Regulatory Analysis and Backfit Considerations

Non-power Production or Utilization Facility License Renewal

U.S. Nuclear Regulatory Commission

March 2017

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Abbreviations

AEA	Atomic Energy Act of 1954, as amended
ADAMS	Agencywide Documents Access and Management System
BLS	Bureau of Labor Statistics
CFR	Code of Federal Regulations
CRGR	Committee to Review Generic Requirements
DOE	U.S. Department of Energy
FSAR	final safety analysis report
GE	General Electric
HEU	high-enriched uranium
ISG	Interim Staff Guidance
kW	kilowatt
LOE	level of effort
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
NPUF	non-power production or utilization facility
PM	project manager
RAI	request for additional information
RTR	research and test reactor
SHINE	SHINE Medical Technologies, Inc.

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Executive Summary

The U.S. Nuclear Regulatory Commission (NRC) is proposing to amend its regulations in title 10 of the *Code of Federal Regulations* (10 CFR) that govern the license renewal process for non-power reactors, testing facilities, and other production or utilization facilities, licensed under the authority of Section 103, Section 104a, or Section 104c of the Atomic Energy Act of 1954, as amended (AEA), that are not nuclear power reactors. In this proposed rule, the NRC collectively refers to these facilities as non-power production or utilization facilities (NPUFs). The proposed rulemaking would amend 10 CFR parts 2, 50, and 51 to: 1) create a definition for "non-power production or utilization facility," or "NPUF"; 2) eliminate license terms for facilities, other than testing facilities, licensed under 10 CFR 50.21(a) or (c); 3) define the license renewal process for testing facilities licensed under § 50.21(c) and NPUFs licensed under 10 CFR 50.22; 4) require all NPUF licensees to submit final safety analysis report (FSAR) updates to the NRC every five years; 5) amend the current timely renewal provision under 10 CFR 2.109, allowing NPUFs to continue operating under an existing license past its expiration date if the facility submits a license renewal application at least two years before the current license expiration date; 6) provide an accident dose criterion of 1 rem (0.01 Sieverts (Sv)) total effective dose equivalent (TEDE) for NPUFs, other than testing facilities; 7) extend the applicability of 10 CFR 50.59 to NPUFs regardless of their decommissioning status; 8) clarify an applicant's requirements for meeting the existing provisions of 10 CFR 51.45; and 9) eliminate the requirement under 10 CFR 50.33(f)(2) to submit financial qualification information with NPUF license renewal applications.

The analysis presented in this document examines the benefits and costs of the proposed rulemaking and implementing guidance relative to the baseline case (i.e., the no action alternative).

The key findings are as follows:

- Proposed Rule Analysis – Costs. As a result of the proposed rule and implementing guidance, the NRC estimates that NPUFs would incur a total one-time implementation cost of $140,000, followed by total operations costs of $1.6 million over the 20-year analysis period ($1.2 million using a 3 percent discount rate or $0.9 million using a 7 percent discount rate).

  The proposed rule and implementing guidance would result in a total one-time cost to the NRC of $720,000 to complete the rulemaking (i.e., analyze public comments, hold public meeting(s), and develop the final rule and regulatory guidance) and oversee the implementation of the new NPUF license renewal requirements. This one-time cost would be followed by total operation costs of approximately $1.8 million over the 20-year analysis period ($1.4 million using a 3 percent discount rate or $1.0 million using a 7 percent discount rate).

  According to Executive Order 12866, Regulatory Planning and Overview (58 FR 190), an economically significant regulatory action is one that would have an annual effect on the economy of $100 million or more. From a cost perspective, this proposed rulemaking does not reach this threshold because the annualized cost of the proposed rule would be $230,000 using a 3 percent discount rate or $260,000 using a 7 percent discount rate.

- Benefits. In terms of the quantitative benefits associated with this proposed rulemaking, NPUFs and the NRC would receive incremental benefits from the elimination of license renewals for qualifying NPUFs (i.e., currently operating research reactors). For NPUFs, this proposed rulemaking in total would result in $5.5 million in cost savings over the 20-year period of analysis ($3.9 million using a 3 percent discount rate or $2.5 million using a 7 percent discount rate). For the NRC, this proposed rulemaking in total would result in $12 million in total cost savings over the 20-year period of analysis ($8.5 million using a 3 percent discount rate or $5.6 million using a 7 percent discount rate).

  Qualitatively, the proposed rulemaking would result in benefits associated with increased regulatory efficiency, as well as minimal benefits to public health and safety (see Section 3.4).

  From a benefits perspective, this proposed rulemaking does not reach the $100 million threshold of Executive Order 12866 because the annualized benefit of the proposed rule would be $830,000 using a 3 percent discount rate and $770,000 using a 7 percent discount rate.

  When compared to incremental costs, the proposed rulemaking would result in a total net benefit of $13 million ($8.9 million using a 3 percent discount rate or $5.3 million using a 7 percent discount rate) over the 20-year analysis period. Of the $13 million in net benefits, NPUFs are expected to receive $3.8 million ($2.5 million using a 3 percent discount rate or $1.5 million using a 7 percent discount rate) and the NRC is expected to receive $9.4 million ($6.4 million using a 3 percent discount rate or $3.8 million using a 7 percent discount rate).

- Decision Rationale. Relative to the no action baseline, the NRC concludes that the quantitative benefits justify the quantitative costs of this proposed rule and would address the inefficiencies and existing issues affecting the NPUF license renewal process.

- Backfit Considerations. The NRC's backfitting provisions for reactors are found in § 50.109. The NRC has determined that § 50.109 does not apply to NPUFs (see Appendix A). Because § 50.109 does not apply to NPUFs, and this proposed rule would apply to NPUFs, a backfit analysis was not prepared for this proposed rule.

1. Introduction

This document presents the regulatory analysis of the proposed rulemaking to streamline the NPUF license renewal process. This section is divided into two parts: Section 1.1 provides background information on the rulemaking; and Section 1.2 identifies the problems that the NRC seeks to address, as well as the objectives for the proposed rulemaking.

1.1 Background

The NRC regulates 36 NPUFs, of which 31 are currently operating. The other five regulated NPUFs are in the process of decommissioning, have possession-only licenses, or are permanently shut down. Sections 103 (for commercial or industrial purposes) and 104a and c (for medical therapy and research and development activities) of the AEA establish the NRC's authority to license NPUFs. The section of the AEA that provides licensing authority for the NRC corresponds directly to the class of license issued to a facility (i.e., Section 104a of the AEA authorizes the issuance of a class 104a license). Sections 104a and c of the AEA require that the Commission impose only the minimum amount of regulation needed to promote common defense and security, protect the health and safety of the public, and permit, under Section 104a, the widest amount of effective medical therapy possible and, under Section 104c, widespread and diverse research and development.

As part of its oversight of NPUFs, the NRC administers an initial licensing process, followed by a license renewal process for those NPUFs that seek to continue operating beyond their initial license term. In 2008, the NRC identified a need to identify and implement efficiencies in the NPUF license renewal process to streamline the process while ensuring that adequate protection of public health and safety is maintained. This need for improvement in the reliability and efficiency of the process was primarily driven by four issues:

1. Following the terrorist attacks of September 11, 2001, NRC staffing priorities were redirected from processing license renewal applications to addressing security initiatives identified following the attacks. In addition, the NRC was focused on implementing 10 CFR 50.64 to convert NPUF licensees to the use of low-enriched uranium.

2. Most NPUFs have limited staff and resources available to execute the steps of the license renewal process. The number of staff available to address the license renewal steps and requirements can range from only one part-time employee at small low-power NPUFs, to as many as four or five full-time employees at large high-power NPUFs. Because the NPUF staff that execute the licensing renewal steps do so in addition to their normal site responsibilities, there are often delays (particularly in responding to requests for additional information (RAI)) in the license renewal process.

3. Many NPUFs have inconsistent existing license infrastructure, which was reflected in license renewal applications. For many NPUFs, the decades between license renewals (and the accompanying FSAR submissions) result in license renewal applications that may be lacking in completeness and accuracy. The incompleteness and inaccuracy of NPUF applications often result in increased time and effort on the part of NRC and NPUF staff to address issues in applications, contributing to the backlog.

4. For power reactors, license renewal reviews have a defined scope, primarily focused on aging management, as described in 10 CFR part 54. For NPUFs, there are not explicit requirements on the content to be addressed during license renewal. Therefore, the scope of review for license renewal is the same as that for an original license. In addition, in response to Commission direction in the Staff Requirements Memorandum (SRM) to SECY-91-061, "Separation of Non-Reactor and Non-Power Reactor Licensing Activities from Power Reactor Licensing Activities in 10 CFR Part 50," the NRC developed licensing guidance for the first time since NPUF applicants were originally licensed (Ref. 1). In that guidance (NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors" (Ref. 2)), the NRC provides detailed descriptions of the scope, content, and format of FSARs and the NRC's process for reviewing initial license applications and license renewal applications. However, at the time of the first license renewals using NUREG-1537, some licensees did not follow the guidance applicable to license renewal applications, nor did they propose an acceptable alternative to the guidance.

Once a backlog of NPUF license renewal applications developed and persisted, the NRC and other stakeholders voiced concerns not only about the backlog, but also about the burdensome nature of the license renewal process itself. The Commission issued SRM-M080317B in April 2008, which directed the NRC staff to examine the license renewal process for NPUFs and identify and implement efficiencies to streamline this process while ensuring adequate protection of the public (Ref. 3).

The NRC staff provided the Commission with plans to improve the review of NPUF license renewal applications in SECY-08-0161, "Review of Research and Test Reactor License Renewal Applications" in October 2008 (Ref. 4). In SECY-08-0161, the NRC staff discussed a public meeting held with stakeholders to gather feedback on the current process, ways it could be improved, and the options the NRC staff was considering for improving the review process. The Commission issued SRM-SECY-08-0161 in March 2009, which instructed the NRC staff to develop program initiatives to address the backlog of existing NPUF license renewal applications (Ref. 5). In addition, the Commission directed the NRC staff to submit a long-term plan for an enhanced NPUF license renewal process. The Commission requested that the plan include development of a basis for redefining the scope of the license renewal process as well as a recommendation regarding the need for rulemaking and guidance development.

The NRC staff issued SECY-09-0095 in June 2009 to provide the Commission with a long-term plan for enhancing the NPUF license renewal process (Ref. 6). In the long-term plan, the NRC staff proposed to develop a draft regulatory basis to support proceeding with rulemaking to streamline and enhance the NPUF license renewal process. The Commission issued SRM-M090811, "Staff Requirements Memorandum – Briefing on Research and Test Reactor (RTR) Challenges" in August 2009, which directed the NRC staff to accelerate the rulemaking to establish a more efficient, effective and focused regulatory framework for NPUF license renewal (Ref. 7).

The NRC staff completed the regulatory basis in August 2012 (Ref. 8). The regulatory basis analyzed the technical, legal, and policy issues; impacts on public health, safety, and security; impacts on licensees; impacts on the NRC; stakeholder feedback; as well as other considerations, and concluded that a rulemaking was warranted.

1.2 Statement of the Problem and Nuclear Regulatory Commission Objectives for the Rulemaking

The NRC has developed this proposed rulemaking in order to address gaps and issues in current regulations. With regard to NPUFs, the Commission directed the NRC staff to develop a streamlined license renewal process for NPUFs. Following the Commission's directive, the NRC staff identified four areas of concern regarding the current license renewal process, which need to be addressed in order to develop a streamlined process. These four areas are: (1) the current reliance on initial licensing regulations for license renewal; (2) the lack of periodic updates to the FSAR; (3) the constraints related to the current "timely renewal" provision in 10 CFR 2.109; and (4) other issues in the existing rule language. The proposed rulemaking would include the following provisions to address these areas of concern:

- Create a definition for "non-power production or utilization facility," or "NPUF." The NRC is proposing to add a specific definition for "non-power production or utilization facility" to 10 CFR 50.2 to establish a term that is flexible in order to capture all non-power facilities licensed under § 50.22 or § 50.21(a) or (c), including medical radioisotope irradiation and processing facilities and research reactors and testing facilities. While these licensees are currently subject to existing regulations, a more inclusive definition would alleviate any ambiguity surrounding applicability for new licensees. This administrative change would not impose any additional cost and is further discussed in Section 3.3. The proposed rule also would make conforming changes in other sections to refer to this new definition.

- Eliminate license terms for facilities, other than testing facilities, licensed under 10 CFR 50.21(a) or (c). By issuing non-expiring licenses for facilities, other than testing facilities, licensed under § 50.21(a) or (c), the NRC would reduce the burden on qualifying NPUFs (i.e., currently operating research reactors), while continuing to protect public health and safety, promote common defense and security, and protect the environment through regular, existing oversight activities, and the proposed addition of routine FSAR update submittals. The proposed rule also would make conforming changes to the termination of license requirements in § 50.82(b) and (c), where license expiration is used as a reference point. The NRC proposes to issue orders following the publication of the final rule to remove license terms from each license. In addition, the orders would establish when the respective licensee's initial FSAR update would be due to the NRC.

- Define the license renewal process for testing facilities and NPUFs licensed under 10 CFR 50.22. By defining a license renewal process in proposed § 50.135 specific to NPUFs with licenses issued under § 50.22 and testing facilities licensed under § 50.21(c), the NRC would consolidate existing requirements for current and future licensees in one section.

- Require all NPUF licensees to submit FSAR updates to the NRC every five years. By requiring periodic updates to the FSAR, the NRC anticipates that licensees would document changes in licensing bases as they occur, which would maintain the continuity of knowledge both for the licensee and the NRC and the understanding of changes and effects of changes on the facility. From a safety perspective, an updated FSAR is important for the NRC's inspection program and for effective licensee operator training

and examinations. The updated FSAR submittals also would enhance the NRC's continuous oversight of facilities during their operation while imposing a minimal amount of regulation needed to promote common defense and security, protect the health and safety of the public, and permit widespread and diverse research and development and the widest possible amount of effective medical therapy.

- Amend the current timely renewal provision under 10 CFR 2.109, allowing NPUF facilities to continue operating under an existing license past its expiration date if the facility submits a license renewal application at least two years before the current license expiration date. Under the proposed rule, if an NPUF subject to license renewal (i.e., licensed under § 50.22 or a testing facility licensed under § 50.21(c)) files a sufficient application for license renewal at least two years (rather than the current 30 days) before the expiration of the existing license, then the existing license would not be deemed to have expired until the application has been finally determined by the NRC. The proposed revision would ensure that the NRC has adequate time to review the sufficiency of NPUF license renewal applications while the facility continues to operate under the terms of its current license.

- Provide an accident dose criterion of 1 rem (0.01 Sv) TEDE for NPUFs other than testing facilities. Currently, the NRC applies the standards in 10 CFR part 20 to NPUFs, other than testing facilities, as the accident dose criteria. More specific dose criteria in accident analyses for NPUFs, other than those NPUFs subject to 10 CFR part 100, are needed. Because of NPUFs' low potential radiological risk to the environment and the public, the part 20 public dose limits are unnecessarily restrictive as applied to accident consequences, such as the maximum hypothetical accidents (MHAs), considered in NPUF license renewal applications.[1] The NRC is proposing to amend its regulations in § 50.34 to add accident dose criterion for NPUFs not subject to part 100. The addition of an accident dose criterion for NPUFs would not require any changes to current licensee practices and, therefore would not result in any incremental costs.

