Regulatory Analysis for NUREG–2214, Managing Aging Processes in Storage (MAPS) Report

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Spent Fuel Management

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ABBREVIATIONS AND ACRONYMS

ADAMS	Agencywide Documents Access and Management System
AMP	aging management program
CFR	Code of Federal Regulations
CoC	certificate of compliance
CPI-U	consumer price index for all urban consumers
ISFSI	independent spent fuel storage installation
MAPS	Managing Aging Processes in Storage
NEI	Nuclear Energy Institute
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
OMB	Office of Management and Budget
PERT	program evaluation and review technique
RAI	request for additional information

1 INTRODUCTION

This document presents the regulatory analysis for NUREG–2214, "Managing Aging Processes in Storage (MAPS) Report." NUREG–2214 provides guidance to the U.S. Nuclear Regulatory Commission (NRC) staff for the safety review of renewal applications for specific licenses of independent spent fuel storage installations (ISFSIs) and certificates of compliance (CoCs) for dry storage systems, as set out in Title 10 of the Code of Federal Regulations (10 CFR) Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste." NUREG–2214 provides one acceptable approach for identifying and managing the effects of aging degradation of spent fuel storage systems.

1.1 Background

In the United States, a portion of the spent nuclear fuel from power reactors is stored in approximately 3,000 dry storage systems, or "casks." The dry storage systems are typically located outdoors at over 70 operating and decommissioned power plant sites. The NRC approves the dry storage of spent fuel through one of two ways:

(1) a specific license for a dry storage facility: This license is granted to the facility owner, and it is based on the cask design, other facility structures and components, site-specific parameters (e.g., design basis accidents), an environmental assessment, and owner qualifications.

(2) a CoC for a dry storage system design: This certificate is granted to a cask vendor. A nuclear power plant owner may store its spent fuel in a certified cask design without first requesting NRC approval, if the cask design addresses the range of conditions and events that may exist at the nuclear power plant facility.

To date, the NRC has issued licenses for ISFSIs and CoCs for dry storage systems for initial terms of 20 years. In accordance with 10 CFR 72.42, "Duration of License; Renewal," and 10 CFR 72.240, "Conditions for Spent Fuel Storage Cask Renewal," the NRC may extend the allowable time in storage for additional 40-year terms. This extension is referred to as the "renewal" of a storage term, and it requires the renewal applicant to address potential aging-related degradation issues (e.g., metal corrosion, concrete degradation) to ensure that dry storage systems will continue to fulfill their important-to-safety functions in the 20- to 60-year period of extended operation.

NUREG–2214 provides guidance to the NRC staff to improve the effectiveness and efficiency of renewal application reviews. NUREG–2214 is a technical basis document that evaluates aging degradation mechanisms to determine if these mechanisms could affect the ability of dry storage system components to fulfill their important-to-safety functions in the period of extended operation. The guidance also provides examples of aging management programs (AMPs) that are considered generically acceptable to address the credible aging mechanisms to ensure the continued safe storage of spent nuclear fuel. An applicant for a renewed license or CoC may reference the information in NUREG–2214 to support its proposed activities to manage aging.

The NRC developed NUREG–2214 in coordination with the nuclear industry and other public stakeholders. The document was the subject of public meetings and was shaped by comments received when the draft report was issued for public comment (Volume 82 of the *Federal Register*, page 49233 (82 FR 49233); October 24, 2017.

1.2 Statement of the Problem and Objective

1.2.1 Problem Statement

The NRC concluded that more guidance was needed to describe acceptable approaches to meet the regulations of 10 CFR 72.42 and 10 CFR 72.240 based on the agency's experience in reviewing the first renewal applications. Because few spent fuel storage system inspections were performed in the first 20-year storage terms, the applicants sometimes had difficulty in defining potential aging mechanisms and developing acceptable approaches to manage aging. As a result, the application process was lengthy and involved many staff requests for additional information (RAIs) to work through the technical issues.

The NRC and the Nuclear Energy Institute (NEI) have issued guidance on the general methodology to develop renewal applications. This guidance includes NUREG–1927, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel," Revision 1, and NEI 14-03, "Format, Content and Implementation Guidance for Dry Cask Storage Operations-Based Aging Management," Revision 2. However, this existing guidance does not address technical issues, and uncertainty in the technical approach to manage aging has contributed to the lengthy renewal application reviews.

To address this problem, the NRC developed NUREG–2214 to provide the staff with the technical bases and guidance for evaluating the aging degradation mechanisms that could affect the safe storage of spent fuel and to provide the staff with an acceptable approach to manage aging through inspections, monitoring activities, and preventive actions. NUREG–2214 does not contain requirements; a renewal applicant can propose alternative approaches for staff review.

1.2.2 Objective

The objective of this regulatory analysis is to assess the benefits and costs of alternatives to issuing NUREG–2214 to ensure the NRC has chosen the most cost-beneficial (i.e., cost-effective) alternative.

2 IDENTIFICATION AND ANALYSIS OF ALTERNATIVE APPROACHES

The NRC has identified two alternatives for consideration.

2.1 Alternative 1—Take No Action

Under this alternative, the NRC would not issue guidance to address the problem of lengthy application reviews because of the lack of clarity on technical issues. This is considered the

"no-action" alternative and serves as the baseline against which the impacts of the second alternative will be measured.

