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

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Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
ASME	American Society of Mechanical Engineers
BLS	Bureau of Labor Statistics (U.S. Department of Labor)
BPV Code	ASME Boiler and Pressure Vessel Code
BWR	boiling-water reactor
CC	concrete containment
CFR	*Code of Federal Regulations*
CNWRA	Center for Nuclear Waste Regulatory Analyses
CPI-U	Consumer Price Index for all urban consumers
DG	draft regulatory guide
FR	*Federal Register*
GAO	U.S. Government Accountability Office
ICE	independent cost estimate
in.	inch(es)
ISI	inservice inspection
IST	inservice testing
MC	metal containment
MWe	megawatt electric
MWe-hr	megawatt electric per hour
NAICS	North American Industry Classification System
NDT	nil ductility temperature
NM	not meaningful
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
NTTAA	National Technology Transfer and Advancement Act
OM	operation and maintenance
OM Code	ASME Code for Operation and Maintenance of Nuclear Power Plants
OMB	Office of Management and Budget
PERT	program evaluation and review technique
PPA	power purchase agreement
PWR	pressurized-water reactor
Rev.	revision
RG	regulatory guide
SI	International System of Units
SOC	Standard Occupational Classification
U.S.C.	United States Code

Abstract

This final rule incorporates by reference into the U.S. Nuclear Regulatory Commission's (NRC's) regulations 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 (BPV Code) and Operation and Maintenance of Nuclear Power Plants (OM Code) 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 that are newly approved by the NRC:

(1) RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 37 (draft regulatory guide (DG)-1295), would supersede the incorporation by reference of RG 1.84, Revision 36, issued August 2014.

(2) RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 18 (DG-1296), would supersede the incorporation by reference of RG 1.147, Revision 17, issued August 2014.

(3) RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 2 (DG-1297), would supersede the incorporation by reference of RG 1.192, Revision 1, issued October 2014.

The ASME Code Cases that are the subject of this rulemaking are the new and revised Section III and Section XI ASME Code Cases listed in Supplement 11 to the 2007 BPV Code through Supplement 10 to the 2010 BPV Code and the OM Code Cases published with the 2009 Edition through the 2012 Edition of the OM Code. This document presents a final regulatory analysis of the incorporation by reference rule for the three RGs that list the Code Cases that are newly approved by the NRC.

To improve the credibility of the NRC staff cost estimates for this regulatory action, the NRC staff cross-checked its results with an independent cost estimate and conducted a sensitivity analysis to identify variables that most affect cost estimates (i.e., cost drivers).

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 for Mechanical Engineers (ASME). The three RGs that the NRC is incorporating by reference are RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 37 (draft regulatory guide (DG)-1295); RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 18 (DG-1296); and RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 2 (DG-1297).

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 benefits and costs of the final rulemaking 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 NRC staff's recommended final rule and implementation guidance would result in a cost-justified change based on the net averted cost to the industry that ranges from $2.42 million using a 7-percent discount rate to $2.87 million using a 3-percent discount rate. Relative to the regulatory baseline, the NRC would realize a net averted cost of $2.52 million using a 7-percent discount rate or $2.81 million using a 3-percent discount rate. The total net benefit is $4.94 million using a 7-percent discount rate to $5.68 million using a 3-percent discount rate.

  According to Executive Order 12866, "Regulatory Planning and Review" (58 FR 190; October 4, 1993), an economically significant regulatory action is one that would have an annual effect on the economy of $100 million or more. From a cost perspective, this final rulemaking does not reach this threshold.

- Qualitative Benefits. Other beneficial factors include meeting the NRC goal of ensuring the protection of public health and safety and the environment through the NRC's approval of new ASME Code Cases, which would allow the use of the most current methods and technology. In addition, the staff-recommended alternative would help ensure that the NRC's actions are effective, efficient, realistic, and timely by eliminating the need for unnecessary NRC review of plant-specific alternative requests. This alternative also would support the NRC's goal of maintaining an open regulatory process because the NRC's approval of ASME Code Cases demonstrates the agency's commitment to participate in the National Consensus Standards process under the National Technology Transfer and Advancement Act of 1995. Other important characteristics that the NRC staff analyzed are the industry's familiarity with the well-established process of approving ASME Code Cases through NRC RGs, the value of a Code Case approval process wherein the Code Cases are consistently applied across the industry, and the value of continuing to support the use of the most updated and technically sound techniques developed by ASME. Considering both the quantitative and qualitative benefits, the rulemaking is justified.

- Decision Rationale. Relative to the no-action baseline, the NRC staff concludes that the cost-beneficial results (averted costs) and the qualitative considerations justify the costs to implement the final rule.

1. Introduction

This document presents the final regulatory analysis for the American Society of Mechanical Engineers (ASME) Code Cases final rule (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16285A012) and the following three associated U.S. Nuclear Regulatory Commission (NRC) regulatory guides (RGs):

- RG 1.84, “Design, Fabrication, and Materials Code Case Acceptability, ASME Section III” (ADAMS Accession No. ML16321A335)

- RG 1.147, “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1” (ADAMS Accession No. ML16321A336)

- RG 1.192, “Operation and Maintenance Code Acceptability, ASME OM Code” (ADAMS Accession No. ML16321A337)

The recommended regulatory action incorporates by reference the latest revisions to the three RGs listed above so that the NRC approves the newly identified ASME Code Cases as alternatives for use to the ASME Code editions and addenda.

2. Statement of the Problem and Objective

2.1. Background

General Design Criterion 1, “Quality Standards and Records,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” states, in part, the following:

> Structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to ensure a quality product in keeping with the required safety function.

The National Technology Transfer and Advancement Act of 1995 (NTTAA) (Public Law 104-113) mandates that, where the Federal agency determines that Government regulation is required, the NRC use an available voluntary consensus standard to carry out the Federal agency’s objective, unless it is inconsistent with law or otherwise impractical. In carrying out this legislation, Federal agencies are to consult with voluntary consensus standards bodies and participate with such bodies in the development of technical standards when such participation is in the public interest and compatible with the agency mission, priorities, and budget resources.

Provisions of the ASME Boiler and Pressure Vessel (BPV) Code have been used since 1971 as one part of the regulatory framework to establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety. Various technical interests (e.g., utility, manufacturing, insurance, and regulatory) are represented on the ASME standards committees that develop, among other things, improved methods for the construction and inservice inspection (ISI) of ASME Class 1, 2, and 3; metal containment (MC); and concrete containment (CC) nuclear power plant components. This broad spectrum of stakeholder participation helps to ensure that various interests are considered.

In 1990, ASME published the initial edition of the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code) that provides rules for the inservice testing (IST) of pumps and valves. The ASME Committee on Operation and Maintenance of Nuclear Power Plants developed and maintains the OM Code. The ASME Board on Nuclear Codes and Standards directive transferred responsibility for development and maintenance of rules for the IST of pumps and valves from the ASME Section XI Subcommittee on Nuclear Inservice Inspection to the ASME OM Code Committee, along with lead responsibility for the development of the OM Code.

The regulations at 10 CFR 50.55a, "Codes and Standards," require nuclear power plant owners to construct Class 1, 2, and 3 components in accordance with Section III, Division 1, of the ASME BPV Code. These regulations also require owners to perform ISI of Class 1, Class 2, Class 3, Class MC, and Class CC components in accordance with Section XI, Division 1, of the BPV Code and to perform IST of Class 1, Class 2, and Class 3 safety-related pumps and valves in accordance with the OM Code. The ASME also publishes Code Cases on a quarterly basis (BPV Code Sections III and XI) or every two years (OM Code) to provide alternatives to existing Code requirements developed and approved by ASME. The ASME Code Cases are developed to allow licensees to gain experience with new technology before it is incorporated into the ASME Code, permit licensees to use advancements in ISI and IST, provide alternative examinations for older plants, provide an expeditious response to user needs, and provide a limited and clearly focused alternative to specific ASME Code provisions.

In March 2016, the NRC issued DG-1295, "Design and Fabrication Code Case Acceptability, ASME Section III" (draft RG 1.84); DG-1296, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1" (draft RG 1.147); and DG-1297, "Operation and Maintenance Code Case Acceptability, ASME OM Code" (draft RG 1.192). In these draft regulatory guides, the NRC identifies those ASME Code Cases that were determined to be acceptable alternatives to applicable parts of ASME BPV Code Section III and Section XI and the OM Code. The ASME Code Cases that were revised are listed in Supplement 11 to the 2007 BPV Code through Supplement 10 to the 2010 BPV Code and the OM Code Cases published with the 2009 Edition through the 2012 Edition of the OM Code.

The NRC's practice is to review ASME BPV and OM Code Cases, determine their acceptability, and specify its findings in the above-stated RGs. The NRC has permitted nuclear power plant licensees to adopt the NRC-approved ASME Code Cases listed in these RGs as alternatives to the requirements in the ASME BPV Code and OM Code, which the NRC has incorporated by reference into 10 CFR 50.55a and either mandated or approved for use. Because the practice of generally referencing the RGs may not fully satisfy the notice and comment provisions of the Administrative Procedure Act, as amended (5 U.S.C. 551 et seq.), the NRC determined that it is necessary to include these ASME Code Cases in NRC regulations through the process of incorporation by reference. Incorporating by reference into the NRC's regulations the latest revisions to the three RGs identifying NRC-approved ASME Code Cases provides these Code Cases with the same legal status and the same notice and comment provisions as the ASME BPV Code and OM Code requirements incorporated by reference in 10 CFR 50.55a.

2.2. 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, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," Revision 37

(2) RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 18

(3) RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 2

These revisions supersede the incorporation by reference of RG 1.84, Revision 36, issued August 2014; RG 1.147, Revision 17, issued August 2014; and RG 1.192, Revision 1, issued October 2014. This regulatory action improves the effectiveness of future licensing actions, is consistent with the provisions of the 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 is consistent with the NRC 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.

2.3. Statement of the Problem

The 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 the licensee to implement the most recent version of that Code Case as listed in the approved or conditionally approved tables in 10 CFR 50.55a. An alternative could be submitted and approved through alternative requests under 10 CFR 50.55a(z); in this case, a licensee could request the use of a previous Code Case, and the NRC would evaluate such a request on a case-by-case basis.

ASME 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 are not changed thereafter except voluntarily by the licensee). Hence, if a licensee implements an ASME BPV Code Section III Code Case and if the NRC incorporates by reference a later version of the Code Case into 10 CFR 50.55a and lists it in the RG tables, that licensee may use either version of the Code Case.

Licensees' ASME BPV Code Section XI ISI and ASME OM Code IST programs are updated every 10 years to the latest edition and addenda of ASME BPV Code Section XI that were incorporated by reference into 10 CFR 50.55a and in effect 12 months before the start of the next inspection interval. Licensees that were using a Code Case before the effective date of 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 burden of having to update their ISI or IST program each time ASME revises a Code Case. Because Code Cases are applicable to specific editions and addenda and because ASME may revise Code Cases that are no longer accurate or adequate, licensees that choose to continue to use a Code Case during the subsequent ISI interval must implement the latest version incorporated by reference in 10 CFR 50.55a and listed in the RGs or apply for an alternative request under 10 CFR 50.55a(z).

3. Identification and Analysis of the Alternative Approaches

Given the existing data and information, the NRC considers a rule change to be the most effective way to implement the NRC-approved ASME Code Cases. The NRC has identified two alternatives to this action: alternative 1—the no-action alternative (i.e., status quo, regulatory baseline) and alternative 2—incorporate by reference into 10 CFR 50.55a through rulemaking the NRC-approved ASME BPV Code Cases in RG 1.84, Revision 37, and RG 1.147, Revision 18, and the ASME OM Code Cases in RG 1.192, Revision 2.

3.1. Alternative 1—No-Action Alternative

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 cause licensees and applicants that desire to use these ASME Code Cases to request and receive approval from the NRC for the use of alternatives under 10 CFR 50.55a(z). The NRC does not recommend this alternative for the following reasons:

- Licensees and applicants would need to submit requests for alternatives to apply Code Cases under 10 CFR 50.55a(z) because those Code Cases have not been approved in the RGs and have not been incorporated by reference in 10 CFR 50.55a. This process would result in increased regulatory burden to licensees, applicants, and the NRC.

- Public confidence in the NRC as an effective regulator may be reduced because the 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 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.

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. This alternative would allow licensees and applicants to implement these ASME Code Cases and their conditions and modifications, if any, without seeking prior NRC approval. This alternative continues the NRC's process 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 Code.

The NRC recommends the rulemaking alternative for the following reasons:

- This alternative reduces regulatory burden on applicants for holders of licenses for nuclear power plants by eliminating the need for licensees to submit plant-specific requests for alternatives in accordance with 10 CFR 50.55a(z) and reduces the need for the NRC to review those submittals.

- This alternative meets the NRC goal of ensuring the protection of public health and safety and the environment by continuing to provide NRC approval of new ASME Code Cases that 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 regulatory process and by affording the public the opportunity to participate in that process.

- This alternative supports the NRC's commitment to participate in the national consensus standard process through the approval of these ASME Code Cases, and it conforms to NTTAA requirements.

- This alternative reduces the NRC's burden of evaluating plant-specific alternative requests, although this burden reduction is offset in part by the periodic rulemakings to update the regulations to incorporate by reference the editions and addenda of the ASME BPV and OM Code. Section 4 of this analysis discusses the costs and benefits of this alternative relative to the regulatory baseline (alternative 1).

4. Evaluation of Benefits and Costs

This section examines the benefits and costs expected to result from alternative 2 relative to the regulatory baseline (alternative 1). All costs and benefits are monetized, when possible. The costs and benefits are then summed to determine whether the difference between the costs and benefits results in a positive benefit. In some cases, benefits and costs 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 alternatives identified in Section 3 are expected to affect. The alternatives would apply to licensees and applicants of nuclear power plants and holders of nuclear power plant design certifications. The NRC believes that nuclear power plant licensees will be the primary beneficiaries. The NRC developed an inventory of the impacted attributes using the list provided in Chapter 5 of NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook," issued January 1997 (Ref. 10.).

