

**Final Regulatory Analysis for Final Rule: Incorporation by
Reference of American Society of Mechanical Engineers
Codes and Code Cases
NRC-2011-0088; RIN 3150-AI97**

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation

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Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
apm	atomic parts per million
ASME	American Society of Mechanical Engineers
ASME Codes	ASME BPV and OM Codes
ASME OM Committee	ASME Committee on Operation and Maintenance of Nuclear Power Plants
BLS	Bureau of Labor Statistics
BPV	boiler and pressure vessel
BPV Code	ASME Boiler and Pressure Vessel Code
CASS	cast austenitic stainless steel
CC	concrete containment
CFR	<i>Code of Federal Regulations</i>
CPI	Consumer Price Index
CPI-U	Consumer Price Index for all urban consumers
CRGR	Committee to Review Generic Requirements
FR	<i>Federal Register</i>
GALL	generic aging lessons learned
GDC	general design criterion/criteria
ISI	inservice inspection
IST	inservice testing
LOE	level of effort
LWR	light-water reactor
MC	metal containment
MOV	motor-operated valve
NDE	nondestructive examination
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
NTTAA	National Technology Transfer and Advancement Act of 1995
OM	operation and maintenance
OM Code	(ASME) Code for Operation and Maintenance of Nuclear Power Plants
OMB	U.S. Office of Management and Budget

PERT	program evaluation and review technique
POV	power-operated valve
Pub. L.	public law
PWR	pressurized-water reactor
PWSCC	primary water stress-corrosion cracking
QAPD	quality assurance program description
RCPB	reactor coolant pressure boundary
Ref.	reference
RPV	reactor pressure vessel
RT	reference temperature
SOC	standard occupational classification
t_n	nominal pipe wall thickness
TS	technical specification(s)
VSL	value of statistical life

Abstract

This draft final rule would incorporate by reference, all with conditions on their use, the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section III, Division 1, and Section XI, Division 1; the 2009 Edition, 2011 Addenda, and 2012 Edition of the ASME Code for Operation and Maintenance of Nuclear Power Plants; and ASME BPV Code Case N-729-4, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1"; Code Case N-770-2, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities Section XI, Division 1"; and Code Case N-824, "Ultrasonic Examination of Cast Austenitic Piping Welds From the Outside Surface Section XI, Division 1." Additionally, the draft final rule would incorporate by reference ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications."

Executive Summary

The U.S. Nuclear Regulatory Commission (NRC) is proposing to amend its regulations to incorporate by reference the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section III, Division 1, and Section XI, Division 1, with conditions on their use. The NRC also proposes to amend its regulations to incorporate by reference the 2009 Edition, 2011 Addenda, and 2012 Edition of the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code), with conditions on their use. The NRC also proposes to incorporate by reference, with conditions on their use, ASME BPV Code Case N-729-4, “Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1”; Code Case N-770-2, “Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities Section XI, Division 1”; and Code Case N-824, “Ultrasonic Examination of Cast Austenitic Piping Welds from the Outside Surface Section XI, Division 1.” Additionally, the NRC proposes to incorporate by reference, for the first time, ASME NQA-1, “Quality Assurance Requirements for Nuclear Facility Applications,” including several editions and addenda to ASME NQA-1 from previous years with slightly varying titles. A significant portion of the averted costs from this final rule results from the reduction in burden of plant-specific requests for alternatives because these provisions are now incorporated by reference.

The analysis presented in this document examines the benefits and costs of the final rulemaking relative to the baseline case (i.e., the no-action alternative). The NRC staff makes the following key findings based on this analysis:

- **Final Rule Analysis.** The final rule recommended by the NRC staff would result in a cost-justified change based on a net (i.e., taking into account both costs and benefits) averted cost to the industry that ranges from \$11.5 million using a 7-percent discount rate to \$22.8 million using a 3-percent discount rate. Relative to the regulatory baseline, the NRC would realize a net averted cost that ranges from \$3.3 million using a 7-percent discount rate to \$4.3 million using a 3-percent discount rate. Table 1 shows the separate total costs and benefits to the industry and the NRC. The alternative to the final rule would result in net averted costs to the industry and the NRC ranging from \$14.7 million using a 7-percent discount rate to \$27.1 million using a 3-percent discount rate.

Table 1 Total Costs and Benefits for Alternative 2

Attribute	Costs		
	Undiscounted	7% NPV	3% NPV
Total Industry Costs:	(\$47,720,000)	(\$27,880,000)	(\$36,440,000)
Total NRC Costs:	(\$459,264)	(\$374,896)	(\$420,292)
Total Costs:	(\$48,180,000)	(\$28,250,000)	(\$36,860,000)

Attribute	Benefits		
	Undiscounted	7% NPV	3% NPV
Total Industry Benefits:	\$88,440,000	\$39,330,000	\$59,280,000
Total NRC Benefits:	\$5,950,000	\$3,650,000	\$4,680,000
Total Benefits:	\$94,390,000	\$42,980,000	\$63,960,000

Attribute	Net Benefits (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry	\$40,720,000	\$11,450,000	\$22,840,000
NRC	\$5,490,736	\$3,275,104	\$4,259,708
Total	\$46,210,000	\$14,730,000	\$27,100,000

- **Nonquantified Benefits.** Other benefits of the recommended final rule include its furtherance of the NRC's ability to meet its goal of ensuring the protection of public health and safety and the environment through the NRC's approval of new editions of the ASME BPV and OM Codes, which allow the use of the most current methods and technology. The recommended final rule is consistent with the provisions of the National Technology Transfer and Advancement Act of 1995 and implementing guidance in U.S. Office of Management and Budget Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities," dated February 10, 1998, which encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry. Finally, the ASME Code consensus process is an important part of the regulatory framework.
- **Uncertainty Analysis.** The simulation analysis shows that the estimated mean averted cost for this draft final rule is \$14.7 million with a 90-percent confidence interval and that the total averted cost is between \$8.19 million and \$21.6 million, assuming a 7-percent discount rate. The number of motor-operated valves requiring quarterly testing and the hourly rate for plant technical staff performing that testing are the factors that are responsible for the largest variation in costs.
- **Decision Rationale.** Relative to the no-action baseline, the NRC staff concludes that the draft final rule is justified from a quantitative standpoint because its provisions would result in net averted costs (i.e., net benefits) to the NRC and the industry. In addition, the NRC staff concludes that the draft final rule is also justified when considering non-quantified costs and benefits, because the number and significance of the non-quantified benefits outweigh the non-quantified costs.

1. Introduction

This document presents the regulatory analysis for the draft final rule to incorporate by reference specific American Society of Mechanical Engineers (ASME) Codes and Code Cases (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16130A538). The recommended draft final rule incorporates by reference the following nine items:

- (1) the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the ASME Boiler and Pressure Vessel (BPV) Code, Section III, Division 1, and ASME BPV Code, Section XI, Division 1
- (2) the 2009 Edition, 2011 Addenda, and 2012 Edition of the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code), specifically—
 - the 2009 Edition and 2011 Addenda to the ASME OM Code, Division 1, “Section IST Rules for Inservice Testing of Light-Water Reactor Power Plants”
 - the 2012 Edition to the ASME OM Code, Division 1, “OM Code: Section IST”
- (3) ASME BPV Code Case N-729-4, “Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1,” ASME approval date: June 22, 2012 (with conditions on its use)
- (4) ASME BPV Code Case N-770-2, “Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities Section XI, Division 1,” ASME approval date: June 9, 2011 (with conditions on its use)
- (5) ASME BPV Code Case N-824, “Ultrasonic Examination of Cast Austenitic Piping Welds From the Outside Surface Section XI, Division 1,” ASME approval date: October 16, 2012 (with conditions on its use)
- (6) ASME BPV Code Case N-513-3, “Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1,” ASME approval date: January 26, 2009 (with conditions on its use)
- (7) ASME BPV Code Case N-852, “Application of the ASME NPT Stamp, Section III, Division 1; Section III, Division 2; Section III, Division 3; Section III, Division 5,” ASME approval date: February 9, 2015 (with conditions on its use)
- (8) ASME OM Code Case OMN-20, “Inservice Test Frequency”

- (9) ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications," including the 1983 Edition through the 1992 Addenda to the 1989 Edition, 1994 Edition, 2008 Edition, and 2009-1a Addenda to the 2008 Edition (with conditions on their use)

2. Statement of the Problem and Objective

ASME develops and publishes the ASME BPV Code that contains requirements for design, construction, and inservice inspection (ISI) of nuclear power plant components, and the ASME OM Code that contains requirements for operation and inservice testing (IST) of nuclear power plant components. Until 2012, ASME issued new editions of the ASME BPV Code every 3 years and addenda to the editions annually, except in years when it issued a new edition. Similarly, ASME periodically published new editions and addenda of the ASME OM Code. Starting in 2012, ASME decided to issue editions of its BPV and OM Codes (no addenda) every 2 years. The new editions and addenda typically revise provisions of the Codes to broaden their applicability, add specific elements to current provisions, delete specific provisions, or clarify them to narrow the applicability of the provision (or a combination of these). The revisions to the editions and addenda of the Codes do not significantly change Code philosophy or approach.

It has been the U.S. Nuclear Regulatory Commission's (NRC's) practice to establish requirements for the design, construction, operation, ISI, and IST of nuclear power plants by approving the use of editions and addenda of the ASME BPV and OM Codes (ASME Codes) in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and Standards." The NRC approves or mandates the use of certain parts of ASME Code editions and addenda in 10 CFR 50.55a through the rulemaking process of "incorporation by reference." Upon incorporation by reference of the ASME Codes into 10 CFR 50.55a, the provisions of the ASME Codes are legally binding NRC requirements as delineated in 10 CFR 50.55a, subject to the conditions on certain specific ASME Code provisions that are set forth in 10 CFR 50.55a. The NRC last incorporated by reference the ASME Code editions and addenda into the regulations in a final rule dated June 21, 2011 (76 FR 36232) (Ref. 8.8.), subject to NRC conditions.

2.1 Background

The general design criteria (GDC) for nuclear power plants contained in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," or, as appropriate, similar requirements in the licensing basis for a reactor facility, provide bases and requirements for the NRC's assessment of the use of generally recognized codes and standards and the potential for, and consequences of, degradation of the reactor coolant pressure boundary (RCPB). The applicable GDC include GDC 1, "Quality Standards and Records," GDC 14, "Reactor Coolant Pressure Boundary," and GDC 32, "Inspection of Reactor Coolant Pressure Boundary."

GDC 1 requires, 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.

GDC 14 establishes the following:

The reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

Additionally, GDC 32 establishes the following:

Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel.

The National Technology Transfer and Advancement Act of 1995 (Pub. L. 104-113) (NTTAA) (Ref. 8.5.) mandates the following:

All Federal agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities determined by the agencies and departments.

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. If the technical standards are inconsistent with applicable law or otherwise impractical, a Federal agency may elect to use technical standards that are not developed or adopted by voluntary consensus bodies.

Provisions of the ASME BPV Code have been used since 1971 as one part of the 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, regulatory) are represented on the ASME standards committees that develop, among other things, improved methods for the construction and ISI of ASME Class 1, 2, and 3; metal containment (MC); and concrete containment (CC) nuclear

power plant components. This broad spectrum of stakeholders helps to ensure that the various interests are considered.

The ASME Board on Nuclear Codes and Standards directive transferred responsibility for the 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 Committee on Operation and Maintenance of Nuclear Power Plants (ASME OM Committee); this led to the development of the OM Code. In 1990, ASME published the initial edition of the OM Code that provides rules for IST of pumps and valves. The ASME OM Committee continues to maintain the OM Code. ASME intended that the OM Code replace the ASME BPV Section XI rules for IST of pumps and valves. The ASME Section XI Committee no longer updates the Section XI rules for IST of pumps and valves that were previously incorporated by reference into NRC regulations.

In 10 CFR 50.55a, the NRC requires that nuclear power plant owners construct Class 1, 2, and 3 components in accordance with Section III, Division 1, of the ASME BPV Code. Regulations in 10 CFR 50.55a also require that owners 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 that they perform IST of Class 1, 2, and 3 safety-related pumps and valves in accordance with the OM Code. Code Cases are developed by ASME to gain experience with new technology before incorporating it 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, clearly focused alternative to specific ASME Code provisions.

2.2 Statement of the Problem

In this regulatory action, the NRC is conditioning the use of certain provisions of the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the ASME BPV Code, Section III, Division 1, and the ASME BPV Code, Section XI, Division 1, including ASME NQA-1, as well as the 2009 Edition, 2011 Addenda, and 2012 Edition of the ASME OM Code and ASME BPV Code Cases N-729-4, N-770-2, and N-824. In addition, the draft final rule regulatory action does not adopt (“excludes”) certain provisions of the ASME Codes.

If the NRC did not conditionally accept ASME Code editions, addenda, and Code Cases, the NRC would disapprove these provisions entirely. The effect would be that licensees and applicants could submit a petition for rulemaking requesting the incorporation by reference of the full scope of the ASME Code editions and addenda that would otherwise be approved as proposed in this final rulemaking (i.e., the request would not be simply for approval of a specific ASME Code provision with conditions). Alternatively, licensees and applicants could submit a larger number of requests for the use of alternatives under 10 CFR 50.55a(z) or requests for exemptions under 10 CFR 50.12 or 10 CFR 52.7, both entitled “Specific exemptions.” These alternative requests could also include similar broad-scope requests for approval to issue the full scope of the ASME Code editions and addenda. These requests would pose an unnecessary additional burden for both the licensee and the NRC, inasmuch as the NRC has

already determined that the ASME Codes and Code Cases that are the subject of this regulatory action are acceptable for use (in some cases with conditions).

2.3 Objective

The objective of this regulatory action is to incorporate by reference the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the ASME BPV Code, Section III, Division 1, and Section XI, Division 1, with conditions on their use. The NRC also proposes to amend its regulations to incorporate by reference the 2009 Edition, 2011 Addenda, and 2012 Edition of the ASME OM Code, with conditions on their use. The NRC also proposes to incorporate by reference ASME BPV Code Cases N-729-4, N-770-2, and N-824, with conditions on their use. The NRC proposes to incorporate by reference, for the first time, ASME NQA-1, including the 1983 Edition through the 1992 Addenda to the 1989 Edition; the 1994 Edition; the 2008 Edition; and the 2009-1a Addenda to the 2008 Edition, with conditions on their use.

3. Identification and Preliminary Analysis of Alternative Approaches

This section analyzes the alternatives that the NRC considered with regard to conditioning the use of certain provisions of the ASME BPV and OM Codes and the regulatory alternatives associated with ASME BPV Code Cases N-729-4, N-770-2, and N-824 and ASME OM Code Case OMN-20. The NRC staff identified two alternatives for the conditioning of the use of certain provisions of the ASME Codes: (1) the no-action alternative (i.e., regulatory baseline) and (2) incorporate by reference the NRC-approved ASME BPV Code and ASME OM Code with conditions.

3.1 Alternative 1—No Action

The no-action alternative is a non-rulemaking alternative. This alternative would not revise the NRC's regulations to incorporate the following nine items by reference:

- (1) the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the ASME BPV Code, Section III, Division 1, and ASME BPV Code, Section XI, Division 1
- (2) the 2009 Edition and 2011 Addenda to the ASME OM Code, Division 1, "Section IST Rules for Inservice Testing of Light-Water Reactor Power Plants," and the 2012 Edition of the ASME OM Code, Division 1, "OM Code: Section IST"
- (3) ASME BPV Code Case N-729-4, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1," ASME approval date: June 22, 2012 (with conditions on its use)
- (4) ASME BPV Code Case N-770-2, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without

Application of Listed Mitigation Activities Section XI, Division 1,” ASME approval date: June 9, 2011 (with conditions on its use)

- (5) ASME BPV Code Case N-824, “Ultrasonic Examination of Cast Austenitic Piping Welds From the Outside Surface Section XI, Division 1,” ASME approval date: October 16, 2012 (with conditions on its use)
- (6) ASME BPV Code Case N-513-3, “Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1,” ASME approval date: January 26, 2009 (with conditions on its use)
- (7) ASME BPV Code Case N-852, “Application of the ASME NPT Stamp, Section III, Division 1; Section III, Division 2; Section III, Division 3; Section III, Division 5,” ASME approval date: February 9, 2015 (with conditions on its use)
- (8) ASME OM Code Case OMN-20, “Inservice Test Frequency”
- (9) ASME NQA-1, “Quality Assurance Requirements for Nuclear Facility Applications,” including the 1983 Edition through the 1992 Addenda to the 1989 Edition; 1994 Edition; 2008 Edition; and 2009-1a Addenda to the 2008 Edition (with conditions on their use)

The no-action alternative would cause licensees and applicants that desire to use these ASME Code addenda, editions, or Code Cases to request and receive approval from the NRC for the use of alternatives under 10 CFR 50.55a(z).

3.1.1 Take No Action on ASME BPV Code Case N-729-4

Under the regulatory baseline, the NRC would not amend the current regulations to require the use of ASME BPV Code Case N-729-4.

Not requiring the use of ASME BPV Code Case N-729-4 would leave in place the current ASME examination frequencies and methods for reactor pressure vessel (RPV) upper head penetration nozzles and welds. In the June 21, 2011, update to 10 CFR 50.55a, the NRC added the required use of ASME BPV Code Case N-729-1, “Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1,” with certain conditions. The required implementation of this Code Case, with certain conditions, enhanced the examination requirements in ASME BPV Code, Section XI, for RPV upper head penetration nozzles and welds. This assures that ASME BPV Code allowable limits will not be exceeded and that primary water stress-corrosion cracking (PWSCC) will not lead to failure of the RPV upper head penetration nozzles or welds. However, ASME found that additional program changes were necessary to establish an effective long-term inspection program for RPV upper heads for pressurized-water reactors (PWRs).

3.1.2 Take No Action on ASME BPV Code Case N-770-2

Under the regulatory baseline, the NRC would not amend the current regulations to require the use of ASME BPV Code Case N-770-2.

Not requiring the use of ASME BPV Code Case N-770-2 would leave in place the current ASME inspection requirements for butt welds. In the June 21, 2011, update to 10 CFR 50.55a, the NRC added the required use of ASME BPV Code Case N-770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS N86182 Weld Filler Material With or Without Application of Listed Mitigation Activities," with certain conditions. The required implementation of this Code Case with conditions provides inspection frequencies and methods for Alloy 82/182 butt welds that are unmitigated as well as butt welds that have been mitigated for PWSCC by any of several mitigation methods. However, this alternative does not establish an effective long-term inspection program for ASME BPV Code Class 1 butt welds in the RCPB, does not establish a new ASME BPV Code Case Table 1 inspection item classification for optimized weld overlay, and does not allow alternatives when complete inspection coverage cannot be met.

3.1.3 *Take No Action on ASME BPV Code Case N-824*

Under the regulatory baseline, the NRC would not amend the current regulations to allow the use of ASME BPV Code Case N-824.

Not allowing the use of ASME BPV Code Case N-824 would leave in place the current ASME inspection requirements as regulatory requirements for the examination of cast austenitic stainless steel (CASS). These requirements, provided in 10 CFR 50.55a, do not give sufficient guidance to assure that the CASS components are being inspected adequately. To illustrate that the ASME BPV Code does not provide adequate guidance, ASME Code, Section XI, Appendix III, Supplement 1, states "Cast materials may preclude meaningful examinations because of geometry and attenuation variables." For this reason, over the past several decades, licensees have been unable to perform effective inspections of welds joining CASS components. To allow for continued operation of their plants, licensees have submitted to the NRC hundreds of requests for relief from the ASME BPV Code requirements for ISI of CASS components, resulting in a significant regulatory burden.

3.2 Alternative 2—Incorporate by Reference ASME BPV and OM Codes and New and Revised Code Cases with Conditions

Alternative 2 consists of incorporating by reference into the *Code of Federal Regulations* certain provisions, with conditions on their use, of the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the ASME BPV Code, Section III, Division 1, and the ASME BPV Code, Section XI, Division 1, including ASME NQA-1, as well as the 2009 Edition, 2011 Addenda, and 2012 Edition of the ASME OM Code. Under this alternative, the NRC would also incorporate by reference, with conditions on their use, ASME BPV Code Cases N-729-4, N-770-2, and N-824 into 10 CFR 50.55a. As a result, the provisions of the ASME Codes would be legally binding NRC requirements as delineated in 10 CFR 50.55a and subject to the conditions on certain specific ASME Code provisions that are set forth in 10 CFR 50.55a.

The NRC recommends this rulemaking alternative for the following reasons:

- This alternative reduces the regulatory burden on applicants or holders of licenses for nuclear power plants by eliminating the need to submit plant-specific requests for alternatives in accordance with 10 CFR 50.55a(z), and it reduces the need for the NRC to review those submittals.
- This alternative meets the NRC's goal of ensuring the protection of public health and safety and the environment by continuing to provide NRC approval of new ASME Code editions and 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 process and by giving the public the opportunity to participate in it.
- This alternative supports the NRC's commitment to participate in the national consensus standard process through the approval of these ASME Code editions, addenda, and Code Cases, and it conforms to NTTAA requirements.
- The initial burden on the NRC to update the regulations by incorporating by reference the editions and addenda of the ASME BPV and OM Codes cited here is more than offset by the reduction in the number of plant-specific alternative requests that the NRC would otherwise evaluate. Section 5 of this analysis discusses the costs and benefits of this alternative relative to the regulatory baseline (Alternative 1).

4. Estimation and Evaluation of Benefits and Costs

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

4.1 Identification of Affected Attributes

This section identifies the components of the public and private sectors, commonly referred to as attributes, that are expected to be affected by the alternatives identified in Section 3. The alternatives would apply to licensees and applicants for nuclear power plants and nuclear power plant design certifications. The NRC believes that nuclear power plant licensees would be the primary beneficiaries. The staff developed an inventory of the impacted attributes using the list provided in Chapter 5 of NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook," issued 1997 (NRC Regulatory Analysis Handbook) (Ref. 8.14.).

The rule would affect the following attributes:

- Public Health (Accident). This attribute accounts for expected changes in radiation exposure to the public caused by changes in accident frequencies or accident consequences associated with the alternative (i.e., delta risk). A decrease in public radiological exposure is a decrease in risk (i.e., benefit); an increase in public exposures is an increase in risk (i.e., cost).
- Occupational Health (Accident). This attribute measures immediate and long-term health effects on 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., cost).
- Occupational Health (Routine). This attribute accounts for radiological exposures to workers during normal facility operations (i.e., non-accident situations). A proposed action could result in an increase in worker exposures. Sometimes this will be a one-time effect (e.g., installation or modification of equipment in a hot area), and sometimes it will be an ongoing effect (e.g., routine surveillance or maintenance of contaminated equipment or equipment in a radiation area).
- 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 related to maintenance, inspection, or testing. Additional costs above the regulatory baseline are considered negative, and cost savings and averted costs are considered positive.
- Industry Operation. This attribute accounts for the projected net economic effect caused by routine and recurring activities required by the proposed alternative on all affected licensees. For example, an alternative that would allow a nuclear power plant licensee to use an ASME BPV Code Case without submitting an alternative request would provide a net benefit (i.e., averted cost) to the licensee.

The effect on industry operation would be the changes to the licensees' design, fabrication, construction, testing, and inspection practices because of the new ASME Code and NRC requirements included in this rule. Some of the changes would result in an increase in burden, and some of the changes would result in a decrease in burden.

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

- NRC Implementation. This attribute accounts for the projected net economic effect on the NRC to place the proposed alternative into operation. It includes NRC implementation costs and benefits incurred in addition to those expected under the regulatory baseline.
- NRC Operation. This attribute accounts for the projected net economic effect on the NRC after the draft final rule is implemented. If the NRC does not approve changes to licensee design, fabrication, construction, testing, and inspection practices because the licensee or applicant wants to use an unapproved ASME Code, the licensee or applicant must request, under 10 CFR 50.55a(z), permission to use the updated ASME Code by submitting a request to apply the updated edition or addenda as an alternative to the ASME Code provisions. This submittal requires additional NRC staff time to evaluate the ASME Code to determine its acceptability and whether any limitations or modifications should apply. Under the draft final rule (Alternative 2), these alternative requests would not be necessary, which would result in a net benefit (i.e., averted cost) for the NRC.

The NRC review costs for any ASME Code alternative requests submitted to the NRC before the effective date of the final rule are considered sunk costs and are not analyzed further in this regulatory analysis.

- Improvements in Knowledge. This attribute accounts for improvements in knowledge by enhancing the ability of the industry and the NRC staff to gain experience with new technology before its incorporation into the ASME Codes, and by permitting licensees to use advancements in ISI and IST. Improved 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.
- 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 continue the best practice of aligning NRC regulations with ASME Code standards, providing the industry with regulatory provisions for which it has sought permission via relief and alternative requests. This rulemaking would ameliorate the effort the industry expends generating these requests and considering alternative means to accomplish the goals of these provisions.
- Other Considerations. This attribute accounts for considerations that are not captured in the preceding attributes. Specifically, this attribute accounts for how Alternative 2 meets specific requirements of the Commission, helps achieve NRC policy, and provides other advantages or detriments.
- Attributes with No Effects. Attributes that are not expected to be affected under any of the alternatives include public health (routine); offsite property; onsite property; other

government, general public, and antitrust considerations; safeguards and security considerations; and environmental considerations.

4.2 Analytical Methodology

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

Of the 11 affected attributes, the analysis evaluates five attributes—industry implementation, industry operation, occupational health (routine), NRC implementation, and NRC operation—on a quantitative basis. Quantitative analysis requires a baseline characterization of the affected society, including factors such as the number of affected entities, the nature of the activities currently performed, and the types of systems and procedures that licensees or applicants would implement, or would no longer implement, because of the proposed alternatives. Where possible, the staff calculated costs for these five attributes using three-point estimates to quantify the uncertainty in these estimates. The majority of the tables used in this regulatory analysis are included in the individual sections for each of the provisions, but certain detailed cost tables are included in Appendix A. The staff evaluated the remaining six attributes on a qualitative basis because the benefits relating to consistent policy application and improvements in ISI and IST techniques are not quantifiable or because the data necessary to quantify and monetize the impacts on these attributes are not available.

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

4.2.1 Regulatory Baseline

This regulatory analysis provides the incremental impacts of the draft final rule relative to a baseline that reflects anticipated behavior in the event the NRC does not undertake regulatory or non-regulatory action. The regulatory baseline assumes full compliance with existing NRC requirements, including current regulations and relevant orders. This is consistent with NUREG/BR-0058, “Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission,” Revision 4, issued September 2004 (Ref. 8.13.), which states that “in evaluating a new requirement..., the staff should assume that all existing NRC and Agreement State requirements have been implemented.” Section 5. of this regulatory analysis presents the estimated incremental costs and benefits of the alternatives relative to this baseline.

4.2.2 Affected Entities

This draft final rule could affect all operating light-water nuclear power reactors and those operating in the future:

- Nuclear facilities. The analysis models 59 plant sites containing one or more operating U.S. light-water nuclear power reactor units in 2017, which reduces to 55 plant sites in 2019.¹
- Operating reactor units. The analysis models 102 reactor units in 2017 and 97 reactor units in 2019. This list of operating reactor units includes Watts Bar Unit 2, Vogtle Units 3 and 4 (expected to begin operations in 2019 and 2020, respectively), and V.C. Summer Units 2 and 3 (expected to begin operations in 2019 and 2020, respectively) for the purposes of this analysis.
- Future operating reactor units. The NRC staff assumes that the draft final rule would affect five future operating light-water nuclear power reactors and considered them in this analysis. The future nuclear power reactors are South Texas Project Units 3 and 4, Enrico Fermi Unit 3, Levy County, and Lee Station. For the purposes of this analysis, these future operating reactor units are considered below with future nuclear power reactor applicants.²

To account for future nuclear power reactor applicants and license holders and current license holders that are anticipated to begin construction after the draft final rule's effective date, the NRC modeled a hypothetical nuclear power reactor based on existing approved future light-water reactor designs to analyze the specific costs and benefits. In such designs, the ASME OM Code would apply to pumps, valves, and snubbers in the same manner as for the known future operating reactor units. The NRC assumes that for safety system design features addressed by the ASME Codes, there would be minimal differences in implementing the draft final rule provisions between the future operating reactor units listed above and the modeled hypothetical nuclear power reactor. However, as the timing of a hypothetical reactor is speculative, the analysis is provided for information purposes only and is not included as part of the decision rationale.

4.2.3 Base Year

All monetized costs are expressed in 2017 dollars. Ongoing costs of operation related to the alternative being analyzed are assumed to begin no earlier than 30 days after publication of the

1 The NRC staff assumes that James A. FitzPatrick will close in 2017 and Pilgrim will close in 2019 based on Entergy Nuclear Operations, Inc.'s announcement (<http://www.entergy.com>). The NRC staff assumes that Clinton will close in 2017, Quad Cities Units 1 and 2 will close in 2018, and Oyster Creek will close in 2019 based on Exelon Corporation's announcements (<http://www.exeloncorp.com>). Ft. Calhoun's board of directors voted on June 16, 2016, to prematurely shut down that plant by December 31, 2016.

2 The NRC issued a combined license for Fermi Unit 3 in 2015 and for South Texas Project Units 3 and 4 in 2016. Levy County and Lee Station units have submitted their license applications, and their schedules are being revised as of December 2016. The timing and certainty for operation of Bellefonte Units 1 and 2, as well as any other future operating licenses, are too speculative to be included in this regulatory analysis.

final rule in the *Code of Federal Regulations* unless otherwise stated, and they are modeled on an annual cost basis.

Estimates are made for one-time implementation costs. The NRC assumes that these costs will be incurred in the first year of the analysis unless otherwise noted.

Estimates are made for recurring annual operating expenses. The values for annual operating expenses are modeled as a constant expense for each year of the analysis horizon. The staff performed a discounted cash flow calculation to discount these annual expenses to 2017 dollar values.

4.2.4 *Discount Rates*

In accordance with guidance from U.S. Office of Management and Budget (OMB) Circular No. A-4, "Regulatory Analysis," issued September 2003 (Ref. 8.21.), and NUREG/BR-0058, Revision 4 (Ref. 8.13.), 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. The choice of a discount rate, and its associated conceptual basis, is a topic of ongoing discussion within the Federal Government. Based on OMB Circular No. A-4 and consistent with NRC past practice and guidance, present-worth calculations in this analysis use 3-percent and 7-percent real discount rates. A 3-percent discount rate approximates the real rate of return on long-term government debt, which serves as a proxy for the real rate of return on savings to reflect reliance on a social rate of time preference discounting concept³. A 7-percent discount rate approximates the marginal pretax real rate of return on an average investment in the private sector, and it is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector. A 7-percent rate is consistent with an opportunity cost⁴ of capital concept to reflect the time value of resources directed to meet regulatory requirements.

4.2.5 *Cost/Benefit Inflat*

The staff estimated the analysis inputs for some attributes based on the values published in the NRC Regulatory Analysis Handbook (Ref. 8.14.) or other sources as referenced, which are provided in prior-year dollars. To evaluate the costs and benefits consistently, these inputs are put into base year dollars. The most common inflator is the Consumer Price Index for all urban consumers (CPI-U), developed by the U.S. Department of Labor, Bureau of Labor Statistics

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

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

(BLS). Using the CPI-U, the prior-year dollars are converted to 2017 dollars. The formula to determine the amount in 2017 dollars is:

$$\frac{CPI-U_{2017}}{CPI-U_{Base\ Year}} \times Value_{Base\ Year} = Value_{2017}$$

Table 2 summarizes the values of CPI-U used in this regulatory analysis.