- Extend the applicability of 10 CFR 50.59 to NPUFs regardless of their decommissioning status. The proposed rule would revise the wording of § 50.59(b) which currently does not apply § 50.59 to NPUFs whose licenses have been amended to cease operations and no longer have fuel onsite (e.g., have returned all of their fuel to the U.S. Department of Energy [DOE]). For licensees that had fuel removed from their site, the NRC must add license conditions identical to those of § 50.59 to allow the licensee to make changes in their facility or changes in their procedures, that would not otherwise require obtaining a license amendment pursuant to § 50.90. The license amendment process imposes an administrative burden on the licensees and the NRC, which could be eliminated with the proposed regulatory change.

- Clarify an applicant's requirements for meeting the existing provisions of 10 CFR 51.45. This change would clarify an applicant's requirements for meeting the existing provisions of § 51.45 and improve consistency throughout 10 CFR part 51 with respect to environmental report submissions required by applicants for licensing actions. The proposed regulatory requirements would help to ensure that the NRC effectively and

[1] The NRC Atomic Safety and Licensing Appeal Board has suggested that the standards in part 20 are unduly restrictive as accident dose criteria for research reactors.

efficiently meets its environmental review requirements consistent with the National Environmental Policy Act (NEPA) and the NRC's regulations for implementing NEPA.

- Eliminate the requirement for NPUFs to submit financial qualification information with license renewal applications under 10 CFR 50.33(f)(2). The basis on which the NRC has relied to reduce or eliminate financial qualification requirements for power reactor licensees, supported by the NRC's NPUF inspection and enforcement programs, can similarly be applied as a basis for eliminating NPUF license renewal financial qualification requirements.

2. Identification and Preliminary Analysis of Alternative Approaches

In addition to the proposed rule (identified as Option 3), the NRC has identified three alternatives for consideration.

- Option 1: Take No Action [Not Selected].
- Option 2: Undertake Rulemaking to Require Final Safety Analysis Report Updates and Revise the Timely Renewal Provision [Not Selected].
- Option 3: Undertake Rulemaking to Require Final Safety Analysis Report Updates, Revise the Timely Renewal Provision, and Eliminate License Terms for Class 104a or c Licensees, Other than Testing Facilities [Selected – Proposed Rule].
- Option 4: No Rulemaking for License Renewal. Issue a New Regulatory Guide and Update NUREG-1537 (Ref. 2) to Incorporate a Streamlined License Renewal Process [Not Selected].

2.1 Option 1: Take No Action [Not Selected]

Under Option 1 (not selected), the NRC would not change existing license terms or the license renewal process, as described in current regulations and guidance. This alternative serves as the baseline against which the impacts of the other identified alternatives are measured.

This option would pose no incremental burden on licensees or on the NRC. However, under this option, the NRC staff would not be responsive to the Commission's direction in SRM-M080317B (Ref. 3). Stakeholders voiced opposition to the status quo during the December 19, 2011, public meeting because it would not incorporate lessons learned from the recent round of NPUF license renewal application reviews. As a result, this option would not achieve the NRC's objectives.

2.2 Option 2: Undertake Rulemaking to Require Final Safety Analysis Report Updates and Revise the Timely Renewal Provision [Not Selected]

Under Option 2 (not selected), the NRC would revise its regulations to require all NPUFs to submit (1) license renewal applications two years in advance of license expiration (rather than the current 30 days) and (2) updated FSARs to the NRC every five years.

The current timely renewal provision in 10 CFR 2.109(a) allows an NPUF licensee to continue operation as long as it has submitted its license renewal application prior to 30 days before the expiration of its existing license. Generally, the NRC has found that 30 days does not provide an adequate amount of time for a thorough acceptance review of the license renewal application. As a result, the license renewal process is prolonged because additional time is needed to address deficiencies in the application that could have been identified before accepting the application for official review. Under this option, § 2.109(a) would be modified to require NPUFs to submit their license renewal applications two years (rather than the current 30 days) before their license is set to expire. This would grant the NRC time to thoroughly review an application and address any issues regarding missing elements without having to prolong the full review of the license renewal application.

This option also would require licensees to submit updated FSARs to the NRC. Under current regulations, licensees are not required to submit updated FSARs on a periodic basis. During the most recent round of license renewal, the NRC found that some licensees lost their licensing bases because licensees had not reflected decades of changes to the facilities in their FSARs. As a result, licensees had to reconstitute their licensing bases through the license renewal process. The reconstitution of licensing bases added burden on both licensees and the NRC and prolonged the license renewal process. This option would require that licensees submit updates to their FSARs to the NRC every five years. This submittal would certify that licensees, over time, include any operational or design changes in their FSARs, ensuring that their licensing basis is kept current and that the NRC is kept aware of any modifications.

The NRC expects that this option would reduce the burden of the license renewal process on licensees and the NRC because of the following:

(1) The current regulatory framework of 30 days is not sufficient for the NRC to complete a comprehensive acceptance review. Additional time would streamline the overall license renewal process by addressing the adequacy of an application prior to addressing the technical content of the application. This would result in a decreased burden to the NRC and licensees and would create efficiencies in the license renewal process.

(2) Requiring licensees to submit an updated FSAR every five years would compel licensees to integrate any changes to their facility operations and design into their licensing basis as they occur, ensuring that their licensing basis remains up to date. Therefore, the burden on the NRC and licensees associated with reconstituting each licensee's licensing basis during license renewal could be avoided, resulting in decreased burden and increased efficiency for both parties.

Although this option would provide some streamlining to the license renewal process by allowing additional time for acceptance reviews and requiring more frequent submittals of FSAR

updates, all NPUF licensees would still have to go through a license renewal application process, which would continue to impose burden on these licensees. The costs imposed by this option are outlined in Section 3.3. Even though this option would result in some efficiencies, this option is not cost-beneficial.

2.3 Option 3: Undertake Rulemaking to Require Final Safety Analysis Report Updates, Revise the Timely Renewal Provision, and Eliminate License Terms for Class 104a or c Licensees, Other than Testing Facilities [Selected – Proposed Rule]

Under Option 3 (the proposed rule), the NRC would eliminate license terms for class 104a or c licensees (i.e., facilities licensed under 10 CFR 50.21(a) or (c)), other than testing facilities. As a result, these licensees would not be subject to a license renewal process. However, in order to ensure that these NPUFs continue to operate safely, this option would implement additional provisions for licensees and the NRC. Further, under this option, the NRC would define a license renewal process for class 103 licensees and testing facilities in proposed § 50.135, consolidating existing requirements for current and future licensees in one section.

For class 104a or c licensees, other than testing facilities, this option would eliminate license terms and require licensees to submit updated FSARs every five years. This requirement would certify that licensees reflect operational or design changes in their FSARs over time, ensuring that their licensing basis is kept current.

For class 103 licensees and testing facilities, this option would still require licensees to submit a license renewal application at the end of their license term to keep operating. But this option also would include the streamlining features described under Option 2 (not selected) (modify the timely renewal provision in 10 CFR 2.109 and require licensees to submit updated FSARs every five years).

This option would eliminate the burden associated with the license renewal process for all but one of the currently licensed NPUFs. This large reduction in burden would be slightly offset by the minimal burden associated with submitting FSARs to the NRC on an ongoing basis.

This option would establish an overall streamlined approach to license renewal that would result in a net burden reduction for both licensees and the NRC without sacrificing safety. Therefore, Option 3 would best address the NRC's regulatory objectives and is the proposed rule option.

2.4 Option 4: Non-rulemaking Alternatives [Not Selected]

The NRC considered other, non-rulemaking approaches, such as issuing a new regulatory guide and updating NUREG-1537 (Ref. 2) to include a streamlined license renewal process. Under Option 4 (not selected) the NRC would update NUREG-1537 to include lessons learned from the license renewal process, including lessons learned from application of the "Interim Staff Guidance on the Streamlined Review Process for License Renewal for Research Reactors" (ISG) (Ref. 10). Although this option would update NUREG-1537 to incorporate lessons learned from past license renewals, these changes would be made to guidance documents and would not have the force of a regulation. As a result, licensees would not have to comply with the changes, and there may be no ensuing benefit.

Although this option could result in increased efficiency for licensees and NRC due to the incorporation of lessons learned, this option does not fully address any of the issues that formed the basis of the Commission's direction and the NRC staff's objectives. Specifically, this option would not address the issue of the lack of regulations specific to the license renewal process for NPUFs. Further, this option would not address the issues associated with the current timely renewal provision. Moreover, because this option and other non-rulemaking approaches do not carry the force of a regulatory action and any provisions would, therefore, be voluntary, they would not achieve the broad applicability of a rulemaking.

3. Estimation and Evaluation of Benefits and Costs: Presentation of Results

This section details the NRC's approach to estimating the costs and benefits of the proposed rule, and presents the results of the analysis:

- Section 3.1 details the methodology, assumptions, and baseline used to evaluate the costs and benefits associated with the options considered in the regulatory analysis.
- Section 3.2 summarizes the costs and benefits associated with the options.
- Section 3.3 presents the details of the costs associated with the proposed rule.
- Section 3.4 discusses the benefits of the proposed rule.
- Section 3.5 provides a discussion of the disaggregated results.
- Section 3.6 discusses the uncertainty analysis.

3.1 Methodology and Assumptions

This section explains the process used to evaluate the costs and benefits associated with the rulemaking options, consistent with the guidance provided in NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission" (Ref. 11). The benefits include desirable changes in affected attributes (e.g., monetary savings, improved safety, reduced burden on licensees, streamlined process), while the costs include any undesirable changes in affected attributes (e.g., monetary costs).

The NRC estimated the costs and benefits of the proposed rule as incremental costs and benefits as compared to a "no action" baseline. The no action baseline includes the historical costs incurred by NPUFs and the NRC during the license renewal process. The NRC estimated all of the incremental costs and benefits resulting from the proposed requirements that would be incurred beginning in 2019, which is the year the final rule is assumed to come into effect. All costs and benefits presented in this analysis are in 2016 dollars.[2]

Affected Universe

The regulatory option under consideration would affect all NPUFs. The costs and benefits affecting individual facilities, however, differ depending on various characteristics (e.g., power level of the NPUF, type of staff employed, and date of last license renewal).

The NRC estimated the costs and benefits incurred by the 31 currently operating NPUFs. Incremental costs and benefits to the other five regulated NPUFs that are in the process of

[2] Where appropriate, values were scaled to 2016 dollars using projections of the consumer price index from Statista (available online at: http://www.statista.com/statistics/244993/projected-consumer-price-index-in-the-united-states/).

decommissioning, have possession-only licenses, or are permanently shut down are not considered in the regulatory analysis. Appendix B details the cost and savings buildup.

For the purposes of estimating the costs and benefits of the proposed rule, the 31 NPUFs included in the analysis are broken into three categories based on the power of the facility: Low (<100 kilowatt (kW)), Medium (≥100 and <1000 kW), and High (≥ 1000 kW). There are five facilities in the Low category, 11 in the Medium category, and 15 facilities in the High category. These divisions allow for the estimation of regulatory compliance costs and savings that differ based on the size and power level of the different facilities. Exhibit 3-1 lists the NPUFs included in the universe of affected entities under this analysis, by category.

Exhibit 3-1. List of NPUFs by Power Level

Low (<100 kW)	Medium (≥100 and <1000 kW)	High (≥ 1000 kW)
Idaho State University	Aerotest*	Armed Forces Radiobiology Research Institute
Purdue University	Dow Chemical Company	Massachusetts Institute of Technology
Rensselaer Polytechnic Institute	GE-Hitachi	National Institute of Standards and Technology (NIST)**
Texas A&M University (AGN)	Kansas State University	North Carolina State University
University of New Mexico	Missouri University of Science and Technology	Oregon State University
	Ohio State University	Pennsylvania State University
	Reed College	Rhode Island Atomic Energy Commission
	University of California (Irvine)	Texas A&M University (TRIGA)
	University of Florida	U.S. Geological Survey
	University of Maryland	University of California (Davis)
	University of Utah	University of Massachusetts (Lowell)
		University of Missouri (Columbia)
		University of Texas
		University of Wisconsin
		Washington State University
5 Facilities	**11 Facilities**	**15 Facilities**

Source: NRC Information Digest, 2015-2016 (NUREG-1350, Vol. 27) Appendix J: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/

*Aerotest is currently shut down, but is included here only for purposes of the regulatory analysis. The Commission has made no determination whether the facility will continue operations by the effective date of the rule.

**NIST has specific requirements discussed in Section 3.2 below.

As described in the *Federal Register* notice, the 31 NPUFs are separated into different groups that will dictate when the licensee's initial FSAR update would be due to the NRC. These groupings also vary the time that different costs and benefits are incurred across the analysis period. Group 1 consists of licensees that completed the license renewal process using the ISG. Group 2 consists of licenses that last completed license renewal prior to the issuance of the ISG (i.e., license renewal was reviewed per NUREG-1537, Part 2). Group 3 would consist of the remaining NPUF licensees, each of which would need to submit a license renewal

application consistent with the format and content guidance in NUREG-1537, Part 1. The staff will review the application per NUREG-1537, Part 2 using the ISG. Exhibit 3-2 details the different groupings.

Exhibit 3-2. List of NPUFs by License Renewal Period

Group 1	Group 2	Group 3
Armed Forces Radiobiology Research Institute	Idaho State University	Aerotest*
Dow Chemical Company	Kansas State University	GE-Hitachi
Purdue University	Massachusetts Institute of Technology	North Carolina State University
Reed College	Missouri University of Science and Technology	University of California (Davis)
Rhode Island Atomic Energy Commission	NIST**	
Texas A&M University (AGN)	Ohio State University	
Texas A&M University (TRIGA)	Oregon State University	
U.S. Geological Survey	Pennsylvania State University	
University of California (Irvine)	Rensselaer Polytechnic Institute	
University of Florida	University of New Mexico	
University of Maryland	University of Utah	
University of Massachusetts (Lowell)	University of Wisconsin	
University of Missouri (Columbia)	Washington State University	
University of Texas		
14 Facilities	**13 Facilities**	**4 Facilities**

*Aerotest is currently shut down, but is included here only for the purposes of the regulatory analysis. The Commission has made no determination whether the facility will continue operations by the effective date of the rule.
**NIST has specific requirements discussed in Section 3.2 below.

Cost Estimation

In order to estimate the costs associated with the proposed rule, the NRC used a work breakdown approach to deconstruct the proposed rule requirements according to the required activities for each requirement. For each required activity, the NRC further subdivided the work across labor categories (i.e., Professor, Operator, Technician, Student, and Administrator). The NRC estimated the required level of effort (LOE) for each labor category and for each required activity in order to develop bottoms-up cost estimates.