This alternative would pose no incremental burden on licensees, CoC holders, or other entities. The NRC would continue to review renewal applications for spent fuel dry storage on a case-by-case basis. However, the NRC would not be responsive to feedback provided on the draft guidance during public meetings and comments received when the draft document was issued for public comment. Because this "no-action" alternative would not make available the most current technical information or incorporate insights from the nuclear industry and the public, this alternative would not achieve the NRC's objective to increase the efficiency of the renewal application process.

2.2 Alternative 2—Issue NUREG–2214

Under this alternative, the NRC would issue NUREG–2214. This new guidance document would establish a clear technical basis for the NRC's safety review of renewal applications for specific licenses of ISFSIs and CoCs for dry storage systems. The NUREG provides current technical reference material and incorporates insights from the nuclear industry and the public on an acceptable approach to manage the aging of spent fuel dry storage systems.

As described in detail in Section 3.4, the NRC expects that this alternative would benefit renewal applicants (industry) and the NRC by clearly identifying credible aging mechanisms and effective AMPs to ensure that the design bases of dry storage systems will be maintained. The availability of this information promotes a more efficient renewal application process, without resulting in a substantive change to ongoing costs (i.e., costs associated with fulfilling the requirements of the issued license or CoC).

Finally, this alternative does not require revisions to other guidance documents such as NEI 14-03 and NUREG–1927 because NUREG–2214 fills a gap in the current guidance framework. Specifically, it provides a technical basis for evaluating the acceptability of approaches to manage the aging of dry storage systems.

3 ESTIMATION AND EVALUATION OF BENEFITS AND COSTS

3.1 Affected Entities

Alternative 2 is expected to affect all applicants for a renewed ISFSI license or storage system CoC. These entities include storage site owners and dry storage system vendors whose initial approved 20-year storage term for the facility or cask design will expire.

The staff notes that general licensees (i.e., licensees under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," that use certified storage casks) implement the AMPs that are part of a renewed CoC. However, as described in detail in Section 3.4, the cost associated with NUREG–2214 has been determined to be associated with the renewal application process. General licensees do not apply for a renewed license or CoC. Similarly, Agreement States are not affected, as they do not perform safety reviews of renewed licenses or CoCs.

3.2 Analytical Methodology

This regulatory analysis follows the guidance in NUREG/BR–0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Revision 4. In addition, the methodology is in accordance with guidance from Office of Management and Budget (OMB) Circular A-4, "Regulatory Analysis," dated September 17, 2003.

In this regulatory analysis, the staff identifies all attributes related to the regulatory action and analyzes them either quantitatively or qualitatively. The benefits include any desirable changes in affected attributes (e.g., monetary savings, improved safety, improved security), while the costs include any undesirable changes in affected attributes (e.g., monetary costs, increased exposures to radiation or physical hazards). This regulatory analysis estimates the incremental costs resulting from issuing NUREG–2214 relative to a baseline that reflects anticipated behavior if the NRC does not undertake any action (Alternative 1). As part of the regulatory baseline used in this analysis, the staff assumes full compliance with existing NRC regulations.

For the quantified regulatory analysis, the staff developed expected values for each benefit and cost. The staff estimated the required level of effort for each required activity under Alternative 2 and labor rates for personnel performing those activities. After determining the benefits and costs, the staff discounted the consequences in future years to the current year of the regulatory action. Finally, the staff summed the benefits and costs for Alternative 2 and compared them to the no-action baseline. After performing the quantitative regulatory analysis, the staff addressed qualitative attributes that are difficult to quantify but important to consider.

The staff gathered data from several sources to develop levels of effort and unit cost estimates. It applied several cost estimation methods in this analysis and used professional knowledge and judgment to estimate some of the costs and benefits, using an analogy method and extrapolation techniques.

To evaluate the effect of uncertainty in the analysis, the staff employed a Monte Carlo simulation, which is an approach to uncertainty analysis in which input variables are expressed as distributions. The result is a distribution of values for the output variable of interest. With a Monte Carlo simulation, it is also possible to determine the input variables that have the greatest effect on the value of the output variable. Section 3.5 gives a detailed description of the Monte Carlo simulation method and presents the results.

3.2.1 Identification of Affected Attributes

The attributes within the public and private sectors that the analyzed alternatives could affect are presented below. This list was created using the potential attributes provided in NUREG/BR–0058. The basis for selecting these attributes is also presented.

Potential affected attributes include the following:

- Public Health (Routine)—This attribute accounts for changes in radiation exposures to members of the public that might result from the proposed regulatory action. NUREG–2214 includes recommendations for managing the aging of spent fuel storage systems to protect the public from the effects of radiation.

- Occupational Exposure (Routine)—This attribute accounts for radiological exposures to workers during normal facility operations. NUREG–2214 includes recommendations for ongoing monitoring and inspection activities that could result in worker exposure to radiation.

- Industry Implementation—This attribute accounts for the projected one-time net economic effect on the affected entities related to using the guidance to submit a renewal application. The issuance of NUREG–2214 could affect the efficiency of the renewal application process by providing one acceptable approach to manage aging effects, which is expected to aid application preparation and reduce NRC staff RAIs.

- Industry Operation—This attribute measures the projected net economic effect of routine and recurring licensee activities that will occur during the renewed storage term (20- to 60-year period of extended operation). NUREG–2214 includes recommendations for ongoing monitoring and inspection activities to ensure that the aging of storage systems is adequately managed.