Table 2 CPI-U Inflation

Base Year	CPI-U Annual Average	Forecast Percent Change from Previous Year
2014	236.736	
2015	239.34	1.10%
2016	242.212	2.20%
2017	247.783	2.30%

Source: BLS Statistics, "Databases, Tables & Calculators by Subject: CPI Inflation Calculator" (Ref. 8.6.).

4.2.6 Labor Rates

For the purposes of this regulatory analysis, the staff applied strict incremental cost principles to develop labor rates that include only labor and material costs that are directly related to the implementation and operation and maintenance of the draft final rule requirements. This approach is consistent with the guidance in NUREG/CR-3568, "A Handbook for Value-Impact Assessment," issued December 1983 (Ref. 8.7.), and general cost-benefit methodology. The NRC incremental labor rate is \$128 per hour.⁵

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 above to inflate these labor rate data to 2017 dollars. The labor rates used in the analysis reflect total hourly compensation, which includes wages and nonwage benefits (using a burden factor of 2.4, applicable for contract labor and conservative for regular utility employees). The 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 proposed 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. **Table 3** summarizes the BLS labor categories that were used to

⁵ The NRC labor rates presented here differ from those developed under the NRC's license fee recovery program (10 CFR Part 170, "Fees for Facilities, Materials, Import and Export Licenses, and Other Regulatory Services under the Atomic Energy Act of 1954, as Amended"). NRC labor rates for fee recovery purposes are appropriately designed for full-cost recovery of the services rendered and as such include nonincremental costs (e.g., overhead, administrative, and logistical support costs).

estimate industry labor costs to implement this draft final rule, and Appendix B lists the industry labor rates used in the analysis. The NRC staff performed an uncertainty analysis, which is discussed in Section 5.12.

Table 3 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)

4.2.7 Sign Conventions

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

4.2.8 Analysis Horizon

The average expiration date of the operating licenses for the 102 operating reactor units is June 2041, which results in 24 remaining years of operation. Assuming the year 2020 as the commencement of commercial operations for Vogtle Unit 4 and V.C. Summer Unit 3 and assuming a 20-year license renewal, these units would end commercial operation in 2080.

The NRC staff assumes that incorporation of ASME Code Cases for operating plants would occur within three cycles of issuing a new edition of the ASME BPV or OM Code or within 6 years, whichever would occur first. The staff used a 6-year period for the effective use of the ASME Code Cases, a relatively short period, for two reasons. First, because ASME updates the edition of the BPV and OM Codes every 2 years, it is likely that those ASME Code Cases used by industry would be incorporated into the relevant Code. Secondly, as 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 an ASME Code

alternative request), shorter time horizons place heavier emphasis on the implementation costs than on the alternative's benefits.

4.2.9 *Cost Estimation*

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

The 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 staff used its collective professional knowledge and judgment to estimate many of the costs and benefits. Additionally, the staff used a build-up method, solicitation of licensee input, and extrapolation techniques to estimate costs and benefits.

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

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

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

To evaluate the effect of uncertainty in the model, the 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 Table 34. The result was a distribution of values for the output variable of interest. Monte Carlo simulation also enables users to determine the

input variables that have the greatest effect on the value of the output variable. Section 5.12 gives a detailed description of the Monte Carlo simulation methods and presents the results.

4.2.10 *NRC Conditioned Codes*

The NRC staff analyzed the ASME BPV and OM Codes and Code Cases to determine whether the ASME Codes are (1) acceptable without conditions, (2) generally acceptable with conditions, or (3) not approved. Generally, when the NRC approves codes with conditions, licensees may experience additional regulatory burden to meet the conditioned requirements. For each applicable case, the conditions would specify the additional activities that must be performed, the limits on the activities specified, or the supplemental information needed to provide clarity (or a combination of these). The draft final rule discusses the NRC's evaluation of the ASME Codes and the reasons for the NRC's proposed conditions. The NRC staff estimated the additional burden for each NRC-proposed condition for an ASME Code provision or Code Case under the affected attributes of industry implementation and industry operation and then its contribution to costs and benefits were integrated into the overall costs and benefits.

4.2.11 *Dollar per Person-Rem Conversion Factor*

The dose averted and the dose conversion factors are only provided in tables that relate to health benefits. The dose averted is the amount of probability-weighted dose (i.e., risk) that is prevented as a result of the alternative based on a linear no-threshold dose response model per year (i.e., the delta risk per year between the regulatory baseline and the alternative). The dose conversion factor (dollar per person-rem) is used to monetize the averted dose to allow comparison to other attributes. The product of the dose averted and the dose conversion factor provides the monetized benefit per year.

Using the dollar value of the health detriment and a risk factor that establishes the nominal probability for stochastic health effects attributable to radiological exposure (i.e., fatal and nonfatal cancers and hereditary effects) provides a dollar per person-rem of \$2,000, rounded to the nearest thousand, according to NUREG-1530, "Reassessment of NRC's Dollar per Person-Rem Conversion Factor Policy," issued December 1995 (Ref. 8.25.).

The NRC currently uses a value of statistical life (VSL)⁶ of \$3 million based on NUREG-1530 and a cancer risk factor of 7.0×10^{-4} per rem, which is a reduction to the closest significant digit of a recommendation by the International Commission on Radiation Protection in Publication No. 60. Therefore, the dollar per person-rem conversion factor is equal to \$3 million multiplied by 7.0×10^{-4} per rem and rounded to the nearest thousand dollars (because of uncertainties) or \$2,000 per person-rem. However, the staff is currently revising NUREG-1530. To estimate the effect of a change in this conversion factor on the results of this regulatory analysis, Table 4

6 The VSL is the monetary value of a mortality risk reduction that would prevent one statistical (as opposed to an identified) death (Ref. 99). The VSL is a key component in the calculation of the dollar per person-rem value, which is the product of the VSL multiplied by a risk coefficient.

provides the parameter evaluated, the parameter value for the base case for the staff's recommendation, and the values from the sensitivity analysis that the staff performed.

Table 4 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

4.3 Data

This analysis discusses the data and assumptions used in analyzing the quantifiable impacts associated with each proposed alternative. The NRC staff used data from subject matter experts, knowledge gained from past rulemakings, and information gained during public meetings and from correspondence to collect data for this analysis. Quantitative and qualitative (i.e., nonquantified) information on attributes affected by the proposed regulatory framework alternatives in the draft final rule were obtained from the NRC staff and comments on the regulatory analyses provided with the proposed rule. The NRC considered the potential differences between the new requirements and the current requirements and incorporated the proposed incremental changes into this regulatory analysis.

5. Presentation of Results

This section presents the quantitative and qualitative results by attribute for Alternative 2, relative to the regulatory baseline. As described in the previous sections, costs and benefits are quantified where possible and are shown to be either positive or a negative, depending on whether the proposed alternative has a favorable or adverse effect relative to the regulatory baseline (Alternative 1). Those attributes not easily represented in monetary values are discussed in qualitative terms. This *ex ante* cost-benefit analysis⁷ provides useful information that can be used when deciding whether to select an alternative, even if the analysis is based on estimates of the future costs and benefits.

The NRC Regulatory Analysis Guidelines (Ref. 8.13.) state that the NRC's periodic review and endorsement of consensus standards, such as new versions of the ASME BPV and OM Codes and associated Code Cases, is a special case. This is because consensus standards have already undergone extensive external review and have been endorsed by the industry. In addition, endorsement of the ASME Codes and Code Cases has been longstanding NRC policy. Licensees and applicants participate in the development of the ASME Codes and Code Cases and are aware that periodic updating of the ASME Codes is part of the regulatory process. Code Cases are ASME-developed alternatives to the ASME BPV and OM Codes that licensees and applicants may voluntarily choose to adopt without submitting an alternative request, if the Code Cases are approved through incorporation by reference in the NRC's

⁷ An *ex ante* cost-benefit analysis is prepared before a policy, program, or alternative is in place and can assist in the decision about whether resources should be allocated to that alternative.

regulations. Finally, endorsement of the ASME Codes and Code Cases is consistent with the NTTAA, inasmuch as the NRC has determined that there are sound regulatory reasons for establishing regulatory requirements for design, construction, operation, ISI, and IST by rulemaking.

In a typical incorporation of new versions of ASME Codes and associated Code Cases, the NRC endorsements can involve hundreds, if not thousands, of individual provisions. Evaluating the benefit *vis-à-vis* 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, the scope of this regulatory analysis does not include an evaluation of individual requirements of the consensus standards that are proposed to be incorporated by reference without any conditions.

5.1 Public Health (Accident)

The industry's practice of adopting the latest ASME BPV and OM Codes and associated Code Cases may incrementally reduce the likelihood of a radiological accident in a positive, but not easily quantifiable, manner. Pursuing Alternative 2 would continue to meet the NRC goal of maintaining safety by continuing to provide NRC approval of the latest ASME Code editions and addenda and to allow the use of Code Cases so that the industry can gain experience with new technology before it is incorporated into the ASME Codes. The allowed use of Code Cases permits licensees to use advancements in ISI and IST and provide alternative examinations for older plants, an expeditious response to user needs, and a limited, 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 would maintain the same level of safety, or may provide an incremental improvement in safety, when compared to the regulatory baseline.

Relative to the regulatory baseline (Alternative 1), Alternative 2 meets the NRC's goal of ensuring the protection of public health and safety and the environment by continuing to provide NRC approval of the latest ASME Codes and associated Code Cases. This allows the industry's use of the most current methods and technology and may decrease the potential for an accident, thus decreasing the overall risk to public health.

Relative to the regulatory baseline, Alternative 2 may decrease the probability of an accident because it ensures that plant safety systems are designed with equipment relied upon to remain functional during and following design-basis accidents and are essential to maintain plant parameters within acceptable limits established for a design-basis event. Therefore, the draft final rule would prevent a potential introduction of a reduction in margin of safety or the introduction of a new failure mode or a common-cause failure mode not previously evaluated that would present an undue hazard, via an accident, to public health and safety and the environment.

Relative to the regulatory baseline, Alternative 2 may also decrease the probability of an accident because licensees would meet the criteria stated in the latest ASME Codes and associated Code Cases for modifications to major safety or protection systems. This includes replacements or installations that address safety issues associated with major changes to the underlying basis of safety systems and protection systems that could adversely affect dependability and reliability arising from potential new failure modes at the system level.

5.2 Occupational Health (Accident and Routine)

The NRC practice of reviewing the latest ASME BPV and OM Codes and associated Code Cases that are then incorporated by reference into the regulations ensures that the mandated ASME Code requirement and approved Code alternatives result in an acceptable level of quality and safety. Pursuing Alternative 2 would continue to meet the NRC goal of maintaining safety by continuing to provide NRC approval of the latest ASME Code editions and addenda and continuing to allow the use of ASME Code Cases to gain experience with new technology before it is incorporated into the ASME Codes. Alternative 2 would permit licensees to use advancements in ISI and IST and provide alternative examinations for older plants, an expeditious response to user needs, and a limited, clearly focused alternative to specific ASME Code provisions. The use of ASME Code Cases may affect occupational health in a positive, but not easily quantifiable, manner. For example, the advancements in ISI and IST may result in an incremental decrease in the likelihood of an accident resulting in worker exposure or in worker radiological exposures during routine inspections or testing when compared to the regulatory baseline. The IST testing of MOVs called for in Mandatory Appendix III, "Preservice and Inservice Testing of Active Electric Motor Operated Valve [MOV] Assemblies in Light-Water Reactor Power Plants," of the ASME OM Code and the provisions in ASME BPV Code Case N-824 have quantifiable effects on the occupational health (routine) attribute. Section 5.4 on industry operation details these effects, including the sensitivity analysis using different dollar per person-rem conversion factors, as they correspond to operational activities resulting from those provisions.

5.3 Industry Implementation

This attribute accounts for the projected net economic effect on the affected licensees as a result of implementation of the proposed regulatory changes. Additional costs above the regulatory baseline are negative, and cost savings and averted costs are positive.

5.3.1 Program Revision to Quality Assurance Program Description to Incorporate the ASME NQA-1 Program

The draft final 10 CFR 50.55a rule that incorporates by reference the 2008 Edition and the 2009-1a Addenda of ASME NQA-1 is optional for licensees to implement. The existing 10 CFR 50.54(a)(3) regulations allow licensees to make changes to a previously accepted quality assurance program description (QAPD) included or referenced in their safety analysis reports without prior NRC approval, provided the changes do not reduce the commitments in the program description as accepted by the NRC. Regulations in 10 CFR 50.54(a)(4) state that

licensees that make changes to the QAPD that reduce the commitments must submit these changes to the NRC for review and approval before implementation. Therefore, the implementation of this draft final rule would not impose additional cost on the industry because the rule's provisions are already required under the existing 10 CFR 50.54(a)(4).

5.3.2 Procedure Revision to Incorporate Concrete Containment Examinations

5.3.2.1 Concrete Containment Examinations—ISI Summary Report

The NRC proposes to add 10 CFR 50.55a(b)(2)(viii)(H) to specify the information that must be provided in the ISI Summary Report required by IWA-6000 when inaccessible concrete surfaces are evaluated under the new code provision IWL-2512. This new condition would replace the existing condition 10 CFR 50.55a(b)(2)(viii)(E) when using the 2007 Edition with the 2009 Addenda through the 2013 Edition of Subsection IWL. Because licensees already perform equivalent actions under the existing condition in 10 CFR 50.55a(b)(2)(viii)(E) when using the 2007 Edition, this change would have negligible impact.

5.3.2.2 Concrete Containment Examinations—Aging Management

The proposed condition in 10 CFR 50.55a(b)(2)(viii)(I) would impose a condition on the technical evaluation requirements in the new article IWL-2512(b) for consistency with NUREG-1801, Revision 2, "Generic Aging Lessons Learned (GALL) Report," issued December 2010 (Ref. 8.10.), with regard to aging management of below-grade concrete. This condition would apply only to holders of renewed licenses under 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," during the period of extended operation (i.e., beyond the expiration date of the original 40-year license) of a renewed license when using IWL-2512(b) of the 2007 Edition with 2009 Addenda through the 2013 Edition of Subsection IWL. The impact would be that the licensees for the 46 sites with renewed licenses under 10 CFR Part 54 would have to perform more frequent inspections and technical evaluations during the period of extended operation. These costs are estimated under Section 5.4 (industry operation) of this regulatory analysis. The NRC estimates that updating inspection procedures to reflect this requirement would require a one-time cost of 23 hours of engineering work per site. Therefore, the estimated cost of updating the inspection procedures for all operating reactors would cost (\$108,400) based on a 7-percent net present value (NPV) and (\$116,983) based on a 3-percent NPV.

Table 5 Industry Implementation—Update Concrete Containment Examination Procedures for Operating Plant Sites

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Update Concrete Containment Examinations procedures	46	23	\$117	(\$124,107)	(\$108,400)	(\$116,983)
Total:					(\$124,107)	(\$108,400)	(\$116,983)

The future reactor applicants and license holders and the existing combined license holders without a construction schedule have not developed their examination procedures and therefore are not expected to be impacted by this provision.

5.3.3 Procedure Revision to Underwater Welding Requirements

The proposed conditions in 10 CFR 50.55a(b)(2)(xii) would allow underwater welding of some irradiated materials (ferritic and austenitic materials, subject to different conditions) based on certain criteria (fast/thermal neutron fluence and helium concentration in atomic parts per million (appm)). The existing regulation in 10 CFR 50.55a(b)(2)(xii) prohibits underwater welding of all irradiated materials without the submission of relief/alternative requests to the NRC and NRC approval of those requests. Therefore, implementing the proposed conditions would not result in additional work or cost to the industry.

5.3.4 Procedure Revision to Incorporate Nondestructive Examination Personnel Certification

The proposed condition in 10 CFR 50.55a(b)(2)(xviii)(D) would prohibit applicants and licensees from using the ultrasonic examination nondestructive examination (NDE) personnel certification requirements in Section XI, Appendix VII, and subarticle VIII-2200 of the 2011 Addenda and 2013 Edition of the ASME BPV Code. The condition would prohibit the use of an accelerated Appendix VII training process for certification of ultrasonic examination personnel based on training and prior experience. Instead, the NRC would require applicants and licensees to use Table VII-4110-1 and the prerequisites for ultrasonic examination personnel requirements in subarticle VIII-2200, Appendix VIII, of the 2010 Edition of the ASME BPV Code. This proposed condition would not result in a change from the requirements of the regulatory baseline.

5.3.5 Procedure Revision to Prohibit the Use of Mechanical Clamping Devices

The proposed condition in 10 CFR 50.55a(b)(2)(xxxii) would prohibit the use of mechanical clamping devices on Class 1 piping and portions of piping systems that form the containment boundary. In the 2010 Edition of the ASME BPV Code, ASME made a change to include mechanical clamping devices under the small items exclusion rules of IWA-4131. In the currently approved 2007 Edition and 2008 Addenda of ASME BPV Code, Section XI, under IWA-4133, "Mechanical Clamping Devices Used as Piping Pressure Boundary," mechanical clamping devices may be used only if they meet the requirements of Mandatory Appendix IX of Section XI of the ASME BPV Code. This prohibition would not result in a change from the requirements contained within the existing regulatory baseline.

5.3.6 Procedure Revision to Incorporate Summary Report Submittal Requirements

The proposed condition in 10 CFR 50.55a(b)(2)(xxxii) would require licensees using the 2010 Edition and later editions and addenda of ASME BPV Code Section XI to continue to submit Summary Reports as required in IWA-6240 of the 2009 Addenda, which is consistent

with current timeframes. This proposed condition would not result in a change from the requirements contained within the existing regulatory baseline.

5.3.7 Procedure Revision to Prohibit the Use of Risk-Informed Allowable Pressure Methodology

The proposed condition in 10 CFR 50.55a(b)(2)(xxxiii) would prohibit the use of Appendix G, Paragraph G-2216, in Section XI of the ASME BPV Code, which was included for the first time in the 2011 Addenda of the ASME BPV Code and requires the continued use of the deterministic methodology of Section XI, Appendix G, to generate pressure-temperature limits. This prohibition would not result in a change from the requirements contained within the existing regulatory baseline.

5.3.8 Procedure Revision to Add Acceptance Standards for the Disposition of Flaws in Class 3 Components

The proposed condition in 10 CFR 50.55a(b)(2)(xxxiv) would require that, when using the 2013 Edition of the ASME BPV Code, Section XI, the licensee shall use the acceptance standards of IWD-3510 for the disposition of flaws in Category D-A components (i.e., welded attachments for vessels, piping, pumps, and valves) to correct an apparent discrepancy between the provisions in IWD-3410 and IWD-3510. This clarification would provide necessary consistency in requirements between IWD-3410 and IWD-3510 and would not result in a change from the requirements contained within the existing regulatory baseline.

5.3.9 Procedure Revision to Specify the Use of Reference Temperature in the K_{Ia} and K_{Ic} Equations

The proposed condition in 10 CFR 50.55a(b)(2)(xxxv) would specify that when licensees use the 2013 Edition of the ASME BPV Code, Section XI, Appendix A, paragraph A-4200, if T_0 is available, then RT_{T_0} may be used in place of RT_{NDT} for applications using the K_{Ic} equation and the associated K_{Ic} curve, but it may not be used for applications using the K_{Ia} equation and the associated K_{Ia} curve. This proposed insertion is consistent with ASME BPV Code Case N-629, "Use of Fracture Toughness Test Data to Establish Reference Temperature [RT] for Pressure Retaining Materials," which was accepted by the NRC without conditions. This condition would not result in a change from the requirements contained within the existing regulatory baseline.

5.3.10 Procedure Revision to Incorporate Fracture Toughness of Irradiated Material Requirements

The proposed condition in 10 CFR 50.55a(b)(2)(xxxvi) would require licensees using ASME BPV Code, Section XI, 2013 Edition, Appendix A, paragraph A-4400, to obtain NRC approval before using irradiated T_0 and the associated RT_{T_0} in establishing the fracture toughness of irradiated materials. The NRC estimated that updating procedures to reflect this proposed condition and submitting these changes to the NRC staff for approval would require 173 hours of engineering work for each currently operating power plant site affected (expected to be

approximately 20 percent of all operating sites). Therefore, the estimated cost of updating procedures for all operating reactors ranges from (\$190,879) based on a 7-percent NPV to (\$205,992) based on a 3-percent NPV.

Table 6 Industry Implementation—Fracture Toughness Provision (Operating Plants)

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Incorporate fracture toughness of irradiated materials requirements	11	173	\$117	(\$218,537)	(\$190,879)	(\$205,992)
Total:					(\$218,537)	(\$190,879)	(\$205,992)

A future power reactor unit that begins commercial operation after 2018 would issue its initial ISI and IST procedures in compliance with this provision and would incur no incremental costs.

5.3.11 Procedure Revision to Incorporate the Ultrasonic Examination Provisions of ASME BPV Code Case N-824

The proposed condition in 10 CFR 50.55a(b)(2)(xxxvii) would allow licensees the option to use the provisions of ASME BPV Code Case N-824, as conditioned, when implementing inservice examinations in accordance with the requirements of ASME BPV Code, Section XI.

The current regulatory requirements in 10 CFR 50.55a for the examination of CASS do not provide sufficient guidance to assure that the CASS components at PWRs are being inspected adequately. For this reason, over the past several decades, licensees have been unable to perform effective inspections of welds joining CASS components. To allow for continued operation of their plants, licensees have submitted to the NRC requests for relief from the ASME BPV Code requirements for ISI of CASS components, resulting in a regulatory burden. Based on the improvements in ultrasonic inspection technology and techniques for CASS components, ASME approved BPV Code Case N-824 on October 16, 2012. The Code Case describes how to develop a procedure capable of meaningfully inspecting welds in CASS components. Using this technology and techniques, CASS materials less than 1.6 inches (41 mm) thick can be reliably inspected for flaws that are 10-percent through-wall or deeper if encoded phased-array examinations are performed using proper ultrasonic frequencies, inspection angles, and inspection unit probe sizes. Additionally, for thicker welds, flaws greater than 30-percent through-wall in depth can be detected using low-frequency encoded phased-array ultrasonic inspections.

The NRC estimates that updating, qualifying, and approving inspection procedures to reflect this proposed condition would require 69 hours of engineering work at each operating plant site. The incremental cost does not include costs for training module development because the training required by the ASME BPV Code Case would not be impacted by the conditions imposed by this draft final rule. New ultrasonic inspection equipment, at a cost of \$28,333 per site, would be required at a mean estimated 23 reactor sites to perform certification training and perform these inspections.

Therefore, the estimated cost of updating procedures, developing training modules, and procuring the test equipment required for these examinations for all operating reactors ranges from (\$726,488) based on a 7-percent NPV to (\$784,010) based on a 3-percent NPV.

Table 7 Industry Implementation—ASME BPV Code Case N-824 Optional Provision (Operating Plants)

Year	Activity	Number of Affected Entities	Per Entity			Cost		
			Labor Hours	Weighted Hourly rate	Equipment	Undiscounted	7% NPV	3% NPV
2019	Procedure Revision to Incorporate the Ultrasonic Examination Provisions of Code Case N-824	23	69	\$117		(\$184,812)	(\$161,422)	(\$174,203)
2019	Ultrasonic Examination equipment to implement Code Case N-824	23			\$28,333	(\$646,944)	(\$565,066)	(\$609,807)
Total:						(\$831,757)	(\$726,488)	(\$784,010)

The NRC staff expects that a future power reactor unit that begins commercial operation after 2020 and chooses to use this optional ASME BPV Code Case N-824 would issue its initial ISI and IST program in compliance with this provision and would incur no incremental costs.

5.3.12 Procedure Revision to Incorporate Motor-Operated Valve Testing Requirements

The proposed condition in 10 CFR 50.55a(b)(3)(ii) would impose four supplemental requirements on the use of Mandatory Appendix III in the 2009 Edition of the ASME OM Code. Mandatory Appendix III represents the incorporation of ASME OM Code Case OMN-1, “Alternative Rules for Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants,” and Code Case OMN-11, “Risk-Informed Testing for Motor-Operated Valves,” into the OM Code. The four supplemental requirements proposed in 10 CFR 50.55a(b)(3)(ii) are (1) MOV diagnostic test interval, (2) MOV testing impact on risk, (3) MOV risk categorization, and (4) MOV stroke time.

Updating procedures to reflect Mandatory Appendix III to the ASME OM Code would require engineering work to identify new MOVs not covered under the current code and either testing those MOVs or performing engineering analysis to demonstrate that each valve will perform its function under design conditions. The subsections below further describe the steps required by this provision. The NRC staff estimates that approximately 10 additional MOVs would be identified and tested or analyzed at each plant at an average cost of (\$15,667) per valve. These cost estimate inputs were obtained from industry representatives who had previously submitted relief requests to implement ASME OM Code Case OMN-1 that the NRC reviewed and approved and who are responsible for updating these procedures and for performing testing according to this provision. A total of 29 units have already completed this relief request process and are operating under this provision, meaning that the costs for this draft final rule are applicable only to the remaining 67 operating plants with regard to this section and the industry operation costs for the provision). Therefore, the estimated cost of performing this one-time review ranges from (\$9.17 million) based on a 7-percent NPV to (\$9.89 million) based on a

3-percent NPV. These implementation costs are reduced by the removal of the quarterly valve testing requirement as described in Section 5.4.13.

Table 8 Industry Implementation—Mandatory MOV Diagnostic Test Provision (Operating Plants)

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Valves	Estimated Cost per Valve	Undiscounted	7% NPV	3% NPV
2019	Identify, test, and analyze newly identified MOVs in accordance with OM Code Appendix III	67	10	\$15,667	(\$10,496,667)	(\$9,168,195)	(\$9,894,115)
Total:					(\$10,496,667)	(\$9,168,195)	(\$9,894,115)

A future power reactor unit that begins commercial operation after 2020 would issue its initial IST procedures in compliance with this provision and would incur no incremental implementation costs.

5.3.12.1 Procedure Revision for ASME OM Code Mandatory Appendix III Motor-Operated Valve Diagnostic Test Interval

The ASME OM Code (2009 Edition and later) specifies the use of Mandatory Appendix III with periodic exercising and diagnostic testing in lieu of quarterly stroke-time testing of MOVs within the scope of the IST program. Mandatory Appendix III represents the incorporation of ASME OM Code Case OMN-1 and Code Case OMN-11 into the OM Code. Regulatory Guide 1.192, “Operation and Maintenance Code Case Acceptability, ASME OM Code,” issued June 2003 (Ref. 8.16.), accepts the voluntary use of ASME OM Code Cases OMN-1 and OMN-11 with specific conditions.

All licensees currently implementing the ASME OM Code are required by 10 CFR 50.55a(b)(3)(ii) to ensure that safety-related MOVs continue to be capable of performing their design-basis safety functions. Also, all licensees are currently implementing MOV programs in response to Generic Letter 96-05, “Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves,” dated September 18, 1996 (Ref. 8.12.), that include periodic testing to verify MOV design-basis capability, as detailed in Section 5.4.13.

5.3.12.2 Program Revision for ASME OM Code Mandatory Appendix III Motor-Operated Valve Testing Impact on Risk

All licensees currently must ensure that the potential increase in core damage frequency and large early-release frequency associated with the extension is acceptably small (see the Commission’s Safety Goal Policy Statement (Ref. 8.18.)) when extending exercise test intervals for high-risk MOVs beyond a quarterly frequency. Table 8 includes the estimated costs to make the conforming change for this requirement in 10 CFR 50.55a(b)(3)(ii).

5.3.12.3 Program Revision for ASME OM Code Mandatory Appendix III Motor-Operated Valve Risk Categorization

The proposed condition in 10 CFR 50.55a(b)(3)(ii) would impose that all licensees currently implementing the ASME OM Code must ensure that safety-related MOVs are categorized according to their safety significance using the methodology described in ASME OM Code Case OMN-3, "Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants," subject to the conditions discussed in Regulatory Guide 1.192 (Ref. 8.16.), or using an MOV risk ranking methodology accepted by the NRC on a plant-specific or industry-wide basis in accordance with the conditions in the applicable safety evaluation. Table 8 includes the estimated costs to make the conforming change for this requirement in 10 CFR 50.55a(b)(3)(ii).

5.3.12.4 Motor-Operated Valve Stroke Time

The proposed condition in 10 CFR 50.55a(b)(3)(ii) would specify that all licensees, when applying Paragraph III-3600, "MOV Exercising Requirements," of Appendix III to the ASME OM Code, shall verify that the stroke time of the MOV satisfies the assumptions in the plant safety analyses. Paragraph III-3600 requires the evaluation of abnormal characteristics (operational, design, or maintenance conditions) as part of MOV exercising. As a lesson learned from the implementation of ASME OM Code Case OMN-1, the NRC staff has determined that a condition is necessary to ensure that licensees verify that the stroke time of the MOV satisfies the assumptions in the safety analyses consistent with plant TS. The staff has discussed this clarification with the industry group on TS. Because Appendix III currently requires consideration of abnormal characteristics during MOV exercising, the staff does not find that this condition would result in a resource impact on licensees. In response to public comments, the NRC staff clarified that the condition would only apply to the MOVs specified in plant TS.

5.3.13 Procedure Revisions to Incorporate Supplemental Requirements on the Use of the ASME OM Code for Future Reactors

The proposed condition in 10 CFR 50.55a(b)(3)(iii) would impose four supplemental requirements on the use of the provisions in the ASME OM Code for the five future reactors assumed for this analysis (see Section 4.2.2). These requirements would involve (1) periodic verification of the design-basis capability of power-operated valves (POVs) other than MOVs already addressed in Appendix III to the ASME OM Code, (2) bi-directional testing of check valves, (3) monitoring flow-induced vibration from hydrodynamic loads and acoustic resonance to identify potential adverse flow effects, and (4) assessment of the operational readiness of pumps, valves, and dynamic restraints within the scope of the regulatory treatment of nonsafety systems program for applicable reactor designs.

The staff estimates that licensee efforts to make conforming changes to the inspection procedures for this requirement in 10 CFR 50.55a(b)(3)(iii) would require 46 hours of work by a technician and 46 hours of work by an engineer per reactor. The estimated total industry

implementation cost for the 10 CFR 50.55a(b)(3)(iii) requirements ranges from (\$20,767) based on a 7-percent NPV to (\$34,079) based on a 3-percent NPV.

Table 9 Industry Implementation—Supplemental Requirements Provision (Future Units)

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2030	Procedure Revisions to Incorporate Supplemental Requirements on the Use of ASME OM Code for New Reactors	5	92	\$109	(\$50,046)	(\$20,767)	(\$34,079)
Total:					(\$50,046)	(\$20,767)	(\$34,079)

This provision is not applicable to currently operating nuclear power plants. As a result, these operating reactor units would incur no incremental costs.

