Incorporation by Reference of American Society of Mechanical Engineers Codes and Code Cases Proposed Rule—Draft Regulatory Analysis

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Rulemaking

October 2018

Abstract

This U.S. Nuclear Regulatory Commission (NRC) is proposing to amend its regulations to incorporate by reference the 2015 and 2017 Editions of the American Society of Mechanical Engineers (ASME) Code Cases for the ASME Boiler and Pressure Vessel Code (BPV Code), Section III, Division 1 and Section XI, Division 1. The proposed rule would also incorporate by reference the 2015 and 2017 Editions of the Operation and Maintenance of Nuclear Power Plants Code (OM Code). The NRC has a well-established practice for approving these consensus standards through the rulemaking process and incorporating them by reference into NRC's requirements at 10 CFR 50.55a, "Codes and standards." This practice increases consistency across the industry and demonstrates NRC's willingness to support the use of the most updated and technically sound techniques developed by the ASME to provide adequate protection to the public.

This document is a draft regulatory analysis of the proposed rule. To improve the credibility of the NRC staff cost estimates for this regulatory action, the staff conducted an uncertainty analysis to consider the effects of input uncertainty on the cost estimate and a sensitivity analysis to identify the variables that most affect the cost estimate (i.e., the cost drivers). Staff's analysis demonstrates that the proposed rule would result in a net averted cost to the industry that ranges from $3.64 million using a 7 percent discount rate to $4.17 million using a 3 percent discount rate. Relative to the regulatory baseline, the NRC would realize a net averted cost that ranges from $2.81 million using a 7-percent discount rate to $3.49 million using a 3-percent discount rate.

Table of Contents

List of Figures

List of Tables

Executive Summary

The U.S. Nuclear Regulatory Commission (NRC) proposes to amend its regulations to incorporate by reference the 2015 and 2017 Editions of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, with conditions on their use. Additionally, the NRC proposes to amend its regulations to incorporate by reference the 2015 and 2017 Editions of the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code), with conditions on their use. A significant portion of the averted costs from this proposed rule results from the reduction in burden of plant-specific requests for alternatives because these provisions would be incorporated by reference.

This regulatory analysis evaluates the costs and benefits associated with the proposed rule relative to the baseline case (i.e., the no-action alternative). The staff makes the following key findings based on this analysis:

- Proposed Rule Analysis. The proposed rule recommended by the staff would result in a cost-justified change based on a net (i.e., taking into account both costs and benefits) averted cost to the industry that ranges from \$3.64 million (7-percent net present value (NPV)) to \$4.17 million (3-percent NPV). Relative to the regulatory baseline, the NRC would realize a net averted cost ranging from \$2.81 million (7-percent NPV) to \$3.49 million (3-percent NPV). Table 1 shows the total costs and benefits to the industry and the NRC of proceeding with the proposed rule. The proposed rule alternative would result in net averted costs to the industry and the NRC ranging from \$6.45 million (7-percent NPV) to \$7.65 million (3-percent NPV).

Table 1 Total Costs and Benefits for Alternative 2

Attribute	**Costs**		
	Undiscounted	7% NPV	3% NPV
Total Industry Costs	(\$5,670,000)	(\$2,830,000)	(\$4,110,000)
Total NRC Costs	(\$1,300,000)	(\$900,000)	(\$1,080,000)
Total Costs	(\$6,970,000)	(\$3,730,000)	(\$5,190,000)
Attribute	**Benefits**		
	Undiscounted	7% NPV	3% NPV
Total Industry Benefits	\$9,920,000	\$6,470,000	\$8,270,000
Total NRC Benefits	\$5,610,000	\$3,710,000	\$4,570,000
Total Benefits	\$15,530,000	\$10,180,000	\$12,840,000
Attribute	**Net Benefits (Costs)**		
	Undiscounted	7% NPV	3% NPV
Industry	\$4,250,000	\$3,640,000	\$4,170,000
NRC	\$4,310,000	\$2,810,000	\$3,490,000
Total	\$8,560,000	\$6,450,000	\$7,650,000

Notes: Numbers rounded to three significant figures. There may be differences between totals because of rounding.
All values are reported in 2018 dollars.

- Nonquantified Benefits. Other benefits of the proposed rule include the NRC's continued ability to meet its goal of ensuring the protection of public health and safety and the environment through the 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 proposed rule is consistent with the provisions of the National Technology Transfer and Advancement Act of 1995 and implementing guidance in U.S. Office of Management and Budget Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities," dated January 27, 2016, which encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry. Finally, the ASME Code consensus process is an important part of the regulatory framework.

- Uncertainty Analysis. The regulatory analysis contains a simulation analysis showing that the estimated mean benefit for this proposed rule is $6.46 million with 90-percent confidence that the total net benefit is between $4.72 million and $11.1 million (7-percent NPV) and that the proposed rule is cost beneficial in all simulations. A reasonable inference from the uncertainty analysis is that proceeding with the proposed rule represents an efficient use of resources and averted costs to the NRC and the industry. The hours for relief request preparation and submission by industry is the factor responsible for the largest variation in averted costs.

- Decision Rationale. Relative to the no-action baseline, the staff concludes that the proposed rule is justified from a quantitative standpoint because its provisions would result in millions of dollars of net averted costs (i.e., net benefits) to the NRC and the industry. In addition, the staff concludes that the proposed rule is also justified when considering nonquantified costs and benefits, because the significance of the nonquantified benefits outweighs that of the nonquantified costs.

Abbreviations and Acronyms

ADAMS	Agencywide Documents Access and Management System
AOV	air-operated valve
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
BWR	boiling-water reactor
CASS	cast austenitic stainless steel
CC	concrete containment
CFR	*Code of Federal Regulations*
COL	combined license
CPI-U	Consumer Price Index for All Urban Consumers
CRGR	Committee to Review Generic Requirements
FPS	fusing procedure specification
FR	*Federal Register*
GDC	general design criterion/criteria
GTAW	gas tungsten arc weld
HDPE	high-density polyethylene
HSTIT	high-speed tensile impact testing
IBR	incorporation by reference
IN	Information Notice
ISI	inservice inspection
IST	inservice testing
ksi	kilopound per square inch
K_{IC}	plain-strain fracture toughness
K_{ID}	dynamic fracture toughness
LOE	level of effort
LWR	light-water reactor
MC	metal containment

MEFPS	manufacturer qualified electrofusion procedure specification
MOV	motor-operated valve
MRP	Materials Reliability Program
MUWE	median usual weekly earnings
NAICS	North American Industry Classification System Code
NDE	nondestructive examination
NPV	net present value
NQA	Nuclear Quality Assurance
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
PWR	pressurized-water reactor
PWSCC	primary water stress-corrosion cracking
PZR	pressurizer
QA	quality assurance
RCPB	reactor coolant pressure boundary
RG	regulatory guide
RPV	reactor pressure vessel
RT	reference temperature
SFPS	standard fusing procedure specification
SG	steam generator
SI	International System (of Units)
VSL	value of statistical life

1. Introduction

This document presents the regulatory analysis for the proposed 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. ML18150A265). The proposed rule incorporates by reference the following items into NRC regulations:

- the 2015 and 2017 Editions to the ASME BPV Code, Section III, Division 1, and Section XI, Division 1, and delineation of NRC requirements for the use of these codes, including conditions.
- the 2015 and 2017 Editions to Division 1 of the ASME OM Code, and delineation of NRC requirements for the use of these codes, including conditions.
- two revised ASME Code Cases and delineation of NRC requirements for the use of these code cases, including conditions
- an Electric Power Research Institute (EPRI), Materials Reliability Project (MRP) Topical Report, "Materials Reliability Program: Topical Report for Primary Water Stress Corrosion Cracking Mitigation by Surface Stress Improvement" (MRP-335, Revision 3-A), that provides requirements for the mitigation of primary water stress-corrosion cracking on reactor vessel head penetrations and dissimilar metal butt welds

The staff analyzed the ASME BPV and OM Code Editions to determine whether they 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.

2. Statement of the Problem and Objective

ASME develops and publishes the ASME BPV Code, which contains requirements for design, construction, and inservice inspection (ISI) of nuclear power plant components, and the ASME OM Code, which 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 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" (IBR). Upon IBR 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 specified in 10 CFR 50.55a. The editions and addenda of the ASME BPV and OM Codes were last incorporated by reference into the regulations in a final rule issued June 2017 (NRC, 2017d), 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 the 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 assure 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 leaktight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel.

The National Technology Transfer and Advancement Act of 1995 (Public Law 104-113, 1995) (NTTAA) 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 developing 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, 2, 3, MC, and 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. ASME develops Code Cases to gain experience with new technology before incorporating it into the ASME Code; permit licensees to use advances in ISI and IST; offer alternative examinations for older plants; respond expeditiously 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 the 2015 and 2017 Editions of the ASME BPV Code, Section III, Division 1, and the ASME BPV Code, Section XI, Division 1, including ASME Nuclear Quality Assurance (NQA)-1, as well as the 2015 and 2017 Editions of the ASME OM Code.

If the NRC did not conditionally accept ASME Code editions (or addenda and Code Cases) the NRC would disapprove these provisions entirely. One outcome of this action might be that licensees and applicants would submit a petition for rulemaking requesting the NRC to IBR the full scope of the ASME Code editions and addenda that would otherwise be approved by this proposed rule (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 on 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 2015 and 2017 Editions of the ASME BPV Code, Section III, Division 1, and Section XI, Division 1, with conditions on their use, and the 2015 and 2017 Editions of the ASME OM Code, 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. The 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) IBR of 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 items by reference:

- the 2015 and 2017 Editions of the ASME BPV Code, Section III, Division 1, and ASME BPV Code, Section XI, Division 1

- the 2015 and 2017 Editions of the ASME OM Code, Division 1

- ASME BPV Code Case N-729-6, "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-770-5, "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"

- Materials Reliability Project Topical Report for Primary Water Stress Corrosion Cracking Mitigation by Surface Stress Improvement (MRP-335, Revision 3-A)

The no-action alternative would mean that licensees and applicants that want to use the many provisions of these ASME Code editions and code cases would have to request and receive approval from the NRC for the use of alternatives under 10 CFR 50.55a(z).

3.2 Alternative 2—Incorporate by Reference ASME BPV and OM Code Editions with Conditions

Alternative 2 consists of incorporating by reference in the *Code of Federal Regulations* the 2015 and 2017 Editions of the ASME BPV Code, Section III, Division 1, and the ASME BPV Code, Section XI, Division 1, as well as the 2015 and 2017 Editions of the ASME OM Code, Division 1, with conditions on their use. Alternative 2 also includes incorporation by reference of ASME BPV Code Cases N-729-6 and N-770-5 and MRP-335, Revision 3-A. 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 specific ASME Code provisions given 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 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 participating in the national consensus standard process through the approval of these ASME Code editions, 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 Costs and Benefits

This section presents the process for evaluating the costs and benefits 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 NUREG/BR-0058, Draft Revision 5, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," issued April 2017 (NRC, 2017c).

The rule would affect the following attributes:

- <u>Public Health (Accident)</u>. This attribute accounts for expected changes in radiation exposure to the public caused by changes in accident frequencies or accident consequences associated with the alternative (i.e., delta risk). 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).

- <u>Occupational Health (Accident)</u>. 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., nonaccident 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 the latest edition of the ASME BPV Code 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 proposed 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 staff time to evaluate the ASME Code to determine its acceptability and whether any limitations or modifications should apply. Under the proposed 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 agency before the effective date of the proposed 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 staff to gain experience with new technology before its incorporation into the ASME Codes and by permitting licensees to use advances in ISI and IST. Improved ISI and IST may also result in the earlier identification of material degradation that, if undetected, could lead to further degradation that eventually causes 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 reduce 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 considerations of public health (routine); offsite property; onsite property; other government; general public; safeguards and security; and the environment.

4.2 Analytical Methodology

This section describes the process used to evaluate costs and benefits 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 10 affected attributes, the analysis evaluates 4 attributes—industry implementation, industry operation, 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 four attributes using three-point estimates to quantify the uncertainty in these estimates. The detailed cost tables used in this regulatory analysis are included in the individual sections for each of the provisions. The staff evaluated the remaining 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 A summarizes the major assumptions and input data.

4.2.1 Regulatory Baseline

This regulatory analysis provides the incremental impacts of the proposed rule compared to a baseline that reflects anticipated behavior if the NRC does not undertake regulatory or nonregulatory action. The regulatory baseline assumes full compliance with existing NRC requirements, including current regulations and relevant orders. This is consistent with NUREG/BR-0058, Draft Revision 5, which states that "in evaluating a new requirement…, the staff should assume that all existing NRC and Agreement State requirements have been implemented." Section 5 of this regulatory analysis presents the estimated incremental costs and benefits of the alternatives compared to this baseline.

4.2.2 Affected Entities

The following nuclear power reactors are affected by the proposed rule:

- <u>Operating reactor sites</u>. The NRC models 59 U.S. light-water nuclear power reactor sites in 2019, 55 plant sites in 2021, and 51 plant sites in 2025.[1]

- <u>Operating reactor units</u>. The analysis models 98 reactor units in 2019, 95 reactor units in 2021, and 91 reactor units in 2024. The following licensees have announced plans to shut down their operating reactors between 2018 and 2025:

  (1) Oyster Creek Nuclear Generating Station—by October 31, 2018 (originally planned to shut down by December 31, 2019)

  (2) Pilgrim Nuclear Power Station—by June 1, 2019

---

[1] The staff assumes that Oyster Creek Nuclear Generating Station will close in 2018 and Three Mile Island Nuclear Station, Unit 1, will close in 2019 based on Exelon Corporation's announcements (http://www.exeloncorp.com). The staff assumes that Pilgrim Nuclear Power Station will close in 2019 based on Entergy Nuclear Operations, Inc.'s announcement (http://www.entergy.com) and Davis-Besse Nuclear Power Station, Unit 1, will close in 2020 based on FirstEnergy Nuclear Operating Company's announcement (http://www.firstenergycorp.com).

(3) Three Mile Island Nuclear Station, Unit 1—on or about September 30, 2019

(4) Davis-Besse Nuclear Power Station—by May 31, 2020

(5) Indian Point Nuclear Generating, Units 2 and 3—by April 30, 2021

(6) Perry Nuclear Power Plant—by May 31, 2021

(7) Beaver Valley Power Station—by October 31, 2021

(8) Palisades Nuclear Plant—by spring 2022 (originally planned to shut down in 2018)

(9) Diablo Canyon Power Plant, Units 1 and 2—in 2025

Table 2 shows the operating plant and site numbers used in this analysis for the 6 years following this proposed rule.

Table 2 Operating Reactor and Site Information

Year	Operating Plants	Sites
2019	98	59
2020	96	57
2021	95	55
2022	92	53
2023	91	52
2024	91	52
2025	90	51

- Future operating reactor units. The staff assumes that the proposed rule would affect five future operating light-water nuclear power reactor units. The future nuclear power reactors considered in this analysis include Vogtle Electric Generating Plant, Units 3 and 4. As of May 2018, eight power reactors that have no published construction schedule hold combined licenses (COLs). These reactors are Fermi, Unit 3; North Anna Power Station, Unit 3; South Texas Project, Units 3 and 4; William States Lee III Nuclear Station, Units 1 and 2; and Turkey Point, Units 6 and 7. Because of this schedule uncertainty, inclusion of all these plants in this analysis is too speculative, so the staff made an assumption that the new Code editions will affect three of the eight reactors that have not started construction; thus, the analysis will include a total of five future reactors.

4.2.3 Base Year

All monetized costs are expressed in 2018 dollars. Ongoing costs of operation related to the alternative being analyzed are assumed to begin no earlier than 30 days after publication of the final rule in the *Code of Federal Regulations* unless otherwise stated, and they are modeled on an annual cost basis. The staff assumes that the rule will be effective in 2019.

One-time NRC implementation costs are estimated. The NRC assumes that these costs will be incurred in years 2018 and 2019.

Recurring annual operating expenses are estimated. 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 2018 dollar values.

4.2.4 Discount Rates

In accordance with guidance from U.S. Office of Management and Budget (OMB) Circular A-4, "Regulatory Analysis," issued September 2003 (OMB, 2003), and NUREG/BR-0058, draft Revision 5, net present value (NPV) 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 NPVs, costs and benefits, regardless of when the cost or benefit is incurred, 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 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 the discounting concept of social rate of time preference.[2] 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 cost[3] of capital concept to reflect the time value of resources directed to meet regulatory requirements.

4.2.5 Cost-Benefit Inflators

The staff estimated the analysis inputs for some attributes based on the values published in the sources referenced, which are provided in prior-year dollars. To evaluate the costs and benefits

---

2 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.

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

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 (BLS). Using the CPI-U, the prior-year dollars are converted to 2018 dollars. The following formula is used to determine the amount in 2018 dollars:

$$\frac{CPI - U_{2018}}{CPI - U_{Base\ Year}}\ x\ Value_{Base\ Year} = Value_{2018}$$

Table 3 summarizes the values of CPI-U used in this regulatory analysis.

Table 3 CPI-U Inflator

Base Year	CPI-U Annual Average[a]	Forecast Percent Change from Previous Year[b]
2016	240.007	
2017	245.120	
2018	250.757	2.30%

Sources:

[a] BLS Statistics, "Archived Consumer Price Index Supplement Files: April 2018 Historical CPI-U, Table 24, Historical Consumer Price Index for All Urban Consumers (CPI-U): U.S. City Average, All Items" (BLS, 2018).

[b] Congressional Budget Office, "The Budget and Economic Outlook: 2017 to 2027," issued January 2017 (Congressional Budget Office, 2017).

4.2.6 Labor Rates

For the purposes of this regulatory analysis, the staff developed labor rates that include only labor and material costs that are directly related to the implementation, operation, and maintenance of the proposed rule requirements. This approach is consistent with the guidance in NUREG/CR-3568, "A Handbook for Value-Impact Assessment," issued December 1983 (NRC, 1983), and general cost-benefit methodology. The NRC incremental labor rate is $131 per hour.[4]

The staff used the 2017 BLS Occupational Employment and Wages data (www.bls.gov) for the nuclear electric power generation industry (North American Industry Classification System (NAICS) Code 221113), which provide labor categories and the mean hourly wage rate by job type, and used the inflator discussed above to inflate these labor rate data to 2018 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

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

for regular utility employees). The staff used the BLS data tables to select appropriate hourly labor rates for performing the estimated procedural, licensing, and utility-related work necessary during and following implementation of the proposed alternative. In establishing this labor rate, wages paid to the individuals performing the work plus the associated fringe benefit component of labor cost (i.e., the time for plant management over and above those directly expensed) are considered incremental expenses and are included. Table 4 summarizes the BLS labor categories that were used to estimate industry labor costs to implement this proposed rule, and Appendix A lists the industry labor rates used in the analysis. The staff performed an uncertainty analysis, which is discussed in Section 5.13.

Table 4 Position Titles and Occupations

Position Title (in This Regulatory Analysis)	**Standard Occupational Classification 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 98 operating reactor units is January 2040, which results in approximately 22 remaining years of operation.

The staff used the remaining expected reactor lifetimes for the effective use of the ASME Code editions because, absent another ASME Code editions rulemaking, these editions would remain in effect for that entire time period.

4.2.9 Cost Estimation

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

The staff gathered data from several sources and consulted ASME Code working group members to develop LOEs and unit cost estimates. The staff applied several cost estimation methods in this analysis and used its collective professional knowledge and judgment to estimate many of the costs and benefits. Additionally, the staff used a buildup method, solicitation of licensee input, and extrapolation techniques to estimate costs and benefits.

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

The staff extrapolated to estimate 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 proposed rule and accompanying regulatory guidance, the staff used data on past projects to determine the labor categories of those 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 staff estimated the LOE based on similar steps in the process for which data were available.

To evaluate the effect of uncertainty in the model, the staff used 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 33. 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 0 gives a detailed description of the Monte Carlo simulation methods and presents the results.

4.2.10 NRC Conditioned Code

The staff analyzed the ASME BPV and OM Code Editions to determine whether they 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 proposed rule discusses the NRC's evaluation of the ASME Code and the reasons for the NRC's proposed conditions. The staff estimated the additional burden for each NRC-proposed condition for an ASME Code provision under the affected attributes of industry implementation and industry operation and then integrated its contribution into the overall costs and benefits.

4.2.11 Dollar per Person-Rem Conversion Factor

Only tables that relate to health benefits show the dose averted and the dose conversion factors. 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 (NRC, 1995).

The NRC currently uses a value of statistical life (VSL)[5] of $3 million based on NUREG-1530 and a cancer risk factor of $7.0\text{x}10^{-4}$ 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, *1990 Recommendations of the International Commission on Radiological Protection* (ICRP, 1991). Therefore, the dollar per person-rem conversion factor is equal to $3 million multiplied by $7.0\text{x}10^{-4}$ 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

5 The VSL is the monetary value of a mortality risk reduction that would prevent one statistical (as opposed to an identified) death (NRC, 1995). 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.

analysis, Table 5 provides the parameter evaluated, the parameter value for the base case for the staff's recommendation, and the values that the staff used in performing a sensitivity analysis.

Table 5 Dollar per Person-Rem Conversion Factor Values for Base Case and Sensitivity Analysis

Estimate	Dollar per person-rem (2014$) (A)	Inflation[a] (B)	Real income growth[b] (C)	Income elasticity (D)	Adjusted dollar per person-rem (2018$) (AxBxCxD)
Base case					$2,000
Low[c]	$3,100	1.0592	1.092	0.5	$3,400
Best[c]	$5,200				$5,800
High[c]	$7,700				$8,500

[a] The inflation value is the ratio of the CPI-U of 2018 to the CPI-U of 2014 (e.g., 251.002/236.736 = 1.0592).

[b] Real income growth is the ratio of the last four quarters of median usual weekly earnings (MUWE) data) (e.g., 0.25[873+854+866+862] = 864) to the 2014 MUWE value (e.g., 791) found in the *Economic News Release* (http://www.bls.gov/bls/newsrels.htm). This ratio is 1.092 (e.g., 864/791).

[c] Alternative dollar per person-rem values are from NUREG-1530, draft Revision 1 (NRC, 2017a).

4.3 Data

This section discusses the data and assumptions used in analyzing the quantifiable impacts associated with each proposed alternative. The 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 proposed rule was obtained from the 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. Results

This section presents the quantitative and qualitative results by attribute for Alternative 2, relative to the regulatory baseline (Alternative 1). As described in the previous sections, costs and benefits are quantified where possible and are shown to be either positive or negative, depending on whether the proposed alternative has a favorable or adverse effect compared to the regulatory baseline. Those attributes that are not presented in monetary values are discussed in qualitative terms. This *ex ante* cost-benefit analysis[6] provides information that can

[6] An "*ex ante* cost-benefit analysis" is prepared before a policy, program, or alternative is in place and can help in deciding whether resources should be allocated to that alternative.

be useful when deciding whether to select an alternative, even if the analysis is based on estimates of the future costs and benefits.

The NRC's regulatory analysis guidelines (NRC, 2017c) state that the NRC's periodic review and endorsement of consensus standards, such as new versions of the ASME Code and associated Code Cases, is a special case because consensus standards have already undergone extensive external review and have been endorsed by industry. In addition, endorsement of the ASME Code and Code Cases has been a longstanding NRC policy. Licensees and applicants participate in the development of the ASME Code and Code Cases and are aware that periodic updating of the ASME Code is part of the regulatory process. Code Cases are ASME-developed alternatives to the ASME BPV and OM Codes, which licensees and applicants may voluntarily choose to adopt without an alternative request if the Code Cases are approved through IBR in the NRC's regulations. Finally, endorsement of the ASME Code and Code Cases is consistent with the NTTAA, inasmuch as the NRC has determined that sound regulatory reasons exist for establishing regulatory requirements for design, maintenance, ISI, and IST and examination by rulemaking.

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

5.1 Public Health (Accident)

The industry's practice of adopting the latest ASME BPV and OM Code editions 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 so that the industry can gain experience with new technology before it is incorporated into the ASME Codes. Improvements in ISI and IST may also result in the earlier identification of material degradation that, if undetected, could cause further degradation that eventually leads to a plant transient. As such, Alternative 2 would maintain the same level of safety or 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 Code editions. 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 on 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 proposed 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 Code editions 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 Code Editions that are then incorporated by reference into the regulations ensures that the mandated ASME Code requirement results 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. Alternative 2 would permit licensees to use advances 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 advances 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. Section 0 details these effects on industry operation, including the sensitivity analysis using different dollar per person-rem conversion factors, as they correspond to radiological exposures during routine inspections or testing when compared to the regulatory baseline 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 (conditions on the ASME Code editions). Additional costs above the regulatory baseline are negative, and cost savings and averted costs are positive.

5.3.1 Conditions on ASME OM Code

The NRC proposes to amend the introductory text of paragraph 10 CFR 50.55a(b)(3) to reference the 1995 Edition through the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv). The NRC also proposes to amend the introductory text of paragraph (b)(3) to include Appendix IV, “Preservice and Inservice Testing of Active Pneumatically Operated Valve Assemblies in Nuclear Reactor Power Plants,” of the

ASME OM Code in the list of mandatory appendices incorporated by reference in 10 CFR 50.55a.

The new Appendix IV in the 2017 Edition of the ASME OM Code provides improved preservice testing and IST of active air-operated valves (AOVs) within the scope of the ASME OM Code. Appendix IV specifies quarterly stroke-time testing of AOVs where practicable, similar to the current requirements in Subsection ISTC of the ASME OM Code. In addition, Appendix IV specifies initial and periodic performance assessment testing for AOVs with high safety significance on a sampling basis over a maximum 10-year interval. The NRC estimates no incremental cost to industry as these conditions simply implement the 2017 Edition of the OM Code.

5.3.2 Reference for Motor-Operated Valve Testing

The NRC proposes to amend 10 CFR 50.55a(b)(3)(ii) to specify that the condition applies to the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv). This will allow future rulemakings to revise 10 CFR 50.55a(a)(1)(iv) to incorporate the latest edition and addenda of the ASME OM Code without the need to revise 10 CFR 50.55a(b)(3)(ii). This change represents a small incremental reduction in burden, which was not quantified.

5.3.3 Reference and Outdated Condition Removal for Check Valves (Appendix II)

The NRC proposes to amend 10 CFR 50.55a(b)(3)(iv) to accept the use of Appendix II, "Check Valve Condition Monitoring Program," to the 2017 Edition of the ASME OM Code without conditions based on its updated provisions. Appendix II to the 2017 Edition of the ASME OM Code incorporates Table II, "Maximum Intervals for Use When Applying Interval Extensions," as well as other conditions currently specified in 10 CFR 50.55a(b)(3)(iv). The NRC also proposes to update 10 CFR 50.55a(b)(3)(iv) to apply Table II to Appendix II to the ASME OM Code, 2003 Addenda through the 2015 Edition. Further, the NRC proposes to remove the outdated conditions in paragraphs (A) through (D) of 10 CFR 50.55a(b)(3)(iv) because these conditions apply to older editions and addenda of the ASME OM Code that are no longer used at nuclear power plants or because these conditions have been incorporated in recent editions and addenda of the ASME OM Code. This change represents a small incremental reduction in burden, which was not quantified.

5.3.4 Subsection ISTE

The NRC proposes to revise 10 CFR 50.55a(b)(3)(viii) to specify that the condition on Subsection ISTE applies to the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv). This would allow future rulemakings to revise 10 CFR 50.55a(a)(1)(iv) to incorporate the latest edition and addenda of the ASME OM Code without the need to revise 10 CFR 50.55a(b)(3)(viii). This is an administrative change to simplify future rulemakings and does not result in any incremental industry implementation costs.

5.3.5 Mandatory Appendix V and Subsection ISTF

The NRC proposes to amend 10 CFR 50.55a(b)(3)(ix) to specify that licensees applying Subsection ISTF in the 2015 Edition of the ASME OM Code shall satisfy the requirements of Mandatory Appendix V, "Pump Periodic Verification Test Program," to the ASME OM Code. This requirement is in addition to the current requirement to satisfy Appendix V when applying Subsection ISTF in the 2012 Edition of the ASME OM Code. Subsection ISTF in the 2017 Edition of the ASME OM Code has incorporated the provisions from Appendix V such that reference to the 2017 Edition of the ASME OM Code is not necessary in this condition. The NRC estimates that no incremental industry implementation costs are associated with these conditions, which are continuations of current requirements.

5.3.6 Valve Position Indication Applicability Condition

The NRC proposes to amend 10 CFR 50.55a(b)(3)(xi) for the implementation of Subsection ISTC-3700, "Position Verification Testing," in the ASME OM Code to apply to the 2012 Edition through the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv). This will allow future rulemakings to revise 10 CFR 50.55a(a)(1)(iv) to incorporate the latest edition and addenda of the ASME OM Code without the need to revise 10 CFR 50.55a(b)(3)(xi). This change represents a small incremental reduction in industry implementation costs and was not quantified.

5.3.7 Condition on Appendix IV on Air-Operated Valves

The NRC proposes a new 10 CFR 50.55a(b)(3)(xii) to require the application of the provisions in Appendix IV to the 2017 Edition of the ASME OM Code, when implementing the 2015 Edition of the ASME OM Code. This condition will provide consistency in the implementation of these two new editions of the ASME OM Code. The NRC estimates no incremental industry implementation costs associated with this condition.

5.3.8 Condition to Relax Schedule for Inservice Testing Code: Initial 120-Month Interval

Several stakeholders submitted public comments asking that the schedule for complying with the latest ASME Code edition and addenda in 10 CFR 50.55a(f)(4)(i) and (g)(4)(i) for the IST and ISI programs, respectively, be relaxed from the current period of 12 months to a new period of 24 months before the applicable milestones in those paragraphs. ASME has reiterated this request in teleconferences with the NRC, discussing the challenges associated with meeting the 12-month schedule for submitting timely relief or alternative requests for NRC review. In preparing this proposed rule, the NRC has determined that relaxation of the schedule for satisfying the latest edition of the ASME OM Code for the initial 120-month IST interval is appropriate. The NRC considers that a 24-month schedule would be contrary to the intent of the requirement to apply the latest edition of the ASME OM Code, which is published every 24 months. Therefore, the NRC proposes to extend the schedule to satisfy the latest edition and addenda of the ASME OM Code from the current 12 months to 18 months for the initial 120-month IST interval.

Allowing licensees 6 additional months to prepare for the initial 120-month IST interval in order to meet the latest edition and addenda of the ASME OM Code would result in some savings and efficiencies from personnel availability to avoiding scheduling conflicts. The NRC estimates that this schedule relaxation would provide a small incremental reduction in industry implementation burden, which was not quantified.

5.3.9 Condition to Relax Schedule for Inservice Testing Code: Successive 120-Month Intervals

As discussed in Section 0, several stakeholders submitted public comments asking that the schedule for complying with the latest ASME Code edition in 10 CFR 50.55a(f)(4)(ii) and (g)(4)(ii) for the IST and ISI programs, respectively, be relaxed from the current period of 12 months to a new period of 24 months before the applicable milestones in those paragraphs. Similarly, the NRC proposes to extend the schedule to satisfy the latest edition and addenda of the ASME OM Code from the current 12 months to 18 months for successive 120-month IST intervals.

As previously discussed, this relaxation would likely result in some industry implementation savings and efficiencies. The NRC estimates that this schedule relaxation may provide a small incremental reduction in industry implementation burden, which was not quantified.

5.3.10 Condition to Maintain Inservice Testing Reporting Requirements

The NRC proposes to amend 10 CFR 50.55a(f)(7) and 10 CFR 50.4(b)(10) to require nuclear power plant applicants and licensees to submit their IST plans and interim IST plan updates related to pumps and valves and those related to snubber examination and testing to NRC Headquarters, the appropriate NRC regional office, and the appropriate NRC resident inspector.

The ASME OM Code states in paragraph (a) of ISTA-3200, “Administrative Requirements,” that IST plans shall be filed with the regulatory authorities having jurisdiction at the plant site. However, ASME is planning to remove this provision from the ASME OM Code in a future edition based on its conclusion that this provision is more appropriate as a regulatory requirement than a Code requirement. This change is proposed in this rulemaking rather than in a future rulemaking so that this reporting requirement remains in effect. The staff uses these plans in evaluating relief and alternative requests and in evaluating deferral of quarterly testing to cold shutdowns and refueling outages. This proposed condition is an administrative change to relocate the provision from the ASME OM Code to 10 CFR 50.55a and 10 CFR 50.4, “Written Communications,” and the NRC estimates that this change would not impose any new incremental industry reporting requirement burdens. Because this condition maintains current regulatory reporting requirements, the NRC estimates no associated incremental industry implementation costs.

5.3.11 Rules for Construction of Nuclear Facility Components—Division 1

The NRC proposes to amend the regulation in 10 CFR 50.55a(a)(1)(E) to incorporate by reference the 2015 and 2017 Editions of the ASME Code and to clarify that only those sections of the mandatory appendices that pertain to Division 1 are incorporated by reference. The NRC estimates no incremental industry costs as a result of this clarification.

5.3.12 Section III Condition: Weld Leg Dimensions

The NRC proposes to revise the existing condition in 10 CFR 50.55a(b)(1)(ii) to make an editorial change and to update the Code edition year. The NRC estimates no incremental industry costs as a result of these editorial changes.

