Regulatory Analysis for the Final Rule: 10 CFR Part 51, Renewing Nuclear Power Plant Operating Licenses—Environmental Review

NRC-2018-0296; RIN 3150-AK32

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

Month Year

ML23205A029

ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) is amending Part 51 of Title 10 of the *Code of Federal Regulations* (10 CFR) "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." This regulatory analysis evaluates the costs and benefits of the rule and implementing guidance relative to the baseline case, the "no action" alternative. The amendments include updates to Table B-1, "Summary of Findings on NEPA [National Environmental Policy Act] Issues for License Renewal of Nuclear Power Plants," in Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," to Part 51 of Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," to align with recent Commission decisions regarding the NEPA analysis of subsequent license renewal (SLR) applications. NUREG-1437, Revision 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (2013 LR GEIS) (NRC, 2013a), provides the technical and regulatory bases for Table B-1. The final rule updates the 2013 LR GEIS, Table B-1, and associated guidance to clearly address the environmental impacts of nuclear power plant SLR; remove the word "initial" from 10 CFR 51.53(c)(3); and make conforming changes to 10 CFR 51.53(c)(3)(ii) and 10 CFR 51.95(c).

EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) is amending Part 51 of Title 10 of the *Code of Federal Regulations* (10 CFR) "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Under the NRC's regulations in 10 CFR Part 51, the renewal of a nuclear power plant operating license requires the preparation of an environmental impact statement (EIS). NUREG-1437, Revision 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (2013 LR GEIS) (NRC, 2013a), provides the technical and regulatory bases for the summary of findings on environmental issues in Table B-1, "Summary of Findings on NEPA [National Environmental Policy Act] Issues for License Renewal of Nuclear Power Plants," in Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," to Part 51 of Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)."

In Commission Order CLI-22-03 (NRC, 2022a) and recent decisions related to Turkey Point Nuclear Generating in CLI-22-02 (NRC, 2022b) and Peach Bottom Atomic Power Station in CLI-22-04 (NRC, 2022c), the Commission determined that the 2013 LR GEIS and Table B-1 did not address subsequent license renewal (SLR). The Commission also found that 10 CFR 51.53(c)(3) only applies to applicants for initial license renewal (initial LR). The final rule updates the 2013 LR GEIS, Table B-1, and associated guidance to clearly address the environmental impacts of SLR; remove the word "initial" from 10 CFR 51.53(c)(3); and make conforming changes to 10 CFR 51.53(c)(3)(ii) and 10 CFR 51.95(c).

This regulatory analysis evaluates the costs and benefits of the final rule, including implementing guidance (Alternative 2), relative to the baseline case, the "no action" alternative.

The NRC staff has made the following key findings:

- Rule Analysis: The final rule would result in an annual average benefit of $12.5 million. Error: Reference source not found and Error: Reference source not found show the net costs and benefits incurred over 10 years. Error: Reference source not found shows the total costs and benefits of the final rule for each entity affected by the rule. Error: Reference source not found shows the total costs and benefits of the final rule to industry and the NRC for each type of licensee group affected by the rule.Error: Reference source not found

Table ES-1 Total Costs and Benefits for Alternative 2

Entity	Total (2023 dollars)[a]		
	Undiscounted	7% NPV[b]	3% NPV
Industry	$89,491,000	$60,971,000	$74,996,000
NRC	$35,996,000	$24,604,000	$30,209,000
Net Benefit (Cost)	**$125,487,000**	**$85,575,000**	**$105,205,000**

[a] Values rounded to the nearest thousand dollars.

[b] Net present value (NPV)

Table ES-2 Total Costs and Benefits by Licensee Group for Alternative 2

Licensee Group	Total (2023 dollars)[a, b]		
	Undiscounted	**7% NPV**	**3% NPV**
Initial LR	($201,000)	($99,000)	($147,000)
Future SLR	$128,816,000	$88,412,000	$108,302,000
Near-term and Submitted Applications, and Issued Subsequently Renewed Licenses	($3,128,000)	($2,738,000)	($2,951,000)
Net Benefit (Cost)	**$125,487,000**	**$85,575,000**	**$105,204,000**

[a] Values rounded to the nearest thousand dollars.

[b] Implementation costs were allotted based on the projected number of affected license renewal applications submitted by that group.

- Nonquantified Benefits: Based upon the assessment of total costs and benefits, the NRC concludes that the rule, if issued, would continue to ensure adequate consideration of the environmental impacts associated with license renewal while increasing regulatory clarity in the license renewal process. The revised rule would result in a more consistent implementation of the NRC's regulatory program and Federal environmental statutes and regulations. Additionally, the rule would ensure that the NRC's license renewal program fully accounts for SLR.

- Uncertainty Analysis: The regulatory analysis contains a Monte Carlo simulation analysis that shows the mean net benefit for this final rule is $86 million, with 90 percent confidence that the net benefit is between $69 million and $102 million using a 7 percent discount rate. The amount of time for licensees to perform an environmental analysis for new Category 2 issues is the factor responsible for the largest variation in averted costs, followed by the amount of time for the NRC to review the environmental analyses for new Category 2 issues.

- Decision Rationale: Relative to Alternative 1, the no action baseline, the NRC concludes that the rule is justified from a quantitative standpoint because its provisions will result in net averted costs (i.e., net benefits) to industry and the NRC. In addition, the NRC concludes that the rule is also justified when considering nonquantified costs and benefits because the significance of the nonquantified benefits (i.e., improvements in the quality of the information provided to the NRC, regulatory clarity, and NRC compliance with Federal environmental statutes and regulations) outweighs the nonquantified costs.

- Implementation. The NRC expects that the final rule would be effective in 2024. However, compliance with the final rule will be required within a year after publication in the *Federal Register*. In addition to the 2013 LR GEIS, the NRC would correspondingly update the applicable guidance documents: Regulatory Guide 4.2, Supplement 1, Revision 1, "Preparation of Environmental Reports for Nuclear Power Plant License

Renewal Applications" (NRC, 2013b), and NUREG-1555, Supplement 1, Revision 1, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Operating License Renewal" (NRC, 2013c). The NRC plans to issue the revised guidance with the final rule.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

AEA	Atomic Energy Act of 1954, as amended
BLS	Bureau of Labor Statistics (U.S. Department of Labor)
CFR	*Code of Federal Regulations*
CPI-U	consumer price index for all urban consumers
EIS	environmental impact statement
EMF	electromagnetic field
FR	*Federal Register*
gpm	gallons per minute
LR	license renewal
LR GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants
NEPA	National Environmental Policy Act
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
OMB	U.S. Office of Management and Budget
PERT	program evaluation and review technique
ROW	right-of-way
SEIS	supplemental environmental impact statement
SLR	subsequent license renewal
SOC	standard occupational classification
SRM	staff requirements memorandum

1 STATEMENT OF PROBLEM AND OBJECTIVE

The U.S. Nuclear Regulatory Commission (NRC) is amending its environmental regulations for the renewal of nuclear power plant operating licenses, including Table B-1, "Summary of Findings on NEPA [National Environmental Policy Act] Issues for License Renewal of Nuclear Power Plants," in Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," to Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," and making conforming changes in 10 CFR 51.53(c)(3)(ii) and 10 CFR 51.95(c).[1] (Hereafter, this document will refer to this table simply as "Table B-1.") Under the NRC's regulations in 10 CFR Part 51, which implement the National Environmental Policy Act of 1969, as amended (NEPA),[2] the renewal of a nuclear power plant operating license requires the preparation of an environmental impact statement (EIS).

To support the preparation of license renewal EISs, the NRC conducted a comprehensive review to identify the common environmental effects of license renewal. The review determined which environmental effects could result in the same (generic) impacts at all nuclear power plants (or a subset of plants) and which effects could result in different levels of impact, requiring nuclear plant-specific analyses for an impact determination. The review culminated in the issuance of NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants (1996 LR GEIS) (NRC, 1996), followed by the publication in the *Federal Register* (FR) on June 5, 1996 (61 FR 28467) of the final rule that codified the 1996 LR GEIS findings.

The introduction to Appendix B to Subpart A of 10 CFR Part 51 states that, on a 10-year cycle, the Commission intends to review the material in Appendix B, including Table B-1, and update it if necessary. The previous revision cycle was completed with the issuance of a final rule (78 FR 37281) and the LR GEIS, Revision 1 (2013 LR GEIS), on June 20, 2013 (NRC, 2013a). The 2013 LR GEIS provides the technical and regulatory bases for the current Table B-1. The LR GEIS, Revision 2 (revised LR GEIS), provides the technical and regulatory bases for the final rule.

In Commission Order CLI-22-03 (NRC, 2022a) and recent decisions related to Turkey Point Nuclear Generating in CLI-22-02 (NRC, 2022b) and Peach Bottom Atomic Power Station in CLI-22-04 (NRC, 2022c), the Commission determined that the 2013 LR GEIS and Table B-1 did not address subsequent license renewal (SLR). Additionally, the Commission found that 10 CFR 51.53(c)(3) only applies to applicants for initial license renewal (initial LR).

1 This rule would also remove the word "initial" from 10 CFR 51.53(c).

2 [2]NEPA requires Federal agencies to analyze the environmental effects of their proposed actions before deciding whether to approve or disapprove the proposed action.

The final rule redefines the number and scope of the environmental issues in Table B-1 that must be addressed by the NRC and applicants during plant-specific license renewal environmental reviews based on changes in the revised LR GEIS. The final rule updates the 2013 LR GEIS to also apply to SLR. It also codifies the lessons learned, knowledge gained, and experience from license renewal environmental reviews performed since development of the 2013 LR GEIS and incorporate changes in environmental regulations, impact methodology, and other new information.