The NRC gathered data from several sources and consulted licensees to develop LOE and unit cost estimates. Mean hourly wage rates for various labor categories were derived from Bureau of Labor Statistics (BLS) 2014 Occupational Employment and Wages data and scaled to 2016 dollars (see footnote 1 in Section 3.1). As per NUREG/CR-4627, "Generic Cost Estimates," direct wage rates are loaded using a multiplier of two to account for licensee and contractor labor and overhead (i.e., fringe, benefits, general administration, and profit) (Ref. 12). Exhibit 3-3 presents the mean wage rates, loaded wage factor, and loaded wage rates used throughout this analysis.

Exhibit 3-3. Wage Rate Estimates by Labor Category (2016$)

Labor Category	Mean Wage Rate	Loaded Wage Factor	Loaded Wage Rate
	A	B	C = A x B
Reactor Director, Engineering Professor	$49.81	2	$99.63
NPUF Operator, Assistant Director	$40.18		$80.36
Nuclear Technician	$37.10		$74.19
Graduate Teaching Assistant	$16.08		$32.16
Administrator Education, Post-Secondary	$49.77		$99.54
NRC Staff			$129.90

NOTE: The loaded wage factor was based on NUREG/CR-4627 (Ref. 12).
The mean wage rate for Engineering Professors (25-1031), Nuclear Power Reactor Operators (51-8011) henceforth NPUF Operator, Nuclear Technicians (19-4051), Graduate Teaching Assistants (25-1191), and Administrators (11-9033) were obtained from BLS data and then scaled to 2016 dollars.
The Nuclear Power Reactor Operator job category was used as a proxy for NPUF Operator based on direct licensee input.
The NRC staff loaded labor rates are estimated to be $128 per hour and are calculated based on actual labor and benefit costs from the prior fiscal year (2015) by office and grade and then scaled to 2016 dollars.

Cost Estimation Methods

The NRC applied several cost estimation methods in this analysis. The professional knowledge and judgment of the NRC staff were used to estimate many of the costs and benefits. Additionally, a build-up method, solicitation of licensee input, and extrapolation techniques were used to estimate costs and benefits.

To begin with, some activities were estimated using the engineering build-up method of cost estimation, which combined incremental costs of an activity from the bottom up to estimate a total cost. For this step, the NRC reviewed previous license applications and extracted the length of each section, in page numbers, and the NRC used these data to develop preliminary LOEs which could then be compared to licensee feedback.

The NRC consulted licensee experts within and outside of the agency to develop most of the LOE estimates used in the analysis. For example, for both cost savings and the costs of the proposed rule, the NRC consulted licensees when estimating the LOE required for the existing license application process. Additionally, the NRC staff contributed to the estimation of LOE required for inspection-related activities.

Extrapolation was used to estimate some cost activities, which relies on actual past or current costs to estimate the future cost of similar activities. For instance, to calculate the estimated costs of the existing license renewal process and the proposed rule, it was necessary for the NRC to extrapolate the labor categories responsible for the work based on limited licensee data. Where possible, the NRC relied directly on licensee input. In addition, the NRC used actual timekeeping data and contractor costs from the review of several NPUF license renewal applications and extrapolated these data to estimate the NRC cost savings per NPUF and the total averted costs. For steps in the current and proposed license renewal process with no data, however, the NRC determined the labor category and distribution of work between the labor categories based on similar steps in the process for which data are available.

To incorporate uncertainty into the model, the NRC employed Monte Carlo simulation, which is an approach to uncertainty analysis where values for input variables are expressed as

distributions defined by the analyst. The analysis was then run multiple (usually 1,000 or more) times and values were chosen at random from the distributions of the input variables. The result was a distribution of values for the output variable of interest. With Monte Carlo simulation, it is also possible to determine the input variables that have the greatest effect on the value of the output variable. See Section 3.6 for a detailed description of the Monte Carlo simulation methods and a presentation of the results.

Time Period of Analysis

To define the period of analysis covered by this regulatory analysis (i.e., the period over which costs and benefits would be incurred), the NRC decided on a 20-year time horizon based on the current, standard 20-year license renewal term for NPUFs. By defining the period of analysis as an increment of 20, the costs and benefits of the proposed rulemaking can be easily extended to include another full round of license renewals. The 20-year analysis period for this regulatory analysis runs from 2019 (the anticipated effective date of the final rule) through 2038.

Present Value Calculations

The NRC calculated the present value of the costs and benefits (in 2016 dollars) that NPUFs would incur over the analysis period. The rule is assumed to be finalized and become effective in 2019. One-time implementation costs for both the NRC and licensees would be incurred in 2019. Beginning in 2020, a once per five-year cost per licensee (to draft and submit a revised FSAR update) will be incurred by the licensee, as well as a cost incurred by the NRC to review the submittal. As discussed previously, licensees were separated into three distinct groupings according to their current license status (shown in Exhibit 3-2). These groups will have a staggered FSAR update submittal schedule to prevent a backlog of FSAR update submittals from occurring. These staggered updates highlight the importance of discounting on the resulting net benefit estimates, as costs and benefits in the near future are weighted higher than those that occur further in the future when a discount rate is applied. In accordance with guidance provided by the Office of Management and Budget in Circular A-4 (“Regulatory Analysis,” 2003), the NRC presents results at both 3 percent and 7 percent discount rates (Ref. 13).

3.2 Summary of Costs and Benefits of the Regulatory Options

This section presents the costs and benefits of the proposed rule with respect to three options: (1) take no action, (2) undertake a rulemaking to revise the timely renewal provision and require FSAR updates, and (3) undertake a rulemaking to revise the timely renewal provision, require FSAR updates, and eliminate license terms for class 104a or c licensees, other than testing facilities. The NRC considered a fourth option (i.e., Option 4) that would use non-rulemaking approaches, such as the issuance of a new regulatory guide and updating NUREG-1537 (Ref. 2), to address the objectives of the rulemaking (see Section 2.4). Option 4 was rejected and not included in the analysis of costs and benefits because this option would not fully address any of the Commission’s directions and the NRC staff’s objectives for the rulemaking. Where possible, the NRC monetizes the impacts of the regulatory options. Those impacts that cannot be monetized are instead described, to the extent possible, quantitatively or qualitatively. This section presents a summary of the total costs and benefits associated with each option. Sections 3.3 and 3.4 describe the costs and benefits of the proposed requirements in greater detail. Note that all costs and benefits presented in this analysis are rounded to two significant figures. The NRC used Monte Carlo simulation methods to account for uncertainty in the

estimated costs and benefits of the proposed rule. See Section 3.6 for a detailed discussion of the uncertainty analysis. Refer to Appendix B for a more detailed presentation of the cost data.

Option 1: Take No Action [Not Selected]

Under Option 1 (not selected), the NRC assumes that the rule would not be implemented; however, existing programs and regulatory efforts would still be in effect. There would be no incremental costs or benefits associated with this option over the 20-year analysis period, as shown in Exhibit 3-4.

Exhibit 3-4. Summary of Incremental Costs and Benefits for Option 1: No Action Baseline [Not Selected]

Incremental Costs	Incremental Benefits
NPUFs: $0 using a 3% discount rate $0 using a 7% discount rate	None.
NRC: $0 using a 3% discount rate $0 using a 7% discount rate	None.

Option 2: Undertake Rulemaking to Require Final Safety Analysis Report Updates and Revise the Timely Renewal Provision [Not Selected]

Under Option 2 (not selected), the NRC assumes that the current license renewal process would remain in place. In addition, the NRC would require submittal of FSAR updates every five years. This additional requirement would impose incremental costs (implementation and operational) to both NPUFs and NRC equal to the costs incurred under the proposed rule (Option 3) without any of the monetized cost savings (benefits).[3] Exhibit 3-5 displays the monetary costs and benefits of Option 2. Note that Total Costs (column B) in Exhibit 3-5 are equal to the Total Costs (column C) of the proposed rule (Option 3) in Exhibit 3-6. The total costs of Option 2 are estimated at $2.8 million (assuming 7 percent discounting) and $3.4 million (assuming 3 percent discounting) over the 20-year analysis period.

[3] While the requirement of licensees to keep FSARs up to date may result in a gain in efficiency during the license renewal process, estimating these efficiencies would be speculative and therefore the NRC does not attempt to quantify or monetize these increases.

Exhibit 3-5. Summary of Total Costs and Benefits for Option 2 [Not Selected] (2016$)

Year		Total Benefits	Total Costs	Net Benefits
		A	B	C = A – B
1	2019	$0	$870,000	($870,000)
2	2020	$0	$380,000	($380,000)
3	2021	$0	$340,000	($340,000)
4	2022	$0	$110,000	($110,000)
5	2023	$0	$0	$0
6	2024	$0	$0	$0
7	2025	$0	$380,000	($380,000)
8	2026	$0	$340,000	($340,000)
9	2027	$0	$110,000	($110,000)
10	2028	$0	$0	$0
11	2029	$0	$0	$0
12	2030	$0	$380,000	($380,000)
13	2031	$0	$340,000	($340,000)
14	2032	$0	$110,000	($110,000)
15	2033	$0	$0	$0
16	2034	$0	$0	$0
17	2035	$0	$380,000	($380,000)
18	2036	$0	$340,000	($340,000)
19	2037	$0	$110,000	($110,000)
20	2038	$0	$0	$0
Undiscounted 20-year total		$0	$4,200,000	($4,200,000)
20-year total with 3% discounting		$0	$3,400,000	($3,400,000)
20-year total with 7% discounting		$0	$2,800,000	($2,800,000)
20-year undiscounted average		$0	$210,000	($210,000)
Annualized with 3% discounting*		$0	$230,000	($230,000)
Annualized with 7% discounting*		$0	$260,000	($260,000)

*The following formula was used to calculate discounted annualized costs and benefits (where r is the discount rate and n is the number of years [20]): $Annualized\ Cost = Present\ Value\ Cost \cdot \frac{r \cdot (1+r)^n}{(1+r)^n - 1}$.

Note that the annualized cost estimates at 3 percent and 7 percent are higher than the undiscounted yearly average cost estimate because the annualized cost formula described above accounts for both the number of periods (20 years) and the discount rate, which together in this formula serve as a growth rate.
Totals may not add due to rounding.

Option 3: Undertake Rulemaking to Require Final Safety Analysis Report Updates, Revise the Timely Renewal Provision, and Eliminate License Terms for Class 104a or c Licensees, Other than Testing Facilities [Selected – Proposed Rule]

Under Option 3 (the proposed rule), the NRC would undertake the proposed rulemaking to alter the existing license renewal process in favor of non-expiring licenses for qualifying facilities. The NRC estimates the costs and benefits of Option 3 relative to a no action baseline (i.e., Option 1). Option 3 would result in incremental costs of $2.8 million (using a 7 percent discount

rate) or $3.4 million (using a 3 percent discount rate) over the 20-year analysis period. Exhibit 3-6 presents the breakdown of total costs.

Exhibit 3-6. Summary of Total Costs for Option 3 [Selected – Proposed Rule] (2016$)

Year		NPUF Cost	NRC Cost	Total Costs
		A	B	C = A + B
1	2019	$140,000	$720,000	$870,000
2	2020	$180,000	$200,000	$380,000
3	2021	$160,000	$180,000	$340,000
4	2022	$53,000	$61,000	$110,000
5	2023	$0	$0	$0
6	2024	$0	$0	$0
7	2025	$180,000	$200,000	$380,000
8	2026	$160,000	$180,000	$340,000
9	2027	$53,000	$61,000	$110,000
10	2028	$0	$0	$0
11	2029	$0	$0	$0
12	2030	$180,000	$200,000	$380,000
13	2031	$160,000	$180,000	$340,000
14	2032	$53,000	$61,000	$110,000
15	2033	$0	$0	$0
16	2034	$0	$0	$0
17	2035	$180,000	$200,000	$380,000
18	2036	$160,000	$180,000	$340,000
19	2037	$53,000	$61,000	$110,000
20	2038	$0	$0	$0
Undiscounted 20-year total		$1,700,000	$2,500,000	$4,200,000
20-year total with 3% discounting		$1,300,000	$2,100,000	$3,400,000
20-year total with 7% discounting		$1,000,000	$1,700,000	$2,800,000
20-year undiscounted average		$85,000	$130,000	$210,000
Annualized with 3% discounting*		$90,000	$140,000	$230,000
Annualized with 7% discounting*		$98,000	$170,000	$260,000

*The following formula was used to calculate discounted annualized costs and benefits (where r is the discount rate and n is the number of years [20]): $Annualized\ Cost = Present\ Value\ Cost \cdot \frac{r \cdot (1+r)^n}{(1+r)^n - 1}$.

Note that the annualized cost estimates at 3 percent and 7 percent are higher than the undiscounted yearly average cost estimate because the annualized cost formula described above accounts for both the number of periods (20 years) and the discount rate, which together in this formula serve as a growth rate.
Totals may not add due to rounding.

By implementing Option 3, a number of cost savings to both the NRC and NPUFs would be realized, as the license renewal process would be retired in favor of non-expiring licenses for qualifying facilities. The NRC estimates the benefits of Option 3 (in terms of averted costs) by estimating the cost of the current license renewal process. By moving to non-expiring licenses, Option 3 would result in incremental benefits of $8.1 million (using a 7 percent discount rate) or

$12.0 million (using a 3 percent discount rate) over the 20-year analysis period. Exhibit 3-7 presents the breakdown of total benefits.

Exhibit 3-7. Summary of Total Benefits for Option 3, the Proposed Rule (2016$)

Year		NPUF Benefits	NRC Benefits	Total Benefits
		A	B	C = A + B
1	2019	$0	$0	$0
2	2020	$0	$0	$0
3	2021	$120,000	$220,000	$340,000
4	2022	$0	$0	$0
5	2023	$0	$0	$0
6	2024	$0	$0	$0
7	2025	$0	$0	$0
8	2026	$260,000	$670,000	$930,000
9	2027	$0	$0	$0
10	2028	$1,200,000	$2,600,000	$3,700,000
11	2029	$1,200,000	$2,600,000	$3,700,000
12	2030	$150,000	$450,000	$590,000
13	2031	$920,000	$2,100,000	$3,000,000
14	2032	$250,000	$480,000	$740,000
15	2033	$250,000	$480,000	$740,000
16	2034	$150,000	$450,000	$590,000
17	2035	$250,000	$480,000	$740,000
18	2036	$250,000	$480,000	$740,000
19	2037	$250,000	$480,000	$740,000
20	2038	$250,000	$480,000	$740,000
Undiscounted 20-year total		$5,500,000	$12,000,000	$17,000,000
20-year total with 3% discounting		$3,900,000	$8,500,000	$12,000,000
20-year total with 7% discounting		$2,500,000	$5,600,000	$8,100,000
20-year undiscounted average		$270,000	$600,000	$870,000
Annualized with 3% discounting		$260,000	$570,000	$830,000
Annualized with 7% discounting		$240,000	$530,000	$770,000

*The following formula was used to calculate discounted annualized costs and benefits (where r is the discount rate and n is the number of years [20]): $Annualized\ Cost = Present\ Value\ Cost \cdot \frac{r \cdot (1+r)^n}{(1+r)^n - 1}$.
Totals may not add due to rounding.

