
REGULATORY ANALYSIS FOR
PROPOSED AMENDMENTS TO REGULATIONS FOR
THE ENVIRONMENTAL REVIEW FOR RENEWAL OF
NUCLEAR POWER PLANT OPERATING LICENSES:
DRAFT FOR COMMENT

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ABSTRACT

This regulatory analysis provides the supporting information for a proposed rule that will amend the Nuclear Regulatory Commission's requirements for environmental review of applications for renewal of nuclear power plant operating licenses. After considering various options, the staff identified and analyzed two major alternatives. Alternative A is to not amend the regulations and to perform environmental reviews under the existing regulations. Alternative B is to assess, on a generic basis, the environmental impacts of renewing the operating license of individual nuclear power plants, and define the issues that will need to be further analyzed on a case-by-case basis. The findings of this assessment are to be codified in 10 CFR 51. The staff has selected Alternative B as the preferred alternative.

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1.0 DISCUSSION OF THE ISSUE

NRC proposes to issue amendments to its regulations in 10 CFR Part 51 to codify the results of a generic environmental evaluation of the impacts associated with the license renewal of individual nuclear power plants. The results of this evaluation are contained in the draft Generic Environmental Impact Statement (GEIS) (NUREG-1437). Experience has shown that for certain environmental and safety issues, rulemaking can yield a number of societal benefits of direct or indirect importance, such as:

- (1) Enhanced stability and predictability of the licensing process by providing regulatory criteria and requirements in discrete generic areas on matters that are significant in the review and approval of license applications.
- (2) Enhanced public understanding and confidence in the integrity of the licensing process by bringing out for public participation important generic issues that are of concern to the agency and to the public.
- (3) Enhanced administrative efficiency in licensing by removing, in whole or in part, generic issues from staff review and adjudicatory resolution in individual licensing proceedings and/or by establishing the importance (or lack of importance) of various safety and environmental issues to the decision process.
- (4) An overall savings in the utilization of resources in the licensing process by the utility industry, those of the public whose interests may be affected by rulemaking, the NRC, and other Federal agencies, State and local government.

Operating licenses for the earliest commercial nuclear plants will begin to expire in the year 2000. The utility industry, DOE and the NRC have begun laying the groundwork for license renewal that will permit the continued safe and reliable operation of many licensed nuclear power plants well beyond their original 40-year license terms. Many electrical utilities have expressed interest in renewal of their currently held operating licenses for an additional period of time.

The NRC understands that the first two applications for license renewal will be submitted in 1991-1992. Based on discussions with licensees and industry representatives NRC anticipates that a significant percentage of existing plants will submit applications for renewal of their operating license 10 to 20 years prior to their expiration. The NRC has issued a proposed rule, 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants" (55 Fed. Reg. 29043, July 17, 1990), that would establish the requirements that an applicant for renewal of a nuclear power plant operating license must meet, the information that must be submitted to the NRC for review so that the agency can determine whether these requirements have in fact been met, and the application procedures.

In addition to the procedural and technical rulemaking under 10 CFR Part 54, the NRC is pursuing a separate rulemaking on 10 CFR Part 51 to generically address potential environmental impacts from renewal of the operating license of individual nuclear power plants. This rulemaking defines potential environmental impacts that need to be addressed in submittals to the NRC for review as a part of the application for license renewal of individual nuclear power plants.

The NRC has concluded that there has been sufficient experience with power plant operation, maintenance, refurbishment and associated environmental impacts to predict the types and magnitude of environmental effects that may arise from renewal of operating licenses and the resulting extended plant operation.

As a part of the rulemaking, a GEIS has been prepared to assess which environmental impacts may occur, under what circumstances and their possible level of significance (Ref. 1). Results thus far indicate the feasibility of categorizing environmental impacts as follows.

- Category 1. A generic conclusion on the impact can be reached for all affected plants.
- Category 2. A generic conclusion on the impact can be reached for plants that fall within defined bounds.
- Category 3. The environmental impact must be evaluated in each individual license renewal application. A generic conclusion on the impact was not reached for any affected plants.

In addition, the results of the study and changes to Part 51 provides the bases for a license renewal supplement to Regulatory Guide 4.2 "Preparation of Environmental Reports for Nuclear Power Stations."

The NRC has sought the views of the public, industry, and other Federal agencies in preparation for this rulemaking. An advance notice of proposed rulemaking (ANPR) entitled, "License Renewal for Nuclear Power Plants: Scope of Environmental Effects," (55 Fed. Reg. 29964, July 23, 1990) was issued. The advance notice outlined the proposed scope of environmental impacts to be addressed, and also identified alternatives for codification in Part 51. Comments were requested and the following questions were asked:

1. Is a generic environmental impact statement, or an environmental assessment, required by NEPA to support this proposed rulemaking, or can the rulemaking be supported by a technical study?
2. What alternative forms of codifying the findings of the generic environmental impact statement should be considered?
3. What activities associated with license renewal will lead to environmental impacts? By what mechanism will they lead to impacts?

4. What topical areas should be covered in the generic environmental impact statement? Should the proposed outline be supplemented or restructured?
5. For each topical area what are the specific environmental issues that should be addressed?
6. For each topical area and each specific issue what information and data are required to perform generic analyses? Where do the information and data exist?
7. For each topical area and each specific issue what criteria should be used to judge the significance of the environmental impact?
8. For each topical area and each specific issue what is the potential for successful generic analysis?
9. What length of extended operating time can reasonably be addressed in the proposed rulemaking? To what extent is it possible to reach generic conclusion about the environmental impacts which would be applicable to plants having renewed operating licenses expiring in the year 2030, or 2040, 2050?

In summary, 29 comments were received, 19 supported the rulemaking, 7 supported it with qualifications, and 3 opposed it. An industry group with support from 16 utilities recommended using a generic environmental survey as a preferred technical method. All of the comments and recommendations have been considered by the NRC in the development of the proposed amendments to Part 51, the GEIS, the supporting guidance of Reg. Guide 4.2, and an Environmental Standard Review Plan (ESRP), NUREG-1429.

2.0 OBJECTIVES OF THE PROPOSED RULEMAKING

The proposed changes to 10 CFR Part 51 will enable the NRC to achieve the following objectives.

- To simplify the preparation of the environmental report by defining the potential generic and specific environmental impacts that must be addressed.
- To improve the efficiency in the NRC's review by removing such generic potential environmental impacts that pose no significant impact to the environment from staff review and adjudicatory resolution in individual license renewal proceedings.
- To permit the use of an environmental assessment (EA) and a finding of no significant impact (FONSI). This rulemaking would reduce resource requirements when the information presented in an applicant's environmental report demonstrates that there are no significant environmental impacts associated with the limited set of issues that are assessed.

- To identify generic environmental impacts for public participation to achieve understanding and resolution, so that hearings for individual plant EISs will be more efficient.

If most of these objectives are realized, there should be an overall savings in the utilization of resources by the public, the utility industry, the NRC and other Federal agencies, and state and local governments.

3.0 ALTERNATIVES

In considering alternatives to the proposed rulemaking for Part 51, the NRC staff has taken into consideration its past experience with environmental impact statements (EISs), environmental assessments (EAs), generic environmental impact statements (GEISs), generic environmental surveys (GESs), and a detailed review of the public comments on proposed Part 51. A wide spectrum of possible options were considered. For example:

1. No rulemaking
2. Use of a GEIS as basis for proposed amendments to Part 51
3. Use of a GES as basis for amending Part 51
4. A categorical exclusion for license renewal
5. Establish an S-3 type table/chart (§51.50) for license renewal
6. Possible combinations of the above.

On review of these possible options, it was concluded that although the use of the GES (option 3) might eliminate certain publication, review and NEPA scoping requirements, these marginal advantages were not considered sufficient to outweigh the perceived disadvantage of whether such a non-NEPA document would be able to sustain legal challenges. In the case of option 4, it was not deemed possible to make the necessary finding that each unit that may apply for license renewal would not have some significant effect on the environment. Option 5 was proven to be impractical since all future environmental impacts of license renewal at individual unit sites were not amenable to generic assessment now. With the determination to remove options 3, 4, and 5 from consideration, option 6 was no longer deemed reasonable because the remaining options (1 and 2) are viewed to be mutually exclusive. Accordingly, the remaining options were judged to provide two reasonable alternatives that could be used to adequately characterize the costs and benefits of the proposed action to amend Part 51.

Alternative A - No Rulemaking. This alternative is a continuation of the current 10 CFR 51 regulations that require license renewal applicants to submit to the NRC a comprehensive update

to their Environmental Report (ER). The whole range of environmental issues related to operation of each unit and any incremental changes related to extended operation under the terms of license renewal would be addressed. The NRC staff would have to review this supplement to the ER and prepare a draft EIS that addressed all environmental impacts associated with the extended operation of the unit under the terms of a renewed license. This would be done in accordance with §51.70 and 51.71. Requests for comments on the draft EIS in accordance with §51.73 and 51.74 would be required. This would be followed by the issuance of a final EIS and an opportunity for hearing would also occur for each individual unit's license renewal EIS.

Alternative B - Undertake Rulemaking to 10 CFR Part 51 to Generically Address Environmental Impacts Potentially Resulting From Nuclear Power Plant License Renewal. This alternative limits the environmental impact issues that must be addressed on a plant-specific basis. Environmental impact issues that can be addressed in a generic sense, and for which findings of acceptability for all affected plants could be made, would not have to be analyzed on a plant-specific basis. Rather, these environmental issues and findings associated with license renewal would be treated generically, and this generic treatment would form the basis for a rule change to 10 CFR 51 to limit the scope of issues that would need to be considered in individual applications for license renewal. Alternative B would require the review and comment periods for the GEIS as required for the draft EIS under Alternative A. However, on conclusion of this process, no further litigation would be necessary or permitted on the findings of the GEIS in individual unit environmental reviews. Category 1 issues would not be addressed. Licensees would, however, address all Category 2 and Category 3 issues.

The GEIS is projected to limit environmental review activity at the time of individual plant license renewal. Alternative B reduces the effort needed by licensees to prepare their license renewal environmental report (ER) update. It also reduces the effort needed by the NRC to review the updated ER and to prepare either a draft EA or an EIS for only a limited number of issues. If the staff determines publication of a plant-specific draft EIS is necessary, it would follow the same procedures as in Alternative A including an opportunity for hearing, but would consider a narrower set of issues. The major difference associated with this determination is that the EA would not require both a draft and final version or consideration of public comments in between. The EA could result in a finding of no significant impact (FONSI) or a determination that an EIS is required. In the event of a FONSI, the cost-benefit balancing conclusion reached in the GEIS and codified in Part 51 would not be reassessed. The cost of an EA and FONSI will be less than that of an EIS. However, the following cost estimates are for a full EIS (Alternative A) and a limited EIS (Alternative B), thus resulting in conservatively low estimates of the savings of implementing Alternative B.

4.0 COSTS

This section discusses the cost impacts of the two alternatives identified in Section 3. The two alternatives delineated above will impact costs to both industry and the NRC associated with license renewal environmental evaluations. Other than cost implications, there are no consequences associated with this proposed rulemaking action. The environmental documents which must be generated, whether based on the no-action alternative or the approach taking advantage of generic findings, must provide equivalent protection to the environment. Any actions taken as a result of these assessments, therefore, are assumed to be the same for either approach. That is, the plant configuration and operation into the license renewal period, and the resulting impacts to the environment, would be the same under either alternative. Any changes in plant structures, systems, and components, or in operating parameters would be primarily driven by the review process required by 10 CFR Part 54. There would be no difference in environmental risk for any plant between the two alternatives, and there would be no difference in radiological exposure associated with either routine operation or accidents. Therefore, only cost consequences are applicable, and only these are considered in this analysis.

The following discussions develop the costs for each approach, and estimate the incremental impacts (savings) associated with the adoption of Alternative B.

4.1. COST BASIS

The cost evaluations for the Part 51 regulatory analysis assume that the effort required to prepare a comprehensive license renewal update to a plant's ER would be roughly comparable to, or at least not greater than, the effort required for the update provided at the Operating License (OL) stage of a plant's licensing process. NUREG-0499, "Preliminary Statement on General Policy for Rulemaking to Improve Nuclear Power Plant Licensing," (Ref. 2) estimates that such efforts at the OL stage were as follows:

Licensee Efforts for OL Stage ER	5000 to 15000 person-hours
NRC Review and EIS Efforts	2000 to 4000 person-hours.

The NRC efforts cited were those associated with the review of the applicant's ER update, and the preparation of the Environmental Impact Statement for the plant. They include efforts of both NRC contractors and NRC staff. Both the industry and NRC effort estimates include allowance for hearings.

The efforts required to perform the equivalent activities for license renewal purposes are estimated to be at about the midpoint of the range cited above for the ER and EIS generated at the

OL stage of the original plant licensing. This estimate is thought to be somewhat conservative since plants seeking license renewal will have actual environmental impact data to draw upon from the initial construction and operation experience. Also, ongoing licensee and government agency assessments of nuclear plant environmental impacts could possibly reduce the effort needed to produce both an ER update for license renewal and the related NRC review efforts. However, the benefit of such information is difficult to quantify *a priori*, and such information may not be available for all plants. The efforts associated with the generation of a license renewal ER update, its review by the NRC, and the generation of the updated EIS for that plant are estimated to be as follows:

Licensee License Renewal ER Update	10000 person-hours
NRC Review and EIS Efforts	3000 person-hours.

These estimates are thought to be reasonably representative of what might occur. There will undoubtedly be considerable variation in the effort required from one plant to the next. The sensitivity of the cost impacts to possible variations in the plant-specific efforts required are addressed in Section 4.5.

The costs associated with generating and reviewing license renewal ERs are based on the following labor rates. They are taken from NRC's generic cost estimating guidelines (Ref. 3), and the base rates are suitably escalated to reflect 1991 dollars.

Licensee labor rate (1991\$, fully burdened)	\$49.30/person-hour
NRC labor rate (1991\$)	\$47.90/person-hour

The industry rate represents fully-burdened cost. The rate shown assumes that a combination of utility staff and contractors or consultants prepare the ER.

The NRC hourly rate shown above reflects incremental costs associated with rulemaking actions. As such, it assumes that certain of NRC's overhead costs are fixed, and would not change because of the proposed rulemaking. In actuality license renewal is likely to require the hiring of additional NRC staff, and to some extent NRC overhead costs could increase. For the purposes of this analysis, these overhead costs are not included. The effect of this approach is to understate the cost savings associated with the proposed alternative.

The draft GEIS encompasses 118 commercial nuclear power generating units in the United States. This excludes Grand Gulf Nuclear Station Unit 2, Perry Nuclear Plant Unit 2, and Washington Nuclear Project Units 1 and 3, whose construction has been indefinitely suspended, are excluded. The 118 units are owned by 52 electric utilities and are located at 74 plant sites. This same reactor population, minus Rancho Seco and Shoreham units (whose operation in the future is

very unlikely), were considered as potential applicants for license renewal. Since multiple unit/plant sites will have to apply separately for each unit, 116 units/plants were assumed to represent the potential number of applications for license renewal that should be considered for the calculation of industry-wide costs.

4.2 ALTERNATIVE A COST IMPACTS

Alternative A, as noted above, is the "no rulemaking" option. Existing regulations regarding environmental assessments must be followed. These current regulations require that a comprehensive ER update and supplemental EIS be produced for each plant proposed for license renewal. All environmental issues would have to be addressed.

Table 1 summarizes the cost impacts to both the nuclear industry and to the NRC. The consequences considering the reactor population as a whole depend on the number of plants for which license renewal is sought. In Table 1 the costs are given as a fraction of the current plant population applying for license renewal. The table also shows costs as a function of discount rate. Rates of 0%, 5%, and 10% are used to cover the practical range of possibilities for the foreseeable future. For each combination of reactor population fraction applying for license renewal and discount rate, separate values are presented for industry costs, NRC cost, and total costs (combined industry and NRC). Table 1 displays implementation costs only. Considerations of development cost impacts are addressed in Section 4.5.

The costs displayed in Table 1 are based on the assumption that applications for license renewal will typically be submitted twelve years prior to the expiration of the original 40-year license. This assumption is consistent with the time profile used in NUREG-1362 (draft), "Regulatory Analysis for Proposed Rule on Nuclear Power Plant License Renewal," (Ref. 4). The exceptions to this assumption apply to the License Renewal Lead Plants, Yankee Rowe, a pressurized water reactor (PWR), and Monticello, a boiling water reactor (BWR). The current licenses for these two plants expire in the years 2000 and 2011, respectively. The cost analysis performed here assumed that the Yankee submittal for license renewal would be made in 1991, and that for Monticello would be in 1992. The assumption was also made that both Yankee and Monticello would be among the plants applying for license renewal, regardless of the fraction of the plant population to actually do so.

The use of discount rates other than 0% requires a time profile of license renewal applications. While it is not known what the actual time profile of applications will be, the profile used is shown in Figure 1. The plot shows the number of license renewal applications submitted per year assuming that each submittal is made 12 years before the 40-year license expiration date. For the cases where less than 100% of the plants seek license renewal, the further assumption was made that the number of applications submitted in any given year would be

proportionately reduced compared to the number shown in Figure 1. Since the Yankee and Monticello applications are assumed for all scenarios, and since these applications occur in the near future, the costs displayed in Table 1 are not quite proportional to the percentage of plants applying for license renewal. Changes in the time profile of applications will result in different present values of cost but does not significantly affect the relative cost of Alternative A compared to Alternative B.