The following are the affected attributes:

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

- Occupational Health (Accident). This attribute measures immediate and long-term health effects associated with site workers because of changes in accident frequency or accident consequences associated with the alternative (i.e., delta risk). A decrease in worker radiological exposure is a decrease in risk (i.e., benefit); an increase in worker exposures is an increase in risk (i.e., 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, advancements in ISI and IST may result in 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). Some operations will cause an increase in worker exposures; sometimes this increase will be a one-time effect (e.g., installation or modification of equipment in a radiation area), and sometimes it will be an ongoing effect (e.g., routine surveillance or maintenance of contaminated equipment or equipment in a radiation area). The use of ASME Code Cases may affect occupational health as a result of radiological exposure during the time required to perform additional weld examinations and pressure testing called for in the Code Case conditions. This additional work will result in increased occupational radiation exposure when compared to the regulatory baseline.

- Industry Implementation. This attribute accounts for the projected net economic effect on the affected licensees to implement the mandated changes. Costs include procedural and administrative activities to maintenance, inspection, or testing procedures.

- Industry Operation. This attribute accounts for the projected net economic effect caused by routine and recurring activities required by the alternative on all affected licensees. Under alternative 2, a licensee of a nuclear power plant would no longer be required to submit a Code Case alternative request under the 10 CFR 50.55a(z), which would provide a net benefit (i.e., averted cost) to the licensee.

  Under 10 CFR 50.55a, the NRC requires nuclear power plant owners to construct Class 1, 2, and 3 components in accordance with Section III, Division 1, of the ASME BPV Code. Under 10 CFR 50.55a, the NRC also requires owners to perform ISI of Class 1, Class 2, Class 3, Class MC, and Class CC components in accordance with Section XI, Division 1, of the ASME BPV Code and to perform IST of Class 1, Class 2, and Class 3 safety-related pumps and valves in accordance with the ASME OM Code. Until 2012, ASME issued new editions of the BPV Code every 3 years and addenda to the editions annually except in years when a new edition was issued. Similarly, ASME has published new editions and addenda of the ASME OM Code regularly. Starting in 2012, ASME decided to issue editions of its BPV and OM Code (no addenda) every 2 years. The ASME also publishes Code Cases on a quarterly basis (ASME BPV Code Sections III and XI) or every two years (ASME OM Code) to provide alternatives to existing Code requirements developed and approved by ASME. Code Cases are developed to allow licensees to gain experience with new technology before incorporation into the ASME Code, permit licensees to use advancements in ISI and IST, provide alternative examinations for older plants, provide an expeditious response to user needs, and provide a limited and clearly focused alternative to specific ASME Code provisions.

Under alternative 2, licensees and applicants are allowed to implement endorsed ASME Code Cases and their conditions and modifications without seeking prior NRC approval. This alternative continues the NRC's process 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 Code.

The Code Case requests and subsequent costs are considered "sunk" (i.e., already incurred) for issued design certifications, submitted design certifications under review, and submitted reactor applications to the NRC.

- 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.

- NRC Operation. This attribute accounts for the projected net economic effect on the NRC after the proposed action is implemented. If the NRC does not approve an ASME Code Case that a licensee or applicant wants to use, the licensee or applicant typically will request, under 10 CFR 50.55a(z), permission to use the ASME Code Cases 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 not be required, which results in a net benefit (i.e., averted cost) for the NRC.

  The NRC's cost to review requests for Code Case alternatives submitted to the agency before the effective date of the final rule are sunk costs and are not considered further in this regulatory analysis.

- Improvements in Knowledge. This attribute accounts for improvements in knowledge by industry and NRC staff gaining experience with new technology before its incorporation into the ASME Codes and by permitting licensees to use advancements in ISI and IST. Improvements in ISI and IST may also result in the earlier identification of material or equipment degradation that, if undetected, could result in further degradation that eventually results in 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 relative to the regulatory baseline. Alternative 2 would increase regulatory efficiency because licensees and applicants that wish to use NRC-approved ASME Code Cases would not require 10 CFR 50.55a(z) alternative requests. Further, alternative 2 is consistent with the provisions of the NTTAA that encourages Federal agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry. Alternative 2 is consistent with the NRC's policy of evaluating the latest versions 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 with international standards to improve regulatory efficiency for both the NRC and international standards groups.

- Attributes with Minimal Effects. Attributes that are not expected to contribute to the results under any of the alternatives include public health (routine), offsite property, onsite property, other government, general public, antitrust considerations, safeguards and security considerations, environmental considerations addressing Section 102(2) of the National Environmental Policy Act of 1969, and other considerations.

4.2. Analytical Methodology

This section describes the process used to evaluate costs and benefits associated with the alternatives, consistent with the guidance in NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Revision 4, issued September 2004 (Ref. 11.). The benefits include desirable changes in affected attributes (e.g., monetary savings, improved safety, reduced burden on licensees, streamlined processes), whereas the costs include any undesirable changes in affected attributes (e.g., monetary costs).

The analysis evaluates five attributes—occupational health (routine), industry implementation, industry operation, NRC implementation, and NRC operation—on a quantitative basis. Quantitative analysis requires a baseline characterization of the affected universe, including characterization of factors such as the number of affected entities, the type and complexity of the NRC-conditioned ASME Code Case tasks, and the administrative processes and procedures that licensees or applicants would implement or no longer implement because of the alternative. The NRC evaluated the remaining attributes using qualitative techniques because the benefits and costs related to consistent policy application and improvements in ISI and IST techniques are not possible or practical (i.e., because of the lack of methodologies or data). Sections 4.2.1 through 4.2.9 describe the analytical method and assumptions used in the quantitative and qualitative analysis of these attributes.

4.2.1. Regulatory Baseline

This draft regulatory analysis measures the incremental impacts of the final rule relative to a baseline that reflects anticipated behavior in the event that the NRC undertakes no additional regulatory (alternative 1, the no-action alternative) action. As part of the regulatory baseline used in this analysis, the NRC staff assumes full licensee compliance with existing NRC regulations. Section 5 presents the estimated incremental costs and benefits of the incorporation by reference of NRC-approved ASME BPV and OM Code Cases (alternative 2) relative to this baseline.

4.2.2. Discount Rates

In accordance with guidance in Office of Management and Budget (OMB) Circular No. A-4, "Regulatory Analysis," dated September 17, 2003 (Ref. 22.), and NUREG/BR-0058, Revision 4, net present worth calculations are used to determine how much society would need to invest today to ensure that the designated dollar amount is available in a given year in the future. By using present worth values, costs and benefits, regardless of when the cost or benefit is incurred in time, are valued to a reference year for comparison. Based on OMB Circular No. A-4 and consistent with the NRC's past practice and guidance, present worth calculations are presented using 3-percent and 7-percent real discount rates.[1] A 3-percent discount rate

1 The rates presented in Appendix C, "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses," revised November 2015, to OMB Circular No. A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," dated October 29, 1992 (Ref. 23.), do not apply to the

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. A 7-percent discount rate approximates the marginal pretax real rate of return on an average investment in the private sector and is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector. A 7-percent rate is consistent with an opportunity cost of capital[2] concept to reflect the time value of resources directed to meet regulatory requirements.

4.2.3. Cost/Benefit Inflators

To evaluate the costs and benefits consistently, the analysis inputs are inflated into 2017 dollars. The most common inflator is the Consumer Price Index for all urban consumers (CPI-U) developed by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). The following formula is used to determine the amount in 2017 dollars:

$$\frac{CPI\,U_{2017}}{CPI\,U_{Value\,Year}} * Value_{Value\,Year} = Value_{2017}$$

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

Table 1 CPI-U, U.S. City Average

Base Year	CPI-U Annual Average[a]	Forecast Percent Change from Previous Year
2014	236.736	
2015	239.340	1.10%
2016	242.212	2.20%
2017	247.783	2.30%

[a] Source: BLS, "Databases, Tables & Calculators by Subject: CPI Inflation Calculator" (Ref. 3)

4.2.4. Labor Rates

For regulatory analysis purposes, labor rates are developed wherein only variable costs that are directly related to the implementation and operation and maintenance of the requirement are included. This approach is consistent with guidance in NUREG/CR-4627, "Generic Cost Estimates," issued February 1992 (Ref. 8.), and general cost-benefit methodology. The NRC incremental labor rate is $128 per hour.[3]

regulatory analysis or benefit-cost analysis of public investment. These rates are used for the lease-purchase and cost-effectiveness analysis, as specified in the circular.

2 Opportunity cost is the value of the next best alternative to a particular activity or resource. An analyst does not need to assess opportunity cost in monetary terms. Opportunity cost can be assessed in terms of anything that is of value.

3 The NRC labor rates presented here differ from those developed under the NRC's license fee recovery program (10 CFR Part 170, "Fees for Facilities, Materials, Import and Export Licenses, and Other Regulatory Services under the Atomic Energy Act of 1954, as Amended"). The NRC labor rates for fee recovery purposes are set for cost recovery of the services rendered and as such include nonincremental costs (e.g., overhead, administrative, and logistical support costs). This labor rate is current as of the time

The estimated mean industry incremental labor rate is $126 per hour. The NRC staff derived these labor rates according to data provided by BLS. The NRC staff used the 2015 Occupational Employment and Wages data, which provided labor categories and the mean hourly wage rate by job type, and used the inflator discussed in Section 4.2.3. to inflate these labor rate data to 2017 dollars. The labor rates used in the analysis reflect total compensation, which includes health and retirement benefits (using a burden factor of 2.0). The NRC 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 following implementation of the alternative. In establishing this labor rate, wages paid for the individuals performing the work plus the associated fringe benefit component of labor cost (i.e., the time for plant management over and above those directly expensed) are considered incremental expenses and are included. The NRC staff also verified that these labor rates are consistent with wage rates submitted by industry in recent severe accident mitigation alternatives cost estimates. Appendix A to this regulatory analysis provides a breakdown of the labor categories considered that may be required to implement this final rule. The NRC staff performed an uncertainty analysis, which is discussed in Section 5.12..

Table 2 Position Titles and Occupations

Position Title (in This Regulatory Analysis)	Occupation (SOC Code)
Managers	Top Executives (111000)
	Chief Executives (111011)
	General and Operations Managers (111021)
	Industrial Production Managers (113051)
	First-Line Supervisors of Mechanics Installers and Repairers (491011)
	First-Line Supervisors of Production and Operating Workers (511011)
Technical Staff	Nuclear Engineers (172161)
	Physicists (192012)
	Nuclear Technicians (194051)
	Industrial Machinery Mechanics (499041)
	Nuclear Power Reactor Operators (518011)
Administrative Staff	Office and Administrative Support Occupations (430000)
	First-Line Supervisors of Office and Administrative Support Workers (431011)
	Office Clerks General (439061)
Licensing Staff	Lawyers (231011)
	Paralegals and Legal Assistants (232011)

4.2.5. Affected Entities

This rule would affect the following entities:

- <u>Operating Reactor Units</u>. The NRC staff models 62 U.S. light-water nuclear power reactors sites in this analysis, which reduces to 56 plant sites in 2019.[4] This list of

the regulatory analysis was prepared and may not represent the latest and most recent labor rate.

4 See NUREG-1350, "2015–2016 Information Digest," Volume 27, issued June 2015 (Ref. 13.). The NRC staff assumes that the James A. Fitzpatrick Nuclear Power Plant will close in 2017 and that Pilgrim will close

operating reactor units includes Watts Bar Nuclear Plant, Unit 2; Vogtle Electric Generating Plant, Units 3 and 4 (expected to begin operations in 2019 and 2020, respectively); and V.C. Summer Nuclear Station, Units 2 and 3 (expected to begin operations in 2019 and 2020, respectively), for the purposes of this analysis. One conditioned ASME Code Case, N-795, is specific to boiling-water reactor (BWR) designs for which there are 22 BWR sites. During calendar year 2019, Oyster Creek Nuclear Generating Station (Oyster Creek) and Pilgrim Nuclear Power Station (Pilgrim), both BWR sites, plan to prematurely shut down, resulting in 20 BWR sites.[5]

- Future Operating Reactor Units. The NRC staff assumes that five future operating light-water nuclear power reactors would be affected by the final rule and are considered in this analysis. These are South Texas Project, Units 3 and 4 (South Texas); Enrico Fermi, Unit 3; Levy County Nuclear Power Plant (Levy County); and William States Lee III Nuclear Station (Lee Station).[6]

To account for new nuclear power reactors under construction that are anticipated to begin operation beginning in 2019, the NRC modeled a hypothetical nuclear power reactor to analyze the costs and benefits. The NRC assumes that there would be no significant differences between the future operating reactor units listed above and the modeled hypothetical nuclear power reactor. The NRC staff assumes these new reactor units would be a pressurized-water reactor (PWR) design.

Assumptions Related to Affected Entities

This analysis does not include other potential new reactors licensed under 10 CFR Part 52, “Licenses, Certifications, and Approvals of Nuclear Power Plants,” and small modular reactors.[7] The NRC does not account for any incremental costs for other combined license applications that may be submitted and affected by the alternatives (e.g., a potential application associated with the NuScale design). The staff considered forecasts of the timing of these applications and the future construction of these reactors as too speculative for this analysis.

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in 2019 based on the announcement by Entergy Nuclear Operations, Inc. (see http://www.entergy.com). The NRC staff assumes Clinton Power Station will close in 2017; Quad Cities Nuclear Power Station, Units 1 and 2, will close in 2018; and Oyster Creek will close in 2019 based on Exelon Corporation’s announcements (see http://www.exeloncorp.com). On June 16, 2016, Fort Calhoun Station’s board of directors voted to prematurely shut down that plant by December 31, 2016.