- NRC Implementation—This attribute accounts for the projected one-time net economic effect per application on the NRC related to using the guidance to review renewal applications. As stated in the Industry Implementation attribute, the issuance of NUREG–2214 is expected to affect the efficiency of the renewal application process.

- NRC Operations—This attribute measures the projected net economic effect of routine and recurring NRC activities that will occur during the renewed storage term. NUREG–2214 includes recommendations for monitoring and inspection activities for which the NRC will be providing ongoing oversight.

- Improvements in Knowledge—This qualitative attribute accounts for the value of consolidating the technical bases for dry storage system aging mechanisms and making this new information publicly available. NUREG–2214 summarizes hundreds of technical papers and worldwide operating experience on aging degradation.

- Regulatory Efficiency—This qualitative attribute accounts for potential nonquantifiable benefits in regulatory and compliance improvements beyond those efficiencies estimated in other attributes.

3.2.2 Base Year of Analysis

The NRC assumes it will issue NUREG–2214 in 2019, so all quantified benefits and costs are escalated or discounted to 2019 dollars.

3.2.3 Time Horizon

The applicability period for the impacted entities is estimated to be 20 years (i.e., 2019 to 2038), which addresses anticipated renewal applications for all storage licenses and CoCs approved to date.

3.2.4 Cost/Benefit Inflators

The NRC estimated the analysis inputs from various sources, some provided in prior-year dollars. To evaluate the costs and benefits consistently, it put these inputs into base-year dollars. The most common inflator is the consumer price index for all urban consumers (CPI-U) developed by the U.S. Department of Labor, Bureau of Labor Statistics. Using the CPI-U, the staff converted prior-year dollars to 2019 dollars, using the formula:

$$\frac{CPI - U_{2019}}{CPI - U_{Base\ Year}}\ x\ Value_{Base\ Year} = Value_{2019}$$

Table 1 summarizes the values of CPI-U used in this regulatory analysis.

Table 1 CPI-U Inflator

Base Year	CPI-U Annual Average[a]	Forecast Percent Change from Previous Year
2017	245.14	
2018	251.28	2.50%
2019	257.5	2.48%

[a] Statistica, "Projected Consumer Price Index in the United States from 2010 to 2023," accessed April 19, 2019

3.2.5 Net Present Value Calculations

The net present value (NPV) calculations determine how much society would need to invest today to ensure that the designated dollar amount is available in a given year in the future. Using discount factors for the costs and benefits allows for future incremental costs and benefits to be valued equally when comparing alternatives. Based on OMB Circular No. A-4, present value calculations are presented using both 3-percent and 7-percent real discount rates, and the decision rationale is based on the 7-percent real discount rate.

3.2.6 Sign Conventions

This analysis uses a sign convention such that all favorable consequences for the alternative are positive and all adverse consequences for the alternative are negative. Negative values are shown using parentheses (e.g., negative $500 is displayed as ($500)).

3.2.7 Assumptions

The analysis uses the following assumptions and considerations to determine the costs associated with the implementation of the alternatives:

- ISFSI licensees and CoC holders would review the guidance in preparation for submitting an application to renew the storage term of spent fuel storage systems and facilities.

- The staff estimates that the guidance would result in a 25-percent reduction in the amount of time required for applicants to develop their applications and respond to staff

RAIs. The NRC also estimates that the guidance will result in a 25-percent reduction in the amount of time required for the staff to review applications, develop RAIs and evaluate responses, and document their safety evaluation. This estimate is based on staff experience with similar guidance for the renewal of power reactor licenses.

- The staff expects that the AMPs developed following the issuance of NUREG–2214 will be similar in scope and breadth as those programs that were submitted with previously NRC-approved renewal applications. As a result, the staff does not expect any change in incremental costs to the industry or the NRC for ongoing aging management activities (e.g., inspections).

3.3 Evaluation of Alternative 1—Take No Action

This regulatory analysis measures the incremental impacts of the alternative relative to a baseline, which reflects anticipated behavior if the staff does not issue NUREG–2214. By definition, the no-action alternative, the baseline for the analysis, does not result in any change in benefits or costs.

3.4 Evaluation of Alternative 2—Issue NUREG–2214

The evaluation of Alternative 2 for each potential affected attribute is presented below.

3.4.1 Public Health (Routine)

The issuance of NUREG–2214 is not expected to result in a change to public radiation exposure. Although the proposed guidance includes recommendations for monitoring and inspection activities to ensure that the public is adequately protected from radiation, these recommendations are consistent with the approaches that the NRC has approved in licensing actions before the guidance was developed. As a result, the effectiveness of the storage system's capability to shield the public from radiation is not expected to change with the issuance of the guidance. Regardless of whether or not guidance is issued, the requirements in 10 CFR 72.42 and 10 CFR Part 72.240 include aging management activities to ensure the public is protected from radiation in the period of extended operation.

3.4.2 Occupational Health (Routine)

The issuance of NUREG–2214 is not expected to result in a change to worker radiation exposure. Similar to the evaluation of public exposure above, the recommended activities to manage the aging of storage systems are largely consistent with those approved before the issuance of the guidance. Regardless of whether or not guidance is issued, the requirements in 10 CFR Part 72.42 and Part 72.240 include aging management activities, such as monitoring and inspections, to ensure important-to-safety functions are fulfilled in the period of extended operation. The issuance of NUREG–2214 is not expected to increase or decrease the scope of inspections, and thus it is not expected to increase or decrease worker exposure during these inspections.