5.3.13 Section III Condition: Independence of Inspection

The NRC is proposing to revise this condition to make it applicable only for the 1995 Edition through the 2009b Addenda of the 2007 Edition, which references the NQA-1-1994 Edition.

The 1995 Edition through the 2009b Addenda of the 2007 Edition of the ASME BPV Code, Section III, Subsection NCA, endorsed the NQA-1-1994 Edition in NCA-4000, “Quality Assurance.” Paragraph (a) of NCA-4134.10, “Inspection,” states, “The provisions of NQA-1 Basic Requirement 10 and Supplement 10S-1, shall apply, except for paragraph 3.1, and the requirements of Inservice Inspection.” Paragraph 3.1, “Reporting Independence,” of Supplement 10S-1 to NQA-1 states, “Inspection personnel shall not report directly to the immediate supervisors who are responsible for performing the work being inspected.” In the 2010 Edition through the latest ASME BPV Code Editions of Subsection NCA, ASME removed the paragraph 3.1 exception for reporting independence.

Based on the above changes to the Code, the NRC is proposing to revise the condition to reflect that this condition is applicable only for the 1995 Edition through the 2009b Addenda of the 2007 Edition, where the NQA-1-1994 Edition is referenced. The NRC estimates no incremental industry implementation costs as a result of this clarification.

5.3.14 Section III Condition: Subsection NH

The NRC proposes to revise this existing condition in 10 CFR 50.55a(b)(1)(vi) because Subsection NH of Section III, Division 1, no longer exists in the 2017 Edition of Section III, Division 1. The change is to reflect that Subsection NH existed from the 1995 Addenda through the 2015 Edition of Section III, Division 1. In 2015, Subsection NH contents were also included in Section III Division 5 Subpart B. In the 2017 Edition of the ASME Code, Subsection NH was deleted from Section III, Division 1, and became part of Section III, Division 5. Section III, Division 5, is not incorporated by reference in 10 CFR 50.55a. The NRC estimates no incremental industry costs as a result of this administrative condition.

5.3.15 Section III Condition: Capacity Certification and Demonstration of Function of Incompressible Fluid Pressure Relief Valves

The NRC proposes to revise the existing condition in 10 CFR 50.55a(b)(1)(vii) so that it applies up to the 2017 Edition. The NRC estimates no incremental industry costs as a result of this change.

5.3.16 Section III Condition: Visual Examination of Bolts, Studs, and Nuts

Visual examination of bolts, studs, and nuts is one of the processes for acceptance of the final product to ensure its structural integrity and its ability to perform its intended function. The 2015 Edition of the ASME Code contains this requirement; however, the 2017 Edition does not require these visual examinations to be performed in accordance with NX-5100 and NX-5500. Therefore, the NRC proposes to add two conditions to ensure that adequate procedures remain and qualified personnel remain capable of determining the structural integrity of these components. All other final examinations for acceptance of the final product in the 2017 Edition require the procedures and personnel to be qualified to NX-5100 and NX-5500.

Therefore, the NRC proposes to add 10 CFR 50.55a(b)(1)(x)(A) to condition the provisions of NB-2582, NC-2582, ND-2582, NE-2582, NF-2582, and NG-2582 in the 2017 Edition of Section III to require that procedures are qualified to NB-5100, NC-5100, ND-5100, NE-5100, NF-5100, and NG-5100, and personnel are qualified to NB-5500, NC-5500, ND-5500, NE-5500, NF-5500, and NG-5500, respectively, to ensure that adequate procedures and personnel remain capable of determining the structural integrity of these components. This is particularly important for small bolting, studs, and nuts that receive only a visual examination. Typically, as stated in NX-4123 of Section III, only inspections under Article NX-4000 (e.g., marking, dimensional measurement, fitting, alignment) are not required to be performed in accordance with NX-5100 and NX-5500 but may be qualified in accordance with the certificate holder's quality assurance program.

Furthermore, the 2017 Edition of Section III requires only that the final surfaces of threads, shanks, and heads be visually examined for workmanship, finish, and appearance in accordance with the requirements of ASTM F788 for bolting material and ASTM F812 for nuts. This examination is for acceptance of the final product to ensure its structural integrity, especially for small bolting that receives only a visual examination. Performing an inspection for workmanship or appearance to the bolting specification does not necessarily ensure the integrity of the bolts and nuts for their intended function in a reactor. The visual examination in Section III for bolting and nuts is intended to determine structural integrity for their intended function as specified in the 2015 Edition of Section III: "Discontinuities such as laps, seams, or cracks that would be detrimental to the intended service are unacceptable."

Therefore, the NRC proposes to add 10 CFR 50.55a(b)(1)(x)(B) to condition the provisions of NB-2582, NC-2582, ND-2582, NE-2582, NF-2582, and NG-2582 in the 2017 Edition of Section III, to require the acceptance criteria from NB-2582, NC-2582, ND-2582, NE-2582, NF-2582, and NG-2582 in the 2015 Edition of Section III.

The NRC estimates no incremental industry implementation costs as a result of these conditions, which continue existing practices and enforce sound engineering principles.

5.3.17 Section III Condition: Certifying Engineer

The NRC is proposing to add a new condition in 10 CFR 50.55a(b)(1)(xii):

> When applying the 2017 and later editions of ASME Code Section III, the NRC does not permit applicants and licensees to use a certifying engineer in lieu of a registered professional engineer for code related activities that are applicable to U.S. nuclear facilities regulated by the U.S. NRC.

The 2017 Edition of ASME BPV Code, Section III, Subsection NCA, updated the following subsections to replace the term “registered professional engineer” with the term “certifying engineer” to be consistent with ASME BPV Code, Section III, Mandatory Appendix XXIII:

- NCA-3255, “Certification of the Design Specifications”
- NCA-3360, “Certification of the Construction Specification, Design Drawings, and Design Report”
- NCA-3551.1, “Design Report”
- NCA-3551.2, “Load Capacity Data Sheet”
- NCA-3551.3, “Certifying Design Report Summary”
- NCA-3555, “Certification of Design Report”
- Table NCA-4134.17-2, “Nonpermanent Quality Assurance Records”
- NCA-5125, “Duties of Authorized Nuclear Inspector Supervisors”
- NCA-9200, “Definitions”

The NRC staff reviewed these changes and determined that the use of a certifying engineer instead of a registered professional engineer is applicable only to non-U.S. nuclear facilities. Therefore, use of a certifying engineer does not apply to U.S. nuclear facilities regulated by the NRC. As a result, the NRC is proposing to add a new condition to 10 CFR 50.55a(b)(1) that would not allow applicants and licensees to use a certifying engineer in lieu of a registered professional engineer for Code-related activities applicable to U.S. nuclear facilities regulated by the NRC. The NRC estimates no incremental industry implementation costs as a result of this condition, which continues previous practice that would have otherwise been altered by the ASME Code.

5.3.18 Conditions on ASME BPV Code, Section XI

The NRC proposes to amend the regulations in 10 CFR 50.55a(b)(2) to incorporate by reference the 2015 and the 2017 Editions (Division 1) of the ASME BPV Code, Section XI. The current regulations in 10 CFR 50.55a(b)(2) incorporate by reference ASME BPV Code, Section XI, 1970 Edition through the 1976 Winter Addenda, and the 1977 Edition (Division 1) through the 2013 Edition (Division 1), subject to the conditions identified in current 10 CFR 50.55a(b)(2)(i) through (b)(2)(xxix). The proposed amendment would revise the introductory text to 10 CFR 50.55a(b)(2) to incorporate by reference the 2015 Edition (Division 1) and the 2017 Edition (Division 1) of the ASME BPV Code, Section XI; clarify the wording; and revise or provide some additional conditions as explained in this document. The NRC estimates no incremental industry implementation costs as a result of this amendatory condition.

5.3.19 Augmented Inservice Inspection Requirements: Implementation of Appendix VIII to Section XI

The NRC proposes to remove 10 CFR 50.55a(g)(6)(ii)(C) from the current regulations. This paragraph describes requirements for initial implementation of supplements in Section XI, Appendix VIII. Licensees are no longer using these older editions and addenda of the Code referenced in this paragraph. Therefore, this condition can be removed without any impact. The NRC estimates no incremental industry implementation costs or averted costs for the removal of this condition.

5.3.20 Clarifying Condition on ASME BPV Code, Section III

The NRC proposes to amend 10 CFR 50.55a(b)(1) to clarify that the conditions on the use of ASME BPV Code, Section III, apply to each construction permit for a utilization facility. The condition also includes various editorial changes to the BPV Code. The NRC estimates that there are no incremental industry implementation costs for this condition because it is a minor clarification of existing requirements.

5.3.21 Appendix XXVI Conditions

The NRC proposes to add a new paragraph with conditions on the use of ASME BPV Code, Section III, Appendix XXVI, for installation of high-density polyethylene (HDPE) pressure piping. This appendix was new in the 2015 Edition of Section III, and the 2017 Edition of Section III added electrofusion joining to this appendix. The 2015 Edition of Section III is the first time the ASME Code has provided rules for the use of polyethylene piping. The NRC has determined that the conditions that follow in 10 CFR 50.55a(b)(1)(xi)(A) through (b)(1)(xi)(E) are necessary for the use of polyethylene piping in Class 3 safety-related applications. The conditions in (b)(1)(xi)(A) and (b)(1)(xi)(B) pertain to butt fusion joints and apply to both the 2015 and 2017 Editions of Section III. The conditions in (b)(1)(xi)(C), (b)(1)(xi)(D), and (b)(1)(xi)(E) pertain to electrofusion joints and apply only to the 2017 Edition of Section III.

Large independent research programs funded by the NRC and industry have shown that joint failure is the most likely cause of structural failure in HDPE piping systems. Poorly manufactured joints are susceptible to early structural failure driven by "slow crack growth," a form of subcritical creep crack growth that is active in HDPE. The five provisions below are intended to ensure high-quality joints in HDPE systems and to reduce the risk of poor joint fabrication. These provisions minimize the risk of joint structural failure and the resulting potential loss of system safety function.

5.3.21.1 Fusing Procedure Specification

The NRC proposes to add a new paragraph to 10 CFR 50.55a(b)(1)(xi)(A), which specifies the essential variables to be used in qualifying fusing procedures for butt fusion joints in HDPE piping installed in accordance with ASME Section III, Mandatory Appendix XXVI. The NRC does not endorse the use of a standardized fusing procedure specification. A fusion procedure specification would need to be generated for each butt fusion joint with the essential variables listed. The same variables would be listed for performance qualifications.

As stated in ASME Section IX, QF-252, essential variables are those that will affect the mechanical properties of the fused joint, if changed, and require requalification of the fusing procedure specification (FPS), standard fusing procedure specification (SFPS), or manufacturer-qualified electrofusion procedure specification (MEFPS), when any change exceeds the specified limits of the values recorded in the FPS for that variable. Through extensive research and field experience, the NRC and industry experts have identified 14 essential variables for HDPE butt fusion for nuclear applications. Of these essential variables, 10 are the same as those identified in ASME Section IX, Table QF-254, which applies to all HDPE butt fusion not limited to nuclear applications. The other four variables deemed essential by the NRC are (1) diameter, (2) cross-sectional area, (3) ambient temperature, and (4) fusing machine carriage model. Industry experts recognize these four additional variables as essential for butt fusion joints in nuclear safety applications, and they are included in a proposal to list essential variables for butt fusion in the 2019 Edition of ASME Section III, Appendix XXVI.

The NRC has determined that the HDPE butt fusion essential variables must be explicitly listed in ASME Section III, which the NRC reviews and incorporates by reference. The NRC neither endorses ASME Section IX nor incorporates it by reference. For nuclear applications, Section III, Mandatory Appendix XXVI, governs the use of HDPE. To ensure that butt fusion joint quality is adequate for nuclear safety applications, the NRC determined that referencing Section IX in Section III, Appendix XXVI, is not sufficient, because changes to Section IX are not formally reviewed and approved by the NRC. Instead, the NRC determined that the essential variables for HDPE butt fusion should be listed in Section III, Appendix XXVI. This provision notes that the HDPE butt fusion essential variables are not listed in the 2015 and 2017 Editions of Section III, Appendix XXVI. Proposals to incorporate these essential variables for butt fusion in the 2019 Edition of the Code have already been drafted and circulated in ASME Code Committees and are likely to be approved. In the meantime, the NRC is proposing to add this provision to ensure butt fusion joint quality for nuclear safety applications.

The NRC estimates that this condition will result in incremental industry implementation costs to develop fusion procedures. Section 0 discusses the industry costs for developing fusing procedures and performing joint fusing in accordance with these procedures.

5.3.21.2 Testing Fusing Procedures

The NRC proposes to add a new paragraph to 10 CFR 50.55a(b)(1)(xi)(B), which will require both bend tests and high-speed tensile impact testing (HSTIT) to qualify fusing procedures for joints in polyethylene piping installed in accordance with ASME BPV Code, Section III, Mandatory Appendix XXVI. The NRC requires both bend tests and HSTIT to qualify the fusion procedures. There are data suggesting that HSTIT may not distinguish between an acceptable and unacceptable HDPE butt fusion joint and therefore should not be considered as a standalone test.

The NRC has done limited confirmatory research on the ability of short-term mechanical tests to predict the inservice behavior of HDPE butt fusion joints. Based on this research, as well as research results from The Welding Institute in the United Kingdom, the NRC lacks conclusive evidence that either of the two tests proposed in Articles XXVI-4342(d) and XXVI-4342(e) is a reliable predictor of joint quality. As a result, the NRC determined that the combination of both test results provides increased and sufficient indication of butt fusion joint quality. Consequently, the NRC is proposing that both tests specified in Articles XXVI-4342(d) and XXVI-4342(e) be part of performance qualification tests. Because industry has procedures for performing either of these two tests, the NRC estimates that this condition does not result in any incremental industry implementation costs. The NRC estimates that the performance of additional bend tests would result in a small incremental industry operation cost, which is discussed in Section 0.

5.3.21.3 Essential Variables for Qualifying Fusing Procedures of Electrofusion Joints in Polyethylene Piping

The NRC is proposing to add a new paragraph to 10 CFR 50.55a(b)(1)(xi)(C) that specifies the essential variables to be used in qualifying fusing procedures for electrofusion joints in polyethylene piping installed in accordance with ASME BPV Code, Section III, Mandatory Appendix XXVI. The NRC does not endorse the use of a standardized fusing procedure specification. A fusion procedure specification will need to be generated for each electrofusion joint with the essential variables as listed. The same variables will be listed for performance qualifications.

ASME Section IX, QF-252, states the following:

> Essential variables are those that will affect the mechanical properties of the fused joint, if changed, and require requalification of the FPS, SFPS, or MEFPS when any change exceeds the specified limits of the values recorded in the FPS for that variable.

Through extensive research and field experience, the NRC and industry experts have identified 16 essential variables for HDPE electrofusion for nuclear applications. Of these essential variables, 12 are the same as those identified in ASME Section IX, Table QF-255, which applies to all HDPE electrofusion not limited to nuclear applications. The other four variables deemed essential by the NRC are (1) fitting Polyethylene material, (2) pipe wall thickness, (3) power supply, and (4) processor. Industry experts recognize these four additional variables as essential for electrofusion joints in nuclear safety applications, and the variables have been included in a proposal to list essential variables for electrofusion in the 2019 Edition of ASME Section III, Appendix XXVI.

The NRC determined that the essential variables for HDPE electrofusion must be explicitly listed in ASME Section III, which the NRC reviews and incorporates by reference. The NRC does not endorse ASME Section IX nor incorporate it by reference. For nuclear applications, ASME Section III, Mandatory Appendix XXVI, governs the use of HDPE. The NRC determined that referencing Section IX in Section III, Appendix XXVI, is not sufficient to ensure electrofusion joint quality for nuclear safety applications, because the NRC does not formally review and approve changes to Section IX. Instead, the NRC has determined that the essential variables for HDPE electrofusion should be listed in Section III, Appendix XXVI. This provision notes that the essential variables for HDPE electrofusion are not listed in the 2015 and 2017 Editions of Section III, Appendix XXVI. Proposals to incorporate these essential variables for electrofusion in the 2019 Edition of the Code have already been drafted and circulated in ASME Code Committees and are likely to be approved. In the meantime, the NRC proposes to add this provision to ensure electrofusion joint quality for nuclear safety applications. The NRC estimates no incremental industry implementation costs for this condition.

5.3.21.4 Qualifying Fusing Procedures for Electrofusion Joints in HDPE Piping

The NRC is proposing to add a new paragraph to 10 CFR 50.55a(b)(1)(xi)(D), which will require both a crush test and an electrofusion bend test to qualify fusing procedures for electrofusion joints in polyethylene piping installed in accordance with the 2017 Edition of the ASME BPV Code, Section III, Mandatory Appendix XXVI. The NRC requires both a crush test and an electrofusion bend test to qualify the electrofusion procedures. The operating experience data on electrofusion joints are extremely limited but indicate some failures. To ensure the structural integrity of electrofusion joints in safety-related applications, the NRC requires that both a crush test and an electrofusion bend test be performed to demonstrate an acceptable HDPE electrofusion joint test.

These tests are intended to demonstrate that a system using electrofusion joints will not lose the ability to perform its safety function during its service life following a repair. The NRC lacks conclusive evidence of the ability of short-term mechanical tests to predict the inservice behavior of HDPE electrofusion joints in nuclear safety-related applications. The NRC considers that neither a crush test nor an electrofusion bend test proposed in Articles XXVI-2332(a) and XXVI-2332(b) may reliably predict electrofusion joint quality. However, the NRC has determined that performing both tests provides increased and sufficient indication of electrofusion joint quality. Consequently, the NRC is requiring that both a crush test and an electrofusion bend test, specified in XXVI-2332(a) and XXVI-2332(b), must be performed as part of performance qualification tests. Section 5.4.23.4 estimates the incremental cost of performing the additional test.

5.3.21.5 Prohibits the Use of Electrofusion Saddle Fittings and Electrofusion Saddle Joints in HDPE Piping

The NRC is proposing to add a new paragraph to 10 CFR 50.55a(b)(1)(xi)(E) that prohibits the use of electrofusion saddle fittings and electrofusion saddle joints. The NRC believes that the failure of electrofusion saddle joints could result in a gross structural rupture leading to the loss of safety function for the system where the joint is present. Consequently, only full 360-degree seamless sleeve electrofusion couplings (as shown in Table XXVI-3311-1 of the ASME BPV Code, Section III, 2017 Edition) and full 360-degree electrofusion socket joints (as shown in the top image in Figure XXVI-4110-2 of the ASME BPV Code, Section III, 2017 Edition) are permitted.

Very limited information and operational experience are available for electrofusion joints in nuclear safety applications, and some U.S. Department of Energy operational experience indicates that failures have occurred in electrofusion joints. The NRC determined that the failure of a saddle-type electrofusion joint could result in structural separation of the electrofusion saddle coupling from the HDPE pipe it is attached to, resulting in a potential loss of flow and loss of safety function in the system. As a result, the NRC is proposing to add a provision to allow only full 360-degree seamless-sleeve-type electrofusion couplings, attached with a socket-type electrofusion joint. The failure of such a joint is far less likely to result in the total loss of flow and safety function. For full 360-degree seamless-sleeve-type electrofusion couplings attached with a socket-type electrofusion joint, full separation of the coupling from the pipe is highly unlikely.

The NRC estimates that this condition does not result in any incremental industry implementation costs; however, the need to construct and install these HDPE piping joint fittings would result in incremental industry operation costs as discussed in Section 5.4.23.

5.3.22 Condition on Effective Edition and Addenda of Subsections IWE and IWL

The NRC proposes to remove the existing condition in 10 CFR 50.55a(b)(2)(vi). A final rule was published in the *Federal Register* (61 FR 41303; August 8, 1996), which incorporated by reference for the first time the ASME BPV Code Section XI, Subsections IWE and IWL. The associated Statements of Consideration for that rule identified the 1992 Edition with 1992 Addenda of Subsections IWE and IWL as the earliest version that the NRC finds acceptable. A subsequent rule (64 FR 51370; September 22, 1999) included the 1995 Edition with the 1996 Addenda as an acceptable edition of the ASME Code. The Statements of Consideration for a later rule (67 FR 60520; September 26, 2002) noted that the 1992 Edition with the 1992 Addenda, or the 1995 Edition with the 1996 Addenda of Subsections IWE and IWL, must be used when implementing the initial 120-month interval for the ISI of Class MC and Class CC components and that successive 120-month interval updates must be implemented in accordance with 10 CFR 50.55a(g)(4)(ii).

This requirement was in place to expedite the initial containment examinations in accordance with Subsections IWE and IWL, which were required to be completed during the 5-year period from September 6, 1996, to September 9, 2001. Because a framework exists for containment examinations in accordance with Subsections IWE and IWL, there is no need for a condition specific to the initial examination interval. The initial interval examinations can be conducted in accordance with the existing guidance in 10 CFR 50.55a(g)(4).

The NRC estimates that the removal of this condition would not result in any incremental industry implementation costs because the 2017 Edition maintains the regulatory baseline for these examinations.

5.3.23 Section XI References to OM Part 4, OM Part 6, and OM Part 10 (Table IWA-1600-1)

The NRC proposes to remove the condition found in 10 CFR 50.55a(b)(2)(vii), which describes the editions and addenda of the OM Code to be used with the Section XI references to OM Part 4, OM Part 6, and OM Part 10 in Table IWA-1600-1 of Section XI when Section XI, Division 1, 1987 Addenda, 1988 Addenda, or 1989 Edition is used. In 10 CFR 50.55a(g)(4)(ii), the NRC requires that the licensee’s successive 120-month inspection intervals comply with the requirements of the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b)(2). Licensees are no longer using these older editions and addenda of the Code referenced in 10 CFR 50.55a(b)(2)(vii); therefore, this condition can be removed without affecting any licensees. The NRC estimates that the removal of this condition would result in no incremental industry implementation costs or benefits because licensees are no longer using these older editions and addenda.

5.3.24 Metal Containment Examinations

The NRC proposes to revise 10 CFR 50.55a(b)(2)(ix) to require compliance with new condition 10 CFR 50.55a(b)(2)(ix)(K). The NRC specifies the application of this condition to all editions and addenda of Section XI, Subsection IWE, of the ASME BPV Code that are incorporated by reference in 10 CFR 50.55a(b). The proposed condition will ensure that containment leak-chase channel systems are properly inspected in accordance with NRC staff expectations.

Regulations in 10 CFR 50.55a(g) require that licensees implement the ISI program for pressure-retaining components and their integral attachments of metal containments and metallic liners of concrete containments in accordance with Subsection IWE of Section XI of the applicable edition and addenda of the ASME Code, incorporated by reference in 10 CFR 50.55a(b) and subject to the applicable conditions in 10 CFR 50.55a(b)(2)(ix). The regulatory condition in 10 CFR 50.55a(b)(2)(ix)(A) or the equivalent provision in Subsection IWE of the ASME Code (2006 and later editions and addenda only) requires that licensees shall evaluate the acceptability of inaccessible areas when conditions in accessible areas indicate the presence of, or result in, degradation in the inaccessible areas.

The containment floor weld leak-chase channel system forms a metal-to-metal interface with the containment shell or liner, the test connection end of which is at the containment floor level. Therefore, the leak-chase system provides a pathway for potential intrusion of moisture that could cause corrosion degradation of inaccessible embedded areas of the pressure-retaining boundary of the basemat containment shell or liner within it. In addition to protecting the test connection, the cover plates, plugs, and accessible components of the leak-chase system within the access box are intended to prevent intrusion of moisture into the access box and into the inaccessible areas of the shell and liner within the leak-chase channels, thereby protecting the shell and liner from potential corrosion degradation that could affect leaktightness.

Licensees are to implement the containment ISI program required by 10 CFR 50.55a in accordance with Subsection IWE of ASME Code Section XI, subject to regulatory conditions. The Code requires special consideration of areas susceptible to accelerated corrosion degradation and aging and barriers intended to prevent intrusion of moisture and water accumulation against inaccessible areas of the containment pressure-retaining metallic shell or liner. The containment floor weld leak-chase channel system is one area subject to accelerated degradation and aging if moisture intrusion and water accumulation are allowed on the embedded shell and liner within it. Therefore, the leak-chase channel system is subject to the ISI requirements of 10 CFR 50.55a(g)(4).

NRC Information Notice (IN) 2014-07, "Degradation of Leak-Chase Channel Systems for Floor Welds of Metal Containment Shell and Concrete Containment Metallic Liner," dated May 5, 2014 (ADAMS Accession No. ML14070A114), discusses examples of licensees not conducting the required ISIs. The IN also summarizes why the staff believes the leak-chase components are within the scope of Subsection IWE of the ASME Code Section XI and how licensees can fulfill the requirements. The staff's guidance recommends that 100 percent of the accessible components of the leak-chase system be inspected during each inspection period (there are three inspection periods in one 10-year inspection interval).

After issuing IN 2014-07, the NRC received feedback from ASME management during a public meeting held on August 22, 2014 (ADAMS Accession No. ML14245A003) that the IN guidance appeared to conflict with ASME Code Section XI, Interpretation XI-1-13-10. In response to this feedback, the NRC issued a letter to ASME on March 3, 2015 (ADAMS Accession No. ML14261A051), which stated that the NRC believes the IN is consistent with the requirements in the ASME Code and the NRC staff may consider adding a condition to 10 CFR 50.55a to clarify the expectations. On April 13, 2015, ASME responded to the NRC's letter (ADAMS Accession No. ML15106A627) and noted that a condition in the regulations may be appropriate to clarify the NRC staff's position.

Based on the operating experience summarized in IN 2014-07 and the industry feedback, the NRC staff is proposing a new condition in 10 CFR 50.55a(b)(2)(ix) to clarify the staff's expectations and to ensure that steel containment shells and liners receive appropriate examinations. The 2017 Edition of the ASME Code added a provision that clearly specifies the examination of leak-chase channels. The provision requires 100-percent examination of the leak-chase channel closures over a 10-year inspection interval, as opposed to 100-percent examination during each inspection period. Although the examination frequency is relaxed compared to the staff's position documented in IN 2014-07, the staff finds the provision in the 2017 Edition acceptable because the examination includes provisions for scope expansion and examinations of additional closures if degradation is identified within an inspection period. The staff chose to align the condition with the acceptable provision in the latest approved edition of the ASME Code. This proposed condition would apply to all editions and addenda of the ASME Code before the 2017 Edition.

The NRC estimates that there are no incremental industry implementation costs associated with these conditions because industry has existing procedures for performing leak-chase channel examinations in accordance with these requirements. This condition will result in averted costs to plants using editions of the ASME Code prior to 2017 because of the relaxation in examination intervals. The NRC did not quantitatively estimate these averted costs.

5.3.25 Reconciliation of Quality Requirements for Replacement Items

The NRC is proposing to delete this condition because ASME BPV Code, Section XI, IWA-4222(a)(2), has never stated that an owner could reconcile to a quality assurance (QA) program not endorsed by the NRC (i.e., 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"; NQA-1; NCA-3800). IWA-4222(a)(2) allows a user to reconcile only between endorsed QA programs. The 2000 Edition of ASME BPV Code, Section XI, added an endnote to IWA-4222(a)(2) to clarify the owner's QA program requirements. The intent of this change was to eliminate the concern that an owner could misinterpret the Code to allow any exception to an owner's QA program requirements. The NRC estimates no incremental industry implementation costs associated with the removal of this condition.

5.3.26 Nondestructive Examination Personnel Certification: Fourth Provision

The NRC proposes to amend the condition in 10 CFR 50.55a(b)(2)(xviii) to extend the applicability to use of the 2011 Addenda through the latest edition incorporated by reference in paragraph 10 CFR 50.55a(a)(1)(ii) of ASME BPV Code, Section XI. This current condition prohibits licensees using the ASME BPV Code, Section XI, 2011 Addenda through the 2013 Edition, from using Appendix VII, Table VII-4110–1, and Appendix VIII, Subarticle VIII-2200. The condition requires licensees and applicants using these versions of Section XI to use the prerequisites for ultrasonic examination personnel certifications in Appendix VII, Table VII-4110–1, and Appendix VIII, Subarticle VIII–2200 in the 2010 Edition. The NRC added this condition when the 2010 through the 2013 Editions were incorporated by reference. However, neither the 2015 Edition nor the 2017 Edition addressed the NRC's concern. Therefore, the NRC is proposing to extend this condition to the latest edition incorporated by reference in paragraph 10 CFR 50.55a(a)(1)(ii).

The NRC estimates no incremental industry costs as a result of the continuation of this existing condition.

5.3.27 Section XI Condition: System Leakage Tests: Second Provision

The NRC proposes to amend the condition in 10 CFR 50.55a(b)(2)(xx)(B) to clarify its expectations related to the nondestructive examination (NDE) required when a system leakage test is performed in lieu of a hydrostatic test following repair and replacement activities performed by welding or brazing on a pressure-retaining boundary. This applies to use of the 2003 Addenda through the latest edition and addenda of ASME BPV Code, Section XI, incorporated by reference in paragraph 10 CFR 50.55a(a)(1)(ii). Industry stakeholders have expressed confusion about the requirements of the current regulation with regard to the Code edition and addenda addressing the requirements for NDE and pressure testing under this condition. The NRC is proposing to modify the condition to clarify that the NDE method (e.g., surface, volumetric) and acceptance criteria of the 1992 or later edition of the ASME BPV Code, Section III, shall be met. The actual NDE and pressure testing may be performed using procedures and personnel meeting the requirements of the licensee's or applicant's current ISI code of record.

The NRC first put this condition in place by a 2008 rule (73 FR 52730; October 10, 2008). The NRC determined that the condition was necessary because the ASME BPV Code eliminated the requirement to perform the Section III NDE when performing a system leakage test in lieu of a hydrostatic test following repairs and replacement activities performed by welding or brazing on a pressure-retaining boundary, in the 2003 Addenda of ASME BPV Code, Section XI. The NRC estimates no incremental costs as a result of this clarifying condition.

5.3.28 Section XI Condition: System Leakage Tests: Third Provision

The NRC proposes to add 10 CFR 50.55a(b)(2)(xx)(C) to provide two conditions for the use of the alternative boiling-water reactor (BWR) Class 1 system leakage test described in IWB-5210(c) and IWB-5221(d) of the 2017 Edition of ASME Section XI. The first condition addresses a prohibition against the production of heat through the use of a critical reactor core to raise the temperature of the reactor coolant and pressurize the RCPB (sometimes referred to as nuclear heat). The second condition addresses the duration of the hold time when testing noninsulated components to allow potential leakage to manifest itself during the performance of system leakage tests.

The alternative BWR Class 1 system leakage test was intended to address concerns that performing the ASME-required pressure test for BWRs under shutdown conditions (1) places the unit in a position of significantly reduced margin, approaching the fracture toughness limits defined in the technical specification pressure-temperature curves, and (2) requires abnormal plant conditions and alignments, incurring additional risks and delays, while providing few added benefits beyond those of tests that could be performed at slightly reduced pressures under normal plant conditions. However, because of restrictions imposed by the pressure control systems, most BWRs cannot obtain reactor pressure corresponding to 100-percent rated power during normal startup operations at low power levels that would be conducive to performing examinations for leakage. The alternative test would be performed at slightly reduced pressures and normal plant conditions, which the NRC finds would constitute an adequate leak examination and would reduce the risk associated with abnormal plant conditions and alignments.

However, the NRC has had a longstanding prohibition against the production of heat through the use of a critical reactor core to raise the temperature of the reactor coolant and pressurize the RCPB. A letter dated February 2, 1990, from James M. Taylor, Executive Director for Operations, NRC, to Nicholas S. Reynolds and Daniel F. Stenger, Nuclear Utility Backfitting and Reform Group (ADAMS Accession No. ML14273A002), established the NRC position on the use of a critical reactor core to raise the temperature of the reactor coolant and pressurize the RCPB. In summary, the NRC's position is that testing under these conditions involves serious impediments to careful and complete inspections and, therefore, inherent uncertainty in ensuring the integrity of the RCPB. Further, the practice is not consistent with basic defense-in-depth safety principles.

IN 98-13, "Post-Refueling Outage Reactor Pressure Vessel Leak Testing before Core Criticality," dated April 20, 1998, reaffirmed the NRC's 1990 position. The NRC issued the IN in response to a licensee that had conducted an ASME BPV Code Section XI leakage test of the reactor pressure vessel (RPV) and subsequently discovered that it had violated 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements," Section IV.A.2.d. This regulation states that pressure tests and leak tests of the reactor vessel that are required by Section XI of the ASME Code must be completed before the core is critical. The IN references NRC Inspection Report 50-254/97-27, dated March 12, 1998 (ADAMS Accession No. ML15216A276), which documents that licensee personnel performing VT-2 examinations of the drywell at one BWR plant covered 50 examination areas in 12 minutes, calling into question the adequacy of the VT-2 examinations.

The following summarizes the bases for the NRC's prohibition of pressure testing with the core critical:

- Nuclear operation of a plant should not begin before completion of system hydrostatic and leakage testing to verify the basic integrity of the RCPB, a principal defense-in-depth barrier to the accidental release of fission products. In accordance with the defense-in-depth safety precept, the nuclear power plant design provides for multiple barriers to the accidental release of fission products from the reactor.