This regulatory analysis evaluates the final rule and one alternative, the "no action" alternative, for which the NRC would not conduct rulemaking but continue to regulate the renewal of nuclear power plant operating licenses using existing NEPA implementing regulations. The no action alternative is the baseline against which the proposed action is compared.

1.1 Description of the Proposed Action

The proposed action is to update the 2013 LR GEIS and the environmental issues in Table B-1 to address the impacts of initial LR and SLR. The rule would also remove the word "initial" from 10 CFR 51.53(c)(3) and make conforming changes in 10 CFR 51.53(c)(3)(ii) and 10 CFR 51.95(c). Additionally, the rule would address recent changes to environmental laws, executive orders, and regulations.

Specifically, the proposed action would redefine the number and scope of the environmental issues that must be addressed by the Commission in conjunction with the review of license renewal applications (initial LR or SLR). The associated draft revised LR GEIS identified 80 environmental issues, 20 of which require a plant-specific analysis. The following summarizes the types of changes to Table B-1 (as enumerated in Appendix A to this analysis):

- One Category 2 issue, "Groundwater quality degradation (plants with cooling ponds at inland sites)" and a related Category 1 issue, "Groundwater quality degradation (plants with cooling ponds in salt marshes)," were consolidated into a single Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)."

- Two related Category 1 issues, "Infrequently reported thermal impacts (all plants)" and "Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication," and the thermal effluent component of the Category 1 issue, "Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses," were consolidated into a single Category 1 issue, "Infrequently reported effects of thermal effluents."

- One Category 2 issue, "Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)," and the impingement component of a Category 1 issue, "Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses," were consolidated into a single Category 2 issue, "Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)."

- One Category 1 issue, “Impingement and entrainment of aquatic organisms (plants with cooling towers),” and the impingement component of a Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” were consolidated into a single Category 1 issue, “Impingement mortality and entrainment of aquatic organisms (plants with cooling towers).”

- One Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” was divided into three Category 2 issues: (1) “Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife Service jurisdiction,” (2) “Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction,” and (3) “Magnuson-Stevens Act: essential fish habitat.”

- Two new Category 2 issues, “National Marine Sanctuaries Act: sanctuary resources” and “Climate change impacts on environmental resources,” were added.

- One Category 2 issue, “Severe accidents,” was changed to a Category 1 issue.

- One new Category 1 issue, “Greenhouse gas impacts on climate change,” was added.

The NRC does not propose to eliminate any environmental issues identified in Table B-1 and evaluated in the 2013 LR GEIS.

Under the proposed action, with the final rule, in addition to updating the 2013 LR GEIS, the NRC would revise the guidance in Regulatory Guide 4.2, Supplement 1, Revision 1, “Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications,” (NRC, 2013b), and NUREG 1555, Supplement 1, Revision 1, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Operating License Renewal,” (NRC, 2013c). The staff uses these guidance documents to evaluate license renewal applications, to conduct plant-specific environmental reviews, and to assist applicants in the preparation of environmental reports as part of their license renewal applications.

1.2 Need for the Proposed Action

The regulations in 10 CFR Part 51 state that the Commission intends to review Table B-1, along with technical supporting documentation (NUREG-1437), on a 10-year cycle and update if necessary. The LR GEIS and Table B-1 have been effective in focusing license renewal environmental reviews on important issues and concerns at each nuclear power plant site, thus increasing the overall efficiency of the NRC’s environmental review and in meeting its NEPA compliance responsibilities. The last rule that amended Table B-1 was published in 2013, along with the 2013 LR GEIS.

The current rulemaking began when the NRC issued a notice of intent to review and potentially update the 2013 LR GEIS. In July 2021, the staff submitted SECY-21-0066, “Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—Environmental Review

(RIN 3150-AK32; NRC-2018-0296)" (NRC, 2021a), to request Commission approval to initiate a rulemaking to amend Table B-1 and update the 2013 LR GEIS and associated guidance. The rulemaking plan also proposed to remove the word "initial" from 10 CFR 51.53(c)(3) and make corresponding changes to the LR GEIS and associated guidance to include applicability to SLR.

In February 2022, the Commission issued Staff Requirements Memorandum (SRM)-SECY-21-0066, "Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses – Environmental Review (RIN 3150-AK32; NRC-2018-0296)" (NRC, 2022d), disapproving the staff's recommendation and directing the staff to develop a rulemaking plan that aligned with Commission Order CLI-22-03 and recent decisions in CLI-22-02 and CLI-22-04 regarding the NEPA analysis of SLR applications. The SRM also directed the staff to (1) proceed with rulemaking to amend Table B-1, (2) remove the word "initial" from 10 CFR 51.53(c)(3), (3) update the 2013 LR GEIS, (4) conduct a thorough analysis of the environmental impacts of SLR to expand the applicability of the LR GEIS, and (5) consider changes to applicable laws and regulations, new data, and experience in conducting similar environmental reviews.

In March 2022, the staff submitted SECY-22-0024, "Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—Environmental Review (RIN 3150-AK32; NRC-2018-0296)" (NRC, 2022e), to request Commission approval to initiate a rulemaking that would align with the Commission Order CLI-22-03, and recent decisions in CLI-22-02, and CLI-22-04.

In April 2022, the Commission issued SRM-SECY-22-0024, "Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—Environmental Review (RIN 3150-AK32; NRC-2018-0296)" (NRC, 2022f), approving the staff's recommendation to proceed with the rulemaking.

Revisions to the 2013 LR GEIS would consider (1) lessons learned and experience gained during previous license renewal reviews conducted since development of the 2013 LR GEIS, and (2) new research, findings, and other information when evaluating the significance of impacts associated with initial LR and one term of SLR. The purpose of this evaluation is to review the findings presented in the 2013 LR GEIS and to ensure that the analysis and assumptions apply to SLR. In doing so, the NRC considered the need to modify, add, or delete any of the environmental issues in the 2013 LR GEIS and codified in Table B-1.

1.3 Existing Regulatory Framework

As mandated by the Atomic Energy Act of 1954, as amended (AEA), the NRC is responsible for protecting public health and safety in the civilian use of nuclear power. The AEA allows the NRC to issue licenses for commercial nuclear power reactors to operate for up to 40 years. The NRC's regulations allow for the renewal of these licenses, with the renewal term including the number of years remaining on the operating license currently in effect plus an additional 20 years. The approval or disapproval of the license renewal application is based on an NRC determination as to whether the nuclear facility can continue to operate safely during the

20-year period of extended operation and whether 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. The term of any renewed license may not exceed 40 years. No specific limitations exist in the AEA or in the NRC's regulations on the number of times a power reactor operating license may be renewed.

Under the NRC's NEPA implementing regulations in 10 CFR Part 51, renewal of a nuclear power plant operating license requires the preparation of an EIS. In this regard, the NRC prepares a supplemental EIS (SEIS) to the LR GEIS for each license renewal application. The primary purpose of the LR GEIS is to identify all environmental issues for license renewal and evaluate those environmental impacts considered to be generic to all nuclear power plants, or a subset of plants. The LR GEIS also identifies issues that need to be addressed in plant-specific environmental reviews for nuclear power plant license renewals, as documented in plant-specific SEISs.

The environmental issues evaluated in the LR GEIS and listed in Table B-1 are characterized as either Category 1, Category 2, or uncategorized. Category 1 issues are considered generic, as the impacts have been found to be essentially the same or similar at all, or a subset of, nuclear plants. Category 1 issues are not reevaluated in nuclear power plant-specific environmental reviews absent new and significant information. Category 2 issues are required to be addressed in each nuclear power plant-specific environmental review. Table B-1 summarizes the findings in the LR GEIS on environmental issues for license renewal of nuclear power plants.

Additionally, to support the staff's environmental review, license renewal applicants must prepare an environmental report under 10 CFR 51.53(c). That section directs applicants for initial LR to analyze Category 2 issues and rely on Table B-1 and the LR GEIS for Category 1 issues. The staff uses the information in that environmental report to analyze Category 2 issues in a plant-specific SEIS to the LR GEIS.

2 IDENTIFICATION AND PRELIMINARY ANALYSIS OF ALTERNATIVE APPROACHES

The NRC analyzed one alternative to the rule, as described in this section.

2.1 Alternative 1: No Action Alternative

The no action alternative maintains the status quo. Under the no action alternative, the NRC would not amend certain provisions of 10 CFR Part 51 relating to the renewal of nuclear power plant licenses, including Table B-1. This alternative serves as the baseline for this analysis.

Initial LR

Under Alternative 1, the NRC would continue to rely upon the findings set forth in the current Table B-1 when determining the scope and magnitude of environmental impacts of an initial operating license renewal for a nuclear power plant. Licensees seeking an initial operating license renewal would continue to comply with the existing provisions of 10 CFR Part 51. This alternative would result in no new direct costs to the NRC or licensees seeking an initial LR.

Future SLR[3]

In accordance with the Commission Order CLI-22-03, Alternative 1 would not address the environmental impacts of renewing the operating license of a nuclear power plant for SLR. This alternative would result in additional costs to the NRC and licensees seeking a future SLR for evaluating all environmental impacts as plant-specific issues.

Near-Term[4] *and Submitted Applications, and Issued*[5] *Subsequently Renewed Licenses*

In accordance with the Commission Orders CLI-22-02 and CLI-22-04, for licensees seeking a near-term SLR or licensees that have submitted an application for an SLR or received an SLR, Alternative 1 would require the evaluation of all environmental issues as plant-specific. This alternative would result in additional costs to the NRC and licensees.