5 This set of sites reflects the NRC’s understanding of licensees’ plans to decommission at the time this regulatory analysis was prepared. As of the time this regulatory analysis was prepared, the licensees for Clinton, FitzPatrick, Fort Calhoun, Oyster Creek, Pilgrim, and Quad Cities had announced intentions to begin decommissioning 2019. Crystal River, Kewaunee, San Onofre, and Vermont Yankee had already begun decommissioning. The NRC observes that licensee decisions regarding decommissioning consider multiple factors and may change before the end of this period. For example, recent licensee announcements relate to potential changes to future plans for Clinton, FitzPatrick, Quad Cities, and Palisades compared to what was assumed in the regulatory analysis. In addition, Fort Calhoun permanently shut down in October 2016. The final costs of the rule would be affected by the number of facilities that decommission during the timeframe considered by this analysis, but the overall conclusions regarding cost/benefit remain valid.

4.2.6. Sign Conventions

This analysis considers that all favorable consequences for the alternative are positive and that all adverse consequences for the alternative are negative. Therefore, additional costs above the regulatory baseline are shown as negative values, and cost savings and averted costs are shown as positive values. Negative values are shown using parentheses (e.g., negative $500 is displayed as ($500)).

4.2.7. Code Case Horizon

The NRC staff assumes that the incorporation of ASME Code Cases would occur within two cycles of issuing a new edition of the Code or within six years, whichever occurs first. A six-year period for the effective use of a Code Case, a relatively short period, was used for two reasons. First, because ASME updates the edition of the Code every two years, those Code Cases used by industry would likely be incorporated into the Code. Second, because the alternatives within this regulatory analysis have up-front costs with benefits that accrue in later years through averted costs (e.g., licensees and applicants no longer need to submit a Code Case alternative request), shorter time horizons place heavier emphasis on the implementation costs than on benefits. In this analysis, a short time horizon is selected to provide a conservative estimate of the alternative 2 impact.

4.2.8. Dollar per Person-Rem Conversion Factor

The NRC is currently revising the dollar per person-rem averted conversion factor of $2,000 per person-rem based on recent information on the value of a statistical life and cancer risk factors. The NRC staff included the proposed updated dollar per person-rem values provided in this analysis.[8]

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6 The NRC issued a combined license for Enrico Fermi Unit 3 in 2015 and for South Texas Units 3 and 4 in 2016. The licensees for the Levy County and Lee Station units have submitted their license applications, and their schedules are being revised as of April 2016. The timing and certainty for operation of the Bellefonte Nuclear Power Station, Units 1 and 2 (Bellefonte), as well as other new operating licenses, are too speculative to be included in this regulatory analysis.

7 The analysis does not include Bellefonte because the site does not have any operating units and new construction is indefinitely delayed. Bellefonte Units 1 and 2 are under the Commission Policy Statement on Deferred Plants (Volume 52 of the *Federal Register*, page 38077 (52 FR 38077; October 14, 1987) (Ref. 9)).

8 The dollar per person-rem conversion factor values range from the current approved value of $2,000 to the draft proposed value of $5,200 in NUREG-1530, “Reassessment of NRC's Dollar Per Person-Rem Conversion Factor Policy,” Revision 1 (draft), issued August 2015 for public comment (Ref. 25.).

Table 3 Dollar per Person-Rem Conversion Factor Sensitivity Values

Parameter	Base Case	Sensitivity Analysis Values (2017 dollars)		
		Low Estimate	Proposed Value	High Estimate
Dollar per person-rem conversion factor	$2,000	$3,100	$5,200	$7,700

4.2.9. Replacement Power Cost

Replacement power costs are the costs for replacing the energy when the NRC requirements on an ASME Code Case specify or result in extended downtime. The NRC assumes that licensees engage in power purchase agreements (PPAs) to economically replace power. Although not all licensees may have PPAs, the licensee will still need to replace the lost power any time the nuclear power plant is not operating to meet its electrical supply obligations.

The NRC is currently updating its estimates for replacement energy costs based on a U.S. competitive electricity market area model. The updated model provides the replacement energy costs by day, week, and year based on the market area for each year between 2010 and 2020. For each U.S. power market area, a lowest and highest cost replacement energy cost estimate was calculated, normalizing for reactor megawatt rating differences. Table 4 lists the estimated replacement energy costs per megawatt-hour for all seven U.S. power market areas.

Table 4 Average Wholesale Electricity Price with a Nuclear Power Plant Outage

U.S. Power Market Area	Low Range $/MWe-hr (2017 Dollars)	High Range $/MWe-hr (2017 Dollars)
NYISO	$44.82	$49.74
PJM	$43.86	$44.23
MISO	$39.20	$42.37
SPP	$39.01	$39.20
SERC	$42.03	$42.61
ERCOT	$42.61	$42.61
WECC	$40.63	$41.91

The estimated replacement power cost ranges from a low estimate of $39.01 per megawatt-hour to a high estimate of $49.74 per megawatt-hour with an average value of $42.49 per megawatt-hour. The average BWR rated electrical output is 1,049 megawatt electric (MWe).[9]

Based on these estimates, Table 5 lists the average estimated replacement energy hourly cost for a typical BWR reactor.

9 The NRC staff calculated the average BWR rated electrical output value from International Atomic Energy Agency Power Reactor Information System data (Ref. 26.).

Table 5 Estimated Replacement Power Hourly Costs for a Typical BWR

Low Estimate (2017 Dollars)	Base Case Estimate (2017 Dollars)	High Estimate (2017 Dollars)
$40,900	$44,600	$52,200

4.2.10. Base Year

The final rule assumes implementation in 2017; therefore, the monetized benefits and costs in this analysis are expressed in 2017 dollars. One-time implementation costs are assumed to be incurred in 2017. Ongoing and annual costs of operation related to the alternatives are assumed to begin in 2018 unless otherwise stated and are then discounted into 2017 dollars.

4.2.11. Cost Estimation

In order to estimate the costs associated with the evaluated alternatives, the NRC staff used a work breakdown approach to deconstruct the requirements according to the required activities for each requirement. 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 NRC staff estimated the required level of effort for each required activity and used a blended labor rate to develop bottom-up cost estimates.

The NRC staff gathered data from several sources and consulted ASME Code working group members to develop levels of effort and unit cost estimates. The NRC staff applied several cost estimation methods in this analysis. The professional knowledge and judgment of the NRC staff were used to estimate many of the costs and benefits. Additionally, the NRC used a buildup method, solicitation of licensee input, and extrapolation techniques to estimate costs and benefits. Finally, the staff performed an independent cost estimate (ICE) to compare it to the NRC's cost estimates in response to the U.S. Government Accountability Office (GAO) concerns and recommendations (Ref. 27.).

The NRC staff began by estimating some activities using the engineering buildup method of cost estimation, combining incremental costs of an activity from the bottom up to estimate a total cost. For this step, the NRC reviewed previous license submittals and extracted the length of each section (in page numbers) and used these data to develop preliminary levels of effort.

The NRC staff consulted subject-matter experts within and outside of the agency to develop most of the level of effort estimates used in the analysis. For example, for both costs and averted costs of the final rule, the NRC staff consulted licensees when estimating the level of effort required for ASME Code Case impacts. Additionally, the NRC staff contributed to the estimation of levels of effort for review-related activities.

The NRC staff used an extrapolation method to estimate some cost activities, which relies on actual past or current costs to estimate the future cost of similar activities. For instance, to calculate the estimated averted costs of alternative requests and the preparation of the final rule and accompanying regulatory guidance, the NRC staff needed to extrapolate the labor categories responsible for the work based on past data. For activities with no available data, however, the NRC staff estimated the level of effort based on similar steps in the process for which data are available.

To incorporate uncertainty into the model, the NRC staff employed Monte Carlo simulation, which is an approach to uncertainty analysis where 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 Appendix B. The result was a distribution of values for the output variable of interest. The Monte Carlo simulation also allows for the determination of input variables that have the greatest effect on the value of the output variable. Section 5.12. contains a detailed description of the Monte Carlo simulation methods and a presentation of the results.

4.2.12. Conditioned Code Cases

The NRC staff analyzes ASME Code Cases to determine whether the Code Cases are (1) acceptable without conditions, (2) generally acceptable with conditions, or (3) not approved. When the NRC generally approves Code Cases with conditions, licensees may incur additional regulatory burden to meet the conditioned Code Cases. 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 DG-1295, DG-1296, and DG-1297 includes these ASME Code Cases. 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 would have additional resource burden on licensees under the industry operation affected attribute. Table 6 lists the conditioned Code Cases.

Table 6 List of Conditioned Code Cases

DG Listing	Conditioned Code Case Number	New Condition Description[a]	Incremental Resources Required[b]
DG-1296	N-576-2	Revised the note to state steam generator tube repair methods require prior NRC approval through the Technical Specifications and that the Code Case does not address certain aspects of this repair.	No additional hours are required for the note change compared to the regulatory baseline.
DG-1296	N-593-2	(1) Essentially 100 percent (not less than 90 percent) of the examination volume A-B-C-D-E-F-G-H must be inspected. (Note: the above condition is identical to condition on the use of Code Case N-593, RG 1.147, Rev. 17.) (2) The examination volume specified in Section XI, Table IWB-2500-1, Examination Category B-D, must be used for the examination of steam generator nozzle-to-vessel welds at least once prior to using the reduced examination volume allowed by Code Case N-593-2.	No additional hours are required for condition (1) because it is part of the regulatory baseline. Condition (2) is related to scheduling and requires no additional hours compared to unconditionally approving the Code Case.

DG Listing	Conditioned Code Case Number	New Condition Description[a]	Incremental Resources Required[b]
DG-1296	N-638-6	(1) Demonstration for ultrasonic examination of the repaired volume is required using representative samples, which contain construction type flaws.	This condition requires minimal additional effort for the following reasons. Condition (1) will require four to six weld examinations per refueling outage. The NRC staff estimates that each weld examination will require 8 hours. This would result in an incremental cost impact to industry for every refueling outage.
DG-1296	N-666-1	(1) A surface examination (magnetic particle or liquid penetrant) must be performed on the completed weld overlay for Class 1 and 2 piping socket welds. Fabrication defects, if detected, must be dispositioned using the surface or volumetric examination acceptance criteria of the Construction Code identified in the Repair/Replacement Plan. (Note: Code Case N-666 was unconditionally approved in Rev. 17 of RG 1.147.)	With respect to condition (1), the NRC estimates that an additional 2 hours would be necessary to prepare and perform the surface examination and to disposition any fabrication defects detected per weld.
DG-1296	N-749	In lieu of the upper shelf transition temperature, T_c, as defined in the Code Case, the following shall be used: T_c = 154.8 °F + 0.82 × RT_{NDT} (in U.S. Customary Units), and T_c = 82.8 °C + 0.82 × RT_{NDT} (in SI Units). T_c is the temperature above which the elastic plastic fracture mechanics (EPFM) method must be applied. Additionally, the NRC defines temperature T_{c1} below which the linear elastic fracture mechanics (LEFM) method must be applied: T_{c1} = 95.36 °F + 0.703 × RT_{NDT} (in U.S. Customary Units), and T_{c1} = 47.7 °C + 0.703 × RT_{NDT} (in SI Units). Between T_{c1} and T_c, while the fracture mode is in transition from LEFM to EPFM, users should consider whether or not it is appropriate to apply the EPFM method. Alternatively, the licensee may use a different T_c value if it can be justified by plant specific Charpy curves.	This conditioned Code Case is for calculation purposes and, therefore, requires no to minimal incremental effort.
DG-1296	N-754	(1) The conditions imposed on the optimized weld overlay design in the NRC safety evaluation for MRP-169, Revision 1-A (ADAMS Accession No(s). ML101620010 and ML101660468) must be satisfied. (2) The preservice and inservice inspections of the overlaid weld must satisfy 10 CFR 50.55a(g)(6)(ii)(F). (3) The first layer of weld metal deposited shall not be credited toward the required optimized weld overlay thickness unless the chromium content of the first layer is at least 24-percent. The presence of the first layer shall be considered in the design analysis requirements of paragraph 2(b) of Code Case N-754 regardless of the chromium content.	These conditions do not require additional effort because licensees must meet either currently acceptable NRC approvals (for condition (1) or the criteria for conditions (2) and (3)).

DG Listing	Conditioned Code Case Number	New Condition Description[a]	Incremental Resources Required[b]
DG-1296	N-778	Licensees must submit the following reports to the regulatory authority: (1) The preservice inspection summary report must be submitted prior to the date of placement of the unit into commercial service. (2) The inservice inspection summary report must be submitted within 90 calendar days of the completion of each refueling outage.	The ASME-approved Code Case requires licensees to submit these reports but gives no requirements related to when the reports should be submitted. The conditions provide submittal requirements and, therefore, require no additional effort compared to unconditionally approving the Code Case.
DG-1296	N-789	(1) Areas containing pressure pads shall be visually observed at least once per month to monitor for evidence of leakage. If the areas containing pressure pads are not accessible for direct observation, then monitoring will be accomplished by visual assessment of surrounding areas or ground surface areas above pressure pads on buried piping, or monitoring of leakage collection systems, if available.	Condition (1) requires additional inspections of the pressure pads. The NRC staff estimates that there will most likely be three pad inspections performed. The NRC staff estimates that the incremental time required to perform a visual inspection of an additional three pads would require between 1 and 10 labor hours with a best estimate of 1.5 hours. These visual inspections would be performed at least once a month.
DG-1296	N-795	(1) The use of nuclear heat to conduct the BWR Class 1 system leakage test is prohibited (i.e., the reactor must be in a non-critical state), except during refueling outages in which the ASME Section XI Category B-P pressure test has already been performed, or at the end of mid-cycle maintenance outages fourteen (14) days or less in duration. (2) The test condition holding times, after pressurization to test conditions, and before the visual examinations commence, shall be 1 hour for non-insulated components.	Condition (1) requires no additional effort compared to unconditional approval of the Code Case. The NRC staff estimates that condition (2)(a) would require an incremental effort of 45 minutes to perform the examination. The NRC staff estimates that the repair and replacement would occur twice per 10-year period per reactor. This Code Case is applicable only to BWR designs.
DG-1296	N-799	(1) The gap between the ultrasonic probe and component surface shall not exceed 0.032 in. If the gap exceeds 0.032 in., the weld shall be considered to be unexamined unless the examination technique is successfully demonstrated on representative mockups. (2) Examination requirements of Section XI, Mandatory Appendix I, paragraph I-3200(c) must be applied. (3) Ultrasonic depth and sizing qualifications for cast austenitic stainless steel components must follow Appendix VIII, Supplement 10, using representative cast austenitic stainless steel mockups containing representative cracks and be independent of other Supplement 10 qualifications.	Condition (1) requires no additional effort compared to unconditional approval of the Code Case. Condition (2) is a stipulation for use. The NRC staff estimates that each weld inspection will require 5 additional labor hours. The NRC staff's best estimate is that two welds will be inspected. The NRC staff's low estimate is one weld, and its high estimate is five welds. The NRC staff notes that there could be