5.3.14 *Procedure Revision to Incorporate Squib Valve Surveillance Requirements for Future Reactors*

Subsection ISTC in the 2012 Edition of the ASME OM Code supplements the preservice and inservice surveillance requirements in the previous editions and addenda of the ASME OM Code for squib valves in future reactors. The combined licenses for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3 (considered as operating reactors in this regulatory analysis) include conditions for preservice and surveillance requirements for their squib valves. The supplemental provisions for squib valves in new reactors in Subsection ISTC in the 2012 Edition of the ASME OM Code are consistent with those license conditions (Refs. 8.1., 8.2., 8.3., and 8.4.). Therefore, the incorporation by reference of the supplemental squib valve provisions in the 2012 Edition of the ASME OM Code into 10 CFR 50.55a would not result in new technical requirements for those reactors.

Similarly, the NRC staff assumes that Levy County and Lee Station would have similar license conditions to those for Vogtle and V.C. Summer because these reactors are based on the same AP1000 reactor design. Therefore, this provision would not result in new technical requirements for those future reactors. However, South Texas Project Units 3 and 4, which are based on the Advanced Boiling-Water Reactor design, and Fermi Unit 3, which is based on the Economic Simplified Boiling-Water Reactor design, have several small squib valves for which the ASME OM Code provisions do not differentiate. Therefore, unless further relaxations are made in the ASME OM Code, South Texas Project Units 2 and 3 and Fermi Unit 3 could incur incremental costs to revise their procedures as a result of the proposed requirements. Because South Texas Project and Fermi do not have scheduled construction dates, the year that the licensees would incur these costs is labeled as “X” in Table 10 and the costs are undiscounted. The NRC staff estimates the procedure change would cost approximately (\$13,021) per site for this provision.

Table 10 Squib Valve Surveillance Provision (Future Units)

Year	Activity	Number of Entities	Per AOR		Cost
			Hours	Weighted Hourly rate	Undiscounted
X	Squib Valve Surveillance Requirements for Future Reactors	3	37	\$117	(\$13,021)
Total:					(\$13,021)

This provision is not applicable to the current generation of operating power plants, which includes the Watts Bar Unit 2 new reactor unit. As a result, these reactor units would incur no incremental costs.

5.3.15 *Procedure Revision to Prohibit the Use of Subsection ISTB (2011 Edition)*

The proposed condition in 10 CFR 50.55a(b)(3)(vii) would prohibit the use of Subsection ISTB in the 2011 Addenda of the ASME OM Code because the addenda expanded the acceptable range of a pump comprehensive test but did not require a pump periodic verification program as

specified in Mandatory Appendix V, “Pump Periodic Verification Test Program,” to the 2012 Edition of the ASME OM Code. The staff expects the proposed condition to have no impact on licensees because they may use Subsection ISTB in the 2012 Edition of the ASME OM Code.

5.3.16 Program Revision to Incorporate ASME OM Code Mandatory Appendix V on the Pump Periodic Verification Test Program

The 2012 Edition of the ASME OM Code specifies the use of Mandatory Appendix V, which establishes the requirements for implementing a pump periodic verification test. The test verifies that pumps that are in a licensee’s IST program can meet the required (differential or discharge) pressure, as applicable, at its highest design-basis accident flow rate. The test, if required, must be performed once every 2 years. If a pump does not have a specific design-basis accident flow rate in the licensee’s credited safety analysis, or if a pump’s comprehensive test flow rate and (differential or discharge) pressure bound the pump’s design-basis accident flow rate and (differential or discharge) pressure, a pump periodic verification test would not be required. This test would be performed after the comprehensive pump test, which is a full-flow test; would use the same flowpath as the comprehensive pump test; and would not require a plant modification to perform. Licensees would expend an estimated nine engineering hours per plant site to make conforming changes to the inspection procedures for this requirement, with the current operating fleet performing this work during the first year the final rule is effective and new reactor units performing this work during their first year of commercial operation. The estimated total industry implementation cost to incorporate this requirement ranges from (\$52,739) based on a 7-percent NPV to (\$57,418) based on a 3-percent NPV.

Table 11 Industry Implementation—ASME OM Code Mandatory Appendix V Provision (Operating and Future Plants)

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Program Revision to Incorporate Mandatory Appendix V on Pump Periodic Verification Program	55	9	\$117	(\$59,356)	(\$51,844)	(\$55,948)
2030	Program Revision to Incorporate Mandatory Appendix V on Pump Periodic Verification Program	2	9	\$117	(\$2,158)	(\$896)	(\$1,470)
Total:					(\$61,514)	(\$52,739)	(\$57,418)

5.3.17 Risk-Informed Inservice Testing of Pumps and Valves Request for Alternative Submittal to Use Subsection ISTE of the ASME OM Code

The proposed condition in 10 CFR 50.55a(b)(3)(viii) would require that licensees may not implement the risk-informed approach for IST of pumps and valves specified in Subsection ISTE, “Risk-Informed Inservice Testing of Components in Light-Water Reactor Nuclear Power Plants,” of the ASME OM Code without first obtaining NRC authorization to use

Subsection ISTE as an alternative to the applicable IST requirements in the ASME OM Code pursuant to 10 CFR 50.55a. Licensees voluntarily decide whether to implement the risk-informed approach for IST. The NRC staff assumes that two licensees would decide to apply Subsection ISTE to their IST programs (one currently operating plant and one new reactor plant), based on current expressed interest in a risk-informed IST program. Each licensee deciding to apply Subsection ISTE would need to submit to the NRC a request for an alternative to the ASME OM Code, with appropriate justification. The request would describe the scope of the risk-informed IST program; the methodology to be applied in risk ranking its components; the methodology used to categorize components according to their safety significance; and the risk-informed IST approach to pump testing, MOV testing, pneumatically and hydraulically operated valve testing, and pump periodic verification testing. The staff estimates that it would require 2,300 hours over 2 years for a licensee to complete the request for the alternative and respond to requests for additional information resulting from the NRC review. This estimate is based on the experience of South Texas Project personnel performing these actions. By submitting these alternative requests to use Subsection ISTE of the ASME OM Code, the two licensees would not need to develop their own risk-informed categorization methodologies, an averted cost. The NRC staff estimates that the costs and averted costs are approximately the same; therefore, it does not expect a net cost or benefit as a result of this provision.

5.3.18 Procedure Revision to Incorporate ASME OM Code Subsection ISTF Pump Testing Requirements for Future Reactors

Subsection ISTF, “Inservice Testing of Pumps in Light-Water Reactor Nuclear Power Plants—Post 2000 Plants,” in the 2011 Addenda to the ASME OM Code specifies IST requirements for pumps within the scope of the ASME OM Code for post-2000 plants. The phrase “post-2000 plants” refers to nuclear power plants that were issued (or will be issued) a construction permit, or combined license for construction and operation, on or after January 1,2000. Subsection ISTF provides essentially the same IST requirements as existing Subsection ISTB for pumps in currently operating nuclear power plants, with one exception. In particular, pumps in new reactors will undergo IST every quarter, rather than Group A or B tests every quarter, and comprehensive tests every 2 years as performed at currently operating plants.⁸ Watts Bar Unit 2 received its construction permit before January 2000 and therefore is not within the scope of Subsection ISTF. Vogtle Units 3 and 4, Fermi Unit 3, and V.C. Summer Units 2 and 3 (treated as operating units in this regulatory analysis) have a passive design without safety-related pumps; therefore, these units would have no additional burden because of this provision. South Texas Project Units 3 and 4 are active Advanced Boiling-Water Reactor plants with safety-related pumps, designed for full-flow testing; therefore these units would have no additional costs in applying Subsection ISTF.

5.3.19 ASME OM Code Case OMN-20 Time Period Extension

The proposed condition allows the use of ASME OM Code Case OMN-20 before its incorporation into the next update of Regulatory Guide 1.192 and incorporation by reference into

8 An ASME OM Code Subsection ISTF inservice test is equivalent to a Subsection ISTB comprehensive test.

10 CFR 50.55a. The Code Case is an optional provision that allows time periods shorter than 2 years to be extended by up to 25 percent for any given pump or valve inservice test. Time periods longer than or equal to 2 years may be extended by up to 6 months for any given pump or valve inservice test. Currently, a licensee must submit one relief request for every 10-year inservice test interval in order to use ASME OM Code Case OMN-20 for the pumps and valves in its program. The provision of this time period extension is a benefit because the ASME OM Code does not have extension provisions for pump or valve inservice tests that align to plant TS extension provisions. Licensees would expend an estimated 8 engineering hours per unit to make the conforming changes to plant documentation for this requirement, with the current operating fleet performing this work during the first year the final rule is effective and new reactor units performing this work during their first year of commercial operation. The staff estimates the cost of modifying the plant procedures to implement ASME OM Code Case OMN-20 to be the same as the cost of submitting a request to allow an extension of the surveillance time period. Therefore, the industry would not incur a net cost as a result of the regulatory provision to allow the use of ASME OM Code Case OMN-20.

5.3.20 Procedure to Incorporate Cast Austenitic Stainless Steel Material Examination Requirements

This proposed condition would add 10 CFR 50.55a(g)(6)(ii)(F)(11) to address requirements for examination through cast stainless steel materials and to establish a deadline of January 1, 2022, for requiring the use of ASME BPV Code Appendix VIII qualifications to meet the inspection requirements of paragraph -2500(a) of ASME BPV Code Case N-770-2 for PWRs. The requirements for volumetric examination of butt welds through cast stainless steel materials are currently being developed as Supplement 9 to the ASME BPV Code, Section XI, Appendix VIII. In accordance with Appendix VIII for supplements that have not been developed, the requirements of Appendix III apply. However, Appendix III requirements are not equivalent to Appendix VIII requirements. Therefore, for the volumetric examination of ASME Class 1 welds, the NRC proposes to require the use of an Appendix VIII qualified procedure to meet the requirements of paragraph 2500(a) of ASME BPV Code Case N-770-2 for examinations of ASME Code Class 1 piping and vessel nozzle butt welds through cast stainless steel materials.

Licensee preparation, qualification, and approval of inspection procedures to reflect this proposed condition would require 30 hours of engineering work per PWR site to revise two plant inspection procedures. A training module to certify inspectors would cost an estimated (\$40,000) to develop, including the creation of a presentation, training supplements, and training documents. The NRC staff estimates that six vendors would create these training modules. Training mockups to allow for the qualification of equipment, procedures, and personnel for each PWR site (including example welds, training equipment, training spaces, and other features) would cost approximately (\$75,000) per mockup, with a need for an estimated 40 mockups for this training program across the industry. These estimates for training modules and mockups are based on NRC and industry experience with similar training programs. The NRC anticipates that vendors would purchase 37 sets with spares of the specialized phased-array search unit, electronics, and scanners. Each set of equipment is estimated to

cost (\$10,500) per set for a total of (\$21,000) including the spare. The current operating fleet would perform this work during the first year after the final rule is effective. The staff assumes that new PWR reactor units co-located at operating PWR plant sites would use the shared site training facilities and would incur negligible additional costs. In addition to the trained inspectors already at PWR sites, each PWR licensee is expected to certify two additional inspectors, for a total of 18 hours of both training and practice on CASS components per site. The estimated total industry implementation cost to incorporate this requirement ranges from (\$3.68 million) based on a 7-percent NPV to (\$3.97 million) based on a 3-percent NPV.

Table 12 Industry Implementation—Cast Stainless Steel Material Examination Provision (Operating Plants)

Year	Activity	Number of Entities / Units	Per Entity			Cost		
			Labor Hours	Weighted Hourly rate	Equipment	Undiscounted	7% NPV	3% NPV
2019	Procedure Revision to Incorporate Cast Stainless Steel Material Examination Requirements	37	30	\$117		(\$130,207)	(\$113,728)	(\$122,733)
2019	Vendor develop training module to certify inspectors to perform cast stainless steel	6			\$40,000	(\$253,333)	(\$221,271)	(\$238,791)
2019	Create training mockups to allow for qualification of equipment,	40			\$75,000	(\$2,975,000)	(\$2,598,480)	(\$2,804,223)
2019	Purchase the specialized phased array search unit,	37			\$21,000	(\$777,000)	(\$678,662)	(\$732,397)
2020	Initial inspector training and practice on CASS components	37	18	\$117		(\$78,124)	(\$63,773)	(\$71,495)
2020	Initial inspector training and practice on CASS components	1	18	\$117		(\$2,111)	(\$1,724)	(\$1,932)
Total:						(\$4,215,776)	(\$3,677,638)	(\$3,971,571)

5.3.21 Clarification of Examination Coverage Requirements for Butt Welds Joining Cast Stainless Steel Material

This proposed condition would add 10 CFR 50.55a(g)(6)(ii)(F)(12) to clarify the examination coverage requirements allowed under Appendix I to ASME BPV Code Case N-770-2 for butt welds joining cast stainless steel material. Under the current requirements in ASME BPV Code, Section XI, Appendix VIII, the volumetric examination of butt welds through cast stainless steel materials is under Supplement 9. However, the ASME BPV Code Committee is still developing Supplement 9 rules. Therefore, it is currently impossible to meet the requirement of Paragraph I.5.1 for butt welds joining cast stainless steel material.

The material of concern is the weld material susceptible to PWSCC adjoining the cast stainless steel material for Class 1 PWR piping and vessel nozzle butt welds. Appendix VIII qualified procedures are available to perform the inspection of the susceptible weld material, but they are not sufficient to inspect the cast stainless steel materials. Therefore, this provision would allow PWR reactor licensees to implement a stress-improvement mitigation technique for butt welds joining cast stainless steel material by using an examination volume that is qualified by Appendix VIII procedures to the maximum extent practical, including 100 percent of the susceptible material volume. This technique would remain applicable until an Appendix VIII

qualified procedure for the inspection through cast stainless steel materials is available in accordance with condition 10 CFR 50.55a(g)(6)(ii)(F)(11). As this provision of the rule would clarify existing requirements, the NRC staff does not expect the industry to incur any additional cost.

5.3.22 *Procedure to Incorporate the Encoding of Ultrasonic Volumetric Examinations*

This proposed condition would add 10 CFR 50.55a(g)(6)(ii)(F)(13) to address the encoding of specific ultrasonic volumetric examinations at PWRs. This proposed condition would address a human performance gap in which inspections using a conventional non-encoded examination failed to detect flaws in ASME Class 1 dissimilar metal welds and in weld overlays. The failures to identify significant flaws shown in recent examinations can be avoided by the use of encoded ultrasonic examinations. Encoded ultrasonic examinations electronically store both the positional and ultrasonic information from the inspections. Encoded examinations allow the inspector to evaluate the data and search for indications outside of a time-limiting environment to assure that the inspection was conducted properly and to allow sufficient time to analyze the data. Additionally, the encoded examination would allow for an independent review of the data by other inspectors or an independent third party. This proposed condition would require that all ultrasonic volumetric examinations of non-mitigated or cracked mitigated dissimilar metal butt welds in the RCPB, within the scope of ASME BPV Code Case N-770-2, have encoded examinations. This training is currently in place for licensees; therefore, this provision would not impose additional costs.

5.3.23 *Clarification of Valve Position Verification Requirements*

This proposed condition would add 10 CFR 50.55a(b)(3)(xi) to specify that when implementing ASME OM Code, Subsection ISTC-3700, licensees shall develop and implement a method to verify that valve operation is accurately indicated by supplementing valve position indicating lights with other indications, such as flow meters or other suitable instrumentation, to provide assurance of proper obturator position. This is not a new requirement but rather a clarification of the intent of the ASME OM Code. The OM Code specifies obturator movement verification in order to detect certain internal valve failure modes consistent with the definition of “exercising” found in ISTA-2000 (i.e., demonstration that the moving parts of a component function). Verification of the ability of an obturator to change or maintain position is an essential element of a determination of valve operational readiness, which is a fundamental aspect of the ASME OM Code. The NRC further discusses this staff position in Section 4.2.7 of NUREG-1482, Revision 2, “Guidelines for Inservice Testing at Nuclear Power Plants: Inservice Testing of Pumps and Valves and Inservice Examination and Testing of Dynamic Restraints (Snubbers) at Nuclear Power Plants—Final Report,” issued 2013 (Ref. 8.20.).

5.4 Industry Operation

This attribute accounts for the projected net economic effect caused by routine and recurring activities required by the proposed alternative for all affected licensees. Under Alternative 2, a nuclear power plant licensee would not need to submit an alternative request under the new

10 CFR 50.55a(z) or a relief request under 10 CFR 50.55a(f) or (g) to receive permission to use a later edition or addenda of the ASME Codes as an alternative to the ASME Code provisions, which provides a net benefit (i.e., averted cost) to the licensee.

The use of later editions and addenda of the ASME BPV and OM Codes and applicable Code Cases would benefit NRC nuclear power plant licensees and applicants for several reasons. Later editions and addenda of the ASME BPV and OM Codes and applicable Code Cases may introduce the use of advanced techniques, procedures, and measures. Code Cases are also suited for use in areas in which 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 that, on implementation of the final rule, licensees and applicants would be able to voluntarily request to use a more recent edition or addenda of the ASME BPV and OM Codes under the provisions in 10 CFR 50.55a(f)(4)(iv) and (g)(4)(iv).⁹

Submission of an alternative request to the NRC is not a trivial matter. 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 therein. If the licensee or applicant determines that use of the Code Case would be beneficial but the NRC has not approved the Code Case, the licensee or applicant must prepare a request for the use of the Code alternative, and appropriate levels of licensee or applicant management must review and approve the request before submission to the NRC. A review of Code alternate requests submitted to the NRC over the last 5 years identified that these submittals ranged from a few pages to several hundred pages, with an average of approximately 32 pages with average technical complexity. Therefore, the NRC estimates that a Code Case submittal requires an average of 280 hours of effort to develop the technical justification and an additional 100 hours to perform research, review, approve, process, and submit the document to the NRC for the use of alternatives under 10 CFR 50.55a(z) (for a total of 380 hours per submittal). 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 Code alternative requests has determined that plant owners submit Code alternative requests that cover multiple units and multiple plant sites. In 2013, 13 Code alternative requests were submitted on coverage-related relief requests related to CASS components. If Alternative 2 is not adopted, the NRC estimates that, on average, this current volume of Code alternative request submittals would remain at this level, and all operating sites would submit requests for the Code provisions in this draft final rule within 3 years of rule implementation. Under Alternative 2, a licensee of a nuclear power plant would no longer need to submit the aforementioned Code alternative requests under the new 10 CFR 50.55a(z), which would provide a net benefit (i.e., averted cost) to the licensee. As

9 Regulations in 10 CFR 50.55a(f)(4) and (g)(4) establish the effective ASME Code edition and addenda to be used by licensees in performing IST of pumps and valves and ISI of components (including supports), respectively. NRC Regulatory Issue Summary 2004-12, "Clarification on Use of Later Editions and Addenda to the ASME OM Code and Section XI," dated July 28, 2004 (Ref. 8.17.), clarified the requirements for IST and ISI programs when using later editions and addenda of the ASME OM Code.

shown in Table 13, the implementation of Alternative 2 would result in the avoidance of 19 additional Code Case submittals (and their associated preparation) each year under the new 10 CFR 50.55a(z). The NRC estimates the industry operation averted costs for operating nuclear power plants to range from \$2.18 million (7-percent NPV) to \$2.35 million (3-percent NPV), yielding a net positive savings for Alternative 2.

Table 13 Industry Operation—Averted Code Case Relief Request Costs

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2018	Code Case relief request preparation and submission	19	380	\$117	\$832,075	\$777,640	\$807,840
2019	Code Case relief request preparation and submission	19	380	\$117	\$832,075	\$726,767	\$784,311
2020	Code Case relief request preparation and submission	19	380	\$117	\$832,075	\$679,221	\$761,467
Total:					\$2,496,226	\$2,183,629	\$2,353,618

5.4.1 Maintenance of Quality Assurance Program Description

The draft final 10 CFR 50.55a rule that incorporates by reference the 2008 Edition and the 2009-1a Addenda of ASME NQA-1 is optional for licensees to implement. The existing 10 CFR 50.54(a)(3) regulations allow licensees to make changes to a previously accepted QAPD included or referenced in the safety analysis report without prior NRC approval, provided the change does not reduce the commitments in the program description as accepted by the NRC. Regulations in 10 CFR 50.54(a)(4) state that licensees that make changes to the QAPD that reduce these commitments must submit these changes to the NRC for review and approval before implementation. Therefore, the inclusion of this draft final rule provision into the plant's QAPD would not impose additional cost on industry operation, because a similar requirement exists in 10 CFR 50.54(a)(4).

5.4.2 Concrete Containment Examinations

5.4.2.1 Concrete Containment Examinations—ISI Summary Report

The NRC proposes to add 10 CFR 50.55a(b)(2)(viii)(H) to specify the information that must be provided in the ISI Summary Report required by IWA-6000 when inaccessible concrete surfaces are evaluated under the new Code provision IWL-2512. This new condition would replace the existing condition 10 CFR 50.55a(b)(2)(viii)(E) when using the 2007 Edition with the 2009 Addenda through the 2013 Edition of Subsection IWL. Because licensees already perform equivalent actions under existing condition 10 CFR 50.55a(b)(2)(viii)(E) when using the 2007 Edition, this change would have negligible impact on industry operation costs.

5.4.2.2 Concrete Containment Examinations—Aging Management

The proposed condition in 10 CFR 50.55a(b)(2)(viii)(I) would impose a condition on the technical evaluation requirements in the new article IWL-2512(b) for consistency with

NUREG-1801, Revision 2, "Generic Aging Lessons Learned (GALL) Report," issued December 2010 (Ref. 8.10.), with regard to aging management of below-grade concrete. This condition applies only to holders of renewed licenses under 10 CFR Part 54 during the period of extended operation (i.e., beyond the expiry date of the original 40-year license) of the renewed license when using IWL-2512(b) of the 2007 Edition with 2009 Addenda through the 2013 Edition of Subsection IWL. The impact is that licensees would have to perform more frequent inspections or technical evaluations during the period of extended operation. The staff assumed that all holders of renewed licenses would perform, on average, 12 additional hours of evaluation or inspection of below-grade concrete during each outage. This estimate may vary by plant based on groundwater and soil properties (e.g., pH, chlorides, sulfates) or the history of degradation experienced. The staff recognizes that licensees currently evaluate the result of their inspections periodically to determine the extent and rate of any degradation of the structures. Furthermore, if a licensee's monitoring program detects degradation, additional degradation-specific condition monitoring and increased frequency of assessments are performed until the licensee's corrective actions are complete and the licensee is assured that the containment can fulfill its intended functions. The first outages after the effective date of the final rule are assumed to occur in 2020, when half of the 49 units with extended licenses would participate (assuming that Vogtle and V.C. Summer apply for extended licenses).¹⁰ The remaining units would perform their inspections in 2021. This examination cycle would continue on a 2-year outage cycle until June 2041, when the current extended nuclear power plant operating licenses expire. The estimated industry operation costs to perform these inspections over the remaining term of the current operating plant extended licenses range from (\$261,661) based on a 7-percent NPV to (\$407,013) based on a 3-percent NPV.

10 The timing given here for incorporating this ASME Code version into the unit's ISI program is a simplifying assumption. Generally, licensees would not implement this change until they update their ISI programs at the end of their current 10-year interval.

Table 14 Industry Operation—Concrete Containment Examinations Provision (Operating Reactors)

Year	Activity	Number of Affected Entities	Per Inspection		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2020	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$21,653)	(\$24,275)
2021	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$21,117)	(\$24,593)
2022	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$18,913)	(\$22,882)
2023	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$18,444)	(\$23,181)
2024	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$16,519)	(\$21,568)
2025	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$16,110)	(\$21,850)
2026	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$14,428)	(\$20,330)
2027	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$14,071)	(\$20,596)
2028	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$12,602)	(\$19,163)
2029	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$12,290)	(\$19,414)
2030	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$11,007)	(\$18,063)
2031	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$10,735)	(\$18,299)
2032	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$9,614)	(\$17,026)
2033	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$9,376)	(\$17,249)
2034	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$8,398)	(\$16,049)
2035	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$8,189)	(\$16,259)
2036	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$7,335)	(\$15,128)
2037	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$7,153)	(\$15,325)
2038	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$6,406)	(\$14,259)
2039	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$6,248)	(\$14,446)
2040	Concrete containment examinations and evaluations	23	12	\$100	(\$26,526)	(\$5,596)	(\$13,441)
2041	Concrete containment examinations and evaluations	24	12	\$100	(\$27,680)	(\$5,457)	(\$13,616)
Total:					(\$596,263)	(\$261,661)	(\$407,013)

Assuming that the five future reactors (at two new sites) apply for an extended license, operation costs to perform these inspections over the 20-year term of the operating plant extended licenses would range from (\$916) based on a 7-percent NPV to (\$9,463) based on a 3-percent NPV.

Table 15 Industry Operation—Concrete Containment Examinations Provision (Future Reactors)

Year	Activity	Number of Affected Entities	Per Inspection		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2070	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$64)	(\$482)
2071	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$90)	(\$701)
2072	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$56)	(\$454)
2073	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$78)	(\$661)
2074	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$49)	(\$428)
2075	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$68)	(\$623)
2076	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$43)	(\$403)
2077	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$60)	(\$587)
2078	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$37)	(\$380)
2079	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$52)	(\$554)
2080	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$32)	(\$358)
2081	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$46)	(\$522)
2082	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$28)	(\$338)
2083	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$40)	(\$492)
2084	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$25)	(\$318)
2085	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$35)	(\$464)
2086	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$22)	(\$300)
2087	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$30)	(\$437)
2088	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$19)	(\$283)
2089	Concrete containment examinations and evaluations	3	12	\$100	(\$3,460)	(\$27)	(\$412)
2090	Concrete containment examinations and evaluations	2	12	\$100	(\$2,307)	(\$17)	(\$267)
Total:					(\$59,972)	(\$916)	(\$9,463)

5.4.3 Underwater Welding Requirements

The proposed conditions in 10 CFR 50.55a(b)(2)(xii) would allow underwater welding of some irradiated materials (ferritic and austenitic materials, subject to different conditions) based on certain criteria (fast/thermal neutron fluence and helium concentration in appm). The existing regulation in 10 CFR 50.55a(b)(2)(xii) prohibits underwater welding of all irradiated materials without the submission of relief/alternative requests to the NRC and NRC approval of those requests. The proposed conditions would not result in additional work or cost to the industry or

the NRC. Because the proposed conditions would eliminate the need for licensees to request special approval from the NRC under certain situations, this draft final rule would result in averted costs to the industry. Table 13 includes these averted costs.

5.4.4 Nondestructive Examination Personnel Certification

The proposed condition in 10 CFR 50.55a(b)(2)(xviii)(D) would prohibit applicants and licensees from using the ultrasonic examination NDE personnel certification requirements in Section XI, Appendix VII, and subarticle VIII-2200 of the 2011 Addenda and 2013 Edition of the ASME BPV Code. It would also prohibit the use of an accelerated Appendix VII training process for certification of ultrasonic examination personnel based on training and prior experience. Instead, the NRC would require applicants and licensees to use Table VII-4110-1 and the prerequisites for ultrasonic examination personnel requirements in subarticle VIII-2200, Appendix VIII, of the 2010 Edition of the ASME BPV Code. This draft final rule provision would not result in a change from the routine and recurring activities contained within the regulatory baseline.

5.4.5 Control the Use of Mechanical Clamping Devices

The proposed condition in 10 CFR 50.55a(b)(2)(xxxii) would prohibit the use of mechanical clamping devices on Class 1 piping and portions of piping systems that form the containment boundary. In the 2010 Edition of the ASME BPV Code, ASME made a change to include mechanical clamping devices under the small items exclusion rules of IWA-4131. In the currently approved 2007 Edition and 2008 Addenda of the ASME BPV Code, Section XI, under IWA-4133, mechanical clamping devices may be used only if they meet the requirements of Mandatory Appendix IX of Section XI of the ASME BPV Code. This prohibition would not result in a change from the routine and recurring activities contained within the existing regulatory baseline.

5.4.6 Summary Report Preparation and Submittal

The proposed condition in 10 CFR 50.55a(b)(2)(xxxiii) would require licensees using the 2010 Edition and later editions and addenda of the ASME BPV Code, Section XI, to continue to submit summary reports as required in IWA-6240 of the 2009 Addenda, which is consistent with current timeframes. This draft final rule provision does not result in a change from the routine and recurring activities contained within the existing regulatory baseline.

5.4.7 Prohibit the Use of Risk-Informed Allowable Pressure Methodology

The proposed condition in 10 CFR 50.55a(b)(2)(xxxiv) would prohibit the use of Appendix G, Paragraph G-2216, in Section XI of the ASME BPV Code, which was included for the first time in the 2011 Addenda of the ASME BPV Code and requires the continued use of the deterministic methodology of Section XI, Appendix G, to generate pressure-temperature limits. This prohibition would not result in a change from the routine and recurring activities contained within the existing regulatory baseline.

5.4.8 *Disposition of Flaws in Class 3 Components*

The proposed condition in 10 CFR 50.55a(b)(2)(xxxiv) would require that when using the 2013 Edition of the ASME BPV Code, Section XI, the licensee shall use the acceptance standards of IWD-3510 for the disposition of flaws in Category D-A components (i.e., welded attachments for vessels, piping, pumps, and valves) to correct an apparent discrepancy between the provisions in IWD-3410 and IWD-3510. This clarification would provide necessary consistency in requirements between IWD-3410 and IWD-3510 and would not result in a change from the routine and recurring activities contained within the existing regulatory baseline.

5.4.9 *Procedure Revision to Specify the Use of Reference Temperature in the K_{Ia} and K_{Ic} Equations*

The proposed condition in 10 CFR 50.55a(b)(2)(xxxv) would specify that when licensees use the 2013 Edition of the ASME BPV Code, Section XI, Appendix A, paragraph A-4200, if T_0 is available, then RT_{T_0} may be used in place of RT_{NDT} for applications using the K_{Ic} equation and the associated K_{Ic} curve, but it may not be used for applications using the K_{Ia} equation and the associated K_{Ia} curve. This proposed insertion is consistent with ASME BPV Code Case N-629, which was accepted by the NRC without conditions. This condition would not result in a change from the routine and recurring activities contained within the existing regulatory baseline.

5.4.10 *Fracture Toughness of Irradiated Material Requirements*

The proposed condition in 10 CFR 50.55a(b)(2)(xxxvi) would require licensees using ASME BPV Code, Section XI, 2013 Edition, Appendix A, paragraph A-4400, to obtain NRC approval before using irradiated T_0 and the associated RT_{T_0} in establishing fracture toughness of irradiated materials. This draft final rule condition would not result in a change from the routine and recurring activities contained within the existing regulatory baseline.

5.4.11 *Ultrasonic Examination Using ASME BPV Code Case N-824 Techniques*

The proposed provision in 10 CFR 50.55a(b)(2)(xxxvii) would allow licensees to use the provisions of ASME BPV Code Case N-824, as conditioned, when implementing inservice examinations in accordance with the requirements of ASME BPV Code, Section XI.

As noted previously in Section 5.3.12, because the CASS components at PWRs are not currently being inspected adequately, licensees must submit to the NRC requests for alternatives to the ASME BPV Code requirements for ISI of CASS components. If Alternative 2 is adopted, the need for alternative requests would be reduced to those situations in which examinations using the encoded phased-array techniques are impractical because of component geometry, metallurgical considerations, or access limitations. The NRC staff estimates that the averted alternative requests would otherwise have taken approximately 345 labor hours of industry staff time per request.