- Hydrotesting must be done essentially water solid (i.e., free of pockets of air, steam, or other gases) so that stored energy in the reactor coolant is minimized during a hydrotest or leak test.

- The elevated reactor coolant temperatures associated with critical operation result in a severely uncomfortable and difficult working environment in plant spaces where the system leakage inspections must be conducted. When the reactor is critical, the greatly increased stored energy in the reactor coolant increases the hazard to personnel and equipment in the event of a leak. As a result, the ability of plant workers to perform a comprehensive and careful inspection becomes greatly diminished.

However, the NRC staff has determined that pressure testing with the core critical is acceptable if performed after repairs of a limited scope, where only a few locations or a limited area needs to be examined, and when ASME Code Section XI, Table IWB-2500-1, Category B-P,[7] has been recently performed, thus verifying the integrity of the overall RCPB. The NRC also notes that the alternative BWR Class 1 system leakage test does not allow for the use of the alternative test pressure following repairs or replacements on the RPV. Therefore, it does not violate 10 CFR Part 50, Appendix G. The NRC determined that the risk associated with nuclear heat at low power is comparable with the risk to the plant, when the test is performed without nuclear heat (with the core subcritical) during midcycle outages, when decay heat must be managed. Performing the pressure test under shutdown conditions at full operating pressure without nuclear heat requires securing certain key pressure control, heat removal, and safety systems. Under such conditions, it is more difficult to control temperature and pressure when there is significant decay heat production, such as after a midcycle outage, which may reduce the margin available to prevent exceeding the plant pressure-temperature limits.

To minimize the personnel safety risk and to avoid rushed examinations, the scope of repairs should be relatively small when the pressure test is conducted using nuclear heat. The alternative BWR Class 1 system leakage test does not place any restrictions on the size or

---

[7] The Table IWB-2500-1, Category B-9, pressure test of the entire RCPB is required once per cycle.

scope of the repairs for which the alternative may be used, except that the alternative test pressure may not be used to satisfy pressure test requirements following repair or replacement activities on the reactor vessel. It is impractical to specify a particular number of welded or mechanical repairs that would constitute a “limited scope.” However, if the plant is still in a refueling outage and has already performed the ASME Section XI Category B-P pressure test of the entire RCPB, it is likely that subsequent repairs would be performed only on an emergent basis and would generally be of a limited scope. Additionally, the Category B-P test will have recently confirmed the overall integrity of the RCPB. For midcycle maintenance outages, the first condition allows the use of nuclear heat to perform the test if the outage duration is 14 days or less. This would tend to limit the scope of repairs and also limit use of the Code Case to outages when decay heat was a significant problem. Therefore, the first condition on the alternative BWR Class 1 system leakage test states the following:

> The use of nuclear heat to conduct the BWR Class 1 system leakage test is prohibited (i.e., the reactor must be in a noncritical state), except during refueling outages in which the ASME Section XI Category B-P pressure test has already been performed, or at the end of midcycle maintenance outages 14 days or less in duration.

With respect to the second condition and adequate pressure test hold time, the technical analysis supporting the alternative BWR Class 1 system leakage test indicates that the lower test pressure provides more than 90 percent of the flow, which would result from the pressure corresponding to 100-percent power. However, a reduced pressure means a lower leakage rate, so additional time is required for inspection personnel to observe sufficient leakage. Section XI, paragraph IWA–5213, “Test Condition Holding Time,” does not require a holding time for Class 1 components once test pressure is obtained. To account for the reduced pressure, the alternative BWR Class 1 system leakage test requires a 15-minute hold time for noninsulated components. The NRC has determined that 15 minutes is not sufficient to allow an adequate examination because it is not possible to predict the entire range of scenarios or types of defects that could result in leakage. While some types of defects could result in immediate leakage (e.g., an improperly torqued bolted connection), other types of defects (e.g., weld defects or tight cracks) could represent a more torturous path for leakage and may result in delayed leakage. Because of the uncertainty in the time required for leakage to occur to an extent readily detectable by visual examination, the staff is proposing to specify a hold time of 1 hour for noninsulated components. Therefore, the second condition for the alternative BWR Class 1 system leakage test requires a 1-hour hold time for noninsulated components.

The 1-hour hold time is 45 minutes longer than the ASME Code requires and occurs at the end of an outage. As a result of this delay in returning to power operation, the NRC estimates that industry would incur incremental short-term replacement power costs and personnel costs similar to the estimate for Code Case N-795 contained in the regulatory analysis for the 2017 ASME Code Case final rule (NRC, 2017f). Section 0 includes estimates of these incremental industry operation costs.

5.3.29 Removal of Condition on Table IWB-2500-1 Examination Requirements

The NRC proposes to remove the condition in 10 CFR 50.55a(b)(2)(xxi) because the inspection of pressurizer and steam generator nozzle inner radii is no longer needed. The requirements for examinations of inner nozzle radii in several components were developed in the ASME Code in reaction to the discovery of thermal fatigue cracks in the inner radius section of BWR feedwater nozzles in the late 1970s and early 1980s. The service-induced flaws that have been observed are cracks at feedwater nozzles associated with mixing of lower temperature water with hot water in a BWR vessel with rare instances of underclad and shallow cladding cracking appearing in pressurized-water reactor (PWR) nozzles. Feedwater nozzle inner radius cracking has not been detected since the plants changed the operation of the low-flow feedwater controller. Significant inspections and repairs were required in the late 1970s and early 1980s to address these problems. The redesign of safe end and thermal sleeve configurations and feedwater spargers, coupled with changes in operating procedures, has apparently been effective. No further occurrences of nozzle fatigue cracking have been reported for PWRs or BWRs.

When the new designs and operating procedures appeared to have mitigated the nozzle inner radius cracking, the ASME Code Section XI requirements to inspect steam generator and pressurizer nozzle inner radii were removed in the 1999 Addenda of ASME Code Section XI. The NRC imposed the condition in 10 CFR 50.55a(b)(2)(xxi) requiring that these areas be inspected in 2002, and since that time, no new cracking has occurred in steam generator or pressurizer nozzle inner radii. The staff finds that the complete absence of cracking since the operational change provides reasonable assurance that the observed cracking was the result of discontinued operational practices. Because the inner radius inspections were instituted solely based on the observed cracking and the cracking mechanism has now been resolved through changes in operation, the staff finds that the intended purpose of the steam generator and pressurizer inner radius exams no longer exists and that the exams can be discontinued.

In addition to the operating experience, the NRC has reviewed the nozzle inner radii examinations as part of approving alternatives and granting relief requests concerning inspections of the pressurizer and steam generator nozzle inner radii. In the safety evaluations for the proposed alternatives, fatigue analysis for a variety of plants shows that there is reasonable assurance that there will not be significant cracking at the steam generator or pressurizer nozzles' inner radii before the end of the operating licenses of the nuclear power plants.

Therefore, based on the design changes, changes in operation, and analysis performed by industry and the NRC, the NRC proposes to remove 10 CFR 55.55a(b)(2)(xxi)(A), which requires the inspection of pressurizer and steam generator nozzle inner radii. The NRC estimates that the industry will incur the implementation costs shown in Table 6 for modifying procedures to no longer perform these inspections. The staff estimates that licensees would incur 23 labor hours to revise affected procedures at 34 operating PWR sites, with estimated costs of ($75,600) using a 7-percent discount rate and ($78,500) using a 3-percent discount rate. The staff also estimates incremental operating costs, shown in Section 0.

Table 6 Revise Pressurizer and Steam Generator Inspection Procedure to Remove Requirement to Inspect the Nozzle Inner Radii

Year	Activity	Number of Affected Entities	Per Entity			Cost		
			Labor Hours	Weighted Hourly rate	Equipment	Undiscounted	7% NPV	3% NPV
2019	Procedure Revision to Remove SG and PZR weld inspection requirements	34	23	$103		($80,846)	($75,557)	($78,492)
					Total:	**($80,846)**	**($75,557)**	**($78,492)**

Note: All values reported in 2018 dollars.

5.3.30 Section XI Condition: Table IWB-2500-1 Examination Requirements

The NRC is proposing to add a new paragraph to 10 CFR 50.55a(b)(2)(xxi)(B) that will place conditions on the use of the provisions of IWB-2500(f) and (g) and Notes 6 and 7 of Table IWB-2500-1 in the 2017 Edition of ASME Section XI. These conditions would require licensees using the provisions of IWB-2500(f) to maintain the evaluations that determined that the plant satisfied the criteria of IWB-2500(f) as records in accordance with IWA-1400. The conditions would prohibit use of a new provision in Section XI, 2017 Edition, Table 2500-1 Category B-D, Full Penetration Welded Nozzles in Vessels, Items B3.90 and B3.100 specific to BWR nuclear power plants with a renewed operating license or a renewed COL in accordance with 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.” The final condition would not allow the use of these provisions to eliminate preservice or inservice volumetric examinations of plants with a COL pursuant to 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” or a plant that receives its operating license after October 22, 2015.

The addition of these provisions is via the incorporation of Code Case N-702, “Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds,” into Section XI, Division 1, of the Code. These conditions are consistent with those proposed for RG 1.147, “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1.” For the initial 40 years of operation, reviews by the NRC indicated that all licensees evaluated the condition adequately, and future review by the NRC is not needed. For the period of extended operation, applications of these provisions are prohibited, so that the licensees could submit alternatives based on plant-specific evaluations based on BWRVIP-241, Appendix A, “BWR Nozzle Radii and Nozzle-to-Vessel Welds Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21),” approved on April 26, 2017, or plant-specific probabilistic fracture mechanics analyses. For the period of extended operation, BWRVIP-241, Appendix A, provided specific guidance.

The NRC believes eliminating the volumetric preservice or inservice examination (as would be allowed by implementing the provisions of IWB-2500(g) and Note 7 of Table IWB-2500-1) should be predicated on good operating experience for the existing fleet, which has not found any inner radius cracking in the nozzles within scope of the Code Case. New reactor designs do not have any operating experience, so the condition ensures that new reactors would perform volumetric examinations of nozzle inner radii in order to gather operating experience.

The NRC estimates no incremental industry implementation costs as a result of these conditions because these approaches are consistent with those currently used.

5.3.31 Section XI Condition: Mitigation of Defects by Modification

The NRC proposes to amend the condition found in 10 CFR 50.55a(b)(2)(xxv) to allow the use of IWA-4340 of Section XI, 2011 Addenda through 2017 Edition, with conditions. The modification of 10 CFR 50.55a(b)(2)(xxv) will include the addition of a paragraph (A), which will continue the prohibition of IWA-4340 for Section XI editions and addenda before the 2011 Addenda, and the addition of a paragraph (B), which will contain the three conditions the NRC proposes to place on the use of IWA-4340 of Section XI, 2011 Addenda through 2017 Edition.

5.3.31.1 Mitigation of Defects by Modification: First Provision

The NRC proposes to add paragraph (A), which will continue the prohibition of IWA-4340 for Section XI editions and addenda before the 2011 Addenda. IWA-4340 as originally incorporated into Section XI, sub-subarticle IWA-4340, did not include critical requirements incorporated into later editions of Section XI such as (1) characterization of the cause and projected growth of the defect, (2) verification that the flaw is not propagating into material credited for structural integrity, (3) prohibition of repeated modifications where a defect area grew into the material required for the modification; and (4) pressure testing. Therefore, the NRC prohibited the use of IWA-4340 in its original form. The NRC estimates no incremental industry implementation costs associated with the continuation of these existing prohibitions.

5.3.31.2 Mitigation of Defects by Modification: Second Provision

The NRC proposes to add paragraph (B), which will allow the use of IWA-4340 of Section XI, 2011 Addenda through 2017 Edition, with three conditions. The NRC believes that IWA-4340 as incorporated into later editions of Section XI was improved with requirements such as (1) characterization of the cause and projected growth of the defect, (2) verification that the flaw is not propagating into material credited for structural integrity, (3) prohibition of repeated modifications where a defect area grew into the material required for the modification, and (4) pressure testing. With the inclusion of these requirements and those stated in the conditions, the staff has concluded that appropriate requirements are in place to provide reasonable assurance that the modification will provide an adequate pressure boundary even while considering potential growth of the defect. The conditions and the basis for each are as follows:

(1) The first proposed condition would prohibit the use of IWA-4340 on crack-like defects or those associated with flow-accelerated corrosion. The design requirements and

potentially the frequency of follow-up inspections might not be adequate for crack-like defects that could propagate much faster than defects caused by loss of material. Therefore, the NRC proposes to prohibit the use of IWA-4340 on crack-like defects. Licensee plant-specific programs based on industry standards manage loss of material because of flow-accelerated corrosion. The frequency of follow-up inspections for loss of material as the result of flow-accelerated corrosion is best managed by these plant-specific programs. In addition, subparagraph IWA-4421(c)(2) contains provisions for restoring minimum required wall thickness by welding or brazing, including loss of material because of flow-accelerated corrosion.

(2) The second proposed condition would require the design of a modification that mitigates a defect to incorporate a loss of material rate either 2 times the actual measured corrosion rate in that pipe location or 4 times the estimated maximum corrosion rate for the piping system. Corrosion rates are influenced by local conditions (e.g., flow rate, discontinuities). The condition is consistent with ASME Code Cases N-786-1, "Alternative Requirements for Sleeve Reinforcement of Class 2 and 3 Moderate Energy Carbon Steel Piping," and N-789, "Alternative Requirements for Pad Reinforcement of Class 2 and 3 Moderate Energy Carbon Steel Piping for Raw Water Service." The staff has concluded that these multipliers are appropriate if the wall thickness near the defect was measured only once. In contrast, if wall thickness measurements were made in two or more refueling outage cycles, the staff has concluded that there is a sufficient span of time to be able to trend the localized corrosion rate into the future. This conclusion is based in part on the follow-up wall thickness measurements that are made subsequent to installation of the modification.

(3) The third proposed condition would require the licensee to perform a wall thickness examination near the modification and relevant pipe base metal during each refueling outage cycle to detect propagation of the flaw into the material credited for structural integrity of the item, unless the examinations in the two refueling outage cycles subsequent to the installation of the modification can validate the projected flaw growth. The staff has concluded that the provision allowed by subparagraph IWA-4340(g) to conduct follow-up wall thickness measurements only to the extent that they demonstrate that the defect has not propagated into the material credited for structural integrity is not sufficient because it does not verify the projected flaw growth. Subparagraph IWA-4340(h) might appear to address the staff's concern; however, it allows for projected flaw growth to be based on "prior Owner or industry experiences with the same conditions" instead of specific measurements in the location of the modification. The condition allows for conducting examinations only in the two refueling outages subsequent to the installation of the modification, consistent with subparagraph IWA-4340(g), if the measurements are capable of projecting the flaw growth.

The NRC estimates that these three conditions do not result in any incremental industry implementation costs. These three conditions do result in incremental operating costs to industry, described in Section 5.4.33.2, and to the NRC, described in Section 5.7.33.2.

5.3.32 Clarification of Condition on Pressure Testing Class 1, 2, and 3 Mechanical Joints

The NRC proposes to amend the condition in 10 CFR 50.55a(b)(2)(xxvi) to clarify its expectations related to the pressure testing of ASME BPV Code Class 1, 2, and 3 mechanical joints disassembled and reassembled during the performance of an activity under ASME BPV Code Section XI. Industry stakeholders have expressed confusion about the current regulatory requirements with regard to when a pressure test is required and which year of the Code the pressure testing should comply with for this condition. The NRC proposes to modify the condition to clarify that all mechanical joints in Class 1, 2, and 3 piping and components greater than NPS-1 that are disassembled and reassembled during the performance of a Section XI activity (e.g., repair or replacement activity) shall be pressure tested in accordance with IWA-5211(a). The pressure testing shall be performed using procedures and personnel meeting the requirements of the licensee's or applicant's current code of record. The NRC first put this condition in place in the 2004 final rule (69 FR 58804; November 1, 2004). The NRC determined the condition was necessary because the ASME BPV Code eliminated the requirements to pressure test Class 1, 2, and 3 mechanical joints undergoing repair and replacement activities in the 1999 Addenda. The NRC believes pressure testing of mechanical joints affected by repair and replacement activities is necessary to ensure and verify the leaktight integrity of the system pressure boundary.

The NRC estimates that this clarification of the requirements of the condition would result in little to no incremental change in costs to industry, which was not quantified.

5.3.33 Condition on Summary Report Submittal

The NRC proposes to amend the condition in 10 CFR 50.55a(b)(2)(xxxii) to address the use of Owner Activity Reports. Through the 2013 Edition of Section XI, owners were required to prepare Summary Reports of preservice and inservice examinations and repair and replacement activities. This condition was added when the 2013 Edition was incorporated by reference because of a change in the wording of the requirement in the Code. Up until that time, owners were required to submit these reports to the regulatory authority having jurisdiction at the plant site. The 2013 Edition changed the wording of the requirement in IWA-6240(c) to state that submittal was necessary only if required by the authority.

The 2015 Edition of Section XI changed the title of these reports from Summary Reports to Owner Activity Reports. Therefore, the NRC is proposing to amend the condition to require submittal of Summary Reports (pre-2015) and Owner Activity Reports (2015). As this modification of the condition concerns only the title of the reports affected by the existing condition, the NRC estimates that it results in little to no incremental industry implementation cost, which was not quantified.

5.3.34 *Condition to Correct Equation: Use of RT_{T0} in the K_{Ia} and K_{Ic} Equations*

The NRC proposes to redesignate the requirements in the current 10 CFR 50.55a(b)(2)(xxxv), which concerns the use of the 2013 Edition of ASME Section XI, Appendix A, paragraph A-4200, as 10 CFR 50.55a(b)(2)(xxxv)(A). The ASME Code has addressed the NRC concern related to this condition in the 2015 Edition; however, this condition is still relevant to licensees using the 2013 Edition and remains in effect. The NRC proposes to add a new paragraph (b)(2)(xxv)(B), which would condition the use of the 2015 Edition of ASME Section XI, Appendix A, paragraph A-4200(c), to define reference temperature RT_{KIa} in equation (a) as "$RT_{KIa} = T_0 + 90.267 \exp(-0.003406T_0)$" in lieu of the equation shown in the Code. The 2015 Edition added paragraph A-4200(c) to provide an alternate method to establish a reference temperature, RT_{T0}, for pressure-retaining materials, using fracture toughness test data. Equation (b) in International System (SI) units shown in paragraph A-4200(c) was derived based on test data, and equation (a) was converted to U.S. customary units. Unfortunately, equation (a) is incorrect because of an error made in the conversion of units. The equation shown above for RT_{KIa} is the correct formula. This administrative change to correct the published equation results in no incremental industry implementation costs.

5.3.35 *Condition on Fracture Toughness of Irradiated Materials*

The NRC proposes to amend the condition found in 10 CFR 50.55a(b)(2)(xxxvi) to extend the applicability to use of the 2017 Edition of Section XI. This current condition requires licensees using ASME BPV Code, Section XI, 2013 Edition, Appendix A, paragraph A-4400, to obtain NRC approval before establishing fracture toughness of irradiated materials using irradiated T_0 and the associated RT_{T0}. This condition was added when the 2013 Edition was incorporated by reference because the NRC believed the newly introduced paragraph A-4200(b) may mislead the users of Appendix A into adopting methodology not accepted by the NRC. Neither the 2015 Edition nor the 2017 Edition addressed the NRC's concern. Therefore, the NRC is proposing to extend this condition to the 2017 Edition. As this condition already exists, the NRC estimates no incremental industry implementation cost resulting from the extension of this condition.

5.3.36 *Cast Austenitic Stainless Steel Inspection Condition: ASME Code Section XI, Appendix III, Supplement 2*

The NRC proposes to add 10 CFR 50.55a(b)(2)(xxxvii) to condition ASME Code Section XI, Appendix III, Supplement 2. Supplement 2 is closely based on ASME Code Case N-824, which was incorporated by reference with conditions in 10 CFR 50.55a(b)(2)(xxxvii). The conditions on ASME Code Section XI, Appendix III, Supplement 2, are consistent with the conditions on ASME Code Case N-824, published in July 2017.

The conditions are derived from research into methods of inspecting cast austenitic stainless steel (CASS) components, published in NUREG/CR-6933, "Assessment of Crack Detection in

Heavy-Walled Cast Stainless Steel Piping Welds Using Advanced Low-Frequency Ultrasonic Methods," issued March 2007 (NRC, 2007a), and NUREG/CR-7122, "An Evaluation of Ultrasonic Phased Array Testing for Cast Austenitic Stainless Steel Pressurizer Surge Line Piping Welds," issued March 2012 (NRC, 2012). These reports show that CASS materials less than 4.064 centimeters (1.6 inches) thick can be reliably inspected for flaws 10-percent through-wall or deeper if encoded phased-array examinations are performed using low ultrasonic frequencies and a sufficient number of inspection angles. Additionally, for thicker welds, flaws greater than 30-percent through-wall in depth can be detected using low-frequency encoded phased-array ultrasonic inspections.

Using NUREG/CR-6933 and NUREG/CR-7122, the NRC has determined that sufficient technical basis exists to condition ASME Code Section XI, Appendix III, Supplement 2. These reports show that CASS materials produce high levels of coherent noise and that the noise signals can be confusing and mask flaw indications. The optimum inspection frequencies for examining CASS components of various thicknesses as described in NUREG/CR-6933 and NUREG/CR-7122 are reflected in proposed condition 10 CFR 50.55a(b)(2)(*xxxviii*)(A). As NUREG/CR-6933 shows that the grain structure of CASS can reduce the effectiveness of some inspection angles, the NRC finds sufficient technical basis for the use of ultrasound using angles including but not limited to 30 to 55 degrees with a maximum increment of 5 degrees. This is reflected in proposed condition § 50.55a(b)(2)(*xxxviii*)(B).

As this condition already exists in Code Case N-824, the incremental industry costs from this condition will incur after the Code Case lifetime has expired (6 years), with the first inspections occurring in fiscal year 2030. Section 0 presents these estimated costs as industry operation costs. There are no incremental industry implementation costs associated with this condition because the Code Case is already active.

5.3.37 Section XI Condition: Nonmandatory Appendix U

The NRC proposes to amend the requirements in the current 10 CFR 50.55a(b)(2)(xxxiv) to make the condition applicable to the latest edition incorporated by reference in paragraph 10 CFR 50.55a(a)(1)(ii). The current condition in 10 CFR 50.55(b)(2)(xxxiv)(A) requires repair and replacement activities temporarily deferred under the provisions of Nonmandatory Appendix U to be performed during the next scheduled refueling outage. The NRC added this condition when the 2013 Edition was incorporated by reference. Neither the 2015 nor the 2017 Edition addressed the NRC's concern. Therefore, the NRC is proposing to extend this condition to the latest edition incorporated by reference in paragraph 10 CFR 50.55a(a)(1)(ii).

The current condition in 10 CFR 50.55a(b)(2)(xxxiv)(B) requires use of a mandatory appendix in ASME Code Case N-513-3 as the referenced appendix for Appendix U, paragraph U-S1-4.2.1(c). This condition was also added when the 2013 Edition was incorporated by reference. Because the 2017 Edition remedied the omission that made this condition necessary, the NRC is proposing to extend this condition only to the 2015 Edition.

The NRC estimates no incremental industry implementation costs resulting from the continuation of this existing condition.

5.3.38 Section XI Condition: Defect Removal

The NRC proposes to add 10 CFR 50.55a(b)(2)(xxxix) to place conditions on the use of ASME BPV Code, Section XI, IWA-4421(c)(1) and IWA-4421(c)(2), for defect removal. The condition in 10 CFR 50.55a(b)(2)(xxxix)(A) establishes that the final configuration of the item will be in accordance with the original construction code, later editions and addenda of the construction code, or a later different construction code, as well as meeting the owner's requirements or revised owner's requirements. In this regard, welding, brazing, fabrication, and installation requirements, as well as design requirements for material, design, or configuration changes, are consistent with the construction code and owner's requirements. This condition retains the intent of the revision to Section XI that (1) replacements in kind are acceptable, (2) replacements with alternative configurations are acceptable as long as construction code and owner's requirements are met, and (3) defect removal is required (this can be accomplished by replacing all or a portion of the item containing the defect).

The NRC proposes to add 10 CFR 50.55a(b)(2)(xxxix)(B) to place conditions on the use of ASME BPV Code, Section XI, IWA-4421(c)(2). The inclusion of subparagraph IWA-4421(c)(2) is intended to address wall thickness degradation in cases where the missing wall thickness is restored by weld metal deposition. This repair activity restores the wall thickness to an acceptable condition; however, it does not "remove" the degraded wall thickness (i.e., the defect). Restoration of wall thickness by welding or brazing makes the need to remove the defect moot. However, increasing the wall thickness of an item to reclassify a crack to be a flaw instead of a defect (i.e., a flaw (imperfection or unintentional discontinuity) of such size, shape, orientation, location, or properties as to be rejectable) is not considered acceptable because there are no provisions in subparagraph IWA-4421(c)(2) for analyses and ongoing monitoring of potential crack growth. This condition would likely result in relief requests from industry, in circumstances where licensees would want to use the provisions of IWA-4421 to repair such defects. Section 0 estimates these costs for industry operation, and Section 0 estimates them for NRC operation.

5.3.39 Section XI Condition: Prohibitions and Restriction on Use of IWB-3510.4(b)

The NRC proposes to add 10 CFR 50.55a(b)(2)(xl) to prohibit the use of ASME BPV Code, Section XI, Subparagraphs IWB-3510.4(b)(4), and IWB-3510.4(b)(5).

ASME BPV Code, Section XI, Subarticle IWB-3500, provides acceptance standards for pressure-retaining components made of ferritic steels. Subparagraph IWB-3510.4 specifies material requirements for ferritic steels for application of the acceptance standards. In earlier editions of the ASME BPV Code, Section XI, the material requirements for ferritic steels for which the acceptance standards of IWB-3500 apply are included in a note under the title of tables that specify allowable flaw sizes (e.g., Table IWB-3510-1, “Allowable Planar Flaws”). Subparagraph IWB-3510.4 separates ferritic materials into three groups:

(1) those with a minimum yield strength of 50 kilopounds per square inch (ksi) or less
(2) five ferritic steels with these material designations: SA-508 Grade 2, Class 2 (former designation—SA-508 Class 2a); SA-508 Grade 3, Class 2 (former designation—SA-508 Class 3a); SA-533 Type A, Class 2 (former designation—SA-533 Grade A, Class 2); SA-533 Type B, Class 2 (former designation—SA-533 Grade B, Class 2); and SA-508 Class 1
(3) those with a yield strength greater than 50 ksi but not exceeding 90 ksi

The material requirements are explicitly specified for ferritic steels with a minimum yield strength of 50 ksi or less and for those with greater than 50 ksi but not exceeding 90 ksi. However, there are no material requirements for the five ferritic steels listed above.

The NRC staff finds subparagraph IWB-3510.4(a) acceptable because it is consistent with the current material requirements for ferritic steels having a minimum yield strength of 50 ksi or less. The NRC staff finds subparagraph IWB-3510.4(c) acceptable because it is consistent with the current material requirements for ferritic steels having a minimum yield strength of greater than 50 ksi up to 90 ksi.

The NRC staff does not find subparagraph IWB-3510.4(b) acceptable for several reasons. The staff plotted the ASME BPV Code, Section XI, static plain-strain fracture toughness (K_{IC}) curve in each of the figures in the technical basis document that shows dynamic fracture toughness (K_{ID}) data for materials listed as IWB-3510.4(b)(1) to IWB-3510.4(b)(4). The staff confirmed that the materials in IWB-3510.4(b)(1) and IWB-3510.4(b)(3) with GTAW welds are acceptable because the data are above the K_{IC} curve with adequate margin to compensate for the limited data size. Additionally, the NRC staff has approved the use the materials in IWB-3510.4 (b)(1) and IWB-3510.4 (b)(3) in a licensing and a design certification application. For the material in IWB-3510.4 (b)(2), K_{ID} data was demonstrated to be above the crack arrest fracture toughness (K_{Ia}). The NRC staff has previously determined the K_{Ia} fracture toughness standard to be acceptable. Hence, the material in IWB-3510.4 (b)(2) is acceptable. However, for the prohibited materials specified in Subparagraphs IWB-3510.4(b)(4), IWB-3510.4(b)(5), the NRC staff observed that in the technical basis document, there is no fracture toughness data associated weld and heat affected zone, or there is no fracture toughness data to support exclusion of the fracture toughness requirements for these materials.

This proposed condition does not change the current material requirements because the testing to meet the material requirements for the three prohibited materials and one restricted material would be performed. Thus, no additional action is expected from industry. Therefore, the NRC estimates no incremental industry implementation costs as a result of this condition.

5.3.40 ASME BPV Code Case N-729-6

In 2008, the NRC issued a final rule to update 10 CFR 50.55a to the 2004 Edition of the ASME BPV Code (73 FR 52730; September 10, 2008). As part of the final rule, 10 CFR 50.55a(g)(6)(ii)(D) implemented an augmented ISI program for the examination of RPV upper head penetration nozzles and associated partial penetration welds. The program required the implementation of ASME BPV Code Case N-729-1, with certain conditions.

The application of ASME BPV Code Case N-729-1 was necessary because the inspections required by the 2004 Edition of the ASME BPV Code, Section XI, were not written to address degradation of the RPV upper head penetration nozzles and associated welds by primary water stress-corrosion cracking (PWSCC). The safety consequences of inadequate inspections of the subject nozzles can be significant. The NRC's determination that the inspections required by the ASME BPV Code are inadequate is based on operating experience and analysis, because nickel-based Alloy 600/82/182 material in the RPV head penetration nozzles and associated welds are susceptible to PWSCC. The absence of an effective inspection regime could, over time, result in unacceptable circumferential cracking, or the degradation of the RPV upper head or other reactor coolant system components by leakage-assisted corrosion. These degradation mechanisms increase the probability of a loss-of-coolant accident.

ASME BPV Code Case N-729-1 provides examination frequencies and methods for RPV upper head penetration nozzles and welds. Industry's use of Code Cases is voluntary, so these provisions were developed, in part, with the expectation that the NRC would incorporate the Code Case by reference into the *Code of Federal Regulations*. Therefore, the NRC adopted rule language in 10 CFR 50.55a(g)(6)(ii)(D) requiring implementation of ASME BPV Code Case N-729-1, with conditions, to enhance the examination requirements in the ASME BPV Code, Section XI, for RPV upper head penetration nozzles and welds. The examinations conducted in accordance with ASME BPV Code Case N-729-1 provide reasonable assurance that ASME BPV Code allowable limits will not be exceeded and that PWSCC will not lead to failure of the RPV upper head penetration nozzles or welds. However, the NRC concluded that certain conditions were needed in implementing the examinations in ASME BPV Code Case N-729-1. These conditions are given in 10 CFR 50.55a(g)(6)(ii)(D).

On March 3, 2016, ASME approved the sixth revision of ASME BPV Code Case N-729 (N-729-6). This revision changed certain requirements based on a consensus review of the inspection techniques and frequencies. ASME deemed these changes necessary to supersede the requirements under previous versions of N-729 to establish an effective long-term inspection program for the RPV upper head penetration nozzles and associated welds in PWRs. The major changes in the latest revisions are the inclusion of peening mitigation and extending the replaced head volumetric inspection period. Other minor changes were made to address editorial issues and to clarify the Code Case requirements.

The NRC proposes to update the requirements of 10 CFR 50.55a(g)(6)(ii)(D) to require licensees of PWRs to implement ASME BPV Code Case N-729-6, with certain conditions. The

NRC conditions have been modified to address the changes in ASME BPV Code Case N-729-6 from the latest NRC-approved ASME Code Case N-729 revision in 10 CFR 50.55a(g)(6)(ii)(D) (Revision 4 (N-729-4)). Subsections 5.3.42.1 through 5.3.42.7 discuss the NRC's revisions to the conditions on ASME BPV Code Case N-729-4.

The NRC proposes to revise the subparagraphs of 10 CFR 50.55a(g)(6)(ii)(D) as summarized in the following discussions to identify the requirement changes in updating from ASME BPV Code Case N-729-4 to N-729-6. Major changes in the Code Case revision are allowing peening as a mitigation method and extending the replaced RPV upper head inspection frequency to 20 years. Additionally, the Code Case revision changed the volumetric inspection requirement for plants with previous indications of PWSCC and allowed the use of similarities in sister plants to extend inspection intervals. The NRC staff is not able to fully endorse these two new item and therefore developed new conditions. The NRC determined that one previous condition restricting the use of Appendix I to the Code Case could be relaxed. Further, the Code Case deadline for baseline examinations of February 10, 2008, has passed. Therefore, the NRC included a condition to ensure that new plants can perform baseline examinations without the need for an alternative to these requirements under 10 CFR 50.55a(z). Finally, in accordance with an NRC authorized alternative to the requirements of the Code Case for surface examinations of the J-groove weld when indications of possible nozzle leakage need to be addressed, the NRC added a condition to allow other licensees to take advantage of the alternative of using a volumetric leak path assessment in lieu of a surface examination.

