Regulatory Analysis for the Final Rule: Approval of American Society of Mechanical Engineers Code Cases

NRC-2017-0025; RIN 3150-AJ94

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Rulemaking, Environmental, and Financial Support

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Abstract

This final rule recommends approval, through the U.S. 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 Code for Operation and Maintenance of Nuclear Power Plants, Division 1, OM Code: Section IST. 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 approved by the NRC:

(1) RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 39, which would supersede the incorporation by reference of RG 1.84, Revision 38, issued October 2019

(2) RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 20, which would supersede the incorporation by reference of RG 1.147, Revision 19, issued October 2019

(3) RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 4, which would supersede the incorporation by reference of RG 1.192, Revision 3, issued October 2019

This regulatory action also is incorporating by reference NUREG-2228, "Weld Residual Stress Finite Element Analysis Validation: Part II—Proposed Validation Procedure," that is associated with a condition in one of the regulatory guides. NUREG-2228 provides the procedure for validating the weld residual stress analysis methodology associated with ASME Code Case N-847.

This document presents the regulatory analysis of the final rule for the three RGs that list the Code Cases the NRC is approving. To improve the credibility of its cost estimates for this regulatory action, the staff conducted (1) an uncertainty analysis to consider the effects of input uncertainty on the cost estimate and (2) a sensitivity analysis to identify the variables that most affect the cost estimate (i.e., the cost drivers).

Contents

List of Figures

List of Tables

Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
ANII	Authorized Nuclear Inservice Inspector
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	*Code of Federal Regulations*
CPI-U	Consumer Price Index for All Urban Consumers
CRGR	Committee to Review Generic Requirements
dpa	displacement(s) per atom
EWR	excavation and weld repair
FR	*Federal Register*
ISI	inservice inspection
IST	inservice testing
ksi	one thousand pounds per square inch
LOE	level of effort
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
NTTAA	National Technology Transfer and Advancement Act of 1995
NUREG	NRC technical report
OM	operation and maintenance
OM Code	ASME Code for 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
RG	regulatory guide

Executive Summary

The U.S. Nuclear Regulatory Commission (NRC) is amending its regulations to incorporate by reference the latest revisions to three NRC regulatory guides (RGs) approving new, revised, and reaffirmed Code Cases published by the American Society of Mechanical Engineers (ASME). The NRC is incorporating by reference the following three RGs:

(1) RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 39

(2) RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 20

(3) RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 4

This regulatory action also is incorporating by reference NUREG-2228, "Weld Residual Stress Finite Element Analysis Validation: Part II—Proposed Validation Procedure," that is associated with a condition in one of the regulatory guides. NUREG-2228 provides the procedure for validating the weld residual stress analysis methodology associated with ASME Code Case N-847.

This regulatory action allows 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 engineering standards for the construction, inservice inspection, and inservice testing of nuclear power plant components.

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

The NRC staff has made the following key findings:

- Final Rule Analysis. The final rule would result in a cost-justified change based on a net averted cost (benefit) to the industry that ranges from $3.92 million using a 7-percent discount rate (net present value (NPV)) to $4.45 million using a 3-percent discount rate. Compared to the regulatory baseline, the NRC would realize a net averted cost (i.e., benefit) that ranges from $1.94 million using a 7-percent discount rate to $2.22 million using a 3-percent discount rate. Table ES-1 shows the net costs and benefits to the industry and the NRC of the final rule. The final rule alternative would result in net averted costs to the industry and the NRC ranging from $5.86 million using a 7-percent discount rate to $6.67 million using a 3-percent discount rate.

Table ES-1 Net Costs and Benefits for Alternative 2

Attribute	Costs		
	Undiscounted	7% NPV	3% NPV
Net Industry Costs:	$0	$0	$0
Net NRC Costs:	$0	$0	$0

Attribute	Benefits		
	Undiscounted	7% NPV	3% NPV
Net Industry Benefits:	$4,920,000	$3,920,000	$4,450,000
Net NRC Benefits:	$2,460,000	$1,940,000	$2,220,000

Attribute	Net Benefits (Costs)		
	Undiscounted	7% NPV	3% NPV
Net Industry:	$4,920,000	$3,920,000	$4,450,000
Net NRC:	$2,460,000	$1,940,000	$2,220,000
Net:	$7,380,000	$5,860,000	$6,670,000

- Nonquantified Benefits. Other benefits of the final rule include the NRC's continued ability to meet its goal of ensuring the protection of public health and safety and the environment through the approval of revised and new code cases of the ASME Boiler and Pressure Vessel Code and ASME Code for 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 final 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 consider adopting 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 describes a Monte Carlo simulation that shows the mean net benefit for this final rule is $5.86 million, with a greater than 99-percent confidence that the rule is net cost beneficial. A reasonable inference from the uncertainty analysis is that proceeding with the final rule represents an efficient use of resources and averted costs to the NRC and the industry because the minimum calculated uncertainty result is a positive value. The hours for relief and alternative request preparation and submission by the industry is the factor responsible for the largest variation in averted costs.

- Decision Rationale. When comparing the final rule to the no-action baseline, the staff concludes that the final rule is justified from a quantitative standpoint because its provisions would result in $5.86 million of net averted costs (i.e., net benefits) to the NRC and the industry. In addition, the staff concludes that the final rule is justified when

considering nonquantified costs and benefits, because the significance of the nonquantified benefits outweighs those of the nonquantified costs.

1. Introduction

This document presents the regulatory analysis of the U.S. Nuclear Regulatory Commission's (NRC) final rule for the American Society of Mechanical Engineers (ASME) Code Cases (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21196A096) and the following three associated regulatory guides (RGs):

- RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 39 (ADAMS Accession No. ML21181A225)
- RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 20 (ADAMS Accession No. ML21181A222)
- RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 4 (ADAMS Accession No. ML21181A223)

With this regulatory action, the NRC is incorporating by reference the latest revisions to the three RGs listed above, thereby approving the newly identified ASME Code Cases. This regulatory action also is incorporating by reference NUREG-2228, "Weld Residual Stress Finite Element Analysis Validation: Part II—Proposed Validation Procedure," that is associated with a condition in one of the regulatory guides. NUREG-2228 provides the procedure for validating the weld residual stress analysis methodology associated with ASME Code Case N-847.

2. Statement of the Problem and Objective

2.1 Background

ASME develops and publishes its Boiler and Pressure Vessel (BPV) Code, which contains requirements for the design, construction, and inservice inspection (ISI) examination of nuclear power plant components, and its Code for Operation and Maintenance of Nuclear Power Plants, Division 1, OM Code: Section IST (OM Code),[1] 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. As such, 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

1 The editions and addenda of the ASME Code for Operation and Maintenance of Nuclear Power Plants have had different titles from 2005 to 2017 and are referred to collectively in this rule as the "OM Code."

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 final rule is the latest in a series of rules that incorporate by reference new versions of several RGs identifying new, revised, and reaffirmed[2] and unconditionally or conditionally acceptable ASME Code Cases that the NRC approves for use. In developing these RGs, the staff reviews ASME BPV and OM Code Cases, determines the acceptability of each Code Case, and publishes its findings in the RGs. The staff revises the RGs periodically as ASME publishes new Code Cases. The NRC incorporates by reference into 10 CFR 50.55a the RGs listing acceptable and conditionally acceptable ASME Code Cases. The NRC published a final rule (85 FR 14736; March 16, 2020) that incorporated by reference into 10 CFR 50.55a the most recent versions of RG 1.84, Revision 38 (NRC, 2019a); RG 1.147, Revision 19 (NRC, 2019b); and RG 1.192, Revision 3 (NRC, 2019c), all issued October 2019.

2.2 Statement of the Problem

ASME may revise Code Cases for many reasons, such as incorporating operational examination and testing experience or updating 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 in detecting a newly discovered degradation mechanism. Therefore, it follows that, when a licensee initially implements a Code Case, 10 CFR 50.55a requires it to use 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 on a case-by-case basis.

ASME BPV Code Section III applies only to new construction (i.e., the edition and addenda to be used in the construction of a plant are selected based on the date of the construction permit, and licensees are not required to later update their Section III code of record). If a licensee implements an ASME BPV Code Section III Code Case and if the NRC incorporates by reference into 10 CFR 50.55a a later version of the Code Case, that licensee may use either version of the Code Case.

Licensee programs under ASME BPV Code Section XI ISI and ASME OM Code IST are updated every 10 years to the latest edition[3] and addenda of ASME BPV Code Section XI and OM Code that were incorporated by reference into 10 CFR 50.55a and in effect 18 months

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2 ASME categorizes Code Cases as one of three types: new, revised, or reaffirmed. A new Code Case provides a new alternative to specific ASME code provisions or addresses a new need. ASME defines a revised Code Case to be a revision (modification) to an existing Code Case to address, for example, technological advancements in examination techniques or to address NRC conditions imposed in one of the RGs that have been incorporated by reference into 10 CFR 50.55a. ASME defines “reaffirmed” as a Code Case that does not have any change to technical content but includes editorial changes.

3 See SRM-SECY-21-0029, “Rulemaking Plan on Relaxation of Inservice Testing and Inservice Inspection Program Update Frequencies Required in 10 CFR 50.55a,” dated November 8, 2021 (ADAMS Accession No. ML21312A490), for recent Commission direction regarding rulemaking to change the requirements for code of record updates.

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 its revision 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 subsequent ISI or IST interval, licensees' code of record updates must also update any Code Cases they chose to use or apply for a Code Case request under 10 CFR 50.55a(z).

2.3 Objective

The objective of this 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, Revision 39
(2) RG 1.147, Revision 20
(3) RG 1.192, Revision 4

These revisions supersede the incorporation by reference of RG 1.84, Revision 38 (NRC, 2019a); RG 1.147, Revision 19 (NRC, 2019b); and RG 1.192, Revision 3 (NRC, 2019c). This regulatory action also is incorporating by reference NUREG-2228, which provides the procedure for validating the weld residual stress analysis methodology associated with ASME Code Case N-847. This regulatory action (1) improves the effectiveness of future licensing actions, (2) is consistent with the provisions of the National Technology Transfer and Advancement Act of 1995 (NTTAA) that encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry, and (3) is consistent with the agency policy of evaluating the latest version of consensus standards already approved by the NRC in terms of their suitability for endorsement by regulation or RG.