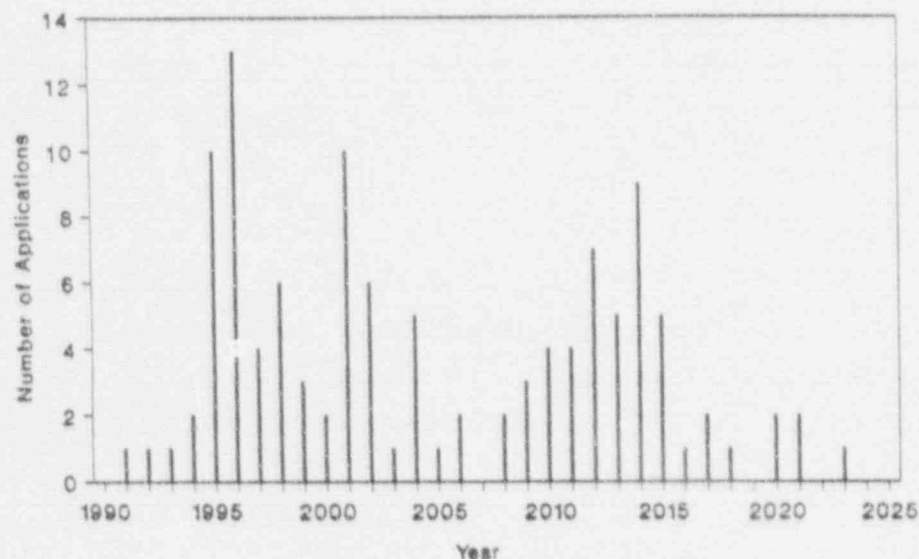


Figure 1. Number of License Renewal Applications per Year

Table 1
Implementation Costs for Alternative A
(Cost in 10^6 1991 \$)

Percent of Reactor Population Applying for License Renewal	Discount Rates		
	0%	5%	10%
Industry Costs			
25%	15.0	8.6	5.8
50%	29.1	16.3	10.6
100%	57.2	31.6	20.2
NRC Costs			
25%	4.4	2.5	1.7
50%	8.5	4.7	3.1
100%	16.7	9.2	5.9
Total Costs			
25%	19.4	11.1	7.5
50%	37.6	21.0	13.7
100%	73.9	40.8	26.1

4.2.1 INDUSTRY COSTS

The licensee's effort needed to prepare a comprehensive, updated ER on any individual plant for which an application for license renewal is submitted is estimated to be 10,000 person-hours. At \$49.30/person-hour, this results in an estimated cost of about \$493,000 per plant in 1991 dollars.

Table 1 indicates that industry costs associated with the preparation of ERs under Alternative A could be as high as \$57 million. This assumes that all 116 plants in the current population (does not include Rancho Seco and Shoreham) apply for license renewal. Projected costs decrease rapidly with increasing discount rates. This occurs because the license renewal applications, and their associated environmental assessments, are spread out over a considerable period of time.

4.2.2 NRC COSTS

As noted in Section 4.1, NRC's efforts associated with the review of license renewal ERs and the generation of plant EISs is estimated to be about 3000 person-hours per plant under Alternative A. This equates to NRC labor costs of about \$144,000 per plant.

Table 1 presents estimates of NRC costs when considering the overall reactor population that may apply for license renewal. The NRC costs associated with Alternative A implementation are estimated to be as much as \$17 million or as little as \$2 million, depending on the number of relicensing applications received and processed and on the discount rate assumed.

4.2.3 TOTAL ALTERNATIVE A IMPLEMENTATION COSTS

The totals shown in Table 1 indicate that the combined cost to both industry and the NRC are estimated to be in the range of about \$7 million to \$74 million. The values displayed for the 5% discount rate are judged to be most realistic, and for this scenario the costs range from about \$11 million to \$41 million.

4.3 ALTERNATIVE B COST IMPACTS

The draft GEIS groups all of the various potential environmental impacts into one-hundred four (104) issues. It classifies each such issue according to the three categories noted in Section 1.0. Of the one-hundred four environmental impact issue groupings evaluated in the draft GEIS, many are of potential consequence only for certain types of plants. The maximum number of issue groupings that would have to be addressed for any individual plant is ninety-seven (97). Key parameters that establish the number of issue groupings pertinent to a given nuclear plant include, among others, the type of cooling system and the ultimate heat sink. The draft GEIS identified twenty-four (24) license renewal environmental impact issues that fell into Categories 2 and 3. These are

the issue groupings that could potentially be addressed by all plants for which license renewal applications are made, or by all such plants whose impacts might fall outside of the bounds evaluated in the GEIS. On the other hand, more than eighty (80) issues are addressed on a generic basis (Category 1), and need not be addressed in individual license renewal applications. The computation of Alternative B costs, therefore, involved evaluating the number of non-generic issues associated with the different types of nuclear plants.

A review of the Category 2 and 3 areas indicates that several apply only to certain types of plants. For example, in aquatic ecology three Category 2 issues apply only to plants with once-through heat dissipation systems and another three apply only to plants with cooling pond heat dissipation systems. This analysis is based on the simplifying assumption that each applicant applying for license renewal will expend effort on twenty-two issues on a plant-specific basis.

Given the number of issues to be addressed on a plant-specific basis, cost consequences associated with Alternative B can be assessed for individual plants and for the industry as a whole. This requires that assumptions be made as to the cost of addressing each plant-specific issue. For the current assessment, cost per area was established simply by dividing the total effort needed to perform a comprehensive assessment by the maximum number of issues addressed in such an effort. In reality, of course, each environmental issue will require an evaluation which involves either more or less than the average effort. The effort required will depend on the complexity of the issue, and for a particular issue will likely vary from one plant to the next. While issue-specific complexity could have been assessed, and labor efforts adjusted accordingly, this approach would introduce additional uncertainties into the evaluation and was not used in this analysis.

The NRC's costs associated with the review of the licensee's ER submittal, and the preparation of the corresponding EIS or EA, were estimated in a manner analogous to the development of licensee costs. NRC's labor effort per issue was established based on the estimated effort needed to conduct a comprehensive review of a full scale ER, as discussed in Section 4.1.

Table 2 summarizes the estimated cost impacts to both industry and the NRC associated with the implementation of Alternative B. As with Table 1 for Alternative A, costs are shown for three discount rates and for three different fractions of the light water reactor power plant population seeking license renewal. Total implementation costs are also displayed.

Table 2
Implementation Costs for Alternative B
(Cost in 10⁶ 1991 \$)

Percent of Reactor Population Applying for License Renewal	Discount Rates		
	0%	5%	10%
Industry Costs			
25%	4.8	3.0	2.3
50%	8.6	5.1	3.6
100%	16.3	9.3	6.2
NRC Costs			
25%	1.4	0.9	0.7
50%	2.5	1.5	1.0
100%	4.7	2.7	1.8
Total Costs			
25%	6.2	3.9	3.0
50%	11.1	6.6	4.6
100%	21.0	12.0	8.0

4.3.1 INDUSTRY COSTS

As noted in Section 4.1, the licensee's effort needed to prepare a comprehensive, updated ER on any plant for which an application for license renewal is submitted is estimated to be 10,000 person-hours. Based on a maximum of ninety-seven (97) issues to be addressed in a comprehensive effort, this yields an average of slightly more than 103 person-hours per issue. This per-issue effort, coupled with the estimate that each plant will have to address twenty-two plant specific issue areas, yields estimates of industry costs. For the industry as a whole, assuming 116 plants apply for license renewal, and for the "average" plant effort associated with Alternative B, the results are as follows:

Total Industry Cost (undiscounted 1991\$)	\$16 million
Average Plant Cost (undiscounted 1991\$)	\$134,000.

The average plant costs given here do not factor in the costs incurred by the lead plants.

The industry costs noted above assume that the two lead plants, Yankee and Monticello, will not benefit from the proposed Part 51 rulemaking, and that both plants will have to prepare comprehensive ERs. The costs for their efforts are assumed to be \$493,000 per plant, and these costs are reflected in the \$16 million quoted for the total industry cost. Also, this industry total cost assumes that all 116 plants in the reactor population apply for license renewal. The costs are undiscounted, i.e., they do not reflect the time spread over which these expenditures are likely to occur.

The Alternative B consequences to industry as a whole depend on the number of facilities for which license renewal is sought. The values presented in Table 2 indicate that costs to industry under Alternative B are estimated to range from as little as \$2.3 million to more than \$16 million, depending on the scenario considered.

The costs displayed in Table 2 are based on the same set of assumptions used to define Alternative A consequences. They assume that, except for the Yankee and Monticello plants, license renewal applications will typically be submitted twelve years prior to the expiration of the original 40-year license. The time profile of number of applications per year shown in Figure 1 was used to develop Table 2.

4.3.2 NRC COSTS

Section 4.1 noted that the NRC's effort to review a comprehensive license renewal ER, and prepare the attendant EIS, is estimated to require on the order of 3000 person-hours. Based on a total of ninety-seven issues that would be addressed in a comprehensive effort as discussed previously in Section 4.3, this gives an average effort of slightly more than 30 person-hours per issue areas. NRC's potential overall expenditures for industry-wide relicensing ER reviews are estimated below. Per plant average expenditures are also noted.

Total Potential NRC Cost (undiscounted 1991\$)	\$4.7 million
NRC Average Per-Plant Cost (undiscounted 1991\$)	\$39,000.

Table 2 gives NRC costs associated with the adoption of Alternative B. Costs are displayed based on the percentage of the reactor plant population seeking license renewal and on alternative discount rates.

4.3.3 TOTAL ALTERNATIVE B IMPLEMENTATION COSTS

The totals shown in Table 2 indicate that the Alternative B combined implementation cost to both industry and the NRC are estimated to be in the range of about \$3 million to \$21 million. The lower figure corresponds to a small fraction of the reactor population pursuing license renewal together with a high (10%) discount rate. The high figure corresponds to all plants seeking license renewal and 0% discount rate. The values displayed for the 5% discount rate are judged to be most realistic, and for this scenario the costs range from about \$4 million to \$12 million.

4.4 INCREMENTAL IMPACTS ASSOCIATED WITH THE ADOPTION OF ALTERNATIVE B

Nuclear plant license renewal, if it is pursued, will require that applicants perform an assessment of potential environmental impacts associated with extended plant life. This requirement can be met with either Alternative A, the no-rulemaking alternative, or Alternative B

which reduces the number of environmental issues that must be addressed on a plant-specific basis. The proposed changes to 10 CFR Part 51, and as represented by Alternative B, can significantly reduce the burden on both industry and the NRC regarding the preparation and review of environmental report updates associated with license renewal and the preparation of the EIS/EA. The draft GEIS indicates that, of the total issues that must be addressed, the majority can be addressed on a generic basis. The proposed changes to 10 CFR Part 51 would limit those license renewal environmental issues which need to be considered on a plant-specific basis and, therefore, would result in significant cost savings to both industry and the NRC. Table 3 summarizes these estimated cost savings. Overall industry savings are estimated to range from about \$41 million for a high percentage of the plant population seeking license renewal and a low discount rate to about \$3 million if few plants apply and a high discount rate prevails. Savings to the NRC due to the adoption of Alternative B range from about \$12 million to about \$1 million over the range of conditions noted. The combined savings to both industry and the NRC range from about \$53 million to \$4 million.

Table 3
Incremental Impacts Associated With
the Adoption of Alternative B
(Cost in 10⁶ 1991 \$)

	Percent of Reactor Population Applying for License Renewal	Discount Rates		
		0%	5%	10%
Industry Costs				
	25%	(-)10.2	(-)5.6	(-)3.5
	50%	(-)20.5	(-)11.2	(-)7.0
	100%	(-)40.9	(-)22.3	(-)14.1
NRC Costs				
	25%	(-)3.0	(-)1.6	(-)1.0
	50%	(-)5.9	(-)3.3	(-)2.1
	100%	(-)11.9	(-)6.5	(-)4.1
Total Costs				
	25%	(-)13.2	(-)7.2	(-)4.5
	50%	(-)26.4	(-)14.5	(-)9.1
	100%	(-)52.9	(-)28.8	(-)18.2

(-)Denotes cost savings

4.5 SENSITIVITY STUDIES

This section discusses the effects of two different elements that can be considered in defining costs of the two alternatives. The first considers the effects of NRC's regulation development costs.

The second considers the effects of the base level of effort required to prepare and review the necessary environmental impacts documentation.

4.5.1 REGULATORY DEVELOPMENT COSTS

The NRC has expended considerable resources in the development of the proposed changes to 10 CFR Part 51. These resources include the efforts needed to develop the proposed changes, prepare the draft GEIS, and perform related actions. The proposed rule will also require the development of a Regulatory Guide for the preparation of updated license renewal environmental reports. Similarly, an Environmental Standard Review Plan must be developed to assist the NRC in its review of the ERs submitted with license renewal applications.

NRC development efforts are also associated with Alternative A, which is the continuation of current requirements. In the absence of the proposed changes to 10 CFR Part 51, an updated license renewal environmental report Regulatory Guide is still needed, as is an updated Environmental Standard Review Plan for the review of these environmental documents submitted by applicants.

Estimates of NRC's regulatory development efforts and costs associated with both Alternative A and the proposed Alternative B are as follows:

	Alternative A	Alternative B
NRC Professional Staff Effort	14 staff months	88 staff months
Staff Cost, 1991\$	\$116,000	\$730,000
Contractor Assistance, 1991\$	\$1,150,000	\$3,800,000
Totals, 1991\$	\$1,270,000	\$4,530,000

The major distinction between the developmental costs of Alternatives A and B, aside from their absolute size, is that A's costs are yet to be incurred whereas B's, for the most part, are already sunk. Because Alternative A's developmental costs are still outstanding they are an appropriate consideration in this regulatory analysis. Only if A is selected will developmental costs on the order of \$1 million be expended. Thus, the incremental cost to proceed with A is \$1 million. Alternatively, if B were chosen, the incremental impact would be considerably smaller because most of its developmental expenditures are sunk costs and as such are no longer relevant. That is, the sunk costs exist independent of our ultimate decision and, therefore, they are not incremental impacts that can be attributed to Alternative B. That portion of B's developmental costs that are still outstanding are relevant but are projected to be smaller than A's developmental costs. However, for conservatism, the staff assumes they are equivalent and thus the cost implications of NRC developmental costs are assumed to be neutral in this regulatory analysis. In

order to see if these sunk costs would have any effect on the bottom line conclusions, a sensitivity study was performed that includes the sunk costs.

Table 4 shows the impact on costs when the expenditures for NRC's regulation development are included in the assessment. The values shown are based on a 5% discount rate. Separate sets of figures are shown for Alternative A, Alternative B, and the differences between Alternative B and Alternative A. The higher development costs of Alternative B are more than offset by the savings possible by implementing the proposed changes to 10 CFR Part 51. With the 5% discount rate, the savings range from about \$4 million to about \$26 million, depending on the number of plants seeking license renewal. At lower discount rates the savings increase for Alternative B relative to Alternative A. Even under the conditions of a small fraction (25%) of the reactor population applying for license renewal and a higher discount rate (~10%) Alternative B remains less costly than Alternative A, including consideration given to the greater regulation development costs of Alternative B.

Table 4
Overall Costs Associated With License Renewal
Environmental Impact Evaluations and Reviews
(10⁶ 1991 \$)
5% Discount Rate

Percent of Reactor Population Applying for License Renewal	Incremental Costs		
	Alternative A	Alternative B	Alt. B Relative to Alt. A
Industry Costs			
25	8.6	3.0	(-)5.6
50	16.3	5.1	(-)11.2
100	31.6	9.3	(-)22.3
NRC Costs			
25	2.5	0.9	(-)1.6
50	4.7	1.5	(-)3.3
100	9.2	2.7	(-)6.5
NRC Development Costs			
	1.3	4.5	3.2
Total Costs			
25	12.4	8.4	(-)4.0
50	22.3	11.1	(-)11.2
100	42.1	16.5	(-)25.6

(-) Denotes cost savings

4.5.2 SENSITIVITY TO ENVIRONMENTAL REPORT AND EIS/EA PREPARATION EFFORTS

Section 4.1 noted that there is uncertainty in the level of effort required for licensees to prepare an ER supplement to accompany their license renewal submittals. Similarly, the level of

effort to be expended by the NRC in the review of these submittals and the attendant preparation of the EIS for each plant is also somewhat uncertain. The reference level of effort assumed for the licensee to prepare an ER for Alternative A was 10,000 person-hours, and the corresponding NRC review and EIS/EA preparation effort was 3,000 person-hours. By taking full advantage of existing ERs and the environmental impact data collected over the years of plant operation, it is possible that licensee efforts could be considerably less than the base effort assumed. Similarly, larger efforts are also possible. For applications for which a FONSI is supportable, it is likely that a lower level of effort may be necessary of applicants as well as the NRC.