5.3.40.1 Implementation

The NRC proposes to revise 10 CFR 50.55a(g)(6)(ii)(D)(1) to change the version of ASME BPV Code Case N-729 from N-729-4 to N-729-6 for the reasons previously given. Because of the incorporation of N-729-6, the date to establish applicability for licensed PWRs will be changed to anytime within 1 year of the effective date of the final rule. This is to allow licensees some flexibility in implementing the requirements. No new inspections are required; therefore, licensees can phase in the new program consistent with their needs and outage schedules. The NRC is also including wording to allow licensees' previous NRC-approved alternatives to remain valid. The NRC staff has reviewed the currently effective proposed alternatives and finds that each can remain effective through the update from ASME Code Case N-729-4 to N-729-6 with the proposed NRC conditions. The NRC estimates there would be a negligible averted industry implementation cost as a result of this flexibility, which was not quantified.

5.3.40.2 Appendix I Use

The NRC proposes to revise 10 CFR 50.55a(g)(6)(ii)(D)(2). The agency has determined that its current condition, which does not permit the use of Appendix I, is no longer necessary. However, the NRC proposes to establish a new condition specifying that the analyses required by the Code Case for missed coverage both above and below the J-groove weld include the analysis described in I-3000. The NRC basis for changing the condition is that its reviews of alternatives proposed by licensees related to this issue over a period of more than 10 years shows that the I-3000 method produces satisfactory results and is correctly performed by licensees. The NRC staff also notes that the probabilistic approach has not been proposed by licensees and has not been evaluated (including the acceptance criteria) by the NRC.

The NRC staff finds that the proposed change to the condition will have little impact on safety, while minimizing the regulatory burden of NRC review and approval of a standardized method to provide reasonable assurance of structural integrity of a reduced inspection area. The NRC estimates that there may be a negligible averted cost as a result of the removal of the existing condition and replacement with a less restrictive condition consistent with current industry preference. The NRC did not quantify this negligible averted industry implementation cost.

5.3.40.3 Surface Exam Acceptance Criteria

The NRC proposes to revise 10 CFR 50.55a(g)(6)(ii)(D)(4), the current condition on surface examination acceptance criteria, to update the ASME BPV Code Case references from N-729-4 to N-729-6. Therefore, the NRC proposes to modify the condition 10 CFR 50.55a(g)(6)(ii)(D)(4) by changing the versions of the applicable ASME BPV Code Case N-729. The NRC estimates no incremental industry implementation cost as a result of this administrative change.

5.3.40.4 Peening

The NRC proposes to add a new condition in 10 CFR 50.55a(g)(6)(ii)(D)(5) that will allow licensees to obtain full inspection relief for peening of their RPV upper heads in accordance with the latest NRC-approved requirements in Materials Reliability Program (MRP)-335R3-A, "Topical Report for Primary Water Stress Corrosion Cracking Mitigation by Surface Stress Improvement," issued November 2016 (EPRI, 2016). This document provides guidelines for the NRC-approved performance criteria, qualification requirements, inspection frequency, and scope. A licensee may peen any component in accordance with the requirements and limitations of the ASME Code. However, to obtain NRC-approved inspection relief for an RPV head mitigated with peening as described in MRP-335R3-A, this proposed condition establishes MRP-335R3-A as the requirement for performance criteria, qualifications, and inspections. Otherwise the requirements of an unmitigated RPV upper head inspection program shall apply.

As part of this proposed condition, the NRC staff is removing two of the requirements in MRP-335R3-A: (1) the submission of a plant-specific alternative to the Code Case will not be required and (2) Condition 5.4 will not be required. The staff has reevaluated the need for NRC Condition 5.4 on the use of MRP-335R3-A, which required volumetric inspection during the N+1 and N+2 refueling outages for plants with previous indication of cracking in their heads, as part of a licensee's proposed alternative to obtain inspection relief after peening of its RPV upper head nozzles and associated J-groove welds. Therefore, NRC Condition 5.4 no longer applies.

The NRC proposed condition combines the use of the latest NRC accepted performance criteria, qualification, and inspection requirements in MRP-335R3-A with an allowance for licensees to no longer be required to submit a plant-specific proposed alternative to adopt the inspection frequency of peened RPV head penetration nozzles in MRP-335R3-A and not be required to adhere to NRC Condition 5.4 of MRP-335R3-A. By removing these requirements in the proposed condition, the NRC no longer needs to highlight nine areas in N-729-6 that do not conform to the current NRC-approved requirements for inspection relief provided under MRP-335R3-A.

As MRP-335, Revision 3-A, is being proposed to be used as a condition against the requirements in the ASME Code Case, the NRC is incorporating by reference MRP-335, Revision 3-A, into §50.55a under Paragraph (a)(4)(i).

The NRC staff estimates that these conditions would result in an incremental averted cost to licensees, which has not been quantified. By allowing the use of peening, with which the industry and the NRC have prior experience, licensees would avoid the need for a more costly unmitigated RPV upper head inspection, as long as the other conditions are met. The net effect of these conditions on industry would be a reduction in the planning for and inspection of the unmitigated RPV upper head and a reduction in occupational radiation dose resulting from the lengthier inspection.

5.3.40.5 Baseline Examinations

The NRC proposes to add a new condition in 10 CFR 50.55a(g)(6)(ii)(D)(6) to address baseline examinations. Note 7(c) of Table 1 of ASME BPV Code Case N-729-6 requires baseline volumetric and surface examinations for plants with an RPV upper head with less than 8 effective degradation years by no later than February 10, 2008. This requirement has been in place since ASME BPV Code Case N-729-1 was first required by this section and is a carryover requirement from the First Revised NRC Order EA-03-009, “Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors,” dated February 20, 2004. However, because any new RPV upper head replacement would have occurred after 2008, this requirement can no longer be met. While it is not expected that a new head using A600 nozzles would be installed, the NRC is conditioning this section to prevent the need for a licensee to submit a proposed alternative for such an event, should it occur. The NRC proposed condition would instead require a licensee to perform a baseline volumetric and surface examination within 2.25 reinspection years not to exceed 8 calendar years, as required for the regular interval of inspection frequency. The NRC estimates that there is no incremental industry implementation cost as a result of changing the 2008 date to an ongoing requirement as intended by the Code Case.

5.3.40.6 Sister Plants

The NRC proposes to add a new condition in 10 CFR 50.55a(g)(6)(ii)(D)(7) to address the use of the term “sister plants” for the examinations of RPV upper heads. The use of sister plants under ASME BPV Code Case N-729-6 would allow extension of the volumetric inspection of replaced RPV heads with resistant materials from the current 10-year inspection frequency to a period of up to 40 years.

As part of mandating the use of ASME BPV Code Case N-729-6 in this rule, the NRC is approving the ASME Code's extension of the volumetric inspection frequency from every 10 years to every 20 years. The NRC staff finds that the documents MRP-375, "Technical Basis for Reexamination Interval Extension for Alloy 690 PWR Reactor Vessel Top Head Penetration Nozzles," and MRP-386, "Recommended Factors of Improvement for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) Growth Rates of Thick-Wall Alloy 690 Materials and Alloy 52, 152, and Variants Welds," provide a sound basis for a 20-year volumetric inspection interval and a 5-year bare metal visual inspection interval for Alloy 690/52/152 materials subject to this Code Case, thereby providing reasonable assurance of the structural integrity of the RPV heads.

However, the NRC is proposing a condition to prohibit the concept of sister plants. If used, this concept would increase the inspection interval for plants with sister plants from 20 years to 40 years. The NRC staff is currently evaluating both the definition of sister plants and factors of improvement between the growth of PWSCC in Alloys 600/82/182 and 690/52/152.

Currently the NRC staff questions whether the criteria for sister plants (i.e., having the same owner) are appropriate. The NRC staff also questions whether other criteria (e.g., environment, alloy heat, and numbers of sisters in a particular group) should be included in the definition.

The NRC staff continues to review information on PWSCC growth rates and factors of improvement for Alloy 690/52/152 and 600/82/182 as proposed in MRP-386. While the NRC staff has concluded that crack growth in Alloy 690/52/152 is sufficiently slower than in Alloy 600/82/182 to support an inspection interval of 20 years, the NRC continues to assess whether the data and analyses support a 40-year interval.

The NRC estimates no incremental cost as a result of refining the definition of "sister plants" before allowing the second inspection interval to change to 40 years from 20 years, in part because this issue will be resolved before the 40-year interval becomes relevant.

5.3.40.7 Volumetric Leak Path

The NRC proposes to add a new condition in 10 CFR 50.55a(g)(6)(ii)(D)(8) to substitute a volumetric leak path assessment for the required surface exam of the partial penetration weld of paragraph 3200(b). The NRC found that a volumetric leak path assessment is more useful to confirm a possible leakage condition through the J-groove weld than a surface examination of the J-groove weld. While a surface examination may detect surface cracking, it will not confirm that such an indication is a flaw that caused leakage. A positive volumetric leak path assessment will provide a clear confirmation of leakage, either through the nozzle, the weld, or both. The NRC notes that since all nozzles have had a volumetric examination, a baseline volumetric leak path assessment is available for comparison, and this provides additional assurance of effectiveness of the volumetric leak path assessment technique. Furthermore, the surface examination is a manual process in a high-radiation field, and the volumetric leak path is automated and remotely performed. The NRC has been receiving relief requests as a result of these circumstances. Thus, to eliminate the need for potential proposed alternatives requiring NRC review and authorization, this condition is proposed to increase regulatory efficiency. Although this condition has no effect on industry implementation costs, it would result in averted relief requests from industry. Sections 5.4.43.7 and 5.7.43.7 address the incremental averted cost to industry and the NRC, respectively.

5.3.41 ASME BPV Code Case N-770-5

In 2011, the NRC issued a final rule (76 FR 36232; June 21, 2011) that included 10 CFR 50.55a(g)(6)(ii)(F) requiring the implementation 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. On November 7, 2016, ASME approved the fifth revision of ASME BPV Code Case N-770 (N-770-5). The major changes from N-770-2, the last revision to be mandated by 10 CFR 50.55a(g)(6)(ii)(F), to N-770-5 included extending the inspection frequency for cold-leg temperature dissimilar-metal butt welds greater than 14 inches in diameter to once per inspection interval not to exceed 13 years, performance criteria and inspections for peening mitigated welds, and ISI requirements for excavate and weld repair mitigations. Minor changes were also made to address editorial issues, to correct figures, or to add clarity. The NRC has determined that the updates and improvements in N-770-5 are sufficient to update 10 CFR 50.55a(g)(6)(ii)(F).

Therefore, the NRC is proposing to update the requirements of 10 CFR 50.55a(g)(6)(ii)(F) to require licensees to implement ASME BPV Code Case N-770-5, with conditions. The previous NRC conditions have been modified to address the changes in ASME BPV Code Case N-770-5 and to ensure that this regulatory framework will provide adequate protection of public health and safety. The following sections discuss each of the NRC's changes to the conditions on ASME BPV Code Case N-770-5.

5.3.41.1 Augmented Inservice Inspection Requirements: Examination Requirements for Class 1 Piping and Nozzle Dissimilar-Metal Butt Welds—(1) Implementation

The NRC proposes to revise this condition in 10 CFR 50.55a(g)(6)(ii)(F)(1) to mandate the use of ASME BPV Code Case N-770-5, as conditioned by this section, in lieu of the current requirement to mandate ASME BPV Code Case N-770-2. The wording of this condition would allow a licensee to adopt this change anytime during the first year after the rule becomes effective. This is to provide flexibility for the licensee to adapt to the new requirements. Included in this provision is an allowance for all previous NRC-approved licensee's alternatives to the requirements of this section to remain valid, regardless of the version of ASME BPV Code Case N-770 they were written against. The NRC staff has reviewed all currently applicable licensee alternatives to this Code Case and has found that the change from Code Case N-770-2 to N-770-5 required by this proposed regulation neither invalidates nor degrades plant safety associated with the continued use of existing alternatives. Therefore, to provide regulatory efficiency, the NRC staff finds that all previous NRC-approved alternatives will remain valid for their specific NRC-approved duration of applicability. The NRC estimates no incremental industry implementation cost as a result of this administrative condition.

5.3.41.2 Categorization

The NRC proposes to revise this condition in 10 CFR 50.55a(g)(6)(ii)(F)(2) to include the categorization of welds mitigated by peening. This condition currently addresses the categorization for inspection of unmitigated welds and welds mitigated by various processes.

The new section in this revised condition categorizes dissimilar-metal butt welds mitigated by peening. MRP-335 is the technical basis summary document for the application of peening in upper heads and dissimilar-metal butt welds to address PWSCC. The NRC staff extensively reviewed this document for generic application. The requirements in the NRC-approved version of this report, MRP-335R3-A, differ in several respects from the requirements in ASME BPV Code Case N-770-5. To avoid confusion with multiple conditions, the NRC proposes to accept categorization of welds as being mitigated by peening, if said peening follows the performance criteria, qualification requirements, and inspection guidelines of MRP-335R3-A. Once implemented, the inspection guidelines of MRP-335R3-A provide inspection relief from the requirements of an unmitigated dissimilar-metal butt weld. As part of this proposed condition, the NRC staff is removing the need for the licensee to submit a plant-specific proposed alternative to implement the inspection relief in accordance with MRP-335R3-A.

As MRP-335, Revision 3-A, is being proposed to be used as a condition against the requirements in the ASME Code Case, the NRC is incorporating by reference MRP-335, Revision 3-A, into §50.55a under Paragraph (a)(4)(i).

The requirements for categorization of all other mitigated or nonmitigated welds remain the same. As noted previously, all of these requirements, except for the categorization of peening, were in the previous conditions for mandated use of ASME BPV Code Cases N-770-2 and N-770-1. The NRC estimates no incremental industry implementation costs as a result of this modification, which allows peening as a mitigation technique, thereby relaxing existing requirements.

5.3.41.3 Baseline Examinations

The NRC proposes to delete the baseline examinations condition in 10 CFR 50.55a(g)(6)(ii)(F)(3). The current condition regarding baseline inspections is unnecessary, as all baseline volumetric examinations are completed. If a baseline examination is required, the licensee would follow the examination requirements in ASME BPV Code Case N-770-5. This condition number is reserved to maintain the NRC condition numbering from the past rulemaking and, in this way, limit the need for additional updating of current procedures and documentation when no substantive change has occurred. The NRC estimates no incremental industry implementation cost as a result of removing this condition.

5.3.41.4 Examination coverage

The NRC proposes to revise this condition to make an editorial change to update the reference to ASME BPV Code Case N-770-2 to N-770-5. The NRC estimates no incremental industry implementation cost as a result of this editorial change.

5.3.41.5 Reporting Requirements

The NRC proposes to revise the reporting condition in 10 CFR 50.55a(g)(6)(ii)(F)(6) to address the deletion of wording in paragraph 3132.3(d) of ASME BPV Code Case N-770-5 and relax the requirement for submitting the summary report to the NRC. The purpose of this condition is to obtain timely notification of unanticipated flaw growth in a mitigated butt weld in the RCPB. While NRC onsite and regional inspectors play a plant-specific role in assessing a plant's current safe operation, the NRC staff is also responsible for assessing the generic impact of the potentially reduced effectiveness of a mitigation technique across the fleet. To address these concerns, the NRC found that if a dissimilar-metal butt weld is degraded, it is necessary for the NRC staff to obtain timely notification of the flaw growth and a report summarizing the evaluation, along with inputs, methodologies, assumptions, and causes of the new flaw or flaw growth, within 30 days of the plant's return to service. This is a relaxation from the previous requirement to provide a report before entering mode 4 prior to startup. In its review of the prior condition, the NRC determined that the burden associated with the submission of a report before entry into mode 4 exceeded the immediate safety benefit from the report. The NRC also determined that a timely notification regarding the event was sufficient to begin the determination of whether an immediate generic safety issue exists. Further, the NRC found the submittal of a report within 30 days is both necessary and sufficient to allow for the evaluation of any long-term impacts of the flaw growth on the overall inspection programs for that specific mitigation type.

The NRC found the deletion of the sentence, "Any indication in the weld overlay material characterized as stress corrosion cracking is unacceptable," from paragraph 3132.3(d) did not have a sufficient technical basis to support its removal. Given that the NRC's approval of weld overlays is based on the resistance of the overlay material to cracking, any flaw growth into this material would call into question the effectiveness of that specific mitigation method. However, the NRC recognizes that there could be instances where NDE measurement uncertainty may require a conservative call on flaw size that may lead to the assumption of flaw growth. Rather than assuming this flaw growth is unacceptable, as stated in the previous requirement mandated under ASME BPV Code Case N-770-2, the NRC found that reasonable assurance of plant safety could be provided by reporting this condition to the NRC for evaluation. This relaxation of the previous requirement allows for regulatory flexibility in assessing the safety significance of any potential flaw growth. The NRC estimates that there is a small reduction in burden to licensees as a result of this increased flexibility, which was not quantified.

5.3.41.6 Deferral

The NRC proposes to revise this condition in 10 CFR 50.55a(g)(6)(ii)(F)(9) to address the potential deferrals of volumetric inspections for welds mitigated by peening and excavate and weld repairs. Volumetric inspections performed once per ISI interval can, in some cases, be deferred to the end of the current 10-year ISI. This could allow an inspection frequency, which is assumed to be about 10 years, to be extended to as many as 20 years. While there are certain conditions that would warrant such an extension, the NRC found two cases where allowing such deferrals would provide an unacceptable reduction in the margin for safety.

For welds peened in accordance with the performance and qualification criteria of MRP-335R3-A, the long-term ISI interval required by MRP-335R3-A, Table 4-1, is once per inspection interval. Note 11 in Table 4-1 would allow deferral of peened welds beyond the 10-year inspection frequency. This deferral would be beyond the NRC technical basis of paragraph 4.6.3 in the NRC safety evaluation of MRP-335R3-A. Therefore, the NRC proposes to revise this condition to prohibit the deferral of examinations of peened welds without the submission of a plant-specific proposed alternative for NRC review and approval.

For welds mitigated with the excavate and weld repair technique (specifically, inspection items M-2, N-1, and N-2), Note 11 in Table 1 of ASME BPV Code Case N-770-5 would allow the deferral of the second inservice examination to the end of the 10-year ISI interval. The NRC finds this deferral unacceptable. If a weld was mitigated near the end of a 10-year ISI interval, the first postmitigation examination might occur at the beginning of the next 10-year ISI interval. Then, because the welds are required to be examined once per interval, the second postmitigation exam would be in the next interval, and since Note 11 allows the exams to be deferred, the inspection interval between the first and second postmitigation exams could approach 20 years. A second postmitigation exam being required within 10 years of the initial postmitigation exam is more consistent with the reinspection timeline for other mitigations, such as full structural weld overlay, and is therefore acceptable to the NRC. However, after the initial and second postmitigation examinations, provided the examination volumes show no indications of crack growth or new cracking, the NRC finds that it is acceptable to allow deferral of examination of these welds as deemed appropriate by the plant owner. Thus, the NRC proposed condition restricts only the deferral of the second inservice examination.

As an additional note concerning the excavate and weld repair technique, the NRC has not fully endorsed the ASME BPV Code Case N-847 for the implementation of this technique. The pertinent conditions are based on the assumption of full effectiveness of the mitigation as described by ASME BPV Code Case N-847.

Given the two new issues identified above, the NRC proposes to revise the condition in 10 CFR 50.55a(g)(6)(ii)(F)(9) to prohibit the deferral of volumetric inspections of welds mitigated by peening under MRP-335R3-A and the first 10-year ISI examination for welds mitigated by excavate and weld repair, inspection items M-2, N-1, and N-2 only. The NRC estimates no incremental industry implementation cost as a result of this clarification and alignment of deferral requirements and categorizations with MRP-335R3-A.

5.3.41.7 Examination technique

The NRC proposes to revise this condition to make an editorial change to update the reference to ASME BPV Code Case N-770-2 to N-770-5. The NRC estimates no incremental industry implementation cost as a result of this editorial change.

5.3.41.8 Cast Stainless Steel

The NRC proposes to amend 10 CFR 50.55a(g)(6)(ii)(F)(11) to provide licensees with an alternative to meeting the current condition. The alternative would be to use ASME Code Case N-824 when examining dissimilar-metal welds where inspections through a CASS component are required. The existing condition requires licensees to have a qualified program in place to inspect dissimilar-metal butt welds with CASS materials from the CASS side by 2022. The NRC recognizes that there is no current Supplement 9 inspection guideline that would meet this requirement. At an NRC public meeting on April 17, 2018, the NRC and industry representatives discussed the estimated number of welds that would be covered by the condition. Given this information, the NRC has determined that rather than requiring a full qualification program to be developed within this timeframe, ASME Code Case N-824 would provide an acceptable alternative and provide reasonable assurance of public health and safety.

ASME BPV Code Case N-824 incorporates best practices for the inspection of cast stainless steel from NUREG/CR-7122 and NUREG/CR-6933. NUREG/CR-7122 showed that pressurizer surge line sized piping welds may be inspectable with existing dissimilar-metal butt weld inspection procedures. NUREG/CR-6933 showed that large-bore cast stainless steel may be inspectable using specialized low-frequency inspection procedures. Therefore, the NRC will modify the condition to allow the use of ASME Code Case N-824, as conditioned in RG 1.147, as an option to the development of Appendix VIII, Supplement 9, qualifications, or qualifications similar to those in Appendix VIII, Supplement 2 or 10, using cast stainless steel mockups, when examining dissimilar-metal welds where inspections through a CASS component are required to obtain volumetric inspection coverage. The NRC estimates no incremental industry implementation cost as the agency is not proposing a change to this requirement.

5.3.41.9 Encoded Ultrasonic Examination

The NRC proposes to revise this current condition, which requires the encoded examination of unmitigated and mitigated cracked butt welds under the scope of ASME BPV Code Case N-770-5. In particular, the staff is revising the proposed condition to address changes in ASME BPV Code Case N-770-5 to include inspection categories B-1 and B-2 for cold-leg welds, which were previously under the single inspection category B, and the new inspection categories N-1, N-2, and O for cracked welds mitigated with the excavate and weld repair technique. The inclusion of these weld categories is in line with the previous basis for this condition.

Further, the NRC proposes to relax the requirement for 100 percent of the required inspection volume to be encoded. The new requirement would allow essentially 100 percent of the required inspection volume to be encoded under the definition of “essentially 100 percent” in ASME BPV Code Case N-460. This Code Case allows the reduction to 90-percent coverage only if a physical limitation or impediment to full coverage is encountered during the inspection. The NRC finds this relaxation appropriate given the potential that the physical size of the encoding equipment may reduce attainable coverage when compared to manual techniques. The NRC staff finds that the reduction in safety associated with this potential minor decrease in coverage is minimal. Adoption of this condition will reduce unnecessary requests for alternatives to this requirement. The NRC estimates no incremental industry implementation cost as a result of this revised condition.

5.3.41.10 Excavate and Weld Repair Cold Leg

The NRC proposes to add a new condition in 10 CFR 50.55a(g)(6)(ii)(F)(14) to address the initial inspection of cold-leg operating temperature welds after mitigation by the excavate and weld repair technique. The excavate and weld repair technique is a new mitigation category introduced in ASME BPV Code Case N-770-5. The first inspection required for inspection item M-2, N-1, and N-2 welds after mitigation is during the first or second refueling outages following mitigation. The NRC finds that ASME BPV Code Case N-770-5 does not provide separate inspection programs between the cold- and hot-leg temperature for the first volumetric inspection. The NRC has determined that, at hot-leg temperatures, one fuel cycle is sufficient for a preexisting, nondetectable crack to grow to detectable size (10-percent through-wall); however, at cold-leg temperatures, crack growth is sufficiently slow that preexisting, undetected cracks are unlikely to reach detectable size in a single fuel cycle. Therefore, before extending the inspection frequency to 10 years or longer, the NRC proposes a condition requiring that the first examination be performed during the second refueling outage following mitigation for cold-leg operating temperature welds. This condition will ensure the effectiveness of the initial volumetric examination in verifying that there is no unanticipated flaw growth in the mitigated weld. The NRC estimates a small incremental cost, which was not quantified, and some loss of scheduling flexibility as a result of this condition, which mandates that the inspection occur in the second refueling outage as opposed to giving licensees a choice between the first and second outages.

5.3.41.11 Cracked Excavate and Weld Repair

The NRC proposes to add a new condition in 10 CFR 50.55a(g)(6)(ii)(F)(15) to address the long-term inspection frequency of cracked welds mitigated by the excavate and weld repair technique (i.e., inspection category N-1). The long-term volumetric inspection frequency for the cracked N-1 welds under ASME BPV Code Case N-770-5 is a 25-percent sample each 10-year inspection interval. In comparison, the NRC notes that the long-term volumetric inspection frequency of a noncracked weld mitigated with excavate and weld repair without stress improvement (inspection category M-2) is 100 percent each 10-year inspection interval. If they do not improve surface stress, M-2 welds could potentially have cracking initiate at any time over the remaining life of the repair. Therefore, a volumetric inspection frequency of once per 10 years is warranted to verify weld structural integrity. However, every N-1 categorized weld already has a preexisting crack, but Code Case N-770-5 would allow a 25-percent sample inspection frequency during each 10-year ISI interval. This could allow some N-1 welds with preexisting flaws to not be volumetrically inspected for the remainder of the plant life. The NRC finds that there is an insufficient technical basis to support the difference in inspection frequency between N-1 and M-2 welds. Therefore, the NRC proposes a condition on N-1 welds that would require the same long-term inspection frequency as determined acceptable by ASME BPV Code Case N-770-5 for M-2 welds (i.e., noncracked 360-degree excavate and weld repair with no stress improvement credited). The NRC estimates no incremental industry implementation costs associated with this condition, which aligns the N-1 inspection frequency with M-2 requirements and good engineering principles.

5.3.41.12 Partial Arc Excavate and Weld Repair

The NRC proposes to add a new condition in 10 CFR 50.55a(g)(6)(ii)(F)(16) to prevent the use of the inspection criteria for the partial arc excavate and weld repair technique contained in ASME BPV Code Case N-770-5. The NRC staff notes that ASME BPV Code Case N-847, which describes the process of installing an excavate and weld repair, has not been included in RG 1.147 and has not been incorporated by reference into 10 CFR 50.55a. As a result, licensees must propose an alternative to the ASME Code to make an excavate and weld repair. Therefore, preventing the use of the inspection criteria in ASME BPV Code Case N-770-5 poses no additional burden on the licensee when viewed in light of the requirement to propose an alternative to the ASME BPV Code to install the excavate and weld repair. The NRC's basis for this condition is that initial research into stress fields and crack growth associated with the ends of the repair indicates the potential for crack growth rates to exceed those expected in the absence of the repair. The NRC estimates no incremental industry implementation cost as a result of this condition, which modifies the contents of alternative requests that are already being submitted by licensees.

5.3.42 Removal of 10 CFR 50.55a(a)(1)(C)(52) and (53) Exclusion

The NRC proposes to revise 10 CFR 50.55a(a)(1)(C)(52) and (53) to remove the exclusion for Article IWB-2000: IWB-2500 "Examination and Inspection: Examination and Pressure Test Requirements," Table IWB-2500-1 "Examination Categories," Item numbers B5.11 and B5.71 from 10 CFR 50.55a(a)(1)(C)(52). Also, the NRC proposes to remove the exclusion for Article IWB-2000: IWB-2500 "Examination and Inspection: Examination and Pressure Test Requirements," Table IWB-2500-1 (B-F) "Examination Category B-F, Pressure Retaining Dissimilar Metal Welds in Vessel Nozzles," Item numbers B5.11 and B5.71; Article IWB-3110 "Preservice Volumetric and Surface Examination Results," paragraph 9a)(3); and Article

IWC-3000 “Acceptance Standards,” IWC-3100 “Evaluation of Examination Results,” IWC-3110 “Preservice Volumetric and Surface Examinations,” IWC-3112 “Acceptance,” paragraph a(3) from 10 CFR 50.55a(a)(1)(C)(53). These paragraphs in the ASME BPV Code, Section XI incorporate the content of ASME Code Cases N-799 and N-813. The NRC developed conditions to ASME Code Cases N-799 and N-813 in the final rulemaking that approved ASME BPV Code Cases for use (83 FR 2331, January 17, 2018). The NRC is adding this condition in order to be consistent with that final rulemaking. Therefore, the NRC does not consider this a new requirement.

5.3.43 Preservice Volumetric and Surface Examinations Acceptance

The NRC proposes to add 10 CFR 50.55a(b)(2)(xli) to continue the prohibition of the use of ASME BPV Code, Section XI, Subparagraphs IWB-3112(a)(3) and IWC-3112(a)(3) in the 2013 through 2017 Edition. The NRC is prohibiting these items in order to be consistent with the final rulemaking that approved ASME BPV Code Cases for use (83 FR 2331, January 17, 2018). Therefore, the NRC does not consider this a new requirement.

5.3.44 Steam Generator Nozzle-to-Component Welds and Reactor Vessel Nozzle-to-Component Welds

The NRC proposes to add 10 CFR 50.55a(b)(2)(xlii) to require that the examination of steam generator nozzle-to-component welds and reactor vessel nozzle-to-component welds must be full volume and that the ultrasonic examination procedures, equipment, and personnel must be qualified by performance demonstration in accordance with Mandatory Appendix VIII of ASME Code, Section XI. These proposed conditions are consistent with the conditions on ASME Code Case N-799 in Regulatory Guide 1.147 Revision 18, which was incorporated by reference in the final rulemaking that approved ASME BPV Code Cases for use (83 FR 2331, January 17, 2018). Therefore, the NRC does not consider this a new requirement.

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

Submission of an alternative request to the NRC is not a trivial matter. Once ASME issues a Code edition, the licensee or applicant must determine the applicability of the Code edition to its facility and the benefits of using it. If the licensee or applicant determines that use of the Code would be beneficial but the NRC has not approved the Code edition, the licensee or applicant must 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 alternative requests submitted to the NRC over the last 5 years found 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 alternative submittal requires an average of 280 hours of effort to develop the technical justification and an additional 100 hours to 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 to request an alternative by weighing the cost against the benefit to be derived. In some cases, licensees may decide to forfeit the benefits of using newer ASME Code, whether in terms of radiological considerations or burden reduction.

A review of past submittals of Code alternative requests shows that plant owners submit Code alternative requests covering multiple units and multiple plant sites. Under Alternative 2, a licensee of a nuclear power plant would no longer need to submit the previously mentioned Code alternative requests under the new 10 CFR 50.55a(z), which would provide a net benefit (i.e., averted cost) to the licensee. The staff analyzed alternative request submittals across multiple years and, based on an assumption that the 2019 ASME Edition final rule would be issued by 2021, determined that the implementation of Alternative 2 would result in the avoidance of approximately 24 additional Code alternative submittals (and their associated preparation) each year under the new 10 CFR 50.55a(z) (see Table 7). The NRC estimates the industry operation averted costs for operating nuclear power plants to range from $2.43 million (7-percent NPV) to $2.62 million (3-percent NPV), yielding a net positive savings for Alternative 2.

---

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

Table 7 Industry Operation—Averted Costs for Code Alternative Requests

Year	Activity	Number of Affected Entities	Per Entity		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Code Case relief request preparation and submission	24	380	$103	$926,493	$865,881	$899,507
2020	Code Case relief request preparation and submission	24	380	$103	$926,493	$809,235	$873,308
2021	Code Case relief request preparation and submission	24	380	$103	$926,493	$756,294	$847,872
				Total:	**$2,779,478**	**$2,431,410**	**$2,620,688**

Note: All values reported in 2018 dollars.

5.4.1 Conditions on ASME OM Code

Section 0 discusses these administrative conditions. The NRC estimates no incremental industry operation costs associated with these conditions, which simply implement the 2017 Edition of the OM Code.

5.4.2 Reference for Motor-Operated Valve Testing

Section 0 discusses this condition. The NRC estimates no incremental industry operation costs associated with this administrative condition.

5.4.3 Reference and Outdated Condition Removal for Check Valves (Appendix II)

Section 0 describes these conditions. The NRC estimates no incremental industry operation costs associated with the removal of these outdated conditions.

5.4.4 Subsection ISTE

Section 0 discusses this condition. The NRC estimates no incremental industry operation costs associated with this administrative condition, which would simplify future rulemakings.

5.4.5 Mandatory Appendix V and Subsection ISTF

Section 0 describes these conditions. The NRC estimates no incremental industry operation costs of these conditions, which are continuations of current requirements.

5.4.6 Valve Position Indication Applicability Condition

Section 0 discusses this condition. There are no estimated incremental industry operation costs associated with this administrative condition.

5.4.7 Condition on Appendix IV on Air-Operated Valves

Section 0 discusses this condition. There are no estimated incremental industry operation costs associated with this condition.

5.4.8 Condition to Relax Schedule for IST Code: Initial 120-Month Interval

Section 0 discusses this condition. The NRC estimates that this schedule relaxation to prepare for the initial 120-month IST interval in order to meet the latest edition and addenda of the ASME OM Code would result in some savings and efficiencies, from personnel availability to avoiding scheduling conflicts. The condition would provide a small incremental reduction in industry operation burden, which was not quantified.

5.4.9 Condition to Relax Schedule for IST Code: Successive 120-Month Intervals

Section 0 discusses this condition. The relaxation of the schedule from 12 months to 18 months to meet the latest edition and addenda of the ASME OM Code for the IST and ISI programs may provide a small incremental reduction in industry operation burden, which was not quantified.