DG Listing	Conditioned Code Case Number	New Condition Description[a]	Incremental Resources Required[b]
		(4) Cracks detected and not depth sized to Appendix VIII type performance-based procedures, equipment, and personnel qualifications shall be repaired or removed.	significant costs from this conditioned Code Case if flaws in the components are detected. This Code Case is applicable only to new reactor designs.
DG-1298	N-818	Revised wording in RG 1.193 to clarify NRC positions regarding examination of austenitic and ferritic welds, that performing a full volume ultrasonic examination for flaws is significantly different than an inservice examination. In summary, the NRC believes that an analytical approach for the acceptance of certain fabrication flaws could be acceptable if appropriately justified and the scope limited to ferritic materials. The NRC believes that significant research will be required to demonstrate that full-volume ultrasonic examination for fabrication flaws is acceptable for austenitic and dissimilar metal welds.	The NRC staff expects that this change in wording will not cause any incremental change in resource requirements because the Code Case remains in RG 1.193 and the alternative requests would be of similar complexity as the regulatory baseline.
DG-1297	OMN-16	Figure 1 was inadvertently omitted from OMN-16, Revision 1, in the 2012 Edition of the OM Code. This Code Case is approved for use provided it is supplemented with Figure 1 of OMN-16 that is in the 2006 Addendum of the OM Code. (Note: OMN-16, 2006 Addenda, was unconditionally approved in Rev. 1 of RG 1.192.)	The NRC staff expects no incremental change in resource requirements between the unconditioned and the conditioned Code Case.
DG-1297	OMN-18	The upper end values of the Group A Test Acceptable Ranges for flow and differential pressure (or discharge pressure) must be $1.06Q_r$ and $1.06\Delta P_r$ (or $1.06P_r$), respectively, as applicable to the pump type. The high values of the Required Action Ranges for flow and differential pressure (or discharge pressure) must be $>1.06Q_r$ and $>1.06\Delta P_r$ (or $1.06P_r$), respectively, as applicable to the pump type.	The NRC staff expects that this condition requires no additional effort compared to the Code Case without conditions.
DG-1297	OMN-19	Applicants or licensees who use this Code Case must implement a pump periodic verification test program. A pump periodic verification test is defined as a test that verifies a pump can meet the required (differential or discharge) pressure as applicable, at its highest design basis accident flow rate. The applicant or licensee must: a. Identify those certain applicable pumps with specific design basis accident flow rates in the applicant's or licensee's credited safety analysis (e.g., technical specifications, technical requirements program, or updated safety analysis report) for inclusion in this program. b. Perform the pump periodic verification test at least once every two years. c. Determine whether the pump periodic verification test is required before declaring the pump operable following replacement,	As indicated in the FR notice for this rulemaking, Code Case OMN-19 allows an extended range that provides for an alternative upper limit level for the acceptance criteria in a comprehensive pump test required by ASME OM Code Subsection ISTB. This condition for a pump periodic verification test is consistent with Mandatory Appendix V, "Pump Periodic Verification Test Program," in the ASME OM Code. As discussed in the *Federal Register* dated September 18, 2015 (80 FR 56820), Appendix V was included in the ASME OM Code to support an

DG Listing	Conditioned Code Case Number	New Condition Description[a]	Incremental Resources Required[b]
		repair, or maintenance on the pump. d. Declare the pump inoperable if the pump periodic verification test flow rate and associated differential pressure (or discharge pressure for positive displacement pumps) cannot be achieved. e. Maintain the necessary records for the pump periodic verification tests, including the applicable test parameters (e.g., flow rate and associated differential pressure, or flow rate and associated discharge pressure, and speed for variable speed pumps) and their basis. f. Account for the pump periodic verification test instrument accuracies in the test acceptance criteria. g. The applicant or licensee need not perform a pump periodic verification test if the design basis accident flow rate in the applicant's or licensee's safety analysis is bounded by the comprehensive pump test or Group A test.	extension of the upper range for the pump acceptance criteria in ASME Subsection ISTB. This same upper range extension is allowed in Code Case OMN-19. As required by Mandatory Appendix V and as specified in the RG 1.192 condition on the use of Code Case OMN-19, licensees will prepare work packages for periodic pump verification tests. The NRC staff estimates that each work package will require 40 labor hours. Additionally, 16 labor hours will be required to update test procedures, and 16 labor hours will be required to determine test points and inspection requirements to perform the initial test. The NRC staff estimates that 0.5 labor hour is required to test each pump and 0.5 labor hour is required to prepare each subsequent periodic test work package. The NRC staff estimates that this periodic pump verification would apply to 7 pumps per unit. The periodic pump tests are performed every 2 years. .
DG-1297	OMN-20	RG 1.192 was updated to add a condition stating that Code Case OMN-20 is applicable to the editions and addenda of the ASME OM Code listed in § 50.55a(a)(1)(iv) (2012 and earlier editions).	There is no cost or benefit as a result of this condition in the final rule because this Code Case and condition will be incorporated by reference in a prior ASME 2009–2013 rulemaking (ADAMS Accession No. ML16130A538) and the averted costs from this condition are included in the regulatory analysis in that ADAMS package (ADAMS Accession No. ML16130A522). Therefore, in this final rule, this condition is treated as status quo.

[a] This information is copied directly from the respective draft regulatory guide.

[b] These incremental hours are the additional time necessary to conform to the NRC conditioned Code Case when using the same Code Case with no NRC conditions as the baseline.

5. Presentation of 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 the alternative has a favorable or adverse effect relative to the regulatory baseline (alternative 1). A discussion is provided for those attributes that are not easily represented in monetary values. Although this *ex ante* cost-benefit analysis[10] provides useful information that can be used when deciding whether to select an 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 decision makers think in depth about specific alternatives and their associated results.

The NRC Regulatory Analysis Guidelines (NUREG/BR-0058) states that the NRC's periodic review and endorsement of consensus standards such as new versions of the ASME Code and associated Code Cases is a special case because consensus standards have already undergone extensive external review and have been endorsed by industry. In addition, endorsement of the ASME Code and Code Cases has been a longstanding NRC policy. Licensees and applicants participate in the development of the ASME Code and Code Cases and are aware that periodic updating of the ASME Code is part of the regulatory process. Code Cases are ASME-developed alternatives to the ASME BPV and OM Code 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 Code and Code Cases is consistent with the NTTAA inasmuch as the NRC has determined that sound regulatory reasons exist for establishing regulatory requirements for design, maintenance, ISI, and IST and examination by rulemaking.

In a typical incorporation of Code Cases, the NRC endorsements can involve hundreds, if not thousands, of individual provisions. Evaluating the benefit in relation to the cost of each individual provision in this regulatory analysis would be prohibitive, and the value gained by performing such an exercise would be limited. 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 continuing to provide the NRC's approval of new ASME Code Cases to allow licensees to gain experience with new technology before incorporation into the ASME Code, permit licensees to use advancements in ISI and IST, provide alternative examinations for older plants, provide an expeditious response 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 result in further degradation that eventually results in a plant transient. As such, alternative 2 maintains the same level of, or may provide an incremental improvement in, safety when compared to the regulatory baseline.

10 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.

5.2. Occupational Health (Accident)

The NRC's practice to review ASME BPV and OM Code Cases, determine their acceptability, and specify its finding 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 would continue to meet the NRC's goal of maintaining safety, permit licensees to use ISI and IST advancements, provide alternative examinations, respond to user needs, and provide alternatives to ASME Code provisions. The NRC 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 NRC 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.

The rule alternative (alternative 2) would allow licensees and applicants to apply voluntarily NRC-approved Code Cases, sometimes with NRC-specified conditions. The NRC lists the approved Code Cases in three RGs that are incorporated by reference in 10 CFR 50.55a.

5.3. Occupational Health (Routine)

The NRC staff estimates that the use of ASME Code Cases will affect occupational health as a result of radiological exposure. The Code Cases listed in Table 7 will result in an incremental increase in worker radiological exposure during routine inspections when compared to the regulatory baseline.

Table 7 Occupational Health Impacts

Code Case	No. of Workers	Incremental Dose per Worker (mrem)	Annual Incremental Dose (mrem)	Cost to Industry (2017 dollars)		
				Undiscounted	7% NPV	3% NPV
N-638	2	25	50	($49,514)	($37,981)	($44,045)
N-789	2	25	50	($96,667)	($74,085)	($85,962)
N-799	2	25	50	($250)	($192)	($222)
			Total Cost	($146,000)	($112,000)	($130,000)

This incremental increase in worker radiological exposure results from the performance of ISI related to the additional weld examinations and inspection of the pressure pads called for by the imposed conditions of the Code Cases. Consequently, the industry would incur a total cost that ranges from ($112,000) using a 7-percent discount rate to ($130,000) using a 3-percent discount rate. The cost incurred is calculated based on the current dollar per person-rem value of $2,000. If the proposed dollar per person-rem values of Table 3 are established, the cost to industry would instead be ($296,000) using a 7-percent discount rate and ($343,000) using a 3-percent discount rate. Therefore, using the proposed dollar per person-rem values has minimal impact on the overall cost of these Code Cases and on the overall cost-beneficial characterization of this final rule.

5.4. Onsite Property—Power Replacement

For Code Case 795, the NRC requires that the hold times after reaching the test conditions during plant startup must be one hour for noninsulated components, which is 45 minutes longer than that required by the current Code Case. The pressure test is an outage critical-path item because it occurs during startup; therefore, extending the pressure test time will extend the outage to perform the test of the repaired or replaced components. The NRC staff estimates that this requirement will add 45 minutes to a plant outage for the repair or replacement activities. The staff assumed that this test would be performed twice per 10-year ISI for each BWR unit with the first occurrences in 2017 and evenly distributed throughout the 10-year interval. The cost estimated is the cost to replace the power that is not generated during the additional 45 minutes. Section 5.6.2. addresses industry labor to perform the test.

Table 8 lists the estimated short-term replacement power costs, using the estimated short-term replacement power hourly costs for a typical U.S. BWR provided in Table 5 and the incremental 45-minute increase in outage time to perform the conditioned Code Case 795 test for which the frequency of the repair and replacement would occur twice per ten-year period per BWR unit.

Table 8 Code Case 795 Short-Term Replacement Power Costs

Year	Mean Incremental Test Duration (hr)	No. of BWR Outages with Code Case 795-1 Inspections	Mean Short-Term Replacement Power Cost ($/hr)	Mean Short-Term Replacement Power Cost (2017 Dollars)		
				Undiscounted	7% NPV	3% NPV
2018	0.75	6	$45,250	($203,625)	($190,304)	($197,694)
2019	0.75	6	$45,250	($203,625)	($177,854)	($191,936)
2020	0.75	6	$45,250	($203,625)	($166,219)	($186,346)
2021	0.75	6	$45,250	($203,625)	($155,345)	($180,918)
2022	0.75	6	$45,250	($203,625)	($145,182)	($175,649)
			Total Cost	($1,018,000)	($835,000)	($933,000)

Table 8 shows that industry would incur a total cost (resulting from short-term replacement power) that ranges from ($835,000) using a 7-percent discount rate to ($933,000) using a 3-percent discount rate.

5.5. Industry Implementation

The NRC staff estimates that updating 10 CFR 50.55a to conform to guidance from the Office of the Federal Register on incorporation by reference required by alternative 2 would result in administrative revisions to update technical material and references for an estimated 50 plant procedures for each nuclear reactor unit. The NRC staff estimates that this one-time cost to revise, review, approve, and issue these procedures would occur in 2017 and would require five hours per procedure. Table 9 lists the best estimate for the total industry implementation cost of this change. The estimates below also include the resources required to implement the procedure changes affected by the conditioned Code Cases. The NRC staff estimates the industry implementation cost for 56 operating nuclear power plant sites would incur a cost of ($1.76 million).

For Code Case N-666-1, the acceptance of the surface examination of the weld overlay as part of the preservice exam results in a one-time industry implementation cost of ($15,000), as shown in Table 9. The total industry implementation costs are ($1.77 million).

Table 9 Industry Implementation Costs

Year	Activities	No. of Reactor Sites	No. of Procedures per Reactor Site	No. of Hours	Labor Rate	One-Time Implementation Cost
2017	Revise plant procedure to incorporate revised references	56	50	5.0	$126	($1,759,000)
	Perform Code Case N-666-1 test	56	--	2.2	$126	($15,000)
					Total	**($1,774,000)**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

A hypothetical new reactor that begins commercial operation after 2017 would issue its initial ISI and IST procedures with the updated references and would incur no incremental costs.

5.6. Industry Operation

The use of ASME BPV and OM Code Cases is beneficial to NRC nuclear power plant licensees and applicants for several reasons. Licensees and applicants will likely obtain cost savings by implementing the alternatives allowed by ASME BPV and OM Code Cases. Licensees and applicants may use Code Cases immediately following the NRC's approval. In addition, Code Cases are stand-alone alternatives to specific provisions contained in the ASME Code, which makes their implementation straightforward. Hence, a Code Case is a good tool for introducing the use of advanced techniques, procedures, and measures on a trial basis to gain experience before the incorporation of the alternatives into the ASME Code and the NRC approval of the later editions and addenda. This experience is used to either refine or reject the new provisions. Code Cases are also suited for use in areas where the application of risk-informed principles indicates that there are too many examinations or tests or that occupational exposure can be reduced. Alternative 2 has the advantage (compared to alternative 1) that, on implementation of the final rule, licensees and applicants will be able to use the Code Cases that the NRC approved through the revised RGs. Therefore, under alternative 2, licensees and applicants will be permitted to apply the Code Cases listed in the subject RGs without the need to seek the NRC's approval through a request for use of alternatives under 10 CFR 50.55a(z).