The sensitivity of the cost results to the level of effort required to prepare and review the necessary environmental impact documents was explored. Table 5 shows the results of this sensitivity study. The savings attributable to the adoption of Alternative B relative to Alternative A are shown for the reference case, and for cases based on one-half and 1.5 times the reference level of effort. The cost savings vary directly with the base level of effort required except for the consideration of regulation development costs. The development costs are assumed to remain fixed, regardless of the base ER/EIS/EA preparation efforts assumed. As indicated in Table 5, the cost savings possible by adopting Alternative B decrease if the labor effort is lower than that assumed for the reference case, and they increase if a higher labor effort is assumed.

4.6 IMPACTS ON OTHER REQUIREMENTS

The proposed 10 CFR Part 51 will have no impact on other NRC programs. There will be a positive benefit in the implementation of 10 CFR Part 51, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," but no other implications. Since this rulemaking applies specifically to NRC licensees, no impact on other government agencies or state programs is foreseen.

4.7 CONSTRAINTS

Since the lead time for applications for license renewal can be up to 20 years, there will be no constraint to implementation arising from scheduling. The time allowed for public participation through the ANPR and the publication of a proposed rule for comment should assure that no policy, institutional or legal considerations that arise will be resolved before issuance of the final rule change. Enforceability of the amended 10 CFR Part 51 will be no different than enforcement of the regulations of the existing 10 CFR 51. Since publication of the final rule, no enforcement problems have been experienced. It should be noted, however, that this rulemaking schedule may

Table 5
Sensitivity of Cost Savings to ER and EIS/EA Preparation Efforts
(10⁶ 1991 \$)
5% Discount Rate

Percent of Reactor Population Applying for License Renewal	Incremental Costs of Alternative B Relative to Alternative A		
	0.5 x Base Case	Base Case	1.5 x Base Case
Industry Costs			
25	(-)2.8	(-)5.6	(-)8.4
50	(-)5.6	(-)11.2	(-)16.8
100	(-)11.2	(-)22.3	(-)33.5
NRC Costs			
25	(-)0.8	(-)1.6	(-)2.4
50	(-)1.7	(-)3.3	(-)5.0
100	(-)3.2	(-)6.5	(-)9.8
NRC Development Costs			
	3.2	3.2	3.2
Total Costs			
25	(-)0.4	(-)4.0	(-)7.6
50	(-)4.1	(-)11.2	(-)18.6
100	(-)11.2	(-)25.6	(-)40.1

(-) Denotes cost savings

not significantly benefit the two lead plants (Yankee Rowe and Monticello) who will submit applications in 1991 and 1992. The extent of any benefits cannot be quantified for these lead plants, even though the information developed thus far will be used to support the staff's environmental findings for each plant.

5.0 DECISION RATIONALE

Adoption of the proposed rule would minimize the costs associated with evaluating the environmental impacts caused by extending the operational licenses of commercial nuclear power reactors. There are no other impacts associated with the adoption of the proposed rule.

The adoption of the proposed rule is estimated to result in substantial cost savings to both the nuclear industry and to the NRC. Savings are anticipated because the rule change would reduce the license renewal environmental impact issues that need to be addressed on a plant-specific basis. The proposed change to 10 CFR Part 51 would reduce or eliminate duplication of effort among license renewal applicants in addressing those environmental issues for which a generic conclusion can be reached on the acceptability of the impacts for all affected plants. Overall industry savings are estimated to range from a high of about \$41 million to about \$3 million, depending on the

percentage of the plant population seeking license renewal and the discount rates applicable. Cost savings to individual applicants for license renewal are estimated to be about \$360,000. Total NRC savings due to the adoption of Alternative B range from about \$1 million to about \$12 million over the range of conditions noted.

Considering the costs to both industry and the NRC, the total cost savings with Alternative B range from \$5 million to \$53 million. With the use of the 5% discount rate, judged to be the most realistic scenario, the savings range from \$7 million to \$29 million.

Based on the findings of this analysis, the staff has selected Alternative B as the preferred approach.

REFERENCES

1. NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants," U.S. NRC, August 1990.
2. NUREG-0499, "Preliminary Statement on General Policy for Rulemaking to Improve Nuclear Power Plant Licensing," December, 1978.
3. NUREG/CR-4627, Rev. 1, "Generic cost Estimates: Abstracts From Generic Studies for Use in Preparing Regulatory Impact Analyses," U.S. NRC, December 1988.
4. NUREG-1362 (draft for comment), "Regulatory Analysis for Proposed Rule on Nuclear Power Plant License Renewal," July, 1990.

DG-4002
NUREG-0099
Regulatory Guide 4.2
Revision 2
Supplement No. 1

GUIDANCE FOR THE PREPARATION OF SUPPLEMENTAL ENVIRONMENTAL
REPORTS IN SUPPORT OF AN APPLICATION TO RENEW
A NUCLEAR POWER STATION OPERATING LICENSE:
DRAFT FOR COMMENT

AUGUST 1991

U.S. NUCLEAR REGULATORY COMMISSION

DRAFT: JUNE 19, 1991

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REFERENCES

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1
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3
4 A. INTRODUCTION
5

6 The National Environmental Policy Act (NEPA) of 1969 (Public
7 Law 91-190, 83 Stat. 852) is implemented by the NRC pursuant
8 to regulations contained in 10 CFR 51. Applications for
9 license renewal for nuclear power plants submitted under 10
10 CFR 54 must include, in response to 10 CFR 51, assessments of
11 a number of specific NEPA issues.
12

13 This document supplements Regulatory Guide 4.2, Revision 2,
14 "Preparation of Environmental Reports for Nuclear Power
15 Stations," NUREG-0099, July 1976. Regulatory Guide 4.2
16 details the information that should be included in an
17 application for a construction permit regarding the
18 environmental impact of construction and operation of the
19 proposed plant and associated facilities. This document
20 supplements Regulatory Guide 4.2 by describing information the
21 NRC staff needs from a supplemental environmental report (ER)
22 for license renewal. By using the format in this guide,
23 applicants can help ensure the completeness of the information
24 provided, assist the NRC staff and others in locating the
25 information, and help reduce the time needed for the review
26 process. Where identical conditions exist and no substantial
27 changes in environmental impact can be identified, the
28 applicant may incorporate, by reference, any information
29 previously submitted to the NRC, or records of decisions
30 previously prepared.
31

32 Amendments to 10 CFR 51 reduced the scope of the environmental
33 review and the level of detail required for renewal of an
34 operating license from that required at the initial licensing
35 stage. The reduced environmental review resulted from the
36 preparation of NUREG-1437, a Generic Environmental Impact
37 Statement (GEIS) that reviewed all NEPA issues for the nuclear
38 power plants that may be candidates for license renewal. The
39 U.S. Nuclear Regulatory Commission (NRC) amendments to 10 CFR
40 51 for license renewal include a generic assessment of the
41 impact of all potential NEPA issues that may be associated
42 with the renewal of the operating license of an individual
43 nuclear power plant. The environmental review for license
44 renewal of an individual nuclear power plant is restricted to
45 those issues not resolved generically. For license renewal,
46 the focus of the review, in both the GEIS and the individual
47 plant assessments, is on the impacts associated with up to 20
48 additional years of plant operation and any refurbishment
49 necessary for that additional period.
50

51 The GEIS identifies changes to plants and their operations
52 that could result under 10 CFR 54; assesses the potential
53 impacts of implementing these changes; assesses the potential
54 impacts of operating the plants for up to an additional 20
55 years; and compares these impacts with those of the

1 alternative means for generating electricity. These findings
2 have been codified in the NRC's environmental protection
3 regulations, 10 CFR 51.
4

5 After docketing a license-renewal application and receiving an
6 applicant's supplemental ER, the NRC staff will prepare an
7 Environmental Assessment (EA) on the limited set of potential
8 environmental issues specified in 10 CFR 51. If after
9 reviewing the applicant's supplemental ER and conducting any
10 independent reviews it believes necessary, the staff finds no
11 significant environmental impacts associated with any of the
12 issues, the NRC will issue a Finding of No Significant Impact
13 (FONSI). The environmental review would be complete at that
14 point. However, if the staff finds significant adverse
15 impacts that would preclude the issuance of a FONSI, the NRC
16 would have to prepare a supplemental environmental impact
17 statement (EIS).
18

19 NUREG-1429, "Environmental Standard Review Plan for the Review
20 of License Renewal Applications for Nuclear Power Plants,"
21 provides guidance for the NRC staff's review of supplemental
22 ERs submitted by applicants. The primary purpose of
23 NUREG-1429 is to ensure the quality and uniformity of staff
24 reviews and to ensure that these reviews are focused on those
25 NEPA concerns associated with license renewal. NUREG-1429 is
26 available to licensees, the public, and other parties, and
27 provides information about the regulatory process and the
28 review of environmental issues associated with license
29 renewal.
30

31 After considering the individual issues, the NRC staff would
32 evaluate in the EIS whether the findings would overturn the
33 Commission's conditional generic determination on the benefits
34 and costs of renewing an individual nuclear power plant
35 operating license. This conditional determination, codified
36 in 10 CFR 51, Subpart A, Appendix B, states that the renewal
37 of an operating license for up to 20 years should have accrued
38 benefits that outweigh the economic, environmental, and social
39 costs of license renewal. Table B.1 of 10 CFR 51, Subpart A,
40 Appendix B, summarizes the findings on all environmental
41 issues covered by the GEIS.
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B. GENERAL GUIDANCE TO APPLICANTS

This guide identifies the information needed by the staff in its assessment of the potential environmental effects of renewing the operating license of a nuclear power plant and establishes a format acceptable to the staff for its presentation. Use of the format of this guide will help ensure the completeness of the information provided, will assist the NRC staff and others in locating the information, and will aid in shortening the time needed for the review process. Conformance with this format, however, is not required. An environmental report with a different format will be acceptable to the staff if it provides an adequate basis for the findings requisite to the issuance of a license or permit. However, because it may be more difficult to locate needed information, the staff review time for such a report may be longer, and there is a greater likelihood that the staff may regard the report as incomplete.

The NRC encourages applicants to incorporate by reference lengthy, detailed information from environmental reports, final environmental statements, environmental assessments, safety-assessment reports, and the GEIS for license renewal. However, such information and findings should be summarized in sufficient detail to minimize the need for a reviewer to refer to the cited documents. The absence of such summaries would lengthen the review time and increase the likelihood that the staff would regard the report as incomplete.

In preparing supplemental environmental reports, applicants should be familiar with the requirements of 10 CFR 51, with the GEIS, which provides the analysis and conclusions codified in 10 CFR 51, and with PG 4.2, Revision 2. Through consultation with the appropriate federal, state, and local agencies, the applicant should also be familiar with applicable requirements that may affect the consideration of various issues codified in 10 CFR 51. The GEIS establishes the bounds and significance of potential environmental impacts at 118 light water nuclear power plants. This includes 113 plants with operating licenses as of June 30, 1992, plus Bellefonte Units 1 and 2, Comanche Peak Unit 2, and Watts Bar Units 1 and 2. All NEPA issues that may be of concern to the NRC in its review of an application for renewal of an operating license are assessed. The scope of those issues reflects the potential effects of plant refurbishment associated with license renewal, up to an additional 20 years of plant operation, and possible changes in the plant's environmental setting. All of the issues identified were combined into 104 issues. For each type of impact, generic findings encompassing as many nuclear power plants as possible were made.

Findings on each of the 104 issues were placed in a framework of three categories as follows:

- 1 • Category 1: A generic conclusion on the impact has
2 been reached for all affected nuclear power plants.
- 3
- 4 • Category 2: A generic conclusion on the impact has
5 been reached for affected nuclear power plants that
6 fall within defined bounds.
- 7
- 8 • Category 3: A generic conclusion on the impact was
9 not reached for any nuclear power plant.

10
11 Findings were also made on the significance of impacts for
12 each of the issues.

- 13
- 14 • "Small" impacts are so minor that they neither
15 warrant detailed investigation nor consideration of
16 mitigative actions when such impacts are negative.
- 17
- 18 • "Moderate" impacts are likely to be clearly evident
19 and usually warrant consideration of mitigation
20 alternatives when such impacts are negative.
- 21
- 22 • "Large" impacts involve either a severe penalty or
23 a major benefit and mitigation alternatives are
24 always considered when such impacts are negative.

25
26 Small impacts result in a finding of no significant impact
27 (FONSI) by the NRC staff. Moderate and large impacts are
28 considered significant. Commitments made in a license renewal
29 application may enable a FONSI to be made if implementing such
30 commitments would reduce moderate impacts to small impacts.

31
32 Appendix A-1, a reproduction of Table B.1 from 10 CFR 51,
33 summarizes all issues and the generic findings on their
34 categories and the level of impact. Of the 104 issues for
35 which findings were made, 80 were categorized as Category 1.
36 These 80 issues require no further treatment. The staff
37 categorized 22 issues as Category 2; these require further
38 analysis in each application. The first step of the analysis
39 is to examine certain plant, site, or community
40 characteristics to determine if bounding conditions are met.
41 If these conditions are met, no further analysis is required.
42 If they are not met, further analysis is required. Two issues
43 were categorized as Category 3; they must be assessed in every
44 license-renewal application. Figure 1.1 summarizes the entire
45 process. Chapter 2 provides guidance on the analysis required
46 for the 22 issues in Category 2 and the two issues in
47 Category 3.

48
49 Table 1.1 lists the Category 2 and Category 3 issues from
50 Appendix A-1, and identifies the sections of the GEIS
51 (NUREG-1437) in which these issues are treated.

Table 1.1
Category 2 and Category 3 Environmental Issues

Name from Table B-1 Appendix B 10 CFR 51	Location in Chapter 2 Of this Document	Location in GEIS	
BENEFITS			
Avoided costs	2.10 Demonstration of Cost Advantage of License Renewal	9.4.5 7.3.6	Economic Analysis Economic impacts
COSTS			
Refurbishment	2.10 Demonstration of Cost Advantage of License Renewal	9.4.5 7.3.6	Economic Analysis Economic impacts
Fuel	2.10 Demonstration of Cost Advantage of License Renewal	9.4.5 7.3.6	Economic Analysis Economic impacts
Operation & maintenance	2.10 Demonstration of Cost Advantage of License Renewal	9.4.5 7.3.6	Economic Analysis Economic impacts
ENVIRONMENTAL IMPACTS			
Effects of refurbishment on surface water quality	2.5 Effects of Refurbishment on Surface Water Quality	3.4.1	Surface Water
Entrainment of fish and shellfish early life stages (once-through cooling)	2.1 Heat Shock, Impingement, and Entrainment Effects on Fish and Shellfish	4.2.3.1.2	Entrainment of Fish and Shellfish

un

Name from Table B-1 Appendix B 10 CFR 51	Location in Chapter 2 Of this Document	Location in GEIS
Impingement of fish and shellfish	2.1 Heat Shock, Impingement, and Entrainment Effects on Fish and Shellfish	4.2.3.1.3 Impingement of Fish and Shellfish
Heat shock	2.1 Heat Shock, Impingement, and Entrainment Effects on Fish and Shellfish	4.2.3.1.4 Heat Shock
Impingement of fish (cooling pond cooling)	2.1 Heat Shock, Impingement, and Entrainment Effects on Fish and Shellfish	4.4.4 Aquatic Ecology
Entrainment of fish early life stages (cooling pond cooling)	2.1 Heat Shock, Impingement, and Entrainment Effects on Fish and Shellfish	4.4.4 Aquatic Ecology
Heat shock (cooling pond cooling)	2.1 Heat Shock, Impingement, and Entrainment Effects on Fish and Shellfish	4.4.4 Aquatic Ecology
Groundwater use conflicts (potable and service water-operation)	2.3 Groundwater Use Conflicts	4.2.2.1.1 Potable and Service Water

Name from Table B-1 Appendix B 10 CFR 51	Location in Chapter 2 Of this Document	Location in GEIS
Groundwater use conflicts (water pumped for dewatering-operation)	2.3 Groundwater Use Conflicts	4.2.2.1.2 Operational Dewatering Systems
Groundwater use conflicts (Ranney wells-operation)	2.3 Groundwater Use Conflicts	4.2.2.1.4 Use of Groundwater for Cooling Tower Makeup
Groundwater quality degradation (cooling ponds- operatin)	2.2 Effects of Cooling Ponds on Groundwater Quality	4.4.3 Groundwater
Refurbishment impacts (terrestrial resources)	2.4 Effects of Refurbishment on Important Plant and Animal Habcats	3.6 Terrestrial Ecology
Threatened or endangered species	2.11 Threatened or Endangered Species	3.5 Aquatic Ecology 3.6 Terrestrial Ecology 4.2.1.1 Environmental Statutes
Microbiological organisms (public health-operation)	2.8 Health Effects of Thermophilic Organisms	4.3.6 Human Health
Electromagnetic fields, acute effects (electric shock-operation)	2.7 Electric Shock from Transmission Line Induced Currents	4.5.4.1 Acute Effects