5.4.10 Condition to Maintain Inservice Testing Reporting Requirements

Section 0 discusses this condition. Because this condition maintains current regulatory reporting requirements, the NRC estimates no associated incremental industry operation costs.

5.4.11 Rules for Construction of Nuclear Facility Components—Division 1

Section 0 discusses this condition. The NRC estimates no associated incremental industry operation costs.

5.4.12 Section III Condition: Weld Leg Dimensions

Section 0 discusses this condition. The NRC estimates no associated incremental industry operation costs.

5.4.13 Section III Condition: Independence of Inspection

Section 0 discusses this condition. The NRC estimates no associated incremental industry operation costs.

5.4.14 Section III Condition: Subsection NH

Section 0 discusses this condition. The NRC estimates no associated incremental industry operation costs.

5.4.15 Section III Condition: Capacity Certification and Demonstration of Function of Incompressible Fluid Pressure Relief Valves

Section 0 discusses this condition. The NRC estimates no associated incremental industry operation costs.

5.4.16 Section III Condition: Visual Examination of Bolts, Studs, and Nuts

Section 0 discusses this condition. The NRC estimates no incremental industry operation costs associated with this condition, which continues existing practices and enforces sound engineering principles.

5.4.17 Section III Condition: Certifying Engineer

Section 0 discusses this condition. The NRC estimates no incremental industry operation costs associated with this condition, which continues existing practices and enforces sound engineering principles.

5.4.18 Conditions on ASME BPV Code, Section XI

Section 0 discusses this condition. The NRC estimates no associated incremental industry operation costs.

5.4.19 Augmented Inservice Inspection Requirements: Implementation of Appendix VIII to Section XI

Section 0 discusses this condition. The NRC estimates no associated incremental industry operation costs.

5.4.20 Clarifying Condition on ASME BPV Code Section III

Section 0 discusses this condition. The NRC estimates no incremental industry operation costs associated with this minor clarification of existing requirements.

5.4.21 Appendix XXVI Conditions

The cost estimates for these conditions consider the incremental cost imposed by the conditions for HDPE installation compared to the unconditioned Code. Other costs associated with piping installation, such as the time required for surveying, excavation of the buried piping, trench dewatering (if applicable), testing and repairing the joints, providing proper pipe bedding and compaction, installing warning tape or identification wire (to facilitate finding the piping the next time), backfilling the trench, restoring the surface conditions, and performing required testing before commissioning the pipe, are common to both the conditioned and unconditioned Code. Therefore, this estimate does not consider these costs.

5.4.21.1 Fusing Procedure Specification

This condition, described in Section 0, would result in incremental costs to licensees developing and using these specific fusing procedures. The NRC estimates that developing and using the specific fusing procedures would cost ($11,500) per site if the site chose to install HDPE piping. The NRC believes that industry will gradually begin using HDPE piping to replace existing steel piping. The NRC has assumed that approximately one site per year will install HDPE piping for a total of 17 HDPE installations by 2035. At that point, the remaining sites, being close to decommissioning, are not expected to install HDPE piping. This assumption is based on the steel piping lasting about 20 years before replacement is needed, and the sites that have already replaced their piping, or are nearing the end of reactor life, not needing to replace the piping again.

This results in operating costs to industry ranging from ($112,000) using a 7-percent discount rate to ($151,000) using a 3-percent discount rate.

Table 8 Costs of Specifying Fusing Procedures during HDPE Installation

Year	Activity	Number of Affected Entities	Establishing and Following Procedures Per Entity	Cost		
				Undiscounted	7% NPV	3% NPV
2019	Specifying Fusing Procedures	1	$11,500	($11,500)	($10,748)	($11,165)
2020	Specifying Fusing Procedures	1	$11,500	($11,500)	($10,045)	($10,840)
2021	Specifying Fusing Procedures	1	$11,500	($11,500)	($9,387)	($10,524)
2022	Specifying Fusing Procedures	1	$11,500	($11,500)	($8,773)	($10,218)
2023	Specifying Fusing Procedures	1	$11,500	($11,500)	($8,199)	($9,920)
2024	Specifying Fusing Procedures	1	$11,500	($11,500)	($7,663)	($9,631)
2025	Specifying Fusing Procedures	1	$11,500	($11,500)	($7,162)	($9,351)
2026	Specifying Fusing Procedures	1	$11,500	($11,500)	($6,693)	($9,078)
2027	Specifying Fusing Procedures	1	$11,500	($11,500)	($6,255)	($8,814)
2028	Specifying Fusing Procedures	1	$11,500	($11,500)	($5,846)	($8,557)
2029	Specifying Fusing Procedures	1	$11,500	($11,500)	($5,464)	($8,308)
2030	Specifying Fusing Procedures	1	$11,500	($11,500)	($5,106)	($8,066)
2031	Specifying Fusing Procedures	1	$11,500	($11,500)	($4,772)	($7,831)
2032	Specifying Fusing Procedures	1	$11,500	($11,500)	($4,460)	($7,603)
2033	Specifying Fusing Procedures	1	$11,500	($11,500)	($4,168)	($7,381)
2034	Specifying Fusing Procedures	1	$11,500	($11,500)	($3,895)	($7,166)
2035	Specifying Fusing Procedures	1	$11,500	($11,500)	($3,641)	($6,958)
			Total:	**($195,500)**	**($112,277)**	**($151,410)**

Note: All values reported in 2018 dollars.

5.4.21.2 Testing Fusing Procedures

Section 0 describes this condition, which would result in incremental costs to licensees from performing the additional bend tests. This regulatory analysis assumes developing and using joint bent testing would cost ($11,500) per site, and approximately one site per year would install HDPE piping, for a total of 17 sites performing the installation to replace existing steel piping by 2035. This assumption is based on the current steel piping lasting about 20 years before replacement is needed, and the sites that have already replaced their piping, or are nearing the end of reactor life, not needing to replace the piping again.

This results in operating costs to industry ranging from ($112,000) using a 7-percent discount rate to ($151,000) using a 3-percent discount rate.

Table 9 Costs of Bend Testing Joints during HDPE Installation

Year	Activity	Number of Affected Entities	Establishing and Following Procedures Per Entity	Cost		
				Undiscounted	7% NPV	3% NPV
2019	Bend Testing of Joints	1	$11,500	($11,500)	($10,748)	($11,165)
2020	Bend Testing of Joints	1	$11,500	($11,500)	($10,045)	($10,840)
2021	Bend Testing of Joints	1	$11,500	($11,500)	($9,387)	($10,524)
2022	Bend Testing of Joints	1	$11,500	($11,500)	($8,773)	($10,218)
2023	Bend Testing of Joints	1	$11,500	($11,500)	($8,199)	($9,920)
2024	Bend Testing of Joints	1	$11,500	($11,500)	($7,663)	($9,631)
2025	Bend Testing of Joints	1	$11,500	($11,500)	($7,162)	($9,351)
2026	Bend Testing of Joints	1	$11,500	($11,500)	($6,693)	($9,078)
2027	Bend Testing of Joints	1	$11,500	($11,500)	($6,255)	($8,814)
2028	Bend Testing of Joints	1	$11,500	($11,500)	($5,846)	($8,557)
2029	Bend Testing of Joints	1	$11,500	($11,500)	($5,464)	($8,308)
2030	Bend Testing of Joints	1	$11,500	($11,500)	($5,106)	($8,066)
2031	Bend Testing of Joints	1	$11,500	($11,500)	($4,772)	($7,831)
2032	Bend Testing of Joints	1	$11,500	($11,500)	($4,460)	($7,603)
2033	Bend Testing of Joints	1	$11,500	($11,500)	($4,168)	($7,381)
2034	Bend Testing of Joints	1	$11,500	($11,500)	($3,895)	($7,166)
2035	Bend Testing of Joints	1	$11,500	($11,500)	($3,641)	($6,958)
			Total:	**($195,500)**	**($112,277)**	**($151,410)**

Note: All values reported in 2018 dollars.

5.4.21.3 Essential Variables for Qualifying Fusing Procedures of Electrofusion Joints in Polyethylene Piping

Section 0 describes this condition. The NRC estimates no associated incremental costs.

5.4.21.4 Qualifying Fusing Procedures for Electrofusion Joints in HDPE Piping

Section 0 describes this condition. The additional test would affect any site, whether operating or new, with HDPE buried piping that needs repair or replacement. The NRC estimates that buried piping has approximately 20 joints and that testing each joint takes about 3 hours. Because of the low failure rate of HDPE, the staff expects that two sites would need to perform the testing required by this condition, by about 2030, resulting in costs ranging from ($6,060) at a 7-percent discount rate to ($9,580) at a 3-percent discount rate.

Table 10 Costs of HDPE Additional Joint Testing

Year	Activity	Number of Affected Entities	Labor Hours	Joints	Weighted Hourly rate	Cost		
						Undiscounted	7% NPV	3% NPV
2030	Perform joint tests	2	3	20	$111	($13,654)	($6,063)	($9,577)
					Total:	**($13,654)**	**($6,063)**	**($9,577)**

Note: All values reported in 2018 dollars.

5.4.21.5 Prohibits the Use of Electrofusion Saddle Fittings and Electrofusion Saddle Joints in HDPE Piping

Section 0 describes this condition. The NRC estimates that this condition would result in licensees manufacturing their own fittings for the joints discussed above and estimates that manufacturing time is about 4 hours per fitting. This results in estimated costs ranging from ($7,540) using a 7-percent discount rate to ($11,900) using a 3-percent discount rate.

Table 11 Costs of Manufacturing Fittings for HDPE Joints

Year	Activity	Number of Affected Entities	Labor Hours	Joints	Weighted Hourly rate	Cost		
						Undiscounted	7% NPV	3% NPV
2030	Manufacture fittings	2	4	20	$111	($16,976)	($7,537)	($11,906)
					Total:	**($16,976)**	**($7,537)**	**($11,906)**

Note: All values reported in 2018 dollars.

5.4.22 Condition on Effective Edition and Addenda of Subsections IWE and IWL

Section 0 describes this condition. The NRC estimates that this condition would not result in any incremental industry operation costs because the 2015 and 2017 Editions maintain the status quo of this condition.

5.4.23 Section XI References to OM Part 4, OM Part 6, and OM Part 10 (Table IWA-1600-1)

Section 0 describes this condition. The NRC estimates that the removal of this condition results in no incremental industry operation costs as the addenda and editions referenced are outdated and no longer used.

5.4.24 Metal Containment Examinations

Section 0 describes this condition, which will relax the examination requirements from once per inspection interval to once per 10 years for plants that are using pre-2017 editions of the ASME Code. The NRC did not quantitatively estimate the averted costs of this relaxation.

5.4.25 Reconciliation of Quality Requirements for Replacement Items

Section 0 describes this condition. The NRC estimates that the removal of this condition results in no incremental industry operation costs as the addenda and editions referenced are outdated and no longer used.

5.4.26 Nondestructive Examination Personnel Certification: Fourth Provision

Section 0 discusses this condition. There are no estimated incremental industry operating costs associated with the continuation of this existing condition.

5.4.27 Section XI Condition: System Leakage Tests: Second Provision

Section 0 discusses this condition. The NRC estimates that no incremental industry operating costs are associated with this condition.

5.4.28 Section XI Condition: System Leakage Tests: Third Provision

This condition, discussed in Section 0, would result in incremental industry operating costs because of replacement energy requirements during the additional 45 minutes of hold time the condition imposes, beyond the 15 minutes in Code Case N-795. The regulatory analysis for the 2017 ASME Code Case final rule (NRC, 2017f) estimated costs through 2022; therefore, this regulatory analysis starts in 2023 and continues through the average BWR license expiration date of 2040, inflating the costs from the prior regulatory analysis from 2017 dollars to 2018 dollars. The cost estimate for short-term replacement power ranges from ($1.30 million) using a 7-percent discount rate to ($1.96 million) using a 3-percent discount rate. The labor costs range from ($4,440) using a 7-percent discount rate to ($7,060) using a 3-percent discount rate.

Table 12 Short-Term Replacement Power Costs for Section XI Leakage Tests

Year	Mean Incremental Test Duration (hr)	No. of BWR Outages with Inspections	Mean Short-Term Replacement Power Cost ($/hr)	Mean Short-Term Replacement Power Cost (2018 dollars)		
				Undiscounted	7% NPV	3% NPV
2023	0.75	6	$46,291	($208,308)	($148,521)	($179,689)
2024	0.75	6	$46,291	($208,308)	($138,805)	($174,455)
2025	0.75	6	$46,291	($208,308)	($129,724)	($169,374)
2026	0.75	6	$46,291	($208,308)	($121,237)	($164,441)
2027	0.75	6	$46,291	($208,308)	($113,306)	($159,651)
2028	0.75	6	$46,291	($208,308)	($105,893)	($155,001)
2029	0.75	6	$46,291	($208,308)	($98,966)	($150,486)
2030	0.75	5	$46,291	($173,590)	($77,076)	($121,753)
2031	0.75	5	$46,291	($173,590)	($72,034)	($118,207)
2032	0.75	4	$46,291	($138,872)	($53,857)	($91,811)
2033	0.75	4	$46,291	($138,872)	($50,334)	($89,137)
2034	0.75	4	$46,291	($138,872)	($47,041)	($86,541)
2035	0.75	3	$46,291	($104,154)	($32,973)	($63,015)
2036	0.75	3	$46,291	($104,154)	($30,815)	($61,180)
2037	0.75	3	$46,291	($104,154)	($28,800)	($59,398)
2038	0.75	2	$46,291	($69,436)	($17,944)	($38,445)
2039	0.75	2	$46,291	($69,436)	($16,770)	($37,325)
2040	0.75	2	$46,291	($69,436)	($15,673)	($36,238)
			Total:	**($2,742,727)**	**($1,299,767)**	**($1,956,145)**

Table 13 Industry Incremental Labor Costs for Section XI Leak Tests

Year	No. of BWR Outages with Inspections	Mean Labor Cost (2018 dollars)		
		Undiscounted	7% NPV	3% NPV
2023	6	($578)	($412)	($499)
2024	6	($578)	($385)	($484)
2025	6	($578)	($360)	($470)
2026	6	($578)	($336)	($456)
2027	6	($578)	($314)	($443)
2028	6	($578)	($294)	($430)
2029	6	($578)	($275)	($418)
2030	5	($578)	($257)	($405)
2031	5	($578)	($240)	($394)
2032	4	($578)	($224)	($382)
2033	4	($578)	($209)	($371)
2034	4	($578)	($196)	($360)
2035	3	($578)	($183)	($350)
2036	3	($578)	($171)	($340)
2037	3	($578)	($160)	($330)
2038	2	($578)	($149)	($320)
2039	2	($578)	($140)	($311)
2040	2	($578)	($130)	($302)
	Total:	**($10,404)**	**($4,436)**	**($7,063)**

5.4.29 Removal of Condition on Table IWB-2500-1 Examination Requirements

Section 0 describes this condition. The NRC estimates that there would be averted industry operation costs resulting from the removal of the condition, because these inspections would no longer be required. Licensees submit relief requests for the pressurizer inspections and perform the steam generator weld inspections every 10 years. The staff estimates there will be 62 PWRs in 2020, 55 PWRs in 2030, and 32 PWRs in 2040, calculating the average number of steam generators per unit using NUREG-1350, Volume 29, Revision 1, "2017–2018 Information Digest," issued December 2017 (NRC, 2017g), requiring two inspections (welds) per steam generator, and 9 hours per inspection. Each pressurizer inspection relief request takes approximately 173 hours. Therefore, removal of the requirements of this condition results in averted costs to industry ranging from $3.02 million (7-percent NPV) to $4.01 million (3-percent NPV). The averted cost from dose ranges from $330,000 (7-percent NPV) to $442,000 (3-percent NPV) using the current dollar per person-rem conversion factor value of $2,000. A sensitivity analysis using the higher dollar per person-rem conversion factors calculated for 2018 in this regulatory analysis was not performed, because all of the costs for these conditions are averted costs. Therefore, a higher factor would simply result in higher averted costs and would show that the cost averted quality of this part of the cost estimate is not sensitive to the dollar per person-rem conversion factor.

Table 14 Steam Generator and Pressurizer Inspections Removed Condition (Operating Reactors) Costs

Year	Activity	Number of Affected Entities	Per Inspection						Cost		
			Labor Hours	SGs per PWR	Radiation Field (rem/hr)	Dollar per person-rem	Inspections per SG	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2020	Inspect Steam Generator welds	62	9	3.1			2	$111	$396,654	$346,453	$373,885
2020	Dose from Steam Generator	62	9	3.1	0.033	$2,000	2		$235,272	$205,496	$221,767
2020	Submit relief requests for PZR	62	173					$122	$1,300,590	$1,135,986	$1,225,931
2030	Inspect Steam Generator welds	55	9	3.2			2	$111	$356,486	$158,284	$250,032
2030	Dose from Steam Generator	55	9	3.2	0.033	$2,000	2		$211,447	$93,885	$148,304
2030	Submit relief requests for PZR	55	173					$122	$1,153,749	$512,278	$809,216
2040	Inspect Steam Generator welds	32	9	3.6			2	$111	$232,225	$52,416	$121,197
2040	Dose from Steam Generator	32	9	3.6	0.033	$2,000	2		$137,742	$31,090	$71,887
2040	Submit relief requests for PZR	32	173					$122	$671,272	$151,515	$350,332
								Dose Total:	$584,461	$330,471	$441,958
								Non-Dose Total:	$4,110,977	$2,356,933	$3,130,593
								Total:	**$4,695,438**	**$3,017,875**	**$4,014,508**

Note: All values reported in 2018 dollars.

5.4.30 Section XI Condition: Table IWB-2500-1 Examination Requirements

Section 0 discusses this condition. The NRC estimates that no incremental industry operating costs are associated with this condition.

5.4.31 Section XI Condition: Mitigation of Defects by Modification

Section 0 discusses this condition. The NRC estimates that no incremental industry operating costs are associated with this condition.

5.4.31.1 Mitigation of Defects by Modification: First Provision

Section 0 discusses this condition. The NRC estimates that no incremental industry operating costs are associated with this condition.

5.4.31.2 Mitigation of Defects by Modification: Second Provision

These conditions, as discussed in Section 0, would result in industry relief requests, welding repairs, and examination and documentation of piping that would require scaffolding installation to perform. The NRC estimates that industry would submit one relief request per year for the crack-like defects, resulting in estimated costs ranging from ($507,000) using a 7-percent discount rate to ($730,000) using a 3-percent discount rate. The staff estimates that each instance has about 10 weld locations, which require two technicians a total of 4 hours per year to inspect. The cost estimate for the welding ranges from ($44,400) using a 7-percent discount rate to ($64,000) using a 3-percent discount rate. Installing and removing the scaffolding for the examinations would take three workers a total of about 8 hours, with estimated costs ranging from ($88,800) using a 7-percent discount rate to ($128,000) using a 3-percent discount rate. The examination and documentation will take two technicians a total of about 4 hours, resulting in estimated costs ranging from ($44,400) using a 7-percent discount rate to ($64,000) using a 3-percent discount rate. The total estimated costs for these conditions range from ($685,000) using a 7-percent discount rate to ($987,000) using a 3-percent discount rate.

Table 15 IWA-4340 Relief Request Costs

Year	Activity	Number of Instances	Per Instance		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Relief request preparation and	1	380	$103	($45,834)	($42,835)	($44,499)
2020	Relief request preparation and	1	380	$103	($45,834)	($40,033)	($43,203)
2021	Relief request preparation and	1	380	$103	($45,834)	($37,414)	($41,944)
2022	Relief request preparation and	1	380	$103	($45,834)	($34,966)	($40,723)
2023	Relief request preparation and	1	380	$103	($45,834)	($32,679)	($39,536)
2024	Relief request preparation and	1	380	$103	($45,834)	($30,541)	($38,385)
2025	Relief request preparation and	1	380	$103	($45,834)	($28,543)	($37,267)
2026	Relief request preparation and	1	380	$103	($45,834)	($26,676)	($36,181)
2027	Relief request preparation and	1	380	$103	($45,834)	($24,930)	($35,128)
2028	Relief request preparation and	1	380	$103	($45,834)	($23,299)	($34,104)
2029	Relief request preparation and	1	380	$103	($45,834)	($21,775)	($33,111)
2030	Relief request preparation and	1	380	$103	($45,834)	($20,351)	($32,147)
2031	Relief request preparation and	1	380	$103	($45,834)	($19,019)	($31,210)
2032	Relief request preparation and	1	380	$103	($45,834)	($17,775)	($30,301)
2033	Relief request preparation and	1	380	$103	($45,834)	($16,612)	($29,419)
2034	Relief request preparation and	1	380	$103	($45,834)	($15,525)	($28,562)
2035	Relief request preparation and	1	380	$103	($45,834)	($14,510)	($27,730)
2036	Relief request preparation and	1	380	$103	($45,834)	($13,560)	($26,922)
2037	Relief request preparation and	1	380	$103	($45,834)	($12,673)	($26,138)
2038	Relief request preparation and	1	380	$103	($45,834)	($11,844)	($25,377)
2039	Relief request preparation and	1	380	$103	($45,834)	($11,069)	($24,638)
2040	Relief request preparation and	1	380	$103	($45,834)	($10,345)	($23,920)
				Total:	**($1,008,338)**	**($506,976)**	**($730,446)**

Note: All values reported in 2018 dollars.

Table 16 IWA-4340 Welding Costs

Year	Activity	Number of Instances	Per Weld			Cost		
			Labor Hours	Number of Workers	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Weld repairs	10	4	2	$100	($4,011)	($3,749)	($3,894)
2020	Weld repairs	10	4	2	$100	($4,011)	($3,504)	($3,781)
2021	Weld repairs	10	4	2	$100	($4,011)	($3,274)	($3,671)
2022	Weld repairs	10	4	2	$100	($4,011)	($3,060)	($3,564)
2023	Weld repairs	10	4	2	$100	($4,011)	($2,860)	($3,460)
2024	Weld repairs	10	4	2	$100	($4,011)	($2,673)	($3,359)
2025	Weld repairs	10	4	2	$100	($4,011)	($2,498)	($3,262)
2026	Weld repairs	10	4	2	$100	($4,011)	($2,335)	($3,167)
2027	Weld repairs	10	4	2	$100	($4,011)	($2,182)	($3,074)
2028	Weld repairs	10	4	2	$100	($4,011)	($2,039)	($2,985)
2029	Weld repairs	10	4	2	$100	($4,011)	($1,906)	($2,898)
2030	Weld repairs	10	4	2	$100	($4,011)	($1,781)	($2,813)
2031	Weld repairs	10	4	2	$100	($4,011)	($1,665)	($2,732)
2032	Weld repairs	10	4	2	$100	($4,011)	($1,556)	($2,652)
2033	Weld repairs	10	4	2	$100	($4,011)	($1,454)	($2,575)
2034	Weld repairs	10	4	2	$100	($4,011)	($1,359)	($2,500)
2035	Weld repairs	10	4	2	$100	($4,011)	($1,270)	($2,427)
2036	Weld repairs	10	4	2	$100	($4,011)	($1,187)	($2,356)
2037	Weld repairs	10	4	2	$100	($4,011)	($1,109)	($2,288)
2038	Weld repairs	10	4	2	$100	($4,011)	($1,037)	($2,221)
2039	Weld repairs	10	4	2	$100	($4,011)	($969)	($2,156)
2040	Weld repairs	10	4	2	$100	($4,011)	($905)	($2,093)
					Total:	**($88,249)**	**($44,370)**	**($63,928)**

Note: All values reported in 2018 dollars.

Table 17 IWA-4340 Scaffolding Installation Costs

Year	Activity	Number of Instances	Per Scaffold			Cost		
			Labor Hours	Number of Workers	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Scaffolding installation	10	8	3	$100	($8,023)	($7,498)	($7,789)
2020	Scaffolding installation	10	8	3	$100	($8,023)	($7,007)	($7,562)
2021	Scaffolding installation	10	8	3	$100	($8,023)	($6,549)	($7,342)
2022	Scaffolding installation	10	8	3	$100	($8,023)	($6,120)	($7,128)
2023	Scaffolding installation	10	8	3	$100	($8,023)	($5,720)	($6,920)
2024	Scaffolding installation	10	8	3	$100	($8,023)	($5,346)	($6,719)
2025	Scaffolding installation	10	8	3	$100	($8,023)	($4,996)	($6,523)
2026	Scaffolding installation	10	8	3	$100	($8,023)	($4,669)	($6,333)
2027	Scaffolding installation	10	8	3	$100	($8,023)	($4,364)	($6,149)
2028	Scaffolding installation	10	8	3	$100	($8,023)	($4,078)	($5,970)
2029	Scaffolding installation	10	8	3	$100	($8,023)	($3,811)	($5,796)
2030	Scaffolding installation	10	8	3	$100	($8,023)	($3,562)	($5,627)
2031	Scaffolding installation	10	8	3	$100	($8,023)	($3,329)	($5,463)
2032	Scaffolding installation	10	8	3	$100	($8,023)	($3,111)	($5,304)
2033	Scaffolding installation	10	8	3	$100	($8,023)	($2,908)	($5,149)
2034	Scaffolding installation	10	8	3	$100	($8,023)	($2,718)	($4,999)
2035	Scaffolding installation	10	8	3	$100	($8,023)	($2,540)	($4,854)
2036	Scaffolding installation	10	8	3	$100	($8,023)	($2,374)	($4,712)
2037	Scaffolding installation	10	8	3	$100	($8,023)	($2,218)	($4,575)
2038	Scaffolding installation	10	8	3	$100	($8,023)	($2,073)	($4,442)
2039	Scaffolding installation	10	8	3	$100	($8,023)	($1,938)	($4,313)
2040	Scaffolding installation	10	8	3	$100	($8,023)	($1,811)	($4,187)
					Total:	**($176,497)**	**($88,740)**	**($127,856)**

Note: All values reported in 2018 dollars.

Table 18 IWA-4340 Examination and Documentation Costs

Year	Activity	Number of Instances	Per Weld			Cost		
			Labor Hours	Number of Workers	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Examination and Documentation	10	4	2	$100	($4,011)	($3,749)	($3,894)
2020	Examination and Documentation	10	4	2	$100	($4,011)	($3,504)	($3,781)
2021	Examination and Documentation	10	4	2	$100	($4,011)	($3,274)	($3,671)
2022	Examination and Documentation	10	4	2	$100	($4,011)	($3,060)	($3,564)
2023	Examination and Documentation	10	4	2	$100	($4,011)	($2,860)	($3,460)
2024	Examination and Documentation	10	4	2	$100	($4,011)	($2,673)	($3,359)
2025	Examination and Documentation	10	4	2	$100	($4,011)	($2,498)	($3,262)
2026	Examination and Documentation	10	4	2	$100	($4,011)	($2,335)	($3,167)
2027	Examination and Documentation	10	4	2	$100	($4,011)	($2,182)	($3,074)
2028	Examination and Documentation	10	4	2	$100	($4,011)	($2,039)	($2,985)
2029	Examination and Documentation	10	4	2	$100	($4,011)	($1,906)	($2,898)
2030	Examination and Documentation	10	4	2	$100	($4,011)	($1,781)	($2,813)
2031	Examination and Documentation	10	4	2	$100	($4,011)	($1,665)	($2,732)
2032	Examination and Documentation	10	4	2	$100	($4,011)	($1,556)	($2,652)
2033	Examination and Documentation	10	4	2	$100	($4,011)	($1,454)	($2,575)
2034	Examination and Documentation	10	4	2	$100	($4,011)	($1,359)	($2,500)
2035	Examination and Documentation	10	4	2	$100	($4,011)	($1,270)	($2,427)
2036	Examination and Documentation	10	4	2	$100	($4,011)	($1,187)	($2,356)
2037	Examination and Documentation	10	4	2	$100	($4,011)	($1,109)	($2,288)
2038	Examination and Documentation	10	4	2	$100	($4,011)	($1,037)	($2,221)
2039	Examination and Documentation	10	4	2	$100	($4,011)	($969)	($2,156)
2040	Examination and Documentation	10	4	2	$100	($4,011)	($905)	($2,093)
					Total:	**($88,249)**	**($44,370)**	**($63,928)**

Note: All values reported in 2018 dollars.

5.4.32 Clarification of Condition on Pressure Testing Class 1, 2, and 3 Mechanical Joints

Section 0 describes this condition. The NRC estimates no incremental industry operation costs associated with this clarification of requirements.

5.4.33 Condition on Summary Report Submittal

Section 0 discusses this condition. The NRC estimates no incremental industry operation costs associated with this administrative condition.

5.4.34 Condition To Correct Equation: Use of RT_{T0} in the K_{Ia} and K_{Ic} Equations

Section 0 discusses this condition. The NRC estimates no incremental industry operation costs associated with this condition to correct the equation.

5.4.35 Condition on Fracture Toughness of Irradiated Materials

Section 0 discusses this condition. This condition is not a change from the status quo, and the NRC estimates no incremental industry operation costs resulting from continuing this condition.

5.4.36 *Cast Austenitic Stainless Steel Inspection Condition: ASME Code Section XI, Appendix III, Supplement 2*

Section 0 describes this condition. The 2015 and 2017 Editions of the ASME BPV Code incorporate Code Case N-824, and this condition is a continuation of that in Code Case N-824. The NRC estimates that continuing this inspection will result in incremental averted costs to industry beyond the expected lifetime of the Code Case (6 years). Because the regulatory analysis for Code Case N-824 estimated costs through 2020, the cost estimate for this regulatory analysis begins with the next inspections in 2030.

Table 19 shows the calculations for the condition applied to the 2015 Edition of the ASME BPV Code, using the NRC expectation of 55 PWRs and 30 sites in 2030 and 32 PWRs and 19 sites in 2040. The staff also estimated that these licensees would require 35 hours per unit to examine welds in CASS components at the 10-year ISI interval. This inspection of pressurizer welds occurs in a radiation field and therefore is expected to result in personnel receiving a radiation dose. 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). However, as a result of this change to the ASME Code, licensees will no longer need to submit weld relief requests, which results in the averted costs for this condition. These averted costs range from $497,000 (7-percent NPV) to $876,000 (3-percent NPV).

Table 19 CASS Ultrasonic Inspection Provision Costs

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
2030	Setup, perform, and document ultrasonic weld exam	55	34.5			$103	($196,171)	($87,102)	($137,590)
2030	Dose from weld exams	55	8.6	0.033	$2,000		($31,151)	($13,831)	($21,848)
2030	Submit relief requests (averted)	30	345			$103	$1,070,024	$475,104	$750,493
2040	Setup, perform, and document ultrasonic weld exam	32	34.5			$103	($114,136)	($25,762)	($59,567)
2040	Dose from weld exams	32	8.6	0.033	$2,000		($18,124)	($4,091)	($9,459)
2040	Submit relief requests (averted)	19	345			$103	$677,682	$152,962	$353,677
						Dose Total:	**($49,275)**	**($17,922)**	**($31,307)**
						Non-Dose Total:	**$1,437,399**	**$515,201**	**$907,013**
						Total:	**$1,388,124**	**$497,279**	**$875,706**

Note: All values reported in 2018 dollars.

The NRC staff uses the methodology in NUREG-1530 to convert radiation exposure into dollars, using a dollar per person-rem conversion factor. (The NRC is currently revising this NUREG.) Table 19 uses the current dollar per person-rem conversion factor of $2,000. The costs from dose for this condition (beginning in 2030) are estimated to range from ($17,900) using a 7-percent NPV to ($31,300) using a 3-percent NPV.

In the proposed revision to NUREG-1530, the staff is recommending changing the dollar per person-rem conversion factor. The recommended values in 2018 dollars, provided in Section 0, are greater than the current dollar per person-rem conversion factor of $2,000. Using a conversion factor of $3,400, the monetized value of the converted radiation resulting from this provision would increase by ($30,700) using a 7-percent NPV and by ($53,700) using a 3-percent NPV when compared to the current $2,000 conversion factor. Using a conversion factor of $5,800, the cost from dose as a result of this provision would increase by ($52,300) using a 7-percent NPV and by ($91,600) using a 3-percent NPV. With a conversion factor of $8,500, the cost from dose as a result of this provision would increase by ($76,700) using a 7-percent NPV and by ($134,000) using a 3-percent NPV. The results in Table 20, which include the nondose total from Table 19, 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 20 CASS Ultrasonic Inspection Provision—Dose Sensitivity Analysis Costs

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
2030	Dose from weld exams	55	8.6	0.033	$3,400	($52,956)	($23,513)	($37,142)
2040	Dose from weld exams	33	8.6	0.033	$3,400	($31,774)	($7,172)	($16,582)
					Non-Dose Total:	**$1,437,399**	**$515,201**	**$907,013**
					Dose Total:	**($84,730)**	**($30,685)**	**($53,725)**
					Total:	**$1,352,669**	**$484,516**	**$853,289**

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
2030	Dose from weld exams	55	8.6	0.033	$5,800	($90,337)	($40,111)	($63,360)
2040	Dose from weld exams	33	8.6	0.033	$5,800	($54,202)	($12,234)	($28,288)
					Non-Dose Total:	**$1,437,399**	**$515,201**	**$907,013**
					Dose Total:	**($144,539)**	**($52,345)**	**($91,648)**
					Total:	**$1,292,860**	**$462,856**	**$815,365**

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
2030	Dose from weld exams	55	8.6	0.033	$8,500	($132,390)	($58,783)	($92,856)
2040	Dose from weld exams	33	8.6	0.033	$8,500	($79,434)	($17,929)	($41,456)
					Non-Dose Total:	**$1,437,399**	**$515,201**	**$907,013**
					Dose Total:	**($211,824)**	**($76,712)**	**($134,312)**
					Total:	**$1,225,575**	**$438,489**	**$772,702**

Note: All values reported in 2018 dollars.

