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Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses

Final Report

U.S. Nuclear Regulatory Commission

Office of Nuclear Regulatory Research

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Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses

Final Report

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**Division of Regulatory Applications
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U.S. Nuclear Regulatory Commission
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ABSTRACT

This regulatory analysis provides the supporting information for a proposed rule that will amend the Nuclear Regulatory Commission's environmental review requirements for applications for renewal of nuclear power plant operating licenses. The objective of the proposed rulemaking is to improve regulatory efficiency by providing for the generic evaluation of certain environmental impacts associated with nuclear plant license renewal. After considering various options, the staff identified and analyzed two major alternatives. With Alternative A, the existing regulations would not be amended. This option requires that environmental reviews be performed 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. In addition, Alternative B removes from NRC's review certain economics-related issues. 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 Statement of the Problem and Objectives

1.1 Background

The operating licenses for the earliest commercial nuclear plants will begin to expire shortly after the year 2000. The utility industry, the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) have been working for many years 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 applications for license renewal will be submitted in 1996-98 time frame for at least one individual nuclear plant and by at least one owners group representing several plants. 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 rule, 10 CFR 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants" (60 Fed. Reg. 22461, May 8, 1995), that establishes 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 amending 10 CFR Part 51 to generically address many of the potential environmental impacts from renewal of the operating license of individual nuclear power plants. This rulemaking defines both environmental issues that are generically addressed in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)," (Ref. 1), and those environmental issues which are to be addressed on a plant-specific basis. All plant-specific potential environmental impact issues are 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 basis for this rulemaking is that 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 most environmental effects that may arise from renewal of operating licenses and the resulting extended plant operation. In addition, experience has shown that for certain environmental and safety issues, rulemaking can yield a number of societal benefits of direct or indirect importance, including:

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 forth 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, other Federal agencies, and State and local governments.

The amendments to 10 CFR Part 51 also provide the NRC with the flexibility to address unreviewed site specific impacts and allow the NRC to otherwise consider fully the environmental impacts of license renewal.

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 the

Objectives

- National Environmental Protection Act (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, 2040, or 2050?

All comments and recommendations received were 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 the Environmental Standard Review Plan (ESRP), NUREG-1429. The proposed rule was published in September, 1991, and the availability of supporting documents and a public workshop to be held on November 4 and 5, 1991, were announced (56 FR 47016).

Numerous comments were received on both the proposed rulemaking and the supporting draft documents, particularly the GEIS. Comments and concerns on the proposed amendments and the supporting documentation were provided by the public, the Council on Environmental Quality (CEQ), the Environmental Protection Agency (EPA), industry representatives and industry organizations, and affected States. Following a review of these

comments the Commission directed the staff to discuss with the States their concerns that the proposed rule conflicted with State regulatory authority regarding need for power and utility economics. The staff conducted several regional workshops to help resolve possible areas of conflict between the proposed rule and States authority.

As a result of the comments received, the NRC has modified the amendments to Part 51. Key changes made to the rule and the GEIS are discussed in the following section.

The amendments to 10 CFR Part 51 define two categories of environmental issues relevant to nuclear plant license renewal. Category 1 issues involve those environmental impacts for which generic analyses have been performed and are to be adopted in plant specific reviews for license renewal. Category 2 issues address those environmental impacts for which plant specific analyses are to be performed. These amendments are based on the evaluations and results presented in the GEIS for nuclear plant license renewal, NUREG-1437. The GEIS was prepared to assess which environmental impacts may occur, under what circumstances, and their possible level of significance.

1.2 Objectives of the Proposed Rulemaking

1.2.1 Original Objectives

The changes to 10 CFR Part 51 were originally intended to enable the NRC to achieve the following objectives:

- 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 simplify the preparation of the environmental report by defining the potential generic and specific environmental impacts that must be addressed, and
- to identify generic environmental impacts for public participation to achieve understanding and resolution, so that hearings for individual plant EISs will be more efficient.

In addition, as originally proposed, the modifications to Part 51 had the objective of permitting the use of an environmental assessment (EA) and a finding of no significant impact (FONSI). As such, this rulemaking would reduce resource requirements when the information presented in an applicant's environmental report demonstrated that there were no significant environmental impacts associated with the limited set of issues that were to be assessed.

1.2.2 Current Objectives

The public comments received, together with those received from CEQ, EPA, State agencies, and industry groups and representatives, prompted the NRC to make several significant modifications to intended amendments to 10 CFR Part 51. Public comments on the adequacy of the analysis for each issue were considered by the staff and, where warranted, changes were made to the analysis and findings in the final GEIS and the rule. Changes were also made in response to comments by CEQ, EPA, and State agencies. Key changes to the amendment of Part 51 include:

- redefining the purpose of and need for license renewal so as to eliminate NRC judgments regarding need for generating capacity in license renewal reviews,
- eliminating generic conclusions regarding the comparison of alternative energy sources to license renewal,
- eliminating the traditional cost-benefit analysis from license renewal NEPA reviews,
- utilizing a site-specific decision standard whereby the NRC would consider only the environmental impacts of the proposed action and alternatives, and would reject an application if the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision-makers would be unreasonable,
- requiring that the NRC prepare a plant specific supplemental environmental impact statement (SEIS), rather than an environmental assessment, which will be issued for public comment as part of the individual plant review process, and

- requiring that the NRC periodically review and update the GEIS and the rule to take account of significant new information related to environmental aspects of license renewal.

The primary objective of the amendments to 10 CFR Part 51 largely remain unchanged. This objective is to improve regulatory efficiency in environmental reviews for license renewal by generically assessing many of the environmental impacts that are associated with license renewal and extended nuclear power plant operation. This rulemaking will result in resource savings to both applicants in the preparation of their submittals and to the NRC in its review of license renewal applications. These savings ultimately benefit the public. The final proposed rule and GEIS also eliminate any possible infringement by the NRC on States authority and that of other Federal agencies by removing from NRC's review aspects related to utility economics, need for power, cost-benefit balancing, and similar issues. The removal of these issues from NRC's review will save resources both for the NRC and for the industry applicants for license renewal. In addition, it will eliminate efforts by the States and non-NRC Federal agencies, as well as the NRC, that might be associated with resolution of disagreements among these parties on the treatment of these controversial issues.

1.3 Impacts on Other Requirements

The proposed amendment to 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 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," but no other interactions. In addition, the removal from NRC's environmental review of economics-related issues eliminates possible duplication of efforts by the NRC and affected States in the review of such issues. The proposed amendment also eliminates potential conflict with matters that are under State regulatory authority.