3 Future SLR refers to SLR applications submitted after the rule becomes effective.

4 Near-term SLR refers to SLR applications submitted before the effective date of the rule.

5 At present, three operating nuclear power plants have received subsequently renewed licenses. In accordance with the Commission Orders CLI-22-02 and CLI-22-04, licenses for two of the three operating nuclear power plants with subsequently renewed licenses are reset to expire at the end of the initial period of extended operation. This was affirmed by the Commission Orders CLI-22-06 (NRC, 2022g) and CLI-22-07 (NRC, 2022h). This direction will hold until either (1) the NRC issues the revised LR GEIS and rule or (2) the staff completes a plant-specific EIS that considers the impacts of nuclear power plant operations during the SLR period, which includes consideration of an applicant's revised environmental report that addresses environmental impacts during the SLR period. The remaining operating nuclear power plant requires no additional action at present and is unaffected by the rule.

2.2 Alternative 2: Rulemaking to Amend 10 CFR Part 51

Under Alternative 2, the NRC would issue a final rule that would establish new, and amend existing, provisions of 10 CFR Part 51 relating to the renewal of nuclear power plant licenses, including Table B-1. Changes include updating all issues in the current Table B-1 to fully account for SLR and are based on the findings described in the revised LR GEIS. The rule includes new, consolidated, and revised Category 1 and 2 issues based on lessons learned, knowledge gained, and experience from license renewal environmental reviews performed since development of the 2013 LR GEIS. The rule also incorporates changes in environmental regulations, impact methodology, and other new information. The rule clarifies issue titles and the scope and resources considered for issue findings.

The rule would apply to all nuclear power plant license renewal applicants and benefit future SLR applicants. Error: Reference source not found in Appendix A to this regulatory analysis presents the changes to the issues and findings in Table B-1 that would result in quantifiable costs and benefits.

3 ESTIMATION AND EVALUATION OF COSTS AND BENEFITS

This section examines the costs and benefits expected to result from the NRC's rule. All costs and benefits are monetized, when possible. The total costs and benefits are then summed to determine whether the difference between the costs and benefits results in a positive benefit. In some cases, costs and benefits are not monetized because meaningful quantification is not possible.

3.1 Identification of Affected Attributes

This section identifies the components of the public and private sectors, commonly referred to as attributes, that are expected to be affected by Alternative 2, the rulemaking alternative, identified in Section 2. Alternative 2 would apply to all NRC applicants renewing their nuclear power reactor(s) operating license. The staff developed an inventory of the impacted attributes using the list in NUREG/BR-0058, draft Revision 5, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," issued January 2020 (NRC, 2020).

The rule would affect the attributes described below.

3.1.1 *Industry Implementation*

This attribute accounts for the projected net economic effect on the industry of implementing the regulatory action for all affected licensees. Under this action, the industry would review the regulations and update its processes and procedures, as necessary.

3.1.2 *Industry Operation*

This attribute accounts for the projected net economic effect on all affected licensees caused by routine and recurring activities required by Alternative 2. Under Alternative 2, licensees would incur costs and benefits resulting from the environmental issues and findings in Table B-1.

3.1.3 *NRC Operation*

This attribute accounts for the projected net economic effect on the NRC caused by routine and recurring activities required by Alternative 2. Under Alternative 2, the NRC would incur costs and benefits resulting from the environmental issues and findings in Table B-1.

3.1.4 *Improvements in Knowledge*

This attribute accounts for the potential value of new information resulting from the implementation of Alternative 2 compared to Alternative 1. Alternative 2 would codify the lessons learned, knowledge gained, and experience from license renewal environmental

reviews performed since development of the 2013 LR GEIS and incorporate changes in environmental regulations, impact methodology, and other new information.

3.1.5 *Regulatory Clarity*

This attribute accounts for regulatory clarity resulting from the implementation of Alternative 2 compared to Alternative 1. Alternative 2 would update the applicability of the revised LR GEIS, Table B-1, and the associated guidance to SLR.

3.1.6 *Environmental Considerations*

This attribute accounts for the consideration of environmental impacts of Federal actions that affect the human environment. Many NRC regulatory actions are handled through an EIS that considers the environmental impacts (both negative and beneficial) from the proposed licensing action. This regulatory action updates Table B-1 and makes other conforming changes in 10 CFR Part 51, which will improve the quality of the environmental information provided to the NRC and facilitate license renewal environmental reviews performed for power reactor license renewal. The discussions of the attributes in Sections 3.1.1–3.1.3 analyze the impacts of these changes.

3.1.7 *Attributes with No Effects*

The following attributes are not expected to contribute to the results under any of the alternatives:

- NRC Implementation
- Public Health (Accident)
- Public Health (Routine)
- Occupational Health (Accident)
- Occupational Health (Routine)
- Offsite Property
- Onsite Property
- Other Government Entities
- General Public
- Safeguards and Security Considerations
- Other Considerations

3.2 Analytical Methodology

This section describes the process used to evaluate costs and benefits associated with Alternative 2. The benefits include any desirable changes in affected attributes (e.g., monetary savings). The costs include any undesirable changes in affected attributes (e.g., monetary costs).

Of the six affected attributes, the analysis quantitively evaluates three attributes—industry implementation, industry operation, and NRC operation. Quantitative analysis requires a baseline characterization of the affected society, including factors such as the number of affected entities, the nature of the activities currently performed, and the types of systems and procedures that applicants would consider or would no longer implement because of the proposed alternatives. Where possible, the NRC calculated costs for these attributes using distributions to quantify the uncertainty in these estimates. The individual sections for each of the provisions include the detailed cost tables used in this regulatory analysis. The NRC evaluated the remaining attributes qualitatively because the benefits relating to regulatory efficiency are not easily quantifiable or because the data necessary to quantify and monetize the impacts of these attributes are not available.

3.2.1 *Regulatory Baseline*

This regulatory analysis measures the incremental costs of the rule relative to a baseline that reflects anticipated behavior if the NRC does not undertake any regulatory action. As part of the regulatory baseline used in this analysis, the staff assumes full licensee compliance with existing NRC regulations. Section 4 of this regulatory analysis presents the estimated incremental costs and benefits of the alternatives compared to this baseline. This regulatory baseline is the no action alternative (i.e., Alternative 1).

3.2.2 *Affected Entities*

The licensees for all 54 operating nuclear power plant sites can apply for license renewal. The licensees for 50 operating nuclear power plants sites have already received an initial 20 -year operating license extension from the NRC. Three operating nuclear power plants sites have received subsequently renewed licenses. Table A-3 includes the timing of the estimated initial LR and SLR submittals for each operating plant.

The analysis estimates the number of initial LR applications, future SLR applications, and near-term and submitted applications, and issued subsequently renewed licenses as follows:

- The NRC is currently reviewing six SLR applications.
- Based on letters of intent, approved timely renewal exemptions, and discussions with licensees, the NRC anticipates receiving two SLR applications through fiscal year 2024.
- As a result of Commission Orders CLI-22-02, CLI-22-04, CLI-22-06, and CLI-22-07, two of the three operating nuclear power plants sites with subsequently renewed licensees have been reset to the end of the initial period of extended operation. The remaining operating nuclear power plant site with an SLR would require no additional action.
- Some operating nuclear power plant sites will become eligible for a subsequent 20-year license extension after fiscal year 2024 (e.g., 60 to 80 years). The NRC expects to

receive an estimated 43 SLR applications during fiscal year 2025 through fiscal year 2035.

- The NRC estimates that it will receive a total of 44 license renewal applications (including initial LR and SLR applications) in the 10-year cycle following the effective date of the rule, as shown in Error: Reference source not found. Currently, sufficient data do not exist to support estimates on license renewal applications beyond 2035.

Table 1 Affected License Renewal Applicants[6]

Calendar Year	Initial LR[a]	Future SLR	Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses	Total License Renewal Applications[b, c]
2025	0	13	10	23
2026	0	2		2
2027	0	2		2
2028	0	1		1
2029	0	0		0
2030	0	1		2
2031	0	1		1
2032	0	2		2
2033	0	2		2
2034	0	5		5
2035	1	4		5
Total Applications	**1**	**33**	**10**	**44**

[a] When this regulatory analysis was prepared, Diablo Canyon Power Plant Units 1 and 2 were scheduled to cease operation in 2024 and 2025, respectively, and therefore are not included in this analysis.

[b] This analysis assumes licensees will submit a license renewal application, which may cover multiple units, as shown in Table A-3.

[c] Advanced nuclear reactors are excluded from this analysis but are considered in the "Regulatory Analysis for the 10 CFR Part 51, Advanced Nuclear Reactor Generic Environmental Impact Statement Proposed Rule," dated December 14, 2021 (NRC, 2021b).

3.2.3 *Base Year*

All monetized costs are expressed in 2023 dollars. The staff expects the NRC to incur implementation costs to prepare and issue a final rule and guidance in 2024. Ongoing operation costs related to Alternative 2 are assumed to begin no earlier than 30 days after publication of the final rule in the *Federal Register*, unless otherwise stated, and are modeled on an annual cost basis. Estimates are made for recurring annual operating expenses. The values for annual operating expenses are modeled as a constant expense for each year of the 10-year analysis horizon. The staff performed a discounted cash flow calculation to discount these annual expenses to 2023 dollar values.

6 Data in Table 1 are current as of September 28, 2023.

3.2.4 *Discount Rates*

In accordance with guidance from Office of Management and Budget (OMB) Circular A-4, "Regulatory Analysis," issued September 2003 (OMB, 2003), and NUREG/BR-0058, net present value (NPV) calculations are used to determine how much society would need to invest today to ensure that the designated dollar amount is available in a given year in the future. Using NPV calculations, costs and benefits are valued to a reference year for comparison, regardless of when the cost or benefit is incurred in time. Based on the 2003 OMB Circular A-4 and consistent with NRC practice and guidance, present-worth calculations in this analysis use 3 percent and 7 percent real discount rates. A 3 percent discount rate approximates the real rate of return on a long term government debt, which serves as a proxy for the real rate of return on savings to reflect reliance on a social rate of time preference discounting concept.[7] A 7 percent discount rate approximates the marginal pretax real rate of return on an average investment in the private sector, and it is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector. A 7 percent rate is consistent with an opportunity cost[8] of capital concept to reflect the time value of resources directed to meet regulatory requirements.