3. Identification and Preliminary Analysis of Alternative Approaches

The NRC has identified two alternatives to this action:

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

(2) Alternative 2: Through rulemaking, incorporate by reference into 10 CFR 50.55a the NRC-approved ASME BPV Code Cases in RG 1.84, Revision 39, and RG 1.147, Revision 20, the ASME OM Code Cases in RG 1.192, Revision 4, and NUREG-2228.

3.1 Alternative 1: No Action

The no-action alternative (status quo, regulatory baseline) is a nonrulemaking alternative. The no-action alternative would not revise the NRC's 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. The no-action alternative would likely result in licensees and applicants requesting and receiving NRC approval under 10 CFR 50.55a(z) to use alternatives each time they want to use these ASME Code Cases. The NRC does not recommend this alternative for the following reasons:

- Licensees and applicants would continue to submit requests for alternatives to apply Code Cases under 10 CFR 50.55a(z) because the NRC has not approved those Code Cases in the RGs and has not incorporated them by reference in 10 CFR 50.55a. This process would continue to impose a regulatory cost on licensees, applicants, and the NRC.

- Public confidence in the NRC as an effective regulator may be reduced because ASME periodically publishes, revises, and annuls its 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 consider adopting voluntary consensus standards as an alternative to their *de novo* 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 the latest revisions to the RGs listing ASME Code Cases that are newly approved by the NRC. It 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 agency'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.

The NRC recommends the rulemaking alternative for the following reasons:

- This alternative reduces the regulatory cost 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), and it reduces the need for the NRC to review those submittals.

- This alternative meets the NRC's goal of ensuring the protection of public health and safety and the environment by continuing to provide NRC approval of new, revised, or reaffirmed ASME Code Cases, which would allow the use of the most current methods and technology.

- This alternative supports the NRC's goal of maintaining an open regulatory process by informing the public about the process and by giving the public the opportunity 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, and it conforms to NTTAA requirements.

- This alternative is quantitatively cost beneficial. Section 5 of this analysis discusses the costs and benefits of this alternative relative to the regulatory baseline (Alternative 1).

4. Estimation and Evaluation of Costs and Benefits

This section presents the process for evaluating the costs and benefits expected to result from Alternative 2 compared to the regulatory baseline (Alternative 1). All costs and benefits are monetized when possible. The net costs and benefits are then summed to determine whether the difference between the costs and benefits results in a positive benefit. In some cases, costs and benefits are not monetized because meaningful quantification is not possible.

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 to be affected by Alternative 2 (the rulemaking alternative identified in Section 3.2). 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, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," draft Revision 5, issued January 2020 (NRC, 2020a).

The rule would affect the following attributes:

- Public Health (Accident). This attribute accounts for expected changes in radiation exposure to the public caused by changes in accident frequencies or accident consequences associated with Alternative 2 (i.e., delta risk relative to Alternative 1). Compared to the regulatory baseline (Alternative 1), Alternative 2 meets the NRC's goal of ensuring the protection of public health and safety and the environment by continuing to approve new ASME Code Cases that allow the use of the most current methods and technology and that may decrease the likelihood of an accident and, therefore, decrease the overall risk to public health.

- Occupational Health (Accident). This attribute measures immediate and longterm health effects experienced by site workers because of changes in accident frequency or consequences associated with Alternative 2 (i.e., delta risk). A decrease in worker radiological exposure is a decrease in risk (i.e., a benefit); an increase in worker exposures is an increase in risk (i.e., a negative benefit). The use of ASME Code Cases may decrease the incremental risk to occupational health following an accident, but this effect is not easily quantifiable. For example, advances in ISI and IST may lead to an

incremental decrease in the frequency of an accident, resulting in averted worker postaccident radiological exposure when compared to the regulatory baseline.

- Occupational Health (Routine). This attribute accounts for radiological exposures to workers during normal facility operations (i.e., nonaccident situations). The staff expects that licensees' 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 reduce worker radiological exposures during routine inspections or testing when compared to the regulatory baseline.

- NRC Implementation. This attribute accounts for the projected net economic effect on the NRC to place the alternative into operation. To implement Alternative 2, the NRC incurs a cost in relation to Alternative 1 (i.e., regulatory baseline) for developing the proposed and final rule and updating corresponding guidance in RG 1.84, RG 1.147, and RG 1.192. These costs are sunk at the end of the final rule stage, which is when this regulatory analysis is published.

- Industry Operation. This attribute accounts for the projected net economic effect on all affected licensees caused by routine and recurring activities required by Alternative 2. Under Alternative 2, licensees of nuclear power plants would submit fewer Code Case requests under 10 CFR 50.55a(z), which would provide a net benefit (i.e., averted cost) to the licensees.

- NRC Operation. This attribute accounts for the projected net economic effect on the NRC after the action is taken. If a licensee or applicant wants to use an ASME Code Case that the NRC has not approved, it will typically request, under 10 CFR 50.55a(z), permission to use the ASME Code Case through a submittal. This submittal requires additional NRC staff time to evaluate the Code Case to determine its acceptability and whether any limitations or modifications should apply. Under Alternative 2, these Code Case alternative requests would be reduced, resulting in a net benefit (i.e., averted cost) to the NRC.

- Improvements in Knowledge. This attribute accounts for improvements in knowledge by permitting licensees to use advances in ISI and IST. Such advances may also result in the earlier identification of material or equipment degradation that, if undetected, could cause further degradation that could eventually lead to a plant transient or the unavailability of plant equipment to respond to a plant transient.

- Regulatory Efficiency. This attribute accounts for regulatory and compliance improvements resulting from the implementation of Alternative 2 compared to Alternative 1. Alternative 2 would increase regulatory efficiency because licensees and applicants that wish to use NRCapproved ASME Code Cases would not require 10 CFR 50.55a(z) alternative requests. Further, Alternative 2 is consistent with NTTAA

provisions that encourage Federal agencies to consider adopting voluntary consensus standards as an alternative to their *de novo* development of standards affecting an industry. Alternative 2 is consistent with the NRC's policy of evaluating the latest version of consensus standards in terms of their suitability for endorsement by regulations and RGs. In addition, Alternative 2 is consistent with the NRC's goal to harmonize its regulations with international standards to improve 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 either 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 costs and benefits associated with the alternatives. The benefits include any desirable changes in affected attributes (e.g., monetary savings, improved safety, improved security). The costs include any undesirable changes in affected attributes (e.g., monetary costs, increased exposures).

Of the eight affected attributes, the analysis quantitatively evaluates three: industry operation, NRC implementation, and NRC operation. Quantitative analysis requires a baseline characterization of the affected society, including factors such as the number of affected entities, the nature of the activities currently performed, and the types of systems and procedures that licensees or applicants would implement, or would no longer implement, because of the alternatives. Where possible, the staff calculated costs for these three attributes using three-point estimates to quantify uncertainty. The detailed cost tables used in this regulatory analysis are included in the individual sections for each of the provisions. The staff evaluated the remaining five attributes qualitatively because the benefits relating to consistent policy application and improvements in ISI and IST techniques are not easily quantifiable or because the data necessary to quantify and monetize the impacts on these attributes are not available.

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

4.2.1 Regulatory Baseline

This regulatory analysis provides the incremental impacts of the final 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, 2020a), 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 Alternative 2 compared to this baseline, the no-action alternative (i.e., Alternative 1).

4.2.2 Affected Entities

This final rule will affect all operating light-water nuclear power plants. The analysis considers 52 plant sites containing one or more operating U.S. light-water nuclear power reactor units in 2022, decreasing to 51 sites in 2025–2027.

4.2.3 Base Year

All monetized costs are expressed in 2021 dollars. Ongoing costs of operation related to Alternative 2 are assumed to begin no earlier than 30 days after publication of the final rule in the *Code of Federal Regulations* unless otherwise stated, and they are modeled on an annual cost basis. All NRC implementation costs are now sunk costs at this stage of rulemaking. Estimates are made for recurring annual operating expenses. The values for annual operating expenses are modeled as a constant expense for each year of the analysis horizon. The staff performed a discounted cash flow calculation to discount these annual expenses to 2021 dollar values.

4.2.4 Discount Rates

In accordance with guidance from U.S. Office of Management and Budget (OMB) Circular A-4, "Regulatory Analysis," issued September 2003 (OMB, 2003), and NUREG/BR-0058, draft Revision 5 (NRC, 2020a), 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 value costs and benefits to a reference year for comparison, regardless of when the cost or benefit is incurred. The choice of a discount rate and its associated conceptual basis is a topic of ongoing discussion within the Federal government. Based on OMB Circular A-4 and consistent with NRC 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 to reflect reliance on a social rate of time preference discounting concept.[4] 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

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

of capital in the private sector. A 7-percent rate is consistent with an opportunity cost[5] of capital concept to reflect the time value of resources directed to meet regulatory requirements.

4.2.5 Cost and Benefit Inflators

The staff estimated the analysis inputs for some attributes based on the values published in NUREG/BR-0058 (NRC, 2020a) or other sources as referenced, which are provided in prior-year dollars. To evaluate the costs and benefits consistently, these inputs are converted into base-year dollars. The most common inflator is the consumer price index for all urban consumers (CPIU), developed by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). Using the CPI-U, the prior-year dollars are converted to 2021 base-year dollars. The following formula is used to determine the amount in 2021 base-year dollars from 2020:

$$\frac{(CPI-U)_{BaseYear}}{(CPI-U)_{2020}} x\, Value_{2020} = Value_{Base\ Year}$$

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

Table 1 CPI-U Inflator

Base Year	CPI-U Annual Average [a]	Actual/Forecast Percent Change from Previous Year
2020	258.811	—
2021	265.114 [b]	2.44%

[a] Statistics from BLS, "Archived Consumer Price Index Supplemental Files: Historical CPI-U, May 2021" (BLS, 2021b).