5.4.37 Section XI Condition: Nonmandatory Appendix U

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.38 Section XI Condition: Defect Removal

Section 0 discusses this condition. The NRC estimates that this condition would result in approximately one relief request per year across all operating reactors. The estimated costs range from ($507,000) using a 7-percent discount rate to ($730,000) using a 3-percent discount rate.

Table 21 IWA-4421 Relief Request Costs

Year	Activity	Number of Instances	Per Instance		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Relief request preparation and submission	1	380	$103	($45,834)	($42,835)	($44,499)
2020	Relief request preparation and submission	1	380	$103	($45,834)	($40,033)	($43,203)
2021	Relief request preparation and submission	1	380	$103	($45,834)	($37,414)	($41,944)
2022	Relief request preparation and submission	1	380	$103	($45,834)	($34,966)	($40,723)
2023	Relief request preparation and submission	1	380	$103	($45,834)	($32,679)	($39,536)
2024	Relief request preparation and submission	1	380	$103	($45,834)	($30,541)	($38,385)
2025	Relief request preparation and submission	1	380	$103	($45,834)	($28,543)	($37,267)
2026	Relief request preparation and submission	1	380	$103	($45,834)	($26,676)	($36,181)
2027	Relief request preparation and submission	1	380	$103	($45,834)	($24,930)	($35,128)
2028	Relief request preparation and submission	1	380	$103	($45,834)	($23,299)	($34,104)
2029	Relief request preparation and submission	1	380	$103	($45,834)	($21,775)	($33,111)
2030	Relief request preparation and submission	1	380	$103	($45,834)	($20,351)	($32,147)
2031	Relief request preparation and submission	1	380	$103	($45,834)	($19,019)	($31,210)
2032	Relief request preparation and submission	1	380	$103	($45,834)	($17,775)	($30,301)
2033	Relief request preparation and submission	1	380	$103	($45,834)	($16,612)	($29,419)
2034	Relief request preparation and submission	1	380	$103	($45,834)	($15,525)	($28,562)
2035	Relief request preparation and submission	1	380	$103	($45,834)	($14,510)	($27,730)
2036	Relief request preparation and submission	1	380	$103	($45,834)	($13,560)	($26,922)
2037	Relief request preparation and submission	1	380	$103	($45,834)	($12,673)	($26,138)
2038	Relief request preparation and submission	1	380	$103	($45,834)	($11,844)	($25,377)
2039	Relief request preparation and submission	1	380	$103	($45,834)	($11,069)	($24,638)
2040	Relief request preparation and submission	1	380	$103	($45,834)	($10,345)	($23,920)
				Total:	**($1,008,338)**	**($506,976)**	**($730,446)**

Note: All values reported in 2018 dollars.

5.4.39 Section XI Condition: Prohibitions and Restriction on Use of IWB-3510.4(b)

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.40 ASME BPV Code Case N-729-6

5.4.40.1 Implementation

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.40.2 Appendix I Use

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.40.3 Surface Exam Acceptance Criteria

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.40.4 Peening

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.40.5 Baseline Examinations

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.40.6 Sister Plants

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.40.7 Volumetric Leak Path

Section 0 discusses this condition. The NRC estimates that licensees would no longer need to submit one relief request per year as a result of this condition. This results in averted costs ranging from $507,000 (7-percent NPV) to $730,000 (3-percent NPV).

Table 22 N-729-6 Relief Request Costs

Year	Activity	Number of Instances	Per Instance		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Relief request preparation and submission	1	380	$103	$45,834	$42,835	$44,499
2020	Relief request preparation and submission	1	380	$103	$45,834	$40,033	$43,203
2021	Relief request preparation and submission	1	380	$103	$45,834	$37,414	$41,944
2022	Relief request preparation and submission	1	380	$103	$45,834	$34,966	$40,723
2023	Relief request preparation and submission	1	380	$103	$45,834	$32,679	$39,536
2024	Relief request preparation and submission	1	380	$103	$45,834	$30,541	$38,385
2025	Relief request preparation and submission	1	380	$103	$45,834	$28,543	$37,267
2026	Relief request preparation and submission	1	380	$103	$45,834	$26,676	$36,181
2027	Relief request preparation and submission	1	380	$103	$45,834	$24,930	$35,128
2028	Relief request preparation and submission	1	380	$103	$45,834	$23,299	$34,104
2029	Relief request preparation and submission	1	380	$103	$45,834	$21,775	$33,111
2030	Relief request preparation and submission	1	380	$103	$45,834	$20,351	$32,147
2031	Relief request preparation and submission	1	380	$103	$45,834	$19,019	$31,210
2032	Relief request preparation and submission	1	380	$103	$45,834	$17,775	$30,301
2033	Relief request preparation and submission	1	380	$103	$45,834	$16,612	$29,419
2034	Relief request preparation and submission	1	380	$103	$45,834	$15,525	$28,562
2035	Relief request preparation and submission	1	380	$103	$45,834	$14,510	$27,730
2036	Relief request preparation and submission	1	380	$103	$45,834	$13,560	$26,922
2037	Relief request preparation and submission	1	380	$103	$45,834	$12,673	$26,138
2038	Relief request preparation and submission	1	380	$103	$45,834	$11,844	$25,377
2039	Relief request preparation and submission	1	380	$103	$45,834	$11,069	$24,638
2040	Relief request preparation and submission	1	380	$103	$45,834	$10,345	$23,920
				Total:	**$1,008,338**	**$506,976**	**$730,446**

Note: All values reported in 2018 dollars.

5.4.41 ASME BPV Code Case N-770-5

5.4.41.1 Augmented Inservice Inspection Requirements: Examination Requirements for Class 1 Piping and Nozzle Dissimilar-Metal Butt Welds—(1) Implementation

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.2 Categorization

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.3 Baseline Examinations

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.4 Examination Coverage

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.5 Reporting Requirements

Section 5.3.41.5 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.6 Deferral

Section 5.3.41.6 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.7 Examination Technique

Section 5.3.41.7 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.8 Cast Stainless Steel

Section 5.3.41.8 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.9 Encoded Ultrasonic Examination

Section 5.3.41.9 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.10 Excavate and Weld Repair Cold Leg

Section 5.3.41.10 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.10 Cracked Excavate and Weld Repair

Section 5.3.41.10 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.41.11 Partial Arc Excavate and Weld Repair

Section 5.3.41.11 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.42 Removal of 10 CFR 50.55a(a)(1)(C)(52) and (53) Exclusion

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.43 Preservice Volumetric and Surface Examinations Acceptance

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.4.44 Steam Generator Nozzle-to-Component Welds and Reactor Vessel Nozzle-to-Component Welds

Section 0 discusses this condition. The staff estimates no incremental industry operation costs associated with this condition.

5.5 Total Industry Costs

Table 23 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 $3.64 million (7-percent NPV) and $4.16 million (3-percent NPV).

Table 23 Total Industry Costs

Attribute	Undiscounted	7% NPV	3% NPV
Implementation Costs:	($80,000)	($80,000)	($80,000)
Operation Costs:	$4,330,000	$3,720,000	$4,240,000
Total Industry Cost:	**$4,250,000**	**$3,640,000**	**$4,160,000**

Notes: Total costs are rounded to the nearest $10,000.
All values reported in 2018 dollars.

5.6 NRC Implementation

The NRC will incur implementation costs for the stages of the rulemaking process. These costs include final rulemaking changes and issuance of the final rule. Proposed rule costs are considered sunk costs at this stage of the rulemaking process. The staff estimates 4,026 hours for development of the final rule package. This results in a cost estimate ranging from ($510,000) using a 7-percent discount rate to ($520,000) using a 3-percent discount rate.

Table 24 NRC Implementation Costs

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2018	Develop and issue final rule	1	2013	$131	($263,638)	($263,638)	($263,638)
2019	Develop and issue final rule	1	2013	$131	($263,638)	($246,390)	($255,959)
				Total:	**($527,275)**	**($510,028)**	**($519,596)**

Note: All values reported in 2018 dollars.

5.6.1 Conditions on ASME OM Code

The staff estimates no incremental NRC implementation costs.

5.6.2 Reference for Motor-Operated Valve Testing

The staff estimates no incremental NRC implementation costs.

5.6.3 Reference and Outdated Condition Removal for Check Valves (Appendix II)

The staff estimates no incremental NRC implementation costs.

5.6.4 Subsection ISTE

The staff estimates no incremental NRC implementation costs.

5.6.5 Mandatory Appendix V and Subsection ISTF

The staff estimates no incremental NRC implementation costs.

5.6.6 Valve Position Indication Applicability Condition

The staff estimates no incremental NRC implementation costs.

5.6.7 Condition on Appendix IV on Air-Operated Valves

The staff estimates no incremental NRC implementation costs.

5.6.8 Condition to Relax Schedule for Inservice Testing Code: Initial 120-Month Interval

The staff estimates no incremental NRC implementation costs.

5.6.9 Condition to Relax Schedule for Inservice Testing Code: Successive 120-Month Intervals

The staff estimates no incremental NRC implementation costs.

5.6.10 Condition to Maintain Inservice Testing Reporting Requirements

The staff estimates no incremental NRC implementation costs.

5.6.11 Rules for Construction of Nuclear Facility Components—Division 1

The staff estimates no incremental NRC implementation costs.

5.6.12 Section III Condition: Weld Leg Dimensions

The staff estimates no incremental NRC implementation costs.

5.6.13 Section III Condition: Independence of Inspection

The staff estimates no incremental NRC implementation costs.

5.6.14 Section III Condition: Subsection NH

The staff estimates no incremental NRC implementation costs.

5.6.15 Section III Condition: Capacity Certification and Demonstration of Function of Incompressible Fluid Pressure Relief Valves

The staff estimates no incremental NRC implementation costs.

5.6.16 Section III Condition: Visual Examination of Bolts, Studs, and Nuts

The staff estimates no incremental NRC implementation costs.

5.6.17 Section III Condition: Certifying Engineer

The staff estimates no incremental NRC implementation costs.

5.6.18 Conditions on ASME BPV Code, Section XI

The staff estimates no incremental NRC implementation costs.

5.6.19 Augmented Inservice Inspection Requirements: Implementation of Appendix VIII to Section XI

The staff estimates no incremental NRC implementation costs.

5.6.20 Clarifying Condition on ASME BPV Code Section III

The staff estimates no incremental NRC implementation costs.

5.6.21 Appendix XXVI Conditions

5.6.21.1 Fusing Procedure Specification

The staff estimates no incremental NRC implementation costs.

5.6.21.2 Testing Fusing Procedures

The staff estimates no incremental NRC implementation costs.

5.6.21.3 Essential Variables for Qualifying Fusing Procedures of Electrofusion Joints in Polyethylene Piping

The staff estimates no incremental NRC implementation costs.

5.6.21.4 Qualifying Fusing Procedures for Electrofusion Joints in HDPE Piping

The staff estimates no incremental NRC implementation costs.

5.6.21.5 Prohibits the Use of Electrofusion Saddle Fittings and Electrofusion Saddle Joints in HDPE Piping

The staff estimates no incremental NRC implementation costs.

5.6.22 Condition on Effective Edition and Addenda of Subsections IWE and IWL

The staff estimates no incremental NRC implementation costs.

5.6.23 Section XI References to OM Part 4, OM Part 6, and OM Part 10 (Table IWA-1600-1)

The staff estimates no incremental NRC implementation costs.

5.6.24 Metal Containment Examinations

The staff estimates no incremental NRC implementation costs.

5.6.25 Reconciliation of Quality Requirements for Replacement Items

The staff estimates no incremental NRC implementation costs.

5.6.26 Nondestructive Examination Personnel Certification: Fourth Provision

The staff estimates no incremental NRC implementation costs.

5.6.27 Section XI Condition: System Leakage Tests: Second Provision

The staff estimates no incremental NRC implementation costs.

5.6.28 Section XI Condition: System Leakage Tests: Third Provision

The staff estimates no incremental NRC implementation costs.

5.6.29 Removal of Condition on Table IWB-2500-1 Examination Requirements

The staff estimates no incremental NRC implementation costs.

5.6.30 Section XI Condition: Table IWB-2500-1 Examination Requirements

The staff estimates no incremental NRC implementation costs.

5.6.31 Section XI Condition: Mitigation of Defects by Modification

The staff estimates no incremental NRC implementation costs.

5.6.31.1 Mitigation of Defects by Modification: First Provision

The staff estimates no incremental NRC implementation costs.

5.6.31.2 Mitigation of Defects by Modification: Second Provision

The staff estimates no incremental NRC implementation costs.

5.6.32 Clarification of Condition on Pressure Testing Class 1, 2, and 3 Mechanical Joints

The staff estimates that the removal of this condition results in no incremental NRC implementation costs.

5.6.33 Condition on Summary Report Submittal

The staff estimates no incremental NRC implementation costs associated with this clarification of requirements.

5.6.34 Condition To Correct Equation: Use of RT_{T0} in the K_{Ia} and K_{Ic} Equations

The staff estimates no incremental NRC implementation costs associated with this condition to correct the equation.

5.6.35 Condition on Fracture Toughness of Irradiated Materials

The staff estimates no incremental NRC implementation costs associated with this condition.

5.6.36 Cast Austenitic Stainless Steel Inspection Condition: ASME Code Section XI, Appendix III, Supplement 2

The staff estimates that this condition results in no incremental NRC implementation costs.

5.6.37 Section XI Condition: Nonmandatory Appendix U

The staff estimates no incremental NRC implementation costs.

5.6.38 Section XI Condition: Defect Removal

The staff estimates no incremental NRC implementation costs.

5.6.39 Section XI Condition: Prohibitions and Restriction on Use of IWB-3510.4(b)

The staff estimates no incremental NRC implementation costs.

5.6.40 ASME BPV Code Case N-729-6

5.6.40.1 Implementation

The staff estimates no incremental NRC implementation costs.

5.6.40.2 Appendix I Use

The staff estimates no incremental NRC implementation costs.

5.6.40.3 Surface Exam Acceptance Criteria

The staff estimates no incremental NRC implementation costs.

5.6.40.4 Peening

The staff estimates no incremental NRC implementation costs.

5.6.40.5 Baseline Examinations

The staff estimates no incremental NRC implementation costs.

5.6.40.6 Sister Plants

The staff estimates no incremental NRC implementation costs.

5.6.40.7 Volumetric Leak Path

The staff estimates no incremental NRC implementation costs.

5.6.41 ASME BPV Code Case N-770-5

The staff estimates no incremental NRC implementation costs.

5.6.41.1 Augmented Inservice Inspection Requirements: Examination Requirements for Class 1 Piping and Nozzle Dissimilar-Metal Butt Welds—(1) Implementation

The staff estimates no incremental NRC implementation costs.

5.6.41.2 Categorization

The staff estimates no incremental NRC implementation costs.

5.6.41.3 Baseline Examinations

The staff estimates no incremental NRC implementation costs.

5.6.41.4 Examination Coverage

The staff estimates no incremental NRC implementation costs.

5.6.41.5 Reporting Requirements

The staff estimates no incremental NRC implementation costs.

5.6.41.6 Deferral

The staff estimates no incremental NRC implementation costs.

5.6.41.7 Examination Technique

The staff estimates no incremental NRC implementation costs.

5.6.41.8 Cast Stainless Steel

The staff estimates no incremental NRC implementation costs.

5.6.41.9 Encoded Ultrasonic Examination

The staff estimates no incremental NRC implementation costs.

5.6.41.10 Excavate and Weld Repair Cold Leg

The staff estimates no incremental NRC implementation costs.

5.6.41.11 Cracked Excavate and Weld Repair

The staff estimates no incremental NRC implementation costs.

5.6.41.12 Partial Arc Excavate and Weld Repair

The staff estimates no incremental NRC implementation costs.

5.6.42 Removal of 10 CFR 50.55a(a)(1)(C)(52) and (53) Exclusion

The staff estimates no incremental NRC implementation costs.

5.6.43 Preservice Volumetric and Surface Examinations Acceptance

The staff estimates no incremental NRC implementation costs.

5.6.44 Steam Generator Nozzle-to-Component Welds and Reactor Vessel Nozzle-to-Component Welds

The staff estimates no incremental NRC implementation costs.

5.7 NRC Operation

When the NRC receives an alternative request, it requires additional staff time to evaluate the acceptability of the request relative to the criteria currently approved by the agency. Under Alternative 2, an additional 24 alternative request submittals per year are expected to not occur, as shown in Section 5.4. By incorporating by reference the ASME Code editions in the *Code of Federal Regulations*, a nuclear power plant licensee could use a more current ASME Code edition or addenda without submitting an alternative request for NRC review.

As shown in Table 25, 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 $1.96 million based on a 7-percent NPV to $2.11 million based on a 3-percent NPV. Therefore, this alternative would provide a net benefit (i.e., averted cost).

Table 25 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	24	242	$131	$746,094	$697,284	$724,363
2020	Review Code Case relief request submittal and issue safety evaluation	24	242	$131	$746,094	$651,668	$703,265
2021	Review Code Case relief request submittal and issue safety evaluation	24	242	$131	$746,094	$609,035	$682,782
				Total:	**$2,238,282**	**$1,957,987**	**$2,110,410**

Note: All values reported in 2018 dollars.

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

5.7.1 Conditions on ASME OM Code

The staff estimates no incremental NRC operation costs.

5.7.2 Reference for Motor-Operated Valve Testing

The staff estimates no incremental NRC operation costs.

5.7.3 Reference and Outdated Condition Removal for Check Valves (Appendix II)

The staff estimates no incremental NRC operation costs.

5.7.4 Subsection ISTE

The staff estimates no incremental NRC operation costs.

5.7.5 Mandatory Appendix V and Subsection ISTF

The staff estimates no incremental NRC operation costs.

5.7.6 Valve Position Indication Applicability Condition

The staff estimates no incremental NRC operation costs.

5.7.7 Condition on Appendix IV on Air-Operated Valves

The staff estimates no incremental NRC operation costs.

5.7.8 Condition to Relax Schedule for Inservice Testing Code: Initial 120-Month Interval

The staff estimates no incremental NRC operation costs.

5.7.9 Condition to Relax Schedule for Inservice Testing Code: Successive 120-Month Intervals

The staff estimates no incremental NRC operation costs.

5.7.10 Condition to Maintain Inservice Testing Reporting Requirements

The staff estimates no incremental NRC operation costs.

5.7.11 Rules for Construction of Nuclear Facility Components—Division 1

The staff estimates no incremental NRC operation costs.

5.7.12 Section III Condition: Weld Leg Dimensions

The staff estimates no incremental NRC operation costs.

5.7.13 Section III Condition: Independence of Inspection

The staff estimates no incremental NRC operation costs.

5.7.14 Section III Condition: Subsection NH

The staff estimates no incremental NRC operation costs.

5.7.15 Section III Condition: Capacity Certification and Demonstration of Function of Incompressible Fluid Pressure Relief Valves

The staff estimates no incremental NRC operation costs.

5.7.16 Section III Condition: Visual Examination of Bolts, Studs, and Nuts

The staff estimates no incremental NRC operation costs.

5.7.17 Section III Condition: Certifying Engineer

The staff estimates no incremental NRC operation costs.

5.7.18 Conditions on ASME BPV Code, Section XI

The staff estimates no incremental NRC operation costs.

5.7.19 Augmented Inservice Inspection Requirements: Implementation of Appendix VIII to Section XI

The staff estimates no incremental NRC operation costs.

5.7.20 Clarifying Condition on ASME BPV Code Section III

The staff estimates no incremental NRC operation costs.

5.7.21 Appendix XXVI Conditions

5.7.21.1 Fusing Procedure Specification

The staff estimates no incremental NRC operation costs.

5.7.21.2 Testing Fusing Procedures

The staff estimates no incremental NRC operation costs.

5.7.21.3 Essential Variables for Qualifying Fusing Procedures of Electrofusion Joints in Polyethylene Piping

The staff estimates no incremental NRC operation costs.

5.7.21.4 Qualifying Fusing Procedures for Electrofusion Joints in HDPE Piping

The staff estimates no incremental NRC operation costs.

5.7.21.5 Prohibits the Use of Electrofusion Saddle Fittings and Electrofusion Saddle Joints in HDPE Piping

The staff estimates no incremental NRC operation costs.

5.7.22 Condition on Effective Edition and Addenda of Subsections IWE and IWL

The staff estimates no incremental NRC operation costs.

5.7.23 Section XI References to OM Part 4, OM Part 6, and OM Part 10 (Table IWA-1600-1)

The staff estimates no incremental NRC operation costs.

5.7.24 Metal Containment Examinations

The staff estimates no incremental NRC operation costs.

5.7.25 Reconciliation of Quality Requirements for Replacement Items

The staff estimates no incremental NRC operation costs.

5.7.26 Nondestructive Examination Personnel Certification: Fourth Provision

The staff estimates no incremental NRC operation costs.

5.7.27 Section XI Condition: System Leakage Tests: Second Provision

The staff estimates no incremental NRC operation costs.

5.7.28 Section XI Condition: System Leakage Tests: Third Provision

The staff estimates no incremental NRC operation costs.

5.7.29 Removal of Condition on Table IWB-2500-1 Examination Requirements

The staff estimates that there would be averted NRC operation costs resulting from the removal of the condition because licensees will no longer need to submit relief requests for pressurizer weld inspections. As shown in Table 26, review of each relief request takes approximately 115 hours and the estimated number of relief requests is 64 in 2020, 55 in 2030, and 32 in 2040. The basis for the estimated number of relief requests is the number of operating PWR units at the inspection intervals. This results in averted costs to the NRC of $1.29 million using a 7-percent discount rate and $1.71 million using a 3-percent discount rate.

Table 26 Costs of Averted Pressurizer Inspection Relief Requests

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2020	Review CASS Inspection relief requests (averted)	62	115	$131	$934,030	$815,818	$880,413
2030	Review CASS Inspection relief requests (averted)	55	115	$131	$828,575	$367,897	$581,146
2040	Review CASS Inspection relief requests (averted)	32	115	$131	$482,080	$108,812	$251,594
				Total:	**$2,244,685**	**$1,292,527**	**$1,713,153**

Note: All values reported in 2018 dollars.

5.7.30 Section XI Condition: Table IWB-2500-1 Examination Requirements

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.31 Section XI Condition: Mitigation of Defects by Modification

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.31.1 Mitigation of Defects by Modification: First Provision

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.31.2 Mitigation of Defects by Modification: Second Provision

The staff estimates that the NRC would incur operation costs associated with reviewing and approving relief requests because of these conditions. The estimated costs range from ($194,000) using a 7-percent discount rate to ($280,000) using a 3-percent discount rate.

Table 27 Costs of IWA-4340 Relief Request Review

Year	Activity	Number of Instances	Per Instance		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Relief request review	1	115	$131	($17,576)	($16,426)	($17,064)
2020	Relief request review	1	115	$131	($17,576)	($15,351)	($16,567)
2021	Relief request review	1	115	$131	($17,576)	($14,347)	($16,084)
2022	Relief request review	1	115	$131	($17,576)	($13,409)	($15,616)
2023	Relief request review	1	115	$131	($17,576)	($12,531)	($15,161)
2024	Relief request review	1	115	$131	($17,576)	($11,712)	($14,719)
2025	Relief request review	1	115	$131	($17,576)	($10,945)	($14,291)
2026	Relief request review	1	115	$131	($17,576)	($10,229)	($13,875)
2027	Relief request review	1	115	$131	($17,576)	($9,560)	($13,470)
2028	Relief request review	1	115	$131	($17,576)	($8,935)	($13,078)
2029	Relief request review	1	115	$131	($17,576)	($8,350)	($12,697)
2030	Relief request review	1	115	$131	($17,576)	($7,804)	($12,327)
2031	Relief request review	1	115	$131	($17,576)	($7,293)	($11,968)
2032	Relief request review	1	115	$131	($17,576)	($6,816)	($11,620)
2033	Relief request review	1	115	$131	($17,576)	($6,370)	($11,281)
2034	Relief request review	1	115	$131	($17,576)	($5,954)	($10,953)
2035	Relief request review	1	115	$131	($17,576)	($5,564)	($10,634)
2036	Relief request review	1	115	$131	($17,576)	($5,200)	($10,324)
2037	Relief request review	1	115	$131	($17,576)	($4,860)	($10,023)
2038	Relief request review	1	115	$131	($17,576)	($4,542)	($9,731)
2039	Relief request review	1	115	$131	($17,576)	($4,245)	($9,448)
2040	Relief request review	1	115	$131	($17,576)	($3,967)	($9,173)
				Total:	**($386,668)**	**($194,411)**	**($280,105)**

Note: All values reported in 2018 dollars.

5.7.32 Clarification of Condition on Pressure Testing Class 1, 2, and 3 Mechanical Joints

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.33 Condition on Summary Report Submittal

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.34 Condition To Correct Equation: Use of RT_{T0} in the K_{Ia} and K_{Ic} Equations

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.35 Condition on Fracture Toughness of Irradiated Materials

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.36 Cast Austenitic Stainless Steel Inspection Condition: ASME Code Section XI, Appendix III, Supplement 2

As discussed in Section 0, this condition is a continuation of the condition for Code Case N-824, applied to the 2015 and 2017 Editions of the ASME BPV Code, and would result in incremental NRC operation costs, which extend beyond the expected lifetime of the Code Case (6 years) to the term of the operating licenses.

This regulatory analysis estimates that the total averted costs for this condition begin in 2030, which is a continuation of the cost estimate of the ASME 2009–2013 Final Rule regulatory analysis of Code Case N-824. As Table 28 shows, the estimated averted costs for this condition range from $265,000 (7-percent NPV) to $466,000 (3-percent NPV).

Table 28 Costs of Averted CASS Weld Relief Requests

Year	Activity	Number of Actions	Hours	Weighted Hourly rate	Cost		
					Undiscounted	7% NPV	3% NPV
2030	Review CASS Inspection relief requests (averted)	30	115	$131	$451,950	$200,671	$316,989
2040	Review CASS Inspection relief requests (averted)	19	115	$131	$286,235	$64,607	$149,384
				Total:	**$738,185**	**$265,278**	**$466,373**

Note: All values reported in 2018 dollars.

5.7.37 Section XI Condition: Nonmandatory Appendix U

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.38 Section XI Condition: Defect Removal

The staff estimates that the NRC would incur operating costs to review and approve the relief requests submitted by industry associated with this condition. As Table 29 shows, the estimated cost to review and approve these relief requests ranges from ($194,000) using a 7-percent discount rate to ($280,000) using a 3-percent discount rate.

Table 29 IWA-4421 Relief Request Review Costs

Year	Activity	Number of Instances	Per Instance		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Relief request review	1	115	$131	($17,576)	($16,426)	($17,064)
2020	Relief request review	1	115	$131	($17,576)	($15,351)	($16,567)
2021	Relief request review	1	115	$131	($17,576)	($14,347)	($16,084)
2022	Relief request review	1	115	$131	($17,576)	($13,409)	($15,616)
2023	Relief request review	1	115	$131	($17,576)	($12,531)	($15,161)
2024	Relief request review	1	115	$131	($17,576)	($11,712)	($14,719)
2025	Relief request review	1	115	$131	($17,576)	($10,945)	($14,291)
2026	Relief request review	1	115	$131	($17,576)	($10,229)	($13,875)
2027	Relief request review	1	115	$131	($17,576)	($9,560)	($13,470)
2028	Relief request review	1	115	$131	($17,576)	($8,935)	($13,078)
2029	Relief request review	1	115	$131	($17,576)	($8,350)	($12,697)
2030	Relief request review	1	115	$131	($17,576)	($7,804)	($12,327)
2031	Relief request review	1	115	$131	($17,576)	($7,293)	($11,968)
2032	Relief request review	1	115	$131	($17,576)	($6,816)	($11,620)
2033	Relief request review	1	115	$131	($17,576)	($6,370)	($11,281)
2034	Relief request review	1	115	$131	($17,576)	($5,954)	($10,953)
2035	Relief request review	1	115	$131	($17,576)	($5,564)	($10,634)
2036	Relief request review	1	115	$131	($17,576)	($5,200)	($10,324)
2037	Relief request review	1	115	$131	($17,576)	($4,860)	($10,023)
2038	Relief request review	1	115	$131	($17,576)	($4,542)	($9,731)
2039	Relief request review	1	115	$131	($17,576)	($4,245)	($9,448)
2040	Relief request review	1	115	$131	($17,576)	($3,967)	($9,173)
				Total:	**($386,668)**	**($194,411)**	**($280,105)**

Note: All values reported in 2018 dollars.

5.7.39 Section XI Condition: Prohibitions and Restriction on Use of IWB-3510.4(b)

The staff estimates no incremental NRC operation costs associated with this activity.

5.7.40 ASME BPV Code Case N-729-6

5.7.40.1 Implementation

The staff estimates no incremental NRC operation costs.

5.7.40.2 Appendix I Use

The staff estimates no incremental NRC operation costs.

5.7.40.3 Surface Exam Acceptance Criteria

The staff estimates no incremental NRC operation costs.

5.7.40.4 Peening

The staff estimates no incremental NRC operation costs.

5.7.40.5 Baseline Examinations

The staff estimates no incremental NRC operation costs.

5.7.40.6 Sister Plants

The staff estimates no incremental NRC operation costs.

5.7.40.7 Volumetric Leak Path

Section 0 discusses this condition. The NRC estimates that it will review one fewer relief request per year as a result of this condition. As Table 30 shows, this results in averted costs ranging from $194,000 (7-percent NPV) to $280,000 (3-percent NPV).

Table 30 N-729-6 Relief Request Review Costs

Year	Activity	Number of Instances	Per Instance		Cost		
			Labor Hours	Weighted Hourly rate	Undiscounted	7% NPV	3% NPV
2019	Relief request review	1	115	$131	$17,576	$16,426	$17,064
2020	Relief request review	1	115	$131	$17,576	$15,351	$16,567
2021	Relief request review	1	115	$131	$17,576	$14,347	$16,084
2022	Relief request review	1	115	$131	$17,576	$13,409	$15,616
2023	Relief request review	1	115	$131	$17,576	$12,531	$15,161
2024	Relief request review	1	115	$131	$17,576	$11,712	$14,719
2025	Relief request review	1	115	$131	$17,576	$10,945	$14,291
2026	Relief request review	1	115	$131	$17,576	$10,229	$13,875
2027	Relief request review	1	115	$131	$17,576	$9,560	$13,470
2028	Relief request review	1	115	$131	$17,576	$8,935	$13,078
2029	Relief request review	1	115	$131	$17,576	$8,350	$12,697
2030	Relief request review	1	115	$131	$17,576	$7,804	$12,327
2031	Relief request review	1	115	$131	$17,576	$7,293	$11,968
2032	Relief request review	1	115	$131	$17,576	$6,816	$11,620
2033	Relief request review	1	115	$131	$17,576	$6,370	$11,281
2034	Relief request review	1	115	$131	$17,576	$5,954	$10,953
2035	Relief request review	1	115	$131	$17,576	$5,564	$10,634
2036	Relief request review	1	115	$131	$17,576	$5,200	$10,324
2037	Relief request review	1	115	$131	$17,576	$4,860	$10,023
2038	Relief request review	1	115	$131	$17,576	$4,542	$9,731
2039	Relief request review	1	115	$131	$17,576	$4,245	$9,448
2040	Relief request review	1	115	$131	$17,576	$3,967	$9,173
				Total:	**$386,668**	**$194,411**	**$280,105**

Note: All values reported in 2018 dollars.

5.7.41 ASME BPV Code Case N-770-5

5.7.41.1 Augmented Inservice Inspection Requirements: Examination Requirements for Class 1 Piping and Nozzle Dissimilar-Metal Butt Welds—(1) Implementation

The staff estimates no incremental NRC operation costs.

5.7.41.2 Categorization

The staff estimates no incremental NRC operation costs.

5.7.41.3 Baseline Examinations

The staff estimates no incremental NRC operation costs.

5.7.41.4 Examination Coverage

The staff estimates no incremental NRC operation costs.

5.7.41.5 Reporting Requirements

The staff estimates no incremental NRC operation costs.

5.7.41.6 Deferral

The staff estimates no incremental NRC operation costs.

5.7.41.7 Examination Technique

The staff estimates no incremental NRC operation costs.

5.7.41.8 Cast Stainless Steel

The staff estimates no incremental NRC operation costs.

5.7.41.9 Encoded Ultrasonic Examination

The staff estimates no incremental NRC operation costs.

5.7.41.10 Excavate and Weld Repair Cold Leg

The staff estimates no incremental NRC operation costs.