For those alternative requests that still need to be submitted, licensees would have to justify how the ultrasonic examination was precluded (e.g., interferences, geometry), which would affect the number of expected units adopting the ultrasonic examination technique. Because this is an optional provision and licensees would need to prepare the necessary justification, the NRC staff estimates that 23 units (mean value)¹¹ would implement this provision. The staff also estimated that these licensees would require an additional 35 hours per unit to examine welds in CASS components at the 10-year ISI interval. The NRC estimates the radiation field at each weld to be 33 millirem per hour and the technician to spend 25 percent of the inspection time at the site of the radiation field (at the weld location).

As shown in Table 16, the NRC estimates that the total industry operation averted costs for operating PWR sites range from \$859,526 based on a 7-percent NPV to \$1.11 million based on a 3-percent NPV. This includes costs from dose ranging from (\$15,923) using a 7-percent NPV to (\$20,641) using a 3-percent NPV.

Table 16 Industry Operation—ASME BPV Code Case N-824 Ultrasonic Examination Optional Provision (Operating PWRs)

Year	Activity	Number of Affected Entities	Per Inspection				Cost		
			Labor Hours	Radiation Field (rem/hr)	Dollar per person-rem	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2020	Setup, perform, and document ultrasonic weld exam	23	34.5			\$100	(\$79,002)	(\$64,489)	(\$72,298)
2020	Dose from weld	23	8.6	0.033	\$2,000		(\$12,932)	(\$10,557)	(\$11,835)
2020	Submit relief requests (averted)	23	345			\$100	\$790,019	\$644,891	\$722,979
2030	Setup, perform, and document ultrasonic weld exam	23	34.5			\$100	(\$79,002)	(\$32,783)	(\$53,796)
2030	Dose from weld	23	8.6	0.033	\$2,000		(\$12,932)	(\$5,366)	(\$8,806)
2030	Submit relief requests (averted)	23	345			\$100	\$790,019	\$327,830	\$537,965
Dose Total:							(\$25,864)	(\$15,923)	(\$20,641)
Non-Dose Total:							\$1,422,034	\$875,449	\$1,134,850
Total:							\$1,396,170	\$859,526	\$1,114,209

The NRC staff uses NUREG-1530, which helps users calculate the dollar per person-rem conversion factor, when selecting the value of this factor for use in regulatory analysis. The NRC is currently revising this NUREG. Table 16 calculates costs from personnel dose using the current dollar per person-rem conversion factor of \$2,000. These costs are estimated to range from (\$15,923) using a 7-percent NPV to (\$20,641) using a 3-percent NPV. In the proposed revision to NUREG-1530, the staff is changing the dollar per person-rem conversion factor to a low value of \$3,100, a best value of \$5,200, and a high value of \$7,700 (yielding a mean value of \$5,267). Table 17 shows that, applying the new proposed dollar per person-rem conversion factor (low, best, and high), the cost from dose for this ASME BPV Code Case N-824 provision would increase over the cost resulting from application of the current dollar per person-rem conversion factor. With a conversion factor of \$3,100, the cost from dose as a result of this

11 This estimate uses a program evaluation and review technique (PERT) distribution to calculate the mean value in which the low estimate is zero, the best estimate is 25, and the high estimate is 38, which is the total number of PWR sites.

provision would increase by (\$8,758) using a 7-percent NPV and by (\$11,353) using a 3-percent NPV. With a conversion factor of \$5,200, the cost from dose as a result of this provision would increase by (\$25,477) using a 7-percent NPV and by (\$33,026) using a 3-percent NPV. With a conversion factor of \$7,700, the cost from dose as a result of this provision would increase by (\$45,380) using a 7-percent NPV and by (\$58,827) using a 3-percent NPV. The results in Table 17 show that the cost-beneficial nature of the industry operation costs are insensitive to the proposed dollar per person-rem conversion factor change, in that they remain cost beneficial.

Table 17 ASME BPV Code Case N-824 Dose—Proposed Conversion Factor

Year	Activity	Number of Affected Entities	Per Inspection			Cost		
			Labor Hours	Radiation Field (rem/hr)	Proposed Dollar per person-rem	Undiscounted	7% NPV	3% NPV
2020	Dose from weld exams	23	8.6	0.033	\$3,100	(\$20,045)	(\$16,363)	(\$18,344)
2030	Dose from weld exams	23	8.6	0.033	\$3,100	(\$20,045)	(\$8,318)	(\$13,650)
Total:						(\$40,090)	(\$24,681)	(\$31,994)
Difference						(\$14,225)	(\$8,758)	(\$11,353)

Year	Activity	Number of Affected Entities	Per Inspection			Cost		
			Labor Hours	Radiation Field (rem/hr)	Proposed Dollar per person-rem	Undiscounted	7% NPV	3% NPV
2020	Dose from weld exams	23	8.6	0.033	\$5,200	(\$33,624)	(\$27,447)	(\$30,771)
2030	Dose from weld exams	23	8.6	0.033	\$5,200	(\$33,624)	(\$13,953)	(\$22,896)
Total:						(\$67,248)	(\$41,400)	(\$53,667)
Difference						(\$41,383)	(\$25,477)	(\$33,026)

Year	Activity	Number of Affected Entities	Per Inspection			Cost		
			Labor Hours	Radiation Field (rem/hr)	Proposed Dollar per person-rem	Undiscounted	7% NPV	3% NPV
2020	Dose from weld exams	23	8.6	0.033	\$7,700	(\$49,789)	(\$40,643)	(\$45,564)
2030	Dose from weld exams	23	8.6	0.033	\$7,700	(\$49,789)	(\$20,661)	(\$33,904)
Total:						(\$99,578)	(\$61,303)	(\$79,468)
Difference						(\$73,714)	(\$45,380)	(\$58,827)

5.4.12 ASME OM Code Mandatory Appendix III Inservice Testing of Motor-Operated Valves

Mandatory Appendix III of the ASME OM Code specifies that MOV exercising occurs on a 2-year interval and MOV diagnostic testing occurs on an interval of 3 to 10 years, rather than the current OM Code requirement of quarterly stroke-time testing of MOVs within the IST program scope. Mandatory Appendix III incorporates ASME OM Code Case OMN-1 and Code Case OMN-11 into the OM Code. Regulatory Guide 1.192 (Ref. 8.16.) accepts the voluntary use of ASME OM Code Cases OMN-1 and OMN-11 with specific conditions.

All nuclear power plant licensees implementing the ASME OM Code are required by 10 CFR 50.55a(b)(3)(ii) to establish a program to ensure that safety-related MOVs continue to be capable of performing their design-basis safety functions. All licensees are currently implementing MOV programs in response to Generic Letter 96-05 (Ref. 8.12.), which includes periodic diagnostic testing to verify MOV design-basis capability. Therefore, the number of MOV exercise tests would decrease from four per year to one every 2 years, with an MOV diagnostic test every 10 years.

The NRC estimates that the industry operation costs for operating nuclear power plants range from a net benefit of \$23.8 million (7-percent NPV) to \$36.2 million (3-percent NPV). Table 18 summarizes the cost of this MOV IST provision for operating reactors; Table 51 in Appendix A to this document provides the detailed calculation. Additionally, the estimated averted cost as a result of radiation dose ranges from \$506,601 (7-percent NPV) to \$782,913 (3-percent NPV), as shown in Table 19, with the detailed calculation provided in Table 52 of Appendix A. As described in Section 5.3.13, the number of MOVs, both current and newly identified as a result of this provision, and these testing costs were estimated based on the NRC staff's polls of industry representatives at 29 operating units that have implemented the MOV provisions through the relief request process.

Table 18 Industry Operation—MOV IST Provision (Operating Reactors)

Activity	Cost		
	Undiscounted	7% NPV	3% NPV
Biannual MOV exercise test	(\$8,483,196)	(\$3,885,582)	(\$5,888,322)
10-year MOV diagnostic test	(\$2,582,025)	(\$1,328,162)	(\$1,864,108)
Quarterly MOV exercise tests averted	\$63,355,231	\$29,018,774	\$43,975,881
Total:	\$52,290,011	\$23,805,030	\$36,223,450

Table 19 Industry Operation—MOV IST Provision (Operating Reactors)—Dose

Activity	Cost		
	Undiscounted	7% NPV	3% NPV
Biannual MOV exercise test dose	(\$216,825)	(\$99,313)	(\$150,502)
10-year MOV diagnostic test dose	(\$263,980)	(\$135,788)	(\$190,582)
Quarterly MOV exercise tests averted dose	\$1,619,322	\$741,702	\$1,123,997
Total:	\$1,138,516	\$506,601	\$782,913

The NRC staff considers future reactors in Table 20 and Table 21, with the detailed calculations provided in Table 53 and Table 54 of in Appendix A. Assuming that the five future reactors apply for an extended license, the operation cost to perform these tests over the 60-year term of the operating plant extended licenses would result in a net benefit (averted cost) that ranges from \$2.22 million (7-percent NPV) to \$4.59 million (3-percent NPV). The estimated averted cost as a result of radiation dose ranges from \$47,994 (7-percent NPV) to \$101,363 (3-percent NPV).

Table 20 Industry Operation—MOV IST Provision (Future Reactors)

Activity	Cost		
	Undiscounted	7% NPV	3% NPV
Biannual MOV exercise test	(\$1,725,011)	(\$370,084)	(\$763,716)
10-year MOV diagnostic test	(\$449,606)	(\$113,105)	(\$206,701)
Quarterly MOV exercise tests averted	\$12,539,484	\$2,700,266	\$5,556,321
Total:	\$10,364,867	\$2,217,076	\$4,585,904

Table 21 Industry Operation—MOV IST Provision (New Reactors)—Dose

Activity	Cost		
	Undiscounted	7% NPV	3% NPV
Biannual MOV exercise test dose	(\$44,090)	(\$9,459)	(\$19,520)
10-year MOV diagnostic test dose	(\$45,967)	(\$11,564)	(\$21,133)
Quarterly MOV exercise tests averted dose	\$320,502	\$69,017	\$142,016
Total:	\$230,445	\$47,994	\$101,363

The tables above calculate costs from personnel dose using the current dollar per person-rem conversion factor of \$2,000. However, as discussed above, the NRC staff is revising NUREG-1530 to include new dollar per person-rem conversion factors. Table 22 shows that the averted costs from dose would increase (higher benefit) using the new proposed dollar per person-rem conversion factors. With the conversion factor of \$3,100, the averted cost from dose for this MOV provision would increase by \$305,028 using a 7-percent NPV and by \$486,352 using a 3-percent NPV. With the conversion factor of \$5,200, the averted cost from dose for this MOV provision would increase by \$887,353 using a 7-percent NPV and by \$1.41 million using a 3-percent NPV. With the conversion factor of \$7,700, the averted cost from dose for this MOV provision would increase by \$1.58 million using a 7-percent NPV and by \$2.52 million using a 3-percent NPV. The results in Table 22 show that the cost-beneficial nature of the industry operation costs are insensitive to the proposed dollar per person-rem conversion factor change, in that they remain cost beneficial.

Table 22 MOV IST Provision—Dose (Proposed Conversion Factor)

Activity	Dollar per person-rem conversion factor	Cost		
		Undiscounted	7% NPV	3% NPV
Operating Reactors Dose	\$3,100	\$1,764,700	\$785,232	\$1,213,515
Future Reactors Dose	\$3,100	\$357,189	\$74,391	\$157,113
	Total Dose	\$2,121,890	\$859,623	\$1,370,629
	Difference	\$752,929	\$305,028	\$486,352

Activity	Dollar per person-rem conversion factor	Cost		
		Undiscounted	7% NPV	3% NPV
Operating Reactors Dose	\$5,200	\$2,960,143	\$1,317,163	\$2,035,574
Future Reactors Dose	\$5,200	\$599,156	\$124,785	\$263,545
	Total Dose	\$3,559,299	\$1,441,949	\$2,299,119
	Difference	\$2,190,338	\$887,353	\$1,414,843

Activity	Dollar per person-rem conversion factor	Cost		
		Undiscounted	7% NPV	3% NPV
Operating Reactors Dose	\$7,700	\$4,383,288	\$1,950,415	\$3,014,216
Future Reactors Dose	\$7,700	\$887,212	\$184,778	\$390,249
	Total Dose	\$5,270,500	\$2,135,193	\$3,404,465
	Difference	\$3,901,539	\$1,580,598	\$2,520,189

5.4.13 ASME OM Code Supplemental Requirements Testing for New Reactors

The proposed condition in 10 CFR 50.55a(b)(3)(iii) would impose four supplemental requirements on the use of the provisions in the ASME OM Code for new reactors with combined licenses issued under 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.” These requirements would involve (1) periodic verification of the design-basis capability of POVs other than MOVs already addressed in Appendix III to the ASME OM Code, (2) bi-directional testing of check valves, (3) monitoring flow-induced vibration from hydrodynamic loads and acoustic resonance to identify potential adverse flow effects, and (4) assessment of the operational readiness of pumps, valves, and dynamic restraints within the scope of the regulatory treatment of nonsafety systems program for applicable reactor designs. These supplemental requirements are currently applied to each new reactor during the licensing process based on direction in Commission policy papers for the design and operation of new reactors. Therefore, no additional incremental costs would be imposed on new reactor licensees as a result of specifying these requirements in 10 CFR 50.55a.

5.4.14 ASME OM Code Requirements for Squib Valve Surveillance for New Reactors

Subsection ISTC in the 2012 Edition of the ASME OM Code supplements the preservice and inservice surveillance requirements in the previous editions and addenda of the ASME OM Code for squib valves in new reactors. The combined licenses for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3 include conditions for preservice and surveillance requirements for their squib valves (Refs. 8.1., 8.2., 8.3., and 8.4.). The supplemental provisions for squib valves in new reactors in Subsection ISTC in the 2012 Edition of the ASME OM Code are consistent with the license conditions currently imposed on Vogtle Units 3 and 4

and V.C. Summer Units 2 and 3. Therefore, the incorporation by reference of the supplemental squib valve provisions in the 2012 Edition of the ASME OM Code into 10 CFR 50.55a would not result in new technical requirements for those reactors. South Texas Project Units 3 and 4 have three small squib valves in the automatic traversing incore probe system, and Fermi Unit 3 has eight squib valves in various fluid systems not covered by license conditions. No additional implementation costs would result from the ASME OM Code requirements for squib valve surveillance in new reactors.

5.4.15 Subsection ISTB (2011 Edition of the ASME OM Code) Testing

The proposed condition in 10 CFR 50.55a(b)(3)(vii) would prohibit the use of Subsection ISTB in the 2011 Addenda of the OM Code because the addenda expanded the acceptable range of a pump comprehensive test but did not require a pump periodic verification program as specified in Mandatory Appendix V in the 2012 Edition of the OM Code. The draft final rule provision would not result in a change from the routine and recurring activities contained within the regulatory baseline.

5.4.16 ASME OM Code Mandatory Appendix V on Pump Periodic Verification Tests

The 2012 Edition of the ASME OM Code specifies the use of Mandatory Appendix V, which establishes the requirements for implementing a pump periodic verification test. The test verifies that pumps that are in a licensee's IST program can meet the required (differential or discharge) pressure, as applicable, at its highest design-basis accident flow rate. The test, if required, must be performed once every 2 years. If a pump does not have a specific design-basis accident flow rate in the licensee's credited safety analysis, or if a pump's comprehensive test flow rate and (differential or discharge) pressure bound the pump's design-basis accident flow rate and (differential or discharge) pressure, a pump periodic verification test would not be required.

The staff estimates that a plant's IST program has 30 pumps, on average, and about 6 of those 30 pumps would require a periodic verification test once every 2 years. The staff estimates that each pump periodic test would require approximately 2.9 hours to set up, perform, and document the test, resulting in an estimate of 17 hours per unit every 2 years. The NRC further estimates that 17 units would perform these tests (a mean estimate based on a three-point estimate with a high value of 25 percent of all units). These estimates are based on NRC staff discussions with licensees at the ASME OM Code meetings, and on the fact that many plant systems covered by the plant's IST program have full-flow test capability. The estimated industry operation costs to perform these pump periodic verification tests over the remaining term of the currently operating plant extended licenses under Alternative 2 range from (\$170,525) based on a 7-percent NPV to (\$256,758) based on a 3-percent NPV.

Table 23 Industry Operation—ASME OM Code Mandatory Appendix V Pump Verification Test Provision (Operating Reactors)

Year	Activity	Number of Affected Units	Labor Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2019	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$26,881)	(\$29,010)
2021	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$23,479)	(\$27,345)
2023	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$20,508)	(\$25,775)
2025	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$17,912)	(\$24,295)
2027	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$15,645)	(\$22,901)
2029	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$13,665)	(\$21,586)
2031	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$11,936)	(\$20,347)
2033	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$10,425)	(\$19,179)
2035	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$9,106)	(\$18,078)
2037	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$7,953)	(\$17,040)
2039	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$6,947)	(\$16,062)
2041	Pump periodic verification test	17	17	\$107	(\$30,777)	(\$6,068)	(\$15,140)
Total:					(\$369,319)	(\$170,525)	(\$256,758)

Assuming that the licensees for the five future reactors apply for an extended license and that less than 25 percent of future units perform the tests, the net operating cost to perform these tests over the 60-year term of the operating plant extended licenses would range from (\$5,963) based on a 7-percent NPV to (\$18,401) based on a 3-percent NPV.

Table 24 Industry Operation—ASME OM Code Mandatory Appendix V Pump Verification Test Provision (Future Reactors)

Year	Activity	Number of Affected Units	Labor Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2030	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$766)	(\$1,257)
2032	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$669)	(\$1,185)
2034	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$585)	(\$1,117)
2036	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$511)	(\$1,053)
2038	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$446)	(\$993)
2040	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$390)	(\$936)
2042	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$340)	(\$882)
2044	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$297)	(\$831)
2046	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$260)	(\$784)
2048	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$227)	(\$739)
2050	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$198)	(\$696)
2052	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$173)	(\$656)
2054	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$151)	(\$619)
2056	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$132)	(\$583)
2058	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$115)	(\$550)
2060	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$101)	(\$518)
2062	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$88)	(\$488)
2064	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$77)	(\$460)
2066	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$67)	(\$434)
2068	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$59)	(\$409)
2070	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$51)	(\$385)
2072	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$45)	(\$363)
2074	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$39)	(\$342)
2076	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$34)	(\$323)
2078	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$30)	(\$304)
2080	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$26)	(\$287)
2082	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$23)	(\$270)
2084	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$20)	(\$255)
2086	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$17)	(\$240)
2088	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$15)	(\$226)
2090	Pump periodic verification test	1	17	\$107	(\$1,847)	(\$13)	(\$213)
Total:					(\$57,245)	(\$5,963)	(\$18,401)

5.4.17 Subsection ISTE (2012 Edition of the ASME OM Code) for Risk-Informed Inservice Testing of Pumps and Valves

It is difficult to estimate with any certainty on a generic basis the incremental costs and benefits for nuclear power plant licensees that implement risk-informed IST of pumps and valves. This is because the incremental costs and benefits depend on the number of licensees adopting this approach, the cost-benefit of the methodology approved, the number of pumps and valves characterized as low risk, and the number of years that the licensees would derive benefits. Because licensees currently have chosen not to implement the approach in Subsection ISTE of the ASME OM Code, they have not realized the benefits expected from this approach, such as the elimination or reduced frequency of recurring ISI and repair or replacement of components, the reduction in personnel training and maintenance costs, the shortened outage time resulting from the reduced testing requirements for low-risk pumps and valves, and the greater flexibility in maintenance scheduling while maintaining an equivalent level of safety.

Under Alternative 2, nuclear power plant licensees may voluntarily adopt this allowable provision. Individual licensees may choose to do so if they determine that the benefits in terms of ongoing savings and the focus of the plant's IST program on risk-significant components would result in plant safety benefits that outweigh the one-time implementation costs. Nuclear power plant licensees not adopting Subsection ISTE (2012 Edition of the ASME OM Code) would see no change in costs or benefits as they would continue to perform IST under the existing regulatory baseline.

5.4.18 ASME OM Code Subsection ISTF Pump Testing for New Reactors

Subsection ISTF of the ASME OM Code specifies IST requirements for pumps within the scope of the ASME OM Code for new reactors. The term "new reactors" refers to nuclear power plants that were issued (or will be issued) a construction permit, or combined license for construction and operation, on or after January 1, 2000. Subsection ISTF provides essentially the same IST requirements as existing Subsection ISTB for pumps in currently operating nuclear power plants, with one exception. In particular, pumps in new reactors will undergo inservice pump testing every quarter, rather than Group A or B tests every quarter, and comprehensive tests every 2 years as performed at currently operating plants. Vogtle Units 3 and 4, Fermi Unit 3, and V.C. Summer Units 2 and 3 have a passive design without safety-related pumps. Watts Bar Unit 2 is not a new reactor (post-2000 plant) by the ASME OM Code definition. The certified design used for South Texas Project Units 3 and 4 provides the capability to perform full-flow testing for pumps covered by IST requirements. Therefore, the NRC staff does not expect any industry incremental operation cost associated with this provision from any of the assumed new reactors.

5.4.19 ASME OM Code Case OMN-20 Time Period Extension

The proposed condition allows the use of ASME OM Code Case OMN-20 before its incorporation into the next update of Regulatory Guide 1.192 (Ref. 8.16.) and incorporation by reference into 10 CFR 50.55a. The Code Case allows time periods shorter than 2 years to be extended by up to 25 percent for any given pump or valve inservice test. Time periods longer than or equal to 2 years may be extended by up to 6 months for any given pump or valve inservice test. Currently, a licensee must submit one alternative request for every 10-year inservice test interval in order to use ASME OM Code Case OMN-20 for the pumps and valves in its program. Although this provision is optional, it does provide scheduling flexibility. As a result, the NRC staff estimates that all licensees would use ASME OM Code Case OMN-20. Licensee staff would otherwise have expended an estimated 230 hours to prepare and submit each alternative request, and the NRC staff assumes that each operating reactor unit licensee would have submitted requests in 2020 and 2030. Implementation of Alternative 2 associated with industry preparation and submission of time period extension requests under ASME OM Code Case OMN-20 over the remaining term of the licenses for the currently operating plants would result in averted costs of \$3.19 million based on a 7-percent NPV and \$4.13 million based on a 3-percent NPV.

Table 25 Industry Operation—Code Case OMN-20 Time Period Extension Optional Provision (Operating Reactors)

Year	Activity	Number of Affected	Per Entity		Cost		
			Labor Hours	Weighted	Undiscounted	7% NPV	3% NPV
2020	Prepare and submit OMN-20 Time Period Extension	96	230	\$117	\$2,590,069	\$2,114,268	\$2,370,280
2030	Time Period Extension Request	96	230	\$117	\$2,590,069	\$1,074,787	\$1,763,711
Total:					\$5,180,138	\$3,189,054	\$4,133,991

For the future reactors, the NRC staff assumes that the licensees would have submitted alternative requests beginning in 2030 and every 10 years thereafter until license expiration for the extended license in 2080. Therefore, the averted costs under Alternative 2 associated with the estimated industry operation efforts to prepare and submit time period extension requests under ASME OM Code Case OMN-20 over the remaining term of the new plant licenses (which includes a 20-year license renewal period) would range from \$111,893 (7-percent NPV) to \$298,032 (3-percent NPV).

Table 26 Industry Operation—ASME OM Code Case OMN-20 Time Period Extension Optional Provision (Future Reactors)

Year	Activity	Number of Affected	Per Entity		Cost		
			Labor Hours	Weighted	Undiscounted	7% NPV	3% NPV
2030	Prepare and submit OMN-20 Time Period Extension	5	230	\$117	\$134,899	\$55,978	\$91,860
2040	Prepare and submit OMN-20 Time Period Extension	5	230	\$117	\$134,899	\$28,457	\$68,352
2050	Prepare and submit OMN-20 Time Period Extension	5	230	\$117	\$134,899	\$14,466	\$50,861
2060	Prepare and submit OMN-20 Time Period Extension	5	230	\$117	\$134,899	\$7,354	\$37,845
2070	Prepare and submit OMN-20 Time Period Extension	5	230	\$117	\$134,899	\$3,738	\$28,160
2080	Prepare and submit OMN-20 Time Period Extension	5	230	\$117	\$134,899	\$1,900	\$20,954
Total:					\$809,397	\$111,893	\$298,032

5.4.20 Program Revision to Inservice Testing Requirements

This proposed condition would not result in a change from the routine and recurring activities contained within the regulatory baseline.

5.4.21 Cast Austenitic Stainless Steel Material Examination Requirements

This proposed condition would add 10 CFR 50.55a(g)(6)(ii)(F)(11) to address requirements for examination through cast stainless steel materials for PWR units and to establish a deadline of January 1, 2019, for requiring the use of ASME BPV Code Appendix VIII qualifications to meet the inspection requirements of paragraph -2500(a) of ASME BPV Code Case N-770-2.

Based on previously submitted ISI relief requests, a PWR unit has between 400 and 1,400 Class 1 piping welds, depending on the unit's design. Most PWR licensees use a risk-informed system that reduces these numbers to a population of between 20 and 30 Class 1 welds that require volumetric examination in their 10-year interval inspection pool.

Licensees currently use Appendix VIII procedures for meeting these inspection requirements; therefore, this provision would not result in additional costs to the industry.

5.4.22 Examination Coverage Requirements for Butt Welds Joining Cast Stainless Steel Material

Under current requirements in the ASME BPV Code, Section XI, Appendix VIII, the volumetric examination of butt welds through cast stainless steel materials for PWR units is under Supplement 9. However, the ASME BPV Code Committee is still developing Supplement 9 rules. Therefore, it is currently impossible to meet the requirement of Paragraph I.5.1 for butt welds joining cast stainless steel material.

This provision would allow PWR licensees to implement a stress improvement mitigation technique for butt welds joining cast stainless steel material by using an examination volume that is qualified by Appendix VIII procedures to the maximum extent practical; including 100 percent of the susceptible material volume. This technique would remain applicable until an Appendix VIII qualified procedure for the inspection through cast stainless steel materials is available in accordance with the condition in 10 CFR 50.55a(g)(6)(ii)(F)(11). However, no cost is associated with this provision because it is not a requirement until 10 CFR 50.55a(g)(6)(ii)(F)(11) is available; therefore, this provision would not become a requirement as a result of this rulemaking.

5.4.23 Encoding of Ultrasonic Volumetric Examinations

This proposed condition would require that specific ultrasonic volumetric examinations of non-mitigated or cracked mitigated dissimilar metal butt welds in the RCPB, within the scope of ASME BPV Code Case N-770-2, have encoded examinations.

The staff estimates that 30 welds in a PWR plant's ISI program, on average, fall into the population requiring encoded examinations every 10 years. The staff estimates that encoding would cost (\$7,500) to perform, on average. This estimate includes costs for job setup performed by various personnel and operators, including radiation control, quality control, and occupational radiological dose staff, and the person-hours of the inspector and the supporting operations personnel, based on NRC staff and industry experience. The NRC staff assumes that the first outages after the effective date of the final rule would occur in 2020, when half of the 65 PWR operating units would participate. The remaining units would perform their inspections in 2021. This examination cycle would continue on a 2-year outage cycle until 2041, when the current nuclear power plant operating licenses expire, on average. The estimated industry operation cost to perform these inspections over the remaining term of the

extended licenses for the currently operating plants ranges from (\$7.06 million) based on a 7-percent NPV to (\$11.0 million) based on a 3-percent NPV.

Table 27 Industry Operation—Encoding Ultrasonic Volumetric Examinations Provision
(Operating PWR Units)

Year	Activity	Number of PWR Units	Number of Weld Inspections	Cost per Weld	Cost		
					Undiscounted	7% NPV	3% NPV
2020	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$596,918)	(\$669,197)
2021	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$557,867)	(\$649,706)
2022	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$521,371)	(\$630,783)
2023	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$487,263)	(\$612,410)
2024	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$455,386)	(\$594,573)
2025	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$425,594)	(\$577,256)
2026	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$397,752)	(\$560,442)
2027	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$371,730)	(\$544,119)
2028	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$347,412)	(\$528,271)
2029	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$324,684)	(\$512,884)
2030	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$303,443)	(\$497,946)
2031	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$283,591)	(\$483,442)
2032	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$265,039)	(\$469,362)
2033	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$247,700)	(\$455,691)
2034	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$231,495)	(\$442,418)
2035	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$216,350)	(\$429,532)
2036	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$202,197)	(\$417,022)
2037	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$188,969)	(\$404,875)
2038	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$176,606)	(\$393,083)
2039	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$165,053)	(\$381,634)
2040	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$154,255)	(\$370,518)
2041	Perform encoded weld inspections	32.5	3	\$7,500	(\$731,250)	(\$144,163)	(\$359,727)
Total:					(\$16,087,500)	(\$7,064,837)	(\$10,984,890)

5.4.24 Clarification of Valve Position Verification Requirements

This proposed condition would not result in a change from the routine and recurring activities contained within the regulatory baseline.

5.5 Total Industry Costs

Table 28 shows the total industry costs broken down between implementation and operation costs for the requirements under Alternative 2. These total industry costs represent averted costs of \$11.5 million using a 7-percent discount rate and \$22.8 million using a 3-percent discount rate.

Table 28 Total Industry Costs

Attribute	Total Industry Cost			Average Unit Cost		
	Undiscounted	7% NPV	3% NPV	Undiscounted	7% NPV	3% NPV
Implementation Costs	(\$16,010,000)	(\$13,960,000)	(\$15,080,000)	(\$166,800)	(\$145,400)	(\$157,100)
Operating Costs	\$55,390,000	\$24,880,000	\$37,050,000	\$577,000	\$259,200	\$385,900
Total	\$40,720,000	\$11,460,000	\$22,830,000	\$424,200	\$119,400	\$237,800

*Note: Total costs are rounded to the nearest \$10,000, average costs are rounded to the nearest \$100.

As shown in Table 28, the estimated total industry implementation costs per unit range from (\$145,400) using a 7-percent discount factor to (\$157,100) using a 3-percent discount factor. Total industry operating averted costs per unit would range from \$259,200 using a 7-percent discount rate to \$385,900 using a 3-percent discount rate. The average implementation and operation averted costs per unit are \$119,400 using a 7-percent discount rate and \$237,800 using a 3-percent discount rate.

5.6 NRC Implementation

5.6.1 Quality Assurance Program Description Review

The proposed 10 CFR 50.55a rule that incorporates by reference the 2008 Edition and the 2009-1a Addenda of ASME NQA-1 is optional for licensees to implement. The existing 10 CFR 50.54(a)(3) regulations allow licensees to make changes to a previously accepted QAPD included or referenced in the safety analysis report without prior NRC approval, provided the change does not reduce the commitments in the program description as accepted by the NRC. Regulations in 10 CFR 50.54(a)(4) state that licensees that make changes to the QAPD that reduce these commitments must submit these changes to the NRC for review and approval before implementation. Therefore, the NRC would not incur an additional cost for implementation of this draft final rule provision, because it is already required under existing 10 CFR 50.54(a)(4) requirements.

5.6.2 Procedure Revision to Incorporate Concrete Containment Examinations

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.3 Procedure Revision to Underwater Weld Requirements

The proposed conditions in 10 CFR 50.55a(b)(2)(xii) allow underwater welding of some irradiated materials (ferritic and austenitic materials, subject to different conditions) based on certain criteria (fast/thermal neutron fluence and helium concentration in appm). The existing regulation in 10 CFR 50.55a(b)(2)(xii) prohibits underwater welding of all irradiated materials without the submission of relief/alternative requests to the NRC and NRC approval of those requests. Implementing the proposed conditions would not result in additional work or cost to the NRC.