Name from Table B-1 Appendix B 10 CFR 51	Location in Chapter 2 Of this Document	Location in GEIS
Housing impacts of refurbishment	2.6 Effects of License Renewal on Housing	3.7.2 Housing
Housing impacts of license renewal term	2.6 Effects of License Renewal on Housing	4.7.2 Housing
Transportation impacts of refurbishment	2.12 Transportation Impacts of Refurbishment	3.7.4.2 Transportation
Low-level radioactive waste storage	2.9 Low-Level Radioactive Waste Storage and Disposal	6.3.2 On-Site Storage
Low-level radioactive waste disposal	2.9 Low-Level Radioactive Waste Storage and Disposal	6.3.3 Disposal and LLW Compacts

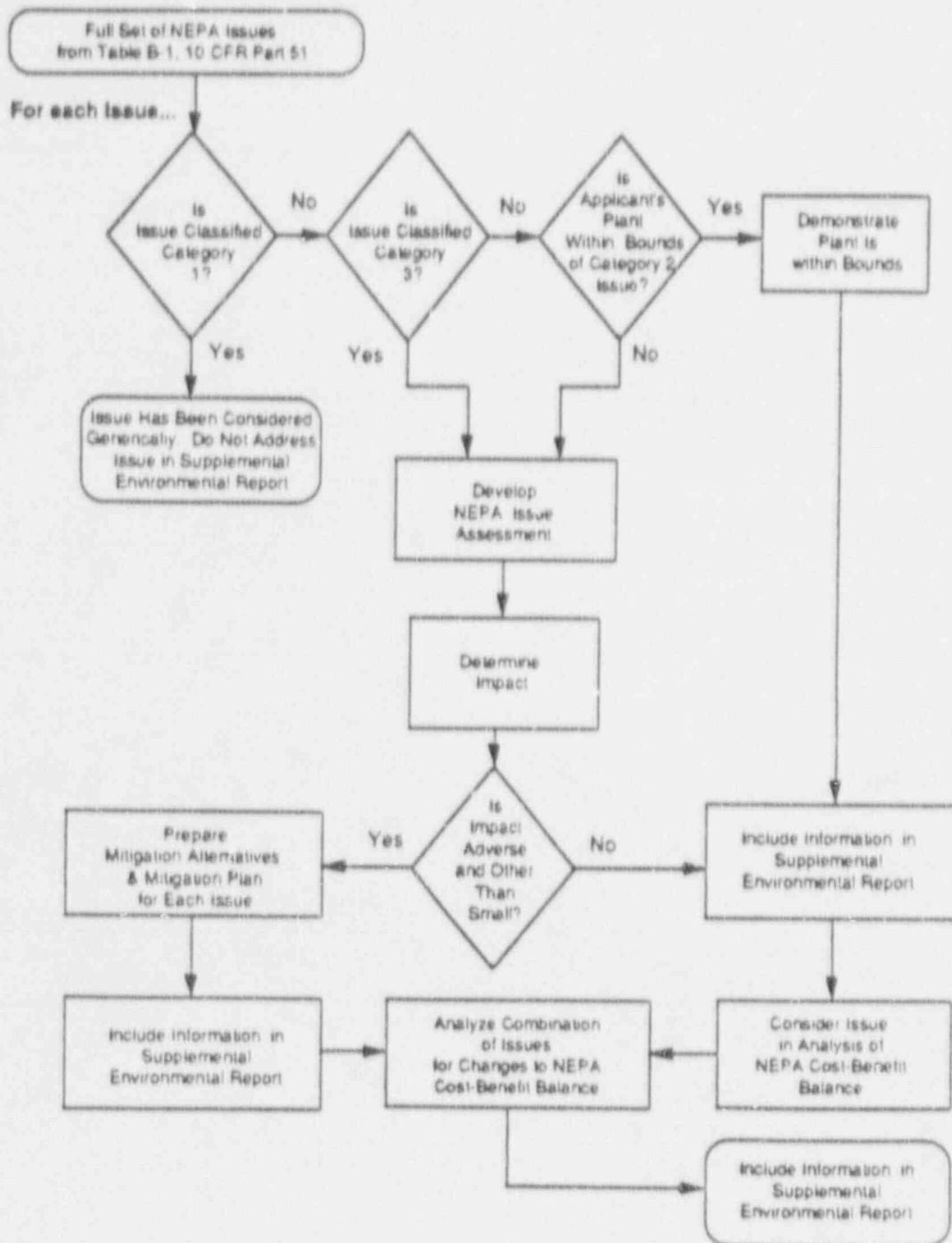


Figure 1.1 NEPA Issues Flowchart

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C. STANDARD FORMAT AND CONTENT OF
SUPPLEMENTAL ENVIRONMENTAL REPORTS

CHAPTER 1. PLANT REFURBISHMENT, OPERATION, AND MAINTENANCE

License renewal may necessitate modifications to a plant, its operations, and its procedures for administrative control. Chapter 1 of a supplemental environmental report should describe those activities that will be taken to prepare the plant for operations under license renewal, and describe any changes in operation and maintenance that will take place during the renewal term. The information provided should focus on modifications directly affecting the environment or affecting plant effluents that affect the environment. Such information should be provided in sufficient detail to give a clear understanding of the sources of environmental effects that must be covered in Chapter 2.

1.1 REFURBISHMENT

Plant modifications and refurbishment activities undertaken for license renewal should be generally characterized in this section. These activities may be compared to refurbishment activities that occur during regularly scheduled plant outages under the current license. Applicants should follow the informational requirements in Chapter 2 to determine the emphasis and level of detail needed in describing plant modifications. Major refurbishment outages associated with license renewal and extended operation should be characterized with regard to duration; change in on-site labor force; affected systems; affected structures and components; and description of the land-use for parking, laydown areas, structures, or any other construction activities. In the context of this guidance, major refurbishment outages are those that last considerably longer than a refueling outage, and are generally comparable to or longer than an outage for replacing a steam generator.

1.2 OPERATION AND MAINTENANCE UNDER LICENSE RENEWAL

This section should generally characterize the changes in plant operating practices, inspections, maintenance activities, and in administrative control procedures during the renewal term. This description should include changes relevant to the issues addressed in Chapter 2. Applicants should follow the requirements in Chapter 2 to determine the emphasis and level of detail needed in describing plant operations.

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1
2 CHAPTER 2. REVIEW OF NEPA ISSUES
3

4 The GEIS analyzes a range of environmental issues for license
5 renewal and reaches conclusions on their impact. Table B-1 of
6 10 CFR 51 provides findings for each of 104 National
7 Environmental Policy Act issues associated with license
8 renewal. The supplemental environmental report submitted as
9 part of each license renewal application is required, under
10 § 51.53(c), to address each of the Category 2 and Category 3
11 environmental issues identified in Table B-1 of 10 CFR 51.
12 For convenience, Table B-1 is reproduced as Table A-1 in the
13 appendix to this Regulatory Guide.
14

15 Table 1.1 of this Regulatory Guide contains the Category 2 and
16 Category 3 issues from Appendix B of 10 CFR 51, and identifies
17 the section of the GEIS and of this chapter where each issue
18 is addressed. It should be noted that the twenty-two
19 Category 2 issues in Table A-1 are consolidated into 10 of the
20 12 topics treated in Chapter 2. Treatment of each of the
21 Category 2 and Category 3 issues should be progressively more
22 detailed, depending on whether a demonstration can be made on
23 bounding and depending on the level of impact. The suggested
24 level of detail for the issue-specific environmental
25 assessments is summarized below.
26

27 A. Category 2 issues
28

- 29 1) If the issue given in § 51.53(c)(3)(ii) is
30 demonstrated to be within the bounds then no
31 further analysis is required.
32
33 2) If the issue is outside the given bounds then an
34 assessment of the environmental impact is required.
35

36 B. Category 3 issues
37

38 Applicants must provide an assessment of the impact
39 (§ 51.53(c)(3)(iii)).
40

41 C. Category 2 and Category 3 issues
42

43 When an assessment indicates an adverse moderate or large
44 impact, the assessment should describe the mitigation
45 measures that will be used.
46

- 47 D. The supplemental ER is required to evaluate whether the
48 overall cost-benefit balance determination in Appendix B
49 of 10 CFR 51 is changed by the individual plant-specific
50 assessment (§ 51.53(c)(4)).
51

1 The remainder of this chapter provides specific guidance for
2 each environmental issue identified as either a Category 2 or
3 Category 3 issue in Table B-1. The issues in Sections 2.1
4 through 2.12 should be addressed in the supplemental
5 environmental report.

6
7 2.1 HEAT SHOCK, IMPINGEMENT, AND ENTRAINMENT EFFECTS ON FISH
8 AND SHELLFISH
9

10 10 CFR 51.53(c)(3)(ii)(A) requires that the supplemental
11 environmental report demonstrate that

12
13 "The nuclear power plant uses only cooling towers for
14 primary condenser cooling or that the license renewal
15 applicant holds current Clean Water Act 316(b)
16 determinations and if necessary a 316(a) variance
17 pursuant to 40 CFR Part 125 or equivalent State permits.
18 If no such demonstration can be made, an assessment of
19 the impact of the individual plant license renewal on
20 fish and shellfish resources resulting from heat shock
21 [Clean Water Act 316(a)] and impingement and entrainment
22 [Clean Water Act 316(b)] must be provided."
23

24 This Category 2 issue is a combination of six related items
25 described in Sections 4.2.3.1.2, 4.2.3.1.3, 4.2.3.1.4, and
26 4.4.4 of the GEIS. The purpose of this section is to provide
27 guidance for preparing the applicant's assessment of license
28 renewal impacts on the aquatic environment and biota at and in
29 the vicinity of the site.
30

31 Impingement and entrainment are cooling system intake-related
32 effects that are considered by EPA or state water quality
33 permitting agencies during the development of National
34 Pollutant Discharge Elimination System (NPDES) permits and
35 Clean Water Act 316(b) determinations. Applicants holding
36 approved 316(b) determinations need not address entrainment or
37 impingement. Applicants without approved 316(b)
38 determinations should describe the reasons why such a
39 determination has not been made, provide an assessment of the
40 character and magnitude of any entrainment and impingement
41 problem, and describe actions taken to resolve the problems.
42

43 The potential for heat shock is also a factor in NPDES
44 permitting. Under the Clean Water Act, applicants must comply
45 with state mixing zone criteria and thermal discharge limits
46 or, if unattainable, obtain site-specific variances. These
47 site-specific variances take the form of Clean Water Act
48 316(a) demonstrations. Applicants having approved 316(a)
49 demonstrations need not evaluate heat shock in their
50 application. Applicants not meeting required limits and
51 without an approved 316(a) variance should describe the
52 reasons why a variance has not been granted, provide an
53 assessment of the character and magnitude of the heat shock
54 problem, and describe actions taken to resolve the problem.
55

1
2 INFORMATION AND ANALYSIS CONTENT
3

4 The types of data and information to be submitted will be
5 affected by site- and plant-specific factors, and the degree
6 of detail should be modified according to the anticipated
7 magnitude of the impacts. The following data or information
8 and analyses should be provided.
9

- 10 A. A description of the condenser cooling system. If the
11 condenser cooling system uses only cooling towers for
12 heat dissipation and neither a 316(a) variance nor a
13 316(b) determination is required, no further information
14 on this issue need be provided. Otherwise, the applicant
15 must provide copies of a current 316(a) variance and/or a
16 316(b) determination, as required. If the required
17 documents are available, item C may be omitted. If
18 either of these documents is required, but not available,
19 further evaluation of the issue should be provided.
20
- 21 B. Recent data and information on the site and vicinity¹:
22
- 23 1. Location and value of the commercial and sport
24 fisheries for both finfish and shellfish.
25
 - 26 2. Distribution and abundance of "important"² species
27 of fish or shellfish and identification of critical
28 life support areas such as spawning areas, nursery
29 grounds, feeding areas, wintering areas, and
30 migration routes.
31
 - 32 3. Presence of endangered or threatened species of
33 fish or shellfish and their habitat preference.
34 Also fishery restriction efforts being undertaken
35 or planned by Federal and State agencies.
36
- 37 C. Estimates of the amount and effect of impingement of fish
38 and shellfish and entrainment of fish and shellfish in
39 early life stages. Of particular concern are effects on

40 ¹ For the purpose of reviewing this issue inclusion of
41 waters within a five mile radius defines "vicinity."

42 ² For the purposes of these environmental reviews a
43 species of fish or shellfish is "important" if a
44 specific causal link can be identified between the
45 proposed project and the species and if one or more of
46 the following criteria applies: (a) the species is
47 commercially or recreationally valuable, (b) the
48 species is threatened or endangered (Pub. Law 93-205,
49 87 Stat. 884), (c) the species affects the well-being
50 of some important species within criteria (a) or (b),
51 or (d) the species is critical to the structure and
52 function of the ecological system.

1 threatened or endangered species and on restoration
2 efforts for anadromous fish. Also provide estimates of
3 the magnitude of the impact for those important species
4 of fish and shellfish having commercial or recreational
5 value that are affected. These estimates may be
6 expressed in terms of dollars, lost opportunity for
7 recreational pursuits, percent reduction in harvest,
8 percent loss of habitat, or other appropriate
9 quantifiers. If impacts are adverse, the applicant
10 should identify actions that can be taken to mitigate the
11 impacts and should describe specific plans for
12 mitigation, if any.
13

- 14 D. The effect of heat shock on species of fish and
15 shellfish. Provide estimates of the amount and effect of
16 impingement of fish and shellfish and entrainment of fish
17 and shellfish in early life stages. Of particular
18 concern are effects on threatened or endangered species
19 and on restoration efforts for anadromous fish. If
20 impacts are adverse, the applicant should identify
21 actions that can be taken to mitigate the impacts and
22 should describe specific plans for mitigation, if any.
23

24 2.2 EFFECTS OF COOLING PONDS ON GROUNDWATER QUALITY

25
26 10 CFR 51.53(c)(3)(ii)(B) requires that the supplemental
27 environmental report demonstrate that:
28

29 "The nuclear power plant is not located at an inland site
30 or does not have cooling ponds. If no such demonstration
31 can be made, an assessment of the impact of the
32 individual nuclear power plant license renewal on
33 groundwater quality must be provided."
34

35 This Category 2 issue is discussed in section 4.4.3 of the
36 GEIS.
37

38 The purpose of this section is to provide guidance to the
39 applicant for identification and assessment of the impacts of
40 groundwater degradation resulting from seepage of cooling pond
41 water. If the applicant cannot demonstrate that the plant is
42 not located at an inland site or does not use cooling ponds,
43 an assessment should be provided.
44

45 INFORMATION AND ANALYSIS CONTENT

46
47 The following types of information and analyses should
48 generally be provided to assess the potential for groundwater
49 quality degradation resulting from seepage of cooling pond
50 water during operation for sites with cooling ponds. In
51 performing assessments, significant consideration should be
52 given to actual experience of the plant over the past 20 or
53 more years of operation. Data based on operational experience
54 is considered more reliable than data based on predictions.
55

- 1 A. The use of closed-cycle cooling ponds. If such a pond is
2 not used, the information called for in items B through J
3 can be omitted.
4
- 5 B. The location of the plant. If the plant site is not
6 located inland, the information called for in items C
7 through J can be omitted.
8
- 9 C. Cooling pond characteristics (e.g., use of liners, use of
10 impermeable materials, impermeable natural soils) that
11 would prevent infiltration into local aquifers.
12
- 13 D. Types and concentrations of impurities in the cooling
14 pond water, and chemistry of soils along pathways to
15 local aquifers.
16
- 17 E. Characteristics including quality of water of local
18 aquifers that could be affected by infiltration of
19 cooling pond water.
20
- 21 F. Federal, State and local groundwater quality
22 requirements, with emphasis on any changes to these
23 requirements that have occurred during the plant's
24 operational period.
25
- 26 G. Identification and characterization of all off-site
27 groundwater users who could be impacted by degradation of
28 aquifers.
29
- 30 H. Mitigation measures proposed by the applicant to avoid or
31 minimize any groundwater degradation impacts.
32
- 33 I. If an assessment is required, a determination of whether
34 contamination of groundwater from the cooling pond(s) is
35 possible. This determination should be based primarily
36 on the concentration of contaminants in the cooling pond
37 water and characteristics of intervening soils and rock.
38 If contamination of groundwater is determined to be
39 highly unlikely, the analysis may be considered complete
40 and the following steps may be omitted.
41
- 42 J. Assessment of the types and magnitudes of contamination
43 introduced into the aquifer. Estimated contamination
44 levels should be compared with Federal and State
45 groundwater quality standards and with water quality
46 requirements of other potentially affected groundwater
47 users. If Federal and State standards are met, and other
48 groundwater users are not impacted, the analysis should
49 be considered complete.
50
51

1 2.3 GROUNDWATER USE CONFLICTS

2
3 10 CFR 51.53(c)(3)(ii)(C) requires that the supplemental
4 environmental report demonstrate that:

5
6 "The nuclear power plant does not use Ranney wells and
7 either does not pump 100 or more gallons per minute of
8 groundwater or does not have private wells located within
9 the cones of depression of the nuclear power plant wells.
10 If no such demonstration can be made, an assessment of
11 the impact of the individual nuclear power plant license
12 renewal on groundwater use conflicts must be provided."
13

14 This Category 2 issue is a combination of three related issues
15 discussed in sections 4.2.2.1.1, 4.2.2.1.2, and 4.2.2.1.4 of
16 the GEIS.