[b] The average CPI-U value for January 2021 through May 2021.

4.2.6 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 that are directly related to the implementation, operation, and maintenance of the final rule requirements. This approach is consistent with the guidance in NUREG/CR-3568, "A Handbook for Value-Impact Assessment," issued December 1983 (NRC, 1983), and general cost-benefit methodology. The NRC incremental labor rate is $137 per hour.[6]

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

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

The staff used the 2020 BLS Occupational Employment and Wages data (https://www.bls.gov), which provided labor categories and the mean hourly wage rate by job type. The staff used the inflator discussed in Section 4.2.5 to inflate these labor rate data to 2021 dollars. The labor rates used in the analysis reflect net hourly compensation, which includes wages and nonwage benefits (using a burden factor of 2.4, applicable for contract labor and conservative for regular utility employees). The staff used the BLS data tables to select appropriate hourly labor rates for performing the estimated procedural, licensing, and utility-related work necessary during and after implementation of the alternative. In establishing this labor rate, wages paid to the individuals performing the work plus the associated fringe benefit component of labor cost (i.e., the time for plant management exceeding those directly expensed) are considered incremental expenses and are included. Table 2 summarizes the BLS labor categories the staff used to estimate industry labor costs to implement this final rule, and Appendix A lists the industry labor rates used in the analysis. The staff performed an uncertainty analysis, which is discussed in Section 5.12.

Table 2 Position Titles and Occupations

Position Title (in this Regulatory Analysis)	Standard Occupational Classification Code
Managers	Top Executives (11-1000)
	Chief Executives (11-1011)
	General and Operations Managers (11-1021)
	Industrial Production Managers (11-3051)
	First-Line Supervisors of Mechanics Installers and Repairers (49-1011)
	First-Line Supervisors of Production and Operating Workers (51-1011)
Technical Staff	Nuclear Engineers (17-2161)
	Physicists (19-2012)
	Nuclear Technicians (19-4051)
	Industrial Machinery Mechanics (49-9041)
	Nuclear Power Reactor Operators (51-8011)
Administrative Staff	Office and Administrative Support Occupations (43-0000)
	First-Line Supervisors of Office and Administrative Support Workers (43-1011)
	Office Clerks, General (43-9061)
Licensing Staff	Lawyers (23-1011)
	Paralegals and Legal Assistants (23-2011)

Source: BLS, "Standard Occupational Classification" (BLS, 2021a)

4.2.7 Sign Conventions

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

4.2.8 Analysis Horizon

The staff analyzed the 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, renewable once for 3 additional years, for a total of 6 years.

4.2.9 Cost Estimation

To estimate the costs associated with the evaluated alternatives, the staff used a work breakdown approach to deconstruct each requirement down to its mandated activities. For each required activity, the NRC further subdivided the work across labor categories (i.e., executives, managers, technical staff, administrative staff, and licensing staff). The staff estimated the required level of effort (LOE) 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 in this analysis and used its collective professional knowledge and judgment to estimate many of the costs and benefits. Additionally, the staff used a buildup method, solicitation of licensee input, and extrapolation techniques to estimate costs and benefits.

The staff began by estimating the cost of some activities using the engineering buildup method, which combines the incremental costs of an activity from the bottom up to establish a net cost. For this step, the NRC reviewed previous license submittals, determined the number of pages in each section, and then 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 ASME codes in the final rule, the staff consulted licensees for information on the associated LOE. The staff contributed to the estimation of LOE for review-related activities.

The staff extrapolated to estimate the cost of some activities, relying on actual past or current costs to estimate the future cost of similar activities. For example, to calculate the estimated averted costs of Code Case alternative requests and the costs for preparation of the final rule and accompanying regulatory guidance, the staff used data from past projects to determine the labor categories of the staff who would perform the work and to estimate the amount of time required under each category to complete the work. 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 a 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 9. The result was a distribution of values

for the output variable of interest. Monte Carlo simulation also enables users to determine the input variables that have the greatest effect on the value of the output variable. Section 5.12 gives a detailed description of the Monte Carlo simulation methods and presents the results.

4.2.10 NRC Code Cases Incorporated by Reference

When the NRC incorporates by reference Code Cases unconditionally, the licensees do not need to submit alternative requests to use these Code Cases. The lack of alternative requests for these Code Cases presents a cost savings to the industry and the NRC. Table 1 of RG 1.147, RG 1.84, and RG 1.192 includes the ASME Code Cases, both new and revised, that the final rule would incorporate by reference.

When the NRC incorporates by reference Code Cases with conditions, licensees may incur an additional regulatory cost to meet the conditioned Code Cases (i.e., Code Cases with new conditions as a result of this final rule). The conditions would specify (for each applicable Code Case) the additional activities that must be performed, the limits on the activities specified in the Code Case, and the supplemental information needed to provide clarity. Table 2 of RG 1.147, RG 1.84, and RG 1.192 includes these ASME Code Cases, both new and revised, that the final rule would incorporate by reference. The final rule and the RGs discuss the NRC's evaluation of the Code Cases and the reasons for the agency's conditions. The conditioned Code Cases can possibly place an additional resource cost on licensees under the affected attribute of industry operation. However, licensees would not need to submit alternative requests to use the conditioned Code Cases. The lack of alternative requests for these conditioned Code Cases presents a cost savings to the industry and the NRC. Table 3 lists the conditions on the Code Cases that this final rule would add, modify, or remove and indicates whether the conditions present an additional resource cost on the industry.

The NRC is including approved Code Cases in this update of the RGs whether or not licensees are likely to use the Code Cases. The incorporation by reference of Code Cases provides the industry flexibility to use certain Code Case methodologies without NRC approval or alternative requests. Any Code Case the staff does not expect the industry to use is estimated as having negligible costs and benefits.

Table 3 Conditioned Code Cases Under Consideration

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
RG 1.84	N-71-20	The conditions on Code Case N-71-20 are effectively the same as the conditions on N-71-19 that the NRC approved in Revision 38 of RG 1.84. When ASME revised N-71, it did not modify the Code Case in a way that would make it possible for the NRC to remove the conditions. Therefore, Revision 39 of RG 1.84 would retain the conditions, with one change made to condition 1 to explain why the condition is in effect:	All of these conditions are effectively identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
		(1) The maximum measured ultimate tensile strength of the component support material must not exceed 170 ksi because of the susceptibility of high-strength materials to brittleness and stress-corrosion cracking.	
RG 1.84	N-155-3	The conditions on Code Case N-155-3 are the same as the conditions on N-155-2 that the NRC approved in Revision 38 of RG 1.84. When ASME revised N-155, it did not modify the Code Case in a way that would make it possible for the NRC to remove the conditions. Therefore, Revision 39 of RG 1.84 retains the conditions.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.84	N-755-4	This Code Case is applicable only to butt fusion joints and eventually became Mandatory Appendix XXVI in the 2015 Edition of ASME BPV Code Section III. The relevant provisions of Code Case N-755-4 are the same as those in Mandatory Appendix XXVI.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.84	N-779	The NRC finds the Code Case satisfactory and technically acceptable for use only with code editions from summer 1979 and later. This Code Case, as written, is not acceptable for use with editions of ASME BPV Code Section III earlier than the Summer 1979 Edition, which included the Delta T1 term in NB-3600 Equation 10, because the Code Case is based on equations used in the Summer 1979 Edition and later editions of the BPV Code.	This condition is a clarification that this Code Case is acceptable as is with ASME BPV Code Section III, Summer 1979 Addenda and later editions. Therefore, the staff has determined that the condition would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.84	N-852	The NRC is including a condition that this Code Case can only be used for the service life of a component that had the horizontally arranged National Pipe Thread Tapered Code Symbol Stamp applied from January 1, 2005, through December 31, 2015.	The staff has determined that this condition would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.84	N-883	This Code Case may be used for the construction of items by a holder of a construction permit, operating license, manufacturing license, or combined license under 10 CFR Part 50 or 10 CFR Part 52 before the establishment of an owner.	The staff has determined that this condition would have no effect on the incremental resources needed for a licensee that uses the Code Case.

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
RG 1.84	N-886	This Code Case is applicable for the use of polyethylene pipe in ASME BPV Code Section III, Class 3, Division 1, above ground applications. This Code Case refers to Mandatory Appendix XXVI to Section III of the ASME Code. The 2015 Edition of Mandatory Appendix XXVI contains butt fusion joints for buried piping. The 2017 Edition of Mandatory Appendix XXVI contains butt fusion and electrofusion joints for buried piping. The NRC is removing three conditions from this Code Case as it was presented in the proposed rule, after determining they are not necessary for safety. The condition that remains is that the use of high-density polyethylene piping in aboveground applications shall be considered in the plant fire protection program.	The staff has determined that this condition would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.147	N-513-5	Code Case N-513-5 contains provisions to permit temporary acceptance of flaws, in moderate energy Class 2 or 3 piping, including elbows, pipe bends, reducers, expanders, branch tees, and gate valves without performing a repair/replacement activity for a limited period. The Code Case contains provisions on the scope, flaw characterization, periodic leakage monitoring, flaw evaluation, and augmented examinations. The NRC finds that the provisions of N-513-5 are acceptable except for the augmented examination provisions in Section 5 of the Code Case. The NRC proposes two conditions to define “flaw” and “significant flaw” as those terms are used in Section 5 of N-513-5. The first condition defines a “flaw” as a nonthrough-wall planar or nonplanar flaw with a wall thickness less than 87.5 percent of the nominal wall thickness of the pipe or the design minimum wall thickness. The second condition defines “significant flaw” as any pipe location that does not satisfy the provisions of Section 3 of N-513-5 or if any detected flaw has a depth greater than 75 percent of the pipe wall thickness.	These conditions apply only if a planar or nonplanar flaw is found during an augmented examination. These conditions clarify how the Code Case should be used, and so the staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.147	N-516-5	In the rulemaking for the 2009 Addenda through 2013 Editions of the ASME Code (82 FR 32934), the NRC-specified conditions should be applied to Section XI, Article IWA-4660, when performing underwater welding on irradiated materials. These conditions provide guidance on what level of neutron irradiation, helium content, or both would require review and approval by the NRC because of the impact of neutron fluence on weldability. These conditions provide separate criteria for three generic classes of material: ferritic material, austenitic material other than P-No. 8 (e.g., nickel-based alloys) and austenitic P-No. 8 material (e.g., stainless steel alloys)..These conditions are currently located in	The additional conditions clarify NRC regulations and were determined by the staff to have no effect on the incremental resources needed for a licensee that uses the Code Case.