3.2.5 *Cost/Benefit Inflators*

The staff estimated the analysis inputs from sources as referenced in Appendix A, and inputs are provided in prior-year dollars. To evaluate the costs and benefits consistently, these inputs are put into 2023 base year dollars. The most common inflator is the consumer price index for all urban consumers (CPI-U) developed by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). Using the CPI-U, the prior-year dollars are converted to 2023 base year dollars. For 2023, the currently reported CPI-U values have been averaged together; the BLS has not determined the entirety of CPI-U for 2023. The formula to determine the amount in 2023 dollars is as follows:

$$\frac{CPI-U_{2023}}{CPI-U_{2022}} x\, Value_{2022} = Value_{2023}$$

7 The "social rate of time preference" discounting concept refers to the rate at which society is willing to postpone a marginal unit of current consumption in exchange for more future consumption.

8 "Opportunity cost" represents what is foregone by undertaking a given action. If the licensee personnel were not engaged in revising procedures, they would be performing other work activities. Throughout the analysis, the NRC estimates the opportunity cost of performing these incremental tasks as the industry personnel's pay for the designated unit of time.

Error: Reference source not found summarizes the values of CPI-U used in this regulatory analysis.

Table 2 CPI-U Inflator

Base Year	CPI-U Annual Average[a]
2022	292.655
2023	303.395

[a] BLS, 2023.

3.2.6 *Labor Rates*

For the purposes of this regulatory analysis, the NRC applied incremental cost principles to develop labor rates that include only labor and material costs directly related to the implementation, operation, and maintenance of the rule requirements. This approach is consistent with the guidance in NUREG/CR-3568, "A Handbook for Value Impact Assessment," issued December 1983 (NRC, 1983), and general cost estimate methodology. The NRC incremental labor rate is $143 per hour for fiscal year 2023.[9]

The staff used the 2021 BLS Occupational Employment and Wages data (BLS, 2021) to obtain labor categories and the mean hourly wage rate by job type, and applied the inflator discussed above to inflate these labor rate data to 2023 dollars. The labor rates used in the analysis reflect total hourly compensation, including wages and nonwage benefits, using a burden factor of 2.4. The NRC used the BLS data tables to select appropriate hourly labor rates for performing the anticipated tasks necessary during and following implementation of the proposed alternative. In establishing this labor rate, wages paid to the individuals performing the work, plus the associated fringe benefit component of labor cost (i.e., insurance premiums, pension, and legally required benefits), are considered incremental expenses and are included. Error: Reference source not found summarizes the BLS labor categories that were used to estimate industry labor costs to implement this rule.

9 The NRC labor rates presented herein differ from those developed under the NRC's license fee recovery program (10 CFR Part 170, "Fees for Facilities, Materials, Import and Export Licenses, and Other Regulatory Services Under the Atomic Energy Act of 1954, as Amended"). NRC labor rates for fee recovery purposes are appropriately designed for full-cost recovery of the services rendered and as such include nonincremental costs (e.g., overhead, administrative, and logistical support costs).

Table 3 Position Titles and Occupations

Position Title (in this Regulatory Analysis)	Standard Occupational Classification (SOC Code)
Managers	General and Operations Managers (111021)
Technical Staff	Biological Scientists (191020)
	Environmental Scientists and Geoscientists (192040)
	Life, Physical, and Social Scientists (190000)
Administrative Staff	Office and Administrative Support Occupations (430000)
	First-Line Supervisors of Office and Administrative Support Workers (431011)
Licensing Staff	Lawyers (231011)

The NRC used BLS labor rates at the 25th percentile, mean, and 75th percentile and adjusted to 2023 dollars as input into the uncertainty analysis, which is described in Section 4. The industry hourly labor rate used in this analysis is $164 per hour.

3.2.7 *Sign Conventions*

The sign conventions used in this analysis are that all favorable consequences for the Alternative 2 are positive and all adverse consequences are negative. Negative values are shown using parentheses (e.g., negative $500 is displayed as ($500)).

3.2.8 *Analysis Horizon*

The analysis horizon is 10 years based on Appendix B to Subpart A of 10 CFR Part 51, which states that the material in Appendix B, including Table B-1, should be reviewed on a 10-year cycle and updated if necessary. This is also consistent with Commission direction in SRM-SECY-21-0066, SRM-SECY-22-0024, and SRM-SECY-22-0036, “Staff Requirements—SECY-22-0036—Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—10-Year Environmental Regulatory Update (NRC-2022-0087),” dated June 17, 2022 (NRC, 2022i).

3.3 Industry Implementation

Under Alternative 2, industry would need to review the rule and update its procedures, as necessary. The staff assumed that these implementation activities would apply to the 18 parent companies of the licensees expected to submit applications under this rule from 2025 through 2035, as well as those licensees that plan to submit near-term SLR applications or licensees that have submitted an SLR application or have received a subsequently renewed license. The staff estimated each parent company would incur $50,000 in costs to perform these activities, allocated evenly between reviewing the regulatory changes and updating their procedures in preparation for using the new requirements. These activities result in costs to industry of approximately ($814,000) using a 7 percent NPV and ($861,000) using a 3 percent NPV, as shown in Error: Reference source not found.

Table 4 Industry Implementation

Year	Activity	No. of Parent Companies	Total per Parent Company	Total (2023 dollars)[a]		
				Undiscounted	7% NPV	3% NPV
2024	Licensee Review New Requirements	18	$25,000	($450,000)	($421,000)	($437,000)
2025	Licensee Procedure(s) Update(s)	18	$25,000	($450,000)	($393,000)	($424,000)
Industry Net Implementation Benefit (Cost)				**($900,000)**	**($814,000)**	**($861,000)**

[a] Values rounded to nearest thousand dollars.

3.4 Industry Operation

Alternative 2 provides 80 issues in Table B-1 (see Error: Reference source not found in Appendix A) that each licensee must assess and include as part of the environmental review of its license renewal application to the NRC.

General assumptions: Assumptions are listed below and apply to all license renewal applicants:

- Category 1 Issue—A Category 1 issue is assumed to require, on average, 95 hours of licensee staff labor to research new and significant information and, as applicable, include information in the environmental report.

- Category 2 Issue—A Category 2 issue is assumed to require, on average, 381 hours of licensee staff labor to complete a plant-specific analysis and to present the analysis in the environmental report.

- Uncategorized Issue—An uncategorized issue is assumed to require, on average, 95 hours of licensee staff labor to research new and significant information and, as applicable, include information in the environmental report.

- Category Change—The net savings per change from Category 2 to Category 1 and the net cost per change from Category 2 to Category 1 is 286 hours.

- Issue Consolidation—Combining similar category issues from the 2013 LR GEIS into a single Category 1 or Category 2 issue in Table B-1 will result in an estimated 70 percent savings, on average, in labor time for each issue removed by consolidation.

- Issue Division—Dividing a category issue from the 2013 LR GEIS into individual issues of the same category in Table B-1, on average, will result in an estimated 50 percent increase in cost and in labor time for each issue added by issue division. For example, if a single Category 2 issue is divided into three Category 2 issues, then the result is an increased incremental cost of 100 percent for a total of 381 hours to analyze the three subdivided Category 2 issues.

Initial LR: All incremental changes from the current Table B-1 to the revised Table B-1 resulting from the revised LR GEIS would apply to initial LR applicants:

- Costs—New Category 2 issues subdividing an existing Category 2 issue, as well as Category-1 issues that are changed to Category 2 issues, including consolidations, would incur costs because these issues would require a plant-specific evaluation. New Category 1 issues would also incur costs to research new and significant information.

- Benefits—The benefits of this rule would result from Category 2 issues that are changed to Category-1 issues, because those issues will no longer require plant-specific evaluation. Combining similar issues into a single category would also result in savings.

Future SLR: All the issues and findings in the revised Table B-1 would apply to future SLR applicants:

- Costs—No incremental costs would be incurred by addressing Category 2 issues because these costs would be incurred with or without the rule.

- Benefits—The rule would result in averted costs for Category 1 issues because those issues will no longer require plant-specific evaluation.

Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses: This group of licensees is expected to submit SLR applications before 2025. Near-term SLR applicants may choose from two options: evaluate all environmental impacts as plant-specific or rely on the current Table B-1 findings when developing their environmental report. This analysis assumes that, at their own risk, licensees seeking a near-term SLR would rely on the current Table B-1 findings when determining the scope and magnitude of environmental impacts of their subsequent license, pending completion of the final rule.[10] This assumption results in cost reductions of approximately 40 percent. Once the rule becomes effective, new Category-1 and 2 issues, and changes from Category 1 to Category 2, including consolidations, would apply to this group of license renewal applicants. Therefore, this group of licensees will need to provide the NRC with additional environmental information as a result of the changes introduced by the rule. The NRC can acquire this information in multiple ways (e.g., the NRC can send requests for additional information or requests for confirmatory information, or licensees can reevaluate and resubmit their applications). This analysis recognizes that the licensee would reevaluate its application against the changes to Table B-1 and resubmit the application to the NRC.

- Costs—The rule would result in additional costs associated with new Category 2 issues and subdividing an existing Category 2 issue, as well as Category 1 issues that are changed to Category 2 issues, including consolidations, because these issues would require plant-specific evaluation. Additional costs associated with new Category 1 issues

10 An amended SLR environmental report has been submitted for Turkey Point Units 3 and 4 that evaluates all environmental impacts as plant-specific. Other SLR applicants also could choose to submit amended environmental reports; however, this alternative is more expensive than Alternative 2 and was not analyzed.

to research new and significant information would be incurred. The licensee would have 1 year to comply, resulting in costs incurred in 2025.