The proposed rulemaking would ease the burden on licensees by creating non-expiring licenses which will result in considerable time and cost savings as compared to Options 1 and 2. Exhibit 3-8 summarizes the incremental costs and benefits of the proposed rule under Option 3. Option 3 would result in net benefits of $5.3 million (using a 7 percent discount rate) or $8.9 million (using a 3 percent discount rate) over the 20-year analysis period.

Exhibit 3-8. Summary of Incremental Costs and Benefits for Option 3 [Selected – Proposed Rule] (2016$)

Year		Total Benefits	Total Costs	Net Benefits
		A	B	C = A - B
1	2019	$0	$870,000	($870,000)
2	2020	$0	$380,000	($380,000)
3	2021	$340,000	$340,000	$980
4	2022	$0	$110,000	($110,000)
5	2023	$0	$0	$0
6	2024	$0	$0	$0
7	2025	$0	$380,000	($380,000)
8	2026	$930,000	$340,000	$590,000
9	2027	$0	$110,000	($110,000)
10	2028	$3,700,000	$0	$3,700,000
11	2029	$3,700,000	$0	$3,700,000
12	2030	$590,000	$380,000	$210,000
13	2031	$3,000,000	$340,000	$2,700,000
14	2032	$740,000	$110,000	$620,000
15	2033	$740,000	$0	$740,000
16	2034	$590,000	$0	$590,000
17	2035	$740,000	$380,000	$360,000
18	2036	$740,000	$340,000	$400,000
19	2037	$740,000	$110,000	$620,000
20	2038	$740,000	$0	$740,000
Undiscounted 20-year total		$17,000,000	$4,200,000	$13,000,000
20-year total with 3% discounting		$12,000,000	$3,400,000	$8,900,000
20-year total with 7% discounting		$8,100,000	$2,800,000	$5,300,000
20-year undiscounted average		$870,000	$210,000	$660,000
Annualized with 3% discounting*		$830,000	$230,000	$600,000
Annualized with 7% discounting*		$770,000	$260,000	$500,000

*The following formula was used to calculate discounted annualized costs and benefits (where r is the discount rate and n is the number of years [20]): $Annualized\ Cost = Present\ Value\ Cost \cdot \frac{r \cdot (1+r)^n}{(1+r)^n - 1}$.

Note that the annualized cost estimates at 3 percent and 7 percent are higher than the undiscounted yearly average cost estimate because the annualized cost formula described above accounts for both the number of periods (20 years) and the discount rate, which together in this formula serve as a growth rate.
Totals may not add due to rounding.

The only currently licensed testing facility, NIST, has specific requirements. The proposed rule would require that NIST continue to be subject to the license renewal process and, additionally, NIST will be tasked with submitting updated FSARs. These requirements result in the full costs of the proposed rule, without any of the averted costs (as the full NPUF license renewal application process will continue). The total 20-year undiscounted cost of the proposed rule to NIST is estimated at $77,000 with an incremental operation cost estimated at $18,000 per

FSAR update. At the time of the drafting of this report, NIST is the only NPUF which would not be eligible for a non-expiring license term.

3.3 Costs of the Proposed Rule

This section details the estimated costs and benefits (i.e., cost savings) of the proposed rule. Under the proposed rule, the following proposed change to 10 CFR part 50 would result in costs:

- Proposed 10 CFR 50.71(e) would require each NPUF licensee to submit an updated FSAR to the NRC every five years.

The following proposed rule change would result in cost savings (see Section 3.4 for detailed discussion of cost savings):

- Proposed § 50.51 would eliminate fixed license terms for NPUFs licensed under § 50.21(a) or (c), other than testing facilities. This rule change would result in cost savings since the affected NPUFs would no longer be required to go through the license renewal application process.

In addition, the proposed rule also would include the following proposed changes, which are not analyzed in this regulatory analysis:

- Proposed changes in 10 CFR 2.109 would require certain NPUF licensees to file an application for license renewal at least two years (rather than the current 30 days) before the expiration of the existing license. This proposed rule provision would not impose any incremental costs on the NPUFs that would continue to be subject to license renewal, as this activity occurs in the baseline, albeit at a different time (30 days before expiration of the existing license). In addition, the NRC expects this proposed rule change to provide cost savings due to efficiency gains during the license renewal process. While this proposed requirement would result in gains in efficiency during the license renewal process, estimating these efficiencies would be speculative and, therefore, the NRC did not attempt to quantify or monetize these increases.

- Proposed changes in § 50.2 would define an NPUF as a non-power reactor, testing facility, or other production or utilization facility, licensed under § 50.21(a), 50.21(c), or 50.22, other than a power reactor. This provision is an administrative change to ensure that all variations of NPUFs would be covered under the proposed rulemaking.

- Proposed changes in § 50.33(f)(2) would eliminate the requirement that NPUF applicants need to submit financial information in their license renewal applications that is equivalent to financial information included at the time of initial licensing. While this proposed requirement would result in cost savings during the license renewal process, estimating these cost savings would be speculative and, therefore, the NRC did not attempt to quantify or monetize these increases.

- Proposed changes in § 50.34 would establish an accident dose criterion for NPUFs. Existing licensees would not need to change any existing practices. Therefore, this proposed provision would not impose incremental costs on licensees.

- Proposed changes in § 50.59(b) would extend the applicability of § 50.59 to NPUFs that have permanently ceased operations and returned fuel to the DOE. For the purposes of this analysis, the NRC does not anticipate existing NPUF licensees to permanently cease operations and return fuel to the DOE during the 20-year period of analysis. Therefore, this administrative change would not result in any costs savings during the 20-year period of analysis.

- Proposed changes in § 50.82 would make conforming changes to existing requirements to align terminology and existing requirements to the terminology and non-expiring license terms in the proposed rule. These administrative changes would not result in incremental costs.

- Proposed § 50.135 would define a license renewal process specific to NPUFs with licenses issued under § 50.22 and testing facilities licensed under § 50.21(c), consolidating existing requirements for current and future licensees in one section. The proposed rule would not change the license renewal process from current requirements. Therefore, the analysis does not include incremental costs for these requirements.

- Proposed changes in 10 CFR 51.45 would cite a new § 51.56 in the list of sections that would require each applicant or petitioner to submit an environmental report. This would be an administrative change that would not impose incremental costs on licensees or the NRC.

- Proposed § 51.56 would clarify the existing requirements for each applicant for an NPUF license or license renewal to submit an environmental report. The NRC currently requires licensees to submit equivalent environmental information in the baseline. This section would establish the regulatory framework, which currently does not exist. Therefore, the proposed provision would not result in any incremental costs.

3.3.1. Affected Entity Implementation

The proposed rule would impose implementation costs on 31 NPUFs. These incremental implementation costs include: reviewing the finalized rule, reviewing the NRC-issued guidance documents, reviewing and updating facility procedures, and allowing the facility's safety review board to review the rule and guidance. One-time NPUF implementation costs are assumed to accrue in 2019 (the expected effective date of the rule).

Exhibit 3-9 presents a breakdown of the NPUF implementation costs by the varying categories of NPUFs (Low, Medium, and High). These costs include: reviewing the finalized rule, reviewing NRC-issued guidance documents, reviewing and updating procedures, and the providing review by the safety review board. The NRC estimates the implementation costs to range from $4,300 for each NPUF in the Low category to $4,900 for each NPUF in the High category.

Exhibit 3-10 details the NPUF's implementation costs, which amount to total costs per category of $22,000 for the Low category, $48,000 for the Medium category, and $73,000 for the High category NPUFs. These per-category costs amount to a total one-time NPUF implementation cost of $140,000 over the 20-year analysis period.

Exhibit 3-9. Breakdown of Affected Entity Implementation Costs per NPUF (2016$)

One-time NPUF Implementation Costs	Low	Medium	High
Reviewing Finalized Rule	$1,000	$1,000	$1,100
Reviewing NRC-Issued Guidance Documents	$1,000	$1,000	$1,100
Reviewing and Updating Procedures	$1,600	$1,600	$2,000
Safety Review Board	$700	$700	$700
Total One-time NPUF Implementation Costs	**$4,300**	**$4,300**	**$4,900**

NOTE: Totals may not add due to rounding.
Totals represent per-NPUF costs.

Exhibit 3-10. Total Present Value Affected Entity Implementation Costs (2016$)

		Low	Medium	High
One-time NPUF Implementation Costs	**A**	$4,300	$4,300	$4,900
Number of NPUFs	**B**	5	11	15
Cost per Category	**C = A x B**	$22,000	$48,000	$73,000
Total Present Value Implementation Cost	**D = ∑ (C)**	**$140,000**		

NOTE: The Cost per Category is equal to the One-time NPUF Implementation Costs multiplied by the Number of NPUFs per category (see Exhibit 3-1). The Present Value Total Implementation Cost is equal to the summation of the Cost per Category. Because all of the implementation costs are assumed to incur during the first year of the rule, discounting at 3 and 7 percent results in the same present value.
Totals may not add due to rounding.

3.3.2. Affected Entity Operation

The proposed rule would impose operational costs on the 31 NPUFs. These incremental operational costs include routine and recurring activities under the proposed rule, such as preparing and submitting an updated FSAR, preparing for and participating in review-related inspection activities, and participating in a lengthened inspection exit meeting. Inspection-related activities resulting from the proposed rule would *not* require new inspections. Instead, any inspection-related activities are add-on activities to inspections happening in the baseline (e.g., the routine inspection program for NPUFs).

Recurring operation costs are assumed to begin in 2020 (one year after the effective date of the rule) for Group 1, 2021 for Group 2, and 2022 for Group 3 (see Exhibit 3-2 for NPUF groupings), based on an NRC-determined phase-in of FSAR submittals. These operational costs are assumed to occur every five years, aligning with the required FSAR updates for each group.

Exhibit 3-11 presents the breakdown of the NPUF operational costs by category. These costs include: preparing the updated FSAR, preparing for the review-related inspection, participating in review-related inspection activities, and participating in a lengthened exit meeting. The NRC estimates the operational cost to be $5,400 per Low category, $8,300 per Medium category, and $18,000 per High category NPUF per FSAR update.

Exhibit 3-11. Breakdown of Affected Entity Operational Costs (2016$)

NPUF Operational Costs	Low	Medium	High
Preparing Updated FSAR	$5,000	$7,500	$17,000
Preparing for Review-Related Inspection	$260	$590	$1,200
Participating in Review-Related Inspection	$130	$130	$250
Participating in Exit Meeting*	$0	$0	$0
Total NPUF Operational Cost per FSAR Update	**$5,400**	**$8,300**	**$18,000**

* Value represents the average from the uncertainty analysis. See Section 3.6 and Appendix B for more information.
NOTE: Totals may not add due to rounding.
Total Costs are per NPUF per FSAR update.

Exhibit 3-12 presents the total NPUF operational costs. Over the course of the 20-year analysis period, there will be four FSAR updates (one every five years). Therefore, the Undiscounted Total Operating Cost (row D) is equal to the Cost per FSAR Update (row C) multiplied by four (for four updates in 20 years). These costs per category amount to a total NPUF operation cost of $1.6 million undiscounted ($900,000 using a 7 percent discount rate and $1,200,000 using a 3 percent discount rate) over the 20-year analysis period.

Exhibit 3-12. Total Present Value Affected Entity Operational Costs (2016$)

		Low	Medium	High
NPUF Operational Cost per FSAR Update	**A**	$5,400	$8,300	$18,000
Number of Licensees	**B**	5	11	15
Operational Cost per Category per FSAR Update	**C = A x B**	$27,000	$91,000	$270,000
Undiscounted Total Present Value Operational Cost	**D = ∑ (C) x 4**	$1,600,000		
Total Present Value NPUF Operational Cost at 3% discounting		$1,200,000		
Total Present Value NPUF Operational Cost at 7% discounting		$900,000		

NOTE: The Operation Cost per Category per FSAR Update (C) is equal to the NPUF Operation Cost per FSAR update (A) multiplied by the number of NPUFs per category (B, see Exhibit 3-1). The Undiscounted Total NPUF Operating Cost (D) is equal to the Operation Cost per Category per FSAR Update (C) multiplied by four (the number of FSAR updates required per NPUF over the 20 year time period of the analysis).
Totals may not add due to rounding.

3.3.3. NRC Implementation

The proposed rule also would impose implementation costs on the NRC. These incremental implementation costs include procedural and administrative activities such as finalizing the rulemaking, developing guidance on the revised license renewal process, issuing orders to remove license terms and trigger FSAR update submittals, training NRC staff, and updating the project manager (PM) qualification program. These one-time costs are assumed to be incurred in 2019.

Exhibit 3-13 presents the NRC's total implementation costs which amount to a one-time cost of $720,000 over the 20-year analysis period. The NRC's implementation costs are not reliant on the number or category of the licensees.

Exhibit 3-13. Breakdown of NRC Implementation Costs (2016$)

NRC One-time Licensee Implementation Costs	Low	Medium	High
Finalizing Rulemaking		$680,000	
Developing Guidance on Revised License Renewal Process		$19,000	
Issue Orders to Remove License Terms		$10,000	
Training NRC Staff		$15,000	
Updating Project Manager Qualification Program		$1,600	
Total Present Value NRC Implementation Cost		**$720,000**	

NOTE: Totals may not add due to rounding.

3.3.4. NRC Operation

The proposed rule also would impose operational costs on the NRC. These incremental operational costs include the recurring activities under the proposed rule such as the review of the updated FSARs, and the preparation and completion of review-related inspection activities. Recurring operation costs are assumed to begin in 2020 (one year after the effective date of the rule) for Group 1, 2021 for Group 2, and 2022 for Group 3.

Exhibit 3-14 details the NRC's operational costs, which amount to $7,800 per Low category licensee, $13,000 per Medium category licensee, and $18,000 per High category licensee. These values amount to the cost of reviewing one round of FSAR updates.

Exhibit 3-15 presents the total NRC operational costs over the analysis period. Over the course of the 20-year analysis period, there will be four updates (one every five years) and, consequently, four reviews. Therefore, these per-category costs amount to total NPUF operational costs of $1.8 million undiscounted ($1,000,000 using a 7 percent discount rate and $1,400,000 using a 3 percent discount rate) over the 20-year analysis period.

Exhibit 3-14. Breakdown of NRC Operational Costs (2016$)

NRC Operational Costs	Low	Medium	High
Reviewing Updated FSAR	$7,800	$10,000	$13,000
Preparing for Review-Related Inspection Activities	$0	$780	$1,600
Completing Review-Related Inspection	$0	$780	$1,600
Closing Review-Related Inspection Activities	$0	$780	$1,600
Total NRC Operational Cost per FSAR Update	**$7,800**	**$13,000**	**$18,000**

NOTE: Totals may not add due to rounding.
Total NRC operation costs are costs per FSAR Update per NPUF.