17
18 This section provides guidance to the applicant for
19 identification and assessment of the environmental impacts of
20 groundwater withdrawal and use during the license renewal
21 period. If the applicant cannot demonstrate that the plant
22 does not use Ranney wells and either does not pump 100 or more
23 gallons per minute of groundwater or does not have private
24 wells located within the cones of depression of the plant
25 wells, the supplemental environmental report should provide an
26 assessment of the impact of groundwater use conflicts.
27

28 INFORMATION AND ANALYSIS CONTENT

29
30 The following types of information and analyses should
31 generally be provided to assess the presence and magnitude of
32 groundwater use conflicts during operation.
33

- 34 A. Identification of any operational groundwater uses or
35 operational dewatering activities. If none, the
36 information called for in items B through G can be
37 omitted.
38
39 B. Locations of on-site wells, depths of wells, and
40 operational pumping capacities and durations. If pumping
41 rates are less than 100 gpm and Ranney wells are not
42 used, the information called for in items C through G can
43 be omitted.
44
45 C. Descriptions of groundwater aquifers under the site,
46 including characteristics needed to determine the size of
47 cones of depression associated with on-site wells.
48
49 D. Determination of sizes of cones of depression of on-site
50 wells.
51

- 1 E. Locations of any off-site wells (existing and known
2 future) within the cones of depression of on-site wells,
3 and the depths, pumping capacities, and water needs for
4 the wells. If no such off-site wells are identified,
5 items F through G may be omitted.
6
- 7 F. Any mitigation measures proposed to avoid or minimize
8 groundwater use conflicts.
9
- 10 G. A determination of the extent to which operational
11 groundwater use or dewatering activities will impact off-
12 site groundwater users (current and known future users).
13 This determination should be based on the amount of water
14 withdrawn on site, the recharge capabilities of the
15 aquifer, locations and elevations of off-site wells, and
16 water needs of other water users.
17
18

19 2.4 EFFECTS OF REFURBISHMENT ON IMPORTANT PLANT AND ANIMAL
20 HABITATS
21

22 10 CFR 51.53(c)(3)(ii)(D) requires that the supplemental
23 environmental report demonstrate that:
24

25 "License renewal-related construction activities that are
26 to be undertaken involving additional on-site land use
27 will not affect important plant and animal habitats. If
28 no such demonstration can be made, an assessment of the
29 impact of the individual plant license renewal on
30 important plant and animal habitats must be provided."
31

32 This Category 2 issue is discussed in section 3.6 of the GEIS.
33

34 An applicant whose plans for license renewal involve
35 construction of new structures or involve laydown areas on
36 previously undisturbed land should briefly describe the
37 activities involved, the areas to be disturbed, and whether
38 important plant and animal habitats will be affected.
39 Particularly important resources include wetlands, habitats
40 used by threatened or endangered species, staging or resting
41 areas for large numbers of waterfowl, rookeries, restricted
42 wintering areas for wildlife, communal roost sites, strutting
43 or breeding grounds of gallinaceous birds, and rare plant
44 community types. The applicant should identify alternative
45 courses of action available to avoid or reduce possible
46 impacts, evaluate the level of impacts, and justify the
47 proposed course of action.
48

49 If important plant and animal habitats occur on a plant site
50 but it is shown they would be avoided during the course of
51 refurbishment activities, the impacts are considered
52 insignificant, and no further evaluation is necessary. If
53 this demonstration cannot be made, the supplemental
54 environmental report should provide an assessment of the
55 impact of on-site land use on important plant and animal

1 habitats. Assessments should be conducted in sufficient
2 detail to project both the potential impacts and provide
3 mitigative measures to control the level of impact.
4

5 INFORMATION AND ANALYSIS CONTENT 6

7 The kinds of information and analyses that should be provided
8 will be affected by site- and plant-specific factors, and the
9 degree of detail should be modified according to the
10 anticipated magnitude of the potential impacts. The following
11 information and analyses should usually be provided:
12

- 13 A. Identification of important plant and animal habitats on-
14 site or in the vicinity. If none, items B and C do not
15 apply.
16
- 17 B. Identification of any construction activities that will
18 involve additional on-site land use that may affect
19 important plant and animal habitats. If none, item C
20 does not apply.
21
- 22 C. For the plant site and vicinity:
23
- 24 1. a map of the site and vicinity showing the area and
25 boundaries of major wetland communities, special
26 habitats (e.g., spring seeps, bogs, sink holes,
27 rare or unique habitats), and any habitats used by
28 "important" species;
29
 - 30 2. a list of "important" terrestrial wetlands
31 vertebrate species known to occur, and lists of
32 invertebrate wetland species of local importance or
33 concern as disease vectors or pests;
34
 - 35 3. estimates of the relative abundance of both
36 commercially and recreationally important wetland
37 game and nongame vertebrates;
38
 - 39 4. any proposed refurbishment activities expected to
40 impact wetland communities that have been defined
41 as rare or unique or that support threatened or
42 endangered species;
43
 - 44 5. estimates of the impact magnitude on these
45 important species having commercial or recreational
46 value. The estimates may be expressed in terms of
47 dollars, lost opportunity for recreational
48 pursuits, percent reduction in harvest, percent
49 loss of habitat, or other appropriate quantifiers;
50
 - 51 6. a description of proposed mitigation measures to
52 minimize the impacts described above; and
53

- 1 7. a list of threatened or endangered wetland species
2 that are known to occur, their site-specific
3 habitat, and estimates of their population.
4

5 Reference may be made, in the assessment of this issue, to
6 information provided in sections 2.1 and 2.7 of the
7 supplemental environmental report. Mitigation is discussed in
8 section 3.6 of the GEIS.
9

10 2.5 EFFECTS OF REFURBISHMENT ON SURFACE WATER QUALITY

11
12 10 CFR 51.53(c)(3)(ii)(E) requires that the supplemental
13 environmental report demonstrate that
14

15 "No major construction activities associated with the
16 individual nuclear power plant license renewal will occur
17 at the site. If no such demonstration can be made, a
18 construction impact control program that will mitigate
19 potential impacts on the aquatic environment from soil
20 erosion or spills must be implemented; and a description
21 of such program must be provided."
22

23 This Category 2 issue is discussed in section 3.4.1 of the
24 GEIS.
25

26 Those applicants whose plans for license renewal and plant
27 life extension involve construction of new structures or
28 involve lay down areas on previously undisturbed land should
29 briefly describe the activities involved, the areas to be
30 disturbed, and commitments to minimize potential impacts from
31 soil erosion or spills. Impacts that might otherwise be
32 considered moderate or large may be rated as small by the
33 staff if applicants demonstrate that approved "best management
34 practice" will be employed to control soil erosion and spills.
35 If this demonstration cannot be made, the supplemental
36 environmental report should provide an assessment of soil
37 erosion impacts and spill impacts.
38

39 This assessment should evaluate the impacts of refurbishment
40 construction activities. These impacts should include
41 building or expanding on-site storage capability for spent
42 fuel. The impact evaluation should be limited to the
43 construction activities themselves and the time period during
44 which the construction is accomplished.
45

46 INFORMATION AND ANALYSIS CONTENT

47
48 The following information and analyses should usually be
49 provided:
50

- 51 A. A discussion of what, if any, major construction
52 activities (e.g., the construction of on-site spent fuel
53 storage facilities) will be needed as part of license
54 renewal. If none, the following items may be omitted.
55

- 1 B. A description of the facilities to be provided or
2 expanded and the associated construction activities.
3
4 C. A description of the magnitude of potential impacts
5 associated with the proposed construction activities and
6 how those impacts will be mitigated, including a
7 description of the construction impact control program
8 and the programs implementation.
9
10 D. A description of the best management practices to be used
11 to control soil erosion and spills, consistent with
12 Section 319 of the Clean Water Act.
13

14 Mitigation measures to help protect surface water quality from
15 refurbishment impacts are discussed in section 3.4.1 of the
16 GEIS.
17

18 2.6 EFFECTS OF LICENSE RENEWAL ON HOUSING

19
20 10 CFR 51.53(c)(3)(ii)(F) requires that the supplemental
21 environmental report demonstrate that:
22

23 "The nuclear power plant is in a medium or high
24 population area³ and not in an area where growth control
25 measures that limit housing development are in effect.
26 If no such demonstration can be made, an assessment of
27 the impact of the individual nuclear power plant license
28 renewal on housing availability must be provided."
29

30 This Category 2 issue is a combination of two related issues
31 discussed in sections 3.7.2 and 4.7.2 of the GEIS.
32

33 If the required demonstration cannot be made, an assessment of
34 how housing availability would be affected by any increased
35 on-site labor force associated with license renewal should be
36 made.
37

38 The applicant should provide demographic data based on the
39 current decade census and, where available, more recent census
40 data.

41 ³ An area is considered to have a medium or high
42 population if any one of the following conditions is
43 satisfied:
44

- 45 (a) the plant is within 20 miles of a city of 25,000;
46 (b) the plant is within 50 miles of a city of 100,000;
47 (c) the population of the area within 20 miles of the
48 plant is 75,000 or more;
49 (d) the population of the area within 50 miles of the
50 plant is 1,500,000 or more; or
51 (e) the population of the area within 20 miles of the
52 plant is 50,000 or more and within 50 miles of the
53 plant the population is 400,000 or more.

1 This assessment should consider incremental on-site labor,
2 peak number of workers and duration of the peak, the number of
3 workers expected to commute daily, the number of workers
4 expected to require temporary and permanent housing, and the
5 inventory of rental and of permanent housing within 50 miles
6 of the site. The incremental demands for housing should be
7 compared to the total inventory of housing and a level of
8 impact assessment (small, moderate or large) should be made.
9

10
11 A similar analysis should be performed to assess the level of
12 impact on housing availability from the incremental labor
13 force during refueling and maintenance outages.
14

15 INFORMATION AND ANALYSIS CONTENT 16

17 The particular kinds of information and analyses that should
18 be provided will be affected by site- and plant-specific
19 factors, and the degree of detail will be modified according
20 to the anticipated magnitude of the potential impacts. The
21 following housing-related information, which may be obtained
22 from the environmental report, and supplemented as necessary
23 from appropriate Federal, State, and local agencies, and
24 housing-related business entities, should be provided:
25

- 26 A. Population density and city size data (current decade
27 census or more recent data where available) to
28 demonstrate whether the plant is situated in a medium or
29 high population area. Information required is population
30 within 20 miles of the plant, population within 50 miles
31 of the plant, and a map showing any cities of 25,000 or
32 more within 20 miles of the plant and any cities of
33 100,000 or more within 50 miles of the plant.
34
- 35 B. Existence of growth controls which limit housing
36 development. If information provided in A and B indicate
37 that the nuclear power plant is in a medium or high
38 population area and not in an area where growth control
39 measures that limit housing development are in effect,
40 then C may be omitted.
41
- 42 C. Number, types, and locations of housing units, including
43 year-round, seasonal homes, mobile homes, hotel/motels
44 and public housing units, and housing characteristics
45 such as the vacancy rates for such units, monthly median
46 gross rentals and costs, site of units, quality, etc.
47
- 48 D. Population change/economic development that could impact
49 on vacancy rates, rental prices and potential for
50 inflation.
51
- 52 E. Location of existing and projected housing and trailer
53 parks; current temporary worker housing patterns;
54 location, type, and value of current housing units; and
55 forecasted location preferences of new personnel.

- 1 F. Potential for conversion of housing units.
2
3 G. The number of workers and duration of assignment for the
4 refurbishment period and for periodic refueling and
5 maintenance outages.
6
7 H. Estimates of peak transient population within 10 miles of
8 the plant, and identification on a map of any major
9 facilities accounting for transient population.
10
11 I. A screening of housing characteristics in the region of
12 the site to determine potentially affected subregions and
13 communities. At least the following factors should be
14 considered:
15
16 * forecasted location preferences of new personnel
17 * forecasted number of personnel and duration of
18 assignment during plant refurbishment and refueling
19 maintenance outages
20 * location of existing and projected housing rental
21 markets in region
22 * transportation accessibility
23 * number and types of housing units
24 * locally enacted measures that limit housing
25 development
26
27 J. An assessment of impacted areas of the region, if any,
28 and the associated communities and forecasts of the
29 extent and magnitude of impacts in terms of housing
30 availability, inflation, changes in housing stock,
31 accessibility to resident population, levels of impact
32 during the refurbishment and refueling/maintenance
33 outages.
34
35 K. A description of any proposed mitigation measures to
36 minimize the potential impacts described above.
37

38 2.7 ELECTRIC SHOCK FROM TRANSMISSION LINE INDUCED CURRENTS
39

40 10 CFR 51.53(c)(3)(ii)(G) requires that the supplemental
41 environmental report demonstrate that:
42

43 "The design of the transmission lines of the nuclear
44 power plant meets the National Electric Safety Code
45 recommendations regarding the prevention of electric
46 shock from induced currents. If no such demonstration
47 can be made, an assessment of the impact of the
48 individual nuclear power plant license renewal on the
49 potential electric shock hazard from the transmission
50 lines of the plant must be provided."
51

52 This Category 2 issue is discussed in Section 4.5.4.1 of the
53 GEIS.
54

1 The potential for electric shock from induced current should
2 be reviewed with respect to the National Electric Safety Code
3 (NESC) recommendation if (1) no NESC review was performed in
4 the NEPA review for the initial operating license; (2) a
5 change in voltage has been made since the initial operating
6 license and no NESC review was performed; or (3) land use
7 features have changed since the original operating license
8 resulting in possible hazardous conditions. Wherever the
9 potential for severe shock exists the applicant should take
10 action to reduce the potential. The results of any analyses
11 and subsequent actions should be reported in the supplemental
12 environmental report.

13
14 This issue concerns those portions of the operating high
15 voltage transmission lines (HVTLs) that connect the plant with
16 the regional electric transmission grid. The scope also
17 includes only acute shock effects. Other HVTL issues,
18 including the issue of chronic health effects from HVTL
19 electric and magnetic fields, have been identified as Category
20 1 issues. Mitigation for this issue is mentioned in section
21 4.5.4.1.1 of the GEIS.

22 23 INFORMATION AND ANALYSIS CONTENT

24
25 Data and information that should be provided for evaluating
26 the existence of, or potential for, electric shock from HVTLs
27 should include the following:

- 28
29 A. A demonstration that the HVTLs meet the National Electric
30 Safety Code. If this demonstration can be made, the
31 impact of this issue is bounded by Appendix B of 10 CFR
32 51 and the following information can be omitted.
- 33
34 B. National Electric Safety Code (current edition)
35 recommendations requirements and applicable state
36 standards.
- 37
38 C. HVTL electrical design and operating parameters including
39 operating voltage, operating current, line capacity,
40 conductor type, conductor configuration and spacing,
41 conductor clearances, and electric and magnetic fields at
42 the center and edge of the right-of-way.
- 43
44 D. Description of complaints received by the applicant or by
45 the relevant regulatory authority concerning electric
46 shock from objects near HVTLs.
- 47
48 E. Descriptions, including photos and maps, of large or
49 linear metal objects near HVTLs, including buildings,
50 fences, railroad tracks, and irrigation pipes.
- 51
52 F. Grounding procedures for stationary objects along the
53 rights-of-way.
- 54

- 1 G. Changes made since initial licensing including operating
2 voltage changes and nearby land-use changes.
3
4 H. Potential for electric shock from large vehicles stopped
5 under the KVTL.
6
7 I. The magnitude of potential impacts on health from the
8 above described shock hazard during the license renewal
9 term.
10
11 J. A description of proposed mitigation measures to minimize
12 the potential impact described above.
13

14 2.8 HEALTH EFFECTS OF THERMOPHILIC ORGANISMS

15
16 10 CFR 51.53(c)(3)(ii)(H) requires that the supplemental
17 environmental report demonstrate that:
18

19 "The nuclear power plant does not use a cooling pond,
20 lake, or canal and does not discharge water to a small
21 river. If no such demonstration can be made, an
22 assessment of the impact of thermophilic organisms on the
23 health of recreational users of affected water must be
24 provided."
25

26 This Category 2 issue is discussed in section 4.3.6 of the
27 GEIS.
28

29 Plants using cooling ponds, lakes, or canals and those
30 discharging to small rivers (average flow less than 2830 m³/s)
31 have the potential to influence thermophilic microorganisms
32 (e.g., Salmonella sp., Shigella sp., Pseudomonas aeruginosa,
33 Legionella sp., Naegleria, Acanthamoeba and thermophilic
34 fungi). Health questions related to public use of affected
35 waters should be addressed by the applicant in the form of
36 consultation with the state health department prior to
37 application for license renewal. If the applicant cannot
38 demonstrate that the plant does not use cooling ponds, lakes,
39 or canals and does not discharge into a small river, the
40 supplemental environmental report should provide an assessment
41 of the potential for health effects and the results of the
42 consultation with the state health department.
43

44 INFORMATION AND ANALYSIS CONTENT

45
46 Information and analyses that should be provided for the
47 evaluation of the existence, and potential for deleterious
48 impacts, of thermophilic microorganisms include the following:
49

- 50 A. Whether the plant uses a cooling pond, lake, or canal, or
51 once-through cooling systems with discharge to a small
52 river (flow rate less than 2830 m³/s). If not, this
53 issue is bounded by Appendix B, 10 CFR 51 and the
54 information called for in items B through I can be
55 omitted.