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
		10 CFR 50.55a(b)(2)(xii)(A) and (B).	
RG 1.147	N-597-3	The NRC made minor editorial changes to the conditions in this Code Case.	These editorial changes will not result in an incremental cost to licensees.
RG 1.147	N-705-1	The condition on Code Case N-705-1 is identical to the condition on Code Case N-705 that the NRC approved in Revision 19 of RG 1.147.	The condition is identical to the condition in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.147	N-766-3	The conditions on Code Case N-766-3 are identical to the conditions on N-766-1 that the NRC approved in Revision 19 of RG 1.147.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.147	N-778	The NRC changed the time limit in the second condition from 90 days to 120 days: The ISI summary report must be submitted within 120 calendar days of the completion of each refueling outage.	The staff does not expect this change to result in an incremental cost or cost reduction to licensees.
RG 1.147	N-831-1	The conditions on Code Case N-831-1 are identical to the conditions on N-831 that the NRC approved in Revision 19 of RG 1.147.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.147	N-847	The Code Case provides guidelines and requirements for a repair/mitigation process for welds. The process, excavation and weld repair (EWR), removes susceptible material from the outside diameter of the pipe and replaces it with more resistant weld material. However, the EWR process, as defined in this Code Case, has certain challenges addressing the cracking mechanisms in these operating environments and materials. Therefore, the NRC is proposing six conditions to ensure the ISI frequency guidelines of the Code Case are in line with the previous requirements and guidance: (1) The first condition is a continuation of the condition of 10 CFR 50.55a(g)(6)(ii)(F)(16), which requires that a partial arc EWR, as described in Inspection Item O of ASME Code Case N-770-5, cannot be used without NRC review and approval for pressurized-water reactor designs. (2) The second condition is related to Figure 1A and Figure 1B of the Code Case. The NRC requires, through the second condition, that the intersection points at the interface between EWR metal and existing base metal must be rounded to minimize stress	The staff expects that licensees are unlikely to use this Code Case and has determined that these conditions would have a negligible effect on the incremental resources needed by licensees. The staff does not expect the change to condition 3 to result in a change in costs to licensees.

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
		concentration. (3) The third condition is related to Section 2(d)(2) of the Code Case, which discusses the flaw evaluations required for the design considerations of the EWR. Therefore, the NRC requires, through the third condition, that flaw analysis include the potential for crack growth through the dilution zone. The NRC has added language to the end of this condition, that the evaluation must allow for change in flaw growth direction. (4) The fourth condition is related to Section 2 of the Code Case. The NRC requires the use of NUREG-2228, "Weld Residual Stress Finite Element Analysis Validation: Part II—Proposed Validation Procedure," issued July 2020, because it provides a proven method for validating the weld residual stress analysis methodology. (5) For the fifth condition, the NRC has concluded that the inspection requirements related to the volumetric examinations for EWRs for boiling-water reactors (BWRs) need to be augmented as follows: a. The first volumetric examination following application of BWR EWR-2A, EWR-1B, and EWR-2B welds is performed to verify effectiveness of the repair/mitigation before the new weld can be placed in a longer term volumetric inspection frequency. Based on the lower operating temperatures of a BWR, and hence the potential slow crack growth rate of the remaining flaw left in service, the NRC has concluded that the examination should occur during the second refueling outage after the EWR application. b. The long-term volumetric inspections for BWRs require modification for EWR-1A EWRs and EWR-1B EWRs because, for EWR-1A EWRs, the augmented inspection requirements are consistent with the conditions of the inspection frequencies of Code Case N-770-5, and for EWR-1B EWRs, due to the design, which would allow a crack to be left in service, should not be allowed to go uninspected for the remainder of plant life. Therefore, the NRC requires the long-term volumetric inspection of these welds at each a10-year ISI interval. (6) For the sixth condition, the NRC has concluded that NRC Generic Letter 88-01,	

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
		"NRC Position on IGSC in BWR Austenitic Stainless Steel Piping," dated January 25, 1988, and its Supplement 1, dated February 4, 1992, or BWRVIP-75-A, represents sufficient requirements subject to the fifth condition above, to determine examination frequencies and scope expansion criteria. Therefore, the sixth condition requires that licensees not use an alternative other than those specified in Table 1, Note (1), of the Code Case.	
RG 1.147	N-864	Code Case N-864 proposes to eliminate the required ASME Code Section XI examination for the reactor vessel threads-in-flange for all ISI intervals. The NRC is proposing conditions on the use of Code Case N-864 that are consistent with the limits the NRC has placed on alternatives requests. The first condition requires that the reactor pressure vessel threads-in-flange examinations (ASME Code Section XI, Examination Category B-G-1, Item No. B6.40) be performed in at least every third 10-year ISI interval. The second condition in Code Case N-864 ensures that sufficient monitoring and maintenance activities are performed when the Code Case is applied. The NRC has added to the second condition that "A facility's maintenance procedures for removal, care, and visual inspection of the reactor head closure studs and threads in flange during each refueling outage satisfy this condition."	The staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case. The addition to the second condition is a clarifying relaxation that may result in a minor cost reduction that was not quantified in this regulatory analysis.
RG 1.147	N-869	The Code Case contains provisions on the scope, flaw characterization, periodic leakage monitoring, flaw evaluation, and augmented examinations. The NRC finds that the augmented examination provisions in Section 5 of the Code Case are inadequate and need additional requirements. The NRC, therefore, proposes two conditions to define "flaw" and "significant flaw" as those terms are used in Section 5 of Code Case N-869. Licensees would apply these definitions to Section 5 when using the Code Case. The first condition defines a "flaw" as a nonthrough-wall planar or nonplanar flaw with a wall thickness less than 87.5 percent of the nominal wall thickness of the pipe or the design minimum wall thickness. The second condition defines "significant flaw" as any pipe location that does not satisfy the provisions of Section 3 of Code Case N-869 or any detected flaw that has a depth greater than 75 percent of the pipe wall thickness.	These conditions apply only if a planar or nonplanar flaw is found during an augmented examination. These conditions clarify how the Code Case should be used, and so the staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.147	N-876	The NRC is proposing two conditions on this Code Case. The first condition applies when	These conditions provide criteria for when the Code

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
		performing underwater laser beam welding on irradiated materials and provides guidance on what level of neutron irradiation, helium content, or both would require NRC review and approval because of the impact of neutron fluence on weldability. The second condition limits the depth of the cladding repair due to concerns with the fracture toughness of the base metal.	Case can be used. The staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.147	N-878	This Code Case addresses the testing and certification of material used in the manufacture of nonwelded fittings but does not address how the licensee must ensure that the procured nonwelded fittings meet the design and testing requirements of ASME BPV Code Section III, NB/NC/ND-3671.7, for Class 1, 2, or 3 applications. Therefore, the NRC is proposing conditions for the licensee to verify the design and testing activities associated with qualification of nonwelded fittings required by ASME BPV Code Section III, NB/NC/ND-3671.7, that are performed by the fabricator. The NRC has added a clarification: "Note: 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 give the Authorized Nuclear Inservice Inspector (ANII) an opportunity to review the design report prior to installation."	These conditions provide clarification for how the Code Case should be used. The staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case. The staff does not expect the clarifying note to result in incremental cost to licensees.
RG 1.147	N-880	This Code Case does not address how the licensee must ensure the procured welded fittings meet the design and testing requirements of ASME BPV Code Section III, NB/NC/ND-3671.7, for Class 1, 2, or 3 applications. Verification that the Section III requirements for the design and testing of these welded fittings are met before use is essential in ensuring that the structural integrity of these Class 1, 2 and 3 systems is maintained. Therefore, the NRC is proposing conditions requiring the licensee to verify the design and testing activities associated with qualification of welded fittings required by ASME BPV Code Section III, NB/NC/ND-3671.7, that are performed by the fabricator. The NRC has added a clarification: "Note: This condition applies only for the licensees that implemented ASME Code Section III design requirements for their original construction code and the licensees that have upgraded their original design requirements to ASME Code Section III."	These conditions provide clarification for how the Code Case should be used. The staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case. The staff does not expect the clarifying note to result in incremental cost to licensees.
RG 1.147	N-889	The NRC is proposing three conditions on this Code Case. The first condition states that this Code Case may not be applied for neutron	These conditions provide criteria for when the Code Case can be used.