Exhibit 3-15. Present Value of NRC Operational Costs (2016$)

		Low	Medium	High
NRC Operational Costs per FSAR Update	**A**	$7,800	$13,000	$18,000
Number of Licensees	**B**	5	11	15
Operational Costs per Category per FSAR Update	**C = A x B**	$39,000	$140,000	$260,000
Undiscounted Total Present Value Operational Cost	**D = ∑ (C) x 4**	$1,800,000		
Total Present Value NRC Operational Cost at 3% discounting		$1,400,000		
Total Present Value NRC Operational Cost at 7% discounting		$1,000,000		

NOTE: The NRC Operation Cost per Category per FSAR Update (C) is equal to the NRC Operation Cost per FSAR update (A) multiplied by the number of NPUFs per category (B, see Exhibit 3-1). The Undiscounted Total NRC Operating Cost (D) is equal to the Operation Cost per Category per FSAR Update (C) multiplied by four (the number of FSAR updates required per NPUF over the 20 year time period of the analysis.
Totals may not add due to rounding.

3.4 Benefits of the Proposed Rule

Relative to the no action baseline, the incremental benefits from the options under consideration are as follows:

- Option 1 (not selected): No action alternative. This option would not result in any incremental benefits.

- Option 2 (not selected): Undertake rulemaking to require FSAR updates and revise the timely renewal provision. This option would result in improvements in the following attributes: Public Health and Safety (Accident), Occupational Health (Accident), Offsite Property, Onsite Property, Environmental Considerations, and Regulatory Efficiency.

- Option 3 (the proposed rule): Undertake rulemaking to require FSAR updates, revise the timely renewal provision, and eliminate license terms for Class 104a or c licensees, other than testing facilities (among other changes described in Section 3.3). This option, which is the proposed option, would result in operation cost savings, improvements to Public Health and Safety, as well as substantial improvements associated with Regulatory Efficiency (as discussed below).

3.4.1 Benefits Associated with Affected Entities and NRC Operation

This section details the estimated benefits (i.e., cost savings) of the proposed rule for both affected entities and the NRC. The monetized benefits of the proposed rule are averted operational costs. The averted operational costs for NPUFs are presented in Exhibit 3-16. These averted costs stem from the savings in time and money created by discontinuing the existing license renewal process for qualifying NPUFs (i.e., currently operating research reactors). The NPUF averted operational cost represents the cost savings per NPUF by switching to non-expiring licenses. The total averaged cost per category is determined by multiplying the averted costs by the number of licensees (row B). Note that the number of licensees differs from Exhibit 3-1 as NIST, Aerotest, and General Electric (GE) are assumed to not have averted costs. These licensees either continue to go through the existing license renewal process (NIST) or have their renewals under the existing process due outside of the time horizon of this analysis. Under this analysis, these licensees (GE and Aerotest), therefore, do not realize any cost savings as a result of the proposed rule. If the analysis time period were

extended, GE and Aerotest would realize cost savings from the proposed rule similar to the savings realized by other licensees.

The NRC conservatively estimates that the proposed rule would result in total cost savings in the form of averted operational costs to affected entities of $5.5 million undiscounted ($2.5 million using a 7 percent discount rate and $3.9 million using a 3 percent discount rate) over the 20-year analysis period.

Exhibit 3-16. Present Value Averted Operational Costs for Affected Entities (2016$)

		Low	Medium	High
NPUF Averted Operational Cost	**A**	$120,000	$150,000	$250,000
Number of Licensees	**B**	5	9	14
Averted Operational Cost per Category	**C = A x B**	$580,000	$1,300,000	$3,600,000
Undiscounted Total Present Value Averted Operational Cost	**D = ∑ (C)**	$5,500,000		
Total Present Value NPUF Averted Operational Cost at 3% discounting		$3,900,000		
Total Present Value NPUF Averted Operational Cost at 7% discounting		$2,500,000		

NOTE: The number of licensees differs from Exhibit 3-1 as NIST, Aerotest, and GE are assumed to not realize any averted costs.
Totals may not add due to rounding.

The averted operational costs realized by the NRC are presented in Exhibit 3-17. These averted operational costs stem from the savings in time and resources from the review of submitted NPUF license renewal applications that would no longer be required under non-expiring license terms.

The NRC's averted operational cost represents the cost savings per NPUF by switching to non-expiring licenses. The total averaged cost per category is determined by multiplying the averted costs by the number of licensees (row B). Note that the number of licensees differs from Exhibit 3-1 as discussed above.

The NRC conservatively estimates that the proposed rule would result in total averted costs to the agency of $12 million undiscounted ($5.6 million using a 7 percent discount rate and $8.5 million using a 3 percent discount rate) over the 20-year analysis period.

Exhibit 3-17. Present Value Averted Operational Costs for NRC (2016$)

		Low	Medium	High
NRC Averted Operational Costs	**A**	$220,000	$450,000	$480,000
Number of Licensees	**B**	5	9	14
Averted Operational Costs per Category	**C = A x B**	$1,100,000	$4,000,000	$6,800,000
Undiscounted Total Present Value Averted Operational Cost	**D = ∑ (C)**	$12,000,000		
Total Present Value NRC Averted Operational Cost at 3% discounting		$8,500,000		
Total Present Value NRC Averted Operational Cost at 7% discounting		$5,600,000		

NOTE: The number of licensees differs from Exhibit 3-1 as NIST, Aerotest, and GE are assumed to not have averted costs.
Totals may not add due to rounding.

It is important to note that these averted costs represent conservative estimates for the total benefits of the proposed rule. The NRC relied on input from licensees to estimate the averted costs. This input varied widely. As a conservatism, the NRC used the lowest LOE estimates provided by the licensees. Therefore, the resulting cost savings values are likely underestimated. Because the proposed rule already results in a net benefit (cost savings), the potential underestimation of averted costs does not affect the cost-beneficial nature of the proposed rule. The potential underestimation of averted costs only means that implementation of the proposed rule could result in higher savings to both licensees and the NRC than are presented in this analysis.

3.4.2 Benefits Associated with Public Health (Accident), Occupational Health (Accident), Offsite Property, Onsite Property, and Environmental Considerations

Because NPUFs operate at a low power level and are recognized as having no major impact on the environment or public health and safety, both the safety risks, public health, occupational health, and environmental benefits associated with the rule are very small.

Under Option 3 (the proposed rule), to qualify for non-expiring license terms, all eligible NPUF licensees would be required to undergo license renewal per NUREG-1537 to ensure that each facility's licensing basis has been adequately re-constituted.[4] The re-constitution of the licensing basis would ensure that all site issues, technical specifications, and FSAR chapters are correct, up-to-date, and consistent with the guidance in NUREG-1537. Because all design and safety feature information must be current and must pass regulatory standards, a reconstituted licensing basis would provide reasonable assurance that licensees operate their facilities safely and consequently that public health and safety are protected.

This proposed rule would add new requirements such as periodic FSAR updates, which would help ensure that a licensee does not lose its reconstituted licensing basis over time. Specifically, because the rule would require that updates to the FSAR occur at much shorter intervals, the NRC and licensees would benefit from greater knowledge management and

[4] By the time the rule would be effective, the NRC will have reconstituted the licensing bases for all but four NPUFs. These four NPUFs would be subject to license renewal prior to being granted a non-expiring license.

information transfer. Moreover, the FSAR updates would allow NRC PMs to monitor and address facility changes or issues far sooner than the current license renewal process allows. This enhanced oversight would provide a safety benefit, because the NRC would be able to more efficiently and effectively identify and address safety concerns.

3.4.3 Benefits Associated with Regulatory Efficiency

Under Option 3 (the proposed rule), the NRC anticipates that the license renewal streamlining requirements would result in benefits to regulatory efficiency. By consolidating existing regulation language regarding the license renewal process, and by revising the timely renewal provision for class 103 licensees and testing facilities, the NRC anticipates a more efficient license renewal process.

The benefit associated with regulatory efficiency for this rulemaking stems from the clarity and consolidation of the regulatory requirements related to license renewal for class 103 licensees and testing facilities in proposed 10 CFR 50.135. Currently, NPUF license renewal requirements are not clearly delineated in title 10 of the CFR. This lack of a regulatory framework causes confusion and difficulty for licensees trying to navigate the license renewal process. By clearly defining the license renewal processes for these facilities, the NRC anticipates a reduction in burden and an increase in regulatory efficiency.

3.5 Disaggregation

The proposed rule (Option 3) imposes additional costs on regulated entities by requiring each NPUF licensee to submit an updated FSAR to the NRC every five years. The one provision of the proposed rule that would impose additional costs on licensees is disaggregated as Option 2 (not selected). Section 3.3 and Appendix B present the disaggregated costs of Option 2 (i.e., costs associated with submitting an updated FSAR) and demonstrate their impact on licensees. The NRC has determined that this provision is necessary to meet the rulemaking objective to streamline the license renewal process while achieving the same reasonable assurance to protect public health and safety and the environment and ensure common defense and security.

3.6 Uncertainty Analysis

To determine the robustness of the costs and net benefits of the proposed rule, the NRC examined how NPUF and the NRC costs change due to uncertainties associated with the NRC's analytical assumptions and input data. As mentioned in Section 3.1, the NRC used Monte Carlo simulation to examine the impact of uncertainty on the estimated net benefits of the proposed rule. These Monte Carlo simulations were performed using the @Risk software package by Palisade Corporation.[5]

Monte Carlo simulations involve introducing uncertainty into the analysis by replacing the point estimates of the variables used to estimate costs and benefits with probability distributions. By defining input variables as probability distributions as opposed to point estimates, the effect of uncertainty on the results of the analysis (i.e., the net benefits) can be effectively modeled.

The Monte Carlo simulations were performed by repeatedly running the analysis, up to 5,000 times. For each iteration of the analysis, a value was chosen randomly from the probability

[5] Information about this software is available online at www.palisade.com.

distributions that define the input variables. The value of the output variable (the net benefits) was recorded for each iteration, and all of the resulting values for the output variable were used to define a distribution for the results.

3.6.1. Uncertainty Model Inputs

In this analysis, the NRC assigned probability distributions to the LOEs, workload percentages, and existing NRC costs to account for uncertainty, and the NRC assigned probability distributions to these inputs for Low, Medium, and High category facilities. The LOEs for both the NPUFs and the NRC for the current license renewal process and the proposed rule are uncertain and, therefore, the NRC assigned distributions to these variables. The NRC also assigned probability distributions to the workload percentages, or the amount of work performed by each labor category. Finally, the NRC relied upon NRC timekeeping data and NRC contractor cost data to develop estimates for the cost of the existing license renewal process to the NRC. The NRC assigned probability distributions informed by these data to the NRC costs.

The probability distributions chosen to represent the different variables in the analysis were bounded by the range of LOE and labor category workloads provided by licensee input and the NRC staff's professional judgment. These distributions have mean values equal to the average LOE or workload per NPUF category (Low, Medium, and High). These mean values appear in the Exhibits in Section 3.2, Section 3.3, and Appendix B.

When defining the probability distributions for use in the Monte Carlo simulation, other summary statistics besides the mean value were needed to characterize the distributions. These other summary statistics include the standard deviation of a distribution with a normal shape, or the minimum and maximum of a triangular distribution. For the LOE distributions, the NRC used input from licensees to set the minimum and maximum values of the triangular distributions. For the workloads by labor category, the NRC used a standard deviation of 10 percent of the mean, which allows the distribution to range by 10 percent of the mean value above and below the mean.

In particular cases, such as for process steps involving review-related inspection activities, the NRC used a discrete distribution. This type of distribution was used when the desired range of the LOE had a high probability of zero and the remaining probability distributed in a range above zero. For example, the NRC used a discrete distribution to model the potential LOE for revising an NPUF license renewal application. The NRC assumes that, for 50 percent of licensees, no revisions are necessary, and, therefore, the LOE would be equal to zero. For the other licensees that would be revising license renewal applications, the NRC estimates that the LOE may be as high as 2,000 hours.

As an example of the variables and distributions used in the Monte Carlo simulations, Exhibit 3-18 displays the inputs for the analysis runs for Medium category facilities (see Exhibit 3-1). The NRC constructed these distributions differently for Low, Medium, and High category facilities. Appendix B contains a more complete list of the variables included in the uncertainty analysis.

Exhibit 3-18. Example Variables and Distributions Used in the Monte Carlo Analysis (Medium Category)

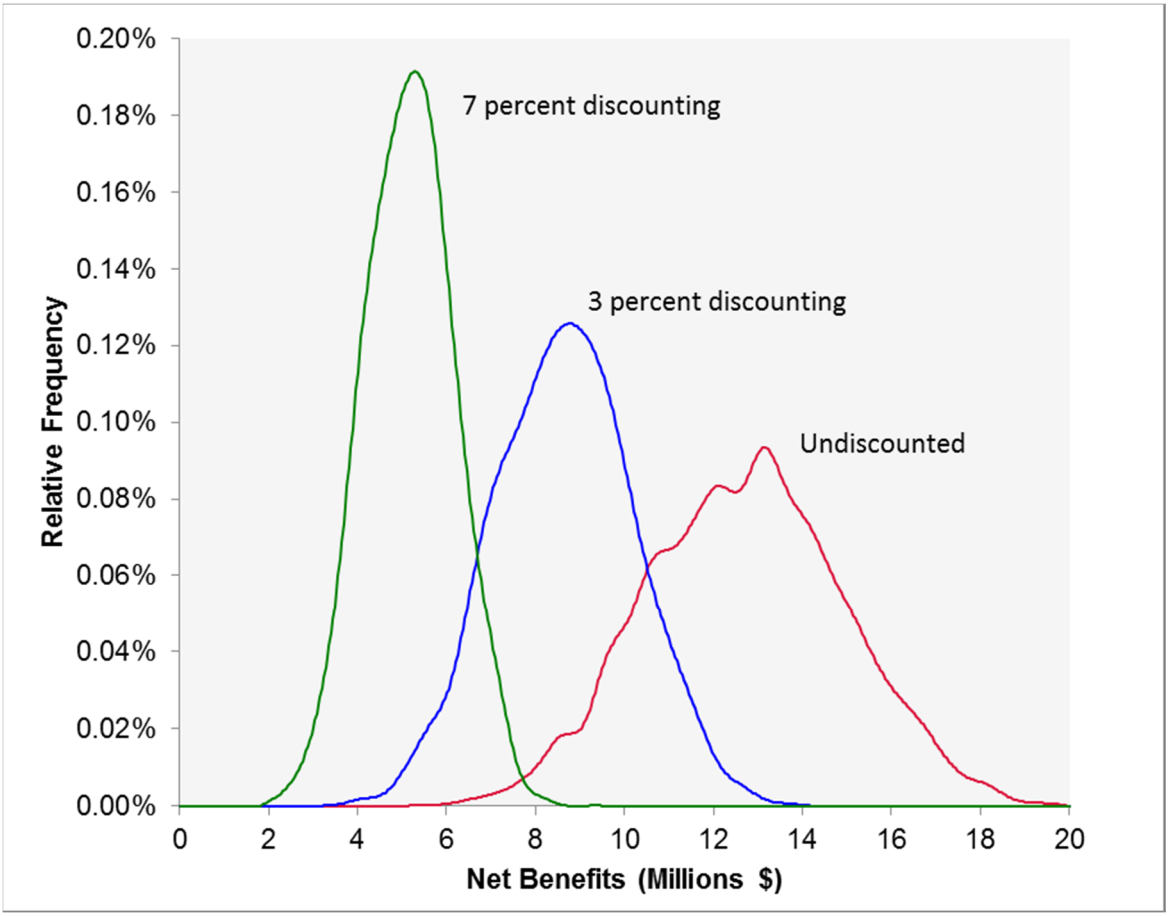
Variable	Description	Distribution	Mean	Standard Deviation	Minimum	Maximum
Responding to RAI Set # 1	NPUF Pre Rule LOE*	Triangular	125 hours		50 hours	200 hours
Preparing Updated FSAR	NPUF Post Rule LOE	Triangular	127.5 hours		110 hours	145 hours
Preparing Updated FSAR	NPUF Post Rule Graduate Student Workload	Triangular	60%	10%		
Revising License Renewal Application	NPUF Pre Rule LOE	Discrete	1000 hours	50%, 0 hours 10%, 1000 hours 10%, 1250 hours 10%, 1500 hours 10%, 1750 hours 10%, 2000 hours		
Training NRC Staff	NRC Post Rule LOE	Triangular	116 hours	10%		

*Costs described as "Pre Rule LOE" are costs assumed not to be incurred by licensees after the effective date of the rule (i.e., averted costs or cost savings).