2.0 Identification of 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 the proposed Part 51. A wide spectrum of possible options were considered. For example:

1. No rulemaking
2. Use of a GEIS as the basis for proposed amendments to Part 51
3. Use of a GES as the 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 removal of 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.

2.1 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, including those addressing need for power, utility economics, cost-benefit balancing, economic evaluation of alternatives and related issues. 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. These actions would be performed 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. These actions would be followed by the issuance of a final EIS and a public hearing for each individual unit's license renewal EIS.

Alternative A requires the preparation of an updated Regulatory Guide (RG) and an updated Environmental Standard Review Plan (ESRP) suitable for use in license renewal actions. Guidance would have to be provided for addressing the full range of environmental impacts pertinent to nuclear plant license renewal.

2.2 Alternative B- Undertake Rulemaking to 10 CFR 51 to Generically Address Environmental Impacts Potentially Resulting from Nuclear 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. These are designated as Category 1 issues. 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 requires 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

Alternatives

permitted on the findings of the GEIS in individual unit environmental reviews unless new and significant information was presented which would bear on the generic treatment of particular issues. Unless significant new information was presented which would conflict with their generic treatment, Category 1 issues would not be addressed. Issues that require evaluation on a plant specific basis are referred to as Category 2 issues. Alternative B requires that licensees address all Category 2 issues pertinent to their particular nuclear power plant(s).

The GEIS limits the 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 a supplemental environmental impact statement for only those issues which must be addressed on a plant specific basis.

The proposed amendment to Part 51 includes provision for periodic NRC reviews of the generic conclusions drawn in the GEIS. The NRC will perform reviews every ten years to evaluate any new or otherwise significant information that becomes available, and which might bear on the generic treatment of particular issues.

In addition to the generic treatment of many environmental issues, the final rule, represented by Alternative B, eliminates consideration of certain issues that are more properly addressed by affected States and possibly by non-NRC Federal Agencies such as the Federal Energy Regulation Commission (FERC). The issues eliminated are those concerning utility economics, need for power, cost-benefit balancing, economic evaluation of alternatives, and similar issues. The NRC has made the decision not to address these issues in order to avoid possible infringement on the rights and authority of the States and other Federal Agencies. In so doing, the NRC will still meet its NEPA requirements. This approach results in resource savings to both the NRC and applicants for license renewal by the removal of these issues from NRC's review, while at the same time avoiding possible jurisdictional conflicts with other entities. As such, this approach also reduces possible expenditures by States and non-NRC Federal agencies in contesting NRC positions on issues likely to be viewed as infringing on the rights of these entities.

The adoption of Alternative B would require the development of an appropriate Regulatory Guide and Environmental Standard Review Plan for license renewal. Only Category 2 issues would have to be treated.

3.0 Estimation of Values and Impacts

This section discusses the values and impacts of the two alternatives identified in Section 2. Values are defined as the "beneficial aspects anticipated from a proposed regulatory action, . . ." Values normally considered in regulatory analyses include:

- Reductions in public and occupational radiation exposure,
- Enhancements to health, safety, or the natural environment,
- Averted onsite impacts,
- Averted offsite property damage,
- Savings to licensees,
- Savings to the NRC,
- Savings to State, local, or tribal governments,
- Improved plant availability,
- Promotion of the efficient functioning of the economy, and
- Reductions in safeguards risks.

Impacts are defined as the "costs anticipated from a proposed regulatory action, . . ." Impact evaluations typically include aspects such the following:

- Costs to licensees,
- Costs to the NRC,
- Costs to State, local, or tribal governments,
- Adverse effects on health, safety, or the natural environment,
- Adverse effects on regulatory efficiency or scientific knowledge needed for regulatory purposes, and
- Adverse effects on the efficient functioning of the economy and private markets.

Of the values and impacts listed above, those pertinent to the evaluation of the two alternatives for the proposed Part 51 rulemaking include protection of health, safety, and the natural environment; savings or costs to the NRC, licensees, and possibly to State governments or non-NRC Federal agencies; promotion of the efficient functioning of the economy; and promotion of regulatory efficiency. The selection of either Alternative A or Alternative B is not expected to have any effect on any of the other values or impacts listed above.

The two alternatives delineated in Section 2 provide equivalent protection to the environment and to health and safety. 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 to assure environmental protection 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.

The primary differences in attributes between the two alternatives are those related to costs. Costs to both industry and to the NRC are associated with license renewal environmental evaluations. All other differences between the two alternatives are qualitative in nature. Therefore, only cost consequences are quantified in the following analysis.

License renewal of nuclear power plants will impact affected States and certain non-NRC Federal agencies in that these entities will be party to decisions affecting the continuation or cessation of nuclear plant operation for plants located within their areas of jurisdiction. However, the license renewal-related efforts and activities of these entities are considered to be the same under both Alternatives A and B. Any costs to these entities, therefore, would be the same for both alternatives, and are excluded from the cost evaluations presented here.

The following discussions develop the costs for each alternative, and estimate the incremental benefits (savings) associated with the adoption of Alternative B. Section 3.1 reviews the assumptions and bases used in evaluating costs and cost differences between the alternatives. The impacts (costs) of proceeding with each alternative are discussed in Section 3.2. Section 3.3 discusses the values associated with the alternatives.

3.1. Assumptions and Cost Basis

3.1.1 Alternative A Versus Alternative B: Areas of Difference

The draft GEIS, together with earlier ERs and EISs prepared for the operating license stage of individual nuclear plants, have identified a total of 104 discrete issues to be addressed relative to license renewal. The final amendments to 10 CFR Part 51 now address 92 issues. The reduction in the number of environmental issues between the draft and final amendments is due to several factors, including: the exclusion of issues related to need for power, utility economics and costs, and cost-benefit balancing; removing generic consideration of alternative energy sources; combining several closely-related issues into fewer issues; and regrouping of certain issues. Of the issues in Appendix B, Table B-1, of the final amendment to Part 51, 68 are classified as Category 1 issues and 22 are classified as Category 2 issues. Two issues are not categorized, but the responsibilities of the NRC and the applicant to address each issue are defined in the rule. A review of the issues listed in Table B-1 of the amendment to Part 51 and those in the draft GEIS indicates that many issues are relevant only to particular nuclear plant settings. This review suggests that, with Alternative A, the ER and EIS for most plants need address only about two-thirds of the total number of issues; the balance of the issues are not applicable or are not pertinent because of the environmental setting of particular plants and because of particular plant design features. For example, certain issues are relevant only to plants with cooling ponds for ultimate heat sinks, while others are applicable only to plants with once-through final cooling systems. Note, however, that the issues related to utility economics, cost-benefit balancing, need for power, etc., are NEPA issues applicable to all plants and would have to be addressed by all ERs and EISs under Alternative A. This analysis has assumed that Alternative A would entail the evaluation of about two-thirds of the issues listed as Category 1 and Category 2 in Appendix B of the amended Part 51, as well as all issues related to plant economics and evaluation of alternatives. Thus, with Alternative A an average of 65 issues were assumed applicable to individual plants.