3.4.3 Industry Implementation

Following the issuance of NUREG–2214, the NRC anticipates that industry renewal applicants would use the guidance to prepare high-quality applications. Because the guidance was developed with significant input from the nuclear industry, it presents a common understanding of the technical issues associated with aging degradation and the steps that are considered acceptable to maintain dry storage systems during the 20- to 60-year period of extended operation. The NRC expects that NUREG–2214 would increase the efficiency of the renewal process by reducing staff RAIs and redundant, case-by-case, reviews of the same technical topics. As a result, the time applicants spend to create an application and address NRC staff comments is estimated to drop by 25 percent.

Table 2 shows averted costs (benefits) resulting from the use of the new guidance. These are one-time costs associated with the renewal application process.

Table 2 Industry Implementation (Net Benefit)

Applicant Activity	Cost to Apply for Renewed Certificate or License[1]	Cost Savings per Application[2]	Number of Applications[3]	Total Cost Savings		
				Undiscounted	7% NPV	3% NPV
Prepare renewal application for CoC and respond to staff questions	$924,000	$243,058	13	$3,159,750	$2,288,889	$2,698,577
Prepare renewal application for site-specific ISFSI license and respond to staff questions	$924,000	$243,058	5	$1,215,288	$957,585	$1,093,692
Total				**$4,375,038**	**$3,246,474**	**$3,792,268**

[1] Historical applicant cost (2013 dollars): Project Execution Plan: Three-Mile Island Unit 2 ISFSI license Renewal, Idaho Cleanup Project.
[2] Twenty-five percent efficiency gain on historical applicant renewal cost; adjusted to 2019 dollars.
[3] The anticipated number of ISFSI license and CoC renewal applications to be submitted between 2019 and 2038.

3.4.4 Industry Operation

The staff does not expect the issuance of NUREG–2214 to result in a change to ongoing costs associated with performing aging management activities (e.g., monitoring activities, inspections) to fulfill the requirements of 10 CFR 72.42 and 10 CFR 72.240. The guidance in NUREG–2214 is consistent with the approaches that the NRC has approved in licensing actions before the guidance was developed. The general scope of ongoing monitoring and inspection activities occurring during the period of extended operation is expected to be similar for all licensees, whether or not the guidance is used in the application process.

3.4.5 NRC Implementation

Following the issuance of NUREG–2214, the staff would use that guidance to review all applications for renewed ISFSI licenses and CoCs. Because the guidance was developed with

significant input from the nuclear industry, it presents a common understanding of the technical issues associated with aging degradation and the steps acceptable to maintain dry storage systems during the 20- to 60-year period of extended operation. The staff expects that NUREG–2214 would increase the efficiency of the renewal process by enabling high-quality applications and reducing redundant, case-by-case, reviews of the same technical topics. As a result, the time the NRC staff expends to review each application and prepare RAIs to resolve technical issues is estimated to be drop by 25 percent.

Table 3 shows the total averted costs (benefits) associated with the use of the new guidance. These are one-time costs per application associated with the renewal application process.

Table 3 NRC Implementation (Net Benefit)

NRC Activity	Time to Review Application (hours)[1]	Time Savings[2] (hours)	No. of Applications	Total Cost Savings[3]		
				Undiscounted	7% NPV	3% NPV
Process renewal applications for certificates of compliance	5,000	1,250	13	$2,096,250	$1,518,501	$1,790,297
Process renewal applications for site-specific ISFSI licenses	4,250	1,063	5	$685,313	$539,991	$616,743
Total				**$2,781,563**	**$2,058,492**	**$2,407,040**

[1] Estimated NRC resources to review and approve renewal applications (www.nrc.gov/waste/spent-fuel-storage/resource-estimates.html)
[2] Twenty-five percent efficiency gain
[3] Labor rate: $129/hour

3.4.6 NRC Operation

The staff does not expect that the issuance of NUREG–2214 would result in a change to ongoing costs associated with the NRC's oversight of aging management activities. The NUREG–2214 guidance is representative of the approved aging management activities in the earlier licensing actions. The general scope of licensees' ongoing monitoring and inspection activities occurring during the period of extended operation is expected to be similar for all licensees, whether or not the new guidance is used in the application process. As a result, the general scope of the NRC's oversight of the licensees' activities is not expected to be substantially different with the issuance of the guidance.

3.4.7 Improvements in Knowledge

NUREG–2214 summarizes hundreds of technical papers and worldwide operating experience on aging degradation and provides a technical basis for the analyses included within renewal applications. This collection of aging information, developed with contributions from industry and public stakeholders, represents a common understanding of key technical issues associated with the safe storage of spent nuclear fuel. Such knowledge not only aids renewal applicants as they gather, organize, and present information in their applications, but it also aids

the public discourse during technical discussions on the approaches used to maintain spent fuel storage systems until spent fuel is moved to a permanent repository.

3.4.8 Regulatory Efficiency

The NRC anticipates that the issuance of the guidance, and the resulting improved understanding of aging processes, would provide efficiency gains by clarifying the technical issues associated with the aging of spent fuel storage systems. However, this attribute should not double-count the quantified renewal application efficiency gains that are already addressed in the attributes above. The staff did not identify any additional nonquantifiable efficiency gains.