- 1 B. Knowledge of the tests for the occurrence of the cited
2 pathogens, and factors germane to their presence in
3 aquatic environs.
4
5 C. Temperature increases of aquatic environs subject to
6 thermal discharges.
7
8 D. Information on the levels of concentration of these
9 organisms which are considered as hazardous to public
10 health. Note: OSHA or other legal standards for
11 exposure to microorganisms do not exist at present.
12
13 E. Information on potential control measures.
14
15 F. Results of analysis made for the presence of deleterious
16 thermophilic microorganisms. These include the enteric
17 pathogens Salmonella sp. and Shigella sp. as well as
18 Pseudomonas aeruginosa and thermophilic fungi. In
19 addition, analyses for the presence of unusually high
20 concentrations of the normally present Legionella sp.
21 (Legionnaires' disease bacteria) and the free-living
22 amoebae of the genera Naegleria and Acanthamoeba should
23 be cited.
24
25 G. An evaluation of the data concerning the occurrence and
26 concentrations of any of the listed deleterious
27 thermophilic microorganisms and whether or not any of
28 them are present under conditions that might be harmful
29 to members of the public coming in contact with them.
30 Consultation with state health departments should be
31 utilized for this evaluation.
32
33 H. A determination of the magnitude of potential impacts of
34 thermophilic organisms on public health during the
35 license renewal term.
36
37 I. A description of proposed mitigation measures to minimize
38 the potential impacts described above.
39

40 2.9 LOW-LEVEL RADIOACTIVE WASTE STORAGE AND DISPOSAL
41

42 10 CFR 51.53(c)(3)(ii)(I) requires that the supplemental
43 environmental report demonstrate that
44

45 "The nuclear power plant will have access to a low-level
46 radioactive waste disposal facility through a low-level
47 waste compact or an unaffiliated state. If no such
48 demonstration can be made, a presentation of capability
49 and plans for interim waste storage must be provided with
50 an assessment of potential ecological habitat destruction
51 due to construction activities."
52
53

1 This is a Category 2 issue that covers two issues under "Solid
2 Waste Management" in Table A-1. These issues are "low-level
3 radioactive waste storage" and "low-level radioactive waste
4 disposal." They are addressed in sections 6.3.2 and 6.3.3 of
5 the GEIS.
6

7 The applicant should demonstrate access to off-site disposal
8 facilities for low-level radioactive waste through a low-level
9 waste compact or an unaffiliated State during the full term of
10 the renewed operating license. If this demonstration is made,
11 no further information is required. If this demonstration is
12 not made, applicants must demonstrate that they have examined
13 their capabilities and plans for on-site storage, storage by
14 off-site contractor, and special waste reduction contingencies
15 or other waste management methods. On-site storage of low-
16 level waste for up to 3 years is considered normal and does
17 not require further analysis. If prolonged on-site storage
18 of low-level waste is required, the potential for plant and
19 animal habitat disturbance should be evaluated.
20

21 INFORMATION AND ANALYSIS CONTENT 22

23 The kinds of information and analyses that should be provided
24 will be affected by site- and plant-specific factors, and the
25 degree of detail should be modified according to the
26 anticipated magnitude of the potential impacts. The following
27 information should usually be provided:
28

- 29 A. A demonstration that the applicant will have access to a
30 low-level radioactive waste disposal facility through a
31 low-level waste compact or an unaffiliated State. If
32 such a demonstration is provided, the following items may
33 be omitted.
34
- 35 B. A description of the plans for both temporary and
36 permanent storage including a description of the interim
37 waste storage systems to be generated during the renewal
38 term.
39
- 40 C. The anticipated quantity and characteristics of the
41 wastes.
42
- 43 D. An assessment of the magnitude of potential plant and
44 animal habitat disruption resulting from the construction
45 of interim waste storage systems.
46
- 47 E. A description of proposed actions to mitigate any
48 moderate to large impacts.
49

1 2.10 DEMONSTRATION OF COST ADVANTAGE OF LICENSE RENEWAL

2
3 10 CFR 91.53(c)(3)(ii)(J) requires a demonstration that:

4
5 "Replacement of equivalent generating capacity by a coal-
6 fired plant has no demonstrated cost advantage⁴ over the
7 individual nuclear power plant license renewal. If no
8 such demonstration can be made, a justification for
9 choosing the license renewal alternative must be
10 provided. For nuclear power plants located in
11 California, Oregon, Washington, or Arizona, applicants
12 for license renewal must provide an assessment of
13 geothermal generating capacity as an alternative to
14 license renewal in addition to the cost demonstration
15 results."
16

17 This Category 2 issue is a combination of four related issues
18 discussed in sections 7.3.6 and 9.4.5 of the GEIS.
19

20 Under a wide set of circumstances nuclear power plant
21 refurbishment and operation during a license renewal period is
22 expected to be economical. However, plants with a history of
23 significantly lower than average capacity factors or higher
24 than average operating and maintenance costs may not be
25 economic to relicense. License renewal of plants with high
26 refurbishment costs may be less economical than building new
27 generating plants. In the States of California, Oregon,
28 Washington, and Arizona geothermal energy may be a source of
29 baseload power with economic and environmental advantages over
30 renewing the license of a nuclear power plant. For nuclear
31 power plants located in these states, applicants must provide
32 an assessment of the cost and environmental impacts of
33 geothermal relative to license renewal.
34

35 Appendix H to NUREG-1437 provides an acceptable simplified
36 screening tool for separating those cases for which a formal
37 economic analysis is necessary from those for which it is not.
38 Combinations of break-even capital costs and future operating
39 costs for license renewal are developed. Refurbishment costs
40 are equivalent to capital costs for this methodology; and
41 future fuel, operation and maintenance (O&M), and interim
42 capital costs comprise the future operating costs. No credit
43 is taken in the threshold analysis for the delay of
44 decommissioning.
45

46 INFORMATION AND ANALYSIS CONTENT

47
48 Table 2.10-1 shows threshold criteria developed by the staff
49 for capital and operational costs of license renewal. These
50 criteria have been developed based on combinations of capital

51 ⁴ In performing the cost demonstration, costs of
52 refurbishment, construction, fuel, and operation and
53 maintenance must be considered.

1 and operational costs for which license renewal would have a
2 margin of economic advantage over the costs of a new
3 conventional coal plant. The margin of advantage for license
4 renewal was built into the criteria by performing a break-even
5 economic analysis between nuclear refurbishment and
6 conventional coal while making assumptions economically
7 advantageous to coal (relative to the reference case cost
8 comparison). First, this analysis is based on cost
9 relationships between NUPLEX and new coal plants beginning in
10 2000 instead of 2020. Because of the cost escalation
11 assumption for coal fuel costs, this change means the
12 threshold values are more advantageous to the new coal
13 alternative than would be the case if they had been identified
14 using the reference case assumptions. Second, in developing
15 the threshold criteria, a new coal plant is assumed to have a
16 70% capacity factor instead of a 60% capacity factor. Third,
17 no credit for the delay of decommissioning is included for
18 nuclear plants. Changing the fuel cost assumptions, assuming
19 70% capacity factor for coal plants (instead of 60% in the
20 margin for uncertainty in the analysis.
21

22 Uncertainties include possible underestimates of refurbishment
23 capital costs, the possibility of higher than historical
24 operating costs during the decommissioning. If its projected
25 capital and operational costs can break even under these
26 assumptions, license renewal is deemed to have met the
27 threshold test. Further, by employing cost relationships as
28 of the year 2000, the threshold analysis is most relevant to
29 the initial license renewal applications.
30

31 Given the modified assumptions, the staff found the
32 relationship that defines the combinations of operational and
33 capital costs that support the economics of license renewal
34 for a twenty-year period. Some of these combinations are
35 presented in Table 2.10-1 for plants that operated at capacity
36 factors of 50%, 60%, or 70%. In other words, if an applicant
37 is able to demonstrate that the plant would meet any of the
38 combinations of operational and capital threshold values
39 presented in Table 2.10-1 for the capacity factor at or above
40 which the plant operates, the plant passes the threshold
41 criteria and the applicant may avoid further economic
42 justification. Alternatively, it passes the threshold
43 criteria if it can demonstrate that it meets any combination
44 of break-even operational and capital threshold values implied
45 by the formula in Table 2.10-1. This formula can be used with
46 any combination of capacity factor and estimated capital costs
47 to find the operational cost threshold value.
48
49

1 Table 2.10-1 Threshold operational cost criteria for capital cost
 2 categories at 50%, 60%, and 70% capacity factors*

For capital cost (1989\$/kW)		Operational cost maximum (1989\$/kW), for capacity factor of:		
Greater than	Less than or equal to	50%	60%	70%
0	100	188	227	267
100	200	180	219	255
200	400	164	203	243
400	600	148	187	226
600	800	132	171	210
800	1,000	115	155	194

13 *The operational cost criteria represent the maximum that the historical
 14 operational costs for the corresponding capacity factor and capital refurbishment
 15 costs. Instead of using this table, a licensee may use the general formula for
 16 calculating an operational cost maximum using a particular capacity factor and
 17 capital refurbishment cost:

18
 19
$$\text{operational cost maximum} = -1.61 + (394.60 \times \text{CF}/100) - (0.0802 \times \text{CC}),$$

20
 21 where CF = the capacity factor, expressed as a percentage, and CC = the estimated
 22 refurbishment capital costs. Refurbishment capital costs must include overnight
 23 construction costs, AFUDC, and the present values of energy replacement and
 24 increased regulatory costs.

25
 26
 27
 28 If an applicant cannot provide this demonstration using the
 29 simplified analysis methodology of Appendix H to NUREG-1437, a
 30 detailed cost analysis should be provided showing that plant license
 31 renewal is the most cost effective option compared to the most
 32 reasonable alternative source of baseload electricity generation,
 33 which may be fired by coal, oil, gas, or may be new nuclear.
 34 Sections 9.3.8 through 9.3.10 of the GEIS discusses the alternatives.

35
 36 If an assessment is required, the applicant should determine the most
 37 reasonable alternative source of baseload electricity generation, and
 38 should compare its cost effectiveness with the license renewal
 39 alternative. Estimates of the cost associated with the most
 40 reasonable alternative source of generation should be provided.
 41 Detailed breakdowns should be provided for cost components such as
 42 overnight investment, allowance for funds used during construction,
 43 interim investment, operation and maintenance, and fuel.

44
 45 2.11 THREATENED OR ENDANGERED SPECIES

46
 47 10 CFR 51.53(c)(3)(iii)(A) requires that the supplemental ER contain
 48 an assessment regarding:

49
 50 "The impact of the individual nuclear power plant license
 51 renewal on threatened or endangered species."

1 This Category 3 issue is addressed in Sections 3.5, 3.6, and 4.2.1.1
2 of the GEIS.

3
4 Applicants should review the current Federal Register and State
5 listings of threatened or endangered species and consult with the
6 appropriate regional office of the U.S. Fish and Wildlife Service and
7 the National Marine Fisheries Service, and the appropriate State
8 agencies, to identify those threatened or endangered species that
9 have been observed in the site area. Applicants should also identify
10 those threatened or endangered species that could be expected within
11 the site area based on area range classification, even though
12 sightings have not been documented.

13
14 If threatened or endangered species are identified as occurring or
15 expected to occur in the site area, applicants should assess the
16 mitigative actions to be taken in license renewal with regard to
17 plant modifications, refurbishment, and renewed operation to
18 determine the potential for direct impact on the identified species
19 or their habitat.

20 21 INFORMATION AND ANALYSIS CONTENT

22
23 Each supplemental environmental report submitted as part of an
24 application for license renewal should include an environmental
25 assessment of threatened or endangered species. This assessment
26 should include the following information and analyses:

- 27
28 A. Lists of endangered, threatened, and candidate species that have
29 been identified for the area of the plant and the area
30 immediately surrounding the plant, based on consultation with
31 the U.S. Fish and Wildlife Service, the National Marine
32 Fisheries Service, and appropriate State agencies.
33
34 B. Documentation of any consultations during the operating lifetime
35 of the plant between the plant personnel and the appropriate
36 Federal and State agencies to identify any new endangered,
37 threatened, or candidate species;
38
39 C. Copies of biological assessments prepared to meet the
40 requirements of the Endangered Species Act;
41
42 D. Records of additional actions taken by the applicant to meet the
43 requirements of the Endangered Species Act;
44
45 E. Description of impacts on endangered, threatened, and candidate
46 species; the magnitude of such impacts; and proposed mitigative
47 measures, if any, to minimize the potential for impact on any of
48 these species or their habitat.

49 50 2.12 TRANSPORTATION IMPACTS OF REFURBISHMENT

51
52 10 CFR 51.53(c)(3)(iii)(B) requires that the supplemental
53 environmental report contain an assessment regarding:
54

1 "The impact of the individual nuclear power plant license
2 renewal on local transportation during periods of license-
3 renewal-related refurbishment activities."
4

5 This Category 3 issue is discussed in Section 3.7.4.2 of the GEIS.
6

7 In assessing the transportation impacts of refurbishment activities,
8 applicants should consider the increase in traffic associated with
9 additional workers and local road and traffic control conditions.
10

11 Applicants should determine the extent to which the service levels on
12 roads within 10 miles of the site will be degraded by increased
13 traffic during periods of refurbishment. Close attention should be
14 given to identifying and assessing potential congestion points, such
15 as intersections, narrow bridges, and segments of roads with low
16 speed limits or numerous traffic signals, or under construction.
17 Whenever the service level will be degraded to below category B for
18 one or more locations for more than 1 month, the applicant should
19 consult with the appropriate highway authorities to determine whether
20 alternatives are available and warranted to reduce traffic impacts.
21 Category B is a level of service, as defined by the Transportation
22 Board, indicating that existing roadways can accommodate traffic
23 without substantial delays even if no improvements are made.
24 Alternatives may include staggered work shifts, shift hours that do
25 not coincide with normal heavy traffic hours, carpool incentives, and
26 additional police or traffic control personnel.
27

28 INFORMATION AND ANALYSIS CONTENT 29

30 Applicants should provide the following information and analyses on
31 transportation in the region around the site. This information may
32 be obtained from the environmental report and supplemented as
33 necessary from appropriate Federal, State, and local agencies.
34

- 35 A. A description of the magnitude, origins, and routes of workers
36 during the proposed plant refurbishment outage and the duration
37 of the outage.
38
- 39 B. Significant changes that have occurred (and are projected to
40 occur prior to refurbishment) to regional and local highway
41 systems since the operating license was issued. This includes
42 changes in flow and constraint, commuting patterns, and
43 conditions of roads and highways.
44
- 45 C. Residential and nonresidential development which has occurred
46 (and is projected to occur prior to refurbishment) since the
47 operating license was issued.
48
- 49 D. Type, availability, and usage of public transportation.
50
- 51 E. Refurbishment modifications that might affect traffic flow to
52 and from the plant site.
53
- 54 F. Characterization of historical and current transportation
55 conditions in the site region to establish the baseline

1 conditions. Use all transportation attributes reflected by the
2 information on site region and actions that may be impacted by
3 refurbishment activities. Provide appropriate frequency
4 distributions, cross-tabulations and graphic representations of
5 the data as appropriate.
6

7 G. Projection of baseline conditions without refurbishment using
8 historic and projected trends, coupled with factors other than
9 refurbishment that may affect transportation.
10

11 H. Comparison of demand factors with "supply" factors, such as the
12 availability and condition of transportation infrastructure,
13 roadways, and transportation system management experience,
14 personnel, and equipment. Also determination of transportation
15 impacts by examining, for example, traffic congestion, community
16 satisfaction or frustration with community transportation
17 systems, and financial and non-financial pressures on local and
18 state jurisdictions to mitigate impacts. Transportation impact
19 will be influenced by such "demand" factors as the number of
20 commuting workers, number of workers per vehicle, availability
21 and use of public transportation or contractor-provided van
22 pooling, and use of transportation systems by secondary workers
23 and dependents.
24

25 I. Focus on potential highway impacts, but recognize that impacts
26 can occur with air, river, and rail systems as well, and that
27 transportation may involve the movement of goods as well as
28 people. Relevant public concerns for transportation-related
29 issues, such as traffic noise and pollution should also be
30 considered.
31

32 J. Assume, for a best estimate, that the in-migrants will settle in
33 the same communities and proportions as current site workers
34 with similar characteristics, taking into account also their
35 expressed location preferences. Assume, for the maximum impact
36 estimate, that all in-migrants will choose housing in one of the
37 smaller communities, thereby concentrating the transportation
38 impacts.
39

40 K. Report anticipated transportation impacts in such terms as
41 anticipated traffic congestion by location, declines in levels
42 of service, required infrastructure improvements, increased
43 potential for accidents, accelerated deterioration of roadway
44 beds and surfaces, system costs, and public concerns.
45

46 L. For transportation impacts that have been identified, describe
47 impacted areas, duration of impacts, and impacted communities of
48 the region. Describe minor transportation impacts in
49 qualitative terms. For adverse impacts (i.e., impacts that
50 should be mitigated or avoided) that can be predicted, the
51 applicant should conduct a more detailed analysis which will,
52 where practical, make quantitative estimates of the magnitude of
53 the impacts and plans for their mitigation.
54
55