5.7.41.11 Cracked Excavate and Weld Repair

The staff estimates no incremental NRC operation costs.

5.7.41.12 Partial Arc Excavate and Weld Repair

The staff estimates no incremental NRC operation costs.

5.7.42 Removal of 10 CFR 50.55a(a)(1)(C)(52) and (53) Exclusion

The staff estimates no incremental NRC operation costs.

5.7.43 Preservice Volumetric and Surface Examinations Acceptance

The staff estimates no incremental NRC operation costs.

5.7.44 Steam Generator Nozzle-to-Component Welds and Reactor Vessel Nozzle-to-Component Welds

The staff estimates no incremental NRC operation costs.

5.8 Total NRC Costs

Table 31 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 $2.81 million (7-percent NPV) to $3.49 million (3-percent NPV).

Table 31 Total NRC Costs

Attribute	NRC Costs		
	Undiscounted	7% NPV	3% NPV
Total NRC Implementation Cost:	($530,000)	($510,000)	($520,000)
Total NRC Operation Cost:	$4,830,000	$3,320,000	$4,010,000
Total NRC Cost:	$4,300,000	$2,810,000	$3,490,000

Note: All values reported in 2018 dollars.

5.9 Total Costs

Table 32 shows the total averted costs (benefits/savings) broken down between implementation and operation, for industry and the NRC, for Alternative 2. These total averted costs are estimated to range from $6.45 million (7-percent NPV) to $7.65 million (3-percent NPV).

Table 32 Total Costs

Attribute	Total Averted Costs (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation	($80,000)	($80,000)	($80,000)
Industry Operation	$4,330,000	$3,720,000	$4,240,000
Total Industry Cost	*$4,250,000*	*$3,640,000*	*$4,160,000*
NRC Implementation	($530,000)	($510,000)	($520,000)
NRC Operation	$4,830,000	$3,320,000	$4,010,000
Total NRC Cost	*$4,300,000*	*$2,810,000*	*$3,490,000*
Net	***$8,550,000***	***$6,450,000***	***$7,650,000***

Note: All values reported in 2018 dollars.

5.10 Improvements in Knowledge

Compared to the regulatory baseline (Alternative 1), Alternative 2 would improve knowledge by allowing the industry and the staff to gain experience with new technology and by permitting licensees to use advances in ISI and IST. Improved ISI and IST may lead to the earlier identification of material degradation that, if undetected, could result in further degradation that eventually causes 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 staff to produce desired on-the-job results, which lead to pride in performance and increased job satisfaction.

5.11 Regulatory Efficiency

Compared 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 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 many requests for alternatives to use more current editions or addenda of the ASME Codes 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*.

5.12 Other Considerations

5.12.1 National Technology Transfer and Advancement Act of 1995

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

5.12.2 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:

- the 2015 and 2017 Editions of the ASME BPV Code, Section III, Division 1, and ASME BPV Code, Section XI, Division 1, with conditions on their use

- the 2015 Edition and 2017 Editions to Division 1 of the ASME OM Code, with conditions on their use

5.12.3 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.

5.12.4 *Reliable Assessment of Cast Austenitic Stainless Steel Materials*

The ability to reliably assess CASS materials is important for life extension and license renewal activities. There remains a level of concern about 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 of assessment, which is constrained by a lack of data, operating experience, and proven NDE solutions.

5.13 Uncertainty Analysis

The staff completed a Monte Carlo sensitivity analysis for this regulatory analysis using the specialty software @Risk[9]. The Monte Carlo approach answers the question, "What distribution of net benefits results from multiple draws of the probability distribution assigned to key variables?"

5.13.1 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 staff provides the following analysis of the variables that have the greatest uncertainty. To perform this analysis, the staff employed a Monte Carlo simulation analysis using the @Risk software program.

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 staff's professional judgment. When defining the probability distributions for use in a Monte Carlo simulation, summary statistics are needed to characterize the distributions. These summary statistics include the minimum, most likely, and maximum values of a program evaluation and review technique (PERT) distribution[10]; the

---

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

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

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

Table 33 identifies the data elements, the distribution and summary statistic, and the mean value of the distribution used in the uncertainty analysis.

Table 33 Uncertainty Analysis Variables

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Steam Generator and Pressurizer Weld Inspection Condition Removal					
Procedure Revision to Incorporate the removal of the condition					
Weighted hourly rate for procedure update	$103.49	PERT	$79.76	$103.57	$126.85
Hours to update steam generators and pressurizer inspection procedures	23.0	PERT	18	20	40
Number of sites	34				
Averted Steam Generator Inspections					
Weighted hourly rate for inspection	$110.82	PERT	$87.64	$110.92	$133.60
Hours to inspect steam generators	9.2	PERT	7.2	8	16
Number of steam generators per PWR	3.0	PERT	2	3	4
Inspections per steam generator	2.0	PERT	2	2	2
Number of PWRs	62				
Averted Pressurizer Inspection Relief Requests					
Weighted hourly rate for relief request	$121.73	PERT	$96.74	$121.53	$147.48
Hours to generate relief request	172.5	PERT	135	150	300
Number of pressurizers per PWR	1.0	PERT	1	1	1
Relief requests per pressurizer	1.0	PERT	1	1	1
Number of PWRs	62				

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
CASS Inspection Mandatory Condition					
Procedure Revision To Incorporate the CASS Ultrasonic Examination Provisions					
Weighted hourly rate for procedure update	$103.49	PERT	$79.76	$103.57	$126.85
Hours to update CASS inspection procedures	69.0	PERT	54	60	120
Number of sites	34				
Weld Exam Relief Requests (10-year recurring exam)					
Hourly rate for technical staff	$121.73	PERT	$96.74	$121.53	$147.48
Hours for relief requests	345.0	PERT	270	300.0	600
Number of sites	34				
Weld Exam Costs (10-year recurring exam)					
Hourly rate for technical staff	$103.49	PERT	$79.76	$103.57	$126.85
Hours for weld exams	34.5	PERT	27	30.0	60
Number of units	62				
Weld Exam Dose Costs (10-year recurring exam)					
Current and 2014 dollar per person-rem conversion factor	$2,000	PERT	$3,100	$5,200	$7,700
2018 dollar per person-rem conversion factor	$5,850	PERT	$3,400	$5,800	$8,500
Radiation field (rem/hour) for weld exams	0.033	PERT	0.007	0.025	0.090
Number of hours	316.9	PERT	236	278	555
Averted Code Case Relief Request Costs (including IWA-4340, IWA-4421, and N-729-6)					
Weighted hourly rate for relief request (engineer)	$121.73	PERT	$96.74	$121.53	$147.48
Relief request preparation and submission (hours)	380.0	PERT	100	380	660
Number of sites	24				
NRC Development and Issuance of Final Rule					
Hourly rate for the NRC	$131.00	PERT	$131.00	$131.00	$131.00
Hours to develop	4025.0	PERT	3150	3500	7000
Number of years	2.0	PERT	2	2	2
NRC Development and Issuance of Final Regulatory Guide Changes					
Hourly rate for the NRC	$131.00	PERT	$131.00	$131.00	$131.00
Hours to develop	920.0	PERT	720	800	1600
Number of years	1.0	PERT	1	1	1

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
NRC Relief Request Review (including IWA-4340, IWA-4421, and N-729-6)					
Hourly rate for the NRC	$131.00	PERT	$131.00	$131.00	$131.00
Hours to review	241.5	PERT	189	210	420
Number of actions	23.6	PERT	16.5	22.5	35.0
NRC Review of CASS Weld Exam Relief Requests (10-year recurring exam)					
Hourly Rate for the NRC	$131.00	PERT	$131.00	$131.00	$131.00
Hours for relief requests	115.0	PERT	90	100.0	200
Number of sites	34				
NRC Review of Pressurizer Inspection Relief Requests Averted Cost (10-year recurring exam)					
Hourly rate for the NRC	$131.00	PERT	$131.00	$131.00	$131.00
Hours for relief requests	115.0	PERT	90	100.0	200
Number of sites	34				
Buried Piping Condition: Specified Fusing Procedure					
Cost per site for fusing procedures	$11,500	PERT	$9,000	$10,000	$20,000
Number of sites	17				
Buried Piping Condition: Bend Testing					
Cost per site for bend testing	$11,500	PERT	$9,000	$10,000	$20,000
Number of sites	17				
IWA-4340 Wall Thickness Measurements					
Install Scaffolding					
Weighted hourly rate	$103.49	PERT	$79.76	$103.57	$126.85
Installation time (hours)	8.0	PERT	7	8	9
Number of workers	3.0	PERT	3	3	3
Number per year	10.0	PERT	9	10	11
Evaluate and Document					
Weighted hourly rate (technician)	$110.82	PERT	$87.64	$110.92	$133.60
Evaluation time	4.0	PERT	3	4	5
Number of workers	2.0	PERT	2	2	2
Number per year	10.0	PERT	9	10	11
HDPE Additional Joint Test Costs (Industry)					
Weighted hourly rate for testing (technician)	$110.82	PERT	$87.64	$110.92	$133.60
Test length (hours)	3.1	PERT	2.5	3	4
Number of joints	20.0	PERT	18	19	26

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
HDPE Manufacture Fitting Costs (Industry)					
Weighted hourly rate for manufacture (technician)	$110.82	PERT	$87.64	$110.92	$133.60
Work time (hours)	3.8	PERT	1	3	10
Number of joints	20.0	PERT	18	19	26

Note: All values reported in 2018 dollars.

5.13.1 Uncertainty Analysis Results

The NRC staff performed the Monte Carlo simulation by repeatedly recalculating the results 10,000 times. For each iteration, the values in Table 33 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 values were used to define the resultant probability distribution.

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

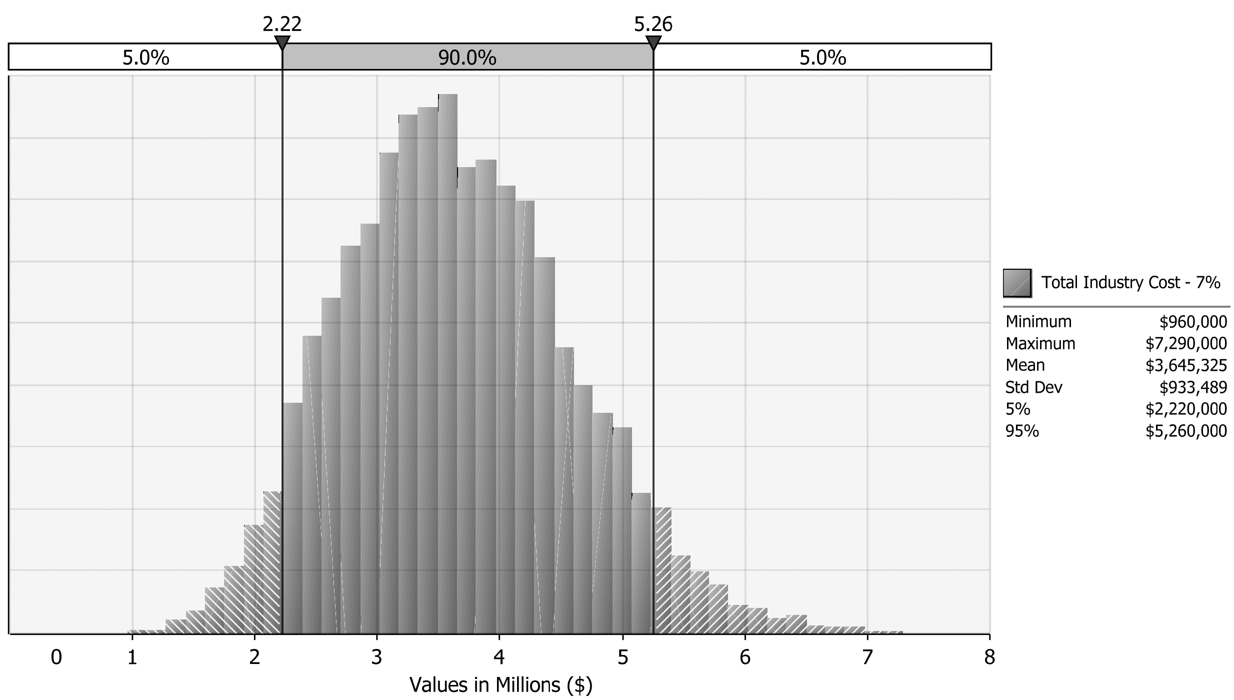

Figure 1 Total Industry Costs (7-Percent NPV)—Alternative 2

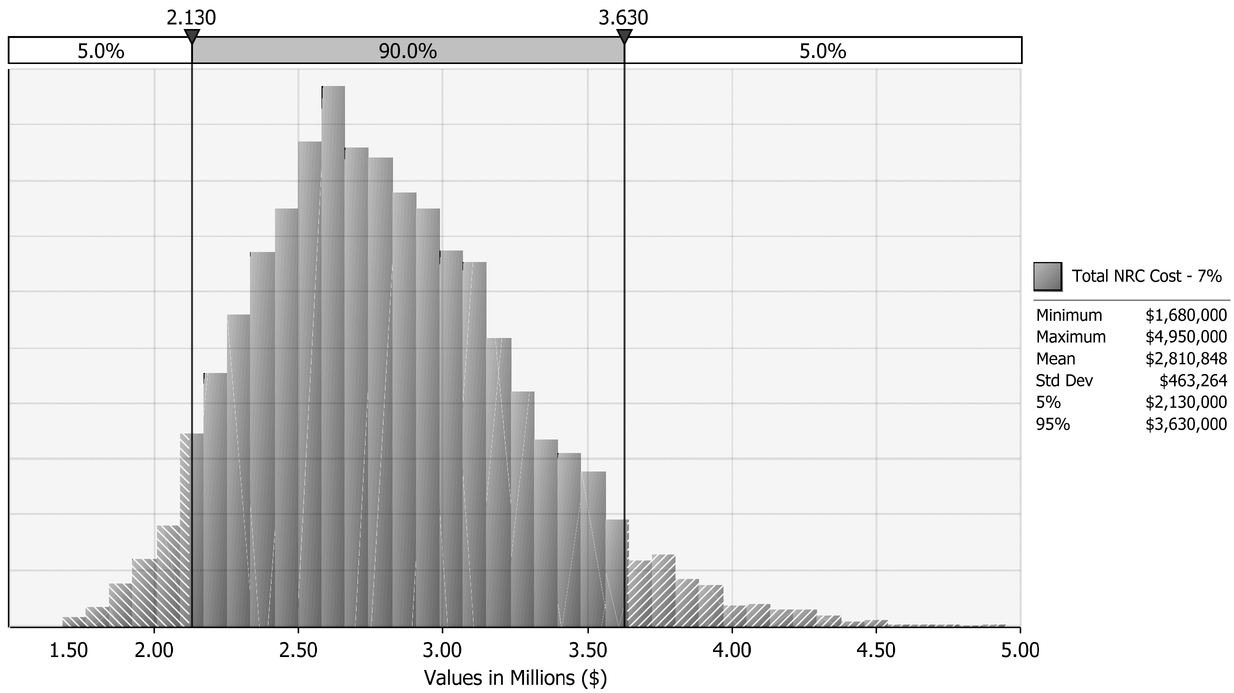

Figure 2 Total NRC Costs (7-Percent NPV)—Alternative 2

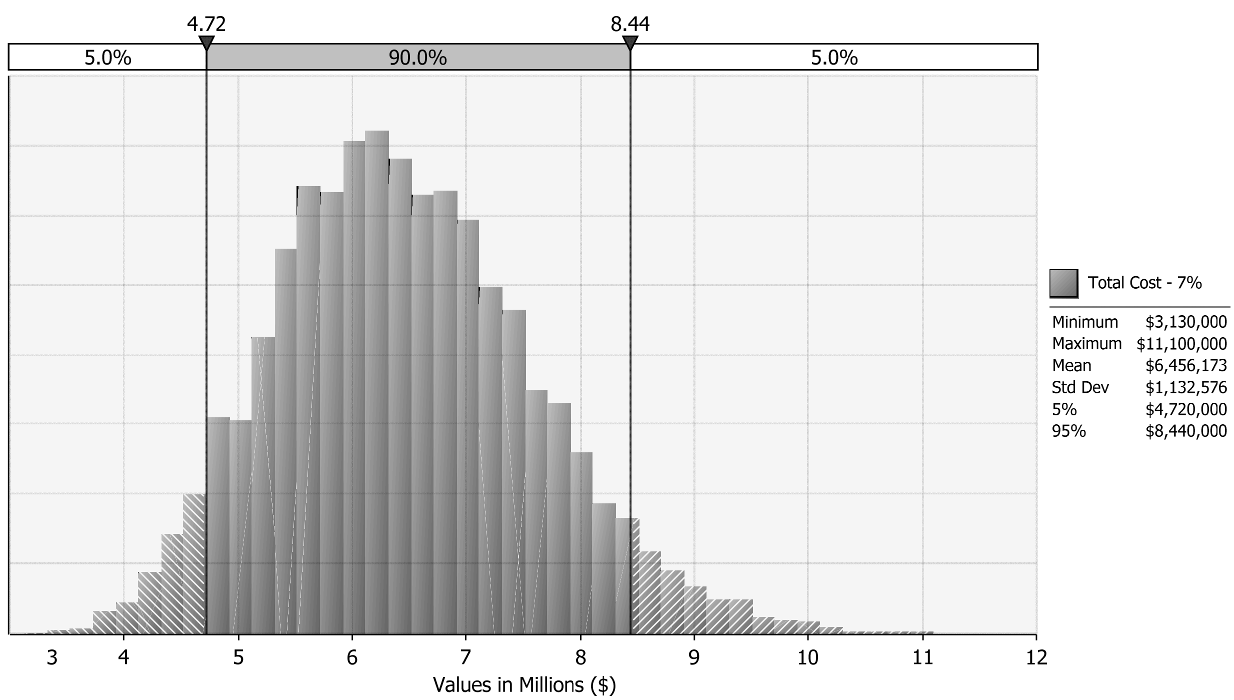

Figure 3 Total Costs (7-Percent NPV)—Alternative 2

Table 34 presents descriptive statistics on the uncertainty analysis. The 5-percent and 95-percent values (labeling the bands to either side of the 90% band) that appear as numerical values on the top of the vertical lines in Figure 1, 2, and 3 are reflected in Table 34 (rounded) as the 0.05 and 0.95 values, respectively.

Table 34 Uncertainty Results Descriptive Statistics (7-Percent NPV)

Uncertainty Result	Incremental Cost-Benefit (2018 million dollars)					
	Min	Mean	Std Dev	Max	0.05	0.95
Total Industry Cost	$0.96	$3.65	$0.933	$7.29	$2.22	$5.26
Total NRC Cost	$1.68	$2.81	$0.463	$4.95	$2.13	$3.63
Total Cost	$3.13	$6.46	$1.13	$11.1	$4.72	$8.44

Examining the range of the resulting output distribution shown in Table 34, it is possible to more confidently discuss the potential incremental costs and benefits of the proposed rule. This table displays the key statistical results, including the 90-percent confidence interval in which the net benefits would fall between the 5th and 95th percentile values.

Figure 4 shows a tornado diagram that identifies the key variables with uncertainty driving the largest impact on total costs (and averted costs) for this proposed rule. This figure ranks the variables based on their contribution to cost uncertainty. Two key variables—the number of hours required for Code relief request preparation and submission and the number of Code Case relief requests—drive the most uncertainty in the costs. The remaining key variables show diminishing variation.

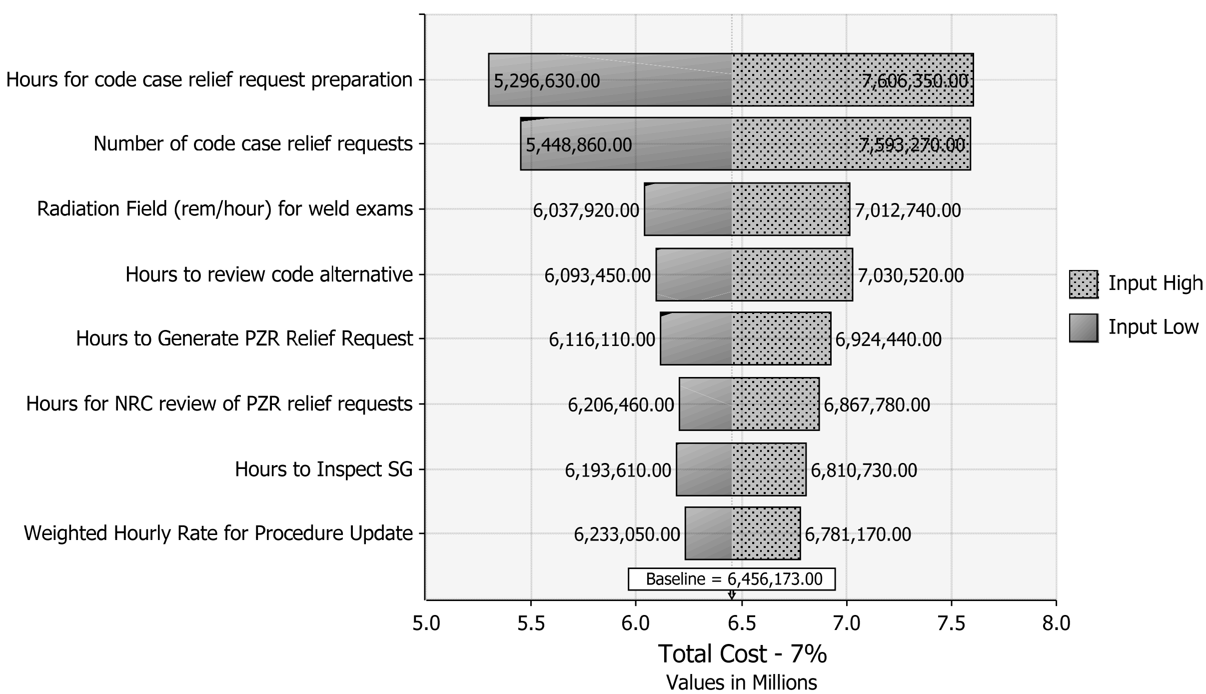

Figure 4 Top 10 Variables for which Uncertainty Drives the Largest Impact on Total Costs (7-Percent NPV)—Alternative 2

5.13.2 *Summary of Uncertainty Analysis*

The simulation analysis shows that the estimated mean benefit (i.e., positive averted costs or savings) for this proposed rule is $6.46 million with a 90-percent confidence interval that the benefit is between $4.72 million and $8.44 million using a 7-percent discount rate, and that the proposed rule is cost beneficial in all simulations. A reasonable inference from the uncertainty analysis is that proceeding with the proposed rule represents an efficient use of resources and averted costs for the NRC and the industry. The rule is also deemed cost beneficial to the industry and to the NRC when they are considered separately.

5.14 Disaggregation

To comply with the guidance in Section 4.3.2, “Criteria for the Treatment of Individual Requirements,” of the NRC Regulatory Analysis Guidelines (NRC, 2017c), the NRC performed a screening review to determine whether any of the individual requirements (or set of integrated requirements) of the proposed rule would be unnecessary to achieve the objectives of the rulemaking. The NRC determined that the objectives of the rulemaking are to incorporate standards by reference; 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 proposed rule would be necessary to achieve one or more objectives of the rulemaking. Table 35 shows the results of this screening review.

Table 35 Disaggregation

Regulatory Goals for Proposed Rule	**(1) Approve Use of the New Code Edition**	**(2) Make IBR Conforming Changes**
2015 Edition of ASME BPV Code	X	X
2017 Edition of ASME BPV Code	X	X
2015 Edition of ASME OM Code	X	X
2017 Edition of ASME OM Code	X	X

Table 36 shows the estimated costs and averted costs to industry, the NRC, and the total for each of the provisions in this proposed rule for which the staff has calculated quantitative costs and benefits. While the proposed rule itself is cost beneficial, the conditions placed on the Section XI system leakage tests, the mitigation of defects by modification, and the Section XI condition on defect removal have notable costs and may warrant further consideration.

Table 36   Costs by Provision

Provision	Industry Averted Cost (Cost) 7% NPV	NRC Averted Cost (Cost) 7% NPV	Total Averted Cost (Cost) 7% NPV
Code Case Relief Requests Averted by Rulemaking	$2,431,410	$1,957,987	$4,389,396
Appendix XXVI Conditions on HDPE	($238,154)	$0	($238,154)
Section XI Condition: System Leakage Tests: Third Provision	($1,304,203)	$0	($1,304,203)
Removal of Condition on Table IWB-2500-1 Examination Requirements	$2,942,317	$1,292,527	$4,234,844
Mitigation of Defects by Modification: Second Provision	($684,456)	($194,411)	($878,867)
Cast Austenitic Stainless Steel Inspection Condition: ASME Code Section XI Appendix III Supplement 2	$497,279	$265,278	$762,557
Section XI Condition: Defect Removal	($506,976)	($194,411)	($701,387)
ASME BPV Code Case N-729-6	$506,976	$194,411	$701,387

5.15 Summary

This regulatory analysis identified both quantifiable and nonquantifiable costs and benefits that would result from incorporating NRC-approved ASME BPV and OM Code editions by reference into the *Code of Federal Regulations*. Although quantifiable costs and benefits appear to be more tangible, the staff urges decisionmakers not to discount costs and benefits that 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 32 above, 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 $6.45 million (7-percent NPV) to $7.65 million (3-percent NPV). The average net averted cost estimated for each reactor unit (based on 96 operating reactor units) ranges from approximately $37,900 (7-percent NPV) to $43,300 (3-percent NPV). Table 32 also shows that Alternative 2 would be cost beneficial for the NRC and the industry when they are considered separately.

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. These benefits are summarized below.

5.15.2.1 Advances in Inservice Inspection and Inservice Testing

Advances in ISI and IST may incrementally decrease the likelihood of a radiological accident, the likelihood of 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 lead to the earlier identification of material degradation that, if undetected, could cause 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 advances 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 lead to further degradation that eventually causes a plant transient. For this reason, Alternative 2 would maintain the same level of safety, or provide an incremental improvement in safety, which may result in an incremental decrease in public health radiation exposures, when compared to the regulatory baseline.

5.15.2.3 Improvements in Inservice Inspection and Inservice Testing Knowledge

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

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

Alternative 2 is consistent with the provisions of the NTTAA and its implementing guidance in OMB Circular A-119 (OMB, 2016), which encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry.

5.15.2.5 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.

5.15.2.6 Increased Public Confidence

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

The timely IBR 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 remains incorporated by reference in the *Code of Federal Regulations*.

5.15.2.7 Increased Cast Austenitic Stainless Steel Material Component Reliability

The ability to reliably assess CASS materials is important for life extension and license renewal activities. There remains a 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 of assessment, which is constrained by a lack of data, operating experience, and proven NDE solutions.

5.15.3 Nonquantified Costs

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

5.16 Safety Goal Evaluation

The proposed rule alternative would allow licensees and applicants to apply the most recent ASME BPV and OM Code editions and addenda and NRC-approved Code Cases, sometimes with NRC-specified conditions. The NRC's safety goal evaluation applies only to regulatory initiatives considered to be generic safety enhancement backfits subject to the substantial additional protection standard at 10 CFR 50.109(a)(3). The NRC does not regard the IBR of ASME Code editions and addenda and NRC-approved Code Cases to be backfitting or to represent an inconsistency with any issue finality provisions in 10 CFR Part 52. The basis for this determination is presented in the proposed rule published in the *Federal Register*. Based on the reasons described, a safety goal evaluation is not appropriate for this regulatory analysis.

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

The IBR of more recent editions and addenda of Section III of the ASME BPV Code does not affect a plant that has received a construction permit or an operating license or a design that has been approved. This is because the edition and addenda to be used in constructing a plant are, under 10 CFR 50.55a, determined based on the date of the construction permit and are not changed thereafter, except voluntarily by the licensee. The IBR of more recent editions and addenda of Section III ordinarily applies only to applicants after the effective date of the final rule incorporating these new editions and addenda. Thus, IBR of a more recent edition and addenda of Section III does not constitute "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

The IBR of more recent editions and addenda of Section XI of the ASME BPV Code and the ASME OM Code affects the ISI and IST programs of operating reactors. However, the Backfit Rule generally does not apply to IBR of later editions and addenda of the ASME BPV Code (Section XI) and OM Code. As previously mentioned, the NRC's longstanding regulatory practice has been to incorporate later versions of the ASME Codes into 10 CFR 50.55a. Under 10 CFR 50.55a, licensees shall revise their ISI and IST programs every 120 months to the latest edition and addenda of Section XI of the ASME BPV Code and the ASME OM Code incorporated by reference into 10 CFR 50.55a 12 months before the start of a new 120-month ISI and IST interval. Thus, when the NRC approves and requires the use of a later version of the Code for ISI and IST, it is implementing this longstanding regulatory practice and requirement.

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

Other circumstances in which the NRC does not apply the Backfit Rule to the approval and requirement to use later Code editions and addenda are as follows:

- The NRC takes exception to a later ASME BPV Code or OM Code provision but merely retains the current existing requirement, prohibits the use of the later Code provision, limits the use of the later Code provision, or supplements the provisions in a later Code.

The Backfit Rule does not apply because the NRC is not imposing new requirements. However, the NRC explains any such exceptions to the Code in the Statement of Considerations and regulatory analysis for the rule.

- An NRC exception relaxes an existing ASME BPV Code or OM Code provision but does not prohibit a licensee from using the existing Code provision. The Backfit Rule does not apply because the NRC is not imposing new requirements.

- Modifications and limitations imposed during previous routine updates of 10 CFR 50.55a have established a precedent for determining which modifications or limitations are backfits or require a backfit analysis (e.g., the final rule dated September 10, 2008 (73 FR 52731) and a correction dated October 2, 2008 (73 FR 57235)). The application of the backfit requirements to modifications and limitations in the current rule are consistent with the application of backfit requirements to modifications and limitations in previous rules.

The IBR and adoption of a requirement mandating the use of a later ASME BPV Code or OM Code may constitute backfitting in some circumstances. In these cases, the NRC would perform a backfit analysis or documented evaluation in accordance with 10 CFR 50.109, "Backfitting." These cases include the following:

- When the NRC endorses a later provision of the ASME BPV Code or OM Code that takes a substantially different direction from the existing requirements, the action is treated as a backfit (61 FR 41303; August 8, 1996).

- When the NRC requires implementation of a later ASME BPV Code or OM Code provision on an expedited basis, the action is treated as a backfit. This applies when implementation is required sooner than it would be if the NRC simply endorsed the Code without any expedited language (64 FR 51370; September 22, 1999).

- When the NRC takes an exception to an ASME BPV Code or OM Code provision and imposes a requirement that is substantially different from the existing requirement, as well as substantially different from the later Code, the action is treated as a backfit (67 FR 60529; September 26, 2002).

5.16.4 Detailed Backfitting Discussion: Proposed Changes beyond Those Necessary to Incorporate by Reference the New ASME BPV and OM Code Provisions

This section discusses the backfitting considerations for all the proposed changes to 10 CFR 50.55a that go beyond the minimum changes necessary and required to adopt the new ASME Code Addenda into 10 CFR 50.55a.

5.16.4.1 ASME BPV Code, Section III

The NRC proposes to make the following changes to the ASME BPV Code, Section III, that need to be evaluated concerning backfitting regulations:

- Add 10 CFR 50.55a(b)(1)(x) to require compliance with two new conditions related to visual examination of bolts, studs, and nuts. Visual examination is one of the processes for acceptance of the final product to ensure its structural integrity and its ability to perform its intended function. The 2015 Edition of the ASME Code requires visual inspection of these components; however, the 2017 Edition does not require these visual examinations to be performed in accordance with NX-5100 and NX-5500. Therefore, the NRC proposes to add two conditions to ensure that adequate procedures remain and qualified personnel remain capable of determining the structural integrity of these components. Since the proposed conditions restore requirements that were removed from the latest edition of the ASME Code, the proposed conditions do not constitute a new or changed NRC position. Therefore, these conditions are not a backfit.

- Add 10 CFR 50.55a(b)(1)(xi) to require conditions on the use of ASME BPV Code, Section III, Appendix XXVI, for installation of HDPE pressure piping. This appendix is new in the 2015 Edition of Section III, because it is the first time the ASME BPV Code has provided rules for the use of polyethylene piping. The use of HDPE is newly allowed by the Code, which provides alternatives to the use of current materials. Therefore, this proposed change is not a backfit.

- Add 10 CFR 50.55a(b)(1)(xii) to prohibit applicants and licensees from using a certifying engineer instead of a registered professional engineer for Code-related activities that are applicable to U.S. nuclear facilities regulated by the NRC. In the 2017 Edition of ASME BPV Code, Section III, Subsection NCA, the several subsections were updated to replace the term “registered professional engineer” with the term “certifying engineer” to be consistent with ASME BPV Code, Section III, Mandatory Appendix XXIII. The NRC staff reviewed these changes and determined that the use of a certifying engineer instead of a registered professional engineer is applicable only to non-U.S. nuclear facilities. Because the use of a certifying engineer is newly allowed by the Code, the addition of the condition that prohibits the use of a certifying engineer instead of a registered professional engineer for Code-related activities is not a backfit.