5.6.1. Averted Costs from Code Case Alternative Request Submittals

Submission of an alternative request to the NRC can be expensive. Once ASME issues a Code Case, the licensee or applicant must determine the applicability of the Code Case to its facility and the benefit derived from using it. If the licensee or applicant determines that use of the Code Case would be beneficial but the NRC has not approved use of the Code Case, a request for the use of the Code Case alternative must be prepared, and appropriate levels of licensee or applicant management must review and approve the request before submitting it to the NRC. A review of Code Case alternate requests submitted to the NRC over the last six years identified that these submittals ranged from a few pages to several hundred pages with an average length of approximately 32 pages with average technical complexity. Therefore, the NRC staff estimates that a Code Case alternative request submittal requires 380 hours per request—an average of 300 hours of effort to develop the technical justification and an additional 80 hours to perform research and to review, approve, process, and submit the document to the NRC for use of alternatives under 10 CFR 50.55a(z). The NRC assumes that licensees or applicants would decide whether an alternative request should be sought by weighing the cost against the benefit to be derived. In some cases, licensees may decide to forfeit the benefits of using a Code Case, whether in terms of radiological considerations or burden reduction.

A review of past submittals of requests to use ASME Code Case alternatives has determined that plant owners submit a Code Case alternative request that covers multiple units and multiple plant sites. The NRC staff has received approximately 30 Code Case alternative requests each year for the last six years. If alternative 2 is not adopted to incorporate by reference the allowable Code Cases, the NRC estimates that, on average, the number of submittals for Code Case alternative requests may increase until ASME incorporates the Code Case into a new edition of the BPV Code or the OM Code. The NRC staff estimates that incorporation of Code Cases would occur within two cycles of issuing a new edition of the Code or within six years. Under alternative 2, a licensee of a nuclear power plant would no longer be required to submit a Code Case alternative request under the new 10 CFR 50.55a(z), which would provide a net benefit (i.e., averted cost) to the licensee. As shown in Table 10, the implementation of alternative 2 would result in the aversion of additional submittals for Code Case alternative requests for Code Cases N-666-1,N-789 and N-795, for a total of 40 alternative requests that would not need to be prepared annually under 10 CFR 50.55a(z). The NRC estimates the costs averted by not needing to prepare submittals for Code Case alternative requests would range from $7.75 million (7-percent net present value (NPV)) to $8.66 million (3-percent NPV).

Table 10 Averted Industry Operation Costs

Year	Alternative Request Submittals	Hours per Submittal	Labor Rate	Averted Industry Operation Costs (2017 Dollars)		
				Undiscounted	7% NPV	3% NPV
2018	40	380	$126	$1,890,171	$1,766,515	$1,835,118
2019	40	380	$126	$1,890,171	$1,650,949	$1,781,668
2020	40	380	$126	$1,890,171	$1,542,943	$1,729,775
2021	40	380	$126	$1,890,171	$1,442,003	$1,679,393
2022	40	380	$126	$1,890,171	$1,347,666	$1,630,478
			Total	**$9,450,000**	**$7,750,000**	**$8,660,000**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

As shown in Table 11, new reactor licensees submitting a request for an ASME Code Case alternative in the first few years after starting commercial operation beginning in 2020 would incur a cost that ranges from $75,800 using a 7-percent discount rate to $86,500 using a 3-percent discount rate, thus yielding net positive savings.

Table 11 Averted Industry Operation Costs for Hypothetical Reactor Code Case Alternative Request Submittal

Year	Activities	Alternative Request Submittals	Hours per Submittal	Labor Rate	Averted Cost Per Year (2017 Dollars)		
					Undiscounted	7% NPV	3% NPV
2022	Average Annual Code Case alternative request preparation, submission, and conforming changes	1	380	$126	$47,752	$34,046	$41,191
2024		1	380	$126	$47,752	$41,708	$45,011
				Total	**$95,500**	**$75,800**	**$86,500**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

Although the NRC expects that incorporating the most recent RGs that list NRC-approved Code Cases by reference into the *Code of Federal Regulations* will decrease industry operation costs, the NRC has not received data from licensees or applicants stating the number of planned submittals of ASME Code Case alternative requests that will no longer be necessary. Because of such uncertainty in these quantifiable industry operation costs, the NRC made conservative estimates on the number of alternative request submittals averted and the amount of industry resources that would have been otherwise required to prepare these submittals. As a result, if the affected licensees and applicants do not use the NRC-approved Code Cases considered in this analysis, the averted operation costs presented in Table 10 and Table 11 are overstated.

5.6.2. Conditioned Code Case Costs

Although Code Cases may provide cost savings to the applicant or licensee from their implementation, Code Cases with conditions may have additional incremental costs compared to the NRC approval of Code Cases without conditions. Therefore, Code Case conditions might reduce the net savings to the applicant or licensee from implementation of a Code Case. Section 4.2.12. of this regulatory analysis provides an overview of the conditioned Code Cases and the incremental increase in estimated labor requirements for meeting those conditioned Code Cases compared to approved Code Cases without conditions. Code Cases N-666-1, N-638-6, N-789, and OMN-19 would require resources from all NRC licensees, whereas Code Case N-795 is applicable only to BWRs, and Code Case N-799 is applicable only to new reactors. Table 12–Table 16 show the incremental industry implementation costs of the conditioned Code Cases.

Table 12 Incremental Industry Operations Costs for Conditioned Code Case N-638-6 (Operating Reactors Only)

Year	Conditioned Code Case N-638-6 Costs (2017 Dollars)		
	Undiscounted	7% Discount	3% Discount
2018	($291,537)	($254,639)	($274,801)
2019	($291,537)	($237,981)	($266,797)
2020	($291,537)	($222,412)	($259,027)
2021	($291,537)	($207,862)	($251,482)
2022	($291,537)	($194,263)	($244,157)
Total	**($1,458,000)**	**($1,117,000)**	**($1,296,000)**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

Table 13 Incremental Industry Operations Costs for Conditioned Code Case N-789 (Operating Reactors Only)

Year	Conditioned Code Case N-789 Costs (2017 Dollars)		
	Undiscounted	7% Discount	3% Discount
2018	($413,010)	($385,991)	($400,981)
2019	($413,010)	($360,739)	($389,302)
2020	($413,010)	($337,139)	($377,963)
2021	($404,465)	($308,565)	($359,362)
2022	($404,465)	($288,378)	($348,895)
Total	**($2,048,000)**	**($1,681,000)**	**($1,877,000)**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

The industry will incur an operating cost to implement Code Case N-795 for the testing and inspection of noninsulated components. This Code Case condition requires a hold time of one hour, which is 45 minutes longer than required by the current Code Case. The NRC staff estimates that this requirement adds 45 minutes for repair and replacement activities. Table 14 lists the incremental labor costs.

Table 14 Incremental Operations Costs for Conditioned Code Case N-795 (Operating BWRs)

		Conditioned Code Case N-795 (2017 Dollars)		
Year	**No. of Code Case 795-1 Inspections**	**Undiscounted**	**7% Discount**	**3% Discount**
2018	6	($565)	($528)	($549)
2019	6	($565)	($494)	($533)
2020	6	($565)	($462)	($517)
2021	6	($565)	($431)	($502)
2022	6	($565)	($403)	($488)
	Total	**($2,800)**	**($2,300)**	**($2,600)**

* Section 5.4. addresses short-term replacement power costs.
** All values are in 2017 dollars.

Table 15 Incremental Operations Costs for Conditioned Code Case N-799 for a Hypothetical New Reactor

Year	Conditioned Code Case N-799 (2017 dollars)		
	Undiscounted	**7% Discount**	**3% Discount**
2020	($7,330)	($5,984)	($6,708)
2021	($7,330)	($5,592)	($6,513)
2022	($7,330)	($5,226)	($6,323)
2023	($7,330)	($4,884)	($6,139)
2024	($7,330)	($4,565)	($5,960)
Total	**($36,700)**	**($26,300)**	**($31,600)**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

As indicated in the FR notice for this rulemaking, Code Case OMN-19 allows an extended range that provides for an alternative upper limit level for the acceptance criteria in a comprehensive pump test required by ASME OM Code Subsection ISTB. This extended range will provide significant cost savings to applicants and licensees by avoiding test results that indicate unacceptable pump performance that would require additional pump evaluation and potential declaration of pump inoperability. As discussed in the *Federal Register* notice dated September 18, 2015 (80 FR 56820), the ASME OM Code includes Mandatory Appendix V, "Pump Periodic Verification Test Program," to support a similar extension of the upper range for the pump acceptance criteria in ASME Subsection ISTB. Code Case OMN-19 allows this same upper range extension. The condition in RG 1.192 for the use of Code Case OMN-19 specifying a pump periodic verification test is consistent with Mandatory Appendix V in the ASME OM Code. The provisions in Mandatory Appendix V and the RG 1.192 condition on the use of Code Case OMN-19 provide assurance that the relaxed upper limit of the acceptance criteria does not result in pumps being considered operable when they are incapable of performing their safety functions. As required by Mandatory Appendix V and as specified in the RG 1.192 condition on the use of Code Case OMN-19, licensees will need to prepare work packages for periodic pump verification tests. The NRC staff estimates that each work package will require a plant engineer 40 labor hours to prepare and issue. Additionally, 16 engineering hours will be required to update plant test procedures, and an additional 16 engineering hours will be required to determine test points and inspection requirements to perform the initial test. The NRC staff estimates that 0.5 hour is required to test each pump. The NRC staff estimates that this periodic pump verification would apply to 7 pumps per unit. The NRC staff assumes that the work packages and test procedures will be prepared in 2019 and that initial comprehensive pump testing will be completed by half of the units in 2019 with the remaining tests completed in 2020. The periodic pump tests occur every two years. The NRC staff estimates that 0.5 hour is required to prepare each subsequent periodic test work package and that 0.5 hour is required to test each pump. Table 16 provides the estimates of the industry costs for conditioned Code Case OMN-19. The estimated industry incremental cost savings range from $216,000 using a 7-percent discount rate to $250,000 using a 3-percent discount rate. Table 16 provides the estimates of the industry cost savings for conditioned Code Case OMN-19. The NRC staff considers that the potential savings from the relaxed acceptance criteria that avoid test failures will significantly exceed the costs of the condition on the use of Code Case OMN-19. For example, a test failure that results in a plant shutdown because of an inoperable pump would result in costs that far exceed the test and procedural costs in this analysis.

Table 16 Incremental Industry Costs for Conditioned Code Case OMN-19 for Operating Reactors

						Industry Cost (2017 Dollars)		
Year	**Activity**	**No. of Items**	**No. of Hours**	**Labor Rate**	**No. of Units**	**Undiscounted**	**7% Discount**	**3% Discount**
2019	Prepare work package and test procedure documents	1	72	$126	10	($90,477)	($79,026)	($85,283)
2019	Initial pump test	7	0.5	$126	10	($4,398)	($3,842)	($4,146)
2019	Cost Averted for Relief Requests		150	$126	10	$188,494	$164,638	$177,673
2021	Prepare subsequent work package	1	72	$126	10	($90,477)	($69,024)	($80,388)
2021	Recurring pump test	7	0.5	$126	10	($4,398)	($3,355)	($3,908)
2021	Cost Averted for Relief Requests		150	$126	10	$188,494	$143,801	$167,474
2023	Prepare subsequent work package	1	72	$126	10	($90,477)	($60,289)	($75,773)
2023	Recurring pump test	7	0.5	$126	10	($4,398)	($2,931)	($3,683)
2023	Cost Averted for Relief Requests		150	$126	10	$188,494	$125,601	$157,860
					Total	**$281,000**	**$216,000**	**$250,000**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.
*** Tests for OMN-19 occur every 2 years.

5.6.3. Total Industry Operations Costs

As shown in Table 17, industry would have averted costs of between $2.42 million (7-percent NPV) to $2.87 million (3-percent NPV).

Table 17 Industry Cost Summary

Cost attribute	Labor	Occupational Health (Routine)	Replacement Power	Undiscounted	7% NPV	3% NPV
One-time implementation	($1,759,273)			($1,759,273)	($1,759,273)	($1,759,273)
Averted alternative requests	$9,450,000			$9,450,000	$7,750,000	$8,660,000
Code Case N-638-6	($1,457,683)	($49,514)		($1,507,198)	($1,155,138)	($1,340,310)
Code Case N-666-1	($15,202)			($15,202)	($15,202)	($15,202)
Code Case N-789	($2,047,961)	($96,667)		($2,144,628)	($1,754,897)	($1,962,465)
Code Case N-795	($2,827)		($1,018,000)	($1,020,827)	($837,319)	($935,590)
Code Case N-799	($36,700)	($250)		($36,950)	($26,492)	($31,822)
Code Case OMN-19	$280,855			$280,855	$215,573	$249,827
			Total	**$3,247,000**	**$2,417,000**	**$2,865,000**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

5.7. NRC Implementation

The NRC has no implementation costs for alternative 2.

5.8. NRC Operation

When the NRC receives an ASME Code Case alternative request, the agency requires additional NRC staff time to evaluate the acceptability of the request relative to currently NRC-approved criteria. Under alternative 2, the NRC would not receive any submittals for Code Case alternative requests related to the Code Cases incorporated by reference into the NRC's regulations. As shown in Table 18, the NRC estimates that each submittal for a Code Case alternative request requires a total of 120 hours for the NRC to evaluate that request—90 hours to perform the technical review, including resolving technical issues, and 30 hours to document the evaluation and respond to the licensee on its request. The cost results in an NRC averted cost of approximately $2.49 million (7-percent NPV) to $2.78 million (3-percent NPV).