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
		exposures greater than 20 displacements per atom (dpa). The second condition states that, at dose levels below 0.75 dpa, the user must use the higher of the CGR predictions in Code Case N-889 or ASME Code Section XI, Nonmandatory Appendix C, C-8520. The final condition states that the irradiated yield stress model for cold-worked molybdenum-bearing materials must be used for cold-worked nonmolybdenum-bearing stainless steels (including Type 204 and 247 stainless steels).	The staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.147	N-890	The condition requires the user to comply with the provisions of ASME BPV Code Section III, NB-2300, and Section III, G-2110(b), to demonstrate the applicability of the ASME K_{Ic} curve to SA-533, Type B, Class 2, material. These provisions require the user to generate the necessary toughness data to demonstrate that the ASME K_{IC} curve is a conservative representation of the actual material toughness.	These conditions clarify how the Code Case should be used. The staff has determined that these conditions would have no effect on the incremental resources needed for a licensee that uses the Code Case.
RG 1.192	OMN-1 Rev 2	The conditions on Code Case OMN-1, Revision 2 (2020 Edition), are identical to the conditions on OMN-1, Revision 2 (2017 Edition), that the NRC approved in Revision 3 of RG 1.192. ASME reaffirmed OMN-1, Revision 2, in the 2020 Edition with no change to the Code Case.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.192	OMN-3	The conditions on Code Case OMN-3 (2020 Edition) are identical to the conditions on OMN-3 (2017 Edition) that the NRC approved in Revision 3 of RG 1.192. ASME reaffirmed OMN-3 in the 2020 Edition with no change to the Code Case.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.192	OMN-4	The conditions on Code Case OMN-4 (2020 Edition) are identical to the conditions on OMN-4 (2017 Edition) that the NRC approved in Revision 3 of RG 1.192. ASME reaffirmed OMN-4 in the 2020 Edition with no change to the Code Case.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.192	OMN-9	The conditions on Code Case OMN-9 (2020 Edition) are identical to the conditions on OMN-9 (2017 Edition) that the NRC approved in Revision 3 of RG 1.192. ASME reaffirmed OMN-9 in the 2020 Edition with no change to the Code Case.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.192	OMN-12	The conditions on Code Case OMN-12 (2020 Edition) are identical to the conditions on OMN-12 (2017 Edition) that the NRC approved in Revision 3 of RG 1.192. ASME reaffirmed OMN-12 in the 2020 Edition with no change to the Code Case.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.192	OMN-18	The staff removed the condition from this Code Case based on public comment. The condition	The staff estimates the removed condition would

RG Listing	Conditioned Code Case Number	New Condition(s) Description	Incremental Resources Required
		that was removed described the upper end values of the Group A test acceptable ranges, and the high values of the required action ranges, for flow and differential pressure.	result in a minor cost reduction to licensees that was not quantified. No additional incremental resources are needed for any licensee that uses the Code Case.
RG 1.192	OMN-19	The conditions on Code Case OMN-19 (2020 Edition) are identical to the conditions on OMN-19 (2017 Edition) that the NRC approved in Revision 3 of RG 1.192. ASME reaffirmed OMN-19 in the 2020 Edition with no change to the Code Case.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.
RG 1.192	OMN-20	The conditions on Code Case OMN-20 (2020 Edition) are identical to the conditions on OMN-20 (2017 Edition) that the NRC approved in Revision 3 of RG 1.192. ASME reaffirmed OMN-20 in the 2020 Edition with no change to the Code Case.	All of these conditions are identical to the conditions in the previous version of the Code Case. Therefore, no incremental resources are needed for any licensee that uses the Code Case.

4.3 Data

The staff used data from subject matter experts and knowledge gained from past rulemakings to estimate the costs and benefits associated with this final rule. Quantitative and qualitative (i.e., non-quantified) information on attributes affected by the final rule came from the staff. The NRC considered the potential differences between the new requirements and the current requirements and estimated the impacts of the incremental changes into this 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 a negative algebraic sign, depending on whether Alternative 2 has a favorable or adverse effect compared to the regulatory baseline (Alternative 1). This section discusses those attributes that are not easily represented in monetary values. Although this *ex ante* cost-benefit analysis[7] provides information that can be used when deciding whether to select the rulemaking alternative, the analysis is based on estimates of the future costs and benefits. Whether the estimates hold in the future, the process of conducting regulatory analyses has value in and of itself because it helps decisionmakers think in depth about specific rulemaking alternatives and their associated results.

The 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

7 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 resources should be allocated to that alternative.

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 BPV and OM Codes that licensees and applicants may voluntarily choose to adopt without an alternative request—if the Code Cases are approved through incorporation by reference in the NRC's regulations. Finally, endorsement of the ASME BPV and OM Codes and Code Cases is consistent with the NTTAA, inasmuch as the NRC has determined that sound regulatory reasons exist for establishing, by rulemaking, regulatory requirements for design, maintenance, ISI, IST, and examinations.

In a typical incorporation of Code Cases, the NRC endorsements can involve hundreds, if not thousands, of individual provisions. Evaluating the benefit in relation to the cost of each individual provision in this regulatory analysis would be prohibitive, and such an exercise would have limited value. Thus, this regulatory analysis does not evaluate individual requirements of the consensus standards.

5.1 Public Health (Accident)

Industry practice to adopt ASME BPV and OM Code Cases through incorporation 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 meet the NRC's goal of maintaining safety by still providing its approval of new ASME Code Cases to allow licensees to gain experience with new technology before incorporation into the ASME code. Alternative 2 would also permit licensees to use advances in ISI and IST, provide alternative examinations for older plants, respond promptly to user needs, and offer a limited and clearly focused alternative to specific ASME code provisions. Improvements in ISI and IST may also result in the earlier identification of material degradation that, if undetected, could cause further degradation that could eventually lead to a plant transient. For these reasons, Alternative 2 maintains the same level of, or may provide an incremental improvement in, safety when compared to the regulatory baseline.

5.2 Occupational Health (Accident and Routine)

The NRC's practice of reviewing ASME BPV and OM Code Cases, determining their acceptability, and specifying its findings in RGs that are incorporated by reference into the regulations 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 meet 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 result in an incremental decrease in the likelihood of an accident and would reduce worker radiological exposures during routine inspections or testing when compared to the regulatory baseline.

5.3 Industry Operation

This attribute accounts for the projected net economic effect of routine and recurring activities required by the alternative for all affected licensees. Under Alternative 2, a nuclear power plant licensee would not need to submit a request for an alternative under 10 CFR 50.55a(z) or a relief request under 10 CFR 50.55a(f) or (g) to receive permission to use a later edition or addendum of the ASME codes (as an alternative to the ASME code provisions) that provides a net benefit (i.e., averted cost) to the licensee.

The use of later editions and addenda of the ASME BPV and OM Codes would benefit nuclear power plant licensees and applicants for several reasons. Later editions and addenda may introduce the use of advanced techniques, procedures, and measures. Alternative 2 has the advantage that, on implementation of the final rule, licensees and applicants would be able to voluntarily ask to use a more recent edition or addendum of the ASME BPV and OM Codes under the provisions in 10 CFR 50.55a(f)(4)(iv) and (g)(4)(iv).[8]

Submission of a Code Case relief or alternative request to the NRC is not a trivial matter. Once ASME issues a code edition, the licensee or applicant must determine the applicability to its facility and the benefit derived from its use. If the licensee or applicant determines that use of the code would be beneficial, but the NRC has not approved the code edition, the licensee or applicant must request the use of the Code Case, and appropriate levels of licensee or applicant management must review and approve the request before submission to the NRC. A review of Code Case requests submitted to the NRC over a 5 year period of time ending in 2014 found that they ranged from a few pages to several hundred pages, with an average of approximately 32 pages of average technical complexity.

Therefore, the NRC estimates that a Code Case request submittal requires an average of 150 hours of effort to develop the technical justification and an additional 80 hours to research, review, approve, process, and submit the document to the NRC for the use of the Code Case alternatives under 10 CFR 50.55a(z) (for a total of 230 hours per submittal). The actual time for a Code Case request submittal may be lower or higher than 230 hours, depending on its complexity. The NRC assumes that licensees or applicants would decide whether to request the use of a code alternative by weighing the cost against the benefit to be derived. In some cases, licensees may decide to forfeit the benefits of using the newer ASME code, whether in terms of radiological considerations or cost reduction.

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8 Regulations in 10 CFR 50.55a(f)(4) and (g)(4) establish the effective ASME code edition and addenda to be used by licensees in performing IST of pumps and valves and ISIs 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), clarified the requirements for IST and ISI programs when using later editions and addenda of the ASME OM Code.

A review of past submittals of Code Case requests has determined that plant owners submit Code Case relief and alternative requests that cover multiple units and multiple plant sites. Based on annual Code Case relief and alternative request submissions before and after ASME final rules are published, the staff estimated that, if Alternative 2 is not adopted, operating sites would submit 26 relief requests annually for the Code Cases in this final rule. Under Alternative 2, a nuclear power plant licensee would no longer need to submit these Code Case alternative requests under 10 CFR 50.55a(z), which would provide a net benefit (i.e., averted cost) to the licensee. As shown in Table 4, Alternative 2 would avert 26 additional Code Case submittals (and their associated preparation) each year under 10 CFR 50.55a(z). The averted Code Case submittals would start in 2022, the year that the final rule is expected to take effect.

Table 4 Industry Operation—Averted Costs for Requests

Year	Activity	Relief Requests Prepared per Year	Total Labor Hours per Relief Request	Weighted Hourly Rate	Cost		
					Undiscounted	7% NPV	3% NPV
2022	Code Case relief request preparation and submission	26	230	$137	$820,000	$770,000	$800,000
2023	Code Case relief request preparation and submission	26	230	$137	$820,000	$720,000	$770,000
2024	Code Case relief request preparation and submission	26	230	$137	$820,000	$670,000	$750,000
2025	Code Case relief request preparation and submission	26	230	$137	$820,000	$630,000	$730,000
2026	Code Case relief request preparation and submission	26	230	$137	$820,000	$580,000	$710,000
2027	Code Case relief request preparation and submission	26	230	$137	$820,000	$550,000	$690,000
				Total:	**$4,920,000**	**$3,920,000**	**$4,450,000**

5.4 Net Industry Costs

Table 5 shows the net industry implementation and operation costs for the requirements under Alternative 2. These net industry costs represent savings of $3.92 million at a 7-percent NPV and $4.45 million at a 3-percent NPV.