5.16.4.2 ASME BPV Code, Section XI

The NRC proposes to make the following changes to the ASME BPV Code, Section XI. These changes need to be evaluated concerning backfitting regulations:

- Revise 10 CFR 50.55a(b)(2)(ix) to require compliance with new condition 10 CFR 50.55a(b)(2)(ix)(K). The NRC staff has developed proposed condition 10 CFR 50.55a(b)(2)(ix)(K) to ensure that containment leak-chase channel systems are properly inspected. This condition clarifies the NRC staff's existing expectations, as described in inspection reports and IN 2014-07, and will apply to all editions of the ASME Code before the 2017 Edition. The NRC considers this condition a clarification of the existing expectations and, therefore, does not consider it a backfit.

As noted previously, after issuance of IN 2014-07, the NRC received feedback during an August 22, 2014, public meeting between the NRC and ASME management noting that the IN guidance appeared to conflict with ASME Code Section XI Interpretation XI-1-13-10. In response to the feedback, the NRC issued a letter to ASME on March 3, 2015, which stated that the NRC believes the IN is consistent with the requirements in the ASME Code and restated the existing NRC staff position. On April 13, 2015, ASME responded to the NRC's letter and noted that a condition in the regulations may be appropriate to clarify the NRC staff's position.

- Revise 10 CFR 50.55a(b)(2)(xx)(B) to clarify the condition with respect to the NRC's expectations for system leakage tests performed in lieu of a hydrostatic pressure test following repair or replacement activities performed by welding or brazing on a pressure-retaining boundary using the 2003 Addenda through the latest edition and addenda of ASME BPV Code, Section XI, incorporated by reference in paragraph 10 CFR 50.55a(a)(1)(ii). This provision requires the licensee to perform the applicable nondestructive testing that would be required by the 1992 or later edition of the ASME BPV Code, Section III. The licensee shall apply the NDE method (e.g., surface, volumetric) and acceptance criteria of the 1992 or later edition of Section III and perform a system leakage test in accordance with IWA-5211(a). The actual NDE and pressure testing may be performed using procedures and personnel meeting the requirements of the licensee's or applicant's current ISI code of record required by 10 CFR 50.55a(g)(4). The proposed condition does not constitute a new or changed NRC position. Therefore, the revision of this condition is not a backfit.

- Add 10 CFR 50.55a(b)(2)(xx)(C) to place two conditions on the use of the alternative BWR Class 1 system leakage test described in IWA-5213(b)(2), IWB-5210(c), and IWB-5221(d) of the 2017 Edition of ASME Section XI. This is a new pressure test allowed by the Code at a reduced pressure as an alternative to the pressure test currently required. This allows a reduction in the requirements, which is consistent with several NRC-approved alternatives or relief requests. Therefore, this proposed change is not a backfit.

- Add 10 CFR 50.55a(b)(2)(xxi)(B) to require that the plant-specific evaluation demonstrating the criteria of IWB-2500(f) are met be maintained in accordance with the owner's requirements. This new paragraph also prohibits the use of the provisions of IWB-2500(f) and Table IWB-2500-1, Note 6 for Examination Category B-D, Item Numbers B3.90 and B3.100, for plants with renewed licenses. It also restricts the provisions of IWB-2500(g) and Table IWB-2500-1, Notes 6 and 7 for Examination Category B-D, Item Numbers B3.90 and B3.100, used to eliminate the preservice or inservice volumetric examination of plants with a COL pursuant to 10 CFR Part 52, or a plant that receives its operating license after October 22, 2015. This proposed revision applies the current requirements for use of these provisions as described in ASME Code Case N-702; the provisions are currently allowed through RG 1.147, Revision 19. Therefore, the NRC does not consider the clarification to be a change in requirements, and this proposed change is not considered a backfit.

- Revise the condition in 10 CFR 50.55a(b)(2)(xxv) to allow the use of IWA-4340 of Section XI, 2011 Addenda through 2017 Edition, with conditions. Add 10 CFR 50.55a(b)(2)(xxv)(A), which will continue the prohibition of IWA-4340 for Section XI editions and addenda before the 2011 Addenda. Because this prohibition applies the current requirements for use of these provisions, the NRC does not consider the addition of 10 CFR 50.55a(b)(2)(xxv)(A) to be a change in requirements. Therefore, this proposed change is not a backfit.

  Add 10 CFR 50.55a(b)(2)(xxv)(B), which will allow the use of IWA-4340 of Section XI, 2011 Addenda through 2017 Edition, with three conditions.

  (1) The first proposed condition would prohibit the use of IWA-4340 on crack-like defects or those associated with flow-accelerated corrosion. The design requirements and potentially the frequency of followup inspections might not be adequate for crack-like defects that could propagate much faster than defects caused by loss of material. Before the change to allow the use of IWA-4340, the provisions of this subarticle were not permitted for any type of defects. By establishing the new conditions, the NRC proposes to allow the use of IWA-4340 for defects such as wall loss resulting from general corrosion. Establishing a condition to not allow the use of IWA-4340 for crack-like defects does not constitute a new or changed NRC position. Therefore, the revision of this condition associated with crack-like defects is not a backfit.

  As established in NUREG-1801, Revision 2, “Generic Aging Lessons Learned (GALL) Report,” issued December 2010 (NRC, 2010), effective management of flow-accelerated corrosion entails (a) an analysis to determine critical locations, (b) limited baseline inspections to determine the extent of thinning at these locations, (c) use of a predictive code (e.g., CHECKWORKS), and (d) followup inspections to confirm the predictions, or repairing or replacing components as necessary. IWA-4340 does not include these provisions. In addition, subparagraph IWA 4421(c)(2) contains provisions for restoring minimum required wall thickness by welding or brazing, which can be used to mitigate a defect associated with flow-accelerated corrosion. The proposed condition related to flow-accelerated corrosion does not constitute a new or changed NRC position. Therefore, the revision of this condition is not a backfit.

(2) The second proposed condition would require the design of a modification that mitigates a defect to incorporate a loss of material rate either 2 times the actual measured corrosion rate in that pipe location or 4 times the estimated maximum corrosion rate for the piping system. This condition is consistent with Code Case N-789, "Alternative Requirements for Pad Reinforcement of Class 2 and 3 Moderate-Energy Carbon Steel Piping, Section XI, Division 1," Section 3, "Design." The NRC has endorsed Code Case N-789 in RG 1.147. The proposed condition does not constitute a new or changed NRC position. Therefore, the revision of this condition is not a backfit.

(3) The third proposed condition would require the owner to perform a wall thickness examination near the modification and relevant pipe base metal during each refueling outage cycle to detect propagation of the flaw. This requirement does not apply if the projected flaw propagation has been validated in two refueling outage cycles subsequent to the installation of the modification. This condition is consistent with Code Case N-789, Section 8, "Inservice Monitoring," which requires followup wall thickness measurements to verify that the minimum design thicknesses are maintained. The followup examination requirements in IWA-4340 are inconsistent with the NRC endorsement of Code Case N-789 in RG 1.147 in that the inspections can be limited to demonstrating that the flaw has not propagated into material credited for structural integrity without validating the project flaw growth. The proposed condition does not constitute a new or changed NRC position. Therefore, the revision of this condition is not a backfit.

- Revise 10 CFR 50.55a(b)(2)(xxvi) to require that a system leakage test be conducted after implementing a repair replacement activity on a mechanical joint greater than NPS-1. The revision will also clarify which Code edition or addenda may be used when conducting the pressure test. This proposed revision clarifies the meaning and intent of the current requirements. The NRC does not consider the clarification to be a change in requirements. Therefore, this proposed change is not a backfit.

- Revise 10 CFR 50.55a(b)(2)(xxxii) to clarify the requirement to submit Summary Reports in pre-2015 Editions and Owner Activity Reports in the 2015 Edition of the ASME BPV Code. This proposed revision clarifies the current requirements. The NRC does not consider the clarification to be a change in requirements. Therefore, this proposed change is not a backfit.

- Add 10 CFR 50.55a(b)(2)(xxxv)(B), which would condition the use of the 2015 Edition of the ASME BPV Code, Section XI, Appendix A, paragraph A-4200(c), to define RTK_{Ia} in equation (a) as $RTK_{Ia} = T_0 + 90.267 \exp(-0.003406T_0)$ in lieu of the equation shown in the Code. When the equation was converted from SI units to U.S. customary units, a mistake was made that makes the equation incorrect. The equation shown above for RTK_{Ia} is the correct formula. Therefore, the proposed addition of this condition is not a backfit.

- Revise 10 CFR 50.55a(b)(2)(xxxvi) to extend the applicability to use of the 2015 and 2017 Editions of Section XI of the ASME BPV Code. The condition was added in the 2009–2013 rulemaking, and ASME did not make changes in the 2015 or 2017 Editions of the BPV Code; therefore, the condition still applies but is not new to this rulemaking. The NRC considers this revision to the condition to be consistent with the meaning and intent of the current requirements. The NRC does not consider the clarification to be a change in requirements. Therefore, this proposed change is not a backfit.

- Add 10 CFR 50.55a(b)(2)(xxxviii) to condition ASME BPV Code, Section XI, Appendix III, Supplement 2. Supplement 2 is closely based on ASME Code Case N-824, which was incorporated by reference with conditions in 10 CFR 50.55a(a)(3)(ii). The conditions on ASME BPV Code, Section XI, Appendix III, Supplement 2, are consistent with the conditions on ASME Code Case N-824. The NRC does not consider this a new requirement. Therefore, this proposed change is not a backfit.

- Add 10 CFR 50.55a(b)(2)(xxxix) to condition the use of Section XI, IWA-4421(c)(1) and IWA-4421(c)(2). The NRC considers these conditions necessary as part of the allowance to use IWA-4340. The proposed condition on the use of IWA-4421(c)(1) and IWA-4421(c)(2) does not constitute a new or changed NRC position. Therefore, the addition of this proposed condition is not a backfit.

- Add 10 CFR 50.55a(b)(2)(xl) to prohibit the use of ASME BPV Code, Section XI, subparagraphs IWB-3510.4(b)(4) and IWB-3510.4(b)(5). The proposed condition does not change the current material requirements because the currently required testing to meet the material requirements for those materials addressed by the new condition would continue to be performed according to the existing requirements. Therefore, this condition on the use of IWB-3510.4(b) does not constitute a new or changed NRC position, and the addition of this proposed condition is not a backfit.

- Revise 10 CFR 50.55a(g)(6)(ii)(D) to implement Code Case N-729-6. On March 3, 2016, ASME approved the sixth revision of ASME BPV Code Case N-729 (N-729-6). The NRC proposes to update the requirements of 10 CFR 50.55a(g)(6)(ii)(D) to require licensees to implement ASME BPV Code Case N-729-6, with conditions. ASME BPV Code Case N-729-6 contains requirements similar to those of N-729-4; however, N-729-6 also contains new requirements to address peening mitigation and inspection relief for replaced RPV heads with nozzles and welds made of more crack-resistant materials. The new NRC conditions on the use of ASME BPV Code Case N-729-6 address operational experience, clarification of implementation, and the use of alternatives to the Code Case.

  The current regulatory requirements for the examination of PWR upper RPV heads that use nickel-alloy materials are in 10 CFR 50.55a(g)(6)(ii)(D). This section was first created by rulemaking (73 FR 52730; September 10, 2008) to require licensees to implement ASME BPV Code Case N-729-1, with conditions, instead of the examinations previously required by the ASME BPV Code, Section XI. The action did constitute a backfit; however, the NRC concluded that imposition of ASME BPV Code Case N-729-1, as conditioned, constituted an adequate protection backfit.

The GDC for nuclear power plants (10 CFR Part 50, Appendix A) or, as appropriate, similar requirements in the licensing basis for a reactor facility, provide bases and requirements for NRC assessment of the potential for, and consequences of, degradation of the RCPB. The applicable GDC include GDC 14; GDC 31, "Fracture Prevention of Reactor Coolant Pressure Boundary"; and GDC 32. GDC 14 specifies that the RCPB be designed, fabricated, erected, and tested to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. GDC 31 specifies that the probability of rapidly propagating fracture of the RCPB be minimized. GDC 32 specifies that components that are part of the RCPB can be periodically inspected to assess their structural and leaktight integrity.

The NRC concludes that IBR of Code Case N-729-6, as conditioned, into 10 CFR 50.55a as a mandatory requirement will continue to provide reasonable assurance of adequate protection of public health and safety. Updating the regulations to require the use of ASME BPV Code Case N-729-6, with conditions, ensures that potential flaws will be detected before they challenge the structural or leaktight integrity of the RPV upper head within current NDE limitations. The Code Case provisions and the NRC-proposed conditions on examination requirements for RPV upper heads are essentially the same as those established under ASME BPV Code Case N-729-4, as conditioned. Exceptions include (1) an introduction of examination relief for upper heads with Alloy 690 penetration nozzles to be examined volumetrically every 20 years in accordance with Table 1 of ASME BPV Code Case N-729-6, (2) introduction of peening as a mitigation technique along with requirements for peening and inspection relief following peening, and (3) substitution of a volumetric leak path examination for a required surface examination if a bare metal visual examination identifies a possible indication of leakage.

For these exceptions, the NRC continues to find that examinations of RPV upper heads, their penetration nozzles, and associated partial penetration welds are necessary for adequate protection of public health and safety. The requirements of ASME BPV Code Case N-729-6, as conditioned, represent an acceptable approach, developed, in part, by a voluntary consensus standards organization, to performing future inspections. The proposed NRC conditions on Code Case N-729-6 address newly defined provisions in the Code for peening and inspection relief for upper heads with Alloy 690 penetration nozzles, which provide alternatives to the use of current requirements and clarify or relax existing conditions. Therefore, the NRC concludes that the proposed IBR of ASME BPV Code Case N-729-6, as conditioned, into 10 CFR 50.55a is not a backfit.

- Revise 10 CFR 50.55a(g)(6)(ii)(F). On November 7, 2016, ASME approved the fifth revision of ASME BPV Code Case N-770 (N-770-5). The NRC proposes to update the requirements of 10 CFR 50.55a(g)(6)(ii)(F) to require licensees to implement ASME BPV Code Case N-770-5, with conditions. ASME BPV Code Case N-770-5 contains baseline and ISI requirements for unmitigated nickel-alloy butt welds and preservice and ISI requirements for mitigated butt welds, similar to those in Code Case N-770-2. However, N-770-5 also contains new provisions that extend the inspection frequency for cold-leg temperature dissimilar-metal butt welds greater than 14 inches in diameter to once per interval, not to exceed 13 years; define performance criteria and examinations for welds mitigated by peening; and establish criteria for ISI requirements for excavate and weld repair PWSCC mitigations. The NRC also made minor changes to address editorial issues, to correct figures, or to add clarity. The agency modified its proposed conditions on the use of ASME BPV Code Case N-770-5 to address the changes in the Code Case, clarify reporting requirements, and address the implementation of peening and excavate and weld repair PWSCC mitigation techniques.

  The current regulatory requirements for the examination of ASME Class 1 piping and nozzle dissimilar-metal butt welds that use nickel-alloy materials are in 10 CFR 50.55a(g)(6)(ii)(F). This section was first created by rulemaking (76 FR 36232; June 21, 2011) to require licensees to implement ASME BPV Code Case N-770-1, with conditions. The NRC added 10 CFR 50.55a(g)(6)(ii)(F) to require licensees to implement ASME BPV Code Case N-770-1, with conditions, instead of the examinations previously required by the ASME BPV Code, Section XI. The action did constitute a backfit; however, the NRC concluded that imposition of ASME BPV Code Case N-770-1, as conditioned, constituted an adequate protection backfit.

  The GDC for nuclear power plants (10 CFR Part 50, Appendix A) or, as appropriate, similar requirements in the licensing basis for a reactor facility, provide bases and requirements for NRC assessment of the potential for, and consequences of, degradation of the RCPB. The applicable GDC include GDC 14, 31, and 32. GDC 14 specifies that the RCPB be designed, fabricated, erected, and tested to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. GDC 31 specifies that the probability of rapidly propagating fracture of the RCPB be minimized. GDC 32 specifies that components that are part of the RCPB can be periodically inspected to assess their structural and leaktight integrity.

  The NRC concludes that IBR of Code Case N-770-5, as conditioned, into 10 CFR 50.55a as a mandatory requirement will continue to provide reasonable assurance of adequate protection of public health and safety. Updating the regulations to require use of ASME BPV Code Case N-770-5, with conditions, ensures that leakage would be unlikely and potential flaws will be detected before they challenge the structural or leaktight integrity of these RCPB piping welds. All current licensees of U.S. PWRs will be required to implement ASME BPV Code Case N-770-5, as conditioned.

The Code Case N-770-5 provisions for the examination requirements for ASME Class 1 piping and nozzle nickel-alloy dissimilar-metal butt welds are similar to those established under ASME BPV Code Case N-770-2, as conditioned. However, Code Case N-770-5 includes provisions for two additional PWSCC mitigation techniques, peening and excavate and weld repair, along with requirements for performance of these techniques and examination of welds mitigated using them. Additionally, Code Case N-770-5 would allow for some relaxation in the reexamination or deferral of certain welds. However, the NRC's proposed condition would not allow this relaxation or deferral of examination requirements. The proposed NRC conditions on Code Case N-770-5 address newly defined provisions in the Code for examinations and performance criteria for mitigation by peening, examinations for mitigation by excavate and weld repair, and extension of the examination frequency for certain cold-leg temperature welds. These provisions offer alternatives to the use of current requirements and clarify or relax existing conditions. The proposed modification to the condition in 10 CFR 50.55a(g)(6)(ii)(F)(11) adds an optional method for meeting the condition. Therefore, the NRC concludes that the proposed IBR of ASME BPV Code Case N-770-5, as conditioned, into 10 CFR 50.55a is not a backfit.

5.16.4.3 ASME OM Code

- Revise the introductory text of paragraph 10 CFR 50.55a(b)(3) to reference the 1995 Edition through the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv) and to include Appendix IV to the ASME OM Code in the list of mandatory appendices incorporated by reference in 10 CFR 50.55a. The revision of 10 CFR 50.55a to incorporate by reference updated editions of the ASME OM Code is consistent with longstanding NRC policy and does not constitute a backfit.

- Revise 10 CFR 50.55a(b)(3)(ii) to specify that the condition on MOV testing applies to the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv). This will allow future rulemakings to revise 10 CFR 50.55a(a)(1)(iv) to incorporate the latest edition of the ASME OM Code without the need to revise 10 CFR 50.55a(b)(3)(ii). This is an administrative change to simplify future rulemakings and, therefore, is not a backfit.

- Revise 10 CFR 50.55a(b)(3)(iv) to (1) accept the use of Appendix II to the 2017 Edition of the ASME OM Code without conditions, (2) update 10 CFR 50.55a(b)(3)(iv) to apply Table II in Appendix II to the ASME OM Code, 2003 Addenda through 2015 Edition, and (3) remove the outdated conditions in paragraphs (A) through (D) of 10 CFR 50.55a(b)(3)(iv). These changes reflect improvements to Appendix II in the 2017 Edition of the ASME OM Code and the removal of outdated conditions on previous editions and addenda of the ASME OM Code. The relaxation of conditions in 10 CFR 50.55a(b)(3)(iv) to reflect the updated ASME OM Code is not a backfit.

- Revise 10 CFR 50.55a(b)(3)(viii) to specify that the condition on Subsection ISTE applies to the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv). This will allow future rulemakings to revise 10 CFR 50.55a(a)(1)(iv) to incorporate the latest edition of the ASME OM Code without the need to revise 10 CFR 50.55a(b)(3)(viii). This is an administrative change to simplify future rulemakings and, therefore, is not a backfit.

- Revise 10 CFR 50.55a(b)(3)(ix) to specify that Subsection ISTF of the ASME OM Code, 2017 Edition, is acceptable without conditions and that licensees applying Subsection ISTF in the 2015 Edition of the ASME OM Code shall satisfy the requirements of Appendix V to the ASME OM Code. Subsection ISTF in the 2017 Edition of the ASME OM Code has incorporated the provisions from Appendix V such that its reference to Subsection ISTF in the 2017 Edition of the ASME OM Code is not necessary. This is an update to the condition to apply to the 2015 Edition (in addition to the 2012 Edition) and a relaxation to remove the applicability of the condition to the 2017 Edition of the ASME OM Code. Therefore, the update to this condition is not a backfit.

- Revise 10 CFR 50.55a(b)(3)(xi) for the implementation of paragraph ISTC-3700 on valve position indication in the ASME OM Code to apply to the 2012 Edition through the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv). This will allow future rulemakings to revise 10 CFR 50.55a(a)(1)(iv) to incorporate the latest edition of the ASME OM Code without the need to revise 10 CFR 50.55a(b)(3)(xi). In addition, the NRC proposes to clarify that this condition applies to all valves with remote position indicators within the scope of Subsection ISTC and all mandatory appendices. This is an administrative change to simplify future rulemakings and clarify the condition and, therefore, is not a backfit.

- Establish 10 CFR 50.55a(b)(3)(xii) to require the application of the AOV provisions to the 2017 Edition of the ASME OM Code, Appendix IV, when implementing the ASME OM Code, 2015 Edition. This will provide consistency between the implementation of these two new editions of the ASME OM Code, and therefore, this condition is not a backfit.

- Revise 10 CFR 50.55a(f)(4)(i) and (ii) to relax the schedule for complying with the latest edition and addenda of the ASME OM Code for the initial and successive IST programs from 12 months to 18 months. This relaxation of the schedule for the IST programs is not a backfit.

- Add 10 CFR 50.55a(f)(7) to state that IST plans and interim IST plan updates for pumps and valves and IST plans and interim plan updates for snubber examination and testing must be submitted to the NRC. This requirement is currently in the ASME OM Code, but ASME is planning to remove it from the ASME OM Code in the future. Therefore, this is not a backfit because the NRC is not imposing a new requirement.

- Revise 10 CFR 50.55a(g)(4)(i) and (ii) to relax the schedule for complying with the latest edition and addenda of the ASME BPV Code for the initial and successive ISI programs from 12 months to 18 months. This relaxation of the schedule for the ISI programs is not a backfit.

5.16.4.4 Backfitting Conclusion

The NRC finds that IBR into 10 CFR 50.55a of the 2015 and 2017 Editions of Section III, Division 1, of the ASME BPV Code subject to the identified conditions; the 2015 and 2017 Editions of Section XI, Division 1, of the ASME BPV Code, subject to the identified conditions; the 2015 and 2017 Editions of the ASME OM Code subject to the identified conditions; and the two Code Cases N-729-6 and N-770-5, subject to the identified conditions, does not constitute backfitting or represent an inconsistency with any issue finality provisions in 10 CFR Part 52.

5.17 Results for the Committee to Review Generic Requirements

This section addresses regulatory analysis information requirements for rulemaking actions or staff positions subject to review by the Committee to Review Generic Requirements (CRGR). All information called for by the CRGR charter (NRC, 2011) is presented in this regulatory analysis or in the *Federal Register* notice for the proposed rule. Table 37 provides a cross-reference between the relevant information and its location in this document or the *Federal Register* notice.

Table 37 Specific CRGR Regulatory Analysis Information Requirements

CRGR Charter Citation	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 to licensees or issued for public comment.	Proposed rule text in *Federal Register* notice for the proposed rule.
Appendix C (ii)	Draft papers or other documents supporting the requirements or staff positions.	*Federal Register* notice for the proposed rule.

CRGR Charter Citation	Information Item to be Included in a Regulatory Analysis Prepared for CRGR Review	Where Item Is Discussed
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 Backfitting and Issue Finality, Section XIII; *Federal Register* notice for the proposed rule.
Appendix C (iv)	The proposed method of implementation.	Regulatory Analysis, Section 0.
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 applies.	Regulatory Analysis, Section 0.
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.	Backfitting and Issue Finality, Section XIII; *Federal Register* notice for the proposed rule.
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.	*Federal Register* notice for the proposed rule.
Appendix C (xi)	Assessment of how the proposed action relates to the Commission’s Safety Goal Policy Statement (NRC, 1986).	Regulatory Analysis, Section 0.

6 Decision Rationale

Table 38 provides the quantified and qualified costs and benefits for Alternative 2. The quantitative analysis used best estimate values.

Table 38 Summary of Totals

Net Monetary Savings or (Costs)—Total Present Value	Nonquantified Benefits or (Costs)
Alternative 1: No Action $0	None
Alternative 2: Incorporate by Reference ASME BPV Code 2015 and 2017 Editions and OM Code 2015 and 2017 Editions, with Conditions Industry: (all provisions) $3.64 million using a 7% discount rate $4.16 million using a 3% discount rate NRC: (all provisions) $2.81 million using a 7% discount rate $3.49 million using a 3% discount rate Net Benefit (Cost): (all provisions) $6.45 million using a 7% discount rate $7.65 million using a 3% discount rate	Benefits: • **Advances in ISI and IST:** May incrementally decrease the likelihood of a radiological accident, the likelihood of postaccident plant worker exposure, and the level of plant worker radiological 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 applicable Code Cases to permit licensees to use advances in ISI and IST; provide alternative examinations for older plants; respond expeditiously to user needs; and provide a limited, clearly focused alternative to specific ASME Code provisions. Improvements in ISI and IST may also lead to the earlier identification of material degradation that, if undetected, could result in further degradation that eventually causes a plant transient. Thus, 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. • **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

Net Monetary Savings or (Costs)— Total Present Value	Nonquantified Benefits or (Costs)
Alternative 2 (continued)	easily quantifiable, manner. The advances in ISI and IST may lead to 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 advances. 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 satisfaction. • **Consistent with the NTTAA and Implementing Guidance:** Alternative 2 is consistent with the provisions of the NTTAA and implementing guidance in OMB Circular A-119, which encourage Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry. Furthermore, the ASME Code consensus process is an important part of the regulatory framework. Costs: • **Nonquantified Costs:** If the staff has 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 Alternative 2 because of the costs averted by 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 38, Alternative 2 relative to the regulatory baseline would result in a net benefit (averted cost) to industry that ranges from $3.64 million (7-percent NPV) to $4.16 million (3-percent NPV). The NRC’s net benefit would range from $2.81 million (7-percent NPV) to $3.49 million

(3-percent NPV). Thus, the total quantitative net averted costs of the rulemaking would range from $6.45 million (7-percent NPV) to $7.65 million (3-percent NPV).

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

The NRC has had a decades-long practice of approving or mandating, or both, the use of certain 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 ensure consistency across the industry and assure the industry and the public that the NRC will continue to support the use of the most updated and technically sound techniques developed by ASME to adequately protect 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 proposed rule regulatory action would exceed the costs of the proposed action, with a confidence interval greater than 90 percent at a 7-percent discount rate. 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 nonquantified costs and benefits, the regulatory analysis shows that the rulemaking is justified because the number and significance of the nonquantified benefits outweigh the nonquantified costs. The uncertainty analysis shows a net benefit (averted cost) for all simulations, with a range of averted cost from $3.13 million to $11.1 million (using a 7-percent NPV).

Therefore, integrating both quantified and nonquantified costs and benefits, the benefits of the proposed rule outweigh the identified quantitative and qualitative impacts attributable to the proposed rule.

7 Implementation Schedule

The final rule will become effective 30 days after the proposed rule's publication in the *Federal Register*. Provisions of this proposed rule are to be implemented within 120 months of the effective date, at the next update to each plant's ISI and IST programs.

8 References

Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

Congressional Budget Office, "The Budget and Economic Outlook: 2017 to 2027," January 2017. Available at https://www.cbo.gov/sites/default/files/115th-congress-2017-2018/reports/52370-outlookonecolumn.pdf; last accessed on April 10, 2018.

Electric Power Research Institute (EPRI), Topical Report, "Materials Reliability Program: Topical Report for Primary Water Stress Corrosion Cracking Mitigation by Surface Stress Improvement (MRP-335, Revision 3-A)," November 2016. ADAMS Accession No. ML16319A282 and also available at https://www.epri.com/#/pages/product/000000003002009241/?lang=en.

International Commission on Radiological Protection (ICRP), *1990 Recommendations of the International Commission on Radiological Protection,* ICRP Publication No. 60, Pergamon Press, 1991.

Public Law 104-113, National Technology Transfer and Advancement Act of 1995, as amended, accessible at http://www.gpo.gov/fdsys/pkg/PLAW-104publ113/pdf/PLAW-104publ113.pdf.

U.S. Department of Labor, Bureau of Labor Statistics (BLS), "NAICS Code: North American Industry Classification System Code," January 2017. Available at http://www.bls.gov/bls/naics.htm; last accessed on April 3, 2018.

BLS, "Archived Consumer Price Index Supplement Files: April 2018 Historical CPI-U, Table 24, Historical Consumer Price Index for All Urban Consumers (CPI-U): U.S. City Average, All Items," May 2018. Available at http://www.bls.gov/cpi/tables.htm; last modified on May 10, 2018.

U.S. Nuclear Regulatory Commission (NRC), NUREG/CR-3568, "A Handbook for Value-Impact Assessment," December 1983 (ADAMS Accession No. ML062830096).

NRC, NUREG-1530 , "Reassessment of NRC's Dollar Per Person-Rem Conversion Factor Policy," December 1995 (ADAMS Accession No. ML063470485).

NRC, 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).

NRC, NUREG/CR-6933, "Assessment of Crack Detection in Heavy-Walled Cast Stainless Steel Piping Welds Using Advanced Low-Frequency Ultrasonic Methods," March 2007a (ADAMS Accession Nos. ML071020410 and ML071020414).

NRC, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 3.9.6, Revision 3, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints," March 2007b (ADAMS Accession No. ML070720041).

NRC, NUREG-1801, Revision 2, "Generic Aging Lessons Learned (GALL) Report," December 2010 (ADAMS Accession No. ML103490041).

NRC, "Charter: Committee to Review Generic Requirements," Revision 8, March 2011. Available at https://www.nrc.gov/about-nrc/regulatory/crgr/charter.html (ADAMS Accession No. ML110620618).

NRC, NUREG/CR-7122, "An Evaluation of Ultrasonic Phased Array Testing for Cast Austenitic Stainless Steel Pressurizer Surge Line Piping Welds," March 2012 (ADAMS Accession No. ML12087A004).

NRC, NUREG-1530, Draft Revision 1, "Reassessment of NRC's Dollar Per Person-Rem Conversion Factor Policy," January 2017a (ADAMS Accession No. ML16147A392).

NRC, Regulatory Guide 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," Revision 2, March 2017b (ADAMS Accession No. ML16321A337).

NRC, NUREG/BR-0058, Draft Revision 5, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," April 2017c (ADAMS Accession No. ML17100A480).

NRC, "Incorporation by Reference of American Society of Mechanical Engineers Codes and Code Cases; Final Rule," June 2017d (ADAMS Accession No. ML16130A530).

NRC, "Approval of American Society of Mechanical Engineers' Code Cases; Final Rule," August 2017e (ADAMS Accession No. ML16285A012).

NRC, "Regulatory Analysis for Final Rule: Approval of American Society of Mechanical Engineers Code Cases," August 2017f (ADAMS Accession No. ML16285A013).

NRC, NUREG-1350, Volume 29, Revision 1, "2017–2018 Information Digest," December 2017g (ADAMS Accession No. ML18037A641).

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

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

Appendix A Major Assumptions and Input Data

Table 39 Major Assumptions and Input Data

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Key analysis dates			
Proposed rule effective date	2019	year	U.S. Nuclear Regulatory Commission (NRC) input
Analysis base year	2018	year	NRC input
Average new reactor unit first year of commercial operation	2021	year	Vogtle Electric Generating Plant, Units 3 and 4, beginning operation in 2021 and 2022, based on the NRC's "Combined License Applications for New Reactors" at http://www.nrc.gov/reactors/new-reactors/col.html with data current as of September 15, 2017 (last accessed on April 3, 2018).
Number of entities			
Number of currently operating reactor units in 2019	98	units	Calculation. Based on NUREG-1350, Appendix A (NRC, 2017g), as supplemented by recent licensee announcements.
Number of forecasted operating reactor units in 2024	91	units	Assumption. Based on NUREG-1350, Appendix A (NRC, 2017g), as supplemented by recent licensee announcements.
Number of new reactor units under construction in 2018	2	units	Assumption. Based on the NRC's "Combined License Applications for New Reactors" at http://www.nrc.gov/reactors/new-reactors/col.html with data current as of September 15, 2017 (last accessed on April 3, 2018). The construction of Vogtle Electric Generating Plant, Unit 3, is expected to be completed in 2021. The construction of Vogtle Unit 4 is expected to be completed in 2022.

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Number of sites			
Number of sites with operating reactors in 2019	59	sites	Calculation: [total number of sites with operating reactors] + [sites with construction completed in 2018] - [sites with all units on site closed in 2018 or 2019]. Information on operating reactor sites was obtained from the NRC's "Operating Nuclear Power Reactors (by Location or Name)" at http://www.nrc.gov/info-finder/reactor/ with data current as of April 4, 2018 (last accessed on May 22, 2018), as supplemented by recent licensee announcements.
Number of sites forecasted with currently operating reactors in 2024	52	sites	Calculation: [total number of sites with operating reactors] + [sites with construction completed in years 2017 through 2024] - [sites with all units on site closed in years 2017 through 2024]. Information on operating reactor sites was obtained from the NRC's "Operating Nuclear Power Reactors (by Location or Name