Alternative B removes the need to evaluate Category 1 issues in individual plant ERs and EISs. In addition, the issues dealing with plant economics and economic evaluation of alternatives are excluded. Thus, the final amendment to Part 51 is expected to require the evaluation of about 10 to 20 plant-specific issues per plant. However, for conservatism, the assumption has been made that all 22 Category 2 issues and the two non-categorized issues would have to be addressed for each plant under Alternative B.

Another area of difference between Alternative B and Alternative A is that the former requires that the NRC periodically review and update the GEIS to assure that all new and significant information pertinent to the evaluation of nuclear plant license renewal environmental impacts is appropriately considered and factored into these assessments. These reviews must be performed at least every ten years. Each review is assumed to require about two person-years of effort to complete. This periodic activity by the NRC could result in the reclassification of particular issues between Categories 1 and 2.

Both Alternatives A and B provide for public hearings and require consideration of public comments received on the draft EISs. Alternative B requires consideration of public comments raising new and significant information on all issues, including Category 1 issues. The associated Alternative B NRC efforts are conservatively estimated to be similar to the resources involved in public comment responses for Alternative A, and are treated accordingly in this analysis. In practice, however, the NRC expects a reduced resource requirement in responding to public comments for Alternative B relative to what is expected with Alternative A.

As is noted in Section 3.1.5, there are also differences in the estimated development costs for the Regulatory Guides and updated Environmental Standard Review Plans between Alternatives A and B. These differences are accounted for in the cost evaluations discussed in Section 3.2.

3.1.2 Efforts Required to Develop an Environmental Report Supplement and Updated Environmental Impact Statement for License Renewal

The cost evaluations for this analysis of the final amendments to Part 51 assume that the effort required by licensees to prepare a comprehensive license renewal update to a plant's ER as called for by Alternative A 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 the licensee efforts at the OL stage were as follows:

Licensee Efforts for OL Stage ER: 5,000 to 15,000 person-hours

The corresponding NRC efforts were:

NRC Review and EIS Efforts: 2,000 to 4,000 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 estimates include allowance for hearings.

Recent NRC experience with the preparation of the EIS for the Watts Bar nuclear plant indicated that about 7,500 staff and contractor hours of effort were needed to update the operating license final environmental impact statement. This update evaluated all the environmental issues addressed in the GEIS for license renewal. Thus, the range of hours cited in NUREG-0499 may not be sufficient to cover NRC's efforts needed to produce a current EIS. The greater effort associated with the Watts Bar EIS is likely due to two factors. First, the environmental review standards have become more strict over the years, and additional effort is needed to assure compliance with the more stringent requirements. Second, considerable time has elapsed since the previous EISs were developed, and the more recent efforts have lost some of the benefit of the mature "learning curve" effects that are likely to have been experienced for the efforts cited in

NUREG-0499. Since the NRC's effort was only an update rather than a new review, it is possible that a complete site-specific analysis of all environmental issues as required by the existing Part 51 could be twice the Watts Bar effort, or as much as 15,000 hours. As more reviews are completed, efficiencies may be gained and the effort per review may be reduced. Based on these considerations of NRC's recent experience in the preparation of an EIS, the following range of efforts was adopted for the current analysis.

NRC Review and EIS Efforts: 5,000 to 15,000 person-hours.

The efforts required to perform the equivalent activities for license renewal purposes are estimated to be at about the midpoint of the ranges cited above for the ER and EIS generated at the OL stage of the original plant licensing, or about 10,000 person-hours. These estimates are 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, and such information may not be available for all plants. The efforts associated with the generation of a full scope license renewal ER update as called for in the existing Part 51 in accordance with §51.70 and 51.71, 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: 10,000 person-hours

NRC Review and EIS Efforts: 10,000 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, and to other important parameters, are addressed in Section 4.3.

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3.1.3 Labor Rates

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 1994 dollars.

Licensee labor rate (1994\$, fully burdened):
\$54.66/person-hour

NRC labor rate (1994\$): \$53.91/person-hour

The industry rate represents fully-burdened costs. 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.

3.1.4 License Renewal Nuclear Power Plant Population

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. The 118 units are owned by 52 electric utilities and are located at 74 plant sites. Recently, however, three nuclear plants, San Onofre Unit One, Trojan and Yankee Rowe, have been permanently shut down, and the Rancho Seco and Shoreham units have been shut down for some time.

In addition, Consumers Power Co. has announced that it will not seek license renewal for the Big Rock Point nuclear plant. The remaining reactor population of 112 units was considered as potentially applying for license renewal. Since multiple unit/plant sites will have to apply separately for each unit, 112 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. No credit was taken for any possible reduction in ER or EIS efforts for reviews of co-located plants.

3.1.5 NRC Regulatory Implementation Costs

Both the no-action alternative, Alternative A, and the proposed rule amendment, Alternative B, will require the development of an updated Regulatory Guide for the preparation of license renewal environmental reports. Similarly, an updated Environmental Standard Review Plan must be developed to assist the NRC in its review of the ERs submitted with license renewal applications. The RG and ESRP development efforts with alternative A are expected to be higher than those for alternative B because the former alternative must address all 104 issues, whereas the latter must address only the 22 Category 2 issues and the two non-categorized issues.

Estimates of the NRC's implementation costs associated with the development of the appropriate RGs and EISs for Alternatives A and B are as shown in the following table. These costs for either alternative are yet to be incurred.

NRC Regulatory Implementation Costs

	Alternative A	Alternative B
Regulatory Guide	\$1,400,000*	\$150,000
Environmental Standard Review Plan		\$350,000
Totals, 1994\$	\$1,400,000	\$500,000

*Includes both RG and ESRP development costs

3.1.6 Benefits from the GEIS

The nuclear plant environmental impact information available in the GEIS should be useful to all applicants for license renewal and to the NRC in the preparation of the required ERs and EISs, even for those issues requiring plant-specific evaluations. The GEIS information should reduce the effort needed by applicants in preparing their ERs. In addition, the NRC's efforts associated with the preparation of EISs for license renewal should be reduced. The GEIS information can be used to assist, for example, in determining the threshold at which particular environmental impacts are considered to be significant. If, for a particular plant, such impacts are expected to remain below these threshold levels for license renewal conditions, the ER and the EIS for that plant can reference the pertinent GEIS information in determining that those impacts will be acceptably low.