Table 5 Net Industry Costs

Attribute	Industry Costs		
	Undiscounted	7% NPV	3% NPV
Net Implementation Costs:	$0	$0	$0
Net Operation Costs:	$4,920,000	$3,920,000	$4,450,000
Net Industry Cost:	**$4,920,000**	**$3,920,000**	**$4,450,000**

Note: Costs are rounded to three significant figures.

5.5 NRC Implementation

The NRC has incurred implementation costs to complete the rulemaking process. These costs include writing the *Federal Register* notice, revising the RGs, reviewing and addressing public comments on the rule, and finalizing the rule. At the conclusion of the final rule stage, all of these NRC implementation costs are sunk, and there is no estimated NRC implementation cost.

5.6 NRC Operation

When the NRC receives a request to use a Code Case as an alternative, the staff requires additional time to evaluate the acceptability relative to the criteria currently approved by the agency. Under Alternative 2, the additional 26 Code Case requests per year would not be required. The averted Code Case requests would start in 2022, the year that the final rule is expected to take effect. If the NRC incorporates the ASME Code Cases by reference in the *Code of Federal Regulations*, a nuclear power plant licensee could use these ASME Code Cases without submitting a request to the NRC for review.

As shown in Table 6, the NRC estimates that each submittal would require, on average, 115 hours of staff time to perform the technical review (including resolving technical issues), document the evaluation, and respond to the licensee's request. The absence of these submittals would result in an NRC averted cost that ranges from $1.94 million based on a 7 percent NPV to $2.22 million based on a 3 percent NPV. Therefore, Alternative 2 would provide a net benefit (i.e., averted cost).

Table 6 NRC Operation Costs—Averted Cost for Requests

Year	Activity	Relief Requests Reviewed per Year	Total NRC Staff Hours per Relief Request	Weighted Hourly Rate	Cost		
					Undiscounted	7% NPV	3% NPV
2022	Review Code Case relief request submittal	26	115	$137	$410,000	$380,000	$400,000
2023	Review Code Case relief request submittal	26	115	$137	$410,000	$360,000	$390,000
2024	Review Code Case relief request submittal	26	115	$137	$410,000	$330,000	$380,000
2025	Review Code Case relief request submittal	26	115	$137	$410,000	$310,000	$360,000
2026	Review Code Case relief request submittal	26	115	$137	$410,000	$290,000	$350,000
2027	Review Code Case relief request submittal	26	115	$137	$410,000	$270,000	$340,000
				Total:	**$2,460,000**	**$1,940,000**	**$2,220,000**

5.7 Net NRC Costs

Table 7 shows the net NRC implementation and operation costs for Alternative 2. The NRC costs represent cost savings; these savings are estimated to range from $1.94 million at a 7 percent discount rate to $2.22 million at a 3 percent discount rate.

Table 7 Net NRC Costs

Attribute	NRC Costs		
	Undiscounted	**7% NPV**	**3% NPV**
Net Implementation Cost:	$0	$0	$0
Net Operation Cost:	$2,460,000	$1,940,000	$2,220,000
Net NRC Cost:	$2,460,000	$1,940,000	$2,220,000

5.8 Net Costs

Table 8 shows the net implementation and operation costs for the industry and the NRC under Alternative 2. These costs represent cost savings to the industry and the NRC and are estimated to range from $5.86 million at a 7 percent discount rate to $6.67 million at a 3 percent discount rate.

Table 8 Net Costs

Attribute	Total Averted Costs (Costs)		
	Undiscounted	**7% NPV**	**3% NPV**
Industry Implementation	$0	$0	$0
Industry Operation	$4,920,000	$3,920,000	$4,450,000
Net Industry Cost	*$4,920,000*	*$3,920,000*	*$4,450,000*
NRC Implementation	$0	$0	$0
NRC Operation	$2,460,000	$1,940,000	$2,220,000
Net NRC Cost	*$2,460,000*	*$1,940,000*	*$2,220,000*
Net:	***$7,380,000***	***$5,860,000***	***$6,670,000***

5.9 Improvements in Knowledge

Compared to the regulatory baseline (Alternative 1), Alternative 2 would improve 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 develop greater knowledge and common understanding of the ASME Code.

5.10 Regulatory Efficiency

Compared to the baseline, Alternative 2 would increase regulatory efficiency because licensees that want to use NRC-approved ASME Code Cases would not need to submit 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. Further, Alternative 2 is consistent with the provisions of the NTTAA, which encourages Federal regulatory agencies to consider adopting 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 the latest versions of consensus standards in terms of their suitability for endorsement by regulations and RGs. Finally, Alternative 2 is consistent with the NRC's goal of harmonizing its regulations with international standards to improve regulatory efficiency for both the NRC and international standards groups.

5.11 Other Considerations

5.11.1 National Technology Transfer and Advancement Act of 1995

Alternative 2 is consistent with the provisions of the NTTAA and its 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 consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry.

5.11.2 Continued NRC Practice of 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 an effective way to implement the updated ASME Code Cases. The updates would amend 10 CFR 50.55a to incorporate by reference the latest revisions to RGs 1.84, 1.147, and 1.192, which list Code Cases published by ASME and approved by the NRC.

5.12 Uncertainty Analysis

The staff completed a Monte Carlo sensitivity 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?"

5.12.1 Uncertainty Analysis Assumptions

The staff provides the following analysis of the variables with the greatest uncertainty on estimates of values. To conduct this analysis, the staff performed a Monte Carlo simulation using the @RISK software program.[9] Monte Carlo simulations involve introducing uncertainty into the analysis by replacing the point estimates of the variables used to determine base-case costs and benefits with probability distributions. By defining input variables as probability distributions instead of point estimates, the influence of uncertainty on the results of the analysis (i.e., the net benefits) can be effectively modeled.

The probability distributions chosen to represent the different variables in the analysis were bounded by the range-referenced input and the staff's professional judgment. When defining the probability distributions for use in a Monte Carlo simulation, summary statistics are needed to characterize the distributions. These summary statistics include the minimum, most likely, and maximum values of a program evaluation and review technique (PERT) distribution,[10] the minimum and maximum values of a uniform distribution, and the specified integer values of a discrete population. The staff used the PERT distribution to reflect the relative spread and skewness of the distribution defined by the three estimates.

Table 9 identifies the data elements; the distribution; and the low, most likely, and high estimates of the distribution that were used in the uncertainty analysis.

Table 9 Uncertainty Analysis Variables

Data Element	Mean Estimate	Distribution	Low Estimate	Most Likely Estimate	High Estimate
Averted Relief Request (Industry)					
Hours to produce request	230	PERT	200	230	260
Annual number of requests	26	PERT	24	26	28
Averted Review of Relief Request (NRC)					
Hours to review	115	PERT	100	115	130
Number of actions (this is a recurring averted cost)	26	PERT	24	26	28
Hourly Rate for NRC					
Weighted hourly rate (NRC)	$137.00	PERT	$136.00	$137.00	$138.00

9 Information about this software is available at https://www.palisade.com.

10 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. Similar to the triangular distribution, the PERT distribution is bounded on both sides and, therefore, may not be adequate for modeling purposes that need to capture tail or extreme events.

Data Element	Mean Estimate	Distribution	Low Estimate	Most Likely Estimate	High Estimate
Hourly Rate for Industry					
Weighted hourly rate (industry)	$137.20	PERT	$109.09	$139.16	$157.43

5.12.2 Uncertainty Analysis Results

The NRC performed the Monte Carlo simulation by recalculating the results 10,000 times. For each iteration, the values identified in Table 9 were chosen randomly from the probability distributions that define the input variables. The values of the output variables were recorded for each iteration, and these values were used to define the resultant probability distribution.

For the analysis shown in each figure below, 10,000 simulations were run in which the key variables were changed to assess the resulting effect on costs and benefits. Figure 1, 2, and 3 display the histograms of the incremental costs and benefits from the regulatory baseline (Alternative 1). The analysis shows that both the industry and the NRC would benefit in terms of cost savings (positive cost) if this rule were issued.

