
Regulatory Analysis for the Proposed Rule: Approval of American Society of Mechanical Engineers Code Cases and Update Frequency

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Abstract

This proposed rule recommends approval, through the Nuclear Regulatory Commission's (NRC) regulations, of the latest revisions to the NRC regulatory guides (RGs) listing American Society of Mechanical Engineers (ASME) Code Cases for the ASME Boiler and Pressure Vessel Code and the ASME Operation and Maintenance of Nuclear Power Plants Code. These are code cases that the NRC finds acceptable or acceptable with NRC-specified conditions ("conditionally acceptable"). The NRC is issuing three RG revisions that identify the ASME Code Cases proposed for NRC approval:

- (1) RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 40 (Draft Regulatory Guide (DG)-1405), would supersede RG 1.84, Revision 39, issued December 2021.
- (2) RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 21 (DG-1406), would supersede RG 1.147, Revision 20, issued December 2021.
- (3) RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 5 (DG-1407), would supersede RG 1.192, Revision 4, issued December 2021.

Furthermore, this proposed rule would change the code of record interval to be twice the ISI or IST interval (from 10 years currently), plus the one-time 1-year extension for IST and ISI programs per their respective ASME Code, or 25 years. This document includes the regulatory analysis of the proposed rule for the three RGs that list the code cases proposed for NRC approval and the code of record interval extension. To increase the credibility of its cost estimates for this regulatory action, the NRC staff conducted (1) an uncertainty analysis to consider the effects of input uncertainty on the cost estimates and (2) a sensitivity analysis to identify the variables that most affect the cost estimates (i.e., the cost drivers).

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Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
ASME	American Society of Mechanical Engineers
ASME Codes	ASME BPV and OM Codes
BLS	Bureau of Labor Statistics
BPV	boiler and pressure vessel
BPV Code	ASME Boiler and Pressure Vessel Code
BWR	boiling-water reactor
CFR	<i>Code of Federal Regulations</i>
CPI-U	Consumer Price Index for All Urban Consumers
CRGR	Committee to Review Generic Requirements
DG	draft regulatory guide
EWR	excavation and weld repair
FR	<i>Federal Register</i>
ISI	inservice inspection
IST	inservice testing
ksi	kilogram per square inch
LOE	level of effort
MRP	materials reliability program
NPV	net present value
NTTAA	National Technology Transfer and Advancement Act of 1995
NUREG	NRC technical report
OM Code	ASME Operation and Maintenance of Nuclear Power Plants, Division 1, OM Code: Section IST
OMB	U.S. Office of Management and Budget
PERT	program evaluation and review technique
PWR	pressurized water reactor
RG	regulatory guide
UTS	ultimate tensile strength

Executive Summary

The NRC is proposing to amend its regulations to incorporate by reference the latest revisions of three NRC regulatory guides (RGs) approving new, revised, and reaffirmed code cases published by the American Society of Mechanical Engineers (ASME). The NRC proposes to incorporate by reference the following three RGs:

- (1) RG 1.84, “Design, Fabrication, and Materials Code Case Acceptability, ASME Section III,” Revision 40 (Draft Regulatory Guide (DG)-1405)
- (2) RG 1.147, “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1,” Revision 21 (DG-1406)
- (3) RG 1.192, “Operation and Maintenance Code Case Acceptability, ASME OM Code,” Revision 5 (DG-1407)

This regulatory action would allow nuclear power plant licensees and applicants for construction permits, operating licenses, combined licenses, standard design certifications, standard design approvals, and manufacturing licenses to voluntarily use the ASME Code Cases newly listed in these RGs as alternatives to ASME engineering standards for the construction, inservice inspection, and inservice testing of nuclear power plant components.

Furthermore, this proposed rule would change the maximum code of record interval to 25 years (from 10 years currently).

This document examines the averted costs (i.e., benefits) and costs of the proposed rulemaking and implementing guidance relative to the baseline case (i.e., the no-action alternative).

The NRC staff has made the following key findings:

- Proposed Rule Analysis: The proposed rule recommended by the staff would result in a cost-justified change based on a net (i.e., taking into account both costs and benefits) averted cost to the industry of between \$29.9 million (7-percent NPV) and \$35.1 million (3-percent NPV). Compared to the regulatory baseline, the NRC would realize net averted costs of between \$4.42 million (7-percent NPV) and \$5.38 million (3-percent NPV). In total, the net averted costs to the industry and the NRC would be between \$34.3 million (7-percent NPV) and \$40.5 million (3-percent NPV). Table ES-1 shows these costs and benefits.

Table ES-1 Total Costs and Benefits for Rulemaking Alternative

Attribute	Costs		
	Undiscounted	7% NPV	3% NPV
Total Industry Costs:	(\$1,288,000)	(\$1,051,000)	(\$1,178,000)
Total NRC Costs:	(\$1,233,000)	(\$1,022,000)	(\$1,136,000)
Total	(\$2,521,000)	(\$2,073,000)	(\$2,314,000)

Attribute	Benefits		
	Undiscounted	7% NPV	3% NPV
Total Industry Benefits:	\$38,000,000	\$30,940,000	\$36,290,000
Total NRC Benefits:	\$7,100,000	\$5,440,000	\$6,520,000
Total	\$45,100,000	\$36,380,000	\$42,810,000

Attribute	Net Benefits (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry	\$36,710,000	\$29,890,000	\$35,110,000
NRC	\$5,870,000	\$4,420,000	\$5,380,000
Total	\$42,580,000	\$34,310,000	\$40,490,000

- Nonquantified Benefits:** The proposed rule would also enable the NRC to continue to protect public health and safety and the environment by approving new and updated code cases from the ASME Boiler and Pressure Vessel Code and ASME Operation and Maintenance of Nuclear Power Plants, Division 1, OM Code: Section IST, which allow the use of the most current methods and technology. The proposed rule is consistent with the provisions of the National Technology Transfer and Advancement Act of 1995 and implementing guidance in U.S. Office of Management and Budget Circular A-119, “Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities,” dated January 27, 2016 (OMB, 2016), which encourage Federal regulatory agencies to adopt voluntary consensus standards as an alternative to de novo agency development of standards affecting an industry. Finally, the ASME Code consensus process is an important part of the regulatory framework.
- Uncertainty Analysis:** The regulatory analysis includes a simulation analysis that shows that the estimated mean benefit for this proposed rule is \$34.3 million using a 7-percent discount rate, with greater than 99-percent confidence that the proposed rule is cost beneficial. It is reasonable to infer from the uncertainty analysis that the proposed rule represents an efficient use of resources and averted costs to the NRC and the industry. The industry averted cost for a code of record update is the factor responsible for the largest variation in averted costs.
- Decision Rationale:** Comparing the proposed rule to the no-action baseline, the staff concludes that the proposed rule is quantitatively justified, because its provisions would result in millions of dollars of net averted costs (i.e., net benefits) for the NRC and the

industry. In addition, the staff concludes that the proposed rule is also justified in terms of qualitative costs and benefits, because the qualitative benefits outweigh the qualitative costs.

1. Introduction

This document presents the regulatory analysis of the NRC's proposed rule on the incorporation by reference of new American Society of Mechanical Engineers (ASME) Code Cases and the following three associated draft regulatory guides (DGs):

- DG-1405, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Regulatory Guide (RG) 1.84, proposed Revision 40
- DG-1406, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," RG 1.147, proposed Revision 21
- DG-1407, "Operation and Maintenance Code Acceptability, ASME OM Code," RG 1.192, proposed Revision 5

The recommended regulatory action proposes to incorporate by reference the latest revisions to the three RGs listed above, so that the NRC approves the newly identified ASME Code Cases. Furthermore, this proposed rule would change the code of record interval to twice the ISI or IST interval (from 10 years currently).

2. Statement of the Problem and Objective

2.1 Background

ASME develops and publishes the ASME Boiler and Pressure Vessel Code (BPV Code), which contains requirements for the design, construction, and inservice inspection (ISI) of nuclear power plant components, and the ASME Operation and Maintenance of Nuclear Power Plants, Division 1, OM Code: Section IST (OM Code), which contains requirements for inservice testing (IST) of nuclear power plant components. In response to BPV and OM Code user requests, ASME develops code cases that provide voluntary alternatives to BPV and OM Code requirements under special circumstances.

The NRC approves the ASME BPV and OM Codes in Section 50.55a of Title 10 of the *Code of Federal Regulations* (10 CFR), "Codes and standards," through the process of incorporation by reference. Each provision of the ASME Codes incorporated by reference into and mandated by 10 CFR 50.55a constitutes a legally binding NRC requirement imposed by rule. As noted previously, ASME Code Cases mostly represent alternative approaches for complying with provisions of the ASME BPV and OM Codes. Accordingly, the NRC periodically amends 10 CFR 50.55a to incorporate by reference the NRC RGs listing approved ASME Code Cases that may be used as voluntary alternatives to the ASME BPV and OM Codes.

This proposed rule is the latest in a series of rules that incorporate by reference new versions of RGs identifying new, revised, and reaffirmed ASME Code Cases, either unconditionally or conditionally acceptable, that the NRC approves for use. In developing these RGs, the NRC staff reviews ASME BPV and OM Code Cases, determines the acceptability of each code case

(i.e., any flexibilities in each code case have a positive or no impact on safety; code cases are based on sound engineering principles and contain no technical errors), and publishes its findings in the RGs. The RGs are revised periodically as ASME publishes new code cases. The NRC incorporates by reference the RGs listing acceptable and conditionally acceptable ASME Code Cases into 10 CFR 50.55a. On March 3, 2022, the NRC published a final rule in the *Federal Register* (87 FR 11934) that incorporated by reference into 10 CFR 50.55a the most recent versions of RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 39 (NRC, 2021c); RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 20 (NRC, 2021d); and RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 4 (NRC, 2021e), all issued in December 2021.

The current ISI, IST, and code of record intervals are all set at 10 years. Code Cases N-921 and OMN-31, proposed to be incorporated by reference in this rulemaking, change the allowable ISI and IST intervals, respectively, to 12 years. Because this change would allow the ISI, IST, and code of record intervals to go out of alignment, leading to administrative costs and potential confusion, the staff has decided to eliminate the requirement to update the code of record every 10 years and replace it with a requirement to update the code of record every two ISI or IST intervals. The revised code of record interval allows the same code of record to be used for two consecutive ISI or IST intervals, each up to 12 years, plus the one-time 1-year extension for IST and ISI programs as specified in the ASME OM Code and ASME BPV Code, respectively, or 25 years.

2.2 Statement of the Problem

ASME may revise code cases for many reasons, such as to incorporate operational examination and testing experience or to update material requirements based on research results. On occasion, an inaccuracy in an equation is discovered, or an examination as practiced is found to be inadequate for detecting a newly discovered degradation mechanism. Therefore, when a licensee initially implements a code case, 10 CFR 50.55a requires the licensee to implement the most recent version of that code case as listed in the approved or conditionally approved tables in 10 CFR 50.55a. A request to use a previous code case could be submitted and approved as an alternative under 10 CFR 50.55a(z); the NRC evaluates such requests case by case.

Section III of the ASME BPV Code applies to both new construction and repair or replacement (under the licensee's ASME Code, Section XI, repair/replacement program) of components originally constructed to ASME Code, Section III. The edition and addenda to be used in the construction of a plant and the repair or replacement of ASME Code, Section III, components depend on the date of the construction permit; licensees are not required to later update their Section III codes of record. If a licensee implements an ASME BPV Code, Section III, code case, and if the NRC later incorporates by reference a newer version of the code case into 10 CFR 50.55a, that licensee may use either version of the code case.

Licensees update their ISI programs under the ASME BPV Code, Section XI, and their IST programs under the ASME OM Code every 10 years, in accordance with the latest editions and addenda of the ASME Codes that have been incorporated by reference into 10 CFR 50.55a and taken effect at least 18 months before the start of the next inspection interval. Licensees that were using an earlier revision of a code case before the effective date of the NRC's final rule incorporating a newer version of it may continue to use the previous version for the remainder of the 120-month ISI or IST interval. This relieves licensees of the costs of having to update their ISI or IST program each time the NRC incorporates a revised code case. In their next ISI or IST interval, licensees must update any code cases they have chosen to use along with their code of record updates, or else they must submit an alternative request under 10 CFR 50.55a(z). The NRC staff has determined that the ASME ISI and IST intervals could be extended to 12 years and that the code of record interval may be extended so that licensees would update their codes of record once for every two ISI and IST intervals. Code Cases N-921 and OMN-31, proposed for incorporation by reference in this rulemaking, extend the allowable ISI and IST intervals, respectively, to 12 years, but the code of record interval is part of the NRC regulations. This creates a misalignment in the intervals that the staff is seeking to prevent through the change to the maximum code of record interval in this proposed rule.

2.3 Objective

The objective of this proposed regulatory action is to incorporate by reference the latest revisions to three RGs that list code cases published by ASME and approved by the NRC:

- (1) RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 40 (DG-1405)
- (2) RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 21 (DG-1406)
- (3) RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 5 (DG-1407)

These revisions supersede the incorporation by reference of RG 1.84, Revision 39 (NRC, 2021c); RG 1.147, Revision 20 (NRC, 2021d); and RG 1.192, Revision 4 (NRC, 2021e). This regulatory action (1) would improve the effectiveness of future licensing actions, (2) would be consistent with the provisions of the National Technology Transfer and Advancement Act of 1995 (NTTAA) that encourage Federal regulatory agencies to adopt voluntary consensus standards as an alternative to de novo agency development of standards affecting an industry, and (3) would be consistent with the NRC policy of evaluating whether the latest versions of already NRC-approved consensus standards are suitable for endorsement by regulation or RG. Furthermore, this proposed rule would change the code of record interval to twice the ISI or IST interval (from 10 years currently).

3. Identification and Preliminary Analysis of Alternative Approaches

The NRC has identified two alternatives for this action:

(1) Alternative 1: No action (i.e., status quo, regulatory baseline).

Alternative 2: Through rulemaking, incorporate by reference into 10 CFR 50.55a the NRC-approved ASME BPV Code Cases in RG 1.84, Revision 40 (DG-1405), and RG 1.147, Revision 21 (DG-1406), and the ASME OM Code Cases in RG 1.192, Revision 5 (DG-1407). Increase the code of record interval to twice the ISI or IST interval, in conjunction with the ISI and IST interval changes in Code Cases N-921 and OMN-31, respectively.