5.6.4 Procedure Revision to Incorporate Nondestructive Examination Personnel Certification

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.5 Procedure Revision to Prohibit the Use of Mechanical Clamping Devices

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.6 *Procedure Revision to Incorporate Summary Report Submittal Requirements*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.7 *Procedure Revision to Prohibit the Use of Risk-Informed Allowable Pressure Methodology*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.8 *Procedure Revision to Add Acceptance Standards for the Disposition of Flaws in Class 3 Components*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.9 *Procedure Revision to Specify the Use of Reference Temperature in the K_{Ia} and K_{Ic} Equations*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.10 *Procedure Revision to Incorporate Fracture Toughness of Irradiated Material Requirements*

The NRC would incur incremental implementation costs to review the submitted procedure changes described above. The staff expects that each review would take approximately 173 hours of NRC staff time. Table 29 shows that the estimated cost for this provision ranges from (\$194,658) based on a 7-percent NPV to (\$218,228) based on a 3-percent NPV.

Table 29 NRC Implementation Costs

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2019	Develop and issue risk informed inservice testing guidance (averted)	2	460	\$128	\$117,760	\$102,856	\$111,000
2020			460	\$128	\$117,760	\$96,127	\$107,767
2020	Review ISTE Submittal and issue a safety evaluation	2	863	\$128	(\$220,800)	(\$180,239)	(\$202,063)
2020	Review Fracture Toughness submittals	11	173	\$128	(\$238,464)	(\$194,658)	(\$218,228)
Total:					(\$223,744)	(\$175,913)	(\$201,524)

5.6.11 *Procedure Revision to Incorporate the Ultrasonic Examination Provisions of ASME BPV Code Case N-824*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.12 *Procedure Revision to Incorporate Motor-Operated Valve Testing Requirements*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.13 *Procedure Revisions to Incorporate Supplemental Requirements on the Use of the ASME OM Code for New Reactors*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.14 *Procedure Revision to Incorporate Squib Valve Surveillance Requirements for New Reactors*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.15 *Procedure Revision to Prohibit the Use of Subsection ISTB (2011 Edition of the ASME OM Code)*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.16 *Program Revision to Incorporate ASME OM Code Mandatory Appendix V on the Pump Periodic Verification Program*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.17 *Risk-Informed Inservice Testing of Pumps and Valves Request for Alternative Submittal to Use Subsection ISTE of the ASME OM Code*

To implement this provision, the NRC would incur a cost in relation to the regulatory baseline (Alternative 1) for reviewing the submittals for this program and issuing safety evaluation reports. The NRC staff estimates that two licensees (one currently operating reactor and one new reactor) would be interested in applying Subsection ISTE to their IST programs. Licensees would submit a request for an alternative to the ASME OM Code to apply Subsection ISTE with appropriate justification for NRC review. The staff estimates that the NRC staff would require 863 hours to review the submittal and approve the request. The staff assumes that this review

would occur in 2020. The availability of Subsection ISTE in the ASME OM Code results in an averted cost for the NRC to develop the proposed and final risk-informed guidance documents for the program, otherwise expected to occur in 2019 and 2020 and requiring 920 hours in total (460 hours per year). Table 29 shows that the estimated averted NRC implementation costs are estimated to range from (\$175,913) using a 7-percent NPV to (\$201,524) using a 3-percent NPV.

5.6.18 *Procedure Revision to Incorporate ASME OM Code Subsection ISTF Pump Testing Requirements for New Reactors*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.19 *ASME OM Code Case OMN-20 Time Period Extension*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.20 *Program Revision to Inservice Testing Requirements*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.21 *Procedure to Incorporate Cast Austenitic Stainless Steel Material Examination Requirements*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.22 *Procedure Revision to Clarify Examination Coverage Requirements for Butt Welds Joining Cast Stainless Steel Material*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.23 *Procedure to Incorporate Encoding of Ultrasonic Volumetric Examinations*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.6.24 *Clarification of Valve Position Verification Requirements*

The staff does not expect the NRC to incur any incremental implementation costs associated with this activity.

5.7 NRC Operation

When it receives an alternative request, the NRC requires additional staff time to evaluate the acceptability of the request relative to the criteria currently approved by the agency. Under Alternative 2, the additional seven alternative request submittals per year would not be required. By incorporating by reference the ASME Code Cases in the *Code of Federal Regulations*, a nuclear power plant licensee could use a more current ASME Code edition or addenda or applicable Code Case without submitting an alternative request for NRC review.

As shown in Table 30, the NRC estimates that each submittal would require 242 hours of staff time to perform the technical review (including resolving technical issues), document the evaluation, and respond to the licensee about its request. The absence of these submittals would result in an NRC averted cost that ranges from \$1.2 million based on a 7-percent NPV to \$1.5 million based on a 3-percent NPV. Therefore, this alternative would provide a net benefit (i.e., averted cost).

Table 30 NRC Operation Costs—Averted Code Alternative Request Review (Operating and New Reactors)

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2019	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$193,498	\$208,819
2020	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$180,839	\$202,737
2021	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$169,009	\$196,832
2022	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$157,952	\$191,099
2023	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$147,619	\$185,533
2024	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$137,961	\$180,129
2025	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$128,936	\$174,883
2026	Review Code Case relief request submittal and issue safety evaluation	7	242	\$128	\$221,536	\$120,501	\$169,789
Total:					\$1,772,288	\$1,236,316	\$1,509,820

The NRC review costs for any ASME Code Case relief requests submitted to the NRC before the effective date of the final rule are considered sunk costs and are not considered further in this regulatory analysis.

5.7.1 Quality Assurance Program Description Review

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.2 *Concrete Containment Examinations*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.3 *Underwater Welding Requirements*

The proposed conditions in 10 CFR 50.55a(b)(2)(xii) would allow underwater welding of some irradiated materials (ferritic and austenitic materials, subject to different conditions) based on certain criteria (fast/thermal neutron fluence and helium concentration in appm). The existing regulation in 10 CFR 50.55a(b)(2)(xii) prohibits underwater welding of all irradiated materials without the submission of relief/alternative requests to the NRC and NRC approval of those requests. The proposed conditions would not result in additional work or cost to the NRC. Because the proposed conditions would eliminate the need for licensees to request special approval from the NRC under certain situations, the draft final rule would result in averted costs to the NRC. These are included in the averted costs of relief/alternative requests shown in Table 30 of this regulatory analysis.

5.7.4 *Nondestructive Examination Personnel Certification*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.5 *Control the Use of Mechanical Clamping Devices*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.6 *Summary Report Review*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.7 *Control the Use of Risk-Informed Allowable Pressure Methodology*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.8 *Review Disposition of Flaws in Class 3 Components*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.9 *Review the Use of Reference Temperature in the K_{Ia} and K_{Ic} Equations*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.10 *Review Fracture Toughness of Irradiated Material Requirements*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.11 *Review Ultrasonic Examinations Using ASME BPV Code Case N-824*

The NRC would benefit from the reduced number of submissions of weld relief requests as a result of this optional provision, mentioned above. As shown in Table 31, this would result in averted costs ranging from \$413,835 (7-percent NPV) to \$536,457 (3-percent NPV).

Table 31 Averted ASME BPV Code Case N-824 Weld Relief Requests

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2020	Review N-824 relief requests (averted)	23	115	\$128	\$336,107	\$274,363	\$307,585
2030	Review N-824 relief requests (averted)	23	115	\$128	\$336,107	\$139,472	\$228,872
Total:					\$672,213	\$413,835	\$536,457

5.7.12 *Review ASME OM Code Mandatory Appendix III Motor-Operated Valve Inservice Testing Results*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.13 *Review ASME OM Code Supplemental Requirements Test Results for New Reactors*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.14 *Procedure Revision to Incorporate Squib Valve Surveillance Requirements for New Reactors*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.15 *Review Subsection ISTB (2011 Edition of the ASME OM Code) Test Results*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.16 Review ASME OM Code Mandatory Appendix V Pump Periodic Verification Program

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.17 Review ASME OM Code Subsection ISTE Risk-Informed Inservice Testing of Pumps and Valves

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.18 Review ASME OM Code Subsection ISTF Pump Testing Results for New Reactors

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.19 Review ASME OM Code Case OMN-20 Time Period Extension

The proposed condition would allow the use of ASME OM Code Case OMN-20 before its incorporation into the next update of Regulatory Guide 1.192 and incorporation by reference into 10 CFR 50.55a. The Code Case allows time periods shorter than 2 years to be extended by up to 25 percent for any given pump or valve inservice test. Time periods longer than or equal to 2 years may be extended by up to 6 months for any given pump or valve inservice test. Currently, a licensee must submit one relief request for every 10-year inservice test interval in order to use ASME OM Code Case OMN-20 for the pumps and valves in its program. The NRC staff estimates that all licensees would use ASME OM Code Case OMN-20. The estimated time that would otherwise have been expended by the NRC staff to review and concur on each alternative request is 115 hours, and the NRC staff assumes that each operating reactor unit licensee would have submitted requests in 2020 and 2030. For the new reactors, the NRC staff assumes that licensees would have submitted requests in 2030, 2040, 2050, 2060, 2070, and 2080.

As shown in Table 32, the averted NRC costs to review the ASME OM Code Case OMN-20 request submittals and issue safety evaluations would range from \$1.8 million based on a 7-percent NPV to \$2.42 million based on a 3-percent NPV. Of these total averted costs, those from operating power reactor review would range from \$1.74 million based on a 7-percent NPV to \$2.26 million based on a 3-percent NPV. Future power reactor averted costs would range from \$61,048 based on a 7-percent NPV to \$162,604 based on a 3-percent NPV.

Table 32 NRC Operation—Review OMN-20 Code Case Alternative Request and Issue Safety Evaluation

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2020	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (operating plants)	96	115	\$128	\$1,413,120	\$1,153,527	\$1,293,205
2030	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (operating plants)	96	115	\$128	\$1,413,120	\$586,395	\$962,266
2030	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (future plants)	5	115	\$128	\$73,600	\$30,541	\$50,118
2040	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (future plants)	5	115	\$128	\$73,600	\$15,526	\$37,293
2050	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (future plants)	5	115	\$128	\$73,600	\$7,892	\$27,749
2060	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (future plants)	5	115	\$128	\$73,600	\$4,012	\$20,648
2070	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (future plants)	5	115	\$128	\$73,600	\$2,040	\$15,364
2080	Review Code Case OMN-20 alternative request submittal and issue safety evaluation (future plants)	5	115	\$128	\$73,600	\$1,037	\$11,432
<i>Operating Reactor Subtotal:</i>					\$2,826,240	\$1,739,921	\$2,255,471
<i>Future Reactor Subtotal:</i>					\$441,600	\$61,048	\$162,604
Total:					\$3,267,840	\$1,800,969	\$2,418,075

5.7.20 *Program Revision to Inservice Testing Requirements*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.21 *Procedure to Incorporate Cast Austenitic Stainless Steel Material Examination Requirements*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.22 *Procedure Revision to Clarify Examination Coverage Requirements for Butt Welds Joining Cast Stainless Steel Material*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.23 *Procedure to Incorporate Encoding of Ultrasonic Volumetric Examinations*

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.7.24 Clarification of Valve Position Verification Requirements

The staff does not expect the NRC to incur any incremental operation costs associated with this activity.

5.8 Total NRC Costs

Table 33 shows the total NRC costs broken down between implementation and operation costs for Alternative 2. These total NRC costs represent averted costs (savings) and are estimated to range from \$3.28 million using a 7-percent discount rate to \$4.26 million using a 3-percent discount rate.

Table 33 Total NRC Costs

Attribute	NRC Costs		
	Undiscounted	7% NPV	3% NPV
Total NRC Implementation Cost:	(\$220,000)	(\$180,000)	(\$200,000)
Total NRC Operation Cost:	\$5,710,000	\$3,450,000	\$4,460,000
Total NRC Cost:	\$5,490,000	\$3,280,000	\$4,260,000

5.9 Improvements in Knowledge

Relative to the regulatory baseline (Alternative 1), Alternative 2 would improve knowledge by enhancing the ability of the industry and the NRC staff to gain experience with new technology and by permitting licensees to use advancements in ISI and IST. Improved ISI and IST may result in the earlier identification of material degradation that, if undetected, could result in further degradation that eventually results in a plant transient. On-the-job learning also increases worker satisfaction. Developing greater knowledge and a common understanding of the ASME BPV and OM Codes and eliminating unnecessary work would better enable the industry and NRC staff to produce desired on-the-job results, which lead to pride in performance and increased job satisfaction.

5.10 Regulatory Efficiency

Relative to the regulatory baseline (Alternative 1), Alternative 2 would increase regulatory efficiency because of the resulting consistency between the ASME BPV and OM Codes and NRC regulations. Licensees and applicants that wish to use more current editions or addenda of the ASME Codes would not be required to submit 10 CFR 50.55a(z) alternative requests to the NRC for review and approval. This would provide licensees and applicants with flexibility and would decrease licensee's uncertainty when making modifications or preparing to perform ISI or IST.

Additionally, Alternative 2 is consistent with the provisions of the NTTAA and its implementing guidance, which encourage 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 policy of evaluating the latest versions of consensus standards in terms of their suitability for endorsement by regulations. 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.

The NRC does not recommend Alternative 1 for the following two reasons:

- (1) Licensees may submit a large number of requests for alternatives to use more current editions or addenda of the ASME Codes and applicable Code Cases under 10 CFR 50.55a(z). This process would result in increased regulatory burden to licensees and the NRC.
- (2) The NRC's role as an effective industry regulator would be undermined. Although ASME periodically publishes and revises its Codes, under Alternative 1, outdated material would remain incorporated by reference in the *Code of Federal Regulations*.

5.11 Other Considerations

5.11.1 National Technology Transfer and Advancement Act of 1995

Alternative 2 is consistent with the provisions of the National Technology Transfer and Advancement Act of 1995 (Ref. 8.5.) and its implementing guidance in OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities," dated February 10, 1998 (Ref. 8.22.), which encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry.

5.11.2 Continued NRC Practice of Incorporation by Reference of ASME Code Editions and Addenda into the Code of Federal Regulations

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

Given the existing data and information, Alternative 2 is the most effective way to implement the updated ASME Codes. The updates would amend 10 CFR 50.55a to incorporate by reference the following ASME Code editions, addenda, and Code Cases:

- the 2009 Addenda, 2010 Edition, 2011 Addenda, and 2013 Edition of the ASME BPV Code, Section III, Division 1, and ASME BPV Code, Section XI, Division 1
- the 2009 Edition, 2011 Addenda, and 2012 Edition of the ASME OM Code

- ASME BPV Code Case N-729-4, “Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1”
- ASME BPV Code Case N-770-2, “Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities, Section XI, Division 1”
- ASME BPV Code Case N-824, “Ultrasonic Examination of Cast Austenitic Piping Welds From the Outside Surface Section XI, Division 1”
- ASME OM Code Case OMN-20, “Inservice Test Frequency
- ASME NQA-1, “Quality Assurance Requirements for Nuclear Facility Applications,” including the 1983 Edition through the 1992 Addenda to the 1989 Edition, 1994 Edition, 2008 Edition, and 2009-1a Addenda to the 2008 Edition

5.11.3 *Risk-Informed Inservice Testing*

The following provisions of the ASME OM Code embody the Alternative 2 risk-informed approach:

- 10 CFR 50.55a(b)(3)(ii): OM Condition: Motor-Operated Valve (MOV) Testing
- 10 CFR 50.55a(b)(3)(iii)(D): New reactor high-risk nonsafety systems
- 10 CFR 50.55a(b)(3)(viii): Subsection ISTE for risk-informed inservice testing of pumps and valves

These ASME OM Code provisions establish risk-informed approaches that are used to maintain nuclear power plant safety and are consistent with the NRC’s efforts to risk-inform its regulatory activities. The risk-informed approach (1) is consistent with the defense-in-depth philosophy, (2) provides reasonable assurance that necessary safety functions will be performed, (3) provides reasonable confidence that any increases in core damage frequency or large early release frequency (and therefore risk) are small, (4) is consistent with the Commission’s Safety Goal Policy Statement, and (5) uses a performance measurement strategy.

5.11.4 *Increased Public Confidence*

Alternative 2 incorporates the current ASME Code edition, addenda, and Code Cases for the design, construction, operation, ISI, and IST of nuclear power plants by approving the use of later editions and addenda of the ASME BPV and OM Codes in 10 CFR 50.55a. This alternative would allow licensees to use risk-informed, performance-based approaches and the

most current methods and technology to design, construct, operate, examine, and test nuclear power plant components while maintaining NRC oversight of these activities, which increases public confidence.

5.11.5 *Reliable Assessment of Cast Austenitic Stainless Steel Materials*

The ability to provide a reliable assessment of CASS materials is important for life extension and license renewal activities. There remains a level of concern with CASS components because of the possibility of thermal embrittlement over time and the limitations of current volumetric inspection techniques. Establishing a robust aging management approach for CASS components would improve the knowledge of the material condition of those components exposed to reactor coolant environments and improve the current state, which is currently constrained by a lack of data, operating experience, and proven NDE solutions.

5.12 **Uncertainty Analysis**

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

5.12.1 *Uncertainty Analysis Assumptions*

As this regulatory analysis is based on estimates of values that are sensitive to plant-specific cost drivers and plant dissimilarities, the NRC staff provides the following analysis of the variables that have the greatest amount of uncertainty. To perform this analysis, the NRC staff used a Monte Carlo simulation analysis using the @Risk software program.¹²

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

The probability distributions chosen to represent the different variables in the analysis were bounded by the range-referenced input and the NRC staff’s professional judgment. When defining the probability distributions for use in a Monte Carlo simulation, summary statistics are needed to characterize the distributions. These summary statistics include the minimum, most likely, and maximum values of a PERT distribution,¹³ the minimum and maximum values of a

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

13 A PERT distribution is a special form of the beta distribution with specified minimum and maximum values. The shape parameter is calculated from the defined *most likely* value. The PERT distribution is similar to a triangular distribution in that it has the same set of three parameters. Technically, it is a special case of a scaled beta (or beta general) distribution. The PERT distribution is generally considered superior to the triangular distribution when the parameters result in a skewed distribution, as the smooth shape of the curve

uniform distribution, and the specified integer values of a discrete population. The staff used the PERT distribution to reflect the relative spread and skewness of the distribution defined by the three estimates.

Table 34 identifies the data elements, the distribution and summary statistic, and the mean value of the distribution that were used in the uncertainty analysis.

Table 34 Uncertainty Analysis Variables

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Program Revision to the QAPD to Incorporate the ASME NQA-1 Program (Hypothetical Units)					
Weighted hourly rate for procedure update	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to revise QAPD program	230	PERT	180	200	400
Number of entities	1	PERT	1	1	1
Update Concrete Containment Examination Procedures (Operating Units)					
Weighted hourly rate for procedure update	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to update concrete containment exam procedures	23.0	PERT	18	20	40
Number of sites	46.0	PERT	46	46	46
Incorporate Fracture Toughness Provision (Operating Sites)					
Weighted hourly rate for procedure update	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to update fracture toughness procedures	172.5	PERT	135	150	300
Number of sites	11	PERT	11	11	11
ASME BPV Code Case N-824 Optional Provision (Operating PWR Sites)					
Procedure Revision to Incorporate the Ultrasonic Examination Provisions of ASME BPV Code Case N-824					
Weighted hourly rate for procedure update	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to update ASME BPV Code Case N-824 procedures	69.0	PERT	54	60	120
Develop Training Module for the Ultrasonic Examination Provisions of ASME BPV Code Case N-824					
Training module cost	\$40,000	PERT	\$20,000	\$40,000	\$60,000
Number of sites	4.83	PERT	0	1	25
Ultrasonic Examination Equipment to Implement ASME BPV Code Case N-824					
Equipment cost and installation	\$28,333.33	PERT	\$20,000	\$25,000	\$50,000
Number of sites	22.83	PERT	0	25	37

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 if it is desired to capture tail or extreme events.

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Mandatory MOV Testing or Engineering Analysis to Demonstrate Alignment with IST (Operating Units)					
Estimated cost per valve	\$15,667	PERT	\$14,000	\$15,000	\$20,000
Number of units	67.0	PERT	67	67	67
Number of valves identified	10	PERT	9	10	11
Supplemental Requirements Provision (Future Units)					
Weighted hourly rate for procedure update (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to revise procedures (engineer)	46.0	PERT	36	40	80
Weighted hourly rate for procedure update (technician)	\$100.29	PERT	\$80.49	\$100.74	\$118.26
Hours to revise procedures (technician)	46.0	PERT	36	40	80
Number of entities	5.0	PERT	5	5	5
Squib Valve Surveillance Provision (Future Units)					
Weighted hourly rate for procedure update (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to update squib valve procedure (engineer)	46.0	PERT	36	40	80
Number of entities	3.0	PERT	3	3	3
ASME OM Code Mandatory Appendix V Provision (Operating and Future Sites)					
Weighted hourly rate for procedure update (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to revise program (engineer)	9.2	PERT	7.2	8.0	16
Number of operating sites	55.0	PERT	55	55	55
Number of new sites	2.0	PERT	2	2	2
ASME OM Code Subsection ISTE Optional Provision (Operating and Future Sites)					
Weighted hourly rate for request (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to obtain authorization (engineer)	2,300.0	PERT	1,800	2,000	4,000
Number of operating sites	1.0	PERT	1	1	1
Number of new sites	1.0	PERT	1	1	1
ASME OM Code Subsection ISTE Optional Provision (Operating and Future Sites)					
Weighted hourly rate for risk-informed categorization (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to produce categorization (engineer)	1,150.0	PERT	900	1000	2000

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Number of operating sites	1.0	PERT	1	1	1
Number of new sites	1.0	PERT	1	1	1
ASME OM Code Subsection ISTF Pump Testing Provision (Future Units)					
Weighted hourly rate for procedure update (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to revise procedures (engineer)	34.5	PERT	27	30	60
Number of plants	5.0	PERT	5	5	5
Cast Stainless Steel Material Examination Provision (Operating PWR Sites)					
Weighted hourly rate for procedure update (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to revise procedures (engineer)	30.0	PERT	20	30	40
Number of training modules	6.3	PERT	1	4.0	21
Cost to develop training module	\$40,000	PERT	\$20,000	\$40,000	\$60,000
Number of training mockups for training program	40	PERT	21	38	65
Cost of training mockups (one instance)	\$75,000	PERT	\$50,000	\$75,000	\$100,000
Equipment costs (phased array probes) for all sites	\$21,000	PERT	\$16,000	\$20,000	\$30,000
Number of sites	37.0	PERT	37	37	37
Hours of training per site	18.0	PERT	16	18	20
Averted Code Case Relief Request Costs (Operating Sites)					
Weighted hourly rate for relief request (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours for relief request preparation and submission	380.0	PERT	100	380	660
Number of sites (recurring annual cost)	18.7	PERT	16	19	20
Concrete Containment Examinations Provision (Operating Units)					
Hourly rate for technician	\$100.29	PERT	\$80.49	\$100.74	\$118.26
Hours for inspections	11.5	PERT	9	10	20
Number of units (recurring annual cost)	23.5	PERT	23.5	23.5	23.5
Concrete Containment Examinations Provision (Future Units)					
Hourly rate for technician	\$100.29	PERT	\$80.49	\$100.74	\$118.26
Hours for examinations	11.5	PERT	9	10	20
Number of sites (recurring annual cost)	2.5	PERT	2	2.5	3
ASME BPV Code Case N-824 Ultrasonic Examination Optional Provision (Operating Units)					
Weld Exam Costs (10-year recurring exam)					
Hourly rate for technical staff	\$100.29	PERT	\$80.49	\$100.74	\$118.26
Hours for weld exams	34.5	PERT	27	30	60

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Weld Exam Dose Costs (10-year recurring exam)					
Current dollar per person-rem conversion factor	\$2,000	PERT	\$2,000	\$2,000	\$2,000
Radiation field (rem/hour) for weld exams	0.033	PERT	0.007	0.025	0.090
Number of hours (recurring cost)	217.5	PERT	0	188	555
Weld Exam Relief Requests (10-year recurring exam)					
Hourly rate for technical staff	\$100.29	PERT	\$80.49	\$100.74	\$118.26
Hours for relief requests	345.0	PERT	270	300	600
MOV IST Provision (Operating Units)					
Quarterly MOV Exercise Tests Averted Costs					
Weighted hourly rate for testing (technical staff)	\$107.05	PERT	\$87.07	\$107.27	\$126.15
Hours per unit (technical staff)	1.0	PERT	1	1	1
Tests per year	4.0	PERT	4	4	4
Number of MOVs for quarterly test	96.0	PERT	70	96.5	120
Number of units (recurring annual cost)	67.0	PERT	67	67	67
MOV Quarterly Personnel Dose Calculation					
Current dollar per person-rem conversion factor	\$2,000	PERT	\$2,000	\$2,000	\$2,000
Radiation field (rem/hour) for quarterly MOV testing	0.033	PERT	0.007	0.025	0.090
Annual change in hours due to MOV testing	1,072	PERT	782	1,078	1,340
Tests per year	4.0	PERT	4	4	4
Biannual MOV Exercise Test					
Weighted hourly rate for testing (technical staff)	\$107.05	PERT	\$87.07	\$107.27	\$126.15
Hours for test (technical staff)	1.0	PERT	1	1	1
Number of MOVs for biannual test	106.0	PERT	79	106.5	131
Number of units (recurring annual cost)	32.5	PERT	32.5	32.5	32.5
Tests per year	1.0	PERT	1	1	1
MOV Biannual Test Personnel Dose Calculation					
Current dollar per person-rem conversion factor	\$2,000	PERT	\$2,000	\$2,000	\$2,000
Radiation field (rem/hour) for biannual MOV testing	0.033	PERT	0.007	0.025	0.090

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Change in hours due to MOV testing (annualized)	144	PERT	107	144	177
Tests per year	1.0	PERT	1	1	1
MOV Diagnostic Test on 10-Year Test Interval					
Weighted hourly rate for testing (technical staff)	\$107.05	PERT	\$87.07	\$107.27	\$126.15
Hours for test (technical staff)	12.0	PERT	8	12	16
Number of MOVs for diagnostic test	10.0	PERT	9	10	11
Number of units (recurring cost)	67.0	PERT	67	67	67
Tests per year	1.0	PERT	1	1	1
MOV Diagnostic Test Personnel Dose Calculation					
Current dollar per person-rem conversion factor	\$2,000	PERT	\$2,000	\$2,000	\$2,000
Proposed dollar per person-rem conversion factor	\$5,267	PERT	\$3,100	\$5,200	\$7,700
Radiation field (rem/hour) for diagnostic MOV testing	0.033	PERT	0.007	0.025	0.090
Change in hours due to MOV testing (every 10 years)	1355	PERT	804	1340	1965
Tests per year	1.0	PERT	1	1	1
ASME OM Code Mandatory Appendix V Pump Verification Test Provision (Operating Units)					
Weighted hourly rate for testing (technical staff)	\$107.05	PERT	\$87.07	\$107.27	\$126.15
Hours for test (technical staff)	17.3	PERT	13.5	15.0	30
Number of units (recurring cost)	16.7	PERT	15	15	25
ASME OM Code Mandatory Appendix V Pump Verification Test Provision (Future Units)					
Weighted hourly rate for testing (technical staff)	\$107.05	PERT	\$87.07	\$107.27	\$126.15
Hours for test (technical staff)	17.3	PERT	13.5	15.0	30
Number of plants (recurring cost)	1.0	PERT	1	1	1
ASME OM Code Case OMN-20 Time Period Extension Optional Provision (Operating Units)					
Weighted hourly rate for relief request (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to submit extension (engineer)	230.0	PERT	180	200	400
Number of units (recurring cost)	96.0	PERT	96	96	96
ASME OM Code Case OMN-20 Time Period Extension Optional Provision (Future Units)					
Weighted hourly rate for relief request (engineer)	\$117.30	PERT	\$94.23	\$117.62	\$139.13
Hours to submit extension (engineer)	230.0	PERT	180	200	400
Number of units (recurring cost)	5.0	PERT	5	5	5

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Industry Operation—Encoding Ultrasonic Volumetric Examinations Provision (Operating PWRs)					
Cost to examine welds	\$7,500	PERT	\$5,000	\$7,500	\$10,000
Additional welds to receive encoding annualized	3	PERT	2	3	4
Number of operating PWR units	65	PERT	65	65	65
NRC Develop and Issue Proposed and Final Rule					
Hourly rate for NRC staff	\$128.00	PERT	\$128	\$128	\$128
Hours to develop and issue rules	920.0	PERT	720	800	1,600
Number of years	2.0	PERT	2	2	2
NRC ASME OM Code Subsection ISTE Risk-informed IST Provision Guidance					
Hourly rate for NRC staff	\$128.00	PERT	\$128	\$128	\$128
Hours to develop and issue guidance	460.0	PERT	360	400	800
Number of actions	2.0	PERT	2	2	2
NRC ASME OM Code Subsection ISTE Risk-informed IST Provision Safety Evaluation Report					
Hourly rate for NRC staff	\$128.00	PERT	\$128	\$128	\$128
Hours to review Subsection ISTE submittal and develop safety evaluation report	862.5	PERT	675	750	1,500
Number of actions	2.0	PERT	2	2	2
NRC Averted Code Alternative Request Review					
Hourly rate for NRC staff	\$128.00	PERT	\$128	\$128	\$128
Hours to review	241.5	PERT	189	210	420
Number of actions (recurring averted cost)	7.2	PERT	7	7	8
NRC Review of ASME OM Code Case OMN-20 Alternative Request and Issue Safety Evaluation (Operating Units)					
Hourly rate for NRC staff	\$128.00	PERT	\$128	\$128	\$128
Hours for safety evaluation report	115.0	PERT	90	100	200
Number of actions	96.0	PERT	96	96	96
NRC Review of ASME OM Code Case OMN-20 Alternative Request and Issue Safety Evaluation (Future Units)					
Hourly rate for NRC staff	\$128.00	PERT	\$128	\$128	\$128
Hours to review and issue safety evaluation report	115.0	PERT	90	100	200
Number of actions	5.0	PERT	5	5	5
NRC Review of ASME BPV Code Case N-824 Weld Exam Relief Requests (10-year recurring exam)					
Hourly rate for NRC technical staff	\$128.00	PERT	\$128	\$128	\$128
Hours for relief requests	115.0	PERT	90	100	200
Number of sites (recurring cost)	22.8	PERT	0	25	37

5.12.2 Uncertainty Analysis Results

The NRC performed the Monte Carlo simulation by repeatedly recalculating the results, up to 10,000 times. For each iteration, the values identified in Table 34 were chosen randomly from the probability distributions that define the input variables. The values of the output variables were recorded for each iteration, and these resulting output variable values were used to define the resultant probability distribution.