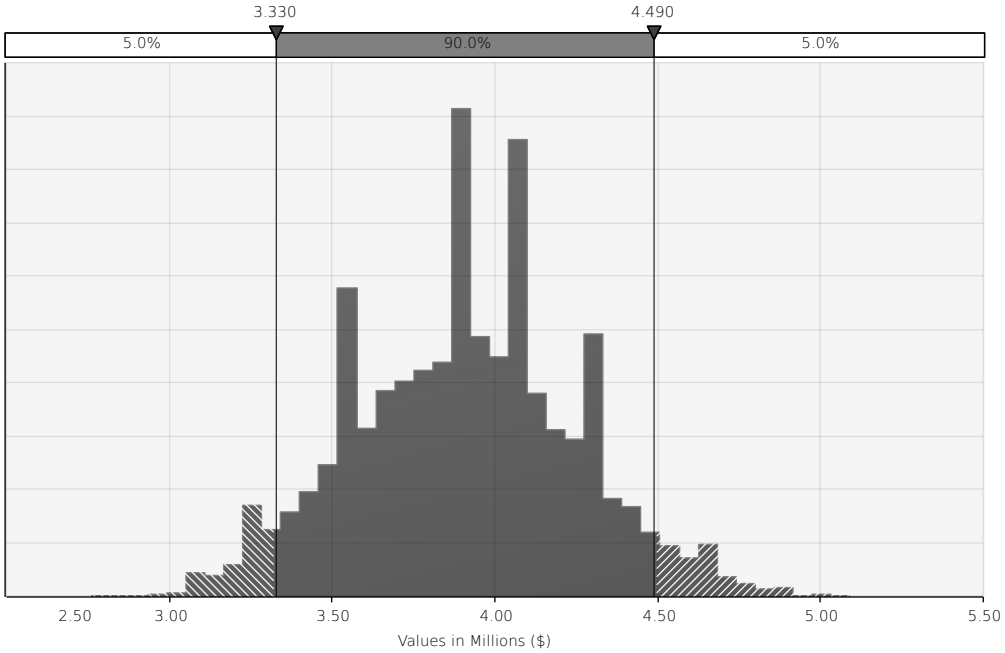

Figure 1 Net Industry Costs (7-percent NPV)—Alternative 2

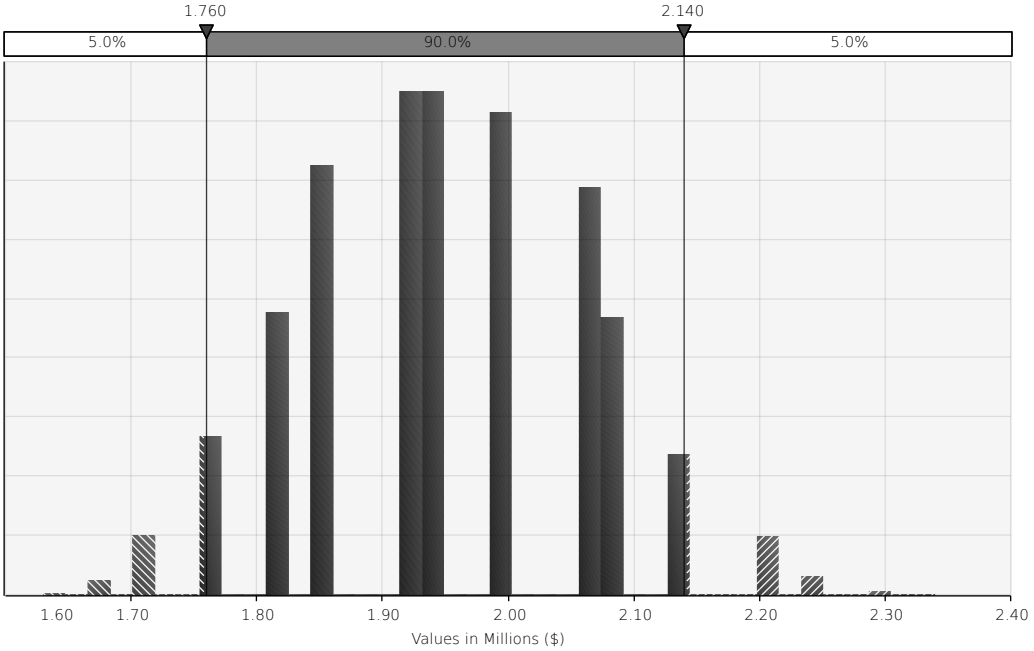

Figure 2 Net NRC Costs (7-percent NPV)—Alternative 2

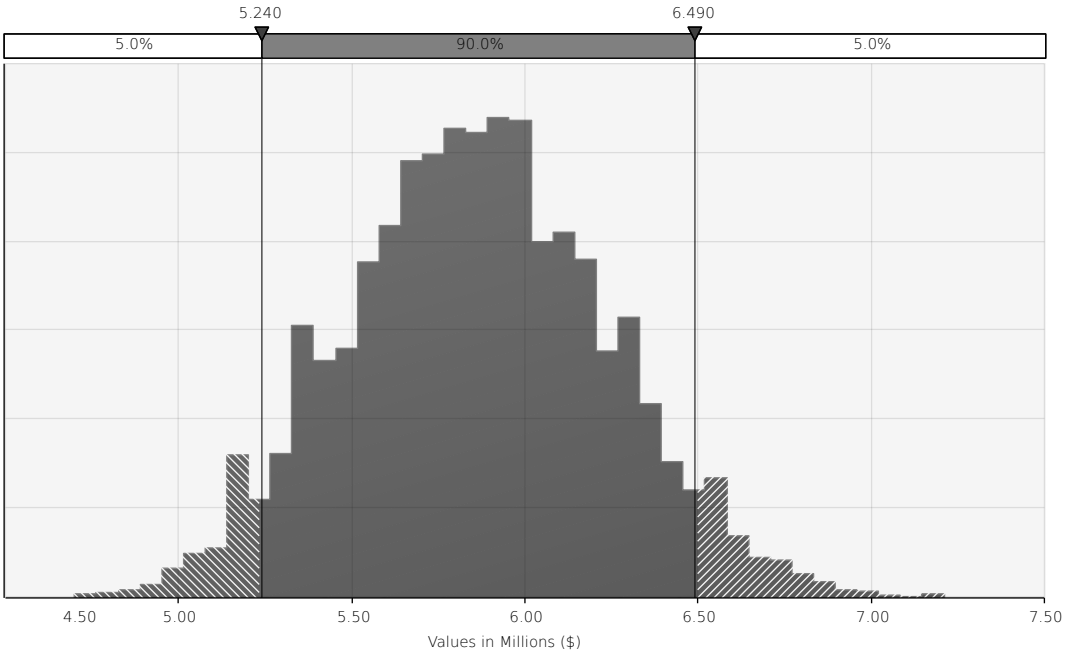

Figure 3 Net Costs (7-percent NPV)—Alternative 2

Table 10 presents descriptive statistics for the uncertainty analysis.

Table 10 Descriptive Statistics for Uncertainty Results (7-Percent NPV)

Uncertainty Result	Incremental Cost-Benefit (2021 million dollars)					
	Min	Mean	Std Dev	Max	5%	95%
Net Industry Cost	$2.76	$3.91	$0.34	$5.09	$3.33	$4.49
Net NRC Cost	$1.63	$1.95	$0.11	$2.34	$1.76	$2.91
Net Cost	$4.70	$5.86	$0.37	$7.21	$5.24	$6.49

Table 10 displays the key statistical results, including the 90-percent confidence interval in which the net benefits would fall between the 5-percent and 95-percent values.

Figure 4 shows a tornado diagram that identifies the cost drivers for this final rulemaking. This figure ranks the cost drivers based on their contribution to the uncertainty in cost. The largest cost drivers are the industry labor rate and the hours for industry to process a relief request and submit it to the NRC. These cost drivers generate the largest variation in the Net costs due to uncertainty. The remaining cost drivers show a diminishing variation of the net cost.

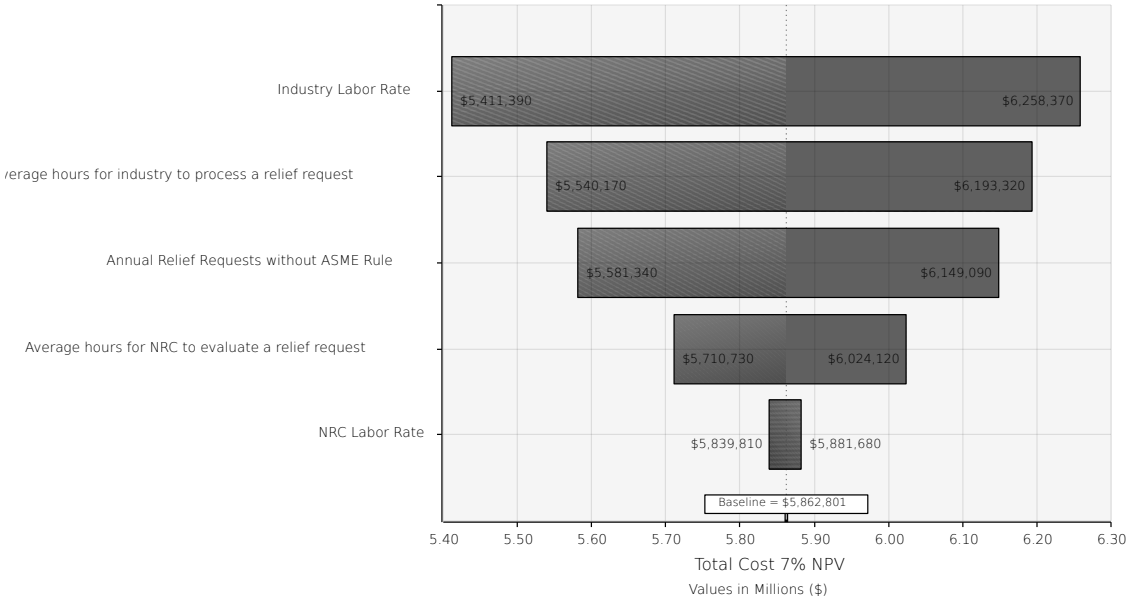

Figure 4 Top 5 Cost Drivers For Which Uncertainty Impacts The Net Costs (7-percent NPV)—Alternative 2

5.12.3 Summary of Uncertainty Analysis

The simulation analysis shows that the estimated mean benefit (i.e., positive averted costs or savings) for this final rule is $5.86 million with 90 percent confidence that the net benefit is between $5.24 million and $6.49 million using a 7 percent discount rate. A reasonable inference from the uncertainty analysis is that proceeding with the final rule represents an efficient use of resources and averted costs for the NRC and the industry because the minimum

calculated uncertainty result is a positive value. Also, the staff estimates that the rule alternative is cost beneficial to the industry and to the NRC when they are considered separately.

5.13 Disaggregation

The NRC performed a screening review to determine whether any of the individual requirements (or set of integrated requirements) of the rule would be unnecessary to achieve the objectives of the rulemaking. The NRC determined that the objectives of the rulemaking are to incorporate RGs by reference and to make conforming changes. Furthermore, the NRC concludes that each of the rule's requirements would be necessary to achieve one or more objectives of the rulemaking. Table 11 provides the results of this review.

Table 11 Disaggregation

Regulatory Goals for Final Rule	(1) Approve Use of the New Code Cases in Each of the RGs	(2) Make Incorporation by Reference Conforming Changes
10 CFR 50.55a(a)(3)(i), NRC RG 1.84, Revision 39	X	X
10 CFR 50.55a(a)(3)(ii), NRC RG 1.147, Revision 20	X	X
10 CFR 50.55a(a)(3)(iii), NRC RG 1.192, Revision 4	X	X
NUREG-2228, Revision 0		X

5.14 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 to be more tangible, the staff urges decisionmakers not to discount costs and benefits that cannot be quantified. Such benefits or costs can be as important as or even more important than benefits or costs that can be quantified and monetized.