3.1 Alternative 1: No Action

The no-action alternative (status quo, regulatory baseline) is a nonrulemaking alternative. Under the no-action alternative, the NRC would not revise its regulations to incorporate by reference the latest revisions to these three RGs and would not make conforming changes to 10 CFR 50.55a to comply with guidance from the Office of the Federal Register for incorporating by reference multiple standards into regulations. Under the no-action alternative, licensees and applicants wishing to use these ASME Code Cases would likely request and receive NRC approval for the use of alternatives under 10 CFR 50.55a(z). The NRC recommends against this alternative for the following reasons:

- Licensees and applicants would need to submit requests for alternatives under 10 CFR 50.55a(z) to apply the code cases under consideration, because these code cases would not have been approved in RGs or incorporated by reference in 10 CFR 50.55a. This process would increase regulatory costs to licensees, applicants, and the NRC.
- Public confidence in the NRC as an effective regulator could be reduced, because ASME periodically publishes, revises, or annuls code cases. Under Alternative 1, outdated material and possibly inaccurate information would remain incorporated by reference into the *Code of Federal Regulations*.
- This alternative does not meet the intent of the NTTAA, which encourages Federal regulatory agencies to adopt voluntary consensus standards as an alternative to de novo agency development of standards affecting an industry.

3.2 Alternative 2: Incorporate by Reference NRC-Approved ASME BPV and OM Code Cases

Alternative 2 would incorporate by reference later revisions to the RGs listing newly NRC-approved ASME Code Cases. This alternative would allow licensees and applicants to implement these ASME Code Cases and their conditions and modifications, if any, without seeking prior NRC approval. This alternative continues the NRC's use of periodic rulemakings to incorporate by reference in 10 CFR 50.55a the latest RGs that list NRC approved alternatives to the provisions of the ASME BPV and OM Codes.

Furthermore, Alternative 2 would change the maximum code of interval to twice the ISI or IST interval (from 10 years currently).

The NRC recommends Alternative 2 for the following reasons:

- This alternative reduces the regulatory costs on applicants or holders of licenses for nuclear power plants by eliminating the need to submit plant-specific requests for alternatives in accordance with 10 CFR 50.55a(z) to apply these code cases. It also eliminates the need for the NRC to review such submittals.
- This alternative meets the NRC's goal of protecting public health and safety and the environment by continuing to approve new, revised, or reaffirmed ASME Code Cases, which enable the use of the latest methods and technology.
- This alternative supports the NRC's goal of maintaining an open regulatory process by informing the public about the process and allowing the public to participate in it.
- This alternative supports the NRC's commitment to participating in the national consensus standard process through the approval of these ASME Code Cases. The alternative also conforms to NTTAA requirements.
- The initial NRC costs to update the regulations by incorporating by reference the ASME Code Cases cited here is more than offset by the reduction in the number of plant-specific alternative requests that the NRC would otherwise need to evaluate.
- The extension of the maximum interval for code of record updates would result in significant averted costs to licensees and some averted costs to the NRC. Section 5 of this analysis discusses the costs and benefits of Alternative 2 relative to the regulatory baseline (Alternative 1).

4. Estimation and Evaluation of Costs and Benefits

This section presents the staff's process for evaluating the expected costs and benefits of each proposed alternative relative to the regulatory baseline (Alternative 1). All costs and benefits are monetized, when possible. The total costs and benefits are then summed to determine whether they constitute a positive benefit. In some cases, costs and benefits are not monetized because meaningful quantification is not possible.

4.1 Identification of Affected Attributes

This section identifies the components of the public and private sectors, commonly referred to as attributes, that the NRC staff expects Alternative 2 to affect. Alternative 2 would apply to licensees and applicants for nuclear power plants and nuclear power plant design certifications. The NRC believes that nuclear power plant licensees would be the primary beneficiaries. The

staff developed an inventory of the affected attributes using the list in NUREG/BR-0058, draft Revision 5, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," issued January 2020 (NRC, 2020).

The rule would affect the following attributes:

Public Health (Accident): This attribute accounts for expected changes in public radiation exposure caused by changes in accident frequencies or accident consequences resulting from Alternative 2 (with changes expressed as delta risk relative to Alternative 1). Compared to the regulatory baseline (Alternative 1), Alternative 2 better promotes the NRC's goal of protecting public health and safety and the environment, because it ensures NRC approval of new ASME Code Cases that allow the use of the latest methods and technology, which may decrease the likelihood of an accident and, therefore, decrease the overall risk to public health.

- Occupational Health (Accident): This attribute measures immediate and long-term health effects for site workers due to changes in accident frequency or accident consequences resulting from Alternative 2 (again expressed as delta risk). A decrease in worker radiological exposure is a decrease in risk (i.e., a benefit); an increase in worker exposure is an increase in risk (i.e., a cost). The use of new ASME Code Cases may incrementally decrease occupational health risks following an accident, but this effect is not easily quantifiable. For example, advances in ISI and IST may incrementally decrease accident frequency, decreasing worker postaccident radiological exposure relative to the regulatory baseline.
- Occupational Health (Routine): This attribute accounts for radiological exposure of workers during normal facility operations (i.e., nonaccident situations). The staff expects that licensees' voluntary use of the NRC-approved code cases would reduce occupational radiation exposure (for example, during routine inspections or testing) in a positive, but not easily quantifiable, manner.
- NRC Implementation: This attribute accounts for the projected net economic effect on the NRC of implementing the alternative, relative to the regulatory baseline. To implement Alternative 2, the NRC would incur the costs of developing the proposed and final rule and updating the corresponding guidance in RG 1.84, RG 1.147, and RG 1.192.
- Industry Operation: This attribute accounts for the projected net economic effect on all licensees of the routine and recurring activities required by Alternative 2. Under Alternative 2, nuclear power plant licensees would need to submit fewer code case requests under 10 CFR 50.55a(z), which would constitute a net benefit (i.e., averted cost) for the licensees.
- NRC Operation: This attribute accounts for the projected net economic effect on the NRC after the proposed action is taken. If the NRC has not approved an ASME Code

Case that a licensee or applicant wants to use, the licensee or applicant typically will request permission to use the code case through a submittal under 10 CFR 50.55a(z). The NRC staff will then have to spend additional time evaluating the submittal to determine whether the code case is acceptable and whether any limitations or modifications should apply. Under Alternative 2, these code case alternative requests would be reduced, which results in a net benefit (i.e., averted cost) for the NRC.

- Improvements in Knowledge: This attribute accounts for increases in knowledge due to advances in ISI and IST. Improvements in ISI and IST may also allow earlier identification of material or equipment degradation that, if undetected, could lead to a plant transient or could compromise plant equipment needed to respond to a plant transient.
- Regulatory Efficiency: This attribute accounts for regulatory and compliance improvements resulting from the implementation of Alternative 2. Alternative 2 would increase regulatory efficiency because licensees and applicants wishing to use NRC-approved ASME Code Cases would not need to submit 10 CFR 50.55a(z) alternative requests. Furthermore, Alternative 2 is consistent with the provisions of the NTTAA that encourage Federal agencies to adopt voluntary consensus standards as an alternative to de novo agency development of standards affecting an industry. Alternative 2 is consistent with the NRC's policy of evaluating whether the latest versions of consensus standards are suitable for endorsement by regulation or RG. In addition, Alternative 2 is consistent with the NRC's goal of harmonizing with international standards to increase regulatory efficiency for both the NRC and international standards groups.
- Attributes with No Effects: Attributes that are not expected to contribute to the results under any of the alternatives include industry implementation; public health (routine); offsite property; onsite property; other government, general public, safeguards, and security considerations; and environmental considerations addressing section 102(2) of the National Environmental Policy Act of 1969.

4.2 Analytical Methodology

This section describes the process used to evaluate the costs and benefits of the proposed alternatives. The benefits include any desirable changes in affected attributes (e.g., monetary savings, increased safety, improved security). The costs include any undesirable changes in affected attributes (e.g., monetary costs, increased exposure).

Of the eight affected attributes, the staff analyzed three quantitatively: industry operation, NRC implementation, and NRC operation. Quantitative analysis requires a baseline characterization of the affected attribute, including factors such as the number of affected entities, the nature of the activities currently performed, and the types of systems and procedures that licensees or applicants would implement, or would no longer implement, under each proposed alternative.

Where possible, the staff calculated costs for these three attributes using three-point estimates to quantify uncertainty. Detailed cost tables appear in the individual sections for each of the attributes.

The staff evaluated the remaining five attributes qualitatively, either because the effects of consistent policy application and improvements in ISI and IST techniques on these attributes are not easily quantifiable, or because the data necessary to quantify and monetize these effects are not available.

The staff has documented its assumptions throughout this regulatory analysis. For the reader's convenience, Appendix A summarizes the major assumptions and input data used in the analysis.

4.2.1 Regulatory Baseline

This regulatory analysis identifies the incremental impacts of the proposed rule relative to a baseline that reflects anticipated behavior if the NRC does not undertake regulatory or nonregulatory action. The regulatory baseline assumes full compliance with existing NRC requirements, including current regulations and relevant orders. This is consistent with NUREG/BR-0058 (NRC, 2020), which states that “in evaluating a new requirement...the staff should assume that all existing NRC and Agreement State requirements have been implemented.” Section 5 of this regulatory analysis presents the estimated incremental costs and benefits of the alternatives compared to this baseline. This regulatory baseline is the no-action alternative (i.e., Alternative 1).

4.2.2 Affected Entities

This proposed rule would affect all operating light-water nuclear power plants. The analysis considers 54 plant sites containing one or more operating U.S. light-water nuclear power reactor units, for a total of 92 currently operating reactors (61 PWR and 31 BWR). The staff made the assumption that the state of California would work with Pacific Gas and Electric Company to pursue license renewal for Diablo Canyon 1 and 2 and keep them from permanently shutting down in 2024 and 2025. The staff made the assumption that all operating reactors would apply for either an initial or subsequent license renewal based on recent trends. In this way, the staff made a simplifying assumption that all currently operating reactors would remain in operation long enough to benefit from one code of record update extension.

4.2.3 Base Year

All monetized costs are expressed in 2021 dollars. Unless stated otherwise, ongoing costs of operation under Alternative 2 are assumed to begin no earlier than 30 days after publication of the final rule in the *Code of Federal Regulations*, which is expected to be in 2024, and they are modeled on an annual cost basis. Estimates of one-time NRC implementation costs are based

on staff experience with similar rulemakings. The NRC assumes that these costs would be incurred in the years 2023 and 2024.

Estimates of recurring annual operating expenses are based on staff experience and stakeholders' statements about costs. The values for annual operating expenses are modeled as a constant expense for each year of the analysis horizon. The staff performed a discounted cash flow calculation to discount these annual expenses to 2021 dollar values.

4.2.4 *Discount Rates*

The staff used net present value (NPV) calculations to determine how much society would need to invest today to ensure that the designated dollar amount is available in a given year in the future. By using NPVs, the staff can translate costs and benefits to a reference year for comparison, regardless of when they are incurred. Based on OMB Circular A-4 "Regulatory Analysis," dated October 9, 2003 (OMB, 2003) and consistent with the NRC's past practice and guidance, present-worth calculations in this analysis use 3-percent and 7-percent real discount rates. A 3-percent discount rate approximates the real rate of return on long-term Government debt, which serves as a proxy for the real rate of return on savings; this reflects the concept of discounting based on the social rate of time preference.¹ A 7-percent discount rate approximates the marginal pretax real rate of return on an average investment in the private sector; it is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector. A 7-percent rate is consistent with the concept of the opportunity cost² of capital; it reflects the time value of resources directed to meet regulatory requirements.

4.2.5 *Labor Rates*

For the purposes of this regulatory analysis, the staff applied strict incremental cost principles to develop labor rates that include only labor and material costs directly related to the implementation, operation, and maintenance of the proposed rule requirements. This approach is consistent with the guidance in NUREG/CR-3568, "A Handbook for Value-Impact Assessment," issued December 1983 (NRC, 1983), and with general cost-benefit methodology. The NRC's incremental labor rate is \$143 per hour.³

¹ The "social rate of time preference" refers to the rate at which society is willing to postpone a marginal unit of current consumption in exchange for more future consumption.

² "Opportunity cost" is what is forgone by undertaking a given action. If licensee personnel were not revising procedures, they would be performing other work activities. Throughout this analysis, the NRC estimates the opportunity cost of performing these incremental tasks as the industry personnel's pay for the designated amount of time.

³ The NRC labor rates presented here differ from those developed under the NRC's license fee recovery program (10 CFR Part 170, "Fees for Facilities, Materials, Import and Export Licenses, and Other Regulatory Services under the Atomic Energy Act of 1954, as Amended"). NRC labor rates for fee recovery

The staff used the 2021 Bureau of Labor Statistics (BLS) Occupational Employment and Wages data (www.bls.gov), which provide labor categories and the mean hourly wage rate by job type. The labor rates used in the analysis reflect total hourly compensation, which includes wages and nonwage benefits (using a burden factor of 2.4, which is applicable for contract labor and conservative for regular utility employees). The staff used the BLS data tables to select appropriate hourly labor rates for the estimated procedural, licensing, and utility-related work necessary during and after implementation of the proposed alternative. These labor rates include wages paid to the individuals performing the work plus the associated fringe benefit component of labor costs (i.e., the time for plant management exceeding those directly expensed), which are considered incremental expenses. Table summarizes the BLS labor categories the staff used to estimate industry labor costs to implement this proposed rule, and Appendix A lists the industry labor rates used in the analysis. The staff also performed an uncertainty analysis, which is discussed in Section 5.13.

Table 1 Position Titles and Occupations

Position Title (In This Regulatory Analysis)	Standard Occupational Classification
Executive	Top Executives (111000)
Managers	Management Occupations (110000)
	Supervisors of Protective Service Workers (331000)
	General and Operations Managers (111021)
	First-Line Supervisors of Mechanics, Installers, and Repairers (491011)
	First-Line Supervisors of Production and Operating Workers (511011)
Technical Staff	Nuclear Engineers (172161)
	Nuclear Technicians (194051)
	Electrical and Electronic Equipment Mechanics, Installers, and Repairers (492000)
	Nuclear Power Reactor Operators (518011)
Administrative Staff	Office Clerks, General (439061)
Licensing Staff	Lawyers (231011)
	Paralegals and Legal Assistants (232011)
Security Staff	Security Guards (339032)

Source: BLS, "May 2021 National Industry Specific Occupational Employment and Wage Estimates; NAICS 221113—Nuclear Electric Power Generation" (BLS, 2021).