Particular plant conditions, including the extent of anticipated license renewal-related refurbishment activities, may result in environmental impacts which are outside the envelope of generic acceptability evaluated in the GEIS. In such cases, and for the affected issues, the GEIS information may be of marginal use in resolving issues. More time and effort on the part of both applicants and the NRC will be needed to address and resolve such issues for such plants. Thus, the GEIS information will not necessarily be helpful in addressing all environmental impact issues at all plants for which license renewal is sought.

The extent of credit that can be taken for the GEIS in reducing ER and EIS preparation efforts will undoubtedly be highly plant specific, and will depend on factors such as plant characteristics, environmental setting, and the planned license renewal activities. Based on anticipated typical license renewal programs, however, the assumption has been made that the information available in the GEIS will reduce ER and EIS efforts by about 20% compared to what would be the case without the GEIS. This benefit has been applied to all issues treated in the GEIS, with the exception of the evaluation of severe accident mitigation design alternatives (SAMDA). The SAMDA issue, because of its complexity, was not assumed to benefit from any related information provided in the GEIS. Note also that the GEIS is currently available, and should

be useful with Alternative A, the no-action alternative, as well as with Alternative B. The information in the GEIS, combined with the staff expertise gained in preparing the GEIS, should also be useful to the NRC in the development of updated Regulatory Guides and Environmental Standard Review Plans needed to support license renewal efforts.

3.1.7 Effort Needed to Evaluate Issues

Section 3.1.2 noted that the estimated mean effort required to prepare a full scope ER as would be needed for license renewal with Alternative A was 10,000 person-hours, and that the related NRC review and EIS preparation effort was also about 10,000 person-hours. Section 3.1.1 noted that the typical number of environmental impact issues that individual plant ER and EIS need address is estimated to be about 65 with Alternative A. The further assumption has been made that certain of the issues are fairly complex and controversial, and take considerably more effort to address than do most of the other issues. Specifically, the following issues are judged to be the most resource intensive as they are historically the most litigious.

- Need for power
- Utility economics
- Cost-benefit balancing
- Solid waste management
- Severe accident mitigation design alternatives

These complex issues are estimated to require about 1000 person-hours per issue to address on the part of both applicants and the NRC in each ER and EIS prepared for nuclear plant license renewal. Each of these issues would have to be addressed for each plant under Alternative A.

The further assumption has been made that the remaining issues to be addressed with Alternative A can be evaluated with modest or moderate efforts. Those 24 issues classified either as Category 2 or not classified in Table B-1 of the proposed final amendment to Part 51 (with the exception of the SAMDA issue) were assumed to require about 180 person-hours each to evaluate, or a "moderate" effort. The remaining issues were assumed to require a low effort of about 25 person-hours each to address. Both the NRC and applicants would expend these efforts. For Alternative A, this

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combination of estimated efforts and number of issues of differing complexities results in a total of 10,000 person-hours for the preparation of an ER by an applicant for license renewal, and for the NRC in its review of the ER and the preparation of the associated EIS. These estimates are consistent with historical experience for the preparation of ERs and EISs. These estimates do not take any credit for the availability of the GEIS.

With Alternative B, one complex set of issues - the uranium fuel cycle and solid waste management - is resolved by generic treatment and Category 1 classifications. The issues of need for power, utility economics, and cost-benefit balancing are removed from NRC's areas of oversight, and need not be addressed. The remaining complex issue to be addressed with Alternative B is that of severe accident mitigation design alternatives. The other Category 2 issues to be addressed on a plant specific basis are assumed to require a moderate effort to address, i.e., about 180 person-hours each. The estimated effort to address Category 2 issues is about 5,000 person-hours each for the NRC and applicants associated with each license renewal application submitted. This estimate assumes no credit taken for the availability of the GEIS information. Thus, Alternative B is expected to require about one-half the effort for license renewal environmental assessments compared to that expected with Alternative A.

With credit taken for the information available in the GEIS, both the NRC and licensee efforts are assumed to be reduced by about 20% for all issues addressed in the GEIS (with the exception of SAMDAs). This benefit is assumed to apply to both Alternative A and Alternative B.

3.2 Estimation of Impacts

The environmental impacts associated with the adoption of either Alternative A or Alternative B are the same in that each alternative provides the same environmental protection. Other than the costs associated with the development of the ERs, EISs, Regulatory Guides, Standard Review Plans, and any costs associated with the hearings, there are no other identified impacts.

3.2.1 Alternative A Cost Impacts

Alternative A, as noted above, is the "no rulemaking" or "no action" 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, including those related to need for power, utility economics, economic evaluation of alternatives, and related issues would have to be addressed.

Table 1 summarizes the cost impacts to both the nuclear industry and to the NRC associated with performing environmental reviews for license renewal under the existing Part 51. 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 3% and 7% 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).

The costs displayed in Table 1 are based on the assumption that applications for license renewal will typically be submitted 12 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 those plants whose licenses expire prior to 2007, and for which less than 12 years are available prior to license expiration. In addition, the cost analysis performed here assumed that one application for license renewal would be made in 1996 or 1997, and an application from one Owners Group representing several plants would be submitted in 1997 or 1998. Since plant-specific ERs and EISs are needed, the costs incurred in the

Table 1. Alternative A Costs
(Cost in 10⁶ 1994 \$)

	Percentage of Population Applying for License Renewal	Discount Rate	
		3%	7%
Industry Costs	25	10.0	7.1
	50	20.1	14.1
	75	30.1	21.2
	100	40.2	28.2
NRC Costs	25	11.3	8.4
	50	21.2	15.3
	75	31.1	22.3
	100	41.0	29.2
Total Costs	25	21.4	15.4
	50	41.3	29.4
	75	61.3	43.4
	100	81.2	57.4

preparation of these evaluations were assumed to be the same on a per-plant basis, regardless of whether or not individual plant or group applications for license renewal were made.

The use of discount rates 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. 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.