- Benefits—The rule would address the gap in applicability for SLR.

Error: Reference source not found summarizes of the costs and benefits to license renewal applicants as a result of the revised Table B-1.

Table 5 Industry Operation Costs

Year	Applicant Group	Total (2023 dollars)		
		Undiscounted	**7% NPV**	**3% NPV**
2025-2035	Initial LR			
	Costs	($129,000)	($57,000)	($91,000)
	Benefits	$0	$0	$0
	Initial LR Subtotal	($129,000)	($57,000)	($91,000)
2025-2035	Future SLR			
	Costs	$0	$0	$0
	Benefits	$92,609,000	$63,667,000	$77,917,000
	Future SLR Subtotal	$92,609,000	$63,667,000	$77,917,000
2025	Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses			
	Costs	($2,089,000)	($1,825,000)	($1,969,000)
	Benefits	$0	$0	$0
	Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses Subtotal	($2,089,000)	($1,825,000)	($1,969,000)
Industry Net Operation Benefit (Cost)		**$90,391,000**	**$61,785,000**	**$75,857,000**

[a] Values rounded to the nearest thousand dollars.

3.5 NRC Operation

Alternative 2 activities affect the NRC environmental review time per license renewal application. The analysis specifies each Table B-1 issue that is evaluated quantitatively.

General assumptions: The following assumptions are made about NRC operation are listed below:

- Category 1 Issue—A Category 1 issue is assumed to require, on average, 43 hours of NRC staff labor to research new and significant information and, as applicable, include information in the supplement to the revised LR GEIS.

- Category 2 Issue—A Category 2 issue is assumed to require, on average, 174 hours of NRC staff labor to complete a plant-specific analysis and to present the information in the supplement to the revised LR GEIS.

- Uncategorized Issue—An uncategorized issue is assumed to require, on average, 43 hours of licensee staff labor to research new and significant information and, as applicable, include information in the environmental report.

- Category Change—The net savings per change from Category 2 to Category 1 and the net cost per change from a Category 2 to Category 1 is 131 hours.

- Issue Consolidation—Combining similar category issues from the 2013 LR GEIS into a single Category 1 or Category 2 issue in the revised Table B-1 will result in an estimated 70 percent savings, on average, in labor time for each issue removed by consolidation.

- Issue Division—Dividing a category issue from the 2013 LR GEIS into individual issues of the same category in the revised Table B-1, on average, will result in an estimated 50 percent increase in cost, in labor time for each issue added by issue division. For example, if a single Category 2 issue is divided into three Category 2 issues, then the result is an increased incremental cost of 100 percent for a total of 174 hours to analyze the three subdivided Category 2 issues.

Error: Reference source not found summarizes the cost savings impact of the changes to Table B-1 as a result of the rule to the NRC for license renewal applications.

Table 6 NRC Operation Costs

Year	Applicant Group	Total (2023 dollars)		
		Undiscounted	**7% NPV**	**3% NPV**
2025-2035	Initial LR			
	Costs	($52,000)	($23,000)	($36,000)
	Benefits	$0	$0	$0
	Initial LR Subtotal	($52,000)	($23,000)	($36,000)
2025-2035	Future SLR			
	Costs	$0	$0	$0
	Benefits	$36,882,000	$25,356,000	$31,031,000
	Future SLR Subtotal	$36,882,000	$25,356,000	$31,031,000
2025	Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses			
	Costs	($834,000)	($729,000)	($786,000)
	Benefits	$0	$0	$0
	Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses Subtotal	($834,000)	($729,000)	($786,000)
	NRC Net Operation Benefit (Cost)	**$35,996,000**	**$24,604,000**	**$30,209,000**

[a] Values rounded to the nearest thousand dollars.
[b] The NRC would also incur incremental costs to withdraw or amend any Commission orders as a result of the rule.

3.6 Improvements in Knowledge

Alternative 2 would amend the regulations to include lessons learned and knowledge and experience gained from license renewal environmental reviews performed since development of the 2013 LR GEIS, which provide a significant source of new information. In addition, new research, findings, and other information were considered in evaluating the significance of impacts associated with initial LR and SLR.

3.7 Regulatory Clarity

Alternative 2 would improve the clarity of the environmental issues identified in Table B-1 and provide consistency with other similar environmental issues (e.g., ecological resource issues) by more clearly describing the title of the issues, scope, and resources considered for issue findings. For example, Table B-1 issues have been divided into separate issues for clarity and consistency with the separate Federal statutes and interagency consultation requirements that the NRC must consider with respect to federally protected ecological resources. Also, the rule would remove the word “initial” from 10 CFR 51.53(c)(3), update the 2013 LR GEIS and associated guidance to apply to SLR, and make conforming changes in 10 CFR 51.53(c)(3)(ii) and 10 CFR 51.95(c).

3.8 Environmental Considerations

Alternative 2 would amend the regulations to update Table B-1 and make other conforming changes in 10 CFR Part 51, which will improve the quality of the environmental information provided to the NRC and facilitate license renewal environmental reviews. This information is necessary for the NRC to ensure compliance with Federal environmental statutes and regulations and to evaluate the potential environmental effects of continued nuclear power plant operations.

4 SUMMARY OF THE RESULTS

4.1 Summary

This regulatory analysis identifies both quantifiable and nonquantifiable costs and benefits that would result from Alternative 2 (rulemaking). Although quantifiable costs and benefits appear to be more tangible, decisionmakers should not discount costs and benefits that cannot be quantified. Such benefits or costs can be as important as or even more important than benefits or costs that can be quantified and monetized.

4.1.1 *Quantified Net Benefits*

Tables 7 and 8 summarize the estimated quantified costs and benefits for Alternative 2 compared to the regulatory baseline (Alternative 1).

Table 7 Summary of Totals by Licensee Group

Licensee Group	Total (2023 dollars)		
	Undiscounted	**7% NPV**	**3% NPV**
Initial LR	($201,000)	($99,000)	($147,000)
Future SLRs	$128,816,000	$88,412,000	$108,302,000
Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses	($3,128,000)	($2,738,000)	($2,951,000)
Net Benefit (Cost)	**$125,487,000**	**$85,575,000**	**$105,204,000**

[a] Values rounded to the nearest thousand dollars.

4.1.2 *Nonquantified Benefits*

In addition to the quantified costs, the NRC has analyzed numerous costs and benefits that could not be monetized but would affect the general public, industry, and the NRC. Table 8 summarizes the quantified and qualitative costs and benefits for Alternative 2. The quantitative analysis used mean values.

Table 8 Summary of Totals

Net Monetary Savings or (Costs)	Nonquantified Benefits or (Costs)
Alternative 1: No Action $0	None
Alternative 2: **Industry: (all provisions)** $61.0 million using a 7% discount rate $75.0 million using a 3% discount rate	**Benefits:** • **Improvements in Knowledge—**Alternative 2 would improve the quality of the information provided to the NRC and facilitate license renewal environmental reviews.

Net Monetary Savings or (Costs)	Nonquantified Benefits or (Costs)
NRC: (all provisions) $24.6 million using a 7% discount rate $30.2 million using a 3% discount rate **Net Benefit (Cost): (all provisions)** $85.6 million using a 7% discount rate $105.2 million using a 3% discount rate	• **Regulatory Clarity—**Alternative 2 would improve the clarity and intent of the environmental requirements, including applicability to SLR, and provide consistency with other ecological resource issues. • **Environmental Considerations—**Alternative 2 would provide the necessary information for the NRC to comply with Federal environmental statutes and regulations. **Costs**: • None identified

4.2 Uncertainty Analysis

The NRC completed a Monte Carlo sensitivity analysis for this regulatory analysis using the specialty software @Risk. The Monte Carlo approach answers the question, "What distribution of net costs and benefits results from multiple draws of the probability distribution assigned to key variables?"

4.2.1 *Uncertainty Analysis Assumptions*

The NRC provides the following analysis of the variables with the greatest uncertainty on estimates of values. As noted above, the NRC performed this analysis with a Monte Carlo simulation analysis using the @Risk software program. Monte Carlo simulations involve introducing uncertainty into the analysis by replacing the point estimates of the variables used to estimate base case costs and benefits with probability distributions. By defining input variables as probability distributions instead of point estimates, the influence of uncertainty on the results of the analysis (i.e., the net benefits) can be modeled effectively.

The probability distributions chosen to represent the different variables in the analysis were bounded by the range referenced input and the NRC staff's professional judgment. When defining the probability distributions for use in a Monte Carlo simulation, summary statistics are needed to characterize the distributions. These summary statistics include (1) the minimum, most likely, and maximum values of a program evaluation and review technique (PERT) distribution.[11] The NRC used the PERT distribution to reflect the relative spread and skewness of the distribution defined by the three estimates.

11 A PERT distribution is a special form of the beta distribution with specified minimum and maximum values. The shape parameter is calculated from the defined "most likely" value. The PERT distribution is similar to a triangular distribution in that it has the same set of three parameters. Technically, it is a special case of a scaled beta (or beta general) distribution. The PERT distribution is generally considered superior to the triangular distribution when the parameters result in a skewed distribution because the smooth shape of the curve places less emphasis in the direction of skew. Similar to the triangular distribution, the PERT distribution is bounded on both sides and therefore may not be adequate for some modeling purposes if the capture of tail or extreme events is desired.

Appendix A identifies the data elements, the distribution and summary statistic, and the mean value of the distribution used in the uncertainty analysis.

4.2.2 *Uncertainty Analysis Results*

The NRC performed the Monte Carlo simulation by repeatedly recalculating the results 10,000 times. For each iteration, the values identified in Appendix A were chosen randomly from the probability distributions that define the input variables. The values of the output variables were recorded for each iteration, and these values were used to define the resultant probability distribution.