4.2.6 Sign Conventions

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

purposes are designed for full-cost recovery of the services rendered and thus include nonincremental costs (e.g., overhead, administrative, and logistical support costs).

4.2.7 Analysis Horizon

The staff analyzed ASME Code Cases that are (1) acceptable without conditions or (2) acceptable with conditions. The ASME Code Cases are in effect for a span of 3 years and are renewable once for 3 additional years, for a total of 6 years. However, because the ISI, IST, and code of record updates involve longer intervals, this regulatory analysis uses a 24-year analysis horizon. This 24-year horizon spans one delayed code of record update for all licensees.

4.2.8 Cost Estimation

To estimate the costs of each alternative evaluated, the staff used a work breakdown approach to deconstruct each requirement into its mandated activities. For each mandated activity, the staff further subdivided the work across labor categories (i.e., executives, managers, technical staff, administrative staff, and licensing staff). The staff estimated the level of effort (LOE) needed for each required activity and used a blended labor rate to develop bottom-up cost estimates.

The staff gathered data from several sources and consulted ASME Code working group members to develop LOE and unit cost estimates. The staff applied several cost estimation methods and used its collective professional knowledge and judgment to estimate many of the costs and benefits. It also used a buildup method and extrapolation techniques to estimate costs and benefits.

The staff began by using the engineering buildup method of cost estimation, which combines the incremental costs of an activity from the bottom up to estimate a total cost. For this step, the staff reviewed previous license submittals, determined the number of pages in each section, and used these data to develop preliminary LOEs.

The staff consulted subject matter experts within and outside the agency to develop most of the LOE estimates used in the analysis. For example, to estimate licensee costs and averted costs (benefits) related to the NRC conditions on the code cases in the proposed rule, the staff consulted licensees about the associated LOE. NRC staff members themselves contributed to LOE estimates for review-related activities.

The staff extrapolated some costs, relying on actual past or current costs to estimate the future costs of similar activities. For example, to calculate the estimated averted costs of code case alternative requests and the costs of preparing the proposed rule and accompanying regulatory guidance, the staff used data from past projects to determine the labor categories of the personnel who would perform the work and to estimate the amount of time required under each category. If data were not available, the staff estimated the LOE based on similar steps in the process for which data were available.

To evaluate the effect of uncertainty in the model, the staff employed Monte Carlo simulation, which is an approach to uncertainty analysis in which input variables are expressed as distributions. The simulation was run 10,000 times, and values were chosen at random from the distributions of the input variables provided in Table 15. The result was a distribution of values for the output variable of interest. Monte Carlo simulation also enables users to determine which input variables most strongly affect the value of the output variable. Section 5.13 describes the Monte Carlo simulation methods in detail and presents the results.

4.2.9 ASME Code Cases Incorporated by Reference

When the NRC incorporates code cases by reference, licensees do not need to submit alternative requests to use these code cases as incorporated. This results in cost savings to the industry and the NRC. Table 1 in each of DG-1405, DG-1406, and DG-1407 lists the ASME Code Cases, both new and revised, that the proposed rule would incorporate by reference.

When the NRC incorporates by reference code cases with conditions, licensees may incur additional regulatory costs to meet the conditions. For each applicable code case, the conditions specify the additional activities that must be performed, the limits on the activities identified in the code case, and the supplemental information needed to provide clarity. Table 2 in each of DG-1405, DG-1406, and DG-1407 lists the ASME Code Cases, both new and revised, that the proposed rule would incorporate by reference with conditions. The proposed rule and the DGs discuss the NRC's evaluation of the code cases and the reasons for the agency's conditions. The conditions on the code cases may cause additional licensee resource costs, affecting the attribute of industry operation. However, the fact that licensees could use the conditioned code cases without submitting alternative requests represents cost savings to both the industry and the NRC. Table 2 lists the conditions on the code cases considered in this proposed rule and the incremental resource required associated with each.

The NRC will include approved code cases in the next update of the RGs, whether or not licensees are likely to use the code cases. The incorporation by reference of code cases gives the industry the flexibility to use certain code case methodologies without NRC approval or alternative requests. The costs and benefits of any code case the staff does not expect the industry to use are estimated as negligible.

Table 2 Conditioned Code Cases under Consideration

DG Listing	Conditioned Code Case Number	Description of Condition(s)	Incremental Resources Required
DG-1405	N-71-21	1. The maximum measured ultimate tensile strength (UTS) of the component support material must not exceed 170 ksi because of the susceptibility of high strength materials to brittleness and stress corrosion cracking. 2. In the last sentence of Paragraph 5.2 of Code Case N-71-21, the evidence presented to and accepted by the Authorized Inspector concerning	1. This condition is identical to a condition in the previous version of the code case; no incremental resources. 2. This condition is identical to a condition in the previous version of the code

DG Listing	Conditioned Code Case Number	Description of Condition(s)	Incremental Resources Required
		<p>exposure of electrodes for a longer period of time must be consistent with Paragraph 5.3.2.3, "Alternative Atmosphere Exposure Time Periods Established by Test," of the AWS D1.1 Code.</p> <p>3. Paragraph 16.2.2 of Code Case N-71-21 is replaced with the following: "When not exempted by 16.2.1 above, the post weld heat treatment must be performed in accordance with NF 4622 except that ASTM A-710 Grade A Material must be at least 1000°F (540°C) and must not exceed 1150°F (620°C) for Class 1 and 2 material and 1175°F (640°C) for Class 3 material."</p> <p>4. The new holding time at temperature for weld thickness (nominal) must be 30 minutes for welds 0.5 inch or less; 1 hour per inch of thickness for welds over 0.5 inch to 5 inches; and for thicknesses over 5 inches, 5 hours plus 15 minutes for each additional inch over 5 inches.</p> <p>5. The fracture toughness requirements as listed in this Code Case apply only to piping supports and not to Class 1, 2 and 3 component supports.</p> <p>6. When welding P-number materials listed in the Code Case, the corresponding S-number welding requirements apply.</p>	<p>case; no incremental resources.</p> <p>3. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>4. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>5. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>6. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p>
DG-1405	N-570-3	1. Design for strength using the Load and Resistance Factor Design method of ANSI/AISC N-690-2018 shall not be used.	1. This condition is based on good engineering practice, and other equivalent methods of design are available. Therefore, this condition does not result in incremental costs.
DG-1406	N-711-2	1. Code Case N-711-2 shall not be used to redefine the required examination volume for preservice examinations or when the postulated degradation mechanism for piping welds is primary water stress-corrosion cracking or crevice corrosion degradation mechanisms.	1. This condition is identical to a condition in the previous version of the code case; no incremental resources.
DG-1406	N-716-3	1. Plants issued a combined license after January 1, 2012, shall submit the results of the application of this Code Case as an alternative in accordance with 50.55a(z) for review and approval prior to implementation.	1. This condition affects two operating plants at one site (Vogtle) and will result in an alternative request, based on the staff's conservative assumption that the licensee will seek to use N-716-3. This code case concerns a risk-informed program for piping and components. The staff position is that operating experience is critical in the development of this program; hence, this condition is based on licensing date.

DG Listing	Conditioned Code Case Number	Description of Condition(s)	Incremental Resources Required
DG-1406	N-754-2	<p>1. The use of this Code Case on a pipe that implements NRC-approved leak-before-break methodology requires the leak-before-break analysis to be updated to verify the required safety margins specified in the original leak-before-break analysis are satisfied.</p> <p>2. The preservice and inservice examinations of the overlaid pipe using this Code Case must be examined in accordance with 10 CFR 50.55a(g)(6)(ii)(F).</p>	<p>1. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>2. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p>
DG-1406	N-766-4	<p>1. Credit cannot be taken to reduce preservice and ISI requirements specified by this Code Case on an inlay or onlay if an inlay or onlay is applied to an Alloy 82/182 dissimilar metal weld that contains an axial indication that has a depth of more than 25 percent of the pipe wall thickness and a length of more than one half of the axial width of the dissimilar metal weld or a circumferential indication that has a depth of more than 25 percent of the pipe wall thickness and a length of more than 20 percent of the circumference of the pipe.</p> <p>2. In lieu of Paragraph 2(e) of the Code Case, pipes with any thickness of inlay or onlay must be evaluated for weld shrinkage, pipe system flexibility, and additional weight of the inlay or onlay.</p> <p>3. If an inlay or onlay is applied to an Alloy 82/182 dissimilar metal weld that contains an indication that exceeds the acceptance standards of Section XI, IWB 3514, and that is accepted for continued service in accordance with Section XI, IWB-3132.3 or IWB-3142.4, the subject weld must be inspected in three successive examinations after inlay or onlay installation.</p> <p>4. Any detectable subsurface indication discovered by eddy current testing in the inlay or onlay during acceptance examinations is prohibited to remain in service.</p> <p>5. The flaw analysis of Paragraph 2(d) of the Code Case must also consider primary water stress corrosion cracking growth in the circumferential and axial directions in accordance with Section XI, IWB 3640.</p>	<p>1. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>2. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>3. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>4. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>5. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p>
DG-1406	N-847-1	<p>1. Use of Code Case N-847-1 is limited to installation of full 360-degree excavation and weld repairs (EWR).</p> <p>2. When implementing Figure 1A, "Cross Section of Typical Dissimilar Metal EWR," and Figure 1B, "Cross Section of Typical Similar Metal EWR," of the Code Case for the design of an EWR, intersection points at the interface between EWR metal and existing base metal must be rounded to mitigate weldability issues.</p> <p>3. The evaluation in section 2(d)(1) of the Code Case must include evaluation of crack growth into the Alloy 690 weld material, including the dilution zones and allowing change in flaw growth direction.</p>	<p>1. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>2. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>3. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p>

DG Listing	Conditioned Code Case Number	Description of Condition(s)	Incremental Resources Required
		<p>4. Residual stress values in section 2 of the Code Case must be developed and validated consistent with NUREG-2228, "Weld Residual Stress Finite Element Analysis Validation: Part II—Proposed Validation Procedure" issued July 2020.</p> <p>5. With respect to Table 1, including notes (1), (3), and (4):</p> <ul style="list-style-type: none"> a. The first inservice inspection examinations for Inspection Item EWR-2A EWRs must be performed during the second refueling outage. For normal water chemistry plants, 100 percent of all EWRs must be inspected every 10 years. For hydrogen water chemistry/noble metal chemical addition plants, 25 percent of the EWRs must be inspected every 10 years. b. The first inservice inspection examinations for Inspection Item EWR-1B EWRs must be performed during the second refueling outage. Regardless of water chemistry mitigative actions, 100 percent of the EWRs must be inspected every 10 years. c. The first inservice inspection examinations for Inspection Item EWR-2B EWRs must be performed during the second refueling outage. <p>6. For the purposes of Table 1, Note (1), licensees must not use an alternative other than those specified in Note (1).</p>	<p>4. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>5. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>6. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p>
DG-1406	N-880-1	<p>1. Use of this Code Case is limited to NPS 2 (DN 50) or smaller fittings.</p> <p>2. For ASME Section III items, this condition applies only for the licensees that implemented ASME Code, Section III design requirements for their original construction code and/or the licensees that have upgraded their original design requirements to ASME Code, Section III. The Licensee must verify the design and testing activities associated with qualification of welded fittings performed by the fabricator as follows:</p> <ul style="list-style-type: none"> a. Review the fabricator's design documentation and methods to ensure the fittings design is in compliance with the Licensee's design specifications, and ASME Section III NB/NC/ND-3671.7 requirements; and either <ul style="list-style-type: none"> i. Supervise and monitor the performance qualification tests of the fittings to ensure the design is in compliance with the Licensee's design specifications and ASME Section III NB/NC/ND-3671.7; or ii. The Licensee or Repair/Replacement Organization conducts qualification tests of the fittings or conducts design analyses to ensure the design is in compliance with the Licensee's design 	<p>1. This condition was previously a part of the code case itself; therefore, no incremental costs are estimated.</p> <p>2. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p> <p>3. This condition is identical to a condition in the previous version of the code case; no incremental resources.</p>

DG Listing	Conditioned Code Case Number	Description of Condition(s)	Incremental Resources Required
		<p>specifications and ASME Section III NB/NC/ND-3671.7.</p> <p>3. The Licensee must give the Authorized Nuclear Inservice Inspector an opportunity to review the design report prior to installation.</p>	
DG-1406	N-899	<p>1. If -2330, <i>Standardized Distributions</i>, are used, only -2331 <i>inside surface repair weld, with safe end</i> and -2332 <i>inside surface repair weld, no safe end</i> are approved for use, as appropriate.</p> <p>2. If a documented repair is found, it must be demonstrated to be bounded by -2331 <i>inside surface repair weld, with safe end</i> or - 2332 <i>inside surface repair weld, no safe end</i>, as appropriate, in order to use those weld residual stress profiles.</p> <p>3. No other weld residual stress profiles of this section can be used, as stated in the code case, without NRC approval.</p> <p>4. When applying -3000, <i>Calculation Of Residual Stress Using Finite Element Analysis</i>, an inside surface repair of 50 percent through-wall or as found through record search, whichever is bounding, is required to be used in the finite element analysis calculation of the weld residual stress profile.</p>	<p>These new conditions effectively require licensees to use the conservative assumption that a repair weld was previously made, to overcome potential documentation issues and uncertainty. However, this conservative approach is standard engineering practice and is the status quo for these welds, with longstanding precedent. Therefore, no incremental cost is estimated as a result of these conditions.</p>
DG-1406	N-906	<p>1. In Paragraph 1(b), if a thermal transient below a temperature range of 500 °F to 625 °F (260 °C to 330 °C) occurs at the flaw location, the flaw evaluation must use the fracture toughness (J_I) and applied stresses that are limiting for the flaw.</p>	<p>1. This condition clarifies the requirement within the Code Case itself using sound engineering principles, and therefore results in no incremental costs to licensees.</p>
DG-1406	N-921	<p>1. The licensee's code of record for the inservice inspection program must be the 2019 Edition of Section XI or later, in order to apply this code case.</p>	<p>1. This condition ensures that licensees attempting to use this code case to lengthen their ISI interval from 10 to 12 years have updated their ASME BPV Code, Section XI beforehand. Licensees seeking to use the 12-year interval may incur incremental costs for alternative requests resulting from this condition.</p>
DG-1407	OMN-31	<p>1. Contrary to the ASME OM Code Case Applicability Index, this OM Code Case may be applied by licensees implementing the ASME OM Code, 2020 Edition through the latest edition of the ASME OM Code incorporated by reference in 10 CFR 50.55a.</p>	<p>1. This condition ensures that licensees attempting to use this code case to lengthen their IST interval from 10 to 12 years have updated their ASME OMN Code beforehand. Licensees seeking to use the 12-year interval may incur incremental costs for alternative requests resulting from this condition.</p>

4.3 Data

The staff used data from subject matter experts, knowledge gained from past rulemakings, and the NRC budget for this rulemaking to estimate the costs and benefits associated with this proposed rule. Staff members provided quantitative and qualitative information on attributes affected by the proposed rule. The staff considered the potential differences between the proposed and existing requirements and incorporated these incremental changes into the regulatory analysis.