1 CHAPTER 3. ASSESSMENT OF OVERALL BENEFIT COST DETERMINATION

2
3 10 CFR 51.53(c)(4) states:

4
5 "The supplemental report must contain an analysis of whether the
6 assessment required by paragraph 51.53(c)(3)(ii)-(iii) of this
7 section changes the findings documented in Table B-1 that the
8 renewal of any operating license for up to 20 years will have
9 accrued benefits that outweigh the economic, environmental and
10 social costs of license renewal."
11

12 The applicant's evaluation should determine whether the new
13 information presented in the supplemental environmental report
14 changes the Commission's conditional generic determination on the
15 cost-benefit balance as stated in Appendix B of 10 CFR 51. The
16 conditional determination is that the renewal of an operating license
17 for up to 20 years will have accrued benefits that outweigh the
18 economic, environmental, and social cost of license renewal. The
19 applicant should consider the overall magnitude of impacts for the
20 set of environmental issues described in Chapter 2 that are
21 applicable to the plant after applying all proposed mitigative
22 measures. If the applicant concludes either (1) that all issues
23 identified in Chapter 2 are irrelevant to its plant or (2) that any
24 environmental impacts are so small that further consideration of
25 mitigative measures is not warranted, then no further analysis is
26 required. However, if adverse impacts that are moderate or large are
27 identified, then the applicant must determine the collective effect
28 of the impacts on the conditional Commission finding on the cost-
29 benefit balance. The applicant should also consider the magnitude of
30 any unavoidable impacts, the required commitment of resources, and
31 the relationship between short-term use and long-term productivity.
32

33 In making this overall evaluation of costs and benefits, applicants
34 may consider those areas in which the impacts of the individual plant
35 license renewal are clearly less or the benefits clearly greater than
36 those found generically in the GEIS. A detailed description of any
37 such counterbalancing factors, the weighting of these factors, and
38 the basis for using plant-specific data in the overall evaluation
39 process should be provided.
40
41
42

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REFERENCES

- 1) NUREG-0099, Regulatory Guide 4.2, Revision 2, "Preparation of Environmental Reports for Nuclear Power Stations," U.S. Nuclear Regulatory Commission, July 1976
- 2) NUREG-1429, "Environmental Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants," U.S. Nuclear Regulatory Commission
- 3) NUREG-1437, Draft 4, "Generic Environmental Impact Statement for License Renewal," U.S. Nuclear Regulatory Commission, May 14, 1991
- 4) NUREG-0555, "Environmental Standard Review Plans for the Environmental Review of Construction Permit Applications for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, May 1979

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APPENDIX A-1

Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants

Issue	Category ¹	Findings ²
PART I. NEED FOR GENERATING CAPACITY		
Need for generating capacity via license renewal	1	LARGE BENEFIT. License renewal of an individual nuclear power plant will be needed to meet generating capacity requirements in the service area and to avoid constructing and operating new generating facilities which would otherwise be necessary to replace the retired nuclear plant.
PART II. IMPACTS OF ALTERNATIVES		
Advantages of alternatives to license renewal	1	NO ADVANTAGE. License renewal of an individual nuclear power plant is found to be preferable to replacement of the generating capacity with a new facility to the year 2020. License renewal is found to be preferable, both environmentally and economically ³ to either new fossil fueled or new nuclear capacity. Wind, solar photovoltaic cells, solar thermal power, hydropower, and biomass are found to be not preferable to license renewal because of technological limitations, availability, and economics. Geothermal ⁴ could be competitive in areas where geothermal resources are readily available. These areas are in the states of California, Oregon, Washington, and Arizona.
PART III. BENEFITS/COST ASSESSMENT		
BENEFITS		
Direct Economic		
Generating capacity	1	LARGE BENEFIT. Will provide from 72×10^3 to 1270×10^3 net kW(e) reflecting the smallest to the largest plant.
Electric energy	1	LARGE BENEFIT. Will provide from 391×10^6 to 6898×10^6 kWh/yr reflecting the smallest to the largest plant.
Avoided costs	2 ³	SMALL TO LARGE BENEFIT. Compared to replacement of electric generating capacity with a new coal-fired plant, license renewal offers savings under a diverse set of conditions.

Indirect

Local taxes Refurbishment	1	SMALL BENEFIT. Tax revenues will increase due to capital improvements.
Local taxes Renewal term	1	SMALL BENEFIT. The impact of tax revenues may vary from small to large depending on the total tax base of the taxing jurisdictions.
Employment Refurbishment	1	SMALL BENEFIT. Impacts on regional employment will be small to moderate depending on the total employment base of the region, and will be short-lived.
Employment Renewal term	1	SMALL BENEFIT. Impacts on regional employment will be small to large depending on the total employment base of the region.

COSTS

Direct Economic³

Refurbishment	2	MODERATE COST. Refurbishment costs will vary widely depending on specific plant requirements. In general, costs will be significantly lower relative to the capital cost of new coal-fired plants.
Fuel	2	SMALL COST. Fuel costs will be much lower than for a new coal-fired plant.
Operation and maintenance	2	LARGE COST. O & M costs will vary widely depending on specific plant performance but on the average they will be significantly more than for a new coal-fired plant.

**Environmental and Socioeconomic
Surface Water Quality, Hydrology, and Use
(for all plants)**

Effects of refurbishment on surface water quality	2	SMALL COST. Impacts are expected to be minor and insignificant during refurbishment if there are no major construction activities associated with the individual plant license renewal or if Best Management Practices (BMPs) are employed to control soil erosion and spills; applicant must provide evidence of approved BMPs in license renewal application.
Effects of refurbishment on surface water use	1	SMALL COST. Water use during refurbishment will not change or will be reduced during reactor outage.
Altered current patterns at intake and discharge structures	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Altered salinity gradients	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Altered thermal stratification of lakes	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Temperature effects on sediment transport capacity	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Scouring due to discharged cooling water	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Eutrophication	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

Discharge of chlorine or other biocides	1	SMALL COST. Effects are readily controlled through National Pollutant Discharge Elimination System (NPDES) permit and periodic modifications, if needed, and is not expected to be a problem during the license renewal term.
Discharge of sanitary wastes	1	SMALL COST. Effects are readily controlled through NPDES permit and periodic modifications, if needed, and is not expected to be a problem during the license renewal term.
Discharge of other chemical contaminants (e.g., metals)	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems. Has been satisfactorily mitigated at other plants. It is not expected to be a problem during the license renewal term.
Water use conflicts	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems. The issue has been a concern at two nuclear power plants with cooling ponds and at two plants with cooling towers, but it will be resolved with appropriate state or regional regulatory agencies outside of NRC license renewal actions. It is not expected to be a problem during the license renewal term.

Aquatic Ecology
(for all plants)

Refurbishment	1	SMALL COST. During plant shutdown and refurbishment there will be negligible effects on aquatic biota due to a reduction of entrainment and impingement of organisms or reduced release of chemicals.
Accumulation of contaminants in sediments or biota	1	SMALL COST. Has been a concern at a single nuclear power plant with a cooling pond, but has been satisfactorily mitigated. Has not been found to be a problem at operating nuclear power plants with cooling towers or once-through cooling systems, or a cooling pond, except for one plant. It was successfully mitigated at that plant. It is not expected to be a problem during the license renewal term.

Entrainment of phytoplankton and zooplankton	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Cold shock	1	SMALL COST. Has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems and has not endangered fish populations. Has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds. It is not expected to be a problem during the license renewal term.
Thermal plume barrier to migrating fish	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Premature emergence of aquatic insects	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Gas supersaturation (gas bubble disease)	1	SMALL COST. Previously a concern at a small number of operating nuclear power plants with once-through cooling systems, but has been satisfactorily mitigated. Has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds. It is not expected to be a problem during the license renewal term.
Low dissolved oxygen in the discharge	1	SMALL COST. Has been a concern at one nuclear power plant with a once-through cooling system. This issue will be monitored in the NPDES permit renewal process. Has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds. It is not expected to be a problem during the license renewal term.
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

Stimulation of nuisance organisms (e.g., shipworms)	1	SMALL COST. Has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where it was a problem. Has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds. It is not expected to be a problem during the license renewal term.
---	---	---

Aquatic Ecology

(for plant with once-through heat dissipation systems)

Entrainment of fish and shellfish early life stages	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. Licensees of plants that do not have an approved Clean Water Act 316(b) determination or equivalent state permit at the time of license renewal application must evaluate the entrainment issue in the license renewal application.
---	---	--

Impingement of fish and shellfish	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. Licensees, of plants that do not have an approved Clean Water Act 316(b) determination or equivalent state permit if required at the time of license renewal application must evaluate the impingement issue in the license renewal application.
-----------------------------------	---	---

Heat shock	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected the problem during license renewal term. Licensees of plants that do not have an approved Clean Water Act 316(a) determination or equivalent state permit, if required, at the time of license renewal application must evaluate the heat shock issue in the license renewal application.
------------	---	---

Aquatic Ecology

(for plants with cooling-tower-based heat dissipation systems)

Entrainment of fish and shellfish early life stages	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.
---	---	--

Impingement of fish and shellfish	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.
Heat shock	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

Aquatic Ecology

(for plants with cooling pond heat dissipation systems)

Impingement of fish	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. Licensees of plants that do not have an approved Clean Water Act 316(b) determination or equivalent state permit at the time of license renewal application must evaluate the impingement issue in the license renewal application.
Entrainment of fish early life stages	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. Licensees of plants that do not have an approved Clean Water Act 316(b) determination or equivalent state permit at the time of license renewal application must evaluate the entrainment issue in the license renewal application.
Heat shock	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. Licensees of plants that do not have an approved Clean Water Act 316(a) determination or equivalent state permit, if required at the time of license renewal application must evaluate the heat shock issue in the license renewal application.

Groundwater Use and Quality, Impacts of Refurbishment

Groundwater use and quality	1	SMALL COST. Extensive dewatering during the original construction on some sites will not be repeated during refurbishment on any sites. Any plants wastes produced during refurbishment will be handled in the same manner as in current operating practices and is not expected to be a problem during the license renewal term.
-----------------------------	---	---

Groundwater Use and Quality, Impacts of Operation

Groundwater use conflicts (potable and service water)	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. Plants pumping 100 or more gpm and having private wells located within cones of depression of reactor wells are required to assess for use conflict during the license renewal term.
Groundwater use conflicts (water pumped for dewatering)	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. Plants pumping 100 or more gpm and having private wells located within cones of depression of plant wells are required to assess for use conflict during the license renewal term.
Groundwater use conflicts (Surface water used as make-up water—potentially affecting aquifer recharge)	1	SMALL COST. Water use conflicts are small and will be resolved as necessary through surface water regulatory mechanism outside of NRC license renewal process and is not expected to be a problem for any plant during the license renewal term.
Groundwater use conflicts (Ranney wells)	2	SMALL COST. Ranney wells can result in potential groundwater depression beyond site boundary. Impacts of large groundwater withdrawal for cooling tower makeup at nuclear power plants using Ranney wells must be evaluated at the time of application for license renewal.
Groundwater quality degradation (Ranney wells)	1	SMALL COST. Groundwater quality at river sites may be degraded by induced infiltration of poor-quality river water into an aquifer that supplies large quantities of reactor cooling water. However, the lower quality infiltrating water would not preclude the current uses of groundwater and is not expected to be a problem during the license renewal term.

Groundwater quality degradation (saltwater intrusion)	1	SMALL COST. Nuclear power plants do not contribute significantly to saltwater intrusion.
Groundwater quality degradation (cooling ponds)	2	SMALL COST. Sites with closed-cycle cooling ponds may degrade groundwater quality. This is not an issue for those plants located in salt marshes. However, for those plants located inland, the quality of the groundwater in the vicinity of the ponds must be shown to be adequate to allow continuation of current uses.

Terrestrial Resources

Refurbishment impacts	2	SMALL COST. Insignificant impact if no loss of important plant and animal habitat occurs. If important plant and animal habitats are affected the potential impact will be assessed at the time of license renewal.
Cooling tower impacts on crops	1	SMALL COST. Salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Cooling tower impacts on native plants	1	SMALL COST. Salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Bird collisions with cooling towers	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

Cooling pond impacts on terrestrial resources	1	SMALL COST. No significant damage to vegetation has been observed as a result of fogging, icing, or increased relative humidity at nuclear reactor cooling ponds. The low levels of water contaminants in cooling ponds are not a threat to wildlife using the ponds. No significant impact is expected at any nuclear power plant during the license renewal term.
Power line right-of-way management (cutting and herbicide application)	1	SMALL COST. Periodic vegetation control causes cyclic changes in the density of wildlife populations dependent on the right-of-way, but long-term densities appear relatively stable. Numerous studies show neither significant positive nor negative effects of power line rights-of-way on wildlife. No significant impact is expected at any nuclear power plant during the license renewal term.
Bird collisions with power lines	1	SMALL COST. Has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	1	SMALL COST. No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified and is not expected to be a problem during the license renewal term.
Floodplains and wetland on power line right-of-way	1	SMALL COST. Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. On rare occasions when heavy equipment may need to enter a wetland to repair a power line, impacts can be minimized through the use of standard practices. No significant impact is expected at any nuclear power plant during the license renewal term.

Threatened or Endangered Species
(for all plants)

Threatened or endangered species	3	Generally, reactor refurbishment and continued operation is not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies must occur to determine if, in fact, threatened or endangered species are present and if they will be adversely affected.
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Air Quality

Air Quality	1	SMALL COST. Air quality impacts from reactor refurbishment associated with license renewal are expected to be small.
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Land Use

On-site land use	1	SMALL COST. Projected on-site land use changes required during refurbishment and the renewal period would be a small fraction of any nuclear power plant site.
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Human Health, Impacts of Refurbishment

Radiation exposures to the public	1	SMALL COST. During refurbishment, the gaseous effluents would result in doses well below the natural background dose. Applicable regulatory dose limits to the public are not expected to be exceeded.
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Occupational radiation exposures	1	SMALL COST. Average occupational doses from refurbishment are expected to be within the range of annual average doses experienced for pressurized-water reactors and boiling-water reactors. Upper-limit cancer and genetic risks from radiation exposure from the incremental doses from refurbishment are expected to be less than 1% of the natural cancer and genetic risks.
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Human Health, Impacts of Operation During License Renewal

Microbiological organisms (occupational health)	1	SMALL COST. Occupational health questions are expected to be resolved using industrial hygiene principles to minimize worker exposures.
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Microbiological organisms (public health)	2	SMALL COST. Has not been found to be a problem at most operating plants and is not expected to be a problem during the license renewal term. At the time of license renewal of plants using cooling ponds, lakes, or canals and plants discharging to small rivers applicants will assess the impact of thermophilic organisms on the health of recreational users of affected water.
Noise	1	SMALL COST. Has not been found to be a problem at operating plants and is not expected to be a problem at any reactor during the license renewal term.
Electromagnetic fields, acute effects (electric shock)	2	SMALL COST. Has not been found to be problem at most operating plants and is not expected to be a problem during the license renewal term. If it cannot be found at the time of license renewal that the transmission lines of the plant meets the National Electric Safety Code recommendations regarding the prevention of shock from induced currents then an assessment of the potential electric shock hazard from the transmission lines of the plant must be provided.
Electromagnetic fields, chronic effects	1	SMALL COST. Biological and physical studies of 60-Hz electromagnetic fields have not found consistent evidence linking harmful effects with field exposures.
Radiation exposures to public	1	SMALL COST. Present radiation doses to the public are very small with respect to natural background radiation; and doses from refurbishment are expected to be similar in magnitudes.
Occupational radiation exposures	1	SMALL COST. Projected maximum occupational doses during the license renewal term are within the range of doses experienced and are considerably below the 5 rem exposure limit.

Socioeconomics

Housing impacts of refurbishment	2	SMALL COST. Not expected to be a problem at any plant located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Housing impacts of the workforce associated with refurbishment will be assessed at the time of license renewal for plants located in sparsely populated areas or in areas with growth control measures that limit housing development.
Housing impacts of license renewal term	2	SMALL COST. Not expected to be a problem at any plant located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Housing impacts of the workforce associated with refueling/maintenance outages will be assessed at the time of license renewal for plants located in sparsely populated areas or in areas with growth control measures that limit housing development.
Public service impacts of refurbishment	1	SMALL COST. Refurbishment induced population growth will be small and will not strain local infrastructure at any plant.
Transportation impacts of refurbishment	3	Impacts are generally expected to be small, however, they must be assessed for each plant to consider the increase in traffic associated with the additional workers and the local road and traffic control conditions.
Public service (including transportation) impacts during license renewal term	1	SMALL COST. No significant impacts are expected during the license renewal term.
Offsite land use impacts of refurbishment	1	SMALL COST. Impacts will not be significant at any plant because plant-induced population growth will have little effect on land use patterns.
Offsite land use impacts of license renewal term	1	SMALL COST. Changes in land use would be associated with population and tax revenue changes resulting from license renewal of a plant. These changes are expected to be small for all plants.

