives to the proposed action, and (2) comparing the economic costs of any competitive alternatives found to be environmentally preferable to the proposed action.

- Environmental Costs The reviewer should review the alternatives judged to be competitive with the proposed project. A table should be prepared to present the staff's comparison of the potential competitive alternatives with the proposed project (see Table 9.2.3-1 for an example). Input to the table can be prepared using NRC's SMALL/MODERATE/LARGE format (see the Introduction). The review should describe any severe environmental impacts that cannot be mitigated, as well as any unusual environmental impacts (e.g., land use) associated with the proposed project or an alternative.
- Health Effects NUREG-0332, *Potential Health and Environmental Effects Attributable to the Nuclear and Coal Fuel Cycle* (NRC 1987), as modified and updated, can be used to estimate health impacts in conjunction with other published information.
- Economic Costs When the reviewer has concluded that a competitive alternative is environmentally preferable to the proposed action and should be considered as the preferred energy source or system, the reviewer should select tables from the examples shown in Tables 9.2.3-3 through 9.2.3-14 to describe economic costs. A summary table should be presented when an environmentally preferable alternative has been identified. Sufficient additional narrative detail should also be included in the input to justify the alternative on an environmental and economic cost basis.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to the reviewers for the following ESRPs, as indicated:

- ESRPs 4 and 5. Obtain information from the reviewers of these ESRPs regarding environmental impact characterizations for the proposed project and measures and controls to limit adverse impacts for the proposed project. This information should be used as a baseline when comparing alternative energy sources and systems.
- ESRP 8.4. Obtain an assessment of the need for power.
- ESRPs 9.2.1 and 9.2.2. Obtain information from the reviewers of these ESRPs to assist in the development of environmental, health, and cost impact data for competitive alternatives that can be compared with the proposed project.

- ESRP 10.4.3. Obtain input from the reviewer of ESRP 10.4.3 during the evaluation of the economic costs of any alternative identified as being environmentally preferable to the proposed project.
- Interface with the Environmental Project Manager (EPM). Obtain input from the EPM when an alternative appears to meet regulatory requirements with less severe impacts than the proposed action. If an environmentally preferable alternative is more costly or provides fewer benefits, obtain input from the EPM to decide whether this alternative should be considered further.

Data and Information Needs

The kinds of data and information needed will be governed by the nature of the competitive alternative energy sources and systems selected by the reviewers of ESRPs 9.2.1 and 9.2.2. Cost data only needs to be obtained for competitive alternatives deemed to be environmentally preferable to the proposed action.

The following data or information should be obtained:

- a summary of the predicted environmental impacts and the staff's impact characterizations (SMALL/MODERATE/LARGE) of construction and operation of the proposed project(s), including both environmental and socioeconomic impacts (from reviewers for ESRP Chapters 4.0 and 5.0)
- a summary of the predicted environmental and health impacts and the staff's impact characterizations (SMALL/MODERATE/LARGE) of the construction and operation of each potential competitive alternative or combination of alternatives which together constitute a competitive alternative identified by the reviewers of ESRPs 9.2.1 and 9.2.2.

The following cost data and information should be obtained when competitive alternatives or combination of alternatives have been identified by the reviewers for ESRPs 9.2.1 and 9.2.2 :

- an assessment of the need for power from the reviewer of ESRP 8.4
- where relevant, capital cost estimates for the proposed project and for each competitive alternative in the format outlined in Table 9.2.3-3
- where relevant, estimated decommissioning costs for the proposed project and for each competitive alternative (from the ER and the reviewer of ESRP 5.9) (see Table 9.2.3-13)
- where relevant, the fixed charge rate for the utility or consortium of utilities as outlined in Table 9.2.3-4
- where relevant, fuel cost estimates at time of application for the proposed project and for other competitive alternatives, as shown in Table 9.2.3-5 (from the ER)

- where relevant, the operation and maintenance costs estimates (fixed component and variable component) at the time of application for the proposed project and each competitive alternative (see Table 9.2.3-9)
- where relevant, escalation rates from date of application through plant lifetime (40-year life) for the components of operation and maintenance and fuel for the proposed project and each competitive alternative. The 40-year life assumption made throughout this ESRP should be modified to conform with current practice when an environmental review is performed.
- where relevant, the discount rate for the proposed project and each competitive alternative.