5 Results

This section presents the quantitative and qualitative results by attribute, relative to the regulatory baseline. As described in the previous sections, costs and benefits are quantified where possible and can have either a positive or negative sign, depending on whether Alternative 2 has a favorable or adverse effect compared to the regulatory baseline (Alternative 1). The section also discusses those attributes that are not easily represented in terms of monetary value. Although this ex ante cost-benefit analysis⁴ provides information that can be used when deciding whether to select the rulemaking alternative, the analysis is based on estimates of future costs and benefits. Whether or not the estimates hold in the future, the process of conducting regulatory analyses has value in itself, because it helps decision-makers think in depth about specific alternatives and their results.

The NRC's regulatory analysis guidelines (NRC, 2020) state that the NRC's periodic review and endorsement of consensus standards, such as new versions of the ASME Codes and associated Code Cases, is a special case, because consensus standards have already undergone extensive external review and have been endorsed by the industry. In addition, endorsement of the ASME Codes and Code Cases has been a longstanding NRC policy. Licensees and applicants participate in the development of the ASME Codes and Code Cases and are aware that periodic updating of the ASME Codes is part of the regulatory process. Code cases are ASME-developed alternatives to the ASME BPV and OM Codes that licensees and applicants may voluntarily choose to adopt without making an alternative request if the code cases are approved through incorporation by reference in the NRC's regulations. Finally, endorsement of the ASME Codes and Code Cases is consistent with the NTTAA, inasmuch as the NRC has determined that sound regulatory reasons exist for establishing regulatory requirements for design, maintenance, ISI, and IST and examination by rulemaking.

In a typical incorporation of code cases, the NRC endorsements can involve hundreds, if not thousands, of individual provisions. This regulatory analysis does not separately evaluate each individual provision, because such an exercise would be prohibitively time-consuming and of limited value.

⁴ An ex ante cost-benefit analysis is prepared before a policy, program, or alternative is in place and can assist in the decision about whether to allocate resources to that alternative.

Table 2 lists all of the ASME Code Cases that this proposed rule would incorporate by reference with conditions, that (1) are new or newly NRC-approved code cases, (2) are new revisions of existing code cases, or (3) have revised or new conditions. The table also notes whether each condition will give rise to incremental costs.

The following code cases have conditions that are identical to existing conditions of code cases already incorporated by reference by the NRC (and therefore result in no incremental costs or benefits):

- N-71-21, “Additional Materials for Subsection NF, Class 1, 2, 3, and MC Supports Fabricated by Welding, Section III, Division 1”
- N-711-2, “Alternative Examination Coverage Requirements for Examination Category B F, B J, C-F-1, C-F-2, and R-A Piping Welds, Section XI, Division 1”
- N-754-2, “Optimized Structural Dissimilar Metal Weld Overlay for Mitigation of PWR Class 1 Items, Section XI, Division 1”
- N-766-4, “Nickel Alloy Reactor Coolant Inlay and Onlay for Mitigation of PWR Full Penetration Circumferential Nickel Alloy Dissimilar Metal Welds in Class 1 Items, Section XI, Division 1”
- N-847-1, “Partial Excavation and Deposition of Weld Metal for Mitigation of Class 1 Items, Section XI, Division 1”

Several code cases have new proposed conditions that are not expected to result in incremental costs or benefits. The proposed condition on N-570-3, “Alternative Rules for Linear Piping and Linear Standard Supports for Classes 1, 2, 3, and MC, Section III, Division 1,” states, “Design for strength using the Load and Resistance Factor Design method of ANSI/AISC N-690-2018 shall not be used.” This condition is based on good engineering practice, and other equivalent methods of design are available. Therefore, the staff does not expect this condition to result in incremental costs or benefits. Two of the proposed conditions on N-880-1, “Alternative to Procurement Requirements of IWA-4143 for Nonstandard Welded Fittings, Section XI, Division 1,” are identical to existing conditions, and the proposed condition 1, “Use of this Code Case is limited to NPS 2 (DN 50) or smaller fittings,” was in revision 0 of the code case itself. Therefore, the staff does not expect these conditions to result in incremental costs or benefits. The staff is proposing four conditions on N-899, “Weld Residual Stress Distributions for Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082, UNS W86182, UNS N06052, or UNS W86152 Weld Filler Material, Section XI, Division 1.” Table 2 lists these conditions in full. Effectively, the conditions require a conservative assumption that the welds in question have previously undergone repair, because of concerns about historical documentation. There is a longstanding precedent for these conditions, which are based on good engineering practice; this approach was the status quo before the establishment of Code Case N-899. Therefore, the staff does not expect these conditions to result in incremental costs or benefits.

The proposed condition on N-906, “Flaw Evaluation Procedure for Cast Austenitic Stainless Steel Piping and Adjacent Fittings, Section XI, Division 1,” states, “In paragraph 1(b), if a thermal transient below a temperature range of 500 °F to 625 °F (260 °C to 330 °C) occurs at the flaw location, the flaw evaluation must use the fracture toughness (J_i) and applied stresses that are limiting for the flaw.” This condition ensures that licensees will use limiting criteria that account for the flaw; it removes the language about the minimum transient temperature because that may not be the limiting temperature under certain conditions. The condition establishes good engineering principles that a licensee would have been expected to use in any case, and it is not expected to significantly affect the calculations used for the evaluation. Therefore, the staff does not expect the condition to result in incremental costs or benefits.

The proposed condition on N-716-3, “Alternative Classification and Examination Requirements, Section XI, Division 1,” states, “Plants issued a combined license after January 1, 2012, shall submit the results of the application of this code case as an alternative in accordance with 10 CFR 50.55a(z) for review and approval before implementation.” This code case concerns a risk-informed program for piping and components, and the NRC staff’s position is that operating experience is critical in developing this program. Therefore, the proposed condition requires newer plants to submit an alternative request to use the code case. This would result in incremental costs for such plants. Finally, the proposed conditions on N-921 and OMN-31 seek to ensure that licensees adopting a 12-year ISI or IST interval will have updated their ASME Editions and Codes of Record to 2019 or 2020. Because a longer ISI and IST interval benefits licensees, the staff expects some licensees (who have recently updated their ASME Editions and Codes of Record) to submit alternative requests because of these conditions, leading to incremental costs for those licensees.

The regulatory changes increasing the code of record interval will result in averted costs for licensees, by letting them perform these activities less frequently. The costs of code of record updates will be postponed by 10 years on average per licensee for the next update, and then 4 more years on average per licensee (using a 24-year interval) for the subsequent update that would have otherwise been necessary. These postponements will lead to averted costs due to the value of money over time.

5.1 Public Health (Accident)

The industry practice of adopting ASME BPV and OM Code Cases as incorporated by reference into the regulations may incrementally reduce the likelihood of a radiological accident in a positive, but not easily quantifiable, manner. Pursuing Alternative 2 would continue to support the NRC’s goal of maintaining safety by approving new ASME Code Cases, to allow licensees to gain experience with new technology before its incorporation into the ASME Codes. Alternative 2 would also enable the NRC to permit licensees to use advances in ISI and IST, provide alternative examinations for older plants, respond promptly to user needs, and offer limited and clearly focused alternatives to specific ASME Code provisions. Improvements in ISI and IST may result in the earlier identification of material degradation that, if undetected, could

eventually lead to a plant transient. For these reasons, Alternative 2 maintains the same level of safety, or may incrementally increase safety, relative to the regulatory baseline.

5.2 Occupational Health (Accident and Routine)

By reviewing ASME BPV and OM Code Cases, determining their acceptability, and specifying its findings in RGs that are incorporated by reference into the regulations, the NRC ensures that the mandated ASME Code requirements and approved Code alternatives result in an acceptable level of quality and safety. Pursuing Alternative 2 (the rule alternative) would continue to support the NRC's goal of maintaining safety, permitting licensees to use ISI and IST advancements, providing alternative examinations, responding to user needs, and offering alternatives to ASME Code provisions. The staff expects that licensees' and applicants' voluntary use of NRC-approved code cases would reduce occupational radiation exposure in a positive, but not easily quantifiable, manner. For example, the staff expects that the use of the approved code cases would incrementally decrease the likelihood of an accident and would reduce worker radiological exposures during routine inspections or testing, relative to the regulatory baseline.

5.3 Industry Implementation

This attribute accounts for the projected net economic effect on licensees of implementing the proposed regulatory changes (conditions on the ASME Code Cases). Additional costs greater than the regulatory baseline are negative, and cost savings and averted costs are positive. The staff does not estimate any incremental implementation costs for the industry as a result of the proposed rule.

5.4 Industry Operation

This attribute accounts for the projected net economic effect of routine and recurring activities required by the proposed alternative for all affected licensees. Under Alternative 2, a nuclear power plant licensee would be able to use more recent ASME Code Cases without submitting a request for an alternative under 10 CFR 50.55a(z) or a relief request under 10 CFR 50.55a(f) or 10 CFR 50.55a(g). This would provide a net benefit (i.e., an averted cost) for licensees. The use of more recent ASME BPV and OM Code Cases may benefit nuclear power plant licensees and applicants in several ways. Later editions and addenda may introduce advanced techniques, procedures, and measures. Upon the implementation of Alternative 2, licensees and applicants would be able to voluntarily ask to use a more recent edition or addenda of the ASME BPV and OM Codes under the provisions in 10 CFR 50.55a(f)(4)(iv) and 10 CFR 50.55a(g)(4)(iv).⁵

⁵ Regulations in 10 CFR 50.55a(f)(4) and 10 CFR 50.55a(g)(4) establish the effective ASME Code editions and addenda to be used by licensees for IST of pumps and valves and ISI of components (including supports), respectively. NRC Regulatory Issue Summary 2004-12, "Clarification on Use of Later Editions and Addenda to the ASME OM Code and Section XI," dated July 28, 2004 (NRC, 2004), clarifies the requirements for IST and ISI programs when using later editions and addenda of the ASME OM Code.

Submission of a code case relief or alternative request to the NRC is not a trivial matter. When ASME issues a new Code Case, the licensee or applicant must determine whether its use would be beneficial. If the use of the code case would be beneficial, but the NRC has not approved it, the licensee or applicant must prepare a request to use the code case, and its management must review and approve the request before submission to the NRC. A review of code case requests submitted to the NRC over a recent 5-year period found that these submittals ranged from a few pages to several hundred pages, with an average of approximately 32 pages of moderate technical complexity.

Therefore, the staff estimates that a code case request submittal under 10 CFR 50.55a(z) requires an average of 150 hours of licensee or applicant effort to develop the technical justification and an additional 80 hours for research, review, approval, processing, and submission to the NRC (making 230 hours per submittal). The actual time needed may be lower or higher than 230 hours, depending on the complexity of the submittal. The NRC assumes that licensees and applicants would decide whether to request the use of an alternative by weighing the costs against the benefits. In some cases, they may decide to forfeit the benefits of using the newer ASME Code Cases, whether these benefits pertain to radiological considerations or cost reduction.

A review of past submittals has determined that plant owners submit code case alternative requests that cover multiple units and multiple plant sites. Based on annual code case alternative request submissions before and after ASME final rules are published, the staff estimates that if Alternative 2 is not adopted, licensees of operating sites would submit 27 alternative requests per year for the code cases in this proposed rule. Alternative 2 would provide a net benefit (i.e., averted cost) for licensees by making it unnecessary for them to prepare and submit these requests. As shown in Table 3, the NRC estimates the industry operation averted costs under Alternative 2 range from \$3.10 million (7-percent NPV) to \$3.94 million (3-percent NPV).

Table 3 Averted Industry Alternative Requests

Year	Activity	Alternative Requests Prepared	Labor Hours	Weighted Hourly Rate	Cost		
					Undiscounted	7% NPV	3% NPV
2025	Code Case alternative request preparation and submission	27	230	\$128	\$795,513	\$606,893	\$706,803
2026	Code Case alternative request preparation and submission	27	230	\$128	\$795,513	\$567,189	\$686,216
2027	Code Case alternative request preparation and submission	27	230	\$128	\$795,513	\$530,084	\$666,229
2028	Code Case alternative request preparation and submission	27	230	\$128	\$795,513	\$495,405	\$646,825
2029	Code Case alternative request preparation and submission	27	230	\$128	\$795,513	\$462,996	\$627,985
2030	Code Case alternative request preparation and submission	27	230	\$128	\$795,513	\$432,706	\$609,694
Total:					\$4,773,075	\$3,095,273	\$3,943,752

The proposed condition on N-716-3 would require the submittal of an alternative request to use the code case, as previously discussed, for plants licensed after the date in the condition. As proposed, this condition would apply only to two units at one site (Vogtle Electric Generating Plant). Therefore, the staff conservatively assumed that one licensee would submit an alternative request in 2024 as a result of the condition, with the corresponding costs estimated as shown in Table 4. Additionally, the staff expects the proposed conditions on N-921 and OMN-31 would result in alternative requests from some licensees that have not updated to the 2019 Edition of Section XI of the ASME BPV Code or the 2020 Edition of the ASME OMN Code, as required in the conditions. Finally, the proposed regulatory language on extending the maximum code of record interval would result in alternative requests from some licensees that have not updated to the 2019/2020 Editions of the ASME Codes as required in the regulatory changes.

The staff assumed that PWR licensees would seek (by submitting alternative requests) to use the 12-year ISI and IST intervals due to their 18-month shutdown intervals, which divides more easily into 12 years than 10, but did not assume BWR licensees would submit alternative requests, in estimating these requests. The staff has estimated the number of licensees based on a uniform distribution of PWR licensees across the current 10-year update interval, assuming that PWR licensees with 8 years or more until the next scheduled update (that is, 20 percent of PWR licensees) would submit alternative requests. This assumption was based on staff judgment that licensees might not find it cost effective to seek to perform another update to the 2019/2020 ASME Code Editions if the previous update was more recent than that. Therefore, the staff estimates that approximately 12 PWR licensees would submit alternative requests in 2024 as a result of this condition and these regulatory changes. For code of record update intervals, all licensees could benefit, therefore the staff assumed 18 licensees (20 percent of all licensees) would submit alternative requests to extend their code of record intervals. These costs are shown in Table 4.