Table 18 NRC Operation Costs

Year	Averted Alternative Request Submittals	Hours per Submittal	Labor Rate	Averted Industry Operation Costs (2017 Dollars)		
				Undiscounted	7% NPV	3% NPV
2018	40	120	$128	$608,000	$568,224	$590,291
2019	40	120	$128	$608,000	$531,051	$573,098
2020	40	120	$128	$608,000	$496,309	$556,406
2021	40	120	$128	$608,000	$463,840	$540,200
2022	40	120	$128	$608,000	$433,496	$524,466
			Total	**$3,040,000**	**$2,493,000**	**$2,784,000**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

As shown in Table 19, the industry's submittal of Code Case alternative requests for new reactors after starting commercial operation in 2020 would incur an NRC review cost in the following year. Consistent with the assumptions made in Section 5.6.1., the NRC staff estimates averted operating costs for new reactors that range from $23,700 using a 7-percent discount rate to $27,300 using a 3-percent discount rate, yielding a net savings for each averted review of a submittal for a Code Case alternative request.

Table 19 Averted NRC Operation Costs for New Reactor ASME Code Case Alternative Request Submittal

Year	Averted Alternative Request Submittals	Hours per Submittal	Labor Rate	Averted NRC Operation Costs (2017 Dollars)		
				Undiscounte d	7% Discount	3% Discount
2023	1	120	$128	$15,360	$10,235	$12,864
2025	1	120	$128	$15,360	$13,416	$14,478
			Total	**30,700**	**$23,700**	**$27,300**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

The total net averted operation cost for NRC and industry is $2.52 million using a 7-percent discount rate to $2.81 million using a 3-percent discount rate.

5.8.1. NRC Operation Averted Cost Sensitivity

Although incorporating the most recent RGs that list NRC-approved Code Cases by reference into the *Code of Federal Regulations* could decrease NRC operation costs, the NRC has not received data from licensees stating the number of planned ASME Code Case alternative request submittals that will no longer be necessary. Because of such uncertainty in the reduced number of planned ASME Code Case alternative request submittals, the NRC made conservative estimates on the number of Code Case alternative request submittals averted and the amount of NRC resources that would have been otherwise required to review these submittals. Verifying these estimates would require industry feedback or empirical testing. If the affected licensees do not use the NRC-approved Code Cases considered in this analysis, the potential averted NRC operation costs presented in Table 18 and Table 19 are overstated.

5.9. Improvements in Knowledge

Alternative 2 relative to the regulatory baseline (alternative 1) would improve the knowledge of industry and NRC staff by allowing them to gain experience with new technology before its incorporation into the ASME Code and by permitting licensees to use advancements in ISI and IST. Developing greater knowledge and common understanding of the ASME Code, as well as eliminating unnecessary work, better enables industry and the NRC staff to produce desired on-the-job results, which leads to pride in performance and increased job satisfaction.

5.10. Regulatory Efficiency

Alternative 2, relative to the regulatory baseline (alternative 1), would increase regulatory efficiency because licensees that wish to use NRC-approved ASME Code Cases would not need to submit requests for alternatives to the NRC's regulations. This would provide licensees with flexibility and would decrease their uncertainty when making modifications 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 to harmonize with international standards to improve regulatory efficiency for both the NRC and international standards groups.

5.11. Disaggregation

To comply with the guidance in Section 4.3.2 of NUREG/BR-0058 on criteria for the treatment of individual requirements, the NRC performed a screening review to determine whether any of the individual requirements (or set of integrated requirements) of the final rule would be unnecessary to achieve the objectives of the rulemaking. The NRC determined that the objectives of the rulemaking are to incorporate by reference RGs and to make conforming changes. Furthermore, the NRC concludes that each of the final rule's requirements would be necessary to achieve one or more objectives of the rulemaking. Table 20 provides the results of this determination.

Table 20 Disaggregation

Regulatory Goals for Final Rule	(1) Approve for 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 37	X	X
10 CFR 50.55a(a)(3)(ii), NRC RG 1.147, Revision 18	X	X
10 CFR 50.55a(a)(3)(iii), NRC RG 1.192, Revision 2	X	X

5.12. Uncertainty Analysis

To determine the robustness of the costs and net benefits contained within this document, the NRC staff examined how the values estimated for benefits and costs change as a result of uncertainties associated with the staff's analytical assumptions and input data. The NRC used Monte Carlo simulations to examine the impact of uncertainty on the estimated net benefits. The NRC staff performed Monte Carlo simulations using the @Risk software package by Palisade Corporation.[11]

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

The probability distributions chosen to represent the different variables in the analysis were bounded by the range of estimates collected and the NRC staff's professional judgment. These distributions have mean values calculated from the low, medium, and high estimates. Appendix B contains these estimates, mean values, and assigned distributions.

When defining the probability distributions for use in the Monte Carlo simulations, other summary statistics besides the mean values are needed to characterize the distributions. These other summary statistics include the standard deviation of a distribution with a normal shape or the minimum and maximum values of a program evaluation and review technique (PERT)[12] distribution. For these distributions, the NRC staff used collected input to set the minimum and maximum values of the PERT distributions.

Lastly, the NRC selected the output variables for the Monte Carlo simulations, which were the estimated net benefits.

5.12.1. Uncertainty Analysis Results

The NRC ran 10,000 simulations. Figure 1 through Figure 4 display the histograms of the realized benefits and costs. The analysis showed that industry would realize operations averted costs (savings). By allowing uncertain assumptions and inputs to range across a distribution, the results are no longer static and instead spread across a range with varying degrees of certainty. In Figure 1, the analysis indicates that, 90 percent of the time the simulation model was run (out of 10,000 times), the industry implementation costs ranged from ($2.18 million) to ($1.37 million), with a mean value of ($1.76 million). Figure 2 shows that, 90 percent of the time, industry operation averted costs ranged from $3.11 million to $7.04 million. Figure 3 shows that, 90 percent of the time, NRC averted costs ranged from $2.14 million to $2.91 million. Figure 4 shows the net averted cost of this final rule ranged from $2.86 million to $6.90 million, and each of the 10,000 iterations showed a net averted cost (net benefit) for the

11 Information about this software is available online at http://www.palisade.com.

12 A PERT distribution is a special form of the beta distribution with the minimum and maximum values specified. 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. It can generally be considered as superior to the triangular distribution when the parameters result in a skewed distribution because the smooth shape of the curve places less emphasis in the direction of skew. Similar to the triangular distribution, the PERT distribution is bounded on both sides and, therefore, may not be adequate for some modeling purposes for which capturing tail or extreme events is desired.

final rule. Table 21 displays the minimum, mean and maximum costs for each regulatory attribute. Additionally, Table 21 shows the 5 percent and 95 percent probabilistic costs for each attribute.

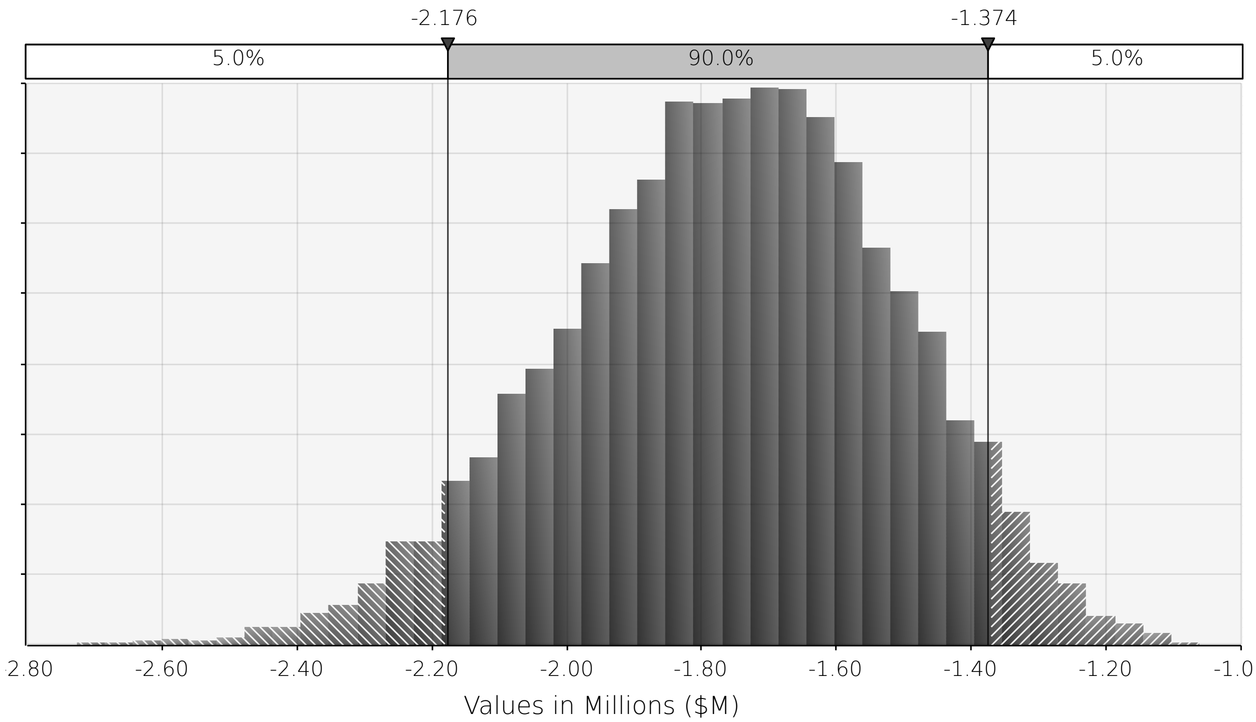

Figure 1 Industry implementation costs (7-percent NPV)

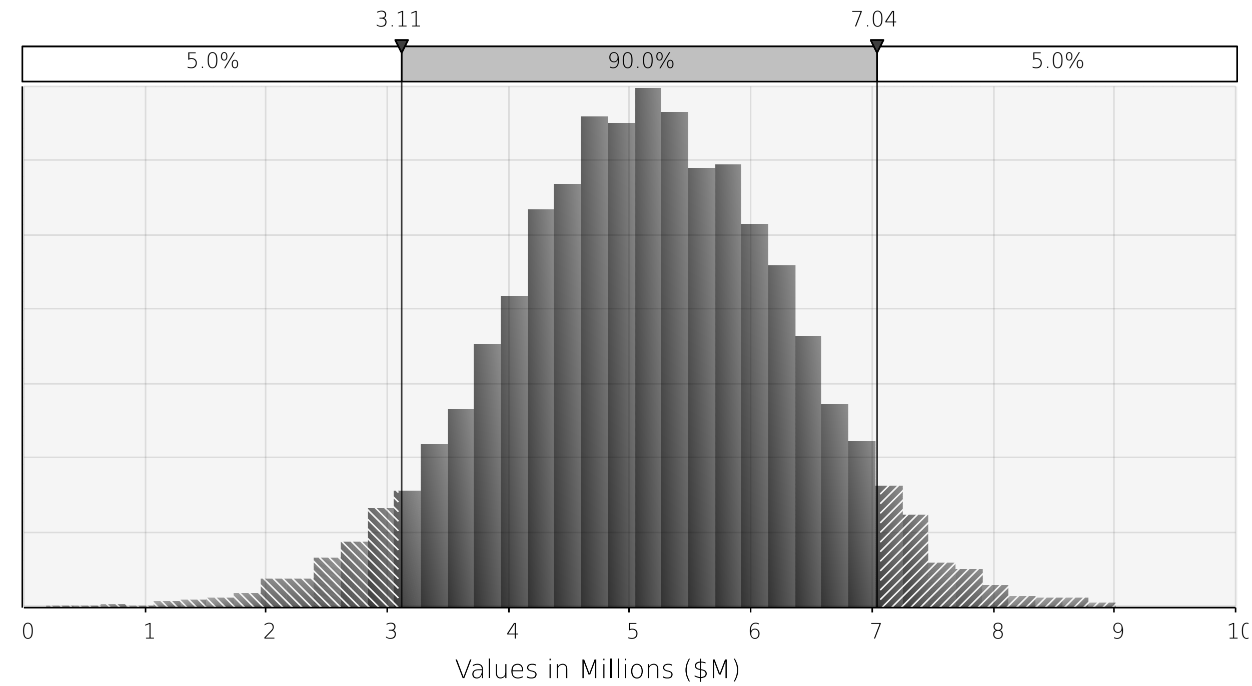

Figure 2 Industry operations costs (7-percent NPV)

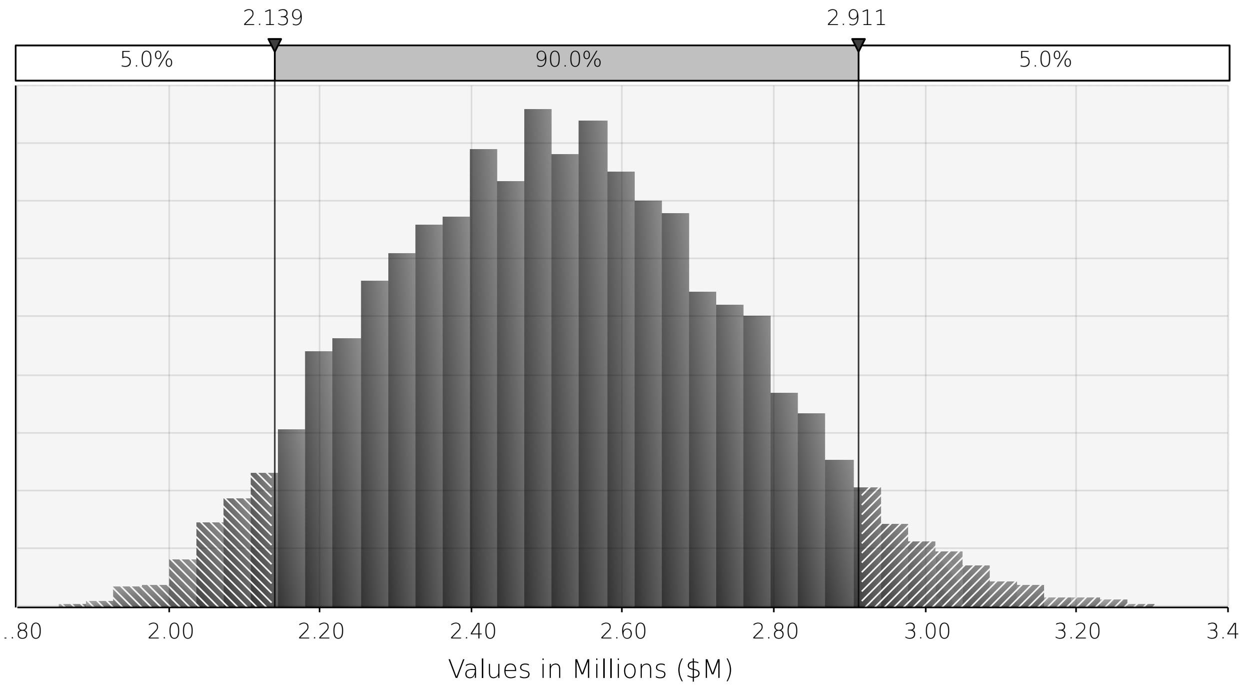

Figure 3 NRC operations averted costs (7-percent discount rate)