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

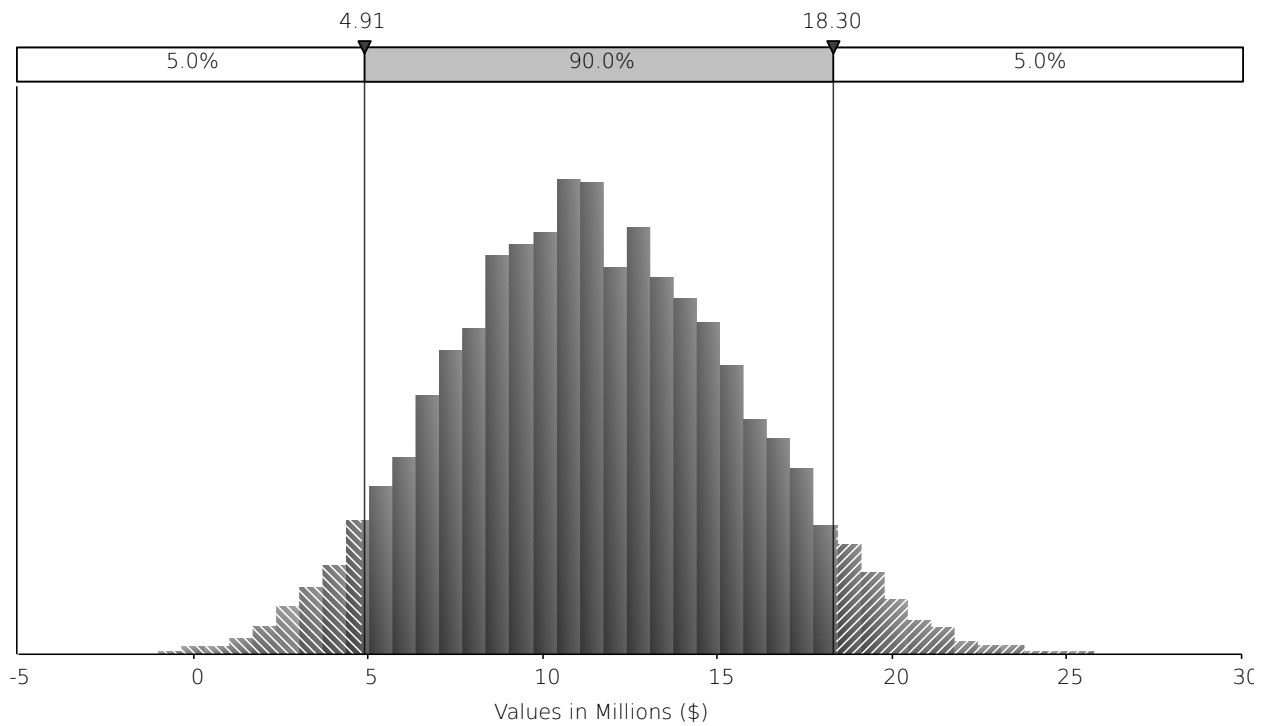


Figure 1 Total industry costs (7-percent NPV)—Alternative 2

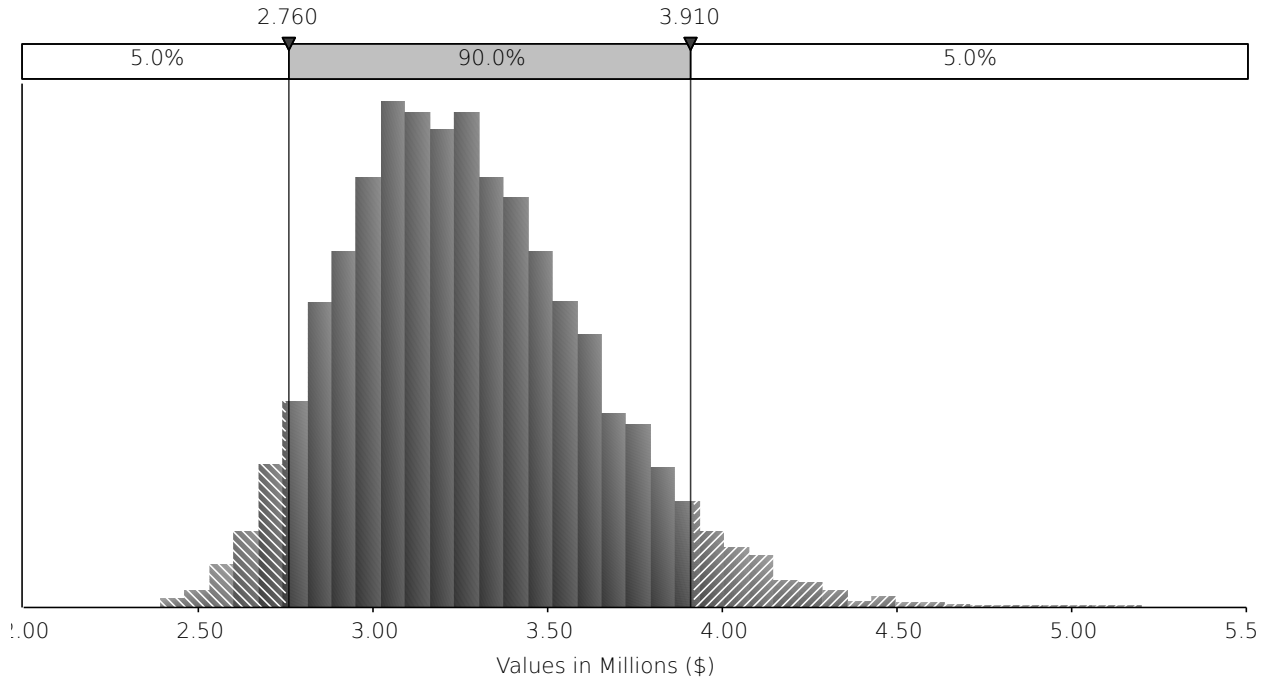


Figure 2 Total NRC costs (7-percent NPV)—Alternative 2

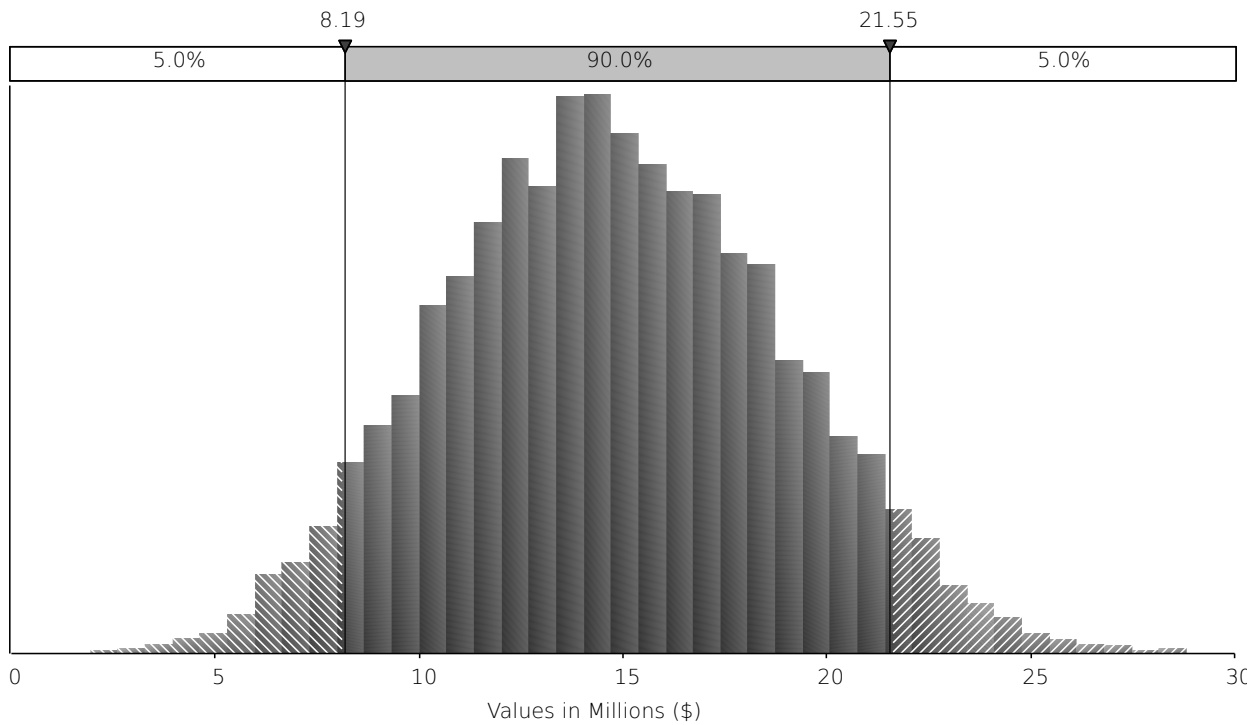


Figure 3 Total costs (7-percent NPV)—Alternative 2

Table 35 presents descriptive statistics on the uncertainty analysis. The 5-percent and 95-percent values (i.e., the bands marked 5.0% on either side of the 90.0% confidence interval)

that appear as numerical values on the top of the vertical lines in Figure 1, 2, and 3 are reflected in Table 35 (rounded) as the 0.05 and 0.95 values, respectively.

Table 35 Uncertainty Results Descriptive Statistics (7-Percent NPV)

Uncertainty Result	Incremental Cost-Benefit (2017 million dollars)					
	Min	Mean	Mode	Max	0.05	0.95
Total Industry Cost	(\$0.99)	\$11.5	\$11.4	\$25.8	\$4.91	\$18.3
Total NRC Cost	\$2.39	\$3.28	\$3.13	\$5.2	\$2.76	\$3.91
Total Cost	\$1.93	\$14.7	\$13.8	\$28.8	\$8.19	\$21.6

Examining the range of the resulting output distribution provided in Table 35, it is possible to more confidently discuss the potential incremental costs and benefits of the draft final rule. This table displays the key statistical results, including the 90-percent confidence interval in which the net benefits would fall between the 5-percent and 95-percent percentile values.

Figure 4 shows a tornado diagram that identifies the key variables whose uncertainty drives the largest impact on total costs (and averted costs) for this draft final rulemaking. This figure ranks the variables based on their contribution to cost uncertainty. Two variables—the number of valves involved in the quarterly MOV testing and the technician hourly rate for performing MOV testing—drive the most uncertainty in the costs. The remaining key variables show diminishing variation.

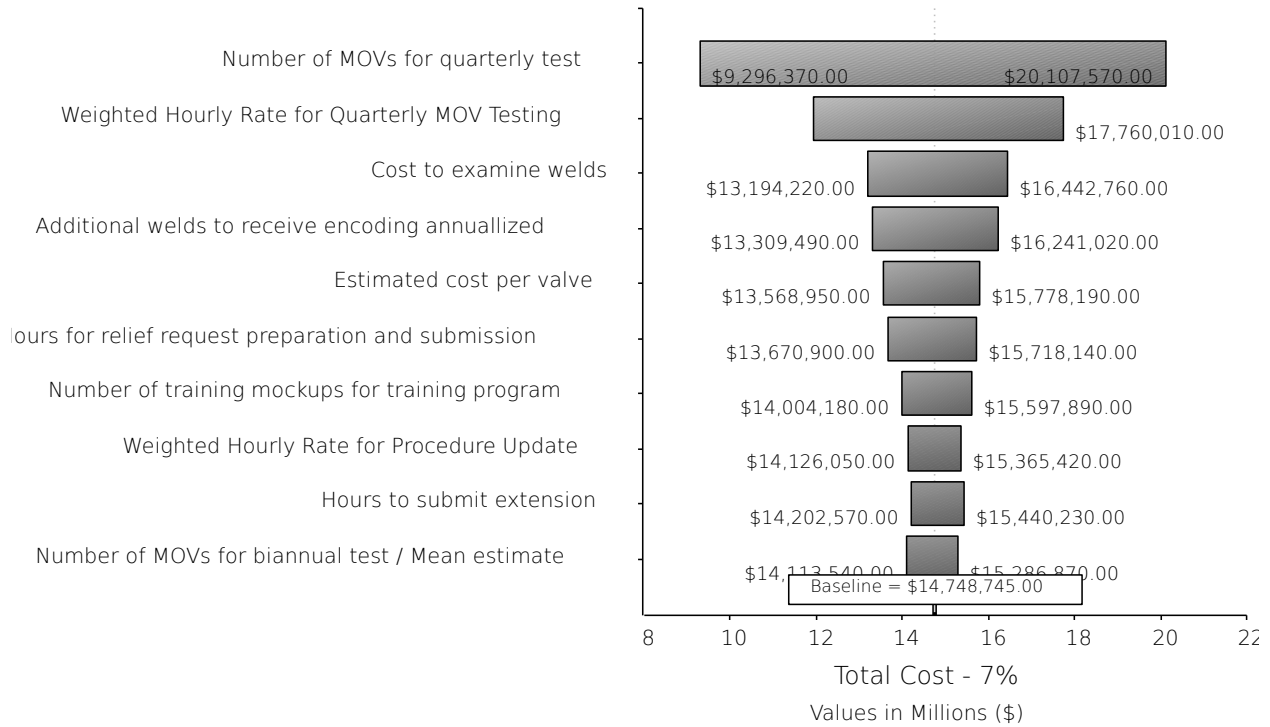


Figure 4 Top 10 variables for which uncertainty drives the largest impact on total costs (7-percent NPV)—Alternative 2

As can be seen in Figure 5, the averted costs for the industry and the NRC for this rulemaking have a mean value of \$41.9 million at a 7-percent discount rate. The uncertainty analysis shows a 95-percent chance that the averted costs will be greater than \$35.6 million. This is the primary reason for concluding that the benefits of this rulemaking outweigh the costs.

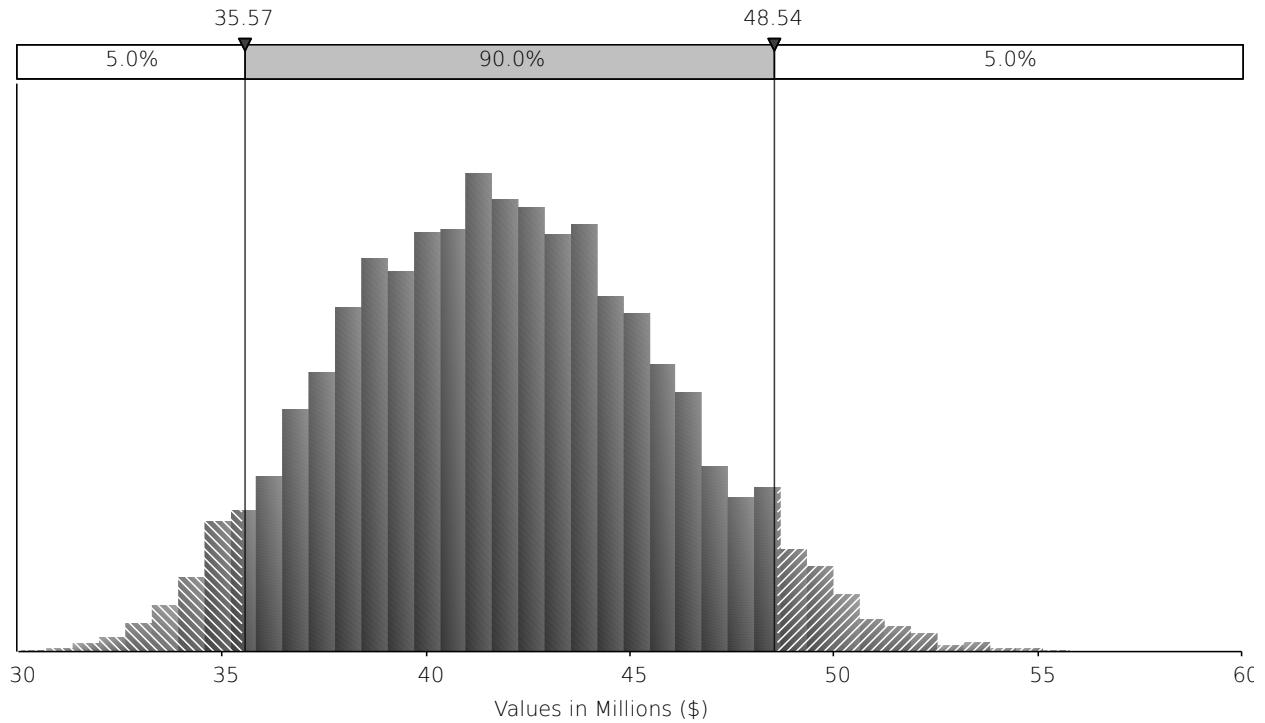


Figure 5 Averted costs (7-percent NPV)—Alternative 2

5.12.3 Summary of Uncertainty Analysis

The simulation analysis shows that the estimated mean benefit (i.e., positive averted costs, savings) for this draft final rule is \$14.7 million with 90 percent confidence that the benefit is between \$8.19 million and \$21.6 million using a 7-percent discount rate (see Table 35). A reasonable inference from the uncertainty analysis is that proceeding with the draft final rule represents an efficient use of resources and averted costs to for the NRC and the industry.

5.13 Disaggregation

In order to comply with the guidance in Section 4.3.2, “Criteria for the Treatment of Individual Requirements,” of the NRC Regulatory Analysis Guidelines (Ref. 8.13.), the NRC performed a screening review to determine whether any of the individual requirements (or set of integrated requirements) of the draft 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 standards; provide updated rules for the design, construction, operation, ISI, and IST of safety-related systems; and impose conditions on the use of the updated standards referenced in the rules. Furthermore, the NRC concludes that each of the requirements in the draft final rule would be necessary to achieve one or more objectives of the rulemaking. Table 36 shows the results of this screening review.

Table 36 Disaggregation

Revised Requirements	Regulatory Goals		
	Incorporate by reference standards	Provide updated rules for design, construction, operation, ISI, and IST	Impose conditions on the use of updated standards
10 CFR 50.55a(a)(1)(i)(E): Rules for Construction of Nuclear Facility Components—Division 1	X	X	
10 CFR 50.55a(a)(1)(ii)(C): Rules for Inservice Inspection of Nuclear Power Plant Components—Division 1	X	X	
10 CFR 50.55a(a)(1)(iii)(C): ASME Code Case N-729-4	X	X	
10 CFR 50.55a(a)(1)(iii)(D): ASME Code Case N-770-2	X	X	
10 CFR 50.55a(a)(1)(iii)(E): ASME Code Case N-824	X	X	
10 CFR 50.55a(a)(1)(iv)(B): Operation and Maintenance of Nuclear Power Plants, Division 1: Section IST Rules for Inservice Testing of Light-Water Reactor Power Plants	X	X	
10 CFR 50.55a(a)(1)(iv)(C): Operation and Maintenance of Nuclear Power Plants, Division 1: OM Code: Section IST	X	X	
10 CFR 50.55a(a)(1)(v): ASME Quality Assurance Requirements	X	X	
10 CFR 50.55a(a)(1)(v)(A): ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities	X	X	
10 CFR 50.55a(a)(1)(v)(B): ASME NQA-1, Quality Assurance Requirements for Nuclear Facility Applications	X	X	
10 CFR 50.55a(b)(1): Conditions on ASME BPV Code, Section III		X	X
10 CFR 50.55a(b)(1)(ii): Section III Condition: Weld Leg Dimensions		X	X
10 CFR 50.55a(b)(1)(iii) Section III Condition: Seismic Design of Piping		X	X
10 CFR 50.55a(b)(1)(iv) Section III Condition: Quality Assurance		X	X

Revised Requirements	Regulatory Goals		
	Incorporate by reference standards	Provide updated rules for design, construction, operation, ISI, and IST	Impose conditions on the use of updated standards
10 CFR 50.55a(b)(1)(vii): Section III Condition: Capacity Certification and Demonstration of Function of Incompressible-Fluid Pressure-Relief Valves		X	X
10 CFR 50.55a(b)(2): Conditions on ASME BPV Code, Section XI		X	X
10 CFR 50.55a(b)(2)(vi): Section XI Condition: Effective Edition and Addenda of Subsection IWE and Subsection IWL		X	X
10 CFR 50.55a(b)(2)(viii): Section XI Condition: Concrete Containment Examinations		X	X
10 CFR 50.55a(b)(2)(viii)(H): Concrete Containment Examinations: Eighth Provision		X	X
10 CFR 50.55a(b)(2)(viii)(I): Concrete Containment Examinations: Ninth Provision		X	X
10 CFR 50.55a(b)(2)(ix): Section XI Condition: Metal Containment Examinations		X	X
10 CFR 50.55a(b)(2)(ix)(D): Metal Containment Examinations: Fourth Provision		X	X
10 CFR 50.55a(b)(2)(x): Section XI Condition: Quality Assurance		X	X
10 CFR 50.55a(b)(2)(xviii)(D): NDE Personnel Certification: Fourth Provision		X	X
10 CFR 50.55a(b)(2)(xxi)(A): Table IWB-2500-1 Examination Requirements: First Provision		X	X
10 CFR 50.55a(b)(2)(xxxi): Section XI Condition: Mechanical Clamping Devices		X	X
10 CFR 50.55a(b)(2)(xxxii): Section XI Condition: Summary Report Submittal		X	X
10 CFR 50.55a(b)(2)(xxxiii): Section XI Condition: Risk-Informed Allowable Pressure		X	X

Revised Requirements	Regulatory Goals		
	Incorporate by reference standards	Provide updated rules for design, construction, operation, ISI, and IST	Impose conditions on the use of updated standards
10 CFR 50.55a(b)(2)(xxxiv): Section XI Condition: Disposition of Flaws in Class 3 Components		X	X
10 CFR 50.55a(b)(2)(xxxv): Section XI Condition: Use of RT _{T0} in the K _{Ia} and K _{Ic} Equations		X	X
10 CFR 50.55a(b)(2)(xxxvi): Section XI Condition: Fracture Toughness of Irradiated Materials		X	X
10 CFR 50.55a(b)(2)(xxxvii): Section XI Condition: Code Case N-824		X	X
10 CFR 50.55a(b)(3): Conditions on ASME OM Code		X	X
10 CFR 50.55a(b)(3)(i): OM Condition: Quality Assurance		X	X
10 CFR 50.55a(b)(3)(ii): OM Condition: Motor-Operated Valve (MOV) Testing		X	X
10 CFR 50.55a(b)(3)(ii)(A): MOV Diagnostic Test Interval		X	X
10 CFR 50.55a(b)(3)(ii)(B): MOV Testing Impact on Risk		X	X
10 CFR 50.55a(b)(3)(ii)(C): MOV Risk Categorization		X	X
10 CFR 50.55a(b)(3)(ii)(D): MOV Stroke Time		X	X
10 CFR 50.55a(b)(3)(iii): OM Condition: New Reactors		X	X
10 CFR 50.55a(b)(3)(iii)(A): New Reactor Power-Operated Valves		X	X
10 CFR 50.55a(b)(3)(iii)(B): New Reactor Check Valves		X	X
10 CFR 50.55a(b)(3)(iii)(C): New Reactor Flow-Induced Vibration		X	X
10 CFR 50.55a(b)(3)(iii)(D): New Reactor High Risk Nonsafety Systems		X	X
10 CFR 50.55a(b)(3)(iv): OM Condition: Check Valves (Appendix II)		X	X
10 CFR 50.55a(b)(3)(iv)(A): Check Valves: First Provision		X	X

Revised Requirements	Regulatory Goals		
	Incorporate by reference standards	Provide updated rules for design, construction, operation, ISI, and IST	Impose conditions on the use of updated standards
10 CFR 50.55a(b)(3)(iv)(B): Check Valves: Second Provision		X	X
10 CFR 50.55a(b)(3)(iv)(C): Check Valves: Third Provision		X	X
10 CFR 50.55a(b)(3)(iv)(D): Check Valves: Fourth Provision		X	X
10 CFR 50.55a(b)(3)(v): OM Condition: Subsection ISTD		X	X
10 CFR 50.55a(b)(3)(v)(A): Snubbers: First Provision		X	X
10 CFR 50.55a(b)(3)(v)(B): Snubbers: Second Provision		X	X
10 CFR 50.55a(b)(3)(vi): OM Condition: Exercise Interval for Manual Valves		X	X
10 CFR 50.55a(b)(3)(vii): OM Condition: Subsection ISTB		X	X
10 CFR 50.55a(b)(3)(viii): OM Condition: Subsection ISTE		X	X
10 CFR 50.55a(b)(3)(ix): OM Condition: Subsection ISTF		X	X
10 CFR 50.55a(b)(3)(x): OM Condition: Code Case OMN-20		X	X
10 CFR 50.55a(b)(3)(xi): OM Condition: Clarification of Valve Position Verification Requirements		X	X
10 CFR 50.55a(f): Inservice Testing Requirements		X	
10 CFR 50.55a(f)(3)(iii)(A): Class 1 Pumps and Valves: First Provision		X	X
10 CFR 50.55a(f)(3)(iii)(B): Class 1 Pumps and Valves: Second Provision		X	X
10 CFR 50.55a(f)(3)(iv)(A): Class 2 and 3 Pumps and Valves: First Provision		X	X
10 CFR 50.55a(f)(3)(iv)(B): Class 2 and 3 Pumps and Valves: Second Provision		X	X
10 CFR 50.55a(g)(6)(ii)(D): Augmented ISI Requirements: Reactor Vessel Head Inspections		X	X

Revised Requirements	Regulatory Goals		
	Incorporate by reference standards	Provide updated rules for design, construction, operation, ISI, and IST	Impose conditions on the use of updated standards
10 CFR 50.55a(g)(6)(ii)(F): Augmented ISI Requirements: Examination Requirements for Class 1 Piping and Nozzle Dissimilar-Metal Butt Welds		X	X

5.14 Hypothetical Future Operating Reactors

The NRC staff is aware of the potential for future operating reactors, but the uncertainties in their likelihood and timing are too great for them to be properly added into the regulatory analysis. Therefore, the NRC assumes a hypothetical future operating reactor (a single reactor at a new site) beginning operation in a hypothetical year (year X), based on 2017 dollars, to determine the cost to the industry and the NRC for the future operating reactor.

As shown in Table 37 through Table 42, the industry would incur both implementation and operating costs in relation to a hypothetical future reactor. The NRC staff expects that a hypothetical future reactor would be designed to incorporate some of the aforementioned provisions affecting future reactors. The tables below estimate the costs of the remaining provisions that would impact a hypothetical future reactor. These include costs for quality assurance program revision, squib valve surveillance requirements, Appendix V pump periodic verification, the ASME OM Code Subsection ISTE provision, ASME OM Code Subsection ISTF pump testing, Appendix V pump period verification, and ASME OM Code Case OMN-20 time period extension requests. The sections above describe all of these costs for future reactors. The total industry cost for a hypothetical future operating reactor is estimated at (\$73,925), undiscounted.

Table 37 Program Revision to QAPD to Incorporate the ASME NQA-1 Program

Year	Activity	Number of Entities	Per AOR		Cost
			Hours	Weighted Hourly rate	Undiscounted
X	Revise QA program to be in alignment with 50.55a	1	230	\$117	(\$26,980)
Total:					(\$26,980)

Table 38 Squib Valve Surveillance Provision

Year	Activity	Number of Entities	Per AOR		Cost
			Hours	Weighted Hourly rate	Undiscounted
X	Program Revision Incorporate Squib Valve Surveillance Requirements for New Reactors	1	46	\$117	(\$5,396)
Total:					(\$5,396)

Table 39 ASME OM Code Mandatory Appendix V Provision

Year	Activity	Number of Entities	Per AOR		Cost
			Hours	Weighted Hourly rate	Undiscounted
X	Program Revision to Incorporate Mandatory Appendix V on Pump Periodic Verification Program	1	9	\$117	(\$1,079)
Total:					(\$1,079)

Table 40 ASME OM Code Subsection ISTE Optional Provision

Year	Activity	Number of Entities	Per AOR		Cost
			Hours	Weighted Hourly rate	Undiscounted
X	Obtain authorization to use Subsection ISTE (Risk-informed IST)	1	1150	\$117	(\$134,899)
Total:					(\$134,899)

Table 41 ASME OM Code Mandatory Appendix V Pump Verification Test Provision

Year	Activity	Number of Entities	Per AOR		Cost		
			Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
X to X + 60	Pump periodic verification test (biannual)	1	17	\$117	(\$121,409)	(\$28,408)	(\$89,820)
Total:					(\$121,409)	(\$28,408)	(\$89,820)

Table 42 ASME OM Code Case OMN-20 Time Period Extension Optional Provision

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
X	Prepare and submit OMN-20 Time Period Extension Request	1	230	\$117	\$26,980	\$26,980	\$26,980
X +10	Prepare and submit OMN-20 Time Period Extension Request	1	230	\$117	\$26,980	\$13,715	\$20,076
X + 20	Prepare and submit OMN-20 Time Period Extension Request	1	230	\$117	\$26,980	\$6,972	\$14,938
X + 30	Prepare and submit OMN-20 Time Period Extension Request	1	230	\$117	\$26,980	\$3,544	\$11,115
X + 40	Prepare and submit OMN-20 Time Period Extension Request	1	230	\$117	\$26,980	\$1,802	\$8,271
X + 50	Prepare and submit OMN-20 Time Period Extension Request	1	230	\$117	\$26,980	\$916	\$6,154
X + 60	Prepare and submit OMN-20 Time Period Extension Request	1	230	\$117	\$26,980	\$466	\$4,579
Total:					\$188,859	\$54,395	\$92,113

As shown in Table 43 through Table 45, the NRC would incur implementation and operation costs because of this rulemaking for a hypothetical future operating reactor. These include costs for quality assurance program review, ASME OM Code Case OMN-20 time period extension requests, and Code Case relief request reviews. All costs correlate to the new reactor costs detailed in the sections above. The total NRC hypothetical future operating reactor averted cost is estimated at \$133,952, undiscounted.

Table 43 Program Revision to QAPD to Incorporate the ASME NQA-1 Program

Year	Activity	Number of Entities	Per AOR		Cost
			Hours	Weighted Hourly rate	Undiscounted
X	Review QA program revision	1	100	\$128	(\$12,800)
Total:					(\$12,800)

Table 44 ASME OM Code Case OMN-20 Time Period Extension Optional Provision

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
X	Prepare and submit OMN-20 Time Period Extension Request	1	115	\$128	\$14,720	\$14,720	\$14,720
X +10	Prepare and submit OMN-20 Time Period Extension Request	1	115	\$128	\$14,720	\$7,483	\$10,953
X + 20	Prepare and submit OMN-20 Time Period Extension Request	1	115	\$128	\$14,720	\$3,804	\$8,150
X + 30	Prepare and submit OMN-20 Time Period Extension Request	1	115	\$128	\$14,720	\$1,934	\$6,064
X + 40	Prepare and submit OMN-20 Time Period Extension Request	1	115	\$128	\$14,720	\$983	\$4,513
X + 50	Prepare and submit OMN-20 Time Period Extension Request	1	115	\$128	\$14,720	\$500	\$3,358
X + 60	Prepare and submit OMN-20 Time Period Extension Request	1	115	\$128	\$14,720	\$254	\$2,498
Total:					\$103,040	\$29,677	\$50,256

Table 45 Averted Code Alternative and Relief Request Review

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost
					Undiscounted
X	Review Code Case relief request submittal and issue safety evaluation	1	242	\$128	\$30,912
Total:					\$30,912

5.15 Summary

This regulatory analysis identified both quantifiable and nonquantifiable benefits and costs that would result from incorporating NRC-approved ASME BPV and OM Code Cases by reference into the *Code of Federal Regulations*. Although quantifiable benefits and costs appear to be more tangible, the staff urges decisionmakers not to discount benefits and costs that are unquantifiable. Such benefits or costs can be just as important as or even more important than benefits or costs that can be quantified and monetized.