Table 4 Licensee Alternative Requests

Year	Activity	Number of Affected Entities	Labor Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2024	Alternative request for N-716-3	1	230	\$128	(\$29,463)	(\$24,051)	(\$26,963)
2024	Alternative requests for N-921	12	230	\$128	(\$359,454)	(\$293,421)	(\$328,951)
2024	Alternative requests for OMN-31	12	230	\$128	(\$359,454)	(\$293,421)	(\$328,951)
2024	Alternative requests for Code of Record interval	18	230	\$128	(\$539,181)	(\$440,132)	(\$493,427)
Total:					(\$1,287,552)	(\$1,051,026)	(\$1,178,292)

The change to the maximum code of record interval averts costs for all licensees over time, and the staff estimates that a code of record update costs approximately \$500,000. The proposed rule would delay the next update by 14 years for PWRs (seeking a 24-year interval), and the subsequent expected update by 4 years. For BWRs, the staff assumed they would seek 20-year intervals to coincide with two ISI/IST intervals of 10 years. Therefore, for BWRs the proposed rule would delay the next update by 10 years, with no subsequent delays within the analysis horizon. As discussed previously, for the purposes of this analysis the staff assumed an

analysis horizon of 24 years, which spans at least one delayed code of record update for all licensees. Table 5 shows the averted costs from changing the maximum code of record interval, for PWRs and BWRs as described above. Again, for all estimates, the staff assumed a uniform distribution of 10 percent of all licensees per year performing the update (as the status quo), basing the estimates on the number of operating reactors and the current 10-year interval.

Table 5 Averted Costs Due to Extended Code of Record Interval

Year	Activity	Number of Affected Entities	Averted Cost per Delayed Update	Cost		
				Undiscounted	7% NPV	3% NPV
2024	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$4,067,884	\$4,560,456
2025	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$3,801,761	\$4,427,627
2026	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$3,553,048	\$4,298,667
2027	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$3,320,605	\$4,173,463
2028	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$3,103,370	\$4,051,906
2029	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$2,900,345	\$3,933,889
2030	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$2,710,603	\$3,819,310
2031	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$2,533,274	\$3,708,068
2032	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$2,367,546	\$3,600,066
2033	Averted Codes of Record Updates	9	\$ 541,667	\$4,983,333	\$2,212,660	\$3,495,210
2034	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$1,378,604	\$2,262,272
2035	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$1,288,415	\$2,196,380
2036	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$1,204,126	\$2,132,408
2037	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$1,125,352	\$2,070,299
2038	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$1,051,730	\$2,009,999
2039	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$982,926	\$1,951,455
2040	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$918,622	\$1,894,617
2041	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$858,525	\$1,839,434
2042	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$802,360	\$1,785,858
2043	Averted Codes of Record Updates (PWRs)	6	\$ 541,667	\$3,322,222	\$749,869	\$1,733,843
2034	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$689,302)	(\$1,131,136)
2035	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$644,208)	(\$1,098,190)
2036	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$602,063)	(\$1,066,204)
2037	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$562,676)	(\$1,035,150)
2038	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$525,865)	(\$1,005,000)
2039	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$491,463)	(\$975,728)
2040	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$459,311)	(\$947,308)
2041	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$429,263)	(\$919,717)
2042	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$401,180)	(\$892,929)
2043	10-years-delayed Codes of Record Updates (BWRs)	3	\$ 541,667	(\$1,661,111)	(\$374,935)	(\$866,921)
2038	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$1,051,730)	(\$2,009,999)
2039	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$982,926)	(\$1,951,455)
2040	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$918,622)	(\$1,894,617)
2041	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$858,525)	(\$1,839,434)
2042	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$802,360)	(\$1,785,858)
2043	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$749,869)	(\$1,733,843)
2044	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$700,812)	(\$1,683,343)
2045	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$654,965)	(\$1,634,313)
2046	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$612,117)	(\$1,586,712)
2047	14-years-delayed Codes of Record Updates (PWRs)	6	\$ 541,667	(\$3,322,222)	(\$572,072)	(\$1,540,497)
Total:				\$33,222,222	\$27,847,362	\$32,346,874

In addition to the averted costs due to the longer intervals, extended update intervals would mean that certain inspections performed one or more times in each interval would occur less frequently over the remainder of reactor life, resulting in further averted costs not quantified in this analysis. Finally, the longer intervals would allow for greater scheduling freedom for all such activities, another source of averted costs not quantified in this analysis. Because the costs and timing of these activities are uncertain, the staff did not quantify the resulting averted costs but

estimates them to be considerable (more than \$100,000 per licensee per interval). The staff also considered whether a longer code of record interval of 20 or 24 years would result in a significant amount of extra work during the updates. Based on the activities performed during these updates, the staff expects having a longer update interval would not result in a noticeable additional amount of work to be performed at each update, specifically for code of record updates. Therefore, the staff did not quantify any potential costs of having a longer update interval.

5.5 Total Industry Costs

Table 6 shows the industry implementation and operation costs under Alternative 2, which add up to averted costs of \$29.9 million at a 7-percent NPV and \$35.1 million at a 3-percent NPV.

Table 6 Total Industry Costs

Attribute	Total Industry Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Implementation Totals:	\$0	\$0	\$0
Operations Totals:	\$36,710,000	\$29,890,000	\$35,110,000
Industry Totals:	\$36,710,000	\$29,890,000	\$35,110,000

Note: Total costs are rounded to three significant figures.

5.6 NRC Implementation

The NRC will incur implementation costs at each stage of the rulemaking process. These include the costs of writing the *Federal Register* notice, revising the RGs, reviewing and addressing public comments on the rule, and developing the final rule. The staff estimates a total of 2,800 hours for developing the rule and 800 hours for revising the RGs, across 2 years (2023 and 2024). Table 7 shows the NRC implementation costs for developing the final rule.

Table 7 NRC Implementation Costs

Year	Activity	Number of Actions	Hours	Weighted Hourly Rate	Cost		
					Undiscounted	7% NPV	3% NPV
2023	Develop Final Rule	1	1400	\$143	(\$200,200)	(\$174,862)	(\$188,708)
2023	Finalize Regulatory Guides	1	400	\$143	(\$57,200)	(\$49,961)	(\$53,916)
2024	Develop / Issue Final Rule	1	1400	\$143	(\$200,200)	(\$163,423)	(\$183,211)
2024	Finalize / Issue Regulatory Guides	1	400	\$143	(\$57,200)	(\$46,692)	(\$52,346)
Total:					(\$514,800)	(\$434,938)	(\$478,182)

5.7 NRC Operation

When the NRC receives a request to use a code case as an alternative, the staff requires additional time to evaluate the request's acceptability relative to the criteria currently approved by the agency. Under Alternative 2, the anticipated 26 code case alternative submittals per year

would not be required. These submittals would be averted starting in 2025, the year after the final rule is expected to take effect.

As shown in Table 8, the NRC estimates that for each submittal, the staff would require, on average, 115 hours to perform the technical review (including resolving technical issues), document the evaluation, and respond to the licensee. The absence of these submittals would result in averted costs for the NRC of between \$1.73 million (7-percent NPV) and \$2.20 million (3-percent NPV).

**Table 8 NRC Operation Costs—Averted Code Alternative Requests
(Operating and New Reactors)**

Year	Activity	Alternative Requests Reviewed	Labor Hours	Weighted Hourly Rate	Cost		
					Undiscounted	7% NPV	3% NPV
2025	Review Code Case alternative request submittal	27	115	\$143	\$444,015	\$338,737	\$394,502
2026	Review Code Case alternative request submittal	27	115	\$143	\$444,015	\$316,577	\$383,011
2027	Review Code Case alternative request submittal	27	115	\$143	\$444,015	\$295,866	\$371,856
2028	Review Code Case alternative request submittal	27	115	\$143	\$444,015	\$276,510	\$361,025
2029	Review Code Case alternative request submittal	27	115	\$143	\$444,015	\$258,421	\$350,510
2030	Review Code Case alternative request submittal	27	115	\$143	\$444,015	\$241,515	\$340,301
Total:					\$2,664,090	\$1,727,625	\$2,201,203

The NRC review costs for any ASME Code alternative requests submitted to the NRC before the effective date of the proposed rule are considered sunk costs, and this regulatory analysis does not address them further.

As discussed previously, under Alternative 2, the NRC will incur costs to review industry alternative requests for N-716-3, N-921, OMN-31 and the proposed regulatory changes to the maximum code of record interval. Table 9 shows these costs.

Table 9 NRC Alternative Request Review Costs

Year	Activity	Number of Affected Entities	Labor Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2024	Alternative request for N-716-3	1	115	\$143	(\$16,445)	(\$13,424)	(\$15,050)
2024	Alternative request for N-921	12	115	\$143	(\$200,629)	(\$163,773)	(\$183,604)
2024	Alternative request for OMN-31	12	115	\$143	(\$200,629)	(\$163,773)	(\$183,604)
2024	Alternative request for Code of Record interval	18	115	\$143	(\$300,944)	(\$245,660)	(\$275,406)
Total:					(\$718,647)	(\$586,630)	(\$657,663)

Finally, the NRC will also benefit from the less frequent code of record updates licensees are performing, as discussed previously. These updates give rise to small, but quantifiable, costs to the NRC. The NRC estimates that for each update, the staff needs to review approximately six alternative requests and requires 16 hours to process and file related documentation. These averted costs total approximately \$72,000 per licensee per update, with net averted costs from update reviews shown in Table 10.

Table 10 Averted Costs from NRC Code of Record Update Reviews

Year	Activity	Number of Affected Entities	Averted Cost per Delayed	Cost		
				Undiscounted	7% NPV	3% NPV
2024	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$542,859	\$608,592
2025	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$507,344	\$590,866
2026	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$474,154	\$573,656
2027	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$443,134	\$556,948
2028	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$414,144	\$540,726
2029	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$387,051	\$524,977
2030	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$361,730	\$509,686
2031	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$338,065	\$494,841
2032	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$315,949	\$480,428
2033	Averted Codes of Record Update Reviews	9	\$72,285	\$665,025	\$295,279	\$466,435
2034	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$183,975	\$301,900
2035	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$171,939	\$293,107
2036	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$160,690	\$284,570
2037	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$150,178	\$276,281
2038	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$140,353	\$268,234
2039	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$131,171	\$260,421
2040	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$122,590	\$252,836
2041	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$114,570	\$245,472
2042	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$107,075	\$238,322
2043	Averted Codes of Record Update Reviews (PWRs)	6	\$72,285	\$443,350	\$100,070	\$231,381
2034	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$91,987)	(\$150,950)
2035	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$85,969)	(\$146,553)
2036	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$80,345)	(\$142,285)
2037	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$75,089)	(\$138,141)
2038	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$70,177)	(\$134,117)
2039	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$65,586)	(\$130,211)
2040	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$61,295)	(\$126,418)
2041	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$57,285)	(\$122,736)
2042	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$53,537)	(\$119,161)
2043	10-years-delayed Codes of Record Update Reviews (BWRs)	3	\$72,285	(\$221,675)	(\$50,035)	(\$115,691)
2038	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$140,353)	(\$268,234)
2039	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$131,171)	(\$260,421)
2040	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$122,590)	(\$252,836)
2041	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$114,570)	(\$245,472)
2042	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$107,075)	(\$238,322)
2043	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$100,070)	(\$231,381)
2044	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$93,523)	(\$224,642)
2045	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$87,405)	(\$218,099)
2046	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$81,687)	(\$211,746)
2047	14-years-delayed Codes of Record Update Reviews (PWRs)	6	\$72,285	(\$443,350)	(\$76,343)	(\$205,579)
Total:				\$4,433,500	\$3,716,226	\$4,316,685

5.8 Total NRC Costs

Table 11 shows the total NRC implementation and operation costs for Alternative 2. The total averted costs for the NRC are estimated to range from \$4.43 million (7-percent NPV) to \$5.38 million (3-percent NPV).

Table 11 Total NRC Costs

Attribute	Total NRC Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Implementation Totals:	(\$510,000)	(\$430,000)	(\$480,000)
Operation Totals:	\$6,380,000	\$4,860,000	\$5,860,000
NRC Totals:	\$5,870,000	\$4,430,000	\$5,380,000

5.9 Total Costs

Table 12 shows the total implementation and operation costs for the industry and the NRC under Alternative 2. These total averted costs are estimated to range from \$34.3 million (7-percent NPV) to \$40.5 million (3-percent NPV).

Table 12 Total Costs

Attribute	Total Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation:	\$0	\$0	\$0
Industry Operation:	\$36,710,000	\$29,890,000	\$35,110,000
<i>Industry Totals:</i>	<i>\$36,710,000</i>	<i>\$29,890,000</i>	<i>\$35,110,000</i>
NRC Implementation:	(\$510,000)	(\$430,000)	(\$480,000)
NRC Operation:	\$6,380,000	\$4,860,000	\$5,860,000
<i>NRC Totals:</i>	<i>\$5,870,000</i>	<i>\$4,430,000</i>	<i>\$5,380,000</i>
Net:	\$42,580,000	\$34,320,000	\$40,490,000

Due to the assumptions in this analysis that PWRs would elect to use 12-year ISI and IST intervals and 24-year code of record update intervals, whereas BWRs would remain on the current 10-year ISI and IST intervals but use 20-year code of record update intervals, BWRs and PWRs have different averted costs. Table 13 and Table 14 below show that a typical PWR has averted costs for industry and NRC of approximately \$562,000 (7-percent NPV) and \$608,000 (3-percent NPV) due to the extended code of record update intervals. A typical BWR has averted costs for industry and NRC of approximately \$246,000 (7-percent NPV) and \$144,000 (3-percent NPV) due to the shorter, yet still extended code of record update intervals.