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of energy alternatives are based on the relevant requirements of the following:

- 40 CFR 1502.14 with respect to “alternatives including the proposed action”
- 10 CFR 51.71(d) and 10 CFR 51, Appendix A to Subpart A with respect to the need to discuss alternatives to the proposed action in the EIS.

Regulatory positions and specific criteria necessary to meet the regulations as identified above are as follows

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), with respect to the analysis of alternative energy sources.

Technical Rationale

The technical rationale for evaluating the applicant’s assessment of alternative energy sources and systems is discussed in the following paragraphs:

The NRC’s environmental protection regulations (10 CFR 51) implementing the NEPA require that the NRC consider reasonable alternatives to a proposed action. This ESRP provides a framework for evaluating competitive alternatives based on overall environmental and health impacts, potential adverse impacts, and costs.

III. REVIEW PROCEDURES

The analysis of competitive alternatives is a two-step process: (1) comparing estimated environmental impacts and health effects, and (2) considering estimated economic costs. To accomplish this, the reviewer should

- (1) Compare estimated environmental impacts and health effects for the proposed project and each competitive alternative.
- (2) Consider the economic costs of each competitive alternative deemed to be environmentally preferable to the proposed action. This analysis should be conducted in consultation with appropriate ESRP 10.4 reviewers. Assistance from these reviewers will be needed to establish the economic-cost data that should be used to develop a benefit-cost comparison with the baseline proposed project. For some costs, a range of costs may be preferable to a point value, particularly when there is considerable uncertainty in the data. To the extent practical, the analysis should be made with the objective of presenting the cost comparisons in tabular form.
- (3) Compile a tabular summary of the staff's characterization of the environmental and health impacts of the proposed action and the competitive alternative(s) (see Table 9.2.3-1 for an example). The characterization should use NRC's SMALL/MODERATE/LARGE characterizations as set out in the Introduction to NUREG-1555. Input for the characterizations should be obtained from the ESRP Ch. 4 and 5 reviewers and the reviewers of ESRP 9.2.1 and 9.2.2.
- (4) The economic cost data to be analyzed for competitive alternatives deemed to be environmentally preferable to the proposed action are the estimated costs of supplying electrical energy services over the expected life of the proposed project. The data should span 40 years unless there are unique factors that apply to the specific competitive alternative(s) under review. In the case of options involving generation, the 40-year levelized cost should be analyzed at appropriate plant capacity factors. The cost comparison between uranium and the alternative fuel should be developed in a tabular form such as shown in Table 9.2.3-2. The reviewer should review the applicant's cost calculations and ensure that they are reasonable. The other tables provided in this ESRP include worksheets that can assist in this evaluation.

IV. EVALUATION FINDINGS

The reviewer should ensure that each competitive alternative energy source and system considered has been described in sufficient detail to enable the reviewer to make an effective analysis and comparison of environmental and health impacts leading to a staff conclusion that the alternative is environmentally preferable, equivalent, or inferior to the proposed project. For those alternatives or combination of alternatives determined to be environmentally preferable to the proposed project, the reviewer should ensure that economic-cost data are available in sufficient detail to enable the reviewer to conduct benefit-cost balancing and comparisons with the proposed project leading to final staff recommendations. The reviewer should also ensure that all comparisons are made on the basis of the proposed project as supplemented with those measures and controls to limit adverse impacts that are proposed by the applicant or identified by the staff. For those alternatives eliminated from consideration, the reviewer should ensure that adequate documented justification for this action has been prepared.

For a review related to construction permit (CP) applications, early site permit applications that include an analysis of energy alternatives, and combined license (COL) applications, the reviewer verifies that

sufficient information has been provided and that NRC staff evaluation supports concluding statements of the following type to be included in the EIS:

The staff reviewed the available information on energy alternatives compared to the proposed project. Based on this review, the staff concludes that the information supports the proposed project.

If the information on energy alternatives indicates that one is superior to the proposed project, a statement similar to the following should be included:

The staff reviewed the information provided on the energy alternatives presented by the applicant. Based on this review, the staff concludes that the information does not provide an adequate basis for deciding to support the proposed project. The staff finds that is a reasonable alternative on the basis of

V. IMPLEMENTATION

The method described in this ESRP should be used by the staff in evaluating conformance with NRC requirements, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the requirements.

VI. REFERENCES

10 CFR 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR 51, Appendix A, "Format for Presentation of Material in Environmental Impact Statements."