3.5 Uncertainty Analysis

To determine the robustness of the estimated costs and benefits, the NRC examined how costs change due to uncertainties associated with the NRC's analytical assumptions and input data. The NRC used Monte Carlo simulation to examine the impact of uncertainty on the estimated net benefits. These Monte Carlo simulations were performed using the @Risk software package by Palisade Corporation.

3.5.1 Uncertainty Analysis Assumptions

Because this regulatory analysis is based on estimates of values that are sensitive to applicant-specific cost drivers and applicant dissimilarities, the NRC provides the following analysis of the variables that have the greatest amount of uncertainty.

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

The probability distributions chosen to represent the different variables in the analysis were bounded by the range-referenced input and the NRC staff's professional judgment. When defining the probability distributions for use in a Monte Carlo simulation, summary statistics are needed to characterize the distributions. These summary statistics include the low estimate, best estimate, and high estimate for a program evaluation and review technique (PERT) distribution. The NRC used the PERT distribution to reflect the relative spread and skewness of the distribution defined by the three estimates. Table 4 identifies the data elements, the distribution, and the mean value of the distribution that were used in the uncertainty analysis.

Table 4 Uncertainty Analysis Variables

Description, General Input	Mean Estimate	Low Estimate	Best Estimate	High Estimate
(Applicant) Prepare renewal application for CoC and respond to staff questions				
Cost savings per applicant/certificate holder for renewal of CoC	$243,058	$121,529	$243,058	$364,587
(NRC) Process renewal application for CoC				
Time savings to renew a CoC (hours)	1,250	750	1,250	1,750
(Applicant) Prepare renewal application for site-specific ISFSI license and respond to staff questions				
Cost savings per applicant/licensee for renewal of site-specific ISFSI license	$243,058	$121,529	$243,058	$364,587
(NRC) Process renewal application for site-specific ISFSI license				
Time savings to renew site-specific ISFSI license (hours)	1,063	638	1,063	1,488

3.5.2 Uncertainty Analysis Results

The staff performed the Monte Carlo simulation by calculating the results 10,000 times. For each analysis iteration, the values identified in Table 4 were chosen randomly from the probability distributions that define the input variables. The values of the output variables were recorded for each iteration and were used to define the resultant probability distribution.

For each figure below, the staff ran 10,000 simulations in which the key variables were changed to assess the resulting effect on costs and benefits. Figures 1 and 2 are histograms of the Alternative 2 incremental costs in comparison to the regulatory baseline (Alternative 1) for the industry and NRC, respectively. In each case, histograms are shown for the present value with 3-percent and 7-percent discount rates. Given that positive numbers represent favorable consequences (i.e., savings), the uncertainty analysis shows that there would be a substantial cost savings to both the industry and NRC associated with issuing NUREG–2214.

Figure 3 displays the total incremental benefit of issuing NUREG–2214 and the sensitivity of the uncertainty analysis to the discount rate. The analysis indicates that Alternative 2 results in a net savings of between $3.5 million and $9.4 million. The mean value of the net benefit is $5.3 million at a 7-percent discount rate. The uncertainty analysis shows a 99-percent chance that issuing NUREG-2214 would be cost effective.

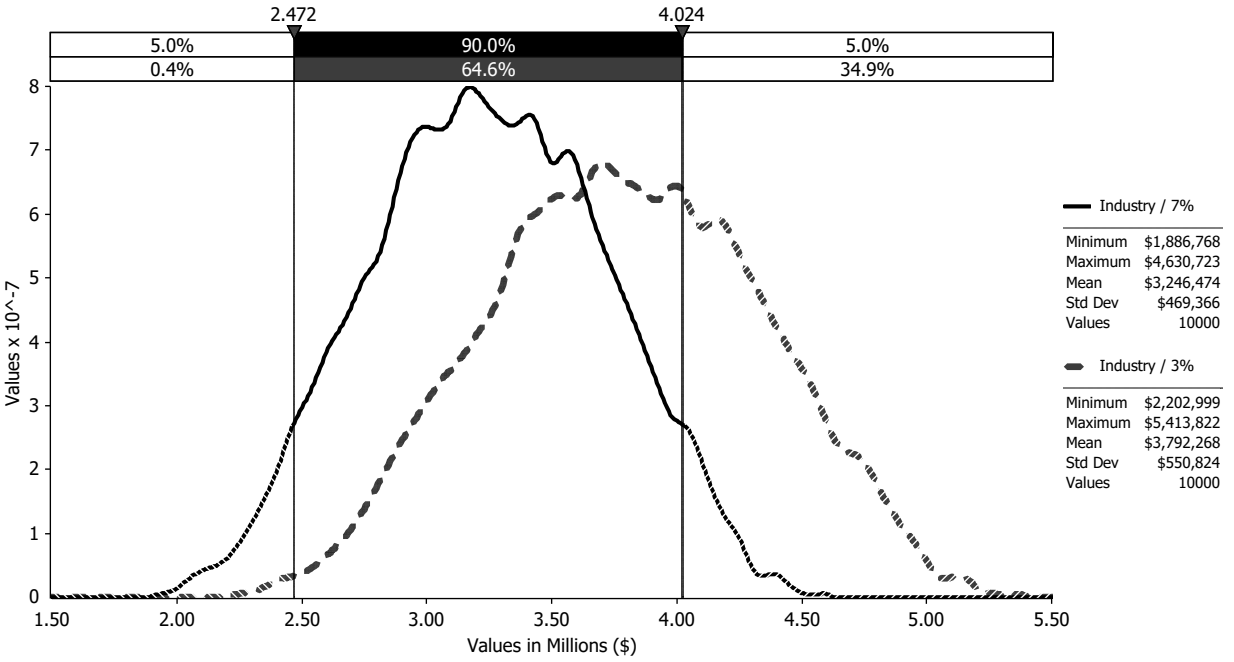

Figure 1 Uncertainty analysis of industry (applicant) cost savings - Alternative 2