5.15.1 Quantified Net Benefit

As shown in Table 46, the estimated quantified incremental averted costs for Alternative 2 relative to the regulatory baseline (Alternative 1) over the remaining term of the affected entities' operating licenses range from approximately \$14.7 million (7-percent discount rate) to \$27.1 million (3-percent discount rate). The average net averted cost estimated for each reactor unit (based on 96 operating reactor units) ranges from approximately \$153,400 (7-percent NPV) to \$282,200 (3-percent NPV). Table 46 shows that Alternative 2 would also be cost beneficial for the NRC and the industry when they are considered separately.

Table 46 Total Costs for Alternative 2, Including All Provisions

Attribute	Total Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation	(\$16,010,000)	(\$13,960,000)	(\$15,080,000)
Industry Operation	\$55,390,000	\$24,880,000	\$37,050,000
Industry Dose	\$1,340,000	\$540,000	\$860,000
<i>Total Industry Cost</i>	<i>\$40,720,000</i>	<i>\$11,460,000</i>	<i>\$22,830,000</i>
NRC Implementation	(\$220,000)	(\$180,000)	(\$200,000)
NRC Operation	\$5,710,000	\$3,450,000	\$4,460,000
<i>Total NRC Cost</i>	<i>\$5,490,000</i>	<i>\$3,270,000</i>	<i>\$4,260,000</i>
Net	\$46,210,000	\$14,730,000	\$27,090,000

*Note: Table values are rounded to the nearest \$10,000. This table does not include the costs for hypothetical reactors.

The proposed optional provisions discussed in this final regulatory analysis would give licensees and applicants an allowed, but optional, method to comply with the ASME BPV and OM Codes. As shown in Table 47, the estimated total costs for Alternative 2, excluding the benefits and costs of these optional provisions, represent averted costs that range from \$11.5 million (7-percent NPV) to \$22.6 million (3-percent NPV). The average averted cost estimated for each reactor unit (based on 96 operating reactor units) is \$120,000 (7-percent NPV) and \$235,000 (3-percent NPV).

Table 47 Total Costs for Alternative 2, Excluding Optional Provisions

Attribute	Total Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation	(\$14,910,000)	(\$13,000,000)	(\$14,040,000)
Industry Operation	\$47,980,000	\$20,700,000	\$31,480,000
Industry Dose	\$1,370,000	\$550,000	\$880,000
<i>Total Industry Cost</i>	<i>\$34,440,000</i>	<i>\$8,250,000</i>	<i>\$18,320,000</i>
NRC Implementation	(\$220,000)	(\$180,000)	(\$200,000)
NRC Operation	\$5,710,000	\$3,450,000	\$4,460,000
<i>Total NRC Cost</i>	<i>\$5,490,000</i>	<i>\$3,270,000</i>	<i>\$4,260,000</i>
Net	\$39,930,000	\$11,520,000	\$22,580,000

*Note: Table values are rounded to the nearest \$10,000. This table does not include costs for hypothetical reactors.

The total industry and NRC cost is a sum of the implementation and operation costs for both groups. The total incremental industry costs are grouped into three categories—ASME BPV Code Section III provisions, ASME BPV Code Section XI provisions, and ASME OM Code provisions. The incorporation of ASME BPV Section III provisions in this draft final rule has no associated costs or benefits to the industry or the NRC. The estimated total incremental cost estimates for the incorporation of ASME BPV Code Section XI provisions range from

(\$9.5 million) based on a 7-percent discount rate to (\$13.4 million) based on a 3-percent discount rate, as shown in Table 48. Therefore, incorporation of the ASME BPV Code Section XI provisions has an overall net cost. The estimated total incremental averted costs for the incorporation of ASME OM Code provisions range from \$24.2 million (7-percent discount rate) to \$40.5 million (3-percent discount rate). Therefore, incorporation of the ASME OM Code provisions would have a significant overall net averted cost (i.e., benefit).

Table 48 Total Net Benefit by ASME Code Section

Section XI Provisions			
Attribute	Total Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation	(\$5,390,000)	(\$4,700,000)	(\$5,080,000)
Industry Operation	(\$14,070,000)	(\$5,360,000)	(\$9,090,000)
Industry Dose	(\$26,000)	(\$16,000)	(\$21,000)
<i>Total Industry Cost</i>	<i>(\$19,490,000)</i>	<i>(\$10,080,000)</i>	<i>(\$14,190,000)</i>
NRC Implementation	\$0	\$0	\$0
NRC Operation	\$890,000	\$620,000	\$750,000
<i>Total NRC Cost</i>	<i>\$890,000</i>	<i>\$620,000</i>	<i>\$750,000</i>
Net	(\$18,600,000)	(\$9,460,000)	(\$13,440,000)

OM Code Provisions			
Attribute	Total Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation	(\$10,620,000)	(\$9,250,000)	(\$10,000,000)
Industry Operation	\$69,470,000	\$30,240,000	\$46,140,000
Industry Dose	\$1,370,000	\$550,000	\$880,000
<i>Total Industry Cost</i>	<i>\$60,220,000</i>	<i>\$21,540,000</i>	<i>\$37,020,000</i>
NRC Implementation	(\$224,000)	(\$176,000)	(\$202,000)
NRC Operation	\$4,830,000	\$2,830,000	\$3,710,000
<i>Total NRC Cost</i>	<i>\$4,610,000</i>	<i>\$2,650,000</i>	<i>\$3,510,000</i>
Net	\$64,830,000	\$24,190,000	\$40,530,000

Note: The net totals are rounded to the nearest \$10,000.

5.15.2 Nonquantified Benefits

In addition to the quantified costs discussed in this regulatory analysis, the attributes of public health (accident), improvements in knowledge, regulatory efficiency, and other considerations would produce a number of nonquantified costs and benefits for the industry and the NRC, which are summarized below.

5.15.2.1 Advancements in Inservice Inspection and Inservice Testing

Advancements in ISI and IST may incrementally decrease the likelihood of a radiological accident, the likelihood of postaccident plant worker exposure, and the level of plant worker radiological exposures during routine inspections or testing. The NRC's approval of later editions and addenda of the ASME BPV and OM Codes and associated Code Cases may

contribute to plant safety by providing alternative examination methods that may result in the earlier identification of material degradation that, if undetected, could result in further degradation and result in a plant transient. These alternative methods may provide increased assurance of plant safety system readiness and may prevent, through inspection and testing, the introduction of a new failure mode or common-cause failure mode not previously evaluated.

5.15.2.2 Reduction in Public Health Radiation Exposures

The industry's practice of adopting the ASME BPV and OM Code Cases that are incorporated by reference into the regulations may incrementally reduce the likelihood of a radiological accident in a positive, but not easily quantifiable, manner. Pursuing Alternative 2 would continue to meet the NRC goal of maintaining safety by continuing to provide NRC approval of later editions and addenda of the ASME Code and associated Code Cases to permit licensees to use advancements in ISI and IST and provide alternative examinations for older plants, an expeditious response to user needs, and a limited, 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 would maintain the same level of safety, or may provide an incremental improvement in safety, when compared to the regulatory baseline, which may result in an incremental decrease in public health radiation exposures.

5.15.2.3 Reduction in Worker Radiation Exposures

The NRC's approval of later editions and addenda of the ASME BPV and OM Codes and associated Code Cases may reduce occupational radiation exposures in a positive, but not easily quantifiable, manner. For example, the advancements in ISI and IST may result in an incremental decrease in the likelihood of an accident resulting in worker exposure when compared to the regulatory baseline.

5.15.2.4 Improvements in Inservice Inspection and Inservice Testing Knowledge

The NRC approval of later editions and addenda of the ASME BPV and OM Codes and associated Code Cases would improve knowledge by enhancing the ability of the industry and the NRC staff to gain experience with new technology before its incorporation into the ASME Codes, and by permitting licensees to use advancements in ISI and IST. Improved ISI and IST may result in the earlier identification of material degradation that, if undetected, could result in further degradation that eventually results in a plant transient.

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

Alternative 2 is consistent with the provisions of the National Technology Transfer and Advancement Act of 1995 (Ref. 8.5.) and its implementing guidance in OMB Circular A-119 (Ref. 8.22.), which encourage Federal regulatory agencies to consider adopting voluntary

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

5.15.2.6 *Continued NRC Practice of Incorporation by Reference of ASME Code Editions and Addenda into the Code of Federal Regulations*

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

5.15.2.7 *Continued Consistency with the NRC's Risk-Informed Approach*

The NRC's risk-informed approach is embodied in Alternative 2 through the incorporation by reference in the *Code of Federal Regulations* the following provisions of the ASME OM Code:

- 10 CFR 50.55a(b)(3)(ii): OM condition—MOV testing
- 10 CFR 50.55a(b)(3)(iii)(D): New reactor high risk nonsafety systems
- 10 CFR 50.55a(b)(3)(viii): Subsection ISTE for risk-informed inservice testing of pumps and valves

These ASME OM Code provisions establish risk-informed approaches that are used to maintain nuclear power plant safety and are consistent with the NRC's efforts to risk-inform its regulatory activities. The risk-informed approach (1) is consistent with the defense-in-depth philosophy, (2) provides reasonable assurance that necessary safety functions will be performed, (3) provides reasonable confidence that any increases in core damage frequency or large early release frequency (and therefore risk) are small, (4) is consistent with the Commission's Safety Goal Policy Statement, and (5) uses a performance measurement strategy.

5.15.2.8 *Increased Public Confidence*

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

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

5.15.2.9 *Increased Cast Austenitic Stainless Steel Material Component Reliability*

The ability to provide a reliable assessment of CASS materials is important for life extension and license renewal activities. There remains a level of concern with CASS components because of the possibility of thermal embrittlement over time and the limitations of current volumetric inspection techniques. Establishing a robust aging management approach for CASS components would improve the knowledge of the material condition of those components exposed to reactor coolant environments and would improve the current state, which is currently constrained by a lack of data, operating experience, and proven NDE solutions.

5.15.3 *Nonquantified Costs*

The NRC staff believes that incorporating by reference the most recent ASME BPV and OM Code editions and addenda and associated NRC-approved Code Cases into the *Code of Federal Regulations* would decrease industry and NRC operation costs. If the NRC staff underestimated the number or the complexity of these eliminated submittals, then the averted costs would increase proportionally, causing the quantified net cost of Alternative 2 to decrease toward a more net-beneficial determination.

5.16 Safety Goal Evaluation

Safety goal evaluations apply 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). A safety goal evaluation determines whether a regulatory requirement should not be imposed generically on nuclear power plants because the residual risk is already acceptably low.

Regulations in 10 CFR 50.55a require nuclear power plant licensees to construct ASME BPV Code Class 1, 2, and 3 components in accordance with Section III, Division 1, of the ASME BPV Code; inspect Class 1, 2, and 3 and Class MC and Class CC components in accordance with Section XI, Division 1, of the ASME BPV Code; and test Class 1, 2, and 3 pumps and valves in accordance with the ASME OM Code. From time to time, the NRC amends 10 CFR 50.55a to incorporate by reference later editions and addenda of Section III, Division 1, of the ASME BPV Code; Section XI, Division 1, of the ASME BPV Code; and the ASME OM Code.

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

Incorporation by reference of later editions and addenda of Section III, Division 1, of the ASME BPV Code is prospective in nature. Incorporation of the later editions and addenda would not affect a plant that has received a construction permit, an operating license, or a combined license, or a design that has been approved. This is because the edition and addenda of the ASME BPV Code to be used in constructing a plant are, by rule, determined based on the date of the construction permit or the combined license and are not changed,

except voluntarily by the licensee with the approval of the NRC. Thus, incorporation by reference of a later edition and addenda of Section III, Division 1, of the ASME BPV Code would not constitute a “backfitting” as defined in 10 CFR 50.109(a)(1).

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

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

- The NRC’s longstanding policy has been to incorporate later versions of the ASME Codes into its regulations; thus, licensees know when receiving their operating licenses that such updating is part of the regulatory process. This is reflected in 10 CFR 50.55a, which requires licensees to revise their ISI and IST programs every 120 months to the latest edition and addenda of Section XI of the ASME BPV Code and of the ASME OM Code incorporated by reference into 10 CFR 50.55a that are in effect 12 months before the start of a new 120-month ISI and IST interval. Thus, when the NRC endorses a later version of an ASME Code, it is implementing this longstanding policy.
- ASME BPV and OM Codes are national consensus standards developed by participants with broad and varied interests, in which all interested parties including the NRC staff and nuclear utility personnel participate. This consideration is consistent with both the intent and spirit of the Backfit Rule (i.e., the NRC provides for the protection of public health and safety but does not unilaterally impose undue burden on applicants or licensees).

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

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

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

5.16.4 Safety Goal Evaluation Result

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

5.17 Results for the Committee to Review Generic Requirements

This section addresses regulatory analysis information requirements for rulemaking actions or NRC staff positions subject to review by the Committee to Review Generic Requirements (CRGR). All information called for by the CRGR charter (Ref. 8.24.) is presented in this regulatory analysis or in the *Federal Register* notice for the proposed rule. Table 49 provides a cross-reference between the relevant information and its location in this document or the *Federal Register* notice.

Table 49 Specific CRGR Regulatory Analysis Information Requirements

CRGR Charter Citation (Ref. 8.24.)	Information Item To Be Included in a Regulatory Analysis Prepared for CRGR Review	Where Item Is Discussed
Appendix C, (i)	The new or revised generic requirement or staff position as it is proposed to be sent out to licensees or issued for public comment.	Draft final rule text in <i>Federal Register</i> notice.
Appendix C, (ii)	Draft papers or other documents supporting the requirements or staff positions.	<i>Federal Register</i> notice for the draft final rule.
Appendix C, (iii)	The sponsoring office's position on each proposed requirement or staff position as to whether the proposal would modify, implement, or relax or reduce existing requirements or staff positions.	Regulatory Analysis, Section 5, and Backfit Analysis, <i>Federal Register Notice</i> for the final rule.
Appendix C, (iv)	The proposed method of implementation.	Regulatory Analysis, Section 7.
Appendix C, (vi)	Identification of the category of power reactors, new reactors, or nuclear materials facilities or activities to which the proposed generic requirement or staff position is applicable.	Regulatory Analysis, Section 4.2.2.
Appendix C, (vii)–(viii)	If the proposed action involves a power reactor backfit and the exceptions at 10 CFR 50.109(a)(4) are not applicable, the items required at 10 CFR 50.109(c) and the required rationale at 10 CFR 50.109(a)(3) are to be included.	Backfit Analysis, <i>Federal Register Notice</i> for the final rule.

CRGR Charter Citation (Ref. 8.24.)	Information Item To Be Included in a Regulatory Analysis Prepared for CRGR Review	Where Item Is Discussed
III.	For proposed generic relaxations or decreases in current requirements or staff positions, provide a determination along with the rationale that (a) the public health and safety and the common defense and security would be adequately protected if the proposed relaxations were implemented and (b) the cost savings attributed to each action would be significant enough to justify the action.	<i>Federal Register</i> notice for the draft final rule.
Appendix C, (xi)	Preparation of an assessment of how the proposed action relates to the Commission’s Safety Goal Policy Statement (Ref. 8.18.).	Regulatory Analysis, Section 5.16.

6. Decision Rationale

Table 50 provides the quantified and qualified costs and benefits for Alternative 2. The quantitative analysis used best estimate values.

Table 50 Summary of Totals

Net Monetary Savings or (Costs)—Total Present Value	Nonquantified Benefits or (Costs)
Alternative 1: No Action \$0	None
<p>Alternative 2: Incorporate by Reference ASME BPV and OM Codes and New and Revised Code Cases with Conditions</p> <p>Industry: (all provisions) \$11.5 million using a 7% discount rate \$22.8 million using a 3% discount rate</p> <p>NRC: (all provisions) \$3.3 million using a 7% discount rate \$4.3 million using a 3% discount rate</p> <p>Net Benefit (Cost): (all provisions) \$14.7 million using a 7% discount rate \$27.1 million using a 3% discount rate</p>	<p>Benefits:</p> <ul style="list-style-type: none"> • Advancements in ISI and IST: May incrementally decrease the likelihood of a radiological accident, the likelihood of postaccident plant worker exposure, and the level of plant worker radiological exposures during routine inspections or testing. • Public Health (Accident): May incrementally reduce the likelihood of a radiological accident in a positive, but not easily quantifiable, manner. Pursuing Alternative 2 would continue to meet the NRC goal of maintaining safety by continuing to provide NRC approval of the use of later editions and addenda of the ASME BPV and OM Codes and

Net Monetary Savings or (Costs)—Total Present Value	Nonquantified Benefits or (Costs)
<p>Alternative 2 (continued)</p>	<p>applicable Code Cases to 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, 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 would maintain the same level of safety or may provide an incremental improvement in safety when compared to the regulatory baseline, which may result in an incremental decrease in public health radiation exposures.</p> <ul style="list-style-type: none"> • Occupational Health (Accident): The use of later editions and addenda of the ASME BPV and OM Code and applicable Code Cases may reduce postaccident occupational radiation exposures in a positive, but not easily quantifiable, manner. The advancements in ISI and IST may result in an incremental decrease in the likelihood of an accident resulting in worker exposure when compared to the regulatory baseline. • Improvements in ISI and IST Knowledge: Staff would gain experience with new technology and ISI and IST advancements. On-the-job learning would increase worker satisfaction. Eliminating unnecessary work would better enable staff to produce desired on-the-job results, which lead to pride in performance and increased job

Net Monetary Savings or (Costs)—Total Present Value	Nonquantified Benefits or (Costs)
	<p>satisfaction</p> <ul style="list-style-type: none"> • Consistent with the NTTAA and Implementing Guidance: Alternative 2 is consistent with the provisions of the NTTAA and implementing guidance in OMB Circular A-119, which encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to <i>de novo</i> agency development of standards affecting an industry. Furthermore, the ASME Code consensus process is an important part of the regulatory framework. <p>Costs:</p> <ul style="list-style-type: none"> • Nonquantified Costs: If the NRC staff underestimated the number or the complexity of these eliminated submittals, then the averted costs would increase proportionally, causing the quantified net costs of Alternative 2 to decrease.

The industry and the NRC would benefit from the final rulemaking Alternative 2 because of the averted costs from licensees not needing to submit and the NRC not needing to review and approve ASME Code alternative requests on a plant-specific basis under the new 10 CFR 50.55a(z). As shown in Table 50, Alternative 2 relative to the regulatory baseline would result in a net benefit (averted cost) to industry that ranges from \$11.5 million (7-percent NPV) to \$22.8 million (3-percent NPV). The NRC’s net benefit would range from \$3.3 million (7-percent NPV) to \$4.3 million (3-percent NPV). Thus, the total quantitative net averted costs of the rulemaking would range from \$14.7 million (7-percent discount rate) to \$27.1 million (3-percent discount rate).

Alternative 2 would also have the qualitative benefit of meeting the NRC goal of ensuring the protection of public health and safety and the environment through the NRC’s approval of the use of later editions and addenda of the ASME BPV and OM Codes and applicable Code Cases. It would also allow for the use of the most current methods and technology. This alternative would also support the NRC’s goal of maintaining an open regulatory process, because approving ASME Codes and Code Cases would demonstrate the agency’s commitment to participate in the national consensus standards process and maintain the NRC’s role as an effective regulator.

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

Based solely on quantified costs and benefits, the regulatory analysis shows that the rulemaking is justified because the total quantified benefits of the draft final rule regulatory action would exceed the costs of the proposed action, for all discount rates up to 7 percent. Certainly, if the qualitative benefits (including the safety benefit, regulatory efficiency, and other nonquantified benefits) are considered together with the quantified benefits, then the benefits would outweigh the identified quantitative and qualitative impacts.

Considering non-quantified costs and benefits, the regulatory analysis shows that the rulemaking is justified because the number and significance of the non-quantified benefits outweigh the non-quantified costs. The uncertainty analysis shows a net benefit (averted cost) for all simulations with a range of averted cost from \$8.19 million to \$21.6 millions (using a 7-percent NPV).

Therefore, integrating both quantified and non-quantified costs and benefits, the benefits of the draft final rule outweigh the identified quantitative and qualitative impacts attributable to the draft final rule.

7. Implementation Schedule

The final rule will become effective 30 days after its publication in the *Federal Register*. Provisions of this final rule are to be implemented within 120 months of the effective date, at the next update to each plant’s ISI and IST programs, with three exceptions. First, for the MOV diagnostic testing in 10 CFR 50.55a(b)(3)(ii) of this final rule, licensees shall evaluate the adequacy of the intervals established within 5 years or three refueling outages, whichever is longer. For ASME BPV Code Cases N-729 and N-770, the effective date of these provisions is the same as the effective date of this final rule, and the requirements (subject to the conditions in this final rule) shall be implemented by the next refueling outage after the effective date of this final rule.

8. References

- 8.1. “Combined License—Vogtle Electric Generating Plant Unit 3, Southern Nuclear Operating Company, Inc., Georgia Power Company, Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, City of Dalton, Georgia, Docket No. 52-025,” License No. NPF-91, effective February 10, 2012 (ADAMS Accession No. ML112991110).
- 8.2. “Combined License—Vogtle Electric Generating Plant Unit 4, Southern Nuclear Operating Company, Inc., Georgia Power Company, Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, City of Dalton, Georgia, Docket No. 50-026,” License No. NPF-92, effective as of February 10, 2012 (ADAMS Accession No. ML113060412).
- 8.3. “Combined License—Virgil C Summer Nuclear Station Unit 2, South Carolina Electric and Gas Company, South Carolina Public Service Authority, Docket No. 52-027,” License No. NPF-93, effective March 30, 2012 (ADAMS Accession No. ML113190393).
- 8.4. “Combined License—Virgil C Summer Nuclear Station Unit 3, South Carolina Electric and Gas Company, South Carolina Public Service Authority, Docket No. 52-028,” License No. NPF-94, effective March 30, 2012 (ADAMS Accession No. ML113190715).
- 8.5. National Technology Transfer and Advancement Act of 1995, Pub. L. 104-113, March 7, 1996, retrievable at <http://www.gpo.gov/fdsys/pkg/PLAW-104publ113/pdf/PLAW-104publ113.pdf>.
- 8.6. U.S. Department of Labor, Bureau of Labor Statistics, “Databases, Tables & Calculators by Subject: CPI Inflation Calculator,” retrievable at <http://www.bls.gov>.
- 8.7. U.S. Nuclear Regulatory Commission, “A Handbook for Value-Impact Assessment,” NUREG/CR-3568, December 1983.
- 8.8. U.S. Nuclear Regulatory Commission, “American Society of Mechanical Engineers (ASME) Codes and New and Revised ASME Code Cases; Final Rule,” 76 FR 36232, June 21, 2011.
- 8.9. U.S. Nuclear Regulatory Commission, “Incorporation by Reference of American Society of Mechanical Engineers Codes and Code Cases,” *Federal Register* notice, proposed rule, August 21, 2015 (ADAMS Accession No. ML14065A203).
- 8.10. U.S. Nuclear Regulatory Commission, “Generic Aging Lessons Learned (GALL) Report,” NUREG-1801, Revision 2, December 2010.

- 8.11. U.S. Nuclear Regulatory Commission, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," Generic Letter 90-05, June 15, 1990 (ADAMS Accession No. ML12339A442).
- 8.12. U.S. Nuclear Regulatory Commission, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," Generic Letter 96-05, September 18, 1996 (ADAMS Accession No. ML11347A419).
- 8.13. U.S. Nuclear Regulatory Commission, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," NUREG/BR-0058, Revision 4, September 2004 (ADAMS Accession No. ML042820192).
- 8.14. U.S. Nuclear Regulatory Commission, "Regulatory Analysis Technical Evaluation Handbook," NUREG/BR-0184, January 1997 (ADAMS Accession No. ML050190193).
- 8.15. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 16, October 2010 (ADAMS Accession No. ML101800536).
- 8.16. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," June 2003 (ADAMS Accession No. ML030730430).
- 8.17. U.S. Nuclear Regulatory Commission, Regulatory Issue Summary 2004-12, "Clarification on Use of Later Editions and Addenda to the ASME OM Code and Section XI," July 28, 2004 (ADAMS Accession No. ML042090436).
- 8.18. U.S. Nuclear Regulatory Commission, "Safety Goals for the Operation of Nuclear Power Plants," 51 FR 28044, August 4, 1986, as corrected and republished at 51 FR 30028, August 21, 1986.
- 8.19. U.S. Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints," Revision 3, March 2007 (ADAMS Accession No. ML070720041).
- 8.20. U.S. Nuclear Regulatory Commission, "Guidelines for Inservice Testing at Nuclear Power Plants: Inservice Testing of Pumps and Valves and Inservice Examination and Testing of Dynamic Restraints (Snubbers) at Nuclear Power Plants—Final Report," NUREG-1482, Revision 2, October 2013 (ADAMS Accession No. ML13295A020).
- 8.21. U.S. Office of Management and Budget, Circular No. A-4, "Regulatory Analysis," September 2003.

- 8.22. U.S. Office of Management and Budget, Circular No. A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities," February 10, 1998.
- 8.23. U.S. Nuclear Regulatory Commission, "Information Digest 2015–2016.", NUREG-1350, Volume 27, August 2015 (ADAMS Accession No. ML15254A321).
- 8.24. U.S. Nuclear Regulatory Commission, "Charter: Committee to Review Generic Requirements," Revision 8, March 2011, ADAMS Accession No. ML110620618.
- 8.25. U.S. Nuclear Regulatory Commission, "Reassessment of NRC's Dollar per Person-Rem Conversion Factor Policy," NUREG-1530, December 1995.

Appendix A Supplemental Cost Tables

Table 51 Motor-Operated Valve (MOV) Testing Program (Operating Reactors)

Year	Activity	Number of Affected Units	Number of Tests per Year	Number of MOVs per Unit	Hours per MOV	Weighted Hourly Rate	Cost		
							Undiscounted	7% NPV	3% NPV
2019	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$322,154)	(\$347,662)
2020	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$301,079)	(\$337,536)
2021	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$281,382)	(\$327,705)
2022	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$262,974)	(\$318,160)
2023	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$245,770)	(\$308,893)
2024	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$229,692)	(\$299,896)
2025	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$214,665)	(\$291,161)
2026	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$200,622)	(\$282,681)
2027	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$187,497)	(\$274,448)
2028	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$175,231)	(\$266,454)
2029	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$163,767)	(\$258,693)
2030	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$153,053)	(\$251,158)
2031	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$143,040)	(\$243,843)
2032	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$133,683)	(\$236,741)
2033	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$124,937)	(\$229,846)
2034	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$116,764)	(\$223,151)
2035	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$109,125)	(\$216,651)
2036	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$101,986)	(\$210,341)
2037	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$95,314)	(\$204,215)
2038	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$89,078)	(\$198,267)
2039	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$83,251)	(\$192,492)
2040	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$77,805)	(\$186,885)
2041	Biannual MOV exercise test	33	1	106	1.00	\$107	(\$368,835)	(\$72,714)	(\$181,442)
2019	MOV diagnostic test (10-year interval)	67	1	10	12.00	\$107	(\$860,675)	(\$751,747)	(\$811,269)
2029	MOV diagnostic test (10-year interval)	67	1	10	12.00	\$107	(\$860,675)	(\$382,150)	(\$603,660)

Year	Activity	Number of Affected Units	Number of Tests per Year	Number of MOVs per Unit	Hours per MOV	Weighted Hourly Rate	Cost		
							Undiscounted	7% NPV	3% NPV
2039	MOV diagnostic test (10-year interval)	67	1	10	12.00	\$107	(\$860,675)	(\$194,266)	(\$449,180)
2019	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$2,405,953	\$2,596,451
2020	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$2,248,554	\$2,520,827
2021	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$2,101,452	\$2,447,404
2022	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,963,974	\$2,376,121
2023	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,835,490	\$2,306,913
2024	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,715,411	\$2,239,722
2025	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,603,188	\$2,174,487
2026	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,498,306	\$2,111,153
2027	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,400,286	\$2,049,663
2028	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,308,679	\$1,989,964
2029	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,223,064	\$1,932,004
2030	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,143,051	\$1,875,732
2031	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$1,068,272	\$1,821,099
2032	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$998,385	\$1,768,057
2033	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$933,070	\$1,716,560
2034	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$872,028	\$1,666,563
2035	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$814,979	\$1,618,023

Year	Activity	Number of Affected Units	Number of Tests per Year	Number of MOVs per Unit	Hours per MOV	Weighted Hourly Rate	Cost		
							Undiscounted	7% NPV	3% NPV
2036	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$761,663	\$1,570,896
2037	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$711,835	\$1,525,142
2038	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$665,266	\$1,480,720
2039	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$621,744	\$1,437,592
2040	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$581,069	\$1,395,721
2041	Quarterly MOV exercise tests averted	67	4	96	1.00	\$107	\$2,754,575	\$543,055	\$1,355,069
Total:							\$52,290,011	\$23,805,030	\$36,223,450

Table 52 MOV Testing Program (Operating Reactors)—Dose

Year	Activity	Number of Affected Units	Number of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Cost		
								Undiscounted	7% NPV	3% NPV
2019	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$8,234)	(\$8,886)
2020	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$7,695)	(\$8,627)
2021	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$7,192)	(\$8,376)
2022	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$6,721)	(\$8,132)
2023	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$6,282)	(\$7,895)
2024	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$5,871)	(\$7,665)
2025	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$5,487)	(\$7,442)
2026	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$5,128)	(\$7,225)
2027	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$4,792)	(\$7,015)
2028	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$4,479)	(\$6,810)
2029	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$4,186)	(\$6,612)
2030	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$3,912)	(\$6,419)
2031	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$3,656)	(\$6,232)
2032	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$3,417)	(\$6,051)
2033	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$3,193)	(\$5,875)
2034	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$2,984)	(\$5,704)
2035	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$2,789)	(\$5,537)
2036	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$2,607)	(\$5,376)

Year	Activity	Number of Affected Units	Number of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Cost		
								Undiscounted	7% NPV	3% NPV
2037	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$2,436)	(\$5,220)
2038	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$2,277)	(\$5,068)
2039	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$2,128)	(\$4,920)
2040	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$1,989)	(\$4,777)
2041	Biannual MOV exercise test dose	33	1	53	0.08	0.033	\$2,000	(\$9,427)	(\$1,859)	(\$4,638)
2019	MOV diagnostic test dose (10-year interval)	67	1	5	4.00	0.033	\$2,000	(\$87,993)	(\$76,857)	(\$82,942)
2029	MOV diagnostic test dose (10-year interval)	67	1	5	4.00	0.033	\$2,000	(\$87,993)	(\$39,070)	(\$61,717)
2039	MOV diagnostic test dose (10-year interval)	67	1	5	4.00	0.033	\$2,000	(\$87,993)	(\$19,861)	(\$45,923)
2019	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$61,495	\$66,364
2020	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$57,472	\$64,431
2021	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$53,712	\$62,554
2022	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$50,198	\$60,732
2023	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$46,914	\$58,963
2024	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$43,845	\$57,246
2025	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$40,977	\$55,579
2026	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$38,296	\$53,960
2027	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$35,790	\$52,388
2028	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$33,449	\$50,862
2029	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$31,261	\$49,381
2030	Quarterly MOV exercise test	67	4	48	0.08	0.033	\$2,000	\$70,405	\$29,216	\$47,943