10 CFR 51.71, "Draft environmental impact statement—contents."

40 CFR 1502.14, "Environmental impact statement."

U.S. Nuclear Regulatory Commission (NRC). 1976. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Rev. 2, Washington, D.C.

U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (NRC/NRR). 1987. *Potential Health and Environmental Effects Attributable to the Nuclear and Coal Fuel Cycle*. NUREG-0332, Washington, D.C.

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Environmental Standard Review Plan are covered by the requirements of 10 CFR Part 51, and were approved by the Office of Management and Budget, approval number 3150-0021.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

Table 9.2.3-1

Summary of Environmental Impacts of Construction and Operation of New Nuclear, Coal-Fired, and Natural Gas-Fired Generating Units, and a Combination of Alternatives

| Impact Category | Nuclear | Coal | Natural Gas | Combination of Alternatives |
|---------------------------------|---------|------|-------------|-----------------------------|
| Land use | | | | |
| Air quality | | | | |
| Water use and quality | | | | |
| Ecology | | | | |
| Waste management | | | | |
| Socioeconomics | | | | |
| Human health | | | | |
| Historic and cultural resources | | | | |
| Environmental justice | | | | |

Table 9.2.3-2. Evaluation of Alternatives

| Categorical Alternatives | Nuclear | Coal | (Others) |
|--|---------|------|----------|
| Environmental preference (preferred, equivalent, inferior) | | | |
| Economic cost | | | |
| Annualized capital cost (mills/kWh) | | | |
| Operations and maintenance cost (mills/kWh) | | | |
| Total cost | | | |

Table 9.2.3-3. Cost Information for Nuclear and Alternative Power Generation Methods

| | | | | | |
|--|--------|--------|--|--------|--------|
| 1. Interest during construction ____ %/year, ____ compound rate | | | 5. Escalation rates Purchased equipment ____ %/year Site labor ____ %/year Materials ____ %/year Composite escalation rate ____ %/year | | |
| 2. Length of construction workweek ____ hours/week | | | 6. Month & year that nuclear steam supply system (NSSS) ordered _____ | | |
| 3. Estimated site labor requirement ____ man-hours/kWe | | | | | |
| 4. Average site labor pay rate (including fringe benefits) effective at month and year of NSSS order ____ \$/hour | | | | | |
| 7. Power Station Cost Estimate as of <u>date (\$M/yr)</u> | | | | | |
| Direct Costs | Unit 1 | Unit 2 | Indirect Costs | Unit 1 | Unit 2 |
| a. Land and land rights | | | a. Construction facilities, equipment, and services | | |
| b. Structures and site facilities | | | b. Engineering and construction management services | | |
| c. Reactor (boiler) plant equipment | | | c. Other costs | | |
| d. Turbine plant equipment, not including heat rejection systems | | | d. Interest during construction (@ ____ %/year) | | |
| e. Heat-rejection system | | | Escalation Escalation during construction (@ ____ %/year) | | |
| f. Electric-plant equipment | | | Total Cost Total Station Cost, @ Start of Commercial Operation Date | | |
| g. Miscellaneous equipment | | | | | |
| h. Spare-parts allowance | | | | | |
| i. Contingency allowance | | | | | |
| Subtotal | | | | | |

Table 9.2.3-4. Fixed-Charge Rates for Electric Utilities (percent)

| Component | Public Owned | Investor-Owned |
|---|--------------|----------------|
| Interest or Return on Investment ^(a) | | |
| Depreciation (40 yr. S.F.) ^(b) | | |
| Interim Replacements | | |
| Property Insurance | | |
| Federal Income Taxes | | |
| State and Local Taxes | | |
| Total Fixed-Charge Rate | | |

(a) Composition of financing should be shown as:

| | |
|-------------------------------|------------------|
| Amount of | Interest or rate |
| Financing (%) | of return (%) |
| Bonds _____ | _____ |
| Preferred Stock _____ | _____ |
| Common Stock _____ | _____ |
| Composite cost of money _____ | _____ |

(b) The sinking fund (S.F.) rate in percent is equal to $\frac{i \cdot 100}{(1+i)^n - 1}$

where i is the composite cost of money and n is the plant life, normally 40 years.