For the analysis shown in Figures 1, 2, and 3, the NRC ran 10,000 simulations in which it changed the key variables to assess the resulting effect on costs and benefits. Figures 1, 2, and 3 display the histograms of the incremental costs and benefits from the regulatory baseline (Alternative 1) for each affected entity and the total net benefit of the rule. The analysis shows that both industry and the NRC have a greater than 99 percent likelihood of incurring benefits that exceed the costs if the NRC issues this rule.

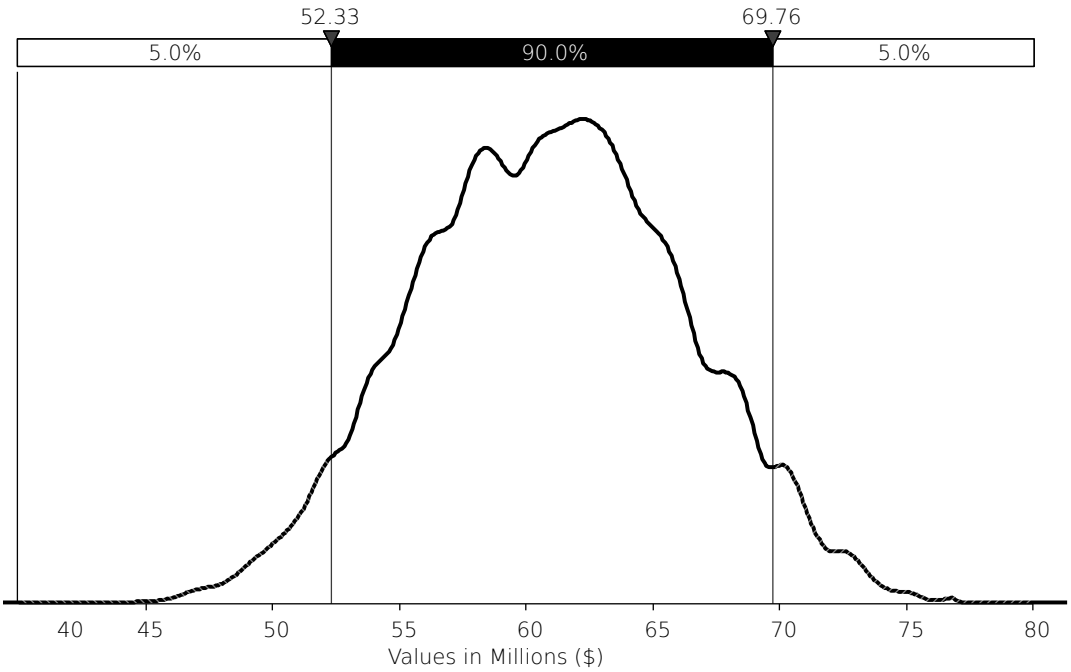

Figure 1 Total Industry Net Benefits (Costs) (7 Percent NPV)—Alternative 2

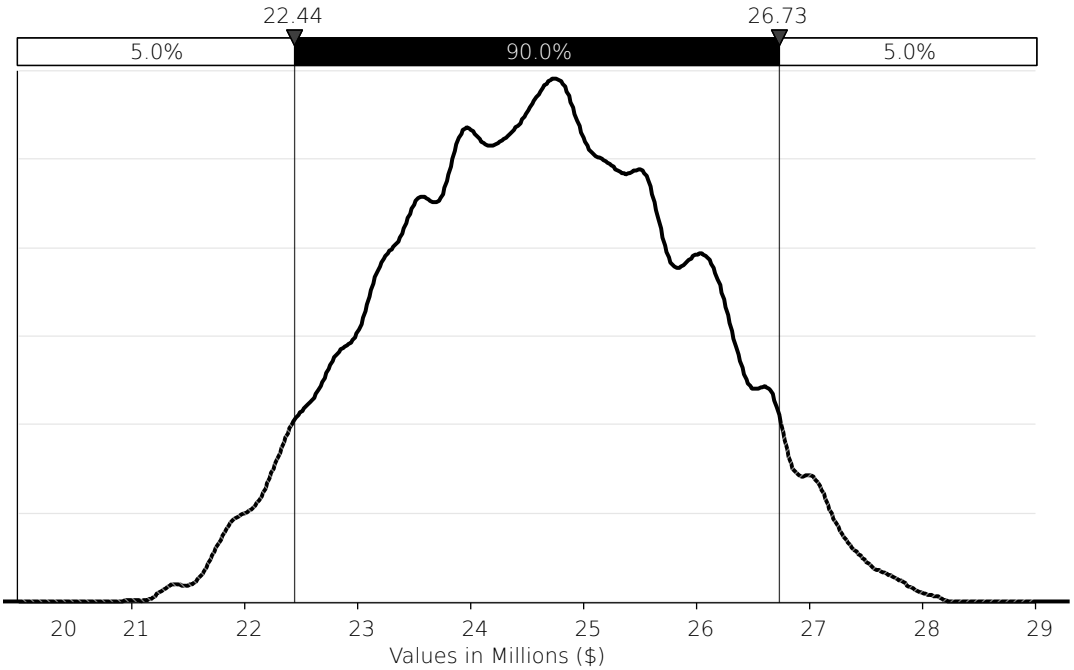

Figure 2 Total NRC Net Benefits (Costs) (7 Percent NPV)—Alternative 2

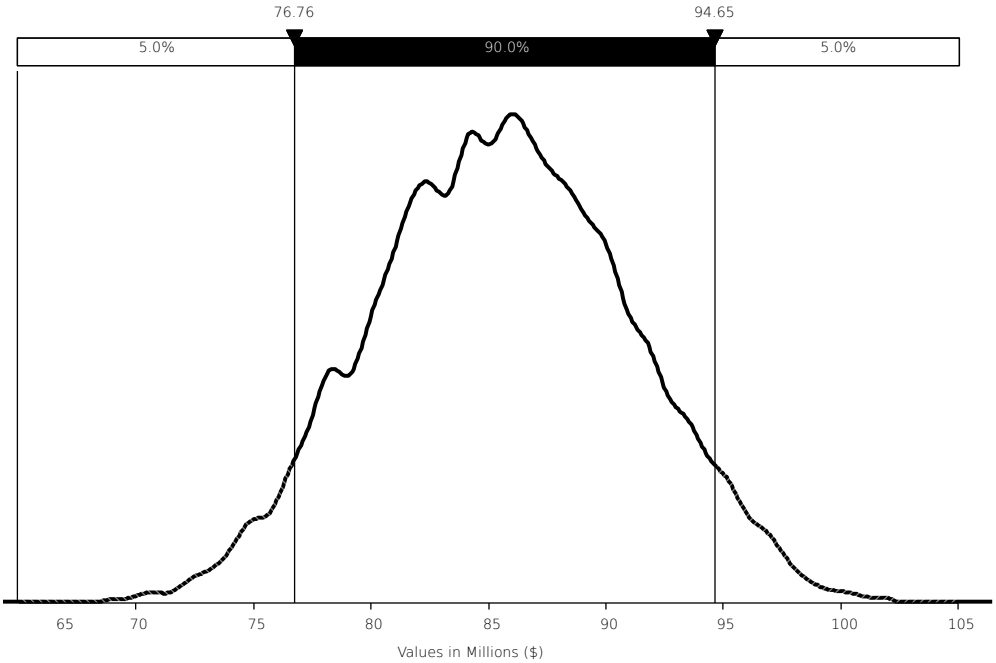

Figure 3 Total Net Benefits (Cost) (7 Percent NPV)—Alternative 2

Error: Reference source not found 9 presents descriptive statistics on the uncertainty analysis. It displays the key statistical results, including the 90 percent confidence interval in which the net benefits would fall between the 5 percent and 95 percent values.

Table 9 Descriptive Statistics for Uncertainty Results (7 Percent NPV)

Uncertainty Result	Incremental Cost-Benefit (2023 Million Dollars)				
	Min	Mean	Max	5%	95%
Net Industry Benefit (Cost)	$44	$61	$77	$52	$70
Net NRC Benefit (Cost)	$21	$25	$28	$22	$27
Total Net Benefit (Cost)	$69	$86	$102	$77	$95

Figure 4 shows a tornado diagram that identifies the cost drivers for this rule. This figure ranks the variables based on their contribution to the uncertainty in cost. The largest cost driver is the amount of time for licensees to perform an environmental analysis for new Category 2 issues, followed by the amount of time for the NRC to review the environmental analyses for new Category 2 issues. These two variables are the largest cost drivers and generate the largest variations in the total net benefit due to uncertainty. The remaining cost drivers show diminishing variation in the total net benefit.