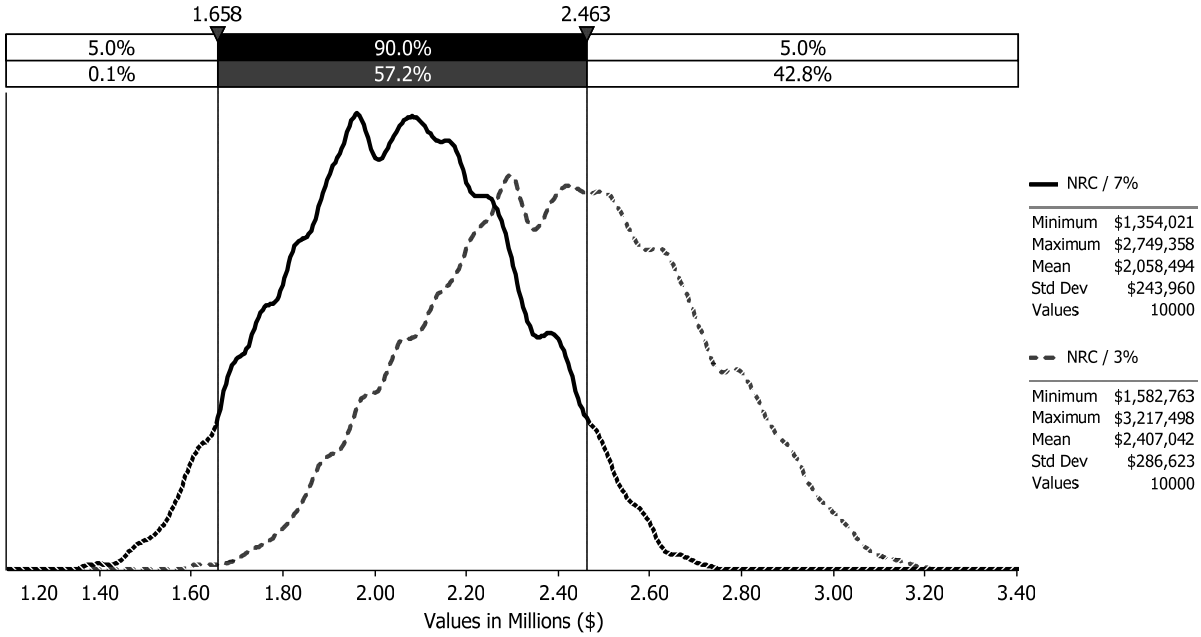

Figure 2 Uncertainty analysis of NRC cost savings - Alternative 2

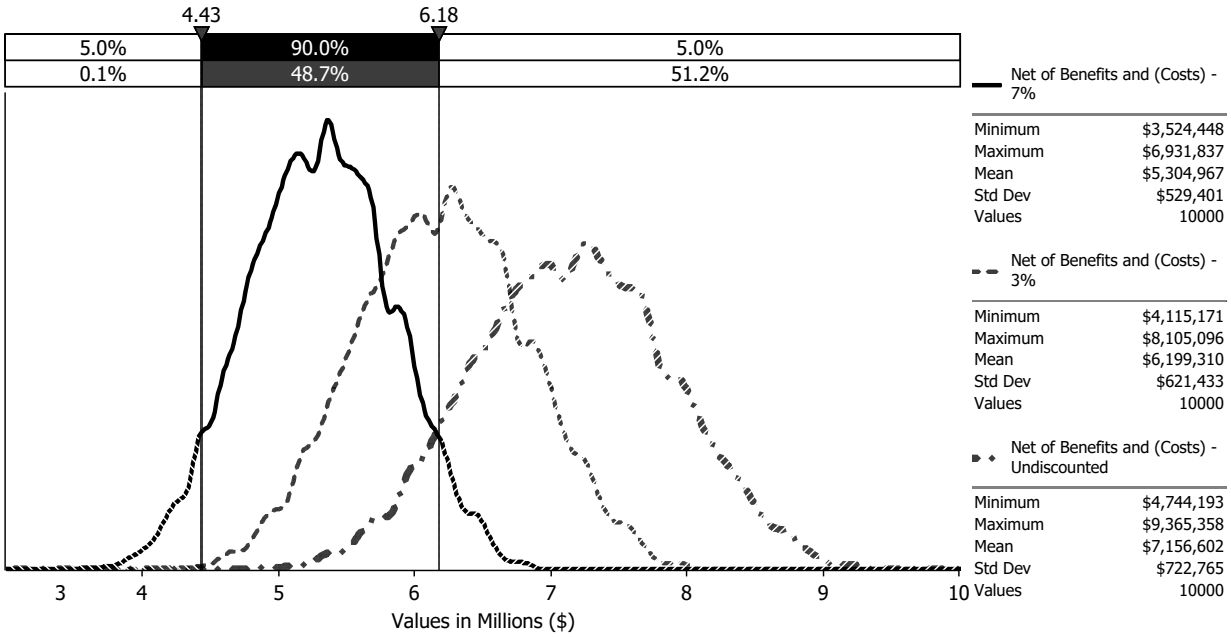

Figure 3 Uncertainty analysis of total net benefit vs. discount rate – Alternative 2

Table 5 displays the key statistical results, including the 90-percent confidence interval in which the net benefits would fall between the 5- and 95-percentile values. Examining the output distribution provided in Table 5 makes it possible to confidently conclude that issuing NUREG–2214 has the potential to result in substantial incremental benefits.