The values presented in Table 1 are based on the assumption that the information in the GEIS is available to both applicants and the NRC, and that this information will be useful in reducing the overall efforts needed to produce both the ERs and EISs for nuclear plant license renewal. As previously noted, the efforts needed to address

issues covered in the GEIS were estimated to be about 80% of what would be needed if the GEIS did not exist.

3.2.1.1 Industry Costs

A licensee's effort needed to prepare a comprehensive, updated ER on any individual plant for which a license renewal application is submitted is estimated to be about 9,000 person-hours, assuming some benefit from the availability of the GEIS information in the preparation of the ER. At \$54.66/person-hour, this effort results in an estimated cost of about \$490,000 per plant in 1994 dollars.

Table 1 indicates that the present value of industry expenditures associated with the preparation of ERs under Alternative A could be as high as \$40 million or as little as \$7 million. The high estimate is based on the assumption that all 112 plants in the current population will apply for renewed licenses, except those permanently shut down or those which are expected to shut down without seeking license renewal. The 3% discount rate was used for the higher estimate. The low-end estimate is based on only 25% of the population applying for renewed licenses, together with the 7% discount rate. The projected present value of

Figure 1. Number of License Renewal Applications per Year

industry costs decreases considerably with the higher discount rate. This reduction occurs because the license renewal applications, and their associated environmental assessments, are spread out over a considerable period of time.

3.2.1.2 NRC Costs

As noted in Section 3.1, NRC's effort associated with the review of license renewal ERs and the generation of plant EISs is estimated to be about 9,000 person-hours per plant under Alternative A. This effort equates to NRC labor costs of about \$485,000 per plant, and it assumes that the GEIS information is available to help reduce the effort needed to address many of the environmental issues.

Costs associated with the development of an updated Regulatory Guide and an updated Environmental Standard Review Plan have been included in the NRC costs presented in Table 1.

The NRC costs in Table 1 associated with Alternative A are estimated to be as much as \$41 million (3% discount rate, 100% of population applying for license renewal) or as little as \$8 million (7% discount rate, 25% of population applying for license renewal).

3.2.1.3 Total Alternative A 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 \$15 million to \$81 million. Per guidance from the Office of Management and Budget (OMB), the reference discount rate is taken to be 7%. If the further assumption is made that license renewal will be pursued for about 75% of the existing nuclear plant population, then the mean estimate for total costs under Alternative A is about \$43 million.

3.2.2 Alternative B Cost Impacts

The GEIS for nuclear plant license renewal groups the various potential environmental impacts into 89 issues. It classifies each such issue according to the two categories noted in Section 1.0. The GEIS identified 22 license renewal environmental impact issues classified as Category 2, and for which a plant-specific evaluation is required with the amended Part 51. Two additional issues are not categorized, but the responsibilities of the NRC and the applicant to address each issue are defined in the rule. A review of the Category 2 issues indicates that several apply only to certain types of plants. For example, in aquatic ecology three Category 2 and non-categorized issues apply only to plants with once-through heat dissipation systems and another three apply only to plants with cooling pond heat dissipation systems. The review of these 24 issues

indicates that, on average, the ER and EIS for a given nuclear plant will only have to address about 10-15 such issues. Also, with the amended Part 51 and the GEIS 68 issues are addressed on a generic basis (Category 1), and need not be addressed in individual license renewal applications or in the NRC's associated EISs. In addition to the significant reduction in the number of environmental issues that must be evaluated on a plant-specific basis with Alternative B, the GEIS information is assumed to reduce the effort needed to address and evaluate all such plant-specific issues.

Table 2 summarizes the estimated cost impacts to both industry and the NRC associated with Alternative B. The table values are based on the conservative assumption that each application for licensee renewal must address all 24 Category 2 and non-categorized issues. As with Table 1 for Alternative A, costs in Table 2 are shown for two discount rates and for several different fractions of the light water reactor power plant population seeking license renewal. Overall costs for both industry and the NRC are also displayed.

3.2.2.1 Industry Costs

Section 3.1 noted that 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 9,000 person-hours. This effort would reflect the broad scope of the ER with Alternative A, and allows for some benefit being taken for the GEIS. However, with Alternative B a maximum of 24 environmental issues would have to be evaluated on a plant-specific basis. The use of the information available in the GEIS should further reduce the effort associated with the preparation of an ER. The combination of relatively few plant-specific issues and the benefits derived from the GEIS result in an estimated licensee effort of about 4,200 person-hours per ER. The corresponding costs are about \$230,000 per license renewal application.

For the industry as a whole, assuming 112 plants apply for license renewal, the costs are estimated to be less than \$20 million for the range of conditions presented in Table 2.

The Alternative B industry cost estimates displayed in Table 2 exclude any costs associated with the issues of utility economics, need for power, cost-benefit balancing, and the uranium fuel cycle and solid waste management. The amended Part 51 excludes consideration of the first three of these issues and the fourth is treated generically. This approach with Alternative B considerably reduces licensee ER preparation efforts compared to that needed with Alternative A.

Table 2. Costs for Alternative B
(Cost in 10⁶ 1994 \$)

	Percentage of Population Applying for License Renewal	Discount Rate	
		3%	7%
Industry Costs	25	4.7	3.3
	50	9.4	6.6
	75	14.1	9.9
	100	18.8	13.1
NRC Costs	25	5.2	3.8
	50	9.9	7.1
	75	14.7	10.4
	100	19.4	13.7
Total Costs	25	9.9	7.1
	50	19.3	13.7
	75	28.7	20.3
	100	38.1	26.8

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Note that license renewal applicants will have to interact with State and non-NRC Federal agencies in addressing the economics-related issues excluded from the amended Part 51. However, such interactions would likely occur several years after the license renewal application submittal to the NRC for a given plant. This interaction with State and other Federal agencies is most likely to occur a few years in advance of the expiration of the plants original license, but not 12 years in advance as is assumed for the submittal to the NRC. Because conditions change with time, any earlier assessments of need for power, utility economics, and evaluation of alternatives as would be needed under the current Part 51 (Alternative A) would have to be reevaluated to reflect then-current conditions. Availability of earlier evaluations for such issues, therefore, is assumed to be of little value toward reducing the associated efforts by industry in interacting with State and non-NRC Federal agencies on these issues. Therefore, the efforts expended by licensees for the purposes of interacting with these non-NRC entities on issues of need for power, economics, cost-benefit balancing, evaluation of alternatives, etc. are considered to be roughly the same with both Alternatives A and B. Licensee efforts needed to address such issues with States and non-NRC Federal agencies are assumed to be incremental to any efforts associated with addressing these issues with the NRC to obtain a renewed license under the provisions of the current Part 51 requirements.