3.6.2. Uncertainty Model Results

Exhibit 3-19 presents a summary of the distribution of the undiscounted net benefits (red), and the results discounted at 3 (blue) and 7 percent (green). The exhibits below present the results and include all categories of facilities (Low, Medium, and High). As can be seen below, regardless of discount rate, the proposed rule has a positive net benefit (100 percent of the distributions are above zero).

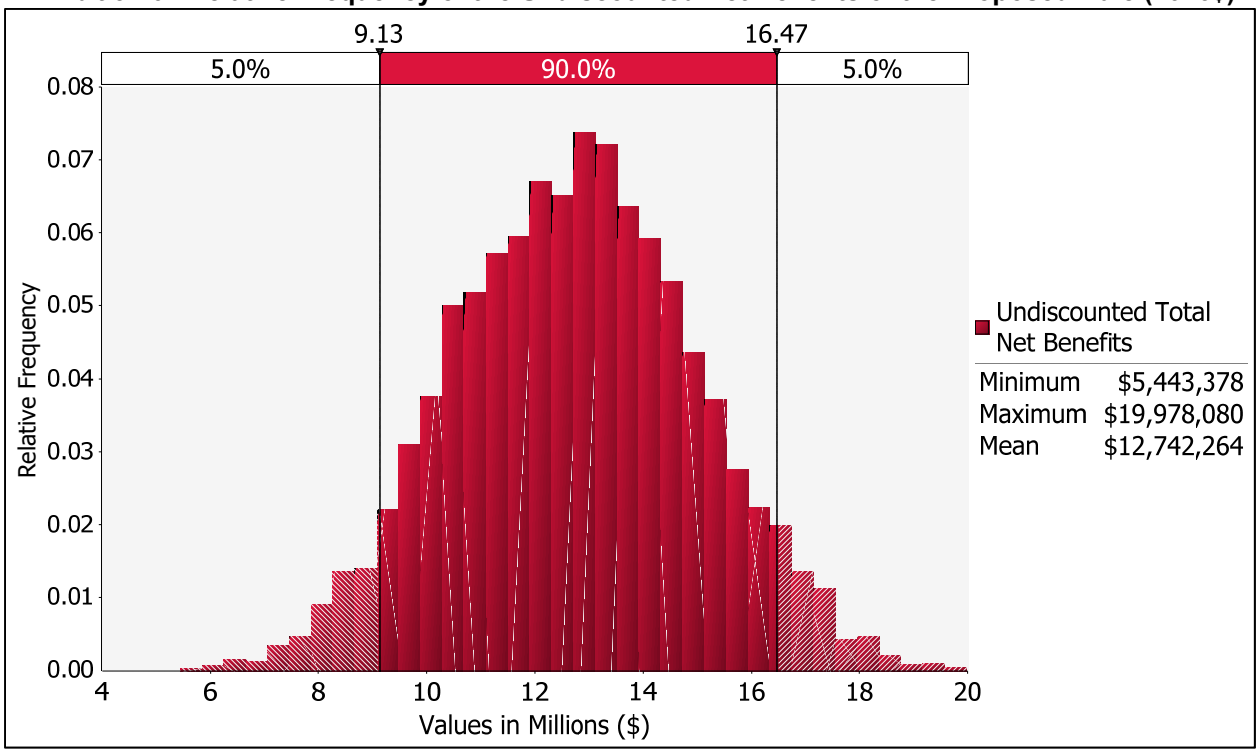
Exhibit 3-19. Relative Frequency of the Net Benefits of the Proposed Rule (2016$)



NOTE: As the discount rate increases in the above exhibit, the distributions become narrower. This narrowing is a result of the decreasing range of present value net benefits as discount rates increase. Larger discount rates result in smaller costs and benefit values in later years in the analysis period, resulting in a smaller range and a narrower distribution.

Exhibit 3-20 displays the results of the uncertainty analysis for the net benefits (benefits minus costs) of the proposed rule. By allowing uncertain assumptions and inputs to range across a distribution the results are no longer static and instead spread across a range with varying degrees of certainty. In this particular simulation, the analysis indicates that 90 percent of the times the model was run (out of 5,000 times) the proposed rule resulted in a benefit of $9.1 million to $16 million. In some iterations, the model did result in a net benefit as low as $5.4 million and as high as $20 million, with an average of $13 million.

Exhibit 3-20. Relative Frequency of the Undiscounted Net Benefits of the Proposed Rule (2016$)



Similarly, the net benefits with 7 and 3 percent discounting can be seen in Exhibit 3-21 and Exhibit 3-22. When using 7 percent discounting, 90 percent of the times the model was run the proposed rule resulted in a benefit of $3.5 million to $6.9 million. In some iterations the model did result in a net benefit as low as $1.8 million and as high as $8.5 million, with an average of $5.2 million.

When using 3 percent discounting, 90 percent of the times the model was run, the proposed rule resulted in a benefit of $6.1 million to $11 million. In some iterations, the model did result in a net benefit as low as $3.5 million and as high as $14 million, with an average of $8.7 million.

Exhibit 3-21. Relative Frequency of the Net Benefits of the Proposed Rule at 7 Percent Discounting (2016$)

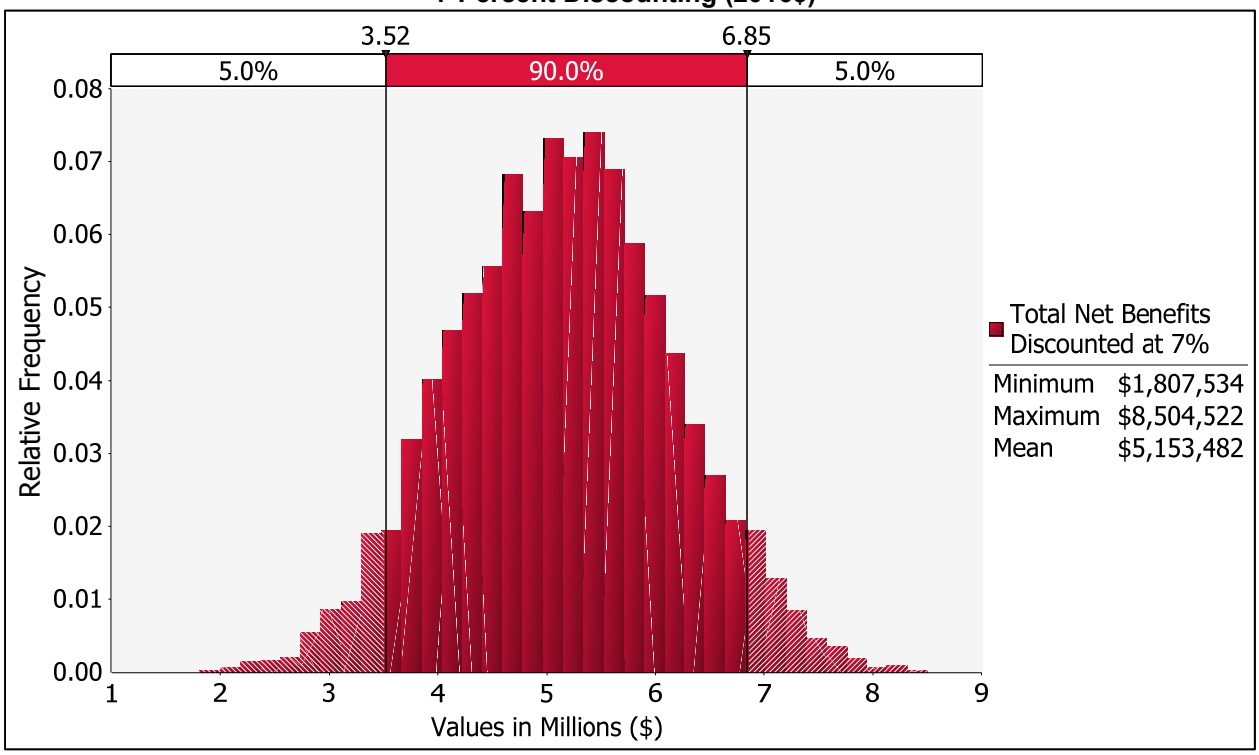
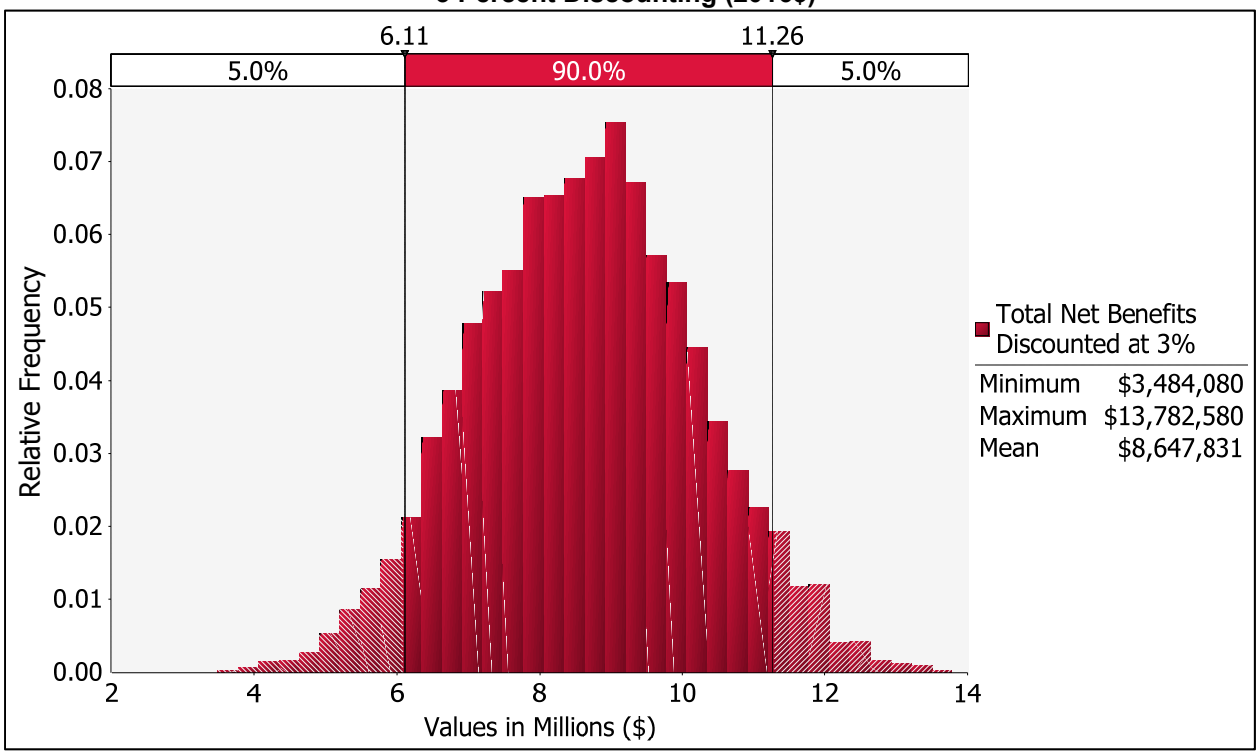


Exhibit 3-22. Relative Frequency of the Net Benefits of the Proposed Rule at 3 Percent Discounting (2016$)



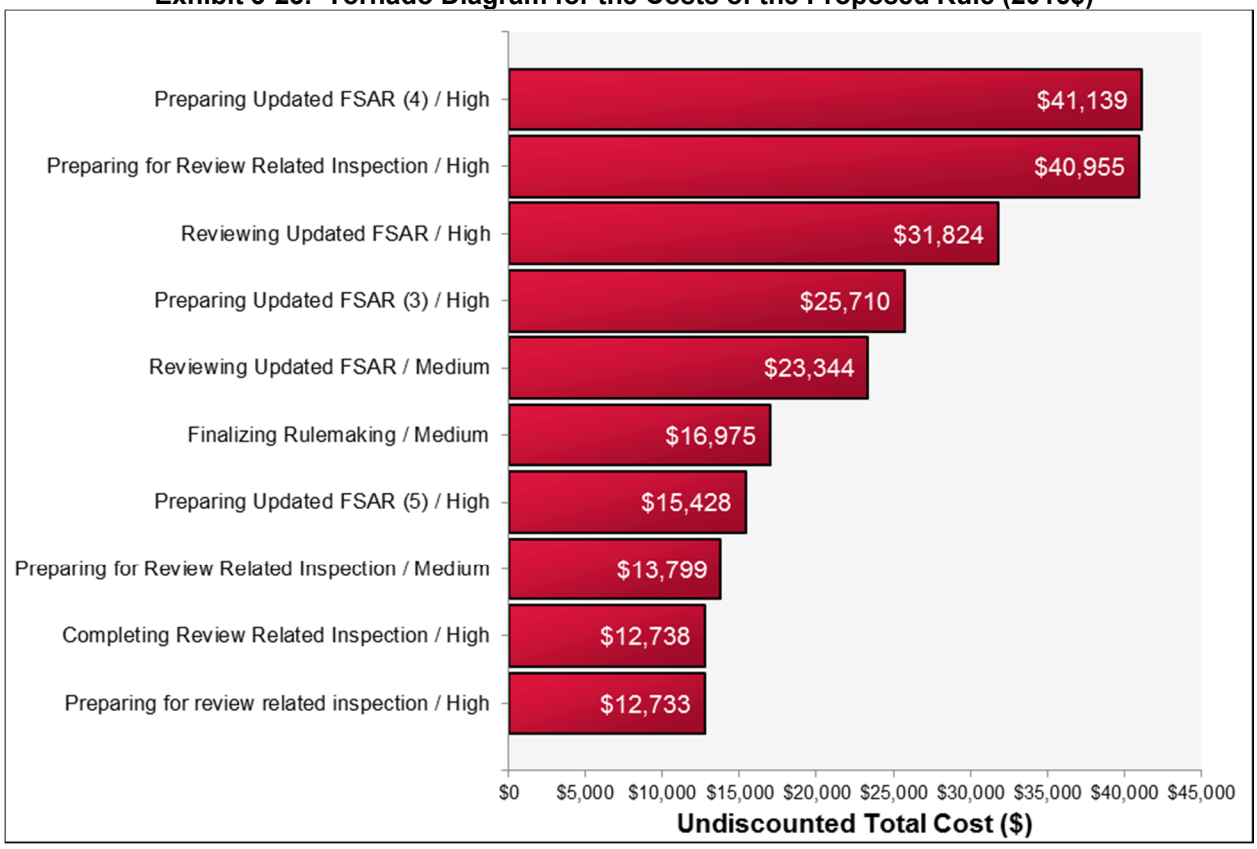
Examining the range of the resulting distributions of net benefits, it is possible to more confidently discuss the potential costs and benefits of the proposed rule. As mentioned above, the exhibits display a 90 percent confidence interval, meaning that the net benefits would fall between the ranges mentioned above for 90 percent of all of the iterations run as part of the Monte Carlo simulations. In all cases, regardless of the discount rate used, the benefits of the proposed rule (in terms of averted costs) would outweigh the implementation costs of the proposed rule that would be incurred by licensees and the NRC. This result is demonstrated by the fact that the resulting distributions of net benefits, whether undiscounted or at 3 or 7 percent discount rates, are always above zero.