Historic resources impacts of refurbishment	1	SMALL COST. No significant impacts are expected during refurbishment.
Historic resources impacts of license renewal term (transmission lines)	1	SMALL COST. No significant impacts are expected during the license renewal term.
Historic resources impacts of license renewal term (normal operations)	1	SMALL COST. No significant impacts are expected during the license renewal term.
Aesthetic impacts of refurbishment	1	SMALL COST. No significant impacts are expected during refurbishment.
Aesthetic impacts of license renewal term	1	SMALL COST. Impacts will be small to moderate depending on the visual intrusiveness of the plant on historic and aesthetic resources in the area.
Aesthetic impacts of license renewal term (transmission lines)	1	SMALL COST. No significant impacts are expected during the license renewal term.

Uranium Fuel Cycle

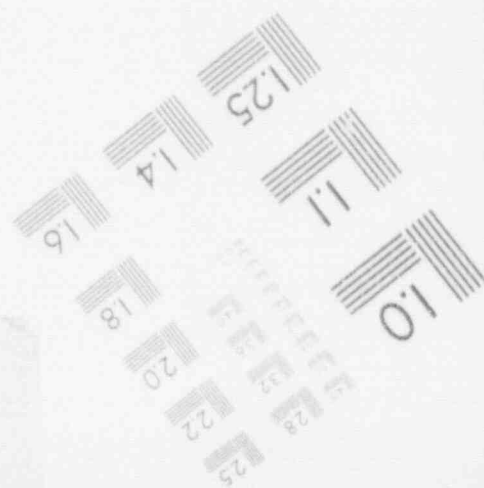
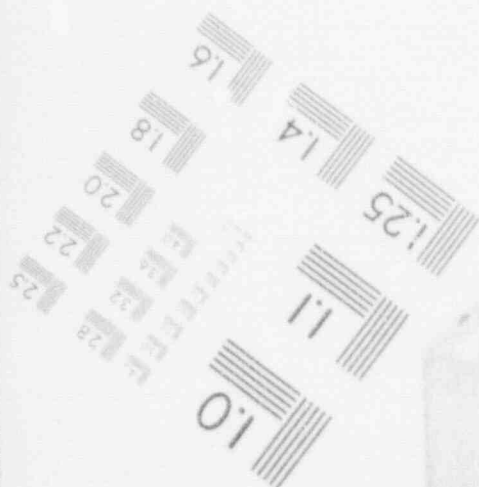
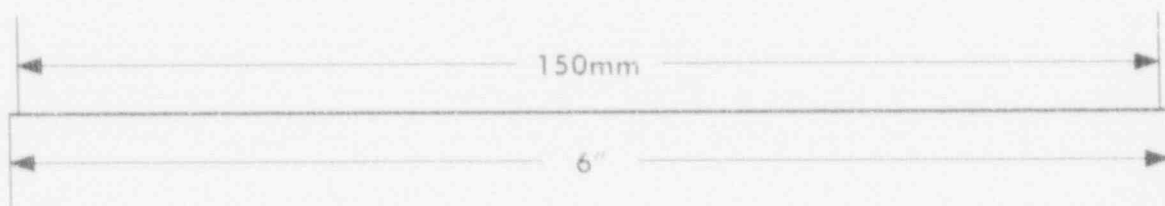
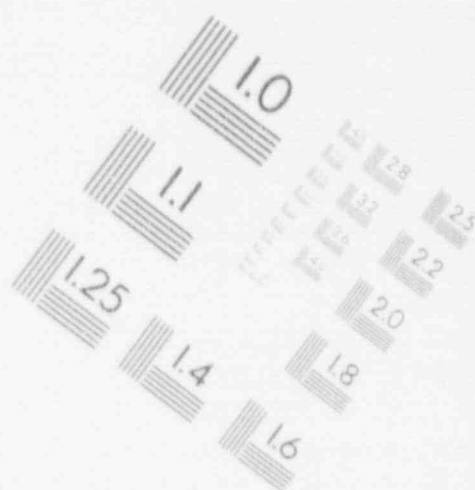
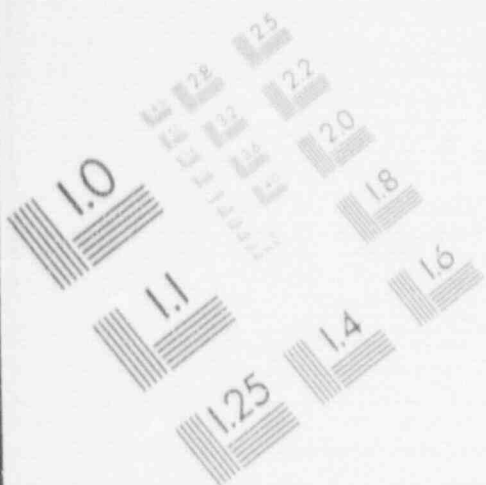
Radiological and nonradiological impacts	1	SMALL COST. Impacts on the U.S. population from radioactive gaseous and liquid releases including radon-222 and technetium-99 is small compared with the impacts of natural background radiation. Nonradiological impacts on the environment are small.
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Environmental Impacts of Postulated Accidents

Design basis accidents	1	SMALL COST. Regulations require that consequences from design basis events remain acceptable for every plant.
Severe Accidents (Atmospheric releases)	1	SMALL COST. Risk from atmospheric releases is small.
Severe Accidents (Fallout onto open bodies of water)	1	SMALL COST. Risks from both the drinking water pathway and the aquatic food pathway are small and interdiction can further reduce both sufficiently for all plants.

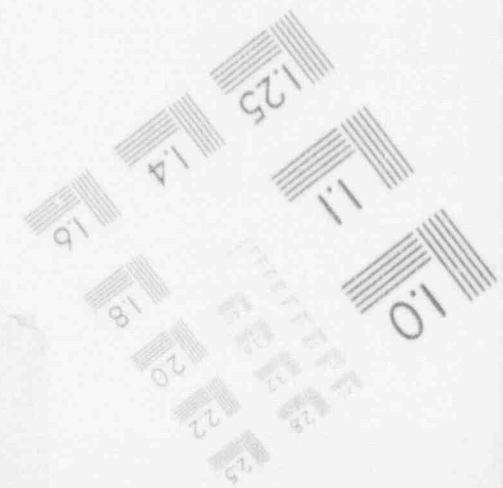
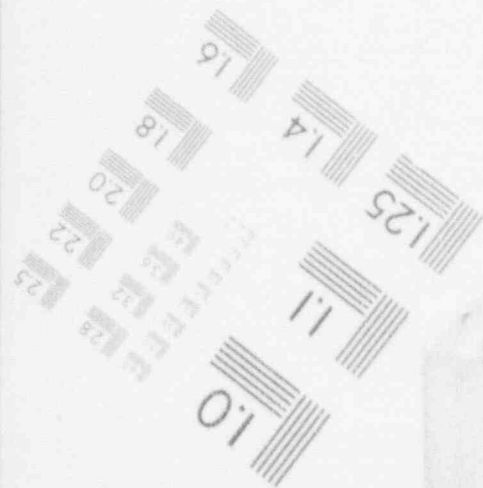
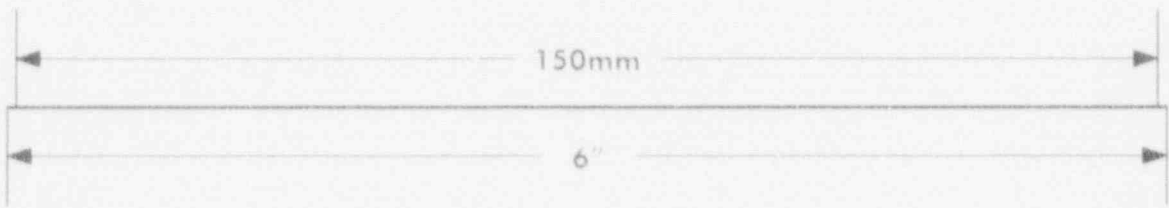
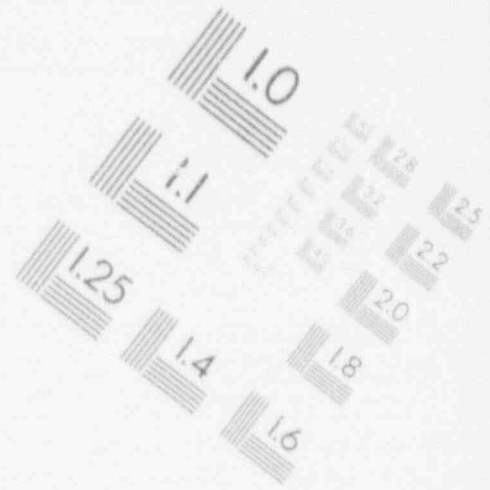
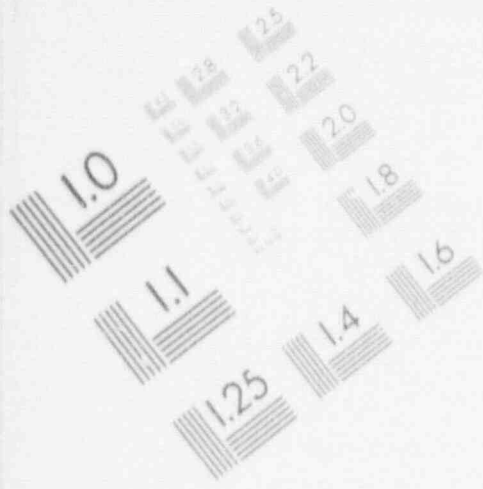
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IMAGE EVALUATION TEST TARGET (MT-3)



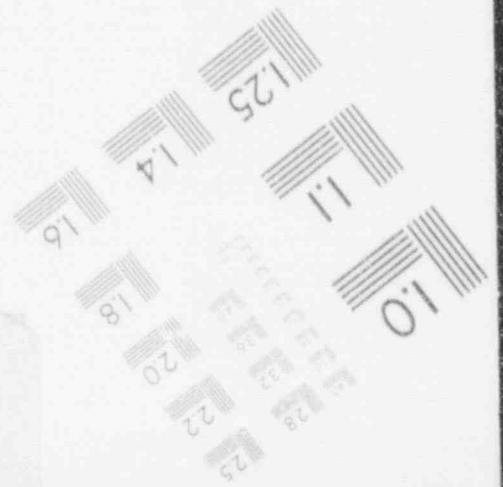
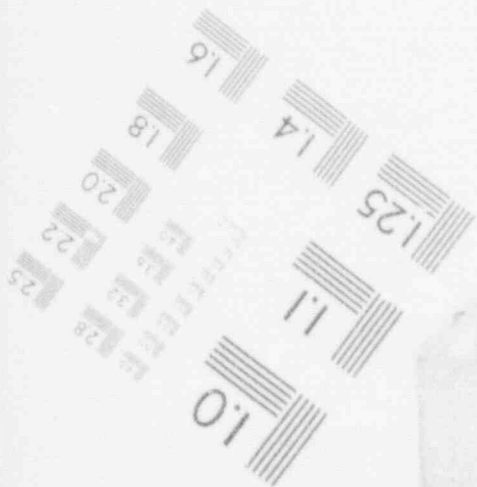
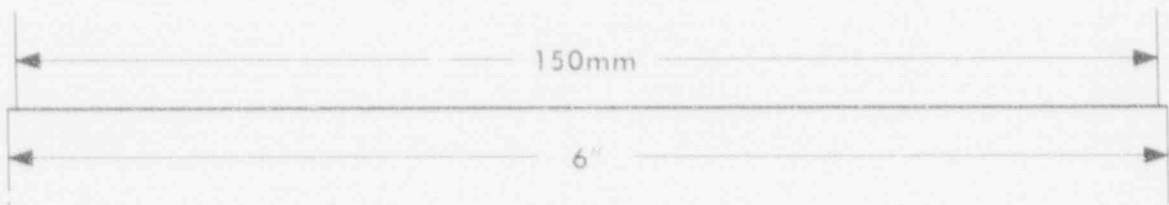
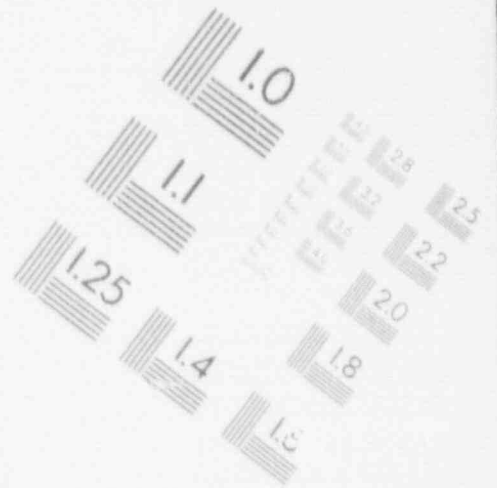
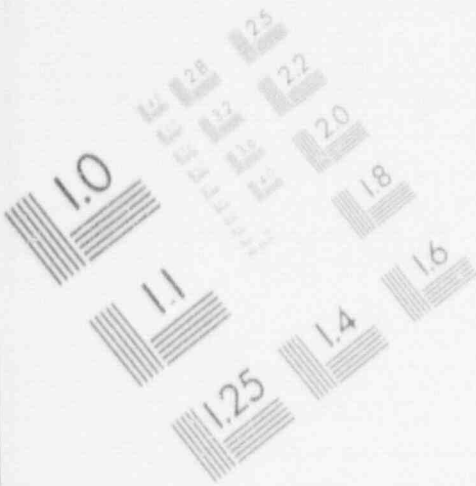
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IMAGE EVALUATION TEST TARGET (MT-3)



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IMAGE EVALUATION TEST TARGET (MT-3)



Severe Accidents (Releases from groundwater)	1	SMALL COST. Interdiction and the low probability of base mat penetration yield a low risk to the public for all plants.
Severe Accidents (Economic consequences)	1	SMALL COST. Predicted costs due to postulated accidents range from \$2000/reactor year to \$374,000/reactor-year.
Severe Accident Mitigation Design Alternatives	1	SMALL COST. Low risk to the environment from severe accidents.

Solid Waste Management

Nonradiological waste	1	SMALL COST. No changes to generating systems are anticipated for license renewal. Existing regulations will ensure proper handling and disposal at all plants.
Low-level radioactive waste storage	2	SMALL COST. Impacts will be small for plants having access to offsite disposal space. For those plants denied the use of off-site disposal space due to delayed compact plans, the potential for ecological habitat disturbance due to construction of on-site storage facilities must be evaluated.
Low-level radioactive waste disposal	2	SMALL COST. Off-site disposal facilities are planning to handle refurbishment and normal operations waste streams for an additional 20 years. If implementation of plans is delayed, plants in affected compact regions or unaffiliated states must plan for extended interim storage for an indefinite period of time and evaluate the impacts of such storage.
Mixed waste	1	SMALL COST. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants.
Spent fuel	1	SMALL COST. A 50% greater volume of spent fuel from an additional 20 years of operation can be safely accommodated on-site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage facility is not available.

Transportation	1	SMALL COST. Rail and truck transport corridors can safely accommodate increased shipments of radioactive wastes associated with license renewal. Shipments would result in impacts within the scope of the Table S.4 rule and therefore would result in acceptable impact.
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Decommissioning

Radiation doses	1	SMALL COST. Doses to the public are small regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem due to buildup of long-lived radionuclides during the license renewal term.
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Waste management	1	SMALL COST. Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.
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Air quality	1	SMALL COST. Air quality impacts of decommissioning are expected to be negligible whether at the end of the current operating term or at the end of the license renewal term.
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Water quality	1	SMALL COST. The potential for significant water quality impacts from erosion or spills is no greater if decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.
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Ecological resources	1	SMALL COST. Decommissioning after either the initial operating period or after a 20 year license renewal period is not expected to have any direct ecological impacts.
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Socioeconomic impacts	1	SMALL COST. Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.
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¹ The numerical entries in this column are based on the following category definitions:

- Category 1: A generic conclusion on the impact has been reached for all affected nuclear power plants.
- Category 2: A generic conclusion on the impact has been reached for affected nuclear power plants that fall within defined bounds.
- Category 3: A generic conclusion on the impact was not reached for any affected nuclear power plants.

2 The findings in this column apply to Category 1 issues and Category 2 issues where plants fall within the bounds of the generic analysis. For Part I of this table, the entry in this column indicates the level of need. For Part II of this table, the entry in this column indicates the relative advantages of alternatives to license renewal. For Part III of this table, the entries in this column are benefits or costs, as indicated by the following headings:

- SMALL impacts are so minor that they warrant neither detailed investigation or consideration of mitigative actions when such impacts are negative.
- MODERATE impacts are likely to be clearly evident and usually warrant consideration of mitigation alternatives when such impacts are negative.
- LARGE impacts involve either a severe penalty or a major benefit and mitigation alternatives are always considered when such impacts are negative.

3 The uncertainty associated with the economic cost of license renewal leads to the requirement that a demonstration will be made by an applicant for license renewal that there is no cost advantage of replacement of equivalent generating capacity by a new coal fired power plant. If no such demonstration can be made, a justification for choosing the license renewal alternative must be provided in the application. The justification will include an assessment of the cost of license renewal relative to reasonable alternative replacement generating capacity. Costs considered must include refurbishment and construction, fuel, and operation and maintenance.