Table 9.2.3-5. Material and Service Unit Costs, for Fuel Supply

| (Year) Dollars | |
|--|----------|
| Fuel Supply | Cost, \$ |
| Coal | |
| Low Sulfur, _____ J/kg, \$/tonne ^(a,b) | |
| High Sulfur, _____ J/kg, \$/tonne ^(b) | |
| Other, e.g. Natural Gas (specify) _____ J/kg, \$/unit | |
| Nuclear Fuel Cycle | |
| Mining & Milling, \$/kg U ₃ O ₈ ^(c) | |
| Conversion to UF ₆ , \$/kg U | |
| Uranium Enrichment, \$/SWU | |
| UO ₂ Fabrication, \$/kg HM ^(d) | |
| MOX Fabrication, \$/kg HM ^(d) | |
| Spent-Fuel Transportation, \$/kg HM | |
| Spent-Fuel Storage, \$/kg HM-yr | |
| Reprocessing, \$/kg HM ^(e) | |
| Waste Disposal, \$/kg HM ^(f) | |
| Plutonium Transportation, \$/g | |
| Plutonium Storage, \$/g-yr | |
| Spent-Fuel Disposal, \$/kg | |
| Losses in Conversion to UF ₆ , % | |
| Losses in Fabrication, % | |
| Losses in Chemical reprocessing, % | |
| <p>(a) Low sulfur refers to coal that does not require sulfur-removal equipment to meet emission standards.</p> <p>(b) Contract price or estimated cost delivered to the plant. Provisions for escalation in contracts should be noted.</p> <p>(c) Contract price or estimated cost for U₃O₈. Provisions for escalation in contracts should be noted.</p> <p>(d) This cost should include shipping to reactor (HM stands for heavy metal in fuel, normally uranium plus plutonium).</p> <p>(e) This cost should include the cost of waste solidification for disposal.</p> <p>(f) This cost should include the cost of shipment to a Federal repository.</p> | |

Table 9.2.3-6. Summary

Plant and Fuel-System Characteristics

| Characteristic | Nuclear | Coal | | Other, e.g., Natural Gas |
|---|---------|----------------|---------------|-----------------------------------|
| | | High Sulfur | Low Sulfur | |
| Plant Thermal Power (MWt) | XXX | XXX | XXX | XXX |
| Generation - Gross (MWe) | XXX | XXX | XXX | XXX |
| Net (MWe) | XXX | XXX | XXX | XXX |
| No. of Generating Units | XXX | XXX | XXX | XXX |
| Heat-Rejection-Rate Total (J/h) | XXX | XXX | XXX | XXX |
| Heat Rejected in Cooling System (J/h) | XXX | XXX | XXX | XXX |
| Heat Rejected in Cooling System Blowdown (J/h) | XXX | XXX | XXX | XXX |
| Heat Rate (J/kWh) | XXX | XXX | XXX | XXX |
| Cooling-Water Req. (m ³ /sec) | XXX | XXX | XXX | XXX |
| Cooling-System Type | XXX | XXX | XXX | XXX |
| FUEL SYSTEM | | | | |
| Fuel Heating Value (J/kg) | | XXX | XXX | XXX |
| Consumption (tonne or other units/yr) | | XXX | XXX | XXX |
| Average Supply per Day | | XXX | XXX | XXX |
| Sulfur Content of Solid Fuel | | XXX | XXX | XXX |
| Ash Content of Solid Fuel | | XXX | XXX | XXX |
| Location of Solid-Fuel Source | | XXX | XXX | XXX |
| Ash Disposal (m ³ /yr) | | XXX | XXX | XXX |
| Sulfur-Removal System | | XXX | XXX | XXX |
| Raw Materials (tonne/yr) | | XXX | XXX | XXX |
| Waste Products (tonne/yr) | | XXX | XXX | XXX |
| SO _x Emissions (tonne/yr) | | XXX | XXX | XXX |

Table 9.2.3-6. (contd)