3.6.3. Sensitivity Analysis

In addition to estimating the probability distributions for the net benefits of the proposed rule, Monte Carlo simulation was used to conduct a sensitivity analysis to determine the variables with greatest impact on the resulting net benefits. Variables shown to have a large effect on the resulting net benefits may deserve more attention and scrutiny than variables shown to have a small or minimal effect.

To estimate the effect of each variable on the net benefits, a regression was performed with the net benefits as the dependent variable and the inputs as the independent variables. The result of this regression is called a “tornado diagram,” and it presents in vertical order the variables with the greatest influence on net benefits. The tornado diagram also displays the resulting regression coefficient for each of the input variables. Exhibit 3-23 presents a tornado diagram for the total costs of the proposed rule. Similarly, Exhibit 3-24 presents the tornado diagram for the net benefits of the proposed rule.

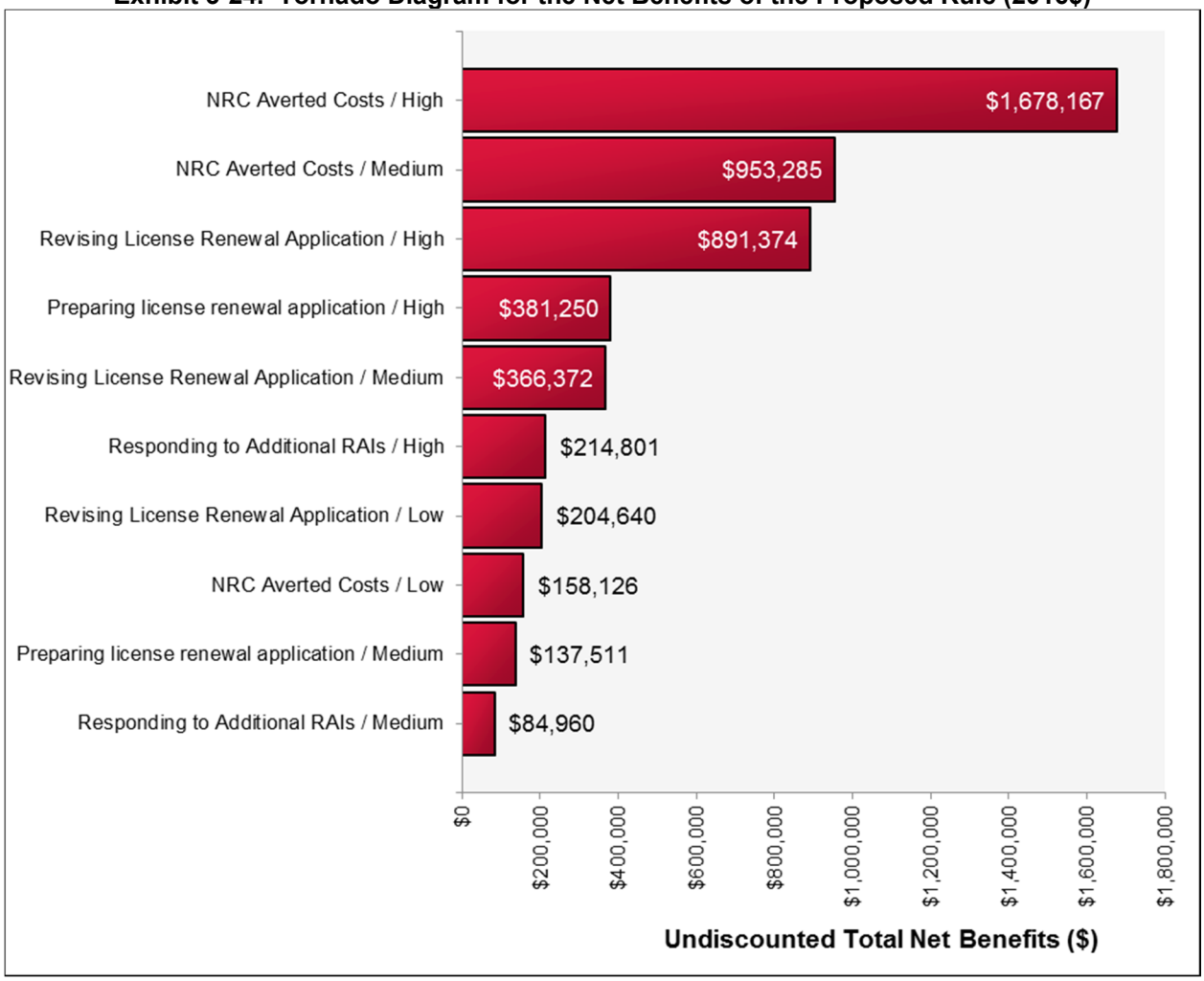
Exhibit 3-23. Tornado Diagram for the Costs of the Proposed Rule (2016$)[1]



[1] Some of the process steps, such as Preparing Updated FSARs, have multiple substeps. Exhibit B-1 and B-2 in Appendix B detail these substeps.

The Y-axis is displayed as Process Step / Category. Therefore, Row 1 shows that the largest driving cost is the cost of preparing the FSAR for the High category facilities.

Exhibit 3-24. Tornado Diagram for the Net Benefits of the Proposed Rule (2016$)



The Y-axis is displayed as Process Step / Category. Therefore, Row 1 shows that the largest net benefit is the NRC averted costs for High category facilities.

Examining the tornado diagrams provides insight into which of the current and new licensing steps have the largest impacts on the results of this analysis. From Exhibit 3-23, the parameters having the greatest influence on the total costs of the proposed rule are the costs for preparing the updated FSARs, preparing for the review related inspections, and reviewing the updated FSARs for the High category facilities. The influence of a variable on the output is not only a function of the value of the variable, but also on the spread of its distribution.

When examining Exhibit 3-24, it is important to note that the values are net benefits and, therefore, are a savings brought about by the proposed rule. The parameters having the greatest influence on the net benefits of the proposed rule are the averted costs, or savings from the proposed rule, for the NRC's review of High and Medium category facilities under the current licensing process.

4. Decision Rationale for Selection of Proposed Action

4.1 Safety Goal Evaluation

Safety goal evaluations are applicable only to regulatory initiatives considered to be generic safety enhancement backfits subject to the substantial additional protection standard at 10 CFR 50.109(a)(3). The NRC has determined that the backfit provision in § 50.109 does not apply to NPUFs (see Appendix A). Because § 50.109 does not apply to NPUFs, a safety goal evaluation is not needed.

4.2 Committee to Review Generic Requirements (CRGR)

Review by the CRGR is not needed because the proposed requirements do not qualify as backfits (see Appendix A).

References

1. U.S. Nuclear Regulatory Commission (NRC), SRM-SECY-91-061, "Separation of Non-Reactor and Non-Power Reactor Licensing Activities from Power Reactor Licensing Activities in 10 CFR Part 50," Washington, DC, April 2, 1991. (Agencywide Document Access and Management System [ADAMS] Accession No. ML010050021)

2. NRC, NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," Washington, DC, February 1996.

3. NRC, SRM-M080317B, "Staff Requirements—Briefing on the State of NRC Technical Programs," Washington, DC, April 3, 2008. (ADAMS Accession No. ML080940439)

4. NRC, SECY-08-0161, "Review of Research and Test Reactor License Renewal Applications," Washington, DC, October 24, 2008. (ADAMS Accession No. ML082550140)

5. NRC, SRM-SECY-08-0161, "Staff Requirements-SECY-08-0161-Review of Research and Test Reactor License Renewal Applications," Washington, DC, March 26, 2009. (ADAMS Accession No. ML090850159)

6. NRC, "Long-Term Plan for Enhancing the Research and Test Reactor License Renewal Process and Status of the Development and Use of the Interim Staff Guidance," SECY-09-0095, Washington, DC, June 24, 2009. (ADAMS Accession No. ML091410581)

7. NRC, SRM-M090811, "Staff Requirements Memorandum – Briefing on Research and Test Reactor (RTR) Challenges," Washington, DC, August 26, 2009. (ADAMS Accession No. ML092380046)

8. NRC, "Non-Power Reactor (NPR) License Renewal Rulemaking-Regulatory Basis Document," Washington, DC, August 27, 2012. (ADAMS Accession No. ML12240A677)

9. NRC, 79 Fed. Reg. 62329, "Definition of a Utilization Facility," Washington, DC, October 17, 2014.

10. NRC, "Interim Staff Guidance on the Streamlined Review Process for License Renewal for Research Reactors," Washington, DC, October 2009. (ADAMS Accession No. ML092240244)

11. NRC, NUREG/BR-0058, Rev. 4, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Washington, DC, September 2004. (ADAMS Accession No. ML042820192)

12. NRC, NUREG/CR-4627, Rev. 2, "Generic Cost Estimates," Washington, DC, January 1992. (ADAMS Accession No. ML13137A259)

13. Office of Management and Budget, Circular A-4, "Regulatory Analysis," Washington, DC, September 17, 2003.

Appendix A: Backfitting and Issue Finality

The NRC's backfitting provisions for reactors are found in 10 CFR 50.109. The regulatory basis for § 50.109 was expressed solely in terms of nuclear power reactors. For example, the NRC's Advanced Notice of Proposed Rulemaking, Policy Statement, Proposed Rule, and Final Rule for § 50.109 each had the same title: "Revision of Backfitting Process for Power Reactors" (48 Fed. Reg. 44217 (Sept. 28, 1983), 48 Fed. Reg. 44173 (Sept. 28, 1983), 49 Fed. Reg. 47034 (Nov. 30, 1984), and 50 Fed. Reg. 38097 (Sept. 20, 1985), respectively). As a result, the NRC has not applied § 50.109 to research reactors, testing facilities, and other non-power facilities licensed under part 50 (e.g., "Final Rule; Limiting the Use of Highly Enriched Uranium in Domestically Licensed Research and Test Reactors," 51 Fed. Reg. 6514 (Mar. 27, 1986); "Final Rule; Clarification of Physical Protection Requirements at Fixed Sites," 58 Fed. Reg. 13699 (Mar. 15, 1993)). In a 2012 final rule concerning non-power reactors, the NRC stated, "The NRC has determined that the backfit provisions in § 50.109 do not apply to test, research, or training reactors because the rulemaking record for § 50.109 indicates that the Commission intended to apply this provision to only power reactors, and NRC practice has been consistent with this rulemaking record" ("Final Rule; Requirements for Fingerprint-Based Criminal History Records Checks for Individuals Seeking Unescorted Access to Non-Power Reactors," 77 Fed. Reg. 27561, 27572 (May 11, 2012)).

Under proposed § 50.2, "NPUFs" would include non-power reactors, testing facilities, or other non-power production or utilization facilities licensed in accordance with §§ 50.21(a) or (c) (Section 104a or c of the AEA) or § 50.22 (Section 103 of the AEA). Because the term "NPUF" would include licensees that are excluded from the scope of § 50.109, NPUFs would not fall within the scope of § 50.109. Because § 50.109 does not apply to NPUFs, and this proposed rule would apply to NPUFs, the NRC did not apply § 50.109 to this proposed rule.

Although NPUF licensees are not protected by § 50.109, for those NPUFs licensed under the authority of Section 104 of the AEA, the Commission is directed to impose the minimum amount of regulation on the licensee consistent with its obligations under the AEA to promote the common defense and security, protect the health and safety of the public, and permit the conduct of widespread and diverse research and development and the widest amount of effective medical therapy possible.

Appendix B: Detailed Cost and Cost Savings Build-up

This section presents the inputs used in the estimation process. The assumptions section provides an explanation of the assumptions used in the estimation process. The exhibits below detail the implementation and operation costs and the benefits of the proposed rule. It is important to note that the hours and workload percentages in the exhibits below are the expected values of the assigned distributions. For this reason, the estimates in the exhibits are rounded to the nearest digit and not beyond. This leads to input estimates which could be misinterpreted as highly specific (i.e., the NRC estimates that process step 1 took 33 hours for a Low category facility). Instead, the values should be read as the means of the distributions applied to the process steps.

Assumptions:

1. Of the 31 existing NPUFs, 30 would be subject to non-expiring licenses. One NPUF would continue to undergo license renewal, but would incur costs for updating and submitting FSARs every five years (see Assumption 12).
2. These facilities fall into different categories (Low, Medium, and High) based on their power levels. See Exhibit 3-1.
3. Fourteen facilities fall into Group 1, 13 facilities fall into Group 2, and 4 facilities fall into Group 3. See Exhibit 3-2.
4. Implementation costs would be incurred in 2019 and operational costs would be incurred beginning in 2020.
5. Group 1 facilities are assumed to begin incurring operational costs in 2020, Group 2 in 2021, and Group 3 in 2022.
6. Each facility would incur a one-time implementation cost (which vary based on category) to develop and implement actions based on the proposed rule.
7. The NRC would incur a one-time implementation cost to implement the rule and train staff.
8. Each facility would incur ongoing operational costs derived from the proposed rule requirement to submit updated FSARs. The cost of the FSAR updates varies by category.
9. Facility operational costs (FSAR updates) would be incurred every five years. The timing of FSAR submittals depends on the group to which the facility belongs (See Assumption (5)).
10. The NRC would incur operational costs to review licensee-submitted FSAR updates in the year of submission. The NRC operational costs begin in 2020 and mirror facility operational costs (every five years and staggered by group).
11. Estimates of LOE are based on the NRC staff's professional judgment and licensee input.
12. The NIST facility would continue to go through the existing license renewal process as well as be tasked with submitting updated FSARs. This assumption results in no averted costs for this facility.
13. The Aerotest facility is currently not operational, but is included here only for the purposes of the regulatory analysis. The Commission has made no determination whether the facility will begin operations in time for the implementation of the rule (by 2019).
14. Both GE and Aerotest are assumed to not have averted costs of the rule because the license renewal process for these facilities would not come due during the time period of this analysis. Therefore, the averted costs for these facilities is zero.