Table 13 Typical BWR vs. PWR Code of Record Averted Costs (Industry)

Year	Activity	Number of Affected Entities	Averted Cost per Delayed Update	Cost		
				Undiscounted	7% NPV	3% NPV
2024	Averted Code of Record Update (BWR and PWR)	1	\$ 541,667	\$541,667	\$442,161	\$495,702
2034	10-years-delayed Code of Record Update (BWR)	1	\$ 541,667	(\$541,667)	(\$224,772)	(\$368,849)
2034	Averted Code of Record Updates (PWR)	1	\$ 541,667	\$541,667	\$224,772	\$368,849
2038	14-years-delayed Code of Record Update (PWR)	1	\$ 541,667	(\$541,667)	(\$171,478)	(\$327,717)
PWR Total:				\$541,667	\$495,456	\$536,833
BWR Total:				\$0	\$217,389	\$126,853

Table 14 Typical BWR vs. PWR Code of Record Averted Costs (NRC)

Year	Activity	Number of Affected Entities	Averted Cost per Delayed Update	Cost		
				Undiscounted	7% NPV	3% NPV
2024	Averted Code of Record Update Review (BWR and PWR)	1	\$72,285	\$72,285	\$59,006	\$66,151
2034	10-years-delayed Code of Record Update Review (BWR)	1	\$72,285	(\$72,285)	(\$29,996)	(\$49,223)
2034	Averted Code of Record Updates Review (PWR)	1	\$72,285	\$72,285	\$29,996	\$49,223
2038	14-years-delayed Code of Record Update Review (PWR)	1	\$72,285	(\$72,285)	(\$22,884)	(\$43,734)
PWR Total:				\$72,285	\$66,119	\$71,640
BWR Total:				\$0	\$29,011	\$16,929

5.10 Improvements in Knowledge

Compared to the regulatory baseline (Alternative 1), Alternative 2 would increase the knowledge of the industry and the NRC staff by permitting licensees to use advances in ISI and IST. The industry and the NRC would also develop greater knowledge and common understanding of the ASME Codes.

5.11 Regulatory Efficiency

Compared to the regulatory baseline, Alternative 2 would increase regulatory efficiency because licensees could use NRC-approved ASME Code Cases without submitting requests for alternatives to the NRC's regulations. This would give licensees flexibility and decrease their uncertainty when modifying or preparing to perform ISI or IST. Furthermore, Alternative 2 is consistent with the provisions of the NTTAA, which encourages Federal regulatory agencies to adopt voluntary consensus standards as an alternative to de novo agency development of standards affecting an industry. Alternative 2 is also consistent with the NRC's policy of evaluating whether the latest versions of consensus standards are suitable for endorsement by regulation or RG. Finally, Alternative 2 is consistent with the NRC's goal of harmonizing with international standards to increase regulatory efficiency for both the NRC and international standards groups.

5.12 Other Considerations

5.12.1 Consistency with National Technology Transfer and Advancement Act of 1995

Alternative 2 is consistent with the provisions of the NTTAA and the implementing guidance in OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities," dated January 27, 2016 (OMB, 2016), which encourage Federal regulatory agencies to adopt voluntary consensus standards as an alternative to de novo agency development of standards affecting an industry.

5.12.2 *Continued Incorporation by Reference of ASME Code Editions and Addenda into the Code of Federal Regulations*

Alternative 2 would continue the NRC's practice of establishing requirements for the design, construction, operation, ISI, and IST of nuclear power plants by approving the use of new ASME BPV and OM Code Cases in 10 CFR 50.55a.

Given the existing data and information, Alternative 2 is the most effective way to implement the updated ASME Code Cases. The rulemaking would amend 10 CFR 50.55a to incorporate by reference the latest revisions to RG 1.84, RG 1.147, and RG 1.192, which list code cases published by ASME and approved by the NRC.

5.12.3 *Increased Public Confidence*

Under Alternative 2, the NRC would approve the use of current ASME Code Cases for the design, construction, operation, ISI, and IST of nuclear power plants, by incorporating them by reference in 10 CFR 50.55a. This alternative would allow licensees to use risk-informed, performance-based approaches and the latest methods and technology to design, construct, operate, examine, and test nuclear power plant components while maintaining NRC oversight of these activities, which would increase public confidence.

5.13 Uncertainty Analysis

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

5.13.1 *Uncertainty Analysis Assumptions*

The staff identified the variables contributing the greatest uncertainty to the estimated values, by performing a Monte Carlo simulation using the @RISK software program.⁶ Monte Carlo simulations involve introducing uncertainty into the analysis by replacing the point estimates of the variables used to represent base-case costs and benefits with probability distributions. By defining input variables as probability distributions instead of point estimates, the user can effectively model the influence of uncertainty on the analysis results (i.e., the net benefits).

The probability distribution chosen to represent each variable was bounded by the range-referenced input and the staff's professional judgment. The probability distributions used in a Monte Carlo simulation need to be characterized by summary statistics. These summary

⁶ Information about this software is available at <http://www.palisade.com>.

statistics include the minimum, most likely, and maximum values of a program evaluation and review technique (PERT) distribution.⁷ The staff used the PERT distribution to reflect the relative spread and skewness of the distribution defined by the three estimates.

Table 15 identifies the data elements, the distributions, and the low, best, and high estimates of the data elements that were used in the uncertainty analysis.

Table 15 Uncertainty Analysis Variables

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Alternative requests for N-716-3, N-921, OMN-31, and code of record					
Alternative request costs (industry)					
Weighted hourly rate for request (industry)	\$128.10	PERT	\$98.11	\$129.91	\$150.87
Hours to produce request	230	PERT	180	230	280
Number of requests (N-716-3)	1				
Number of requests (N-921)	12	PERT	6	12	17
Number of requests (OMN-31)	12	PERT	6	12	17
Number of requests (Code of Record)	18	PERT	9	18	26
Alternative request costs (NRC)					
Weighted hourly rate (NRC)	\$143.00	PERT	\$143.00	\$143.00	\$143.00
Hours to approve request	115	PERT	90	115	140
Number of requests (licensee)	1				
Averted costs from code case alternative requests					
Weighted hourly rate for request	\$128.10	PERT	\$98.11	\$129.91	\$150.87
Request preparation and submission (hours)	230	PERT	180	230	280
Number of requests per year	27				
Averted costs from delayed code of record updates					
Estimated cost of code of record update (Industry)	\$541,667	PERT	\$250,000	\$500,000	\$1,000,000
Estimated cost of code of record update review (NRC)	\$72,285	PERT	\$50,000	\$70,928	\$100,000
Number of updates per year	9				

⁷ A PERT distribution is a special form of the beta distribution with specified minimum and maximum values. The shape parameter is calculated from the defined *most likely* value. The PERT distribution is similar to a triangular distribution in that it has the same set of three parameters. Technically, it is a special case of a scaled beta (or beta general) distribution. The PERT distribution is generally considered superior to the triangular distribution when the parameters result in a skewed distribution, as the smooth shape of the curve places less emphasis in the direction of skew. Like the triangular distribution, the PERT distribution is bounded on both sides and therefore may not be adequate for modeling that needs to capture tail or extreme events.

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Costs to develop and issue final RG changes (NRC)					
Hourly rate for NRC	\$143.00	PERT	\$143.00	\$143.00	\$143.00
Hours to develop	400	PERT	94	378	755
Number of years	2				
Averted code alternative request review costs (NRC)					
Hourly rate for NRC	\$143.00	PERT	\$143.00	\$143.00	\$143.00
Hours to review	115	PERT	90	115	140
Number of actions (this is a recurring averted cost)	27				

5.13.2 Uncertainty Analysis Results

The staff performed the Monte Carlo simulation by recalculating the analysis results 10,000 times. For each iteration, the values identified in Table 15 were chosen randomly from the probability distributions defining the input variables, the values of the output variables were recorded, and these values were used to define the resultant probability distribution.

For the analysis shown in each figure below, the staff ran 10,000 simulations, changing the key variables to assess the resulting effects on costs and benefits. Figure 1, 2, and 3 display histograms of the total incremental costs and benefits relative to the regulatory baseline (Alternative 1). The analysis shows that both the industry and the NRC will benefit in terms of cost savings (positive averted costs) if this rule is issued.

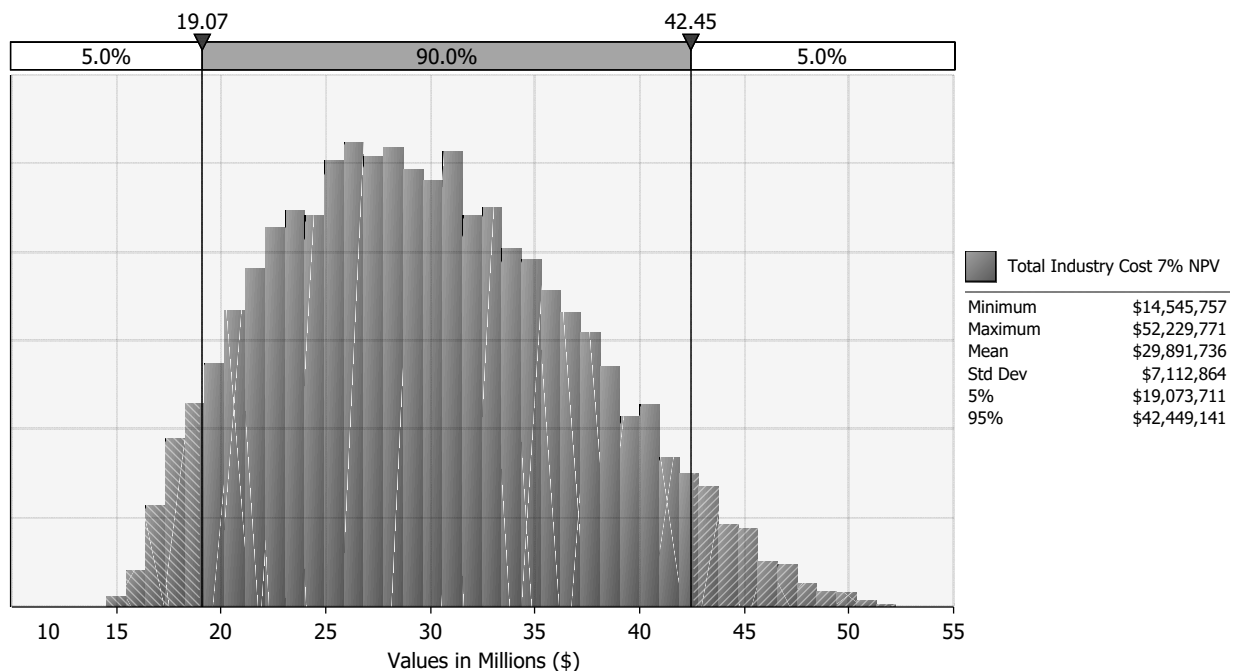


Figure 1 Total Industry Averted Costs (7-percent NPV)—Alternative 2

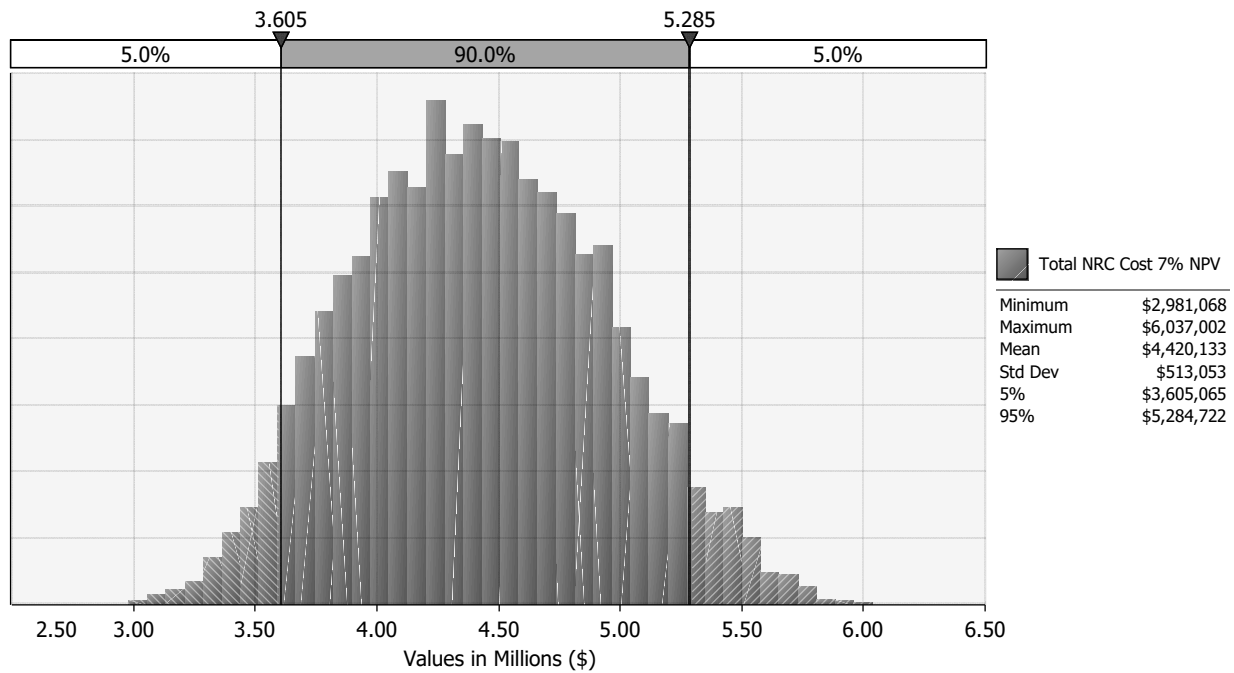


Figure 2 Total NRC Costs (7-percent NPV)—Alternative 2

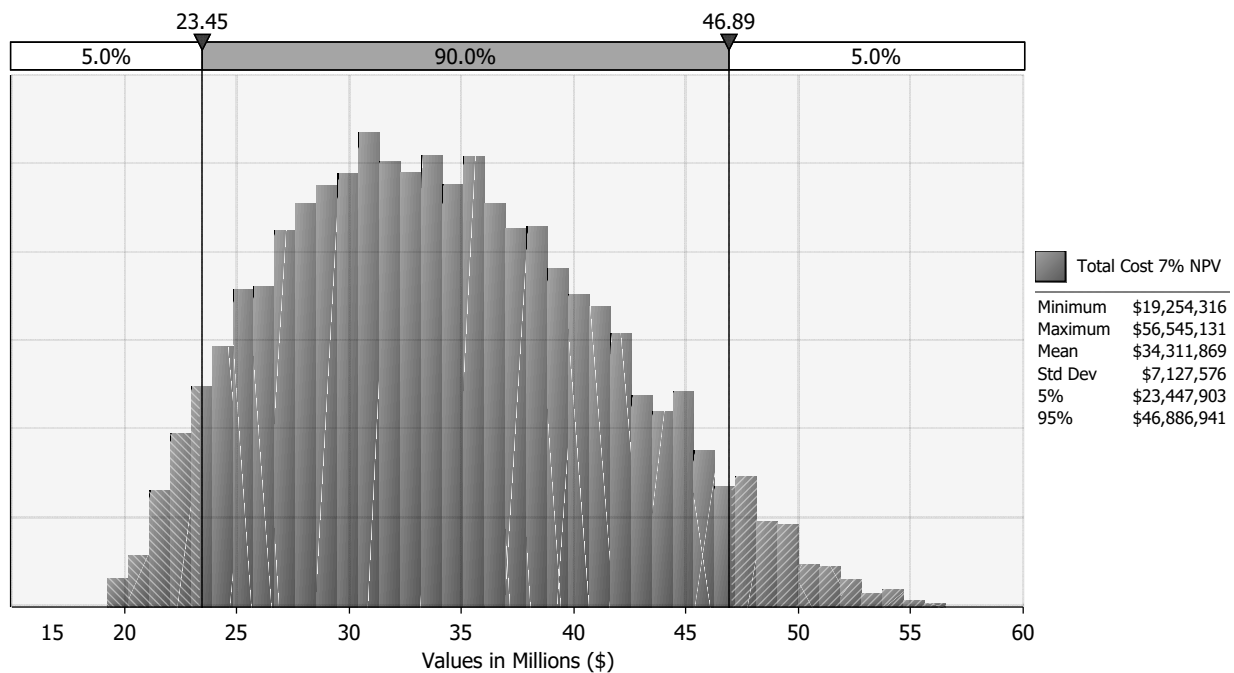


Figure 3 Total Costs (7-percent NPV)—Alternative 2

Table 16 presents descriptive statistics for the uncertainty analysis. In particular, the table shows the ranges of the output distributions, which give a clearer picture of the potential incremental costs and benefits of the proposed rule. The 5-percent and 95-percent values

shown (rounded) in Table 16 also appear as numerical values in Figure 1, 2, and 3, above the vertical lines marking the endpoints of the 90-percent confidence intervals.