Table 5 Net Benefit of Alternative 2 (7-Percent Discount Factor)

Uncertainty Result	Cost Savings (2019 million dollars)				
	Minimum	**Mean**	**Maximum**	**5%**	**95%**
Total Industry Cost	$1.9	$3.2	$4.6	$2.5	$4.0
Total NRC Cost	$1.4	$2.1	$2.7	$1.7	$2.5
Total	$3.5	$5.3	$6.9	$4.4	$6.2

Note: The total cost is not the total of the above values because these are not normal distributions.

Figure 4 identifies the key variables whose uncertainty has the largest impact on total costs (and averted costs) for this analysis. This figure ranks the variables based on their contribution to cost uncertainty, using a 7-percent discount factor. Four variables drive the most uncertainty in the costs: (1) cost per applicant/certificate holder for renewal of CoCs, (2) the number of NRC hours to renew a CoC, (3) cost per applicant/licensee for renewal of site-specific ISFSI license, and (4) the number of NRC hours to renew an ISFSI license. The influence of a variable on the output is not only a function of the value of that variable, but also of the spread of its distribution and the number of licensing actions to which the variable applies.

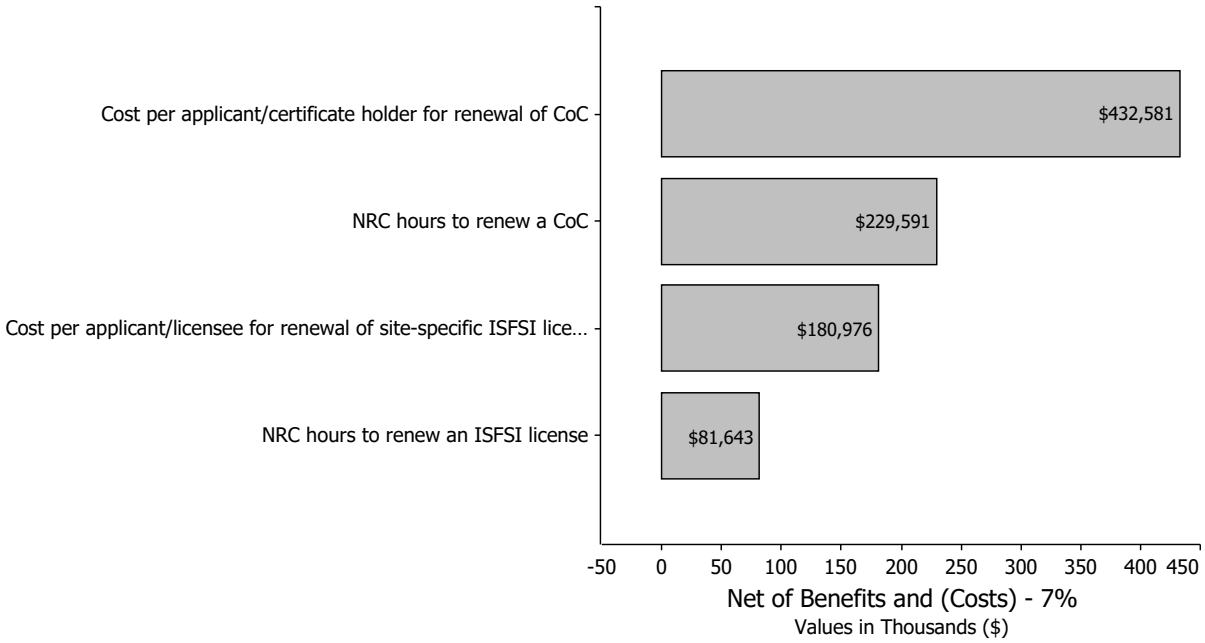

Figure 4 Effect of uncertainty of key variables on output mean (7-percent discount factor)

3.5.3 Summary of Uncertainty Analysis

The simulation analysis shows that the estimated mean benefit for issuing NUREG–2214 is $5.3 million, with 90-percent confidence that the benefit is between $4.4 million and $6.2 million using a 7-percent discount rate.

As illustrated in Figure 3, variation in key variables results in net benefit distributions that range from $3.5 million and $9.4 million from the regulatory baseline of Alternative 1 (Take No Action) when accounting for different discount factors.

3.6 Disaggregation

The NRC performed a screening review to determine whether any provisions would be unnecessary to achieve the regulatory objectives. The staff did not identify any unnecessary or unrelated provisions; therefore, it did not perform a disaggregation for this regulatory analysis.

4 PRESENTATION OF RESULTS

Table 6 summarizes both quantifiable and nonquantifiable costs and benefits that would result from issuing NUREG–2214. Although quantifiable costs and benefits appear to be more tangible, the NRC urges decisionmakers not to discount costs and benefits that are nonquantifiable. Such benefits or costs can be just as important as, or even more important than, benefits or costs that can be quantified and monetized.