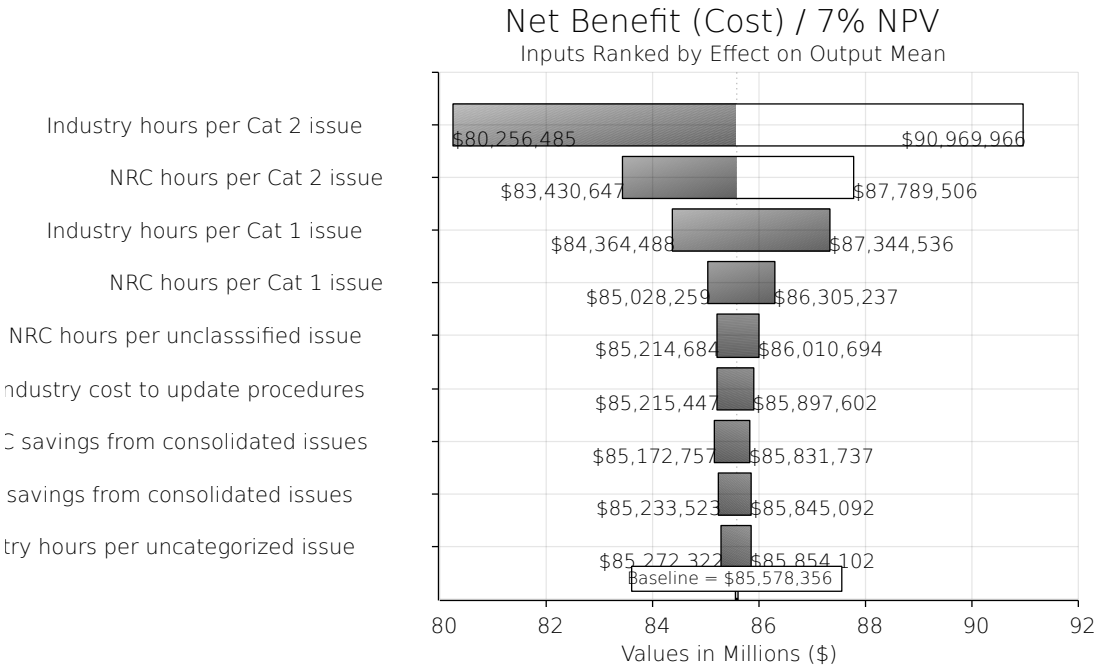

Figure 4 Tornado Diagram—Total Averted Costs—7 Percent NPV

4.2.3 *Summary of Uncertainty Analysis*

The simulation analysis shows that the estimated mean benefit (i.e., positive averted costs or savings) for this rule is $86 million, with 90 percent confidence that the net benefit is between $69 million and $102 million using a 7 percent discount rate. The NRC's quantitative estimates show that the rule alternative (Alternative 2) is cost-beneficial to industry and the NRC.

4.3 Disaggregation

To comply with the guidance in NUREG/BR-0058, Section 4.3.2, "Criteria for the Treatment of Individual Requirements," the NRC performed a screening review to determine whether any individual requirement would be unnecessary to achieve the objectives of the rulemaking. The staff did not identify any unnecessary or unrelated provisions; therefore, it did not perform a disaggregation for this regulatory analysis.

5 DECISION RATIONALE AND IMPLEMENTATION

The assessment of total costs and benefits discussed above leads the NRC to conclude that the rule, if implemented, would continue to ensure awareness of the environmental impacts of license renewal, increase regulatory clarity in the license renewal process, increase regulatory consistency, and reduce the regulatory burden for industry and the NRC. Based solely on quantified costs and benefits, the regulatory analysis shows that the rulemaking is justified because the total quantified benefits of the regulatory action will exceed the costs of the final action, for all discount rates up to 7 percent. Considering nonquantified costs and benefits, the regulatory analysis shows that the rulemaking is justified because the number and significance of the nonquantified benefits outweigh the nonquantified costs. Therefore, considering both quantified and nonquantified costs and benefits indicates that the benefits of the rule outweigh the identified quantitative and qualitative impacts attributable to the rule.

1The NRC assumed for this analysis that this final rule would be effective in 2024. In addition to the LR GEIS, Revision 2, the agency will issue a revision to Regulatory Guide 4.2, Supplement 1, Revision 2, and NUREG-1555, Supplement 1, Revision 2, with the final rule.

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NRC, “Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—Environmental Review (RIN 3150-AK32; NRC-2018-0296),” SECY-22-0024, March 25, 2022e (ML22062B643).

NRC, “Staff Requirements—SECY-22-0024—Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—Environmental Review (RIN 3150-AK32; NRC-2018-0296),” SRM-SECY-22-0024, April 5, 2022f (ML22096A035).

NRC, Commission Memorandum and Order CLI-22-06, June 3, 2022g (ML22154A215).

NRC, Commission Memorandum and Order CLI-22-07, June 3, 2022h (ML22154A217).

NRC, “Staff Requirements—SECY-22-0036—Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—10-Year Environmental Regulatory Update (NRC-2022-0087),” SRM-SECY-22-0036, June 17, 2022i (ML22168A130).

NRC, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants,” Draft NUREG-1437, Revision 2, Vols. 1, 2, and 3 (ML23202A170, package).

NRC, “Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications,” Draft Regulatory Guide 4.2, Supplement 1 (ML23201A144).

NRC, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal,” NUREG-1555, Supplement 1, Revision 2 (ML23201A227).

APPENDIX A SUPPORTING INFORMATION

Table A-10 Changes to Table B-1

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
Land Use			
1	Onsite land use	1	No change
2	Offsite land use	1	No change
3	Offsite land use in transmission line right-of-ways (ROWs)	1	No change
Visual Resources			
4	Aesthetic impacts	1	No change
Air Quality			
5	Air quality impacts	1	Revised issue title from *Air quality impacts (all plants)* and the order of the topics discussed in the finding (operations aspects followed by refurbishment)
6	Air quality effects of transmission lines	1	Revised issue finding by adding the phrase “from transmission lines”
Noise			
7	Noise impacts	1	No change
Geologic Environment			
8	Geology and soils	1	Revised issue finding (i.e., that the environmental review does not consider the impacts of geological hazards on nuclear power plants)
Surface Water Resources			
9	Surface water use and quality (non-cooling system impacts)	1	No change
10	Altered current patterns at intake and discharge structures	1	No change
11	Altered salinity gradients	1	No change
12	Altered thermal stratification of lakes	1	No change
13	Scouring caused by discharged cooling water	1	No change
14	Discharge of metals in cooling system effluent	1	No change
15	Discharge of biocides, sanitary wastes, and minor chemical spills	1	No change

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
16	Surface water use conflicts (plants with once-through cooling systems)	1	No change
17	Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)	2	No change
18	Effects of dredging on surface water quality	1	No change
19	Temperature effects on sediment transport capacity	1	Revised issue finding by adding the phrase “during the license renewal term” for clarity
Groundwater Resources			
20	Groundwater contamination and use (non-cooling system impacts)	1	Revised issue finding by adding “U.S.” and adding the acronym “EPA” for clarity
21	Groundwater use conflicts (plants that withdraw less than 100 gallons per minute [gpm])	1	No change
22	Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])	2	No change
23	Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	2	No change
24	Groundwater quality degradation resulting from water withdrawals	1	No change
25	Groundwater quality degradation (plants with cooling ponds)	2	Consolidated Category 1 issue, *Groundwater quality degradation (plants with cooling ponds in salt marshes)*, with Category 2 issue, *Groundwater quality degradation (plants with cooling ponds at inland sites)* and includes saltwater intrusion and encroachment on adjacent surface water and groundwater quality as potential site-specific factors for cooling ponds
26	Radionuclides released to groundwater	2	No change

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
Terrestrial Resources			
27	Non-cooling system impacts on terrestrial resources	2	Revised issue title from *Effects on terrestrial resources (non-cooling system impacts)* and scope of issues and resources considered in the finding
28	Exposure of terrestrial organisms to radionuclides	1	Minor revisions to issue finding for clarity
29	Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)	1	Revised scope of issues and resources considered in the finding
30	Cooling tower impacts on terrestrial plants	1	Revised issue title from *Cooling tower impacts on vegetation (plants with cooling towers)* and scope of issues and resources considered in the finding
31	Bird collisions with plant structures and transmission lines	1	Minor revisions to issue finding for clarity
32	Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	2	Revised scope of issues and resources considered in the finding
33	Transmission line right-of-way (ROW) management impacts on terrestrial resources	1	Revised scope of issues and resources considered in the finding
34	Electromagnetic field effects on terrestrial plants and animals	1	Revised issue title from *Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)* and scope of issues and resources considered in the finding

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
Aquatic Resources			
35	Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	2	Revised issue title from *Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)* and issue findings to reflect revised Clean Water Act Section 316(b) requirements and to consolidate the impingement component of the Category 1 issue, *Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses*
36	Impingement mortality and entrainment of aquatic organisms (plants with cooling towers)	1	Revised issue title from *Impingement and entrainment of aquatic organisms (plants with cooling towers)* and issue findings to reflect revised Clean Water Act Section 316(b) requirements and to consolidate the impingement component of the Category 1 issue, *Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses*
37	Entrainment of phytoplankton and zooplankton	1	Revised issue title from *Entrainment of phytoplankton and zooplankton (all plants)* and scope of issues and resources considered in the finding
38	Effects of thermal effluents on aquatic organisms (plants with once-through cooling systems or cooling ponds)	2	Revised issue title from *Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)* and scope of issues and resources considered in the finding
39	Effects of thermal effluents on aquatic organisms (plants with cooling towers)	1	Revised issue title from *Thermal impacts on aquatic organisms (plants with cooling towers)* and scope of issues and resources considered in the finding

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
40	Infrequently reported effects of thermal effluents	1	Revised issue title from *Infrequently reported thermal impacts (all plants)* and consolidated the Category 1 issue *Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication* and the thermal effluent component of the Category 1 issue, *Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses*
41	Effects of nonradiological contaminants on aquatic organisms	1	Revised scope of issues and resources considered in the finding
42	Exposure of aquatic organisms to radionuclides	1	Revised scope of issues and resources considered in the finding
43	Effects of dredging on aquatic resources	1	Revised issue title from *Effects of dredging on aquatic organisms* and scope of issues and resources considered in the finding
44	Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	2	Revised scope of issues and resources considered in the finding
45	Non-cooling system impacts on aquatic resources	1	Revised issue title from *Effects on aquatic resources (non-cooling system impacts)* and scope of issues and resources considered in the finding
46	Impacts of transmission line right-of-way (ROW) management on aquatic resources	1	Revised scope of issues and resources considered in the finding
***Federally Protected Ecological Resources*[a]**			
47	Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife Service jurisdiction	2	Revised issue title from *Threatened, endangered, and protected species and essential fish habitat* and divided issue into three issues for each Federal statute and interagency consultation requirement
48	Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction	2	Subdivided Category 2 issue