3.2.2.2 NRC Costs

Section 3.1 noted that the NRC's effort to review a comprehensive license renewal ER, and prepare the attendant EIS per the requirements of the current Part 51, is estimated to require on the order of 10,000 person-hours. With the reduced number of plant-specific issues to be addressed under the amended Part 51, and the benefit of the information available in the GEIS, the related NRC effort is estimated to about 4,200 hours per EIS. The associated costs are estimated to be about \$225,000 per ER review and EIS preparation. Total NRC costs with Alternative B are estimated to be less than \$20 million. This value includes the estimated effort needed to prepare a suitable RG and ESRP.

The proposed amendment to Part 51 includes provision for periodic reviews of Appendix B of the rule to assure that any new and significant

information on nuclear plant environmental impacts is factored into NRC license renewal evaluations. Each review is estimated to require about two staff years of effort. The costs associated with these periodic reviews of Appendix B have been included in the NRC costs shown in Table 2. Costs associated with the development of an updated Regulatory Guide and an updated ESRP are also included in the costs shown.

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.

3.2.2.3 Total Alternative B Costs

The totals shown in Table 2 indicate that the Alternative B combined costs to both industry and the NRC are estimated to be in the range of about \$7 million to \$38 million. The lower figure corresponds to a small fraction of the reactor population pursuing license renewal together with a high (7%) discount rate. The high figure corresponds to all plants seeking license renewal and a 3% discount rate. The values displayed for the 7% discount rate are judged to be most realistic, and for this scenario the costs range from about \$7 million to \$27 million.

3.3 Estimation of Values

Several values (benefits) are expected to result from the adoption of Alternative B. First, there are significant cost savings because of the improved efficiency with which environmental reviews for nuclear plant license renewal can be performed. This improved efficiency derives from the generic treatment of many issues which have been determined to have no significant impact on the environment. These issues would not be subject to staff review or adjudicatory resolution in individual license renewal proceedings. Significant resources would be saved by license renewal applicants, the NRC, and ultimately the public, by the generic treatment of these environmental issues. The proposed amendment to Part 51 requires the development of a plant-specific supplemental EIS, and makes provision for both public comment on each SEIS and for hearings. These provisions help assure comprehensive evaluation of license renewal

issues, and they assure that any new and significant information on particular issues will be factored into these evaluations.

The cost savings projected with the adoption of Alternative B are discussed in Section 4. Values other than cost savings expected with Alternative B are qualitative in nature. Nevertheless, they are highly important. Among the qualitative benefits are the following.

Enhanced stability and predictability of the licensing process should be achieved by the proposed amendment by providing regulatory criteria and requirements in discrete generic areas on matters that are significant in the review and approval of license applications. This stability and predictability should provide potential applicants with encouragement to seriously evaluate the license renewal option. These factors also promote the efficient functioning of the economy by reducing burdens on licensees and the NRC which might otherwise act as impediments to licensees pursuing license renewal.

The proposed amendment will enhance public understanding and confidence in the integrity of the

licensing process by providing for public participation in the assessment of important generic issues that are of concern to the agency and to the public. The final amendment incorporates numerous changes relative to the original proposed changes to Part 51, and these changes were made in response to public comments on the proposed amendment and the GEIS.

Alternative B eliminates any possible infringement by the NRC on States authority and that of other Federal agencies by removing from NRC's review aspects related to utility economics, need for power, cost-benefit balancing, and similar issues. The removal of these issues from NRC's review will potentially save resources both for the NRC and for the industry applicants for license renewal. In addition, it will eliminate efforts by the States and non-NRC Federal agencies, as well as the NRC, that might be associated with resolution of disagreements among these parties on the treatment and evaluation of these controversial issues. Cost savings associated with the avoidance of controversy-resolution efforts on the part of the NRC, other Federal agencies, or states have not been quantified because of the speculative nature of the need for such efforts.

4.0 Results - Incremental Values Associated with the Adoption of Alternative B

The overall results developed in this analysis of the proposed amendments of Part 51 are discussed below. Section 4.1 presents the differences in the costs between Alternatives A and B. Since the costs to both the NRC and industry are less with Alternative B than with Alternative A, the cost differences represent savings associated with the adoption of the proposed final amendments to Part 51. The display of estimated savings is presented in the same format as was used in Sections 3.2.1 and 3.2.2 for the individual alternatives.

Many of the input parameters used to estimate costs have considerable uncertainty associated with them. As part of these evaluations, an uncertainty evaluation was performed. Section 4.2 presents the results of this uncertainty evaluation. It provides "best estimates" of cost savings to the NRC and industry, as well as of the net value. Estimates are also provided of the 5th and 95th percentiles of the summary savings distributions.

Section 4.3 presents the results of sensitivity studies performed. The key sensitivity explored is that associated with the base efforts required by industry to prepare an updated ER and for the NRC to review the ER and prepare a supplemental EIS.

4.1 Industry and NRC Cost Savings with Alternative B

Nuclear plant license renewal 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 provides for treatment of certain environmental issues on a generic basis. The proposed changes to 10 CFR Part 51, 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 EISs by limiting the number of license renewal environmental issues which need to be considered on a plant-specific basis. The draft GEIS indicates that, of the total issues that must be addressed, the majority can be addressed on a generic basis. Alternative B, 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 \$21 million for a high percentage of the plant population seeking license renewal and a low discount rate, to about \$4 million if application is made for relatively few plants and a high discount rate prevails. Savings to the NRC due to the adoption of Alternative B range from about \$22 million to about \$5 million over the range of conditions noted. The combined savings to both industry and the NRC range from about \$43 million to \$8 million.

4.2 Best Estimates and Uncertainty Analysis

An uncertainty analysis was performed both to arrive at a best estimate of the savings anticipated with Alternative B and to characterize the overall uncertainty associated with the results. The uncertainty analysis utilized a Monte Carlo simulation with 10,000 trials of each parameter of interest. Table 4 lists the key parameters used in the analysis, their mean values and error factors, and the type of uncertainty distribution assumed for the simulations.

The uncertainties in this analysis derive from the simplifying assumptions embedded in the model as well as from the data limitations.

Where the value of a parameter is uncertain, the best estimate is the mean of all possible values, weighted by their relative likelihood. Formal uncertainty analysis requires that each best estimate be supplanted by a cumulative probability distribution for the possible values of the parameter. This "uncertainty distribution" indicates, for various possible values of the parameter, the probability that the actual value will not be greater. This could be expressed, for example, as a table of percentiles for that parameter. The 5th percentile and the 95th percentile would be low and high estimates; the actual value should fall between them 90% of the time. The 50th percentile would be the median; in the long run about half of the actual values would be lower than their median and half would be higher.