Table 6 Summary of Total Benefit (or Costs)

Monetary Benefit (or Costs)	Nonmonetary Benefits (or Costs)
Alternative 1—No Action $0	**Alternative 1—No Action** None
Alternative 2—Issue NUREG–2214 **Qualitative Benefits:** Industry Net Benefit: $3.2 million using a 7% discount rate $3.8 million using a 3% discount rate NRC Net Benefit: $2.1 millon using a 7% discount rate $2.4 million using a 3% discount rate **Total Quantitative Net Benefit:** $5.3 million using a 7% discount rate $6.2 million using a 3% discount rate	**Alternative 2—Issue NUREG–2214** **Qualitative Benefits:** • Improvements in knowledge are realized by providing a summary of hundreds of technical papers and worldwide operating experience on aging degradation. Such knowledge not only aids renewal applicants as they gather, organize, and present information in their applications, but it also aids the public discourse during highly technical, and often contentious, discussions on the approaches used to maintain spent fuel storage systems until spent fuel is moved to a permanent repository • The issuance of regulatory guidance will enable greater regulatory efficiency, as applicants will be able to more effectively prepare, and the staff efficiently review, renewal applications because of clarity in the staff's technical position and the need for fewer NRC-generated RAIs. Some, if not all, of this benefit is accounted for in the quantified monetary benefits. • No significant change in public or occupational radiation exposure. **Total Qualitative Net Benefit:** • Positive qualitative benefit

5 DECISION RATIONALE

The analysis shows that industry applicants for renewal of spent fuel dry storage terms from 20 to 60 years would incur substantial benefits from the proposed Alternative 2. The issuance of NUREG–2214 encourages applicants to use a regulatory process that would allow them to submit high quality applications that would save millions of dollars in renewal application costs over the 20-year regulatory analysis period. The NRC would similarly experience a savings of millions of dollars, as the time required to review and approve an application is anticipated to decrease by reducing RAIs from the NRC staff and reducing redundant, case-by-case, reviews of the same technical topics.

Based solely on quantified costs and benefits, the regulatory analysis shows that the issuance of NUREG–2214 would result in a benefit to industry that ranges from $3.2 million (7-percent discount rate) to $3.8 million (3-percent discount rate). The NRC's benefit ranges from $2.1 million (7-percent discount rate) to $2.4 million (3-percent discount rate). Therefore, the total quantitative net benefit (averted costs) of issuing the guidance would range from $5.3 million (7-percent discount rate) to $6.2 million (3-percent discount rate).

Even if the issuance of NUREG–2214 were found to not be cost-beneficial on a monetary basis, the nonquantified costs and benefits in Table 6 show that issuing the guidance document may be justified because it is anticipated to result in net benefits to improvements in knowledge and increases in regulatory efficiency. The knowledge shared by NUREG–2214 is expected to facilitate safety enhancements for long-term storage of spent nuclear fuel. The document aids the understanding of aging degradation and can assist the prioritizing of actions to ensure that storage systems can perform their safety functions until the fuel can be moved to a permanent repository.

Therefore, when considering both quantified and nonquantified costs and benefits, the staff concludes that the issuance of NUREG–2214 is expected to result in a beneficial impact, which provides an adequate basis to conclude that Alternative 2 is the preferred alternative.

The staff recommends Alternative 2, issue NUREG–2214, as this provides the greatest cost benefit.

6 REFERENCES

NRC, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel," NUREG-1927, Rev. 1, June, 2017, ADAMS Accession No. ML16179A148. Available at https://www.nrc.gov/docs/ML1617/ML16179A148.pdf.

NRC, "Managing Aging Processes in Storage (MAPS) Report: Draft Report for Comment," NUREG–2214, October 24, 2017, ADAMS Accession No. ML17289A237. Available at https://www.nrc.gov/docs/ML1728/ML17289A237.pdf.

NRC, NUREG/BR–0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Rev. 4, September 2004.

NRC, "Generic Cost Estimates: Abstracts from Generic Studies for Use in Preparing Regulatory Impact Analyses," prepared by Science and Engineering Associates, Inc., for the NRC, NUREG/CR-4627, Rev. 2, February 1992, ADAMS Accession No. ML13137A259.

Nuclear Energy Institute, "Format, Content and Implementation Guidance for Dry Cask Storage Operations-Based Aging Management for Dry Cask Storage." NEI 14-03, Rev. 2., December 2016. Agencywide Documents Access and Management System (ADAMS) Accession No. ML16356A210. Available at https://www.nrc.gov/docs/ML1635/ML16356A210.pdf.

Statistica, “Projected Consumer Price Index in the United States from 2010 to 2023.” Available at http://www.statista.com/statistics/244993/projected-consumer-price-index-in-the-united-states/Statistics. Last accessed April 19, 2019.

U.S. Code of Federal Regulations, “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste.” Part 72, Chapter 1, Title 10, “Energy.”

U.S. Department of Labor, Bureau of Labor Statistics, “Databases, Tables & Calculators by Subject,” Occupational Employment Statistics, Occupational Employment and Wages. Available at https://www.bls.gov/data/.

U.S. Office of Management of the Budget, “Regulatory Analysis,” Circular A-4, September 17, 2003. Available at https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/.

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