Table 16 Descriptive Statistics for Uncertainty Results (7-Percent NPV)

Uncertainty results	Incremental cost-benefit (2021 dollars, millions)					
	Min	Mean	Std dev	Max	5%	95%
Total industry cost	\$14.5	\$29.9	\$7.11	\$52.2	\$19.1	\$42.4
Total NRC cost	\$2.98	\$4.42	\$0.51	\$6.04	\$3.61	\$5.28
Total cost	\$19.3	\$34.3	\$7.13	\$56.5	\$23.4	\$46.9

Figure 4 shows a tornado diagram that identifies the cost drivers with the greatest impact for the proposed rulemaking. The figure ranks the top six cost drivers based on their contribution to the uncertainty in cost. The largest cost driver is the industry averted cost for code of record updates; the uncertainty in these quantities generates the largest variation in the total costs.

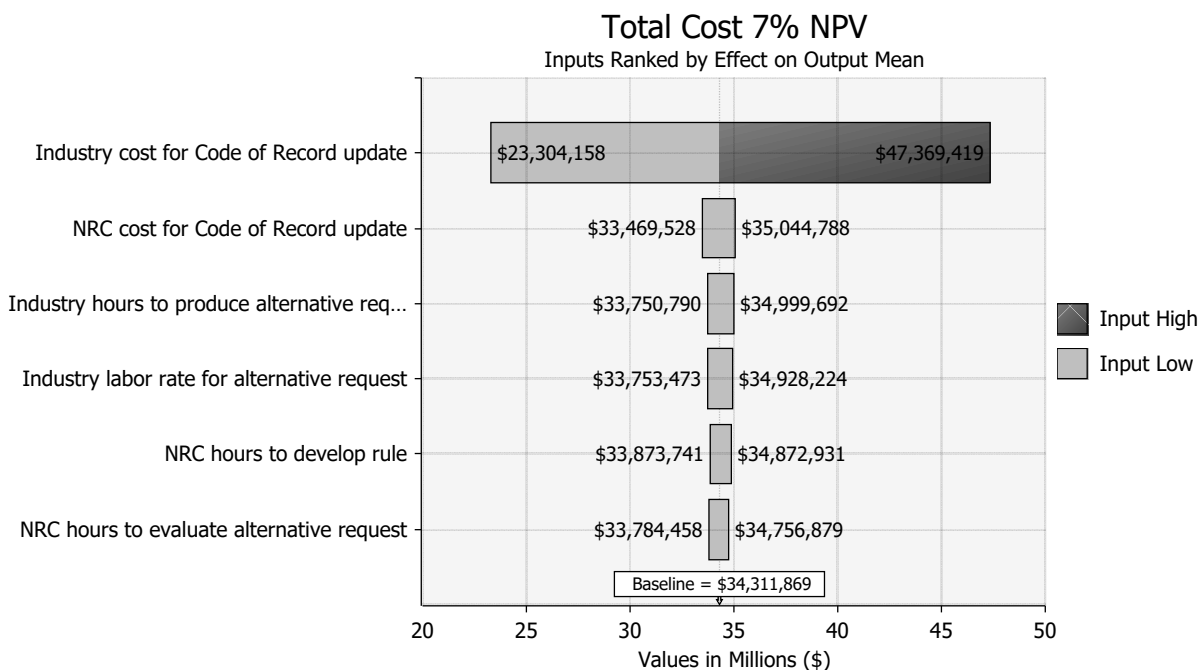


Figure 4 Top Six Cost Drivers in Terms of Uncertainty (7-percent NPV)—Alternative 2

5.13.3 Summary of Uncertainty Analysis

The uncertainty analysis shows that the estimated mean benefit (i.e., positive averted costs or savings) for this proposed rule is \$34.3 million at 7-percent NPV, and that there is greater than 99-percent confidence that the proposed rule is cost beneficial. It is reasonable to infer that proceeding with the proposed rule represents an efficient use of resources and averted costs for the NRC and the industry. The rule would also be cost beneficial to the industry and to the NRC considered separately.

5.14 Disaggregation

The NRC performed a screening review to determine whether it would be possible to eliminate any of the individual requirements (or any set of integrated requirements) of the rule while still achieving the objectives of the rulemaking. The NRC determined that the objectives of the rulemaking were to incorporate RGs by reference and to make conforming changes, and that each of the rule's requirements would be necessary to achieve one or more objectives of the rulemaking. Table 17 provides the results of this review.

Table 17 Disaggregation

Regulatory goals for proposed rule	(1) Approve use of new code cases in each RG	(2) Make conforming changes for incorporation by reference	(3) Extend ISI, IST, and code of record intervals
10 CFR 50.55a(a)(3)(i); NRC RG 1.84, Revision 40 (DG-1405)	X	X	X
10 CFR 50.55a(a)(3)(ii); NRC RG 1.147, Revision 21 (DG-1406)	X	X	X
10 CFR 50.55a(a)(3)(iii); NRC RG 1.192, Revision 5 (DG-1407)	X	X	X
Regulatory changes to code of record intervals		X	X

While both the proposed incorporation by reference of the aforementioned ASME Code Cases and the proposed regulatory changes to the maximum allowable code of record interval result in averted costs to both industry and the NRC, the regulatory changes for the code of record interval constitute the bulk of the averted costs, as shown in Table 18 and Table 19. Note that these two tables do not include the costs resulting from the proposed rule, but instead only the averted costs, so that this comparison can be made more clearly.

Table 18 Net Averted Costs to Industry

Attribute	Industry Averted Operation Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Code Case IBR Totals:	\$3,490,000	\$2,040,000	\$2,770,000
Code of Record Interval Totals:	\$33,220,000	\$27,850,000	\$32,350,000
Industry Totals:	\$36,710,000	\$29,890,000	\$35,120,000

Table 19 Net Averted Costs to NRC

Attribute	NRC Averted Operation Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Code Case IBR Totals:	\$1,950,000	\$1,140,000	\$1,540,000
Code of Record Interval Totals:	\$4,430,000	\$3,720,000	\$4,320,000
Industry Totals:	\$6,380,000	\$4,860,000	\$5,860,000

5.15 Summary

This regulatory analysis identified both quantifiable and nonquantifiable costs and benefits that would result from incorporating NRC-approved ASME BPV and OM Code Cases by reference into the *Code of Federal Regulations*. Although quantifiable costs and benefits appear more tangible, the staff urges decision-makers not to discount costs and benefits that cannot be quantified or monetized, as the latter may be of equal or greater importance.

5.15.1 Quantified Net Benefit

As shown in Table 12 above, the estimated quantified incremental averted costs for Alternative 2 over the 24-year analysis horizon, relative to the regulatory baseline (Alternative 1), range from approximately \$34.3 million (7-percent NPV) to \$40.5 million (3-percent NPV). Table 12 also shows that Alternative 2 would be cost beneficial for the NRC and the industry considered separately.

5.15.2 Nonquantified Benefits

In addition to the quantified costs discussed in this regulatory analysis, the proposed rule would lead to several nonquantified costs and benefits for the general public, industry, and the NRC, in relation to the attributes of public health (accident), occupational health (accident and routine), increases in knowledge, regulatory efficiency, and other considerations. These costs and benefits are summarized below.

5.15.3 Advances in Inservice Inspection and Inservice Testing

Advances in ISI and IST may incrementally decrease the likelihood of a radiological accident, the likelihood of postaccident plant worker exposure, and the level of plant worker radiological exposure during routine inspections or testing. The NRC's approval of later editions and addenda of the ASME BPV and OM Codes and associated code cases may contribute to plant safety by providing alternative examination methods that may result in the earlier identification of material degradation that, if undetected, could eventually lead to a plant transient. These alternative methods may increase assurance of plant safety system readiness and may prevent, through inspection and testing, the introduction of a new failure mode or common-cause failure mode not previously evaluated. Furthermore, the longer ISI and IST intervals give licensees more flexibility in scheduling the required maintenance, inspection, and testing activities in each

interval, and activities that must be performed a certain number of times in each interval will be performed fewer times throughout the remaining reactor life. These are significant benefits that were not quantified.

5.15.3.1 Reduction in Public Health Radiation Exposures

The industry's practice of adopting the ASME BPV and OM Code Cases that are incorporated by reference into the regulations may incrementally reduce the likelihood of a radiological accident in a positive, but not easily quantifiable, manner. Pursuing Alternative 2 would continue to support the NRC's goal of maintaining safety by approving later editions and addenda of the ASME Code and associated code cases, thus permitting licensees to use advances in ISI and IST, providing alternative examinations for older plants, responding promptly to user needs, and providing limited and clearly focused alternatives to specific ASME Code provisions. Improvements in ISI and IST may also result in the earlier identification of material degradation that, if undetected, could eventually lead to a plant transient. Therefore, Alternative 2 would either maintain the same level of safety, or incrementally increase safety and thus incrementally decrease public radiation exposure, relative to the regulatory baseline.

5.15.3.2 Reduction in Worker Radiation Exposures

The NRC's approval of later editions and addenda of the ASME BPV and OM Codes and associated code cases may reduce occupational radiation exposure in a positive, but not easily quantifiable, manner. For example, the advances in ISI and IST may result in an incremental decrease in the likelihood of an accident resulting in worker exposure compared to the regulatory baseline. Furthermore, the extended ISI and IST intervals would result in fewer inspections, tests, and other activities per year, resulting in reduced occupational radiation exposure.

5.15.3.3 Improvements in Inservice Inspection and Inservice Testing Knowledge

The NRC approval of later editions and addenda of the ASME BPV and OM Codes and associated code cases would increase knowledge by enhancing the ability of the industry and the staff to gain experience with new technology before its incorporation into the ASME Codes and by permitting licensees to use advances in ISI and IST. Improved ISI and IST may result in the earlier identification of material degradation that, if undetected, could eventually lead to a plant transient. However, this benefit could be offset in part by the decreased number of ISI and IST inspections per year.

5.15.3.4 Consistency with National Technology Transfer and Advancement Act of 1995

Alternative 2 is consistent with the provisions of the NTAA and the implementing guidance in OMB Circular A-119, which encourage Federal regulatory agencies to adopt voluntary

consensus standards as an alternative to de novo agency development of standards affecting an industry.

5.15.3.5 *Continued Incorporation by Reference of ASME Code Editions and Addenda into the Code of Federal Regulations*

Alternative 2 would continue the NRC's practice of establishing requirements for the design, construction, operation, ISI, and IST of nuclear power plants by approving the use of later editions and addenda of the ASME BPV and OM Codes in 10 CFR 50.55a.

5.15.1.6 *Increased Public Confidence*

Alternative 2 would incorporate the current ASME Code edition, addenda, and code cases for the design, construction, operation, ISI, and IST of nuclear power plants by approving the use of editions and addenda of the ASME BPV and OM Codes in 10 CFR 50.55a. This alternative would allow licensees to use risk-informed, performance-based approaches and the most current methods and technology to design, construct, operate, examine, and test nuclear power plant components, while maintaining NRC oversight of these activities.

The timely incorporation by reference of current addenda and editions of the ASME BPV and OM Codes into the *Code of Federal Regulations* and the review and approval of associated code cases would help the NRC remain an effective industry regulator. This role would be undermined if outdated material remains incorporated by reference in the *Code of Federal Regulations*.

5.15.2 *Nonquantified Costs*

The staff believes that incorporating by reference the most recent ASME BPV and OM Code editions and addenda and associated NRC-approved code cases into the *Code of Federal Regulations* would decrease industry and NRC operation costs. If the staff has underestimated the number or the complexity of these eliminated submittals, then the averted costs would increase proportionally.

5.16 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) or the issue finality provisions in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." Some aspects of this rule may have generic safety impacts because they may affect the likelihood of core damage or spent fuel damage, which generally are the focus of a quantitative safety goal evaluation. However, the magnitude of this change is not readily quantifiable because the potential impact of longer testing and inspection intervals for ISI and IST activities has not been determined; however, the staff expects these

effects to be minimal. A more dominant effect of this rule is to reduce costs on the regulated entities and the NRC, resulting in cost savings for both.

5.17 Backfitting Discussion

5.17.1 *Section A: Incorporation by Reference of Later Editions and Addenda of Section III, Division 1, of the ASME BPV Code*

The proposed rule alternative would allow licensees and applicants to apply the most recent ASME BPV and OM Code Cases approved by the NRC, sometimes with NRC-specified conditions. The NRC's safety goal evaluation applies 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 does not regard the incorporation by reference of NRC-approved ASME Code Cases to be backfitting or to represent an inconsistency with any issue finality provisions in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The *Federal Register* notice of proposed rulemaking states the basis for this determination.