Results

**Table 3. Incremental Savings Associated With the Adoption of Alternative B
(Cost in 10⁶ 1994 \$)**

	Percentage of Population Applying for License	Discount Rate	
		3%	7%
Industry Savings	25	5.4	3.8
	50	10.7	7.5
	75	16.1	11.3
	100	21.4	15.0
NRC Savings	25	6.1	4.6
	50	11.3	8.2
	75	16.5	11.9
	100	21.7	15.5
Total Savings	25	11.4	8.3
	50	22.0	15.7
	75	32.5	23.1
	100	43.1	30.6

Table 4. Uncertainty Analysis Input Parameters and their Distribution Characteristics

Parameter	Mean Value	Error Factor	Assumed Distribution
Incremental No. of basic environmental issues to be addressed with Alt. A vs Alt. B	40	1.7	log normal
Incremental No. of moderately complex environmental issues to be addressed with Alt. A vs Alt. B	0	-	-
Incremental No. of complex environmental issues to be addressed with Alt. A vs Alt. B	4	1.6	log normal
Industry and NRC effort per basic issue, labor-hrs	20*	1.7	log normal
Industry and NRC effort per moderately complex issue, labor-hrs	150*	1.5	log normal
Industry and NRC effort per complex issue, labor-hrs	1,000	1.7	log normal
NRC labor rate, \$/hr (1994\$)	\$53.91**	1.1	log normal
Industry labor rate, \$/hr (1994\$)	\$54.66**	1.5	log normal
No. of license renewal applications submitted	70	1.5	uniform

*Efforts shown include benefits assumed from availability of GEIS information for low and moderately complex issues.

**Costs shown do not reflect present-worth effects.

Because many parameters cannot have negative values, uncertainty distributions tend to be skewed. The 95th percentile may be more than double the median when the 5th percentile cannot be negative. In such distributions, the instances of the actual value being above the median tend to increase the mean by more than the amount it is reduced by occasions when the actual value is below the median. Consequently, the mean of a such a parameter tends to be larger than the median.

The uncertainty distribution for the sum of two parameters is a convolution integral involving the uncertainty distributions for the separate parameters, provided that their uncertainties are not correlated. There is no simple procedure for estimating the parameters of the resulting distribution without considering the integral.

A log normal distribution was assumed for most of the parameters used in the uncertainty analysis. This distribution is such that the logarithm of the parameter has a normal distribution. One key variable, the number of license renewal applications submitted, was assumed to be characterized by a uniform distribution. A uniform distribution has equally likely values between a minimum and maximum and zero probability outside of the defined range. In this regard, the assumption of a minimum of 28 license renewal applications being submitted could be viewed as being optimistic. However, given the need for future generating capacity and the absence of technical issues that would make relicensing very difficult, this minimum number of submittals is deemed reasonable. Error factors are defined as the ratio of the 95th percentile value to the median or as the ratio of the median to the 5th percentile value. The error factors were estimated based on considerations of the range of reasonable values for each parameter of interest.

The estimates of labor efforts indicated in Table 4 are those associated with industry and NRC actions needed to address these issues on a plant specific basis. The labor rates displayed have not been adjusted to reflect the effects of the license renewal environmental reviews being spread out over a considerable time period. Figure 1 indicated that anticipated license renewal application submittals and the related review activity are expected to commence in 1997 and continue almost through 2025. To account for present worth effects of future efforts, a factor was developed based on the application submittal profile shown in Figure 1 and on a 7% discount rate. This factor was applied to the output of the Monte Carlo simulation.

The results of the uncertainty analysis are displayed in Table 5. This table presents the 5th percentile, mean value, and 95th percentile for the key output variables.

Table 5 indicates that the mean value or best estimate of savings to industry and the NRC with the adoption of the final amendment to Part 51 is about \$20 million. This figure represents the present worth of future savings associated with Alternative B relative to Alternative A, the no-action option. This figure also represents the Net Value of the proposed amendment to Part 51. The 5th and 95th percentile values indicate that the actual savings are expected to lie between \$9 million and \$36 million with a probability of 90%. The \$20 million estimated savings is very close to the value that would be obtained from the Total Savings values in Table 3 (7% discount rate), and assuming that 70 applications for license renewal are submitted (62.5% of applicable reactor population; $\$30.6\text{E}6 \times 0.625 = \$19.1\text{E}6$).

Table 5. Uncertainty Analysis Results (7% Discount Rate, 10^6 1994 \$)

	5th Percentile	Mean Value	95th Percentile
Industry Savings	3.7	9.4	19.0
NRC Savings	4.6	9.8	17.9
Net Value of Alt. B relative to Alt. A	8.6	19.2	36.4

Results

Note that in Table 5 the sum of the industry and NRC mean values for savings add up to the mean Net Value. The 5th and 95th percentile values for NRC and industry savings, however, are not expected to sum to the corresponding Net Value estimates.

4.3 Sensitivity Studies

This section discusses the effects of different elements that can be considered in defining costs of the two alternatives. The elements for which sensitivity evaluations were performed include (1) the effects of NRC regulatory development costs, and (2) environmental report and EIS preparation costs. Tables 1 through 3, presented previously, show the sensitivity of the projected costs and savings to variations in discount rate and in the number of license renewal applications submitted.

4.3.1 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, conduct public workshops on the proposed rule and draft GEIS, compile comments and develop responses, and perform related actions. These are

actions that have already been completed. The expenditures through April, 1995, by the NRC for these actions are estimated to be as follows:

NRC staff effort:	17 staff years
Staff labor costs:	\$1.8 million
Contractor support costs:	\$6.0 million

Thus, the NRC's total expenditures thus far on this rulemaking are about \$7.8 million. These are referred to as sunk costs.

Note that with both Alternatives A and B additional (future) costs will be incurred by the agency in the development of the updated Regulatory Guides and updated ESRP needed. The effects of these future costs were already included in the estimates shown in Tables 1 through 3.

Table 6 shows the impact on projected savings with Alternative B when the expenditures for NRC's regulation development are included in the assessment. Values are shown for both 3% and 7% discount rates. The evaluation of the effects of sunk costs assumed that the \$7.8 million was uniformly spent over the period from 1988 through 1994. The annual expenditures were future-valued at the specified discount rates. The effects of these future valued sunk cost expenditures are included in Table 6.