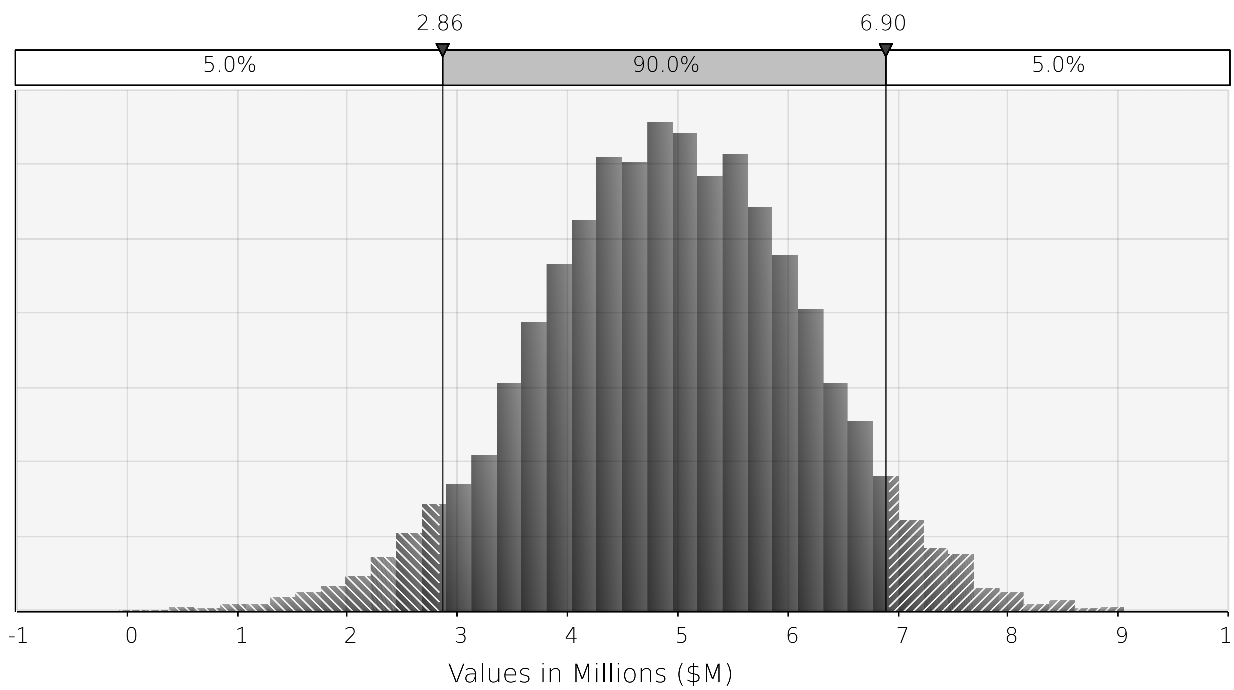

Figure 4 Total (7-percent discount rate)

Table 21 Uncertainty Results Descriptive Statistics

Uncertainty Result	Minimum	Mean	Maximum	5%	95%
Industry One-Time Implementation (7% Discount Rate)	($2.73)	($1.76)	($1.06)	($2.18)	($1.38)
Industry Operation (7% Discount Rate)	$0.19	$5.12	$9.01	$3.11	$7.04
NRC Operation (7% Discount Rate)	$1.86	$2.52	$3.30	$2.14	$2.91
Net Benefit (Cost) (7% Discount Rate)	($0.69)	$4.93	$9.06	$2.86	$6.90

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 million dollars.

Figure 5 shows a tornado diagram, which identifies the factors whose uncertainty drives the largest impact on total costs (and averted costs) for this rulemaking. The uncertainty regarding the number of hours required to prepare and disposition an alternative request, the range in industry labor rates, and the number of alternative requests averted drive the largest amount of uncertainty in the costs (and averted costs) of the rulemaking. The rest of the variables in Figure 5 show diminishing variation with respect to the net benefit mean value for this regulatory action.

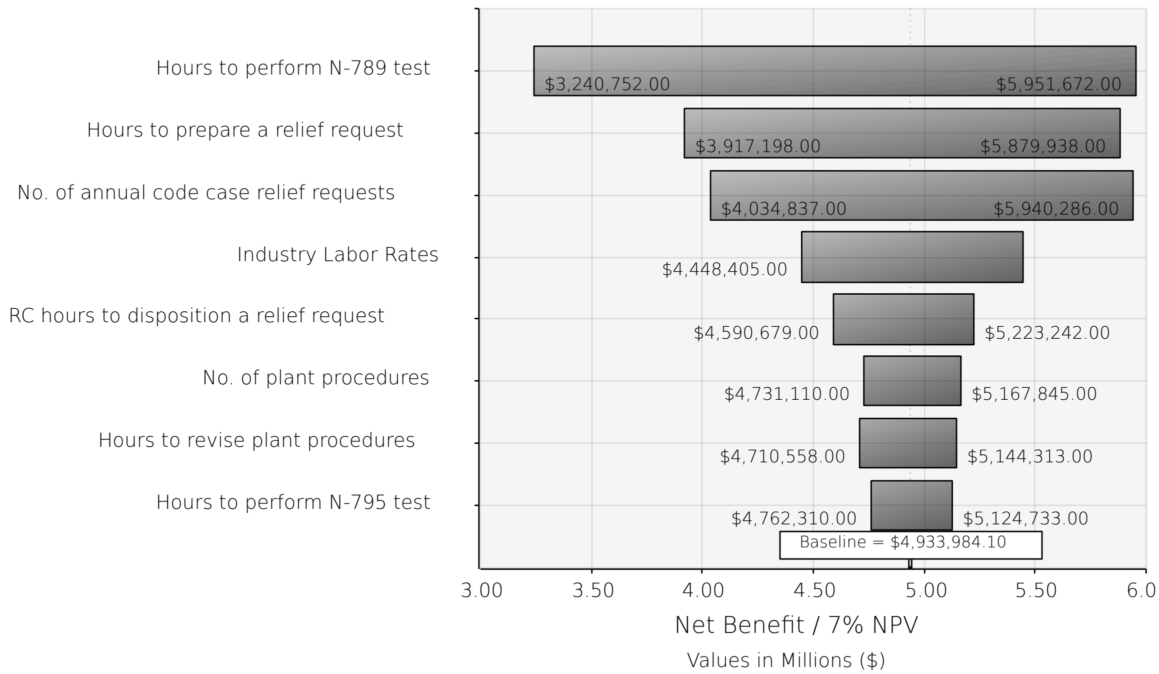

Figure 5 Net benefit (cost) tornado diagram based on 7-percent discount rate—inputs ranked by effect on output mean

5.12.2. Summary of Uncertainty Analysis

A Monte Carlo analysis found that amending the final rule would result in a positive net benefit (e.g., savings) for all 10,000 simulations using either a 7-percent or a 3-percent discount rate. Given the uncertainties involved in obtaining these estimates, a reasonable inference from the analysis is that proceeding with the final rule represents a fiscally efficient use of resources.

5.13. Independent Cost Estimate

In December 2014, GAO published GAO-15-98, "Nuclear Regulatory Commission—NRC Needs to Improve Its Cost Estimates by Incorporating More Best Practices" (Ref. 27.). The GAO report examined the extent to which the NRC's cost-estimating procedures support development of reliable cost estimates and follow specific best practices in GAO-09-3SP, "GAO Cost Estimating and Managing Capital Program Costs," issued March 2009 (Ref. 28). As a result of this audit, GAO recommended that the NRC align its cost-estimating procedures with the relevant cost-estimating best practices in GAO-09-3SP in an effort to ensure that it prepares its future cost estimates in accordance with relevant cost-estimating best practices. Additionally, GAO recommended that the NRC demonstrate credibility in its cost estimates by cross-checking the results with ICEs that are developed by others and by conducting a sensitivity analysis to identify variables most affecting cost estimates (i.e., cost drivers).

In response to the GAO concerns and recommendations, the NRC tasked the Center for Nuclear Waste Regulatory Analyses (CNWRA) to perform an ICE for this regulatory action. CNWRA used the same cost-estimating procedures that the NRC staff uses (e.g., NUREG/BR-0058 and NUREG/BR-0184), but the methods and techniques employed by

CNWRA were independent of those used by the NRC staff. The NRC compared the results of both efforts and revised the draft NRC regulatory analysis to incorporate the following changes:

- The incremental cost of Code Case N-666-1 was removed and converted to a one-time cost.
- The electric power replacement cost caused by the shutdown of a nuclear unit for repair and maintenance was added.
- Cost impact of routine occupational radiation dose was added.
- Pump verification test costs were added to the OMN Code Cases.
- Inputs (i.e., the number of labor hours and number of weld examinations) for generating the cost uncertainty statistics were revised.

Based on the ICE input, the NRC staff updated the regulatory analysis to incorporate these changes. Table 22 summarizes the impact on the estimated costs.

Table 22 Regulatory Analysis Estimate Changes

Attribute	Net Benefit (Costs) (7% NPV)		
	Pre-ICE NRC Estimate (A)	Revised NRC Estimate (B)	Percent Change (A - B)/A
Industry Implementation	($1,478,000)	($1,759,273)	(19%)
Industry Operation	$5,560,000	$5,123,783	8%
Occupational Health (Routine)		($112,257)	NM[a]
Replacement Power Cost		($835,000)	NM
Total Industry Costs	$4,080,000	$2,417,253	41%
NRC Implementation	($640,000)	$0	100%
NRC Operation	$2,734,000	$2,516,620	8%
Total NRC Cost	$2,090,000	$2,516,620	(20%)
Net Benefit	**$6,176,000**	**$4,933,873**	20%

[a] NM = not meaningful

5.14. Summary

To determine a net integrated benefit-cost figure, this regulatory analysis identifies and integrates both quantifiable and nonquantifiable benefits and costs that will emerge from incorporating the most recent RGs that list the NRC-approved Code Cases by reference into the *Code of Federal Regulations*.

5.14.1. Quantified Net Benefit

Table 23 shows that, based on the estimated total net benefit for alternative 2 relative to the regulatory baseline over the six year timeframe of the alternative, the quantitative benefits outweigh the costs by a range of approximately $4.93 million (7-percent NPV) to $5.68 million (3-percent NPV).

Table 23 Total Net Benefits and Costs

Attribute	Total Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation	($1,759,000)	($1,759,000)	($1,759,000)
Industry Operation	$6,170,000	$5,124,000	$5,688,000
Occupational Health (Routine)	($146,000)	($112,000)	($130,000)
Replacement Power Cost	($1,018,000)	($835,000)	($933,000)
Total Industry Costs	$3,247,000	$2,417,000	$2,865,000
NRC Implementation	$0	$0	$0
NRC Operation	$3,071,000	$2,517,000	$2,812,000
Total NRC Cost	$3,071,000	$2,517,000	$2,812,000
Net Benefit	**$6,317,000**	**$4,934,000**	**$5,677,000**

* Rounding may have caused discrepancies in the calculations.
** All values are in 2017 dollars.

5.14.2. Qualitative Benefits

In addition to averted costs from the elimination of planned ASME Code Case alternative request submittals, impacts related to the attributes of public health (accident) and occupational health (accident and routine), improved regulatory efficiency, and an increase of knowledge produce a number of nonquantifiable benefits for industry and the NRC. For example, advancements in ISI and IST may provide an incremental reduction of the likelihood of a radiological accident, incrementally decrease the likelihood of post-accident plant worker exposure, and incrementally decrease plant worker radiological exposures during routine inspections or testing. Alternative 2 would provide the following four nonquantifiable benefits from regulatory efficiency:

(1) flexibility and a decrease in uncertainty when licensees make modifications or prepare to perform ISI or IST

(2) consistency 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

(3) consistency with the NRC's policy of evaluating the latest versions of consensus standards in terms of their suitability for endorsement by regulations and RGs

(4) consistency with the NRC's goal to harmonize with international standards to improve regulatory efficiency for both the NRC and international standards groups

The incorporation by reference of the latest revisions to three RGs that include the NRC-approved Code Cases into the *Code of Federal Regulations* provides significant gain by allowing for the consistent application of these Code Cases, consistency with the provisions of the NTTAA, and harmonization with international standards. The NRC staff believes that the agency's timely review and approval of Code Cases will help maintain its role as an effective industry regulator that would otherwise be undetermined if outdated material would remain incorporated by reference into the *Code of Federal Regulations*.

Furthermore, the opportunity for staff to improve its knowledge results in increased job satisfaction. Developing greater knowledge and common understanding of the ASME Code, as well as eliminating unnecessary work, better enables the industry and the NRC staff to produce desired on-the-job results, which leads to pride in performance and increased job satisfaction.

5.14.3. Nonquantified Costs

As discussed in Sections and 5.8.1., the NRC staff believes that incorporating by reference the most recent RGs that list NRC-approved Code Cases into the *Code of Federal Regulations* would decrease industry and NRC operation costs. If the NRC staff underestimated the number or the complexity of these eliminated submittals, the averted costs would increase proportionally, thus causing the quantified net cost of alternative 2 to decrease.