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
49	Magnuson-Stevens Act: essential fish habitat	2	Subdivided Category 2 issue
50	National Marine Sanctuaries Act: sanctuary resources	2	New Category 2 issue
Historic and Cultural Resources			
51	Historic and cultural resources	2	Revised scope of issues and resources considered in the finding
Socioeconomics			
52	Employment and income, recreation and tourism	1	No change
53	Tax revenue	1	Revised issue title from *Tax revenues*
54	Community services and education	1	No change
55	Population and housing	1	No change
56	Transportation	1	No change
Human Health			
57	Radiation exposures to plant workers	1	No change
58	Radiation exposures to the public	1	No change
59	Chemical hazards	1	Revised issue title from *Human health impact from chemicals*
60	Microbiological hazards to plant workers	1	No change
61	Microbiological hazards to the public	2	Revised issue title from *Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)* and issue findings to reflect the fact that microbiological organisms are a concern wherever plants discharge thermal effluents to publicly-accessible surface waters.
62	Electromagnetic fields (EMFs)	Uncategorized	Revised issue title from *Chronic effects of electromagnetic fields (EMFs)*
63	Physical occupational hazards	1	No change
64	Electric shock hazards	2	No change
Postulated Accidents			
65	Design-basis accidents	1	No change

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
66	Severe accidents	1	Revised from a Category 2 issue to a Category 1 issue and revised issue finding to reflect the fact that the probability-weighted consequences of severe accidents are small and to reflect knowledge gained that severe accident mitigation alternatives do not warrant further plant-specific analysis
Environmental Justice			
67	Impacts on minority populations, low-income populations, and Indian Tribes	2	Renamed issue title from *Minority and low-income populations* and revised issue finding to consider Indian Tribes and subsistence consumption
Waste Management			
68	Low-level waste storage and disposal	1	No change
69	Onsite storage of spent nuclear fuel	1	No change
70	Offsite radiological impacts of spent nuclear fuel and high-level waste disposal	1	No change
71	Mixed-waste storage and disposal	1	No change
72	Nonradioactive waste storage and disposal	1	No change
Greenhouse Gas Emissions and Climate Change			
73	Greenhouse gas impacts on climate change	1	New Category 1 issue
74	Climate change impacts on environmental resources	2	New Category 2 issue
Cumulative Effects			
75	Cumulative effects	2	Revised issue title from *Cumulative impacts* and revised issue finding to reflect changes to Council on Environmental Quality definition at 40 CFR 1508.1(i)(3)
Uranium Fuel Cycle			
76	Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste	1	No change

Issue No.	Table B-1 Issues	Category	Changes to Table B-1
77	Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste	1	No change
78	Nonradiological impacts of the uranium fuel cycle	1	No change
79	Transportation	1	No change
Termination of Nuclear Power Plant Operations and Decommissioning			
80	Termination of plant operations and decommissioning	1	No change

[a] Three of the four federally protected ecological resources issues are not new issues. Issues 47–49 were subdivided from an existing issue in accordance with applicable Federal statute and interagency consultation requirements. Issue 50 specifically addresses a newly identified Federal statute and interagency consultation requirement.

Note: All issues in Table B-1 fully account for subsequent license renewal and are based on the findings described in the revised NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (LR GEIS).

Table A-11 Major Assumptions and Input Data

Description	Mean Estimate	Distribution	Low Estimate	Most Likely Estimate	High Estimate	Source or Basis of Estimate
General Input						
Analysis base year	2023					NRC assumption
Year NRC rule is effective	2024					NRC assumption
Compliance Effective Date	2025					Calculated value. (NRC rule year + 1 year)
Timeframe of analysis (years)	10					Timeframe is consistent with next LR GEIS update
Alternative discount factor	3%					NUREG/BR-0058, OMB guidance
Principal discount factor	7%					NUREG/BR-0058, OMB guidance
NRC staff hourly labor rate	$143					NRC calculation
Licensee average labor rate	$164	PERT	$131.88	$169.57	$191.31	BLS.gov table hourly rate was inflated to 2023 dollars using CPI-U values and a 2.4 multiplier was applied to account for fringe and indirect management costs
No. of parent companies	18					NRC estimate
No. of licensees yet to request an initial license renewal	1					NRC estimate

Description	Mean Estimate	Distribution	Low Estimate	Most Likely Estimate	High Estimate	Source or Basis of Estimate
No. of licensees with near-term and submitted applications, and issued subsequently renewed licenses	10					NRC estimate
No. of licensees with future subsequently renewed licenses	44					NRC estimate
Alternative 1 Input Data for Alternative 2 Averted Costs						
NRC Inputs						
Hours per Category 1 issue	43	PERT	39	43	48	NRC estimate
Hours per Category 2 issue	174	PERT	156	174	191	NRC estimate
Hours per uncategorized issue	43	PERT	39	43	48	NRC estimate
Savings from consolidated issues	70%	PERT	60%	70%	80%	NRC estimate
Increased percentage cost from subdividing issues	50%	PERT	40%	50%	60%	NRC estimate based on historical data and expert opinion
Industry Inputs						
Hours per Category 1 issue	95	PERT	86	95	105	NRC estimate
Hours per Category 2 issue	381	PERT	343	381	420	NRC estimate
Hours per uncategorized issue	95	PERT	86	95	105	NRC estimate
Savings from consolidated issues	70%	PERT	60%	70%	80%	NRC estimate
Increased percentage cost from subdividing issues	50%	PERT	40%	50%	60%	NRC estimate based on historical data and expert opinion
Alternative 2 Input Data						
NRC Inputs						
Hours to prepare and issue final rule	17,710	PERT	15,939	17,710	19,481	NRC estimate
Hours to prepare and issue final guidance	1,678	PERT	1,510	1,678	1,846	NRC estimate
NRC contractor support to prepare and issue final guidance	$1,500,000	PERT	$1,350,000	$1,500,000	$1,650,000	NRC estimate
Category 2 to Category 1 (hours saved)	131					NRC calculation
Category 1 to Category 2 (hours added)	131					NRC calculation
Category 1 consolidation (hours saved)	30					NRC calculation based on consolidated issues savings
Category 2	122					NRC calculation

Description	Mean Estimate	Distribution	Low Estimate	Most Likely Estimate	High Estimate	Source or Basis of Estimate
consolidation (hours saved)						based on consolidated issues savings
Industry Inputs						
Parent company to review regulations and update procedures	$50,000	PERT	$45,000	$50,000	$55,000	NRC estimate
Category 2 to Category 1 (hours saved)	286					NRC calculation
Category 1 to Category 2 (hours added)	286					NRC calculation
Category 1 consolidation (hours saved)	67					NRC calculation based on consolidated issues savings
Category 2 consolidation (hours saved)	267					NRC calculation based on consolidated issues savings

Table A-3 Operating Nuclear Power Plants by Licensee Group[12]

Calendar Year	Initial LR	Future SLR[a]	Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses
2025		Arkansas Nuclear One Unit 1[b] Brunswick Unit 1 and 2 Calvert Cliffs Unit 1 and 2 Cooper Unit 1 D.C. Cook Unit 1 and 2 H.B. Robinson Unit 2 Edwin I. Hatch Unit 1 and 2 James A. FitzPatrick Millstone Unit 2 and 3 Nine Mile Point Unit 1 and 2 Prairie Island Units 1 and 2 Quad Cities Units 1 and 2 R.E. Ginna	Browns Ferry Units 1, 2, and 3 Dresden Units 2 and 3 Monticello Oconee Units 1, 2, and 3 North Anna Units 1 and 2 Peach Bottom Units 2 and 3 Point Beach Units 1 and 2 St. Lucie Units 1 and 2 Turkey Point Units 3 and 4 V.C. Summer Unit 1
2026		Beaver Valley Unit 1 and 2 Salem Unit 1 and 2	
2027		Davis-Besse Joseph M. Farley Unit 1 and 2	
2028		Arkansas Nuclear Unit 2	
2029			
2030		Sequoyah Unit 1 and 2	
2031		McGuire Unit 1 and 2	
2032		LaSalle County Unit 1 and 2 Susquehanna Unit 1 and 2	
2033		Catawba Units 1 and 2 Columbia	
2034		Byron Unit 1 and 2	

12 Data in Table A-3 are current as of September 28, 2023.

Calendar Year	Initial LR	Future SLR[a]	Near-Term and Submitted Applications, and Issued Subsequently Renewed Licenses
	Watts Bar Unit 1	Callaway Unit 1 Grand Gulf Unit 1 Limerick Unit 1 and 2 Waterford Unit 3	
2035		Fermi Unit 2 Palo Verde Unit 1, 2, and 3 River Bend Unit 1 Wolf Creek Unit 1	

[a.] Future SLRs are estimated based on the current license expiration date.
[b.] Arkansas Nuclear One intends to submit separate applications for Units 1 and 2.

SUBJECT: REGULATORY ANALYSIS FOR THE FINAL RULE: 10 CFR PART 51, RENEWING NUCLEAR POWER PLANT OPERATING LICENSES—ENVIRONMENTAL REVIEW, DATED: XXXXX

ADAMS Accession Nos.: PKG: ML22165A003; Regulatory Analysis: ML22165A008

OFFICE	NMSS/REFS/RASB	QTE	NMSS/REFS/RASB/BC	NMSS/SLED/D
NAME	PNoto	JDaughtery	CBladey	THolahan
DATE	10/27/223	11/14/2023	12/15/2023	1212/2024
OFFICE	NMSS/D	OGC	NRR/D	EDO
NAME	JLubinski (RLewis for)	MSmith	AVeil (RTayor for)	DDorman
DATE	12/18/2024	01/18/2024	12/18/2024	01/25/2024

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