Table 6. Sunk Cost Effects on Estimated Net Savings Associated With Alternative B
(Cost in 10⁶ 1994 \$)

Percentage of Population Applying for License Renewal		Discount Rate	
		3%	7%
Industry Savings	25	5.4	3.8
	50	10.7	7.5
	75	16.1	11.3
	100	21.4	15.0
NRC Savings	25	-2.3	-4.7
	50	2.9	-1.1
	75	8.1	2.6
	100	13.3	6.2
Total Savings	25	3.0	-1.0
	50	13.6	6.4
	75	24.1	13.8
	100	34.7	21.3

The values shown in Table 6 include the effects of both the NRC's sunk costs and the differences in future development costs between Alternatives A and B for the updated Regulatory Guides and updated ESRPs. The figures indicate that 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 3% discount rate, the overall savings range from about \$6 million to about \$35 million, depending on the number of plants seeking license renewal. At the higher discount rate the savings decreases for Alternative B relative to Alternative A, but net savings are still anticipated.

Even under the conditions of one-half of the reactor population applying for license renewal and a higher discount rate (7%) Alternative B remains less costly than Alternative A, including consideration given to the greater regulation development costs of Alternative B.

4.3.2 Sensitivity to Environmental Report and EIS Preparation Efforts

Table 7 explores the sensitivity of the cost results to the level of effort required to prepare and review the necessary environmental impact documents. 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 the NRC's regulation development costs. The development costs are assumed to remain fixed, regardless of the base ER/EIS preparation efforts required. As indicated in Table 7, 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.

**Table 7. Sensitivity of Cost Savings to ER and EIS Preparation Effort Requirements
(7% Discount Rate, Costs in 10⁶ 1994 \$)**

Savings with Alternative B Relative to Alternative A				
	Percentage of Population Applying for License Renewal	0.5 x Base Case	Base Case	1.5 x Base Case
Industry Savings	25	1.9	3.8	5.6
	50	3.8	7.5	11.3
	75	5.6	11.3	16.9
	100	7.5	15.0	22.6
NRC Savings	25	2.7	4.6	6.4
	50	4.6	8.2	11.9
	75	6.4	11.9	17.4
	100	8.2	15.5	22.8
Total Savings	25	4.6	8.3	12.0
	50	8.3	15.7	23.1
	75	12.0	23.1	34.3
	100	15.7	30.6	45.4

5.0 Decision Rationale

Adoption of the proposed rule would minimize the costs of evaluating the environmental impacts caused by extending the operational licenses of commercial nuclear power reactors. There are no other quantifiable values or impacts associated with the proposed final amendment to 10 CFR Part 51. However, there are several qualitative benefits anticipated 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 has been reached on the acceptability of the impacts for all affected plants. In addition, the proposed rule eliminates from NRC's review several issues related to utility economics, cost-benefit balancing, and need for power. Overall industry savings are estimated to range from a high of about \$21 million to a low of about \$4 million, depending on the percentage of the plant population seeking license renewal and the discount rates applicable. The best estimate of industry savings, assuming a 7% discount rate, is \$9 million. Cost savings to individual applicants for license renewal are estimated to be about \$250,000. Total NRC savings due to the adoption of Alternative B range from about \$4 million to about \$19 million over the range of conditions noted, with the best estimate being \$10 million (7% discount rate).

Considering the costs to both industry and the NRC, the total cost savings with Alternative B range from \$7 million to \$38 million. With the use of the 7% discount rate as recommended by OMB, the best estimate of total savings is \$19 million.

Values other than cost savings expected with Alternative B are qualitative in nature. Among the qualitative benefits are the following.

Enhanced stability and predictability of the licensing process should be achieved by the proposed amendment by providing regulatory criteria and requirements in discrete generic areas on matters that are significant in the review and approval of license applications. This stability and predictability should provide potential applicants with encouragement to seriously evaluate the license renewal option. These factors also promote the efficient functioning of the economy by reducing burdens on licensees and the NRC which might otherwise act as impediments to license renewal.

The proposed amendment will enhance public understanding and confidence in the integrity of the licensing process by providing for public participation in the assessment of important generic issues that are of concern to the agency and to the public. The final amendment incorporates numerous changes relative to the original proposed changes to Part 51, and these changes were made in response to public comments on the proposed amendment and the GEIS.

Alternative B eliminates any possible infringement by the NRC on States authority and that of other Federal agencies by removing from NRCs review aspects related to utility economics, need for power, cost-benefit balancing, and similar issues. The removal of these issues from NRC's review will save resources both for the NRC and for the industry applicants for license renewal. In addition, it will eliminate efforts by the States and non-NRC Federal agencies, as well as the NRC, that might be associated with resolution of disagreements among these parties on the treatment and evaluation of these controversial issues.

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

6.0 Implementation

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 earliest applications for license renewal are expected in the 1996-98 time frame. The earliest applicants may not be able to benefit from the GEIS and the amended Part 51, depending on their schedule for preparing the required ER and timing of final changes to Part 51. Significant public participation has already occurred on this

rulemaking and has resulted in important modifications to the proposed rule. These changes are reflected in the final amendment. This public participation and input, together with the changes made to the amendment, help assure that all policy, institutional and legal considerations have been resolved. Enforceability of the amended 10 CFR Part 51 will be no different than enforcement of the regulations of the existing 10 CFR 51.

References

1. NUREG-1437, Vols. 1 and 2 (draft for comment), "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," U.S. Nuclear Regulatory Commission, August 1991.
2. NUREG-0499, "Preliminary Statement on General Policy for Rulemaking to Improve Nuclear Power Plant Licensing," U.S. Nuclear Regulatory Commission, December, 1978.
3. NUREG/CR-4627, Rev. 1 "Generic Cost Estimates: Abstracts From Generic Studies for Use in Preparing Regulatory Impact Analyses," U.S. Nuclear Regulatory Commission, February 1989.
4. NUREG-1362 (draft for comment), "Regulatory Analysis for Proposed Rule on Nuclear Power Plant License Renewal," U.S. Nuclear Regulatory Commission, July 1990.

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

THIS REGULATORY ANALYSIS PROVIDES THE SUPPORTING INFORMATION FOR A RULE THAT AMENDS THE NUCLEAR REGULATORY COMMISSION'S REQUIREMENTS FOR ENVIRONMENTAL REIEW 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 CODIFIED IN 10 CFR PART 51. THE STAFF HAS SELECTED ALTERNATIVE B AS THE PREFERRED ALTERNATIVE.

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