5.15. Safety Goal Evaluation

The final rule alternative (alternative 2) would allow licensees and applicants to apply NRC-approved Code Cases voluntarily, sometimes with NRC-specified conditions. Three RGs that are incorporated by reference into 10 CFR 50.55a list the approved Code Cases.

An applicant's or a licensee's voluntary application of an approved Code Case does not constitute backfitting because there is no imposition of a new requirement or new position. Similarly, voluntary application of an approved Code Case by a 10 CFR Part 52 applicant or licensee does not represent the NRC's imposition of a requirement or action, which is inconsistent with any issue finality provision in 10 CFR Part 52. For these reasons, the NRC finds that this final rule does not involve any provisions requiring the preparation of a backfit analysis or documentation demonstrating that one or more of the issue finality criteria in 10 CFR Part 52 are met. Furthermore, the safety goal evaluation applies only to regulatory initiatives considered to be generic safety enhancement backfits subject to the substantial additional protection standard at 10 CFR 50.109(a)(3). Therefore, a safety goal evaluation is not appropriate for this regulatory analysis.

6. Decision Rationale

Table 24 provides the monetary savings and costs and nonmonetary benefits and costs for alternative 2, incorporating by reference into 10 CFR 50.55a the latest revision of the RGs that list Code Cases that are newly approved for use by the NRC. The quantitative analysis used the best estimate values, which are expressed in the monetary savings and costs.

Table 24 Summary of Totals

Net Monetary Savings (or Costs)— Total Present Value	**Nonmonetary Benefits or (Costs)**
Alternative 1: No Action $0	**Nonmonetary Benefits:** None
Alternative 2: Incorporate by reference NRC-approved ASME BPV and OM Code Cases	**Nonmonetary Benefits:** • <u>Public Health (Accident)</u>. The likelihood of a radiological accident may be reduced by allowing for advancements in ISI and IST that

<table>
<tr><th>Net Monetary Savings (or Costs)—
Total Present Value</th><th>Nonmonetary Benefits or (Costs)</th></tr>
<tr><td>Industry:
$2.42 million using a 7% discount rate
$2.87 million using a 3% discount rate

NRC:
$2.52 million using a 7% discount rate
$2.81 million using a 3% discount rate

Net Benefit (Cost):
$4.93 million using a 7% discount rate
$5.68 million using a 3% discount rate

The quantified results show that alternative 2 is cost beneficial.</td><td>may result in earlier identification of material degradation that, if undetected, could result in further degradation that eventually results in a plant transient.

• <u>Occupational Health (Accident)</u>. Advancements in ISI and IST may result in an incremental decrease in the likelihood of an accident resulting in postaccident worker exposure.

• <u>Improvement in Knowledge</u>. Code Cases are developed to allow licensees to gain experience with new technology and to use advancements in ISI and IST. On-the-job learning increases worker satisfaction. Eliminating unnecessary work better also enables the staff to produce desired on-the-job results, which leads to pride in performance and increased job satisfaction.

• <u>Regulatory Efficiency</u>. Licensees that wish to use NRC-approved ASME Code Cases would not require exemptions from NRC regulations. This practice is consistent with the following:
- the provisions of the NTTAA
- the NRC’s policy of evaluating the latest versions of consensus standards in terms of their suitability for endorsement by regulations and RGs
- the NRC’s goal to harmonize with international standards to improve regulatory efficiency for both the NRC and international standards groups

Nonmonetary Costs:
• <u>Industry and NRC Operation Costs</u>. If the number of planned industry submittals or the effort to prepare these submittals are less than the NRC assumed in the regulatory analysis, the averted quantified costs are overstated.

The NRC staff’s evaluation of qualitative benefits and costs show that alternative 2 is justified.</td></tr>
</table>

The staff recommends alternative 2. As shown in Table 24, alternative 2, relative to the regulatory baseline, is cost beneficial and would result in a net averted cost to the industry from $2.42 million (7-percent NPV) to $2.87 million (3-percent NPV). Relative to the regulatory baseline, the NRC would realize a net benefit of $2.52 million (7-percent NPV) to $2.81 million (3-percent NPV) in net benefits. The estimated net benefit is $4.93 million (7-percent NPV) and

$5.68 million (3-percent NPV). Alternative 2 is also justified when considering the nonmonetized considerations. Alternative 2 has the benefit of meeting the NRC's goal of ensuring the protection of public health and safety and the environment through the NRC's approval of new ASME Code Cases that allow the use of the most current methods and technology. In addition, this alternative would help ensure that the NRC's actions are effective, efficient, realistic, and timely by eliminating the need for the NRC's review of plant-specific alternative requests. This alternative would also support the NRC's goal of maintaining an open regulatory process, because the agency's approval of ASME Code Cases demonstrates its commitment to participate in the national consensus standards process.

Other important considerations lead the NRC staff to recommend alternative 2, including the following:

- the industry's familiarity with the well-established process of approving Code Cases through NRC RGs;
- the public perception that the Code Case approval process is consistent across the industry;
- the public perception that the NRC will continue to support the use of the most updated and technically sound techniques developed by ASME while continuing to provide adequate protection to the public.

The NRC staff concludes that alternative 2 is justified when integrating the cost-beneficial results and the qualitative considerations in the decision.

7. Implementation Schedule

The final rule will become effective 30 days after its publication in the *Federal Register*.

8. Regulatory Guides

The NRC has revised RG 1.84 (Revision 37), RG 1.147 (Revision 18), and RG 1.192 (Revision 2). The revisions to these RGs identify those ASME Code Cases that the NRC has determined to be acceptable alternatives to applicable parts of ASME BPV Code Sections III and XI and the ASME OM Code. This regulatory analysis identifies the Code Cases that the NRC determined to be acceptable alternatives and that were not included in previous versions of these guides.

Code Cases provide alternatives to existing requirements in the ASME BPV and OM Code. Licensees implement Code Cases voluntarily. Thus, the RGs, if incorporated by reference into 10 CFR 50.55a, do not impose new or amended requirements on existing licensees and regulated entities. Generally, the use of the alternative provisions of the Code Cases does not result in associated installation or continuing costs. Finally, because many Code Cases provide more effective examinations and tests or were developed for reducing occupational exposure, implementation of Code Cases overall results in reduced costs and occupational exposure.

9. References

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Appendix A
Industry Labor Rates

Utilities (Sector 22)—Industry: Electric Power Generation, Transmission, and Distribution (NAICS Code 221100[a])

Position Title	Occupation (SOC Code)[b]	Hourly Mean Wage (2015 Dollars)	Hourly 25th Percentile Wage (2015 Dollars)	Hourly 75th Percentile Wage (2015 Dollars)	Source[c]
Executive	Top Executives (111000)	$74.04	$50.42	$88.85	http://www.bls.gov/oes/current/oes111011.htm
	Chief Executives (111011)	$99.35	$69.44	$119.22[d]	http://www.bls.gov/oes/current/oes_nat.htm#11-0000
	Average	***$86.70***	***$59.93***	***$104.03***	
Managers	First-Line Supervisors of Production and Operating Workers (511011)	$46.40	$34.76	$58.02	http://www.bls.gov/oes/current/oes511011.htm
	First-Line Supervisors of Mechanics Installers and Repairers (491011)	$45.74	$36.65	$56.43	http://www.bls.gov/oes/current/oes491011.htm
	Industrial Production Managers (113051)	$61.78	$47.31	$71.73	http://www.bls.gov/oes/current/oes113051.htm
	General and Operations Managers (111021)	$71.28	$50.13	$84.07	http://www.bls.gov/oes/current/oes111021.htm
	Average	***$56.30***	***$42.21***	***$67.56***	
Technical Staff	Nuclear Engineers (172161)	$49.54	$41.02	$57.99	http://www.bls.gov/oes/current/oes172161.htm
	Nuclear Technicians (194051)	$39.84	$33.12	$45.99	http://www.bls.gov/oes/current/oes194051.htm
	Nuclear Power Reactor Operators (518011)	$43.26	$37.57	$48.83	http://www.bls.gov/oes/current/oes518011.htm
	Industrial Machinery Mechanics (499041)	$33.28	$26.29	$40.64	http://www.bls.gov/oes/current/oes499041.htm
	Average	***$41.48***	***$34.50***	***$48.36***	
Admin. Staff	Office and Administrative Support Occupations (430000)	$27.57	$19.35	$35.28	http://www.bls.gov/oes/current/naics4_221100.htm#43-0000
	First-Line Supervisors of Office and Administrative	$42.21	$31.18	$53.10	http://www.bls.gov/oes/current/oes431011.htm

Position Title	Occupation (SOC Code)[b]	Hourly Mean Wage (2015 Dollars)	Hourly 25th Percentile Wage (2015 Dollars)	Hourly 75th Percentile Wage (2015 Dollars)	Source[c]
	Support Workers (431011)				
	Office Clerks, General (439061)	$22.81	$16.12	$28.50	http://www.bls.gov/oes/current/oes439061.htm
	Average	***$30.86***	***$22.22***	***$38.96***	
Licensing Staff	Paralegals and Legal Assistants (232011)	$30.95	$26.55	$35.61	http://www.bls.gov/oes/current/oes232011.htm
	Lawyers (231011)	$73.33	$48.82	$88.00	http://www.bls.gov/oes/current/oes231011.htm
	Average	***$52.14***	***$37.69***	***$61.80***	
Physicist	Physicists (192012)	$39.40	$29.16	$46.77	http://www.bls.gov/oes/current/oes192012.htm
Total	***Average***	***$51.15***	***$37.62***	***$61.25***	
	Burdened Labor Rate	***$122.75***	***$90.28***	***$147.00***	
	Burdened Labor Rate in 2017 Dollars	***$127.08***	***$93.47***	***$152.18***	

[a] The NAICS code is the "North American Industry Classification System" code (see http://www.bls.gov/bls/naics.htm).

[b] The SOC code is the "Standard Occupational Classification" code (see http://www.bls.gov/soc/home.htm).

[c] The BLS data were extracted using a custom query function accessible at http://www.bls.gov/oes/current/oes111011.htm. The query selected used multiple occupations for one industry. The industry sector selected was Sector 22—Utilities, and the industry selected was Industry 221100—Electric Power Generation, Transmission, and Distribution. The table lists the occupation SOC codes. The U.S. Nuclear Regulatory Commission (NRC) staff extracted the data in May 2016.

[d] The U.S. Department of Labor, Bureau of Labor Statistics (BLS), wage is equal to or greater than $90.00 per hour or $187,199 per year without specifying a value. For this analysis, the NRC staff estimated that the 90th percentile is approximately 30 percent greater than the mean

Appendix B
Uncertainty Analysis Variables

Uncertainty Variable Description	Distribution	Low Estimate	Best Estimate	High Estimate	Mean Value
General					
Number of reactor sites	PERT	55	56	56	56
Number of reactor units	PERT	95	97	97	97
Number of BWR sites	PERT	17	18	18	18
Number of BWR units	PERT	27	28	28	28
Number of PWR sites	PERT	37	38	38	38
Number of PWR units	PERT	67	69	69	69
Number of new reactor units		5	5	5	5
Industry (one time, per site)					
Revise plant procedures (No. of procedures)	PERT	40	50	60	50.0
Hours per procedure	PERT	4	5	6	5.0
Industry (annually recurring, per site, Code Cases N-666-1 and N-789)					
Average number of annual Code Case alternative requests submitted[a]	PERT	26	30	38	30.7
Average number of hours to prepare and submit an alternative request	PERT	304	380	456	380.0
Number of incremental hours to perform a Code Case N-666-1 test	PERT	1	2	4	2.2
Number of incremental hours to perform a Code Case N-789 test	PERT	1	1.5	10	2.8
Industry (annually recurring, per site, Code Case N-795)					
Average number of annual Code Case alternative requests submitted[a]	PERT	8.5	9	9	8.9
Hours to submit an alternative request	PERT	96	120	144	120.0
Number of incremental hours to perform Code Case N-795 test	PERT	0.5	0.75	1.0	0.75
Industry (annually recurring, per site, Code Case N-799)					
Average number of annual Code Case alternative requests submitted					5.0
Hours to submit an alternative request	PERT	304	380	456	380

Uncertainty Variable Description	Distribution	Low Estimate	Best Estimate	High Estimate	Mean Value
Number of incremental hours to perform a Code Case N-799 test	PERT	5	10	25	11.7
NRC (one time)					
Issue final rule and supporting regulatory guides (hours)	PERT	1,888	2,360	2,832	2,360
NRC (recurring)					
Hours to disposition an alternative request	PERT	96	120	144	120
Conversion Factors					
Baseline dollar per person-rem conversion factor	PERT	$2,000	$2,000	$2,000	$2,000
Proposed dollar per person-rem conversion factor	PERT	$3,100	$5,200	$7,700	$5,267
Replacement power costs (MWe-hr)	PERT	$40,900	$44,600	$52,200	$45,250
Labor Rates					
Industry	PERT	$93	$127	$152	$126
NRC					$128

[a] This line item is for the whole industry. The other variables in this subsection of this table are per site.

SUBJECT: Regulatory Analysis for Final Rule: Approval of American Society of Mechanical Engineers Code Cases NRC-2012-0059; RIN 3150-AJ13 DATED:

ADAMS Accession No.: PKG: ML16285A003**; Regulatory Analysis:** ML16285A013 *via email

OFFICE	NRR/DPR/PRMB/RA	NRR/DPR/PRMB/RAT	NRR/DPR/PRMB/RS	NRR/DPR/PRMB/BC
NAME	CHowells	FSchofer	GLappert	MKhanna
DATE	12/6/2016	12/15/2016	12/8/2016	12/7/2016
OFFICE	NRR/DPR/D*	QTE	NRR/DE/D*	RES/D*
NAME	LLund (MGavrilas for)	JDougherty*	JLubinski	MWeber (EHackett for)
DATE	12/23/2017	11/21/2016	1/19/2017	1/24/2017
OFFICE	NRO/D*	OCIO/CSD/FPIB*	OGC*	NRR/D
NAME	VOrdaz (RCaldwell for)	DCullison	SClark	BHolian
DATE	1/24/2017	1/27/2017	3/15/2017	

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