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.

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.

**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.

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**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)<br><br>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<br>Purchased equipment ____ %/year<br>Site labor ____ %/year<br>Materials ____ %/year<br>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 ____ $/hour | | | | | |
| 7. Power Station Cost Estimate as of date ($M/yr) | | | | | |
| 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<br>Escalation during construction (@ _____%/year) | | |
| f. Electric-plant equipment | | | Total Cost<br>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 Financing (%) | Interest or rate 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 $U_3O_8$[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, % | |

(a) Low sulfur refers to coal that does not require sulfur-removal equipment to meet emission standards.
(b) Contract price or estimated cost delivered to the plant. Provisions for escalation in contracts should be noted.
(c) Contract price or estimated cost for $U_3O_8$. Provisions for escalation in contracts should be noted.
(d) This cost should include shipping to reactor (HM stands for heavy metal in fuel, normally uranium plus plutonium).
(e) This cost should include the cost of waste solidification for disposal.
(f) This cost should include the cost of shipment to a Federal repository.

**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 | | | | |
| $U_3O_8$ 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)

| No Recycle | | | | | Recycle Pu & U | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Item | Escalation Rate %/yr[a] | 19__-Cost[b] $/kgHM | 19__-Cost[b] mill/kWh | Escalation to (19__) mill/kWh | 40-yr Level Cost mill/kWh[c] | 19__-Cost[b] $/kgHM | 19__-Cost[b] mill/kWh | Escalation to (19__) mill/kWh | 40-yr Level Cost mill/kWh[c] |
| $U_3O_8$ 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 $S0_2$ Coal | | | Low $S0_2$ Coal | | |
|---|---|---|---|---|---|---|---|---|---|
| Capacity factor, %[(a)] | xx | xx | xx | xx | xx | xx | xx | xx | xx |
| 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)] | xx | xx | xx | xx | xx | xx |
| 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.<br>(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.<br>(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.