5.14.1 Quantified Net Benefit

As shown in Table 8 above, the estimated quantified averted costs for Alternative 2, compared to the regulatory baseline (Alternative 1), over 6 years will be from approximately $6.20 million (7-percent discount rate) to $7.04 million (3-percent discount rate). Table 8 shows that Alternative 2 would also be cost beneficial for the NRC and the industry when they are considered separately.

5.14.2 Nonquantified Benefits

In addition to the quantified costs discussed in this regulatory analysis, the attributes of public health (accident), occupational health (accident and routine), improvements in knowledge, regulatory efficiency, and other considerations would produce several non-quantified costs and benefits for the general public, the industry, and the NRC. The sections below summarize these benefits.

5.14.2.1 Advances in Inservice Inspection and Inservice Testing

Advances in ISI and IST may incrementally decrease the likelihood of a radiological accident, the likelihood of post-accident plant worker exposures, and the level of plant worker radiological exposures 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 cause further degradation and 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.

5.14.2.2 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 meet the NRC goal of maintaining safety by approving later editions and addenda of the ASME codes and associated Code Cases to permit licensees to use advances in ISI and IST, provide alternative examinations for older plants, respond promptly to user needs, and offer a limited and clearly focused alternative to specific ASME code provisions. Improvements in ISI and IST may also result in the earlier identification of material degradation that, if undetected, could cause further degradation that eventually could lead to a plant transient. As such, Alternative 2 would maintain the same or possibly an incrementally improved level of safety that could result in an incremental decrease in public radiation exposures when compared to the regulatory baseline.

5.14.2.3 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 exposures 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 when compared to the regulatory baseline.

5.14.2.4 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 improve 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 cause further degradation that could eventually lead to a plant transient.

5.14.2.5 Consistent with National Technology Transfer and Advancement Act of 1995 and Implementing Guidance

Alternative 2 is consistent with the provisions of the NTTAA and its implementing guidance in OMB Circular A-119, which encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry.

5.14.2.6 Continued NRC Practice of 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.

5.14.2.7 Increased Public Confidence

Alternative 2 would incorporate the current ASME BPV and OM Code edition, addenda, and Code Cases for the design, construction, operation, ISI, and IST of nuclear power plants by approving their use 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*.

5.14.3 Nonquantified Costs

The staff believes that incorporating by reference into the *Code of Federal Regulations* the most recent ASME BPV and OM Code editions and addenda and associated NRC-approved Code Cases would decrease industry and NRC operating costs. If the staff has underestimated the

number or the complexity of these eliminated submittals, then the averted costs would increase proportionally.

5.15 Safety Goal Evaluation

The final 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 in 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 the final rule states the basis for this determination.

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

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).

5.15.2 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 of the ASME OM Code for the following reasons:

- The NRC's longstanding policy has been to incorporate later versions of the ASME BPV and OM Codes into its regulations; thus, licensees know when receiving their operating licenses 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 every 120 months 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 12 months before the start of a new 120-month 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 an undue cost on applicants or licensees).

5.15.3 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 or limits or prohibits 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.

5.15.4 Safety Goal Evaluation Result

Based on the reasons described, a safety goal evaluation is not appropriate for this regulatory analysis.

5.16 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) is presented in this regulatory analysis or in the *Federal Register* notice for the final rule. Table 12 provides a cross-reference between the relevant information and its location in this document or the *Federal Register* notice.

Table 12 Specific CRGR Information Requirements for Regulatory Analysis

CRGR Procedures Citation (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 as it is issued as a final rule	Final rule text in *Federal Register* notice for the final rule
Appendix B, (ii)	Draft papers or other documents supporting the requirements or staff positions	*Federal Register* notice for the final rule
Appendix B, (iii)	The sponsoring office's position on each requirement or staff position as to whether it would modify, implement, relax, or reduce existing requirements or staff positions	Regulatory Analysis, Section 5, and Backfitting and Issue Finality, Section XIII, *Federal Register* notice for the final rule
Appendix B, (iv)	The method of implementation	Regulatory Analysis, Section 7
Appendix B, (vi)	Identification of 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)	If the action involves a power reactor backfit and the exceptions at 10 CFR 50.109(a)(4) are not applicable, the items required at 10 CFR 50.109(c) and the required rationale at 10 CFR 50.109(a)(3)	Backfitting and Issue Finality, Section XIII, *Federal Register* notice for the final rule
Appendix B, (xvi)	An assessment of how the action relates to the Commission's Safety Goal Policy Statement	Regulatory Analysis, Section 5.15

6 Decision Rationale

Table 13 provides the quantified and qualified costs and benefits for Alternative 2. The quantitative analysis used best estimate values.

Table 13 Summary of Costs and Benefits

Net Monetary Savings or (Costs)—Net Present Value	Nonquantified Benefits or (Costs)
Alternative 1: No action $0	None
Alternative 2: Incorporate by reference RG 1.84, Revision 39; RG 1.147,	Benefits: • **Advances in ISI and IST:** May

Net Monetary Savings or (Costs)—Net Present Value	Nonquantified Benefits or (Costs)
Revision 20; RG 1.192, Revision 4; and NUREG-2228 Industry (all provisions): $3.92 million using a 7% discount rate $4.45 million using a 3% discount rate NRC (all provisions): $1.94 million using a 7% discount rate $2.22 million using a 3% discount rate Net Benefit (Cost) (all provisions): $5.86 million using a 7% discount rate $6.67 million using a 3% discount rate	incrementally decrease the likelihood of a radiological accident, the likelihood of post-accident plant worker exposure, and the level of plant worker radiological exposures during routine inspections or testing. • **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 meet the NRC goal of maintaining safety by approving the use of later editions and addenda of the ASME BPV and OM Codes and applicable Code Cases to permit licensees to use advances in ISI and IST, provide alternative examinations for older plants, respond expeditiously to user needs, and provide a limited and clearly focused alternative to specific ASME Code provisions. Improvements in ISI and IST may also result in the earlier identification of material degradation that, if undetected, could cause further degradation that could eventually lead to a plant transient. As such, when compared to the regulatory baseline, Alternative 2 would maintain or possibly incrementally improve the level of safety, which may result in an incremental decrease in public radiation exposures. • **Occupational Health (Accident and Routine):** The use of later editions and addenda of the ASME BPV and OM Codes and applicable Code Cases may reduce post-accident occupational radiation exposures in a positive, but not easily quantifiable, manner. The advances in ISI and IST may result in an incremental decrease in the likelihood of

Net Monetary Savings or (Costs)—Net Present Value	Nonquantified Benefits or (Costs)
	an accident resulting in worker exposure when compared to the regulatory baseline. • **Improvements in Knowledge:** The NRC and industry staff would gain experience with new technology and ISI and IST advances. • **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 consider adopting 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. <u>Costs:</u> • **Nonquantified Costs:** If the staff has underestimated the number or the complexity of these eliminated submittals, then the averted costs would increase proportionally.

The industry and the NRC benefit from the final rule (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).

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 NRC'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 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 the NRC's role as an effective regulator.

The NRC has had a decades-long practice of approving or mandating, or both, the use of certain of these 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 net quantified benefits of the regulatory action would exceed the costs of the 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 cost from $4.70 million to $7.20 million at a 7-percent NPV. Therefore, integrating both quantified and nonquantified costs and benefits, the benefits of the final rule outweigh the costs to implement the rule.

7 Implementation Schedule

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

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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			
Year of final rule	2022	year	U.S. Nuclear Regulatory Commission (NRC) input.
Analysis base year	2021	year	NRC input.
Number of Reactor Units			
Number of currently operating reactor units in 2022	92	units	Based on Appendix A to NUREG-1350, Volume 32, "2020–2021 Information Digest," issued October 2020.
Number of forecasted operating reactor units in 2025	91	units	Based on NUREG-1350, Volume 32, Appendix A; the staff anticipates operation of Vogtle Electric Generating Plant, Units 3 and 4, in 2021 and 2022, respectively.
Number of forecasted operating reactor units in 2026	90	units	Based on NUREG-1350, Volume 32, Appendix A; the staff anticipates operation of Vogtle Electric Generating Plant, Units 3 and 4, in 2021 and 2022, respectively.
Number of Sites			
Number of sites with currently operating reactors in 2022	52	sites	Information on operating reactor sites was 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 March 24, 2021 (last accessed on April 15, 2021).
Number of sites forecasted with currently operating reactors in 2025	51	sites	Calculation: [total number of sites with operating reactors] + [sites with construction completed in years 2020 through 2024] - [sites with all units closed in years 2020 through 2024]. Information on operating reactor sites was obtained from the NRC's "Operating Nuclear Power Reactors (by Location or Name)" https://www.nrc.gov/info-finder/reactors/ with data current as of March 24, 2021 (last accessed on April 15, 2021).

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Applicability Period (Years)			
Final rule applicability term	6	years	Code Cases last 3 years and are typically renewed once, for a total of 6 years.
Labor Rates			
Executive	$229	Dollars per hour	Labor rates used are from the Bureau of Labor Statistics (BLS) Employer Costs for National Compensation Survey dataset, 2020 values. These hourly rates were inflated to 2021 dollars using values of the Consumer Price Index for All Urban Consumers. A multiplier of 2.4, which includes fringe and indirect management costs, was then applied and resulted in the displayed labor rates.
Managers	$144	Dollars per hour	BLS tables.
Technical staff	$119	Dollars per hour	BLS tables.
Administrative staff	$76	Dollars per hour	BLS tables.
Licensing staff	$138	Dollars per hour	BLS tables.
Nuclear engineer	$153	Dollars per hour	BLS tables.
Nuclear technician	$107	Dollars per hour	BLS tables.
NRC staff	$137	Dollars per hour	NRC calculation, 2021.

REGULATORY ANALYSIS FOR THE FINAL RULE: APPROVAL OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE CASES [NRC-2017-0025; RIN 3150-AJ94] DATED

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