Incorporation by reference of the code cases of Section III, Division 1, of the ASME BPV Code is prospective in nature. Incorporation of the code cases would not affect a design that has been approved or a plant that has received a construction permit, an operating license, or a combined license. This is because the code cases of the ASME BPV Code to be used in constructing a plant are, by rule, determined based on the date of the construction permit or the combined license and are not changed, except voluntarily by the licensee with NRC approval. Thus, incorporation by reference of later code cases of Section III, Division 1, of the ASME BPV Code would not constitute a "backfitting" as defined in 10 CFR 50.109(a)(1).

5.17.2 *Section B: Incorporation by Reference of Later Editions and Addenda of Section XI, Division 1, of the ASME BPV and OM Codes*

Incorporation by reference of later code cases of Section XI, Division 1, of the ASME BPV Code and of the ASME OM Code would affect the ISI and IST programs of operating reactors. However, the Backfit Rule generally does not apply to incorporation by reference of later code cases of Section XI of the ASME BPV Code and the ASME OM Code for the following reasons:

- The NRC's longstanding policy has been to incorporate later versions of the ASME Codes into its regulations; thus, when licensees receive their operating licenses, they know that such updating is part of the regulatory process. This is reflected in 10 CFR 50.55a, which requires licensees to revise their ISI and IST programs periodically to the latest edition and addenda of Section XI of the ASME BPV Code and of the ASME OM Code incorporated by reference into 10 CFR 50.55a that are in effect 18 months before the start of a new ISI and IST interval. Thus, when the NRC endorses a later version of an ASME Code, it is implementing this longstanding policy.

- The ASME BPV and OM Codes are national consensus standards developed by participants with broad and varied interests, in which all interested parties, including the NRC staff and nuclear utility personnel, participate. This consideration is consistent with both the intent and spirit of the Backfit Rule (i.e., the NRC provides for the protection of public health and safety but does not unilaterally impose undue costs on applicants or licensees).

5.17.3 *Other Circumstances in Which the NRC Does Not Apply the Backfit Rule to the Endorsement of a Later Code*

The NRC does not apply the Backfit Rule to the endorsement of a later code in the following other circumstances:

- When the NRC takes exception to a later ASME BPV or OM Code provision and merely retains the current existing requirement, prohibits the use of the later code provision, or limits the use of the later code provision, the Backfit Rule would not apply because the NRC is not imposing new requirements. However, the NRC provides the technical or policy bases, or both, for taking exceptions to the code in the Statement of Considerations for the rule.
- When an NRC exception relaxes an existing ASME BPV or OM Code provision but does not prohibit a licensee from using the existing code provision, the Backfit Rule would not apply.

5.18 Results for the Committee to Review Generic Requirements

This section addresses regulatory analysis information requirements for rulemaking actions or staff positions subject to review by the Committee to Review Generic Requirements (CRGR). All information called for by the CRGR procedures (NRC, 2018) appears in this regulatory analysis or in the *Federal Register* notice for the proposed rule. Table 20 provides a cross-reference between the relevant information and its location in this document or the *Federal Register* notice.

Table 20 Specific CRGR Information Requirements for Regulatory Analysis

Citation in CRGR Procedures (NRC, 2018)	Information Item to Be Included in a Regulatory Analysis Prepared for CRGR Review	Where Item Is Discussed
Appendix B, (i)	The new or revised generic requirement or staff position in the proposed rule	Proposed rule text in <i>Federal Register</i> notice
Appendix B, (ii)	Draft papers or other documents supporting the requirements or staff positions	<i>Federal Register</i> notice for the proposed rule

Citation in CRGR Procedures (NRC, 2018)	Information Item to Be Included in a Regulatory Analysis Prepared for CRGR Review	Where Item Is Discussed
Appendix B, (iii)	The sponsoring office's position on whether each requirement or staff position would modify, implement, relax, or reduce existing requirements or staff positions	Regulatory Analysis, Section 5, and Section XIII, "Backfitting and Issue Finality," of <i>Federal Register</i> notice for the proposed rule
Appendix B, (iv)	The method of implementation	Regulatory Analysis, Section 7
Appendix B, (vi)	The category of power reactors, new reactors, or nuclear materials facilities or activities to which the generic requirement or staff position applies	Regulatory Analysis, Section 4.2.2
Appendix B, (vii)–(viii)	The items required at 10 CFR 50.109(c) and the required rationale at 10 CFR 50.109(a)(3) if the action involves a power reactor backfit and the exceptions at 10 CFR 50.109(a)(4) are not applicable	Section XIII, "Backfitting and Issue Finality," of <i>Federal Register</i> notice for the proposed rule
Appendix B, (xvi)	An assessment of how the action relates to the Commission's Safety Goal Policy Statement	Regulatory Analysis, Section 5.16

6 Decision Rationale

Table 21 provides the quantified and qualified costs and benefits for Alternative 2. The quantitative analysis used mean values.

Table 21 Summary of Totals

Net Monetary Savings or (Costs)—Total Present Value	Nonquantified Benefits or (Costs)
Alternative 1: No action \$0	None
Alternative 2: Incorporate by reference RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 40 (DG-1405); RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 21 (DG-1406); and RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 5 (DG-1407).	<u>Benefits:</u> <ul style="list-style-type: none"> Advances in ISI and IST: May incrementally decrease the likelihood of a radiological accident, the likelihood of postaccident plant worker exposure, or the level of plant worker radiological exposure during routine inspections or testing.

Net Monetary Savings or (Costs)—Total Present Value	Nonquantified Benefits or (Costs)
<p>Change the code of record interval in 10 CFR 50.55a to twice the ISI or IST interval.</p> <p>Industry (all provisions): \$29.9 million using 7% NPV \$35.1 million using 3% NPV</p> <p>NRC (all provisions): \$4.42 million using 7% NPV \$5.38 million using 3% NPV</p> <p>Net benefit (cost) (all provisions): \$34.3 million using 7% NPV \$40.5 million using 3% NPV</p>	<ul style="list-style-type: none"> Public Health (Accident): May incrementally reduce the likelihood of a radiological accident in a positive, but not easily quantifiable, manner. Pursuing Alternative 2 would continue to support the NRC's goal of maintaining safety by approving later editions and addenda of the ASME BPV and OM Codes and applicable Code Cases, thus permitting licensees to use advances in ISI and IST, providing alternative examinations for older plants, responding promptly to user needs, and providing limited and clearly focused alternatives to specific ASME Code provisions. Improvements in ISI and IST may also result in the earlier identification of material degradation that, if undetected, could eventually lead to a plant transient. Therefore, relative to the regulatory baseline, Alternative 2 would either maintain the same level of safety or incrementally increase safety, thus incrementally decreasing public radiation exposure. Occupational Health (Accident and Routine): The use of later editions and addenda of the ASME BPV and OM Code and applicable code cases may reduce postaccident occupational radiation exposures in a positive, but not easily quantifiable, manner. Advances in ISI and IST may incrementally decrease the likelihood of an accident resulting in worker exposure relative to the regulatory baseline. Improvements in Knowledge: The NRC and industry staff would gain experience with new technology and ISI and IST advances.

Net Monetary Savings or (Costs)—Total Present Value	Nonquantified Benefits or (Costs)
(continued from above)	<ul style="list-style-type: none"> Consistent with the NTTAA and Implementing Guidance: Alternative 2 is consistent with the provisions of the NTTAA and implementing guidance in OMB Circular A-119, which encourage Federal regulatory agencies to adopt voluntary consensus standards as an alternative to de novo agency development of standards affecting an industry. Furthermore, the ASME Code consensus process is an important part of the regulatory framework. <p><u>Costs:</u></p> <ul style="list-style-type: none"> Nonquantified Costs: If the staff has underestimated the number or the complexity of these eliminated submittals, then the averted costs would increase proportionally. Furthermore, the longer ISI and IST intervals give licensees more flexibility in scheduling the required maintenance, inspection, and testing activities in each interval, and activities that must be performed a certain number of times in each interval will be performed fewer times throughout the remaining reactor life. These are significant benefits that were not quantified.

The industry and the NRC would benefit from the proposed rulemaking (Alternative 2) because of the averted costs from licensees not needing to submit and the NRC not needing to review and approve ASME Code Case requests on a plant-specific basis under 10 CFR 50.55a(z). As shown in Table 21, compared to the regulatory baseline, Alternative 2 would result in net benefits (averted costs) for the industry that range from \$29.9 million (7-percent NPV) to \$35.1 million (3-percent NPV). The NRC's net benefit would range from \$4.42 million (7-percent NPV) to \$5.38 million (3-percent NPV). Thus, the total quantitative net averted costs of the rulemaking would range from \$34.3 million (7-percent NPV) to \$40.5 million (3-percent NPV).

Alternative 2 would also have the qualitative benefit of meeting the NRC goal of ensuring the protection of public health and safety and the environment through the agency's approval of the use of later ASME BPV and OM Code Cases. It would also allow for the use of the most current

methods and technology. This alternative would also support the NRC's goal of maintaining an open regulatory process, because approving ASME Code Cases would demonstrate the agency's commitment to participating in the national consensus standards process and maintain its status as an effective regulator.

The NRC has had a decades-long practice of approving or mandating, or both, the use of certain ASME Code Cases in 10 CFR 50.55a through the rulemaking process of "incorporation by reference." Retaining the practice of approving or mandating the ASME Codes would continue the regulatory stability and predictability provided by the current practice. Retaining the practice would also ensure consistency across the industry and assure the industry and the public that the NRC will continue to support the use of the most updated and technically sound techniques developed by ASME to provide adequate protection to the public. In this regard, these ASME Codes are voluntary consensus standards developed by participants with broad and varied interests, and they have already undergone extensive external review before being evaluated by the NRC. Finally, the NRC's use of the ASME Codes is consistent with the NTTAA, which directs Federal agencies to adopt voluntary consensus standards instead of developing "Government-unique" standards (i.e., those developed by Federal agencies), unless inconsistent with applicable law or otherwise impractical.

Based solely on quantified costs and benefits, the regulatory analysis shows that the rulemaking is justified because the total quantified benefits of the proposed regulatory action would exceed the costs of the proposed action, for all discount rates up to 7 percent. Certainly, if the qualitative benefits (including the safety benefit, regulatory efficiency, and other nonquantified benefits) are considered together with the quantified benefits, then the benefits would outweigh the identified quantitative and qualitative impacts. The uncertainty analysis shows a net benefit (averted cost) for all simulations with a range of averted costs from \$19.3 million to \$56.5 million (at a 7-percent NPV).

Therefore, after integrating both quantified and nonquantified costs and benefits, the benefits of the proposed rule outweigh the costs to implement the rule.

7 Implementation Schedule

This rule would become effective 30 days after the publication of the final rule in the *Federal Register*.

8 References

U.S. Code of Federal Regulations, "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter I, Title 10, "Energy."

U.S. Code of Federal Regulations, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 52, Chapter I, Title 10, "Energy."

U.S. Code of Federal Regulations, “Fees for Facilities, Materials, Import and Export Licenses, and Other Regulatory Services under the Atomic Energy Act of 1954, as Amended,” Part 170, Chapter I, Title 10, “Energy.”

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NRC, NUREG-2228, “Weld Residual Stress Finite Element Analysis Validation: Part II-Proposed Validation Procedure,” Volume 33, July 2020 (ML20212L592).

NRC, NUREG-1350, “2021–2022 Information Digest,” Volume 33, October 2021a (ML21300A280).

NRC, Regulatory Guide 1.193, “ASME Code Cases Not Approved for Use,” Revision 7, December 2021b (ML21181A224).

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NRC, Draft Regulatory Guide, DG-1405, “Design, Fabrication, and Materials Code Case Acceptability, ASME Section III,” proposed Revision 40, January 2023a (ML22195A282).

NRC, Draft Regulatory Guide, DG-1406, “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1,” proposed Revision 21, January 2023b (ML22195A284).

NRC, Draft Regulatory Guide, DG-1407, “Operation and Maintenance Code Case Acceptability, ASME OM Code,” proposed Revision 5, January 2023c (ML22196A063).

Office of Management and Budget (OMB), Circular A-4, "Regulatory Analysis," October 9, 2003. Available at <https://www.federalregister.gov/documents/2003/10/09/03-25606/circular-a-4-regulatory-analysis>.

OMB, Circular No. A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities," January 27, 2016. Available at <https://www.federalregister.gov/documents/2016/01/27/2016-01606/revision-of-omb-circular-no-a-119-federal-participation-in-the-development-and-use-of-voluntary>.

Public Law 104-113, "National Technology Transfer and Advancement Act of 1995[as Amended]." Available at <http://www.gpo.gov/fdsys/pkg/PLAW-104publ113/pdf/PLAW-104publ113.pdf>.

Appendix A Major Assumptions and Input Data

Table A-1 Major Assumptions and Input Data

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Key years			
Final rule effective year	2024	year	NRC input
Analysis base year	2021	year	NRC input
Number of entities			
Number of operating reactor units	92	units	Based on NUREG-1350, “Information Digest,” Volume 33, Appendix A, issued October 2021. Units 3 and 4 of the Vogtle Electric Generating Plant are expected to begin operation in 2022 and 2023, respectively.
Number of operating PWR units	61	units	
Number of operating BWR units	31	units	
Number of sites			
Number of sites with operating reactors	54	sites	Obtained from the NRC’s “Operating Nuclear Power Reactors (by Location or Name)” at https://www.nrc.gov/info-finder/reactors/ with data current as of October 1, 2021 (last accessed on May 20, 2022).
Analysis Horizon	24	years	Code cases last 3 years and are typically renewed once, for a total of 6 years; however, 24 years were analyzed to account for the longer update intervals.
Labor Rates			
Managers	\$184	Dollars per hour	Labor rates used are from the BLS Employer Costs for National Compensation Survey dataset, 2021 values. A multiplier of 2.4, which includes fringe and indirect management cost, was then applied and resulted in the displayed labor rates.
Technical staff	\$125	Dollars per hour	BLS tables
Administrative staff	\$99	Dollars per hour	BLS tables
Licensing staff	\$146	Dollars per hour	BLS tables
Nuclear technician	\$124	Dollars per hour	BLS tables
Nuclear engineer	\$130	Dollars per hour	BLS tables
NRC	\$143	Dollars per hour	NRC calculation