Exhibit B-1. Description of Existing NPUF License Renewal Process Substeps

Existing Process Steps	Substep	Description of Substep
Preparing License Renewal Application	**1**	Collect information for narrative components of license renewal application
	2	Draft narrative chapters of license renewal application
	3	Collect information for technical components of license renewal application
	4	Draft technical chapters of license renewal application
	5	Review by management
Responding to RAI Set #1	**1**	Review RAIs
	2	Collect information
	3	Draft RAI responses
	4	Review by management
Responding to Additional RAIs	**1**	Review RAIs, collect information, draft responses, and review by management
Revising License Renewal Application	**1**	Review, collect information, and conduct additional analyses
	2	Revise license renewal application
	3	Review by management

Exhibit B-2. Description of Post-Rule FSAR Process Substeps

Post-Rule Process Steps	Substep	Description of Substep
NPUFs		
Preparing Updated FSAR	**1**	Collect and review recent annual reports
	2	Collect and review other information regarding updates to facility (e.g., license amendments, Section 50.59 analyses)
	3	Draft updates to narrative chapters
	4	Draft updates to technical chapters
	5	Review by management and submittal
Preparing 2nd Updated FSAR	**1**	Collect and review recent annual reports
	2	Collect and review other information regarding updates to facility (e.g., license amendments, 50.59 analyses)
	3	Draft updates to narrative chapters
	4	Draft updates to technical chapters
	5	Review by management and submittal
NRC		
Reviewing Updated FSAR	**1**	Conduct initial review
	2	Review narrative sections
	3	Review technical sections
	4	Review by management
Reviewing 2nd Updated FSAR	**1**	Conduct initial review
	2	Review narrative sections
	3	Review technical sections
	4	Review by management

Exhibit B-3a. NPUF Averted Costs of the Proposed Rule

Existing Process Steps	Sub step	Cost Inputs								Cost per Category		
		Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
			Low	Medium	High		Low	Medium	High			
NPUF Averted Costs												
Preparing License Renewal Application	**1**	Reactor Director / Professor	33	63	65	$49.81	10%	10%	80%	$324	$623	$5,181
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	10%	$0	$0	$522
		Nuclear Technician				$37.10	0%	0%	10%	$0	$0	$482
		Graduate Student				$16.08	90%	90%	0%	$941	$1,809	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	2	Reactor Director / Professor	228	438	455	$49.81	15%	15%	80%	$3,400	$6,538	$36,265
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	10%	$0	$0	$3,656
		Nuclear Technician				$37.10	0%	0%	10%	$0	$0	$3,376
		Graduate Student				$16.08	85%	85%	0%	$6,220	$11,961	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	3	Reactor Director / Professor	33	63	65	$49.81	10%	10%	80%	$324	$623	$5,181
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	10%	$0	$0	$522
		Nuclear Technician				$37.10	0%	0%	10%	$0	$0	$482
		Graduate Student				$16.08	90%	90%	0%	$941	$1,809	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0

Existing Process Steps	Sub step	Cost Inputs								Cost per Category		
		Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
			Low	Medium	High		Low	Medium	High			
NPUF Averted Costs												
	4	Reactor Director / Professor	325	625	650	$49.81	30%	30%	80%	$9,714	$18,680	$51,807
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	10%	$0	$0	$5,223
		Nuclear Technician				$37.10	0%	0%	10%	$0	$0	$4,823
		Graduate Student				$16.08	70%	70%	0%	$7,317	$14,072	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	5	Reactor Director / Professor	33	63	65	$49.81	25%	25%	25%	$809	$1,557	$1,619
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	0%	$0	$0	$0
		Nuclear Technician				$37.10	0%	0%	0%	$0	$0	$0
		Graduate Student				$16.08	0%	0%	0%	$0	$0	$0
		Institution Administrator				$49.77	75%	75%	75%	$2,426	$4,666	$4,853
Responding to RAI Set #1	**1**	Reactor Director / Professor	13	13	10	$49.81	25%	25%	10%	$311	$311	$103
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	45%	$0	$0	$372
		Nuclear Technician				$37.10	0%	0%	45%	$0	$0	$344
		Graduate Student				$16.08	75%	75%	0%	$302	$302	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	2	Reactor Director / Professor	38	38	31	$49.81	25%	25%	10%	$934	$934	$308

Existing Process Steps	Sub step	Cost Inputs								Cost per Category		
		Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
			Low	Medium	High		Low	Medium	High			
NPUF Averted Costs												
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	45%	$0	$0	$1,117
		Nuclear Technician				$37.10	0%	0%	45%	$0	$0	$1,032
		Graduate Student				$16.08	75%	75%	0%	$905	$905	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	3	Reactor Director / Professor	50	50	41	$49.81	25%	25%	10%	$1,245	$1,245	$410
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	45%	$0	$0	$1,490
		Nuclear Technician				$37.10	0%	0%	45%	$0	$0	$1,376
		Graduate Student				$16.08	75%	75%	0%	$1,206	$1,206	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	4	Reactor Director / Professor	25	25	21	$49.81	25%	25%	10%	$623	$623	$205
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	45%	$0	$0	$745
		Nuclear Technician				$37.10	0%	0%	45%	$0	$0	$688
		Graduate Student				$16.08	75%	75%	0%	$603	$603	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
Responding to Additional RAIs	**1**	Reactor Director / Professor	528	528	528	$49.81	25%	25%	10%	$13,138	$13,138	$5,255
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	45%	$0	$0	$19,075

Existing Process Steps	Sub step	Cost Inputs								Cost per Category		
		Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
			Low	Medium	High		Low	Medium	High			
NPUF Averted Costs												
		Nuclear Technician				$37.10	0%	0%	45%	$0	$0	$17,612
		Graduate Student				$16.08	75%	75%	0%	$12,725	$12,725	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
Revising License Renewal Application	**1**	Reactor Director / Professor	100	100	100	$49.81	25%	25%	10%	$2,491	$2,491	$996
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	45%	$0	$0	$3,616
		Nuclear Technician				$37.10	0%	0%	45%	$0	$0	$3,339
		Graduate Student				$16.08	75%	75%	0%	$2,412	$2,412	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	2	Reactor Director / Professor	850	850	850	$49.81	25%	25%	10%	$21,171	$21,171	$8,468
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	45%	$0	$0	$30,736
		Nuclear Technician				$37.10	0%	0%	45%	$0	$0	$28,379
		Graduate Student				$16.08	75%	75%	0%	$20,505	$20,505	$0
		Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
	3	Reactor Director / Professor	50	50	50	$49.81	25%	25%	25%	$1,245	$1,245	$1,245
		NPUF Operator / Asst. Dir.				$40.18	0%	0%	0%	$0	$0	$0
		Nuclear Technician				$37.10	0%	0%	0%	$0	$0	$0

Existing Process Steps	Sub step	Cost Inputs								Cost per Category		
		Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
			Low	Medium	High		Low	Medium	High			
NPUF Averted Costs												
		Graduate Student				$16.08	0%	0%	0%	$0	$0	$0
		Institution Administrator				$49.77	75%	75%	75%	$3,733	$3,733	$3,733
Total NPUF Operation Cost (Per NPUF)										$115,965	$145,887	$254,635
Number of NPUFs										5	9	14
Total NPUF Cost per Category										$579,823	$1,312,980	$3,564,896
Total NPUF Averted Cost										$5,457,699		

NOTE: NIST, Aerotest, and GE are assumed to not have averted costs. Therefore, the number of licensees is not 5, 11, and 15 as per Exhibit 3-1.

Exhibit B-3b. Averted Costs of the Proposed Rule

Existing License Renewal Costs	Cost Inputs		
	Cost per Category		
	Low	Medium	High
NRC Averted Costs			
Minimum Cost Per NPUF	$145,490	$176,912	$187,122
Maximum Cost Per NPUF	$300,072	$693,708	$774,225
Average Cost Per NPUF	$222,781	$447,355	$482,933
Number of NPUFs	5	9	14
Total Cost per Category	**$1,113,905**	**$4,026,192**	**$6,761,060**
Total NRC Averted Cost	**$11,901,156**		

NOTE: NIST, Aerotest, and GE are assumed to not have averted costs. Therefore, the number of licensees is not 5, 11, and 15 as per Exhibit 3-1.

Exhibit B-4a. NPUF Implementation Costs of the Proposed Rule

Post-Rule Process Steps	Cost Inputs								Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
		Low	Medium	High		Low	Medium	High			
NPUF Implementation (One-Time) Costs											
Reviewing Finalized Rule	Reactor Director / Professor	12	12	12	$49.81	80%	80%	50%	$956	$956	$598
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	25%	$0	$0	$241
	Nuclear Technician				$37.10	0%	0%	25%	$0	$0	$223
	Graduate Student				$16.08	20%	20%	0%	$77	$77	$0
	Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0

Post-Rule Process Steps	Cost Inputs								Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
		Low	Medium	High		Low	Medium	High			
NPUF Implementation (One-Time) Costs											
Reviewing NRC Issued Guidance Documents	Reactor Director / Professor	12	12	12	$49.81	80%	80%	50%	$956	$956	$598
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	25%	$0	$0	$241
	Nuclear Technician				$37.10	0%	0%	25%	$0	$0	$223
	Graduate Student				$16.08	20%	20%	0%	$77	$77	$0
	Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
Reviewing and Updating Procedures	Reactor Director / Professor	24	24	24	$49.81	50%	50%	33%	$1,196	$1,196	$796
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	33%	$0	$0	$643
	Nuclear Technician				$37.10	0%	0%	33%	$0	$0	$594
	Graduate Student				$16.08	50%	50%	0%	$386	$386	$0
	Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
Safety Review Board	Reactor Director / Professor	7	7	7	$49.81	50%	50%	50%	$349	$349	$349
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	0%	$0	$0	$0
	Nuclear Technician				$37.10	0%	0%	0%	$0	$0	$0
	Graduate Student				$16.08	0%	0%	0%	$0	$0	$0
	Institution Administrator				$49.77	50%	50%	50%	$348	$348	$348
Total NPUF One-Time Cost (per NPUF)									$4,346	$4,346	$4,853
Number of NPUFs									5	11	15

Post-Rule Process Steps	Cost Inputs								Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
		Low	Medium	High		Low	Medium	High			
NPUF Implementation (One-Time) Costs											
Total NPUF One-Time Cost									$21,729	$47,804	$72,798
									$142,331		

Exhibit B-4b. NPUF Operation Costs of the Proposed Rule

Post-Rule Process Steps	Cost Inputs								Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
		Low	Medium	High		Low	Medium	High			
NPUF Operation (Ongoing) Costs											
Preparing Updated FSAR	Reactor Director / Professor	85	127.5	197.5	$49.81	25%	25%	15%	$2,117	$3,176	$2,951
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	35%	$0	$0	$5,555
	Nuclear Technician				$37.10	0%	0%	35%	$0	$0	$5,129
	Graduate Student				$16.08	60%	60%	0%	$1,640	$2,461	$0
	Institution Administrator				$49.77	15%	15%	15%	$1,269	$1,904	$2,949
Preparing for Review Related Inspection	Reactor Director / Professor	4	9	14	$49.81	50%	50%	33%	$199	$448	$460
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	34%	$0	$0	$377
	Nuclear Technician				$37.10	0%	0%	34%	$0	$0	$348
	Graduate Student				$16.08	50%	50%	0%	$64	$145	$0

Post-Rule Process Steps	Cost Inputs								Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload			Low	Medium	High
		Low	Medium	High		Low	Medium	High			
NPUF Operation (Ongoing) Costs											
	Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
Participating in Review Related Inspection	Reactor Director / Professor	2	2	3	$49.81	50%	50%	33%	$100	$100	$99
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	34%	$0	$0	$81
	Nuclear Technician				$37.10	0%	0%	34%	$0	$0	$75
	Graduate Student				$16.08	50%	50%	0%	$32	$32	$0
	Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
Participating in Exit Meeting	Reactor Director / Professor	0	0	0	$49.81	50%	50%	33%	$0	$0	$0
	NPUF Operator / Asst. Dir.				$40.18	0%	0%	34%	$0	$0	$0
	Nuclear Technician				$37.10	0%	0%	34%	$0	$0	$0
	Graduate Student				$16.08	50%	50%	0%	$0	$0	$0
	Institution Administrator				$49.77	0%	0%	0%	$0	$0	$0
Total NPUF Operation Cost (Per NPUF)									$5,422	$8,265	$18,023
Number of NPUFs									5	11	15
Total NPUF Operation Cost per FSAR Update (Every 4 Years)									$27,110	$90,912	$270,341
									$388,363		
Total NPUF Operations Cost in analysis period (20 years)									$1,553,453		

Exhibit B-4c. NRC Implementation Costs of the Proposed Rule

Post-Rule Process Steps	Cost Inputs						Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload	Low	Medium	High
		Low	Medium	High					
NRC Implementation (One-Time) Costs									
Finalizing Rulemaking	FY17 FOL				1.5	100%	$678,000		
	FY17 ($k)				$405,000	100%			
	NRC Annual Wage Rate				$182,000	100%			
Developing Guidance on revised License Renewal Process	NRC Staff	150			$130/hr	100%	$19,485		
Issue Orders to Remove License Terms	NRC Staff	80			$130/hr	100%	$10,392		
Training NRC Staff	NRC Staff	116			$130/hr	100%	$15,069		
Updating Project Manager Qualification Program	NRC Staff	12			$130/hr	100%	$1,559		
Total NRC Implementation Cost							$724,505		

Exhibit B-4d. NRC Operation Costs of the Proposed Rule

Post-Rule Process Steps	Cost Inputs						Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload	Low	Medium	High
		Low	Medium	High					
NRC Operations (per FSAR Update) Costs									
Reviewing Updated FSAR	NRC Staff	6	8	10	$130/hr	100%	$779	$1,039	$1,299
	NRC Staff	18	24	30	$130/hr	100%	$2,338	$3,118	$3,897
	NRC Staff	24	32	40	$130/hr	100%	$3,118	$4,157	$5,196

Post-Rule Process Steps	Cost Inputs						Cost per Category		
	Labor Category or Input	Hours per Category			Rate	Workload	Low	Medium	High
		Low	Medium	High					
NRC Operations (per FSAR Update) Costs									
	NRC Staff	12	16	20	$130/hr	100%	$1,559	$2,078	$2,598
Preparing for Review Related Inspection Activities	NRC Staff	0	6	12	$130/hr	100%	$0	$779	$1,559
Completing Review Related Inspection	NRC Staff	0	6	12	$130/hr	100%	$0	$779	$1,559
Closing Review Related Inspection Activities	NRC Staff	0	6	12	$130/hr	100%	$0	$779	$1,559
Total NRC Operations Cost (per FSAR Update)							$7,794	$12,730	$17,667
Number of NPUFs							5	11	15
Rounds of FSAR Updates							4		
Total NRC Operations Cost in analysis period (20 years)							$1,776,012		