| Characteristic | Nuclear | Coal | | Other, e.g., Natural Gas |
|--|---------|----------------|---------------|-----------------------------------|
| | | High Sulfur | Low Sulfur | |
| NO _x Emissions (tonne/yr) | | XXX | XXX | XXX |
| Particulate Emissions (tonne/yr) | | XXX | XXX | XXX |
| VOC Emissions (tonne/yr) | | | | |
| CO ₂ Emissions (tonne/yr) | | | | |
| Nuclear-Fuel System | | | | |
| U ₃ O ₈ Consumption (tonne/yr) | XXX | | | |
| Specific Power MWt/MTHM | XXX | | | |
| Fuel load (kg U) | XXX | | | |
| New Fuel (trucks/yr) | XXX | | | |
| Spent Fuel (railcars/yr) | XXX | | | |
| High-Level Waste (m ³ /yr) | XXX | | | |
| EQUILIBRIUM FUEL CYCLE | | | | |
| Initial Enrichment (% U-235) | XXX | | | |
| Final Enrichment (% U-235) | XXX | | | |
| Burn up, Average (MWDT/kg U) | XXX | | | |
| Plutonium Production after Losses (g/kg U) | XXX | | | |
| TRANSMISSION SYSTEM | | | | |
| New Corridors (km) | XXX | XXX | XXX | XXX |
| New Towers, Existing Corridors (km) | XXX | XXX | XXX | XXX |
| New Conductors, Existing Towers (km) | XXX | XXX | XXX | XXX |

Table 9.2.3-7. Plant and Alternatives Capital-Investment Summary^(a)

Date estimate made _____
Date cost escalated to _____

| | Unit 1 (\$) | Unit 2 (\$) | Alternatives | Alternatives |
|--|-------------|-------------|--------------|--------------|
| DIRECT COST | | | | |
| Land and Land Rights | | | | |
| Physical Plant | | | | |
| Structures and Site Facilities | | | | |
| Reactor Plant Equipment | | | | |
| Turbine Plant Equipment | | | | |
| Electric Plant Equipment | | | | |
| Misc. Plant Equipment | | | | |
| Subtotal | | | | |
| Spare Parts Allowance | | | | |
| Contingency Allowance | | | | |
| Subtotal | | | | |
| INDIRECT COST | | | | |
| Construction Facilities, Equipment, and Services | | | | |
| Engineering and Const. Mgt. Services | | | | |
| Other Costs | | | | |
| Interest During Construction | | | | |
| Subtotal | | | | |
| Start of Const. Cost | | | | |
| Escalation During Const. (___% yr.) | | | | |
| Total Plant Capital Investment | | | | |
| Cost, \$ per kWe Net | | | | |
| UNIT COST, MILL/kWh AT __%, FIXED CHARGE RATE: | | | | |
| 50% Capacity Factor | | | | |
| 60% Capacity Factor | | | | |
| 70% Capacity Factor | | | | |
| (a) Alternatives should include all generating and non-generating alternatives. For some alternatives such as conservation, different categories of "physical plant" may apply. Footnotes should describe assumptions, cost basis, references, unusual situation, etc. | | | | |

Table 9.2.3-8. Summary of Nuclear-Fuel-Cycle Cost for A (PWR)

| Item | No Recycle | | | | Recycle Pu & U | | | | |
|--|--|--------------------------|--------------|----------------------------------|--|--------------------------|--------------|----------------------------------|--|
| | Escalatio n Rate %/yr ^(a) | 19__-Cost ^(b) | | Escalation to (19__) mill/kWh | 40-yr Level Cost mill/kWh ^(c) | 19__-Cost ^(b) | | | 40-yr Level Cost mill/kWh ^(c) |
| | | \$/kgHM | mill/kW h | | | \$/kgHM | mill/kW h | Escalation to (19__) mill/kWh | |
| U ₃ O ₈ Cost as UF ₆ | XXX ^(d) | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Enrichment | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Fabrication | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| SPENT FUEL DISPOSAL: | | | | | | | | | |
| Storage, 5 yr/l yr | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Shipping | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Disposal | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Reprocessing | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Waste Disposal | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Spent U-235 Credit | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Pu Credit | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |
| Pu Storage, 1 yr | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXX |

Table 9.2.3-9. Fixed and Variable Portions of Operating and Maintenance Cost

| Item | Nuclear | | | High SO ₂ Coal | | | Low SO ₂ Coal | | |
|---|-----------|-----------|-----------|---------------------------|-----------|-----------|--------------------------|-----------|-----------|
| Capacity factor, % ^(a) | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> |
| O&M COST FOR INITIAL YEAR OF OPERATION | | | | | | | | | |
| Fixed, mill/kWh | | | | | | | | | |
| Variable, mill/kWh | | | | | | | | | |
| LEVELIZED COSTS ^(b) | | | | | | | | | |
| Fixed, mill/kWh | | | | | | | | | |
| Variable, mill/kWh | | | | | | | | | |
| (a) Capacity factors of 70, 60, and 50% are suggested. (b) The O&M cost was escalated at _% per year and discounted at _% to obtain the present value. The present value was amortized over 40 years at _% to produce the levelized value. | | | | | | | | | |