Year	Activity	Number of Affected Units	Number of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Cost		
								Undiscounted	7% NPV	3% NPV
	dose averted									
2031	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$27,304	\$46,546
2032	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$25,518	\$45,190
2033	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$23,849	\$43,874
2034	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$22,289	\$42,596
2035	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$20,830	\$41,356
2036	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$19,468	\$40,151
2037	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$18,194	\$38,982
2038	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$17,004	\$37,846
2039	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$15,891	\$36,744
2040	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$14,852	\$35,674
2041	Quarterly MOV exercise test dose averted	67	4	48	0.08	0.033	\$2,000	\$70,405	\$13,880	\$34,635
Total:								\$1,138,516	\$506,601	\$782,913

Table 53 MOV Testing Program (New Reactors)

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit	Hours per MOV	Technician Hourly Rate	Industry Operation Cost (2017 dollars)		
							Undiscounted	7% NPV	3% NPV
2019	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$19,825)	(\$21,395)
2020	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$27,792)	(\$31,157)
2021	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$17,316)	(\$20,166)
2022	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$24,275)	(\$29,369)
2023	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$15,124)	(\$19,009)
2024	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$21,202)	(\$27,683)
2025	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$13,210)	(\$17,918)
2026	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$18,519)	(\$26,094)
2027	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$11,538)	(\$16,889)
2028	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$16,175)	(\$24,596)
2029	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$10,078)	(\$15,920)
2030	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$14,128)	(\$23,184)
2031	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$8,802)	(\$15,006)
2032	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$12,340)	(\$21,853)
2033	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$7,688)	(\$14,144)
2034	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$10,778)	(\$20,599)
2035	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$6,715)	(\$13,332)
2036	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$9,414)	(\$19,416)
2037	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$5,865)	(\$12,567)
2038	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$8,223)	(\$18,302)
2039	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$5,123)	(\$11,846)
2040	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$7,182)	(\$17,251)
2041	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$4,475)	(\$11,166)
2042	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$6,273)	(\$16,261)
2043	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$3,908)	(\$10,525)
2044	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$5,479)	(\$15,327)

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit	Hours per MOV	Technician Hourly Rate	Industry Operation Cost (2017 dollars)		
							Undiscounted	7% NPV	3% NPV
2045	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$3,414)	(\$9,921)
2046	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$4,786)	(\$14,447)
2047	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$2,982)	(\$9,351)
2048	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$4,180)	(\$13,618)
2049	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$2,604)	(\$8,814)
2050	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$3,651)	(\$12,836)
2051	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$2,275)	(\$8,308)
2052	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$3,189)	(\$12,099)
2053	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$1,987)	(\$7,831)
2054	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$2,785)	(\$11,405)
2055	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$1,735)	(\$7,382)
2056	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$2,433)	(\$10,750)
2057	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$1,516)	(\$6,958)
2058	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$2,125)	(\$10,133)
2059	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$1,324)	(\$6,559)
2060	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$1,856)	(\$9,551)
2061	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$1,156)	(\$6,182)
2062	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$1,621)	(\$9,003)
2063	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$1,010)	(\$5,827)
2064	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$1,416)	(\$8,486)
2065	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$882)	(\$5,493)
2066	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$1,237)	(\$7,999)
2067	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$771)	(\$5,177)
2068	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$1,080)	(\$7,540)
2069	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$673)	(\$4,880)
2070	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$943)	(\$7,107)
2071	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$588)	(\$4,600)
2072	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$824)	(\$6,699)
2073	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$513)	(\$4,336)
2074	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$720)	(\$6,315)
2075	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$448)	(\$4,087)

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit	Hours per MOV	Technician Hourly Rate	Industry Operation Cost (2017 dollars)		
							Undiscounted	7% NPV	3% NPV
2076	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$629)	(\$5,952)
2077	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$392)	(\$3,853)
2078	Biannual MOV exercise test	3	1	106	1.00	\$107	(\$34,046)	(\$549)	(\$5,610)
2079	Biannual MOV exercise test	2	1	106	1.00	\$107	(\$22,698)	(\$342)	(\$3,631)
2019	MOV diagnostic test (10-year interval)	5	1	10	12.00	\$107	(\$64,229)	(\$56,101)	(\$60,542)
2029	MOV diagnostic test (10-year interval)	5	1	10	12.00	\$107	(\$64,229)	(\$28,519)	(\$45,049)
2039	MOV diagnostic test (10-year interval)	5	1	10	12.00	\$107	(\$64,229)	(\$14,497)	(\$33,521)
2049	MOV diagnostic test (10-year interval)	5	1	10	12.00	\$107	(\$64,229)	(\$7,370)	(\$24,943)
2059	MOV diagnostic test (10-year interval)	5	1	10	12.00	\$107	(\$64,229)	(\$3,746)	(\$18,560)
2069	MOV diagnostic test (10-year interval)	5	1	10	12.00	\$107	(\$64,229)	(\$1,904)	(\$13,810)
2079	MOV diagnostic test (10-year interval)	5	1	10	12.00	\$107	(\$64,229)	(\$968)	(\$10,276)
2019	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$179,549	\$193,765
2020	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$167,803	\$188,121
2021	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$156,825	\$182,642
2022	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$146,565	\$177,322
2023	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$136,977	\$172,158
2024	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$128,016	\$167,143
2025	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$119,641	\$162,275
2026	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$111,814	\$157,549
2027	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$104,499	\$152,960
2028	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$97,663	\$148,505
2029	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$91,273	\$144,179
2030	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$85,302	\$139,980
2031	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$79,722	\$135,903
2032	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$74,506	\$131,945

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit	Hours per MOV	Technician Hourly Rate	Industry Operation Cost (2017 dollars)		
							Undiscounted	7% NPV	3% NPV
2033	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$69,632	\$128,102
2034	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$65,077	\$124,370
2035	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$60,819	\$120,748
2036	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$56,841	\$117,231
2037	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$53,122	\$113,817
2038	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$49,647	\$110,501
2039	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$46,399	\$107,283
2040	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$43,363	\$104,158
2041	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$40,527	\$101,125
2042	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$37,875	\$98,179
2043	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$35,397	\$95,320
2044	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$33,082	\$92,543
2045	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$30,917	\$89,848
2046	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$28,895	\$87,231
2047	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$27,005	\$84,690
2048	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$25,238	\$82,223
2049	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$23,587	\$79,829
2050	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$22,044	\$77,504
2051	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$20,602	\$75,246
2052	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$19,254	\$73,055
2053	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$17,994	\$70,927
2054	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$16,817	\$68,861
2055	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$15,717	\$66,855
2056	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$14,689	\$64,908
2057	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$13,728	\$63,017
2058	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$12,830	\$61,182
2059	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$11,990	\$59,400
2060	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$11,206	\$57,670
2061	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$10,473	\$55,990
2062	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$9,788	\$54,359
2063	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$9,147	\$52,776

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit	Hours per MOV	Technician Hourly Rate	Industry Operation Cost (2017 dollars)		
							Undiscounted	7% NPV	3% NPV
2064	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$8,549	\$51,239
2065	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$7,990	\$49,747
2066	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$7,467	\$48,298
2067	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$6,978	\$46,891
2068	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$6,522	\$45,525
2069	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$6,095	\$44,199
2070	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$5,697	\$42,912
2071	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$5,324	\$41,662
2072	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$4,976	\$40,449
2073	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$4,650	\$39,270
2074	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$4,346	\$38,127
2075	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$4,062	\$37,016
2076	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$3,796	\$35,938
2077	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$3,548	\$34,891
2078	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$3,315	\$33,875
2079	Quarterly MOV exercise tests averted	5	4	96	1.00	\$107	\$205,565	\$3,099	\$32,888

Table 54 MOV Testing Program (New Reactors)—Dose

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
2019	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$507)	(\$547)
2020	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$710)	(\$796)
2021	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$443)	(\$515)
2022	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$620)	(\$751)
2023	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$387)	(\$486)
2024	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$542)	(\$708)
2025	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$338)	(\$458)
2026	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$473)	(\$667)
2027	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$295)	(\$432)
2028	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$413)	(\$629)
2029	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$258)	(\$407)
2030	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$361)	(\$593)
2031	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$225)	(\$384)
2032	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$315)	(\$559)
2033	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$197)	(\$362)
2034	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$275)	(\$526)

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
2035	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$172)	(\$341)
2036	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$241)	(\$496)
2037	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$150)	(\$321)
2038	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$210)	(\$468)
2039	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$131)	(\$303)
2040	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$184)	(\$441)
2041	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$114)	(\$285)
2042	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$160)	(\$416)
2043	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$100)	(\$269)
2044	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$140)	(\$392)
2045	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$87)	(\$254)
2046	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$122)	(\$369)
2047	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$76)	(\$239)
2048	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$107)	(\$348)
2049	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$67)	(\$225)
2050	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$93)	(\$328)
2051	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$58)	(\$212)
2052	Biannual MOV exercise test	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$82)	(\$309)

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
	dose									
2053	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$51)	(\$200)
2054	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$71)	(\$292)
2055	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$44)	(\$189)
2056	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$62)	(\$275)
2057	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$39)	(\$178)
2058	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$54)	(\$259)
2059	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$34)	(\$168)
2060	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$47)	(\$244)
2061	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$30)	(\$158)
2062	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$41)	(\$230)
2063	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$26)	(\$149)
2064	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$36)	(\$217)
2065	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$23)	(\$140)
2066	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$32)	(\$204)
2067	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$20)	(\$132)
2068	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$28)	(\$193)
2069	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$17)	(\$125)

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
2070	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$24)	(\$182)
2071	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$15)	(\$118)
2072	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$21)	(\$171)
2073	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$13)	(\$111)
2074	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$18)	(\$161)
2075	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$11)	(\$104)
2076	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$16)	(\$152)
2077	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$10)	(\$98)
2078	Biannual MOV exercise test dose	3	1	53	0.08	0.033	\$2,000	(\$870)	(\$14)	(\$143)
2079	Biannual MOV exercise test dose	2	1	53	0.08	0.033	\$2,000	(\$580)	(\$9)	(\$93)
2019	MOV diagnostic test dose (10-year interval)	5	1	5	4.00	0.033	\$2,000	(\$6,567)	(\$5,736)	(\$6,190)
2029	MOV diagnostic test dose (10-year interval)	5	1	5	4.00	0.033	\$2,000	(\$6,567)	(\$2,916)	(\$4,606)
2039	MOV diagnostic test dose (10-year interval)	5	1	5	4.00	0.033	\$2,000	(\$6,567)	(\$1,482)	(\$3,427)
2049	MOV diagnostic test dose (10-year interval)	5	1	5	4.00	0.033	\$2,000	(\$6,567)	(\$753)	(\$2,550)
2059	MOV diagnostic test dose (10-year interval)	5	1	5	4.00	0.033	\$2,000	(\$6,567)	(\$383)	(\$1,897)
2069	MOV diagnostic test dose (10-year interval)	5	1	5	4.00	0.033	\$2,000	(\$6,567)	(\$195)	(\$1,412)
2079	MOV diagnostic test dose (10-year interval)	5	1	5	4.00	0.033	\$2,000	(\$6,567)	(\$99)	(\$1,051)
2019	Quarterly MOV exercise test	5	4	48	0.08	0.033	\$2,000	\$5,254	\$4,589	\$4,953

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
	dose averted									
2020	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$4,289	\$4,808
2021	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$4,008	\$4,668
2022	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$3,746	\$4,532
2023	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$3,501	\$4,400
2024	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$3,272	\$4,272
2025	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$3,058	\$4,148
2026	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$2,858	\$4,027
2027	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$2,671	\$3,910
2028	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$2,496	\$3,796
2029	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$2,333	\$3,685
2030	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$2,180	\$3,578
2031	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$2,038	\$3,474
2032	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,904	\$3,372
2033	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,780	\$3,274
2034	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,663	\$3,179
2035	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,555	\$3,086
2036	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,453	\$2,996

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
2037	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,358	\$2,909
2038	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,269	\$2,824
2039	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,186	\$2,742
2040	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,108	\$2,662
2041	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$1,036	\$2,585
2042	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$968	\$2,509
2043	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$905	\$2,436
2044	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$846	\$2,365
2045	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$790	\$2,296
2046	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$739	\$2,230
2047	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$690	\$2,165
2048	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$645	\$2,102
2049	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$603	\$2,040
2050	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$563	\$1,981
2051	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$527	\$1,923
2052	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$492	\$1,867
2053	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$460	\$1,813
2054	Quarterly MOV exercise test	5	4	48	0.08	0.033	\$2,000	\$5,254	\$430	\$1,760

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
	dose averted									
2055	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$402	\$1,709
2056	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$375	\$1,659
2057	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$351	\$1,611
2058	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$328	\$1,564
2059	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$306	\$1,518
2060	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$286	\$1,474
2061	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$268	\$1,431
2062	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$250	\$1,389
2063	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$234	\$1,349
2064	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$219	\$1,310
2065	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$204	\$1,271
2066	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$191	\$1,234
2067	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$178	\$1,199
2068	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$167	\$1,164
2069	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$156	\$1,130
2070	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$146	\$1,097
2071	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$136	\$1,065

Year	Activity	No. of Affected Units	No. of Tests per Year	No. of MOVs per Unit in Rad Field	Hours per MOV	Radiation Field (rem/hr)	Dollar per Person-Rem	Industry Operation Cost (2017 dollars)		
								Undiscounted	7% NPV	3% NPV
2072	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$127	\$1,034
2073	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$119	\$1,004
2074	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$111	\$974
2075	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$104	\$946
2076	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$97	\$919
2077	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$91	\$892
2078	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$85	\$866
2079	Quarterly MOV exercise test dose averted	5	4	48	0.08	0.033	\$2,000	\$5,254	\$79	\$841

Appendix B Major Assumptions and Input Data

Table 55 Major Assumptions and Input Data

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Key Analysis Dates			
Final Rule Effective Date	2017	year	NRC input
Analysis Base Year	2017	year	NRC input
Average new reactor unit first year of commercial operation	2020	year	Calculation of the average commercial operation commencement date of the four new reactor units. Information on the scheduled commercial operation dates of each new reactor unit obtained from http://www.southerncompany.com/about-us/our-business/southern-nuclear/home.cshtml , https://www.scana.com/investors/investor-news#nuclear-development and https://www.tva.gov/Energy/Our-Power-System/Nuclear . These websites were last accessed on April 14, 2016.
Average new reactor unit first year of extended commercial operation	2060	year	Calculation of the average new reactor unit first year of extended commercial operation based on a 40-year operating license.
Number of Entities			
Number of currently operating reactor units in 2016	99	units	NRC, NUREG-1350, "Information Digest 2015–2016," Volume 27, August 2015 (Ref. 8.23.), Appendix A, U.S. Commercial Nuclear Power Reactors—Operating Reactors." Data current as of August 2015. Available at ADAMS Accession No. ML15254A321.
Number of forecasted operating reactor units in 2017	99	units	Calculation. Based on NRC, NUREG-1350 (Ref. 8.23.), Appendix A. Available at ADAMS Accession No. ML15254A321.

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Number of forecasted operating reactor units in 2020	97	units	Calculation. Based on NRC, NUREG-1350 (Ref. 8.23.), Appendix A. Available at ADAMS Accession No. ML15254A321. James A. FitzPatrick closing in 2017 and Pilgrim in 2019, based on the announcement by Entergy Nuclear Operations, Inc. (see http://www.energy.com), and Oyster Creek closing in 2019 based on Exelon Corporation's announcement (http://www.exeloncorp.com). Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3 opening in 2019 and 2020, based on NRC, "Combined License Applications for New Reactors." Data current as of February 18, 2016. Available at http://www.nrc.gov/reactors/new-reactors/col.html , last accessed on April 14, 2016. Watts Bar Unit 2 operating as of October 2015.
Number of forecasted operating PWR units in 2017	65	units	Based on NRC, NUREG-1350 (Ref. 8.23.), Appendix A. Available at ADAMS Accession No. ML15254A321.
Number of new PWR units under construction	0	units	Based on NRC, NUREG-1350 (Ref. 8.23.), Appendix A. Available at ADAMS Accession No. ML15254A321.
Number of new reactor units under construction in 2016	4	units	NRC, "Combined License Applications for New Reactors." Data current as of February 18, 2016. Available at http://www.nrc.gov/reactors/new-reactors/col.html , last accessed on April 14, 2016. The construction of two units is expected to be completed in 2019. The construction of the remaining two units is expected to be completed in 2020.
Number of new reactor units under construction in 2020	5	units	NRC, "Combined License Applications for New Reactors." Data current as of February 18, 2016. Available at http://www.nrc.gov/reactors/new-reactors/col.html , last accessed on April 14, 2016. The construction of two units is expected to be completed in 2019. The construction of the

Data Element	Best Estimate	Unit	Source or Basis of Estimate
			remaining two units is expected to be completed in 2020.
Number of Sites			
Sites with currently operating reactors in 2016	60	sites	Calculation of the total number of sites with operating reactors. Information on operating reactor sites was obtained from NRC, "Operating Nuclear Power Reactors (by Location or Name)." Data current as of November 9, 2015. Available at http://www.nrc.gov/info-finder/reactor/ , last accessed on April 14, 2016.
Sites with currently operating reactors in 2017	59	sites	Calculation: [total number of sites with operating reactors] + [sites with construction completed in 2017] - [sites with unit closed in 2017]. Information on operating reactor sites was obtained from NRC, "Operating Nuclear Power Reactors (by Location or Name)." Data current as of November 9, 2015. Available at http://www.nrc.gov/info-finder/reactor/ , last accessed on April 14, 2016.
Sites with currently operating reactors in 2020	57	sites	Calculation: [total number of sites with operating reactors] + [sites with construction completed in years 2017 through 2020] - [sites with units closed in years 2017 through 2020]. Information on operating reactor sites was obtained from NRC, "Operating Nuclear Power Reactors (by Location or Name)." Data current as of November 9, 2015. Available at: http://www.nrc.gov/info-finder/reactor/ , last accessed on April 14, 2016.
Sites with projected new reactors under a 10 CFR Part 52 license	2	sites	NRC, "Combined License Applications for New Reactors." Data current as of February 18, 2016. Available at http://www.nrc.gov/reactors/new-reactors/col.html , last accessed on April 14, 2016.
Sites with currently operating PWR reactors	38	sites	NRC, "Operating Nuclear Power Reactors (by Location or Name)." Data current as of November 9, 2015. Available at http://www.nrc.gov/info-finder/reactor/ , last accessed on

Data Element	Best Estimate	Unit	Source or Basis of Estimate
			April 14, 2016.
Final Rule Applicability Period (Years)			
Final rule applicability term for currently operating reactors	24	years	Calculation of the average remaining licensed operating period of all currently operating reactors until license expiration. Information on the operating license expiration date of each reactor obtained from NRC, NUREG-1350 (Ref. 8.23.), Appendix A. Available at ADAMS Accession No. ML15254A321.
Final rule applicability term for new reactor licenses	60	years	Assumption based on a 40-year operating license and a 20-year license renewal
Current Use of ASME NQA-1 in QAPD			
No. of current operating licensees that currently use ASME NQA-1 in QAPD	48	licensees	NRC estimate.
No. of current operating licensees that currently do not use ASME NQA-1 in QAPD	52	licensees	Calculation. [total number of currently operating reactor units] – [number of licensees that incorporate ASME NQA-1 requirements in their QAPD].
No. of new licensees that use ASME NQA-1 in QAPD	5	licensees	NRC estimate.
No. of new licensees that currently do not use ASME NQA-1 in QAPD	0	licensees	Calculation. [total number of new reactor units] – [number of new licensees that incorporate ASME NQA-1 requirements in their QAPD].
Number of licensees that will apply ASME OM Code Subsection ISTE	1	licensees	NRC estimate.
Number of Licensees Impacted by ASME OM Code Subsection ISTF Pump Testing Requirements for New Reactors			
Number of new reactor units with a passive design	4	units	NRC input.
Number of new reactor units impacted by ASME OM Code	1	units	Calculation. [number of new reactors units] - [number of new reactor units with a passive design]

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Subsection ISTF			
Number of licensees with extended licenses impacted by concrete containment examinations	67	licensees	Calculation. Based on NRC, NUREG-1350 (Ref. 8.23.), Appendix A. Available at ADAMS Accession No. ML15254A321.
Average expiration date of extended licenses	06/2041	year	Calculation. [Average of expiration year for extended licenses] - [final rule effective year]. Based on NRC, NUREG-1350 (Ref. 8.23.), Appendix A. Available at ADAMS Accession No. ML15254A321.
Industry One-Time Costs			
Program revision to QAPD to incorporate the ASME NQA-1 program	200	hours	NRC estimate. Program revision occurs within first year after rule is effective.
Update concrete containment examination procedures	20	hours	NRC estimate. Program revision occurs within first year after rule is effective.
Procedure revision to incorporate fracture toughness of irradiated material requirements	20	hours	NRC estimate. Procedure revision occurs within first year after rule is effective.
Procedure revision to incorporate the ultrasonic examination provisions of ASME BPV Code Case N-824	20	hours	NRC estimate. Procedure revision occurs within first year after rule is effective.
Develop training module for the ultrasonic examination provisions of ASME BPV Code Case N-824	\$40,000	dollars	NRC estimate. Training module developed within first year after rule is effective.
Ultrasonic examination equipment to implement ASME BPV Code Case N-824	\$25,000	dollars	NRC estimate. Equipment procured within first year after rule is effective. Site basis.
Revise inspection and test procedures to reflect ASME	\$15,000	dollars	NRC estimate. Procedure revision occurs within first year after rule is effective.

Data Element	Best Estimate	Unit	Source or Basis of Estimate
OM Code Appendix III requirements and demonstrate valve performance			
Procedure revisions to incorporate supplemental requirements on the use of ASME OM Code for new reactors	80	hours	NRC estimate. Procedure revision occurs within first year of new reactor commercial operation.
Program revision to incorporate squib valve surveillance requirements for new reactors	40	hours	NRC estimate. Procedure revision occurs within first year of new reactor commercial operation.
Program revision to incorporate Mandatory Appendix V on pump periodic verification program	8	hours	NRC estimate. Procedure revision occurs within first year after rule is effective for operating plants and first year of commercial operation for new plants.
Risk-informed inservice testing of pumps and valves request for alternative submittal to use ASME OM Code Subsection ISTE	1,000	hours/year	NRC estimate. Procedure revision occurs within first year after rule is effective.
Procedure revision to incorporate ASME OM Code Subsection ISTF pump testing requirements for hypothetical new reactor	30	hours	NRC estimate. Procedure revision occurs within first year after rule is effective for operating plants and first year of commercial operation for new plants.
ASME OM Code Case OMN-20 time period extension plant procedure revision	400	hours	NRC estimate. Procedure revision occurs within first year after rule is effective for operating plants and first year of commercial operation for new plants.
Procedure revision to incorporate cast stainless steel material examination requirements	30	hours	NRC estimate. Procedure revision occurs within first year after rule is effective for operating plants and first year of commercial operation for new plants.
Develop training module to certify inspectors to perform cast stainless steel material examinations	\$40,000	dollars	NRC estimate. Training module development occurs within first year after rule is effective for operating plants and first year of commercial operation for new plants.

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Create training mockups to allow for qualification of equipment, procedures, and personnel	\$30,000	dollars	NRC estimate. The development of a sufficient number of mockups is required to establish an ASME BPV Code Appendix VIII program for examination of ASME Code Class 1 piping and vessel nozzle butt welds through cast stainless steel materials. Significant time and resources are needed to create mockups and to allow for qualification of equipment, procedures and personnel. Training mockups are developed beginning in 2017 on a site basis (covers both operating and new reactors).
Purchase the specialized phased-array search unit, electronics, and scanners	\$370,000	dollars	NRC estimate. Specialized equipment procured on a plant site basis.
Initial inspector training and practice on CASS components	18	hours	NRC estimate. Two inspectors each receiving 8 hours of training and practice. Training occurs 1 year after training module and mockups are prepared and specialized test equipment is purchased.
Procedure revision to incorporate encoding of ultrasonic volumetric examinations	200	hours	NRC estimate. Procedure revision occurs within first year after rule is effective for operating plants and first year of commercial operation for new plants.
Develop training module to certify inspectors to perform encoding of specific ultrasonic volumetric examinations	\$40,000	dollars	NRC estimate. Training module development is performed on a site basis and costs are incurred in 2017.
Create training mockups to allow for qualification of equipment, procedures, and personnel for encoding of specific ultrasonic volumetric examinations and purchase equipment	\$2,000,000	dollars	NRC estimate. Training mockups occur within first year after rule is effective for operating plants and first year of commercial operation for new plants.
Industry Recurring Costs			
Averted ASME Code Case Relief Requests			

Data Element	Best Estimate	Unit	Source or Basis of Estimate
ASME Code Case relief request preparation and submission	330	industry eng. hours	NRC estimate
Number of averted ASME Code Case relief submissions	20	submittals per year	NRC estimate
New reactor ASME Code Case submittal	1	submittals per year	NRC estimate
Concrete Containment Examinations			
Perform concrete containment examination inspections	10	hours per inspection	NRC estimate. Applicable to operating units with renewed licenses under 10 CFR Part 54.
Concrete containment examinations and evaluations	59	inspections	NRC estimate. Applicable to operating units with renewed licenses under 10 CFR Part 54.
Immediate ASME Code repair or replace	0	month	NRC input. Flaw is detected during an outage before plant restart.
Deferred ASME Code repair or replace	26	month	Calculation. [Maximum deferral is 26 months]
Cost of repair or replacement	\$10,000	dollars	Example cost.
ASME BPV Code Case N-824 Ultrasonic Examinations			
Number of sites performing weld examinations	40	sites	NRC estimate.
Setup, perform, and document ultrasonic weld exam	30	hours	NRC estimate.
Inspection period	10	years	One inspection every 10 years.
ASME OM Code Mandatory Appendix III IST of MOVs			
Quarterly MOV exercise tests averted	4	tests per year	NRC input.
Quarterly MOV exercise tests averted	1	hour	NRC estimate.
Number of MOVs impacted	97	valves in program	NRC estimate

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Biannual MOV exercise test	107	tests	ASME OM Code Mandatory Appendix III new requirement.
Biannual MOV exercise test duration	1	hour	NRC estimate.
MOV diagnostic test duration	90	tests	ASME OM Code Mandatory Appendix III new requirement.
MOV diagnostic test on 10-year test interval	12	hour	NRC estimate.
MOV additional valves identified	10	Valves per unit	ASME OM Code Mandatory Appendix III new requirement.
Units that have already implemented MOV provision	29	units	Industry polling.
ASME OM Code supplemental requirements testing for new reactors			No additional requirements beyond current licensing provisions based on Commission policy for new reactors.
ASME OM Code Mandatory Appendix V on Pump Periodic Verification Tests			
Number of plants affected	15	units	NRC estimate.
Pump periodic verification test	5	pumps	NRC estimate. .A plant's IST program has 30 pumps; of these, five pumps require periodic verification testing.
Pump periodic verification test frequency	2	years	NRC estimate. Once every 2 years.
Pump periodic verification test duration	15	technician hours	NRC estimate.
ASME OM Code Case OMN-20 Time Period Extension			
Prepare and submit time period extension alternative request	400	hours	NRC estimate. For operating reactors, submitted in 2018, 2028, and 2038. For new reactors, submitted in 2020, 2030, 2040, 2050, 2060, and 2070.
Cast Stainless Steel Material Examination Requirements			
Perform and document CASS material inspections	30	welds	NRC estimate based on previously submitted ISI relief requests.
Cost per weld inspection	\$7,500	dollars	NRC estimate.

Data Element	Best Estimate	Unit	Source or Basis of Estimate
CASS material inspections begin	2019	year	NRC input.
5.4.24. Encoding of Ultrasonic Volumetric Examinations			
Perform encoded weld inspections	30	welds	NRC estimate of the number of non-mitigated or cracked mitigated dissimilar metal butt welds in the reactor coolant pressure boundary, within the scope of ASME BPV Code Case N-770-2.
Cost per weld inspection	\$7,500	hours	NRC estimate.
Encoded weld inspection frequency	10	years	NRC estimate.
NRC Implementation Costs			
5.5.17 Risk-Informed Inservice Testing of Pumps and Valves Request for Alternative Submittal to Use ASME OM Code Subsection ISTE			
Develop and issue risk-informed inservice testing guidance	400	hours	NRC estimate.
Review ASME OM Code Subsection ISTE submittal and issue a safety evaluation	750	hours	NRC estimate.
NRC Operation Costs			
5.6 Averted ASME Code Case Relief Requests (Operating Plants)			
Review ASME Code alternative request submittal and issue safety evaluation (operating plants)	210	NRC hours	NRC estimate. The average NRC level of effort to review a typical coverage-related relief submittal and issue a safety evaluation is approximately 90 engineering review hours plus 30 hours for concurrence and issue. Complex relief requests involving CASS and dissimilar metal welds under ASME BPV Code Case N-770 can take twice as much technical review time and involve specialized contractor support.
Number of averted ASME Code Case relief submissions	7	submittals per year	NRC estimate based on past experience (tied to industry averted ASME Code Case relief requests discussed above).
5.6 Averted ASME Code Case Relief Requests (New Plants)			
Review ASME Code Case relief	210	NRC hours	NRC estimate. This is the same average NRC level of effort to

Data Element	Best Estimate	Unit	Source or Basis of Estimate
request submittal and issue safety evaluation (new plants)			review a typical coverage-related relief submittal and issue a safety evaluation as for operating plants.
Number of averted ASME Code Case relief submissions	1	submittals per year	NRC estimate based on past experience (tied to industry averted ASME Code Case relief requests discussed above).
5.6.20 Review ASME OM Code Case OMN-20 Time Period Extension			
Review ASME OM Code Case OMN-20 alternative request submittal and issue safety evaluation (operating plants)	200	NRC hours	NRC estimate. The NRC level of effort to review an ASME OM Code Case OMN-20 alternative request submittal and issue a safety evaluation is approximately 80 engineering review hours plus 20 hours for concurrence and issue.
Review ASME OM Code Case OMN-20 alternative request submittal and issue safety evaluation (new plants)	200	NRC hours	NRC estimate. The NRC level of effort to review an ASME OM Code Case OMN-20 alternative request submittal and issue a safety evaluation is approximately 80 engineering review hours plus 20 hours for concurrence and issue.
Labor Rates			
Industry engineer or plant supervisor	\$123	dollars per hour	Labor rates used are from the Bureau of Labor Statistics Employer Costs for National Compensation Survey data set, 2015 values. These hourly rates were inflated to 2017 dollars using values of CPI-U. A multiplier of 2.4, which includes fringe and indirect management costs, was then applied and resulted in the given labor rates.
Managers	\$140	dollars per hour	
Technical staff	\$103	dollars per hour	
Administrative staff	\$77	dollars per hour	
Licensing staff	\$130	dollars per hour	
Industry plant technician	\$99	dollars per hour	
NRC engineer	\$128	dollars per hour	NRC, Rulemaker@nrc.gov, "NRC Labor Rates for Use in Regulatory Analyses," 2016.

SUBJECT: FINAL REGULATORY ANALYSIS FOR FINAL RULE: INCORPORATION BY REFERENCE OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODES AND CODE CASES NRC-2011-0088; RIN 3150-AI97 DATED: **April 10, 2017**

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