Table 9.2.3-10. Carrying Charges for (BWR) Nuclear-Fuel Cycle

| Charges | No Recycle | | | Recycle Pu & U | | |
|--|------------|-----------|-----------|----------------|-----------|-----------|
| Capacity Factor % ^(a) | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> | <u>XX</u> |
| CARRYING CHARGES FOR FUEL, (_%) | | | | | | |
| (Yr) Dollars, \$/kgHM | | | | | | |
| Escalated to (year) | | | | | | |
| 40 years' Levelized Cost, \$/kgHM ^(b) | | | | | | |
| Levelized Unit Cost, mill/kWh ^(b) | | | | | | |
| (a) Capacity factors of 70, 60, and 50% are suggested. (b) The carrying charges were escalated at _% per year and discounted at _% to obtain a present value. The present value was amortized over 40 years at _% to produce the levelized value. | | | | | | |

Table 9.2.3-11. Calculation of Levelized Costs of Coal

| Costs | High Sulfur | Low Sulfur |
|--|-------------|------------|
| (Year) Coal Cost, \$/ton | | |
| Escalated at %/yr to decision year ____, \$/tonne | | |
| 1985 price escalated at ____% per yr, discounted at ____% and amortized over 40 years, at ____, \$/ton | | |
| Unit cost, mill/kWh | | |
| (a) Using a net heat rate of ____ J/kWh and a coal heating value of ____ J/kg. (b) Using a net heat rate of ____ J/kWh and a coal heating value of ____ J/kg. | | |

Table 9.2.3-12. Cost and Carrying Charges for Coal Stockpile

| Capacity Factor, % ^(a) | xx | xx | xx |
|--|----|----|----|
| COST OF 3 MONTHS STOCKPILE | | | |
| High-Sulfur Coal, \$10 ⁶ | | | |
| Low-Sulfur Coal, \$10 ⁶ | | | |
| UNIT COST OF CARRYING CHARGES ^(b) | | | |
| High-Sulfur Coal, Mill/kWh | | | |
| Low-Sulfur Coal, Mill/kWh | | | |
| (a) Capacity factors of 70, 60, and 50% are suggested. (b) Based on __% carrying charges. | | | |

Table 9.2.3-13. Calculation of Cost of Decommissioning

| Costs | Nuclear | | Coal | Other |
|---|-------------|--------------|----------|-------|
| | Lowest Cost | Highest Cost | | |
| Decommissioning Cost, \$10 ⁶ (a) | | | | |
| Annual Sinking-Fund Payment, \$10 ⁶ | -- | -- | -- | |
| CAPACITY FACTOR, % | | | | |
| Unit Cost, Mill/kWh | -- -- -- | -- -- -- | -- -- -- | |
| (a) Cost estimates escalated at __% to 20__, the end of plant life. | | | | |

Table 9.2.3-14. Capital Cost and Unit Generation Cost Comparison for Nuclear and Coal-Fired Generation Station

| Cost | Nuclear (U and Pu recycle) | | Nuclear (No U or Pu recycle) | | High-SO ₂ Coal | | Low-SO ₂ Coal | |
|---|----------------------------------|--|------------------------------------|--|---------------------------|--|--------------------------|--|
| Capital Cost, \$/kW, Net | | | | | | | | |
| (Capacity Factor, %) ^(a) | | | | | | | | |
| UNIT COST: MILL/kWh | | | | | | | | |
| | | | | | | | | |
| CAPITAL CHARGES EXCLUDING TAX | | | | | | | | |
| Capital Charges for Tax (%) | | | | | | | | |
| OPERATION & MAINTENANCE | | | | | | | | |
| Fixed ^(b) | | | | | | | | |
| Variable ^(b) | | | | | | | | |
| Fuel Cost ^(b) | | | | | | | | |
| Charges on Fuel Investment | | | | | | | | |
| Decommissioning | | | | | | | | |
| Total Mill/kWh | | | | | | | | |
| (a) 40-yr levelized cost. Capacity factors of 50, 60, and 70% are suggested. | | | | | | | | |
| (b) The ___ costs were escalated at ___% per year and discounted at ___% per yr over a 40-yr lifetime to obtain present worth value. The present value was amortized at ___% over 40 yrs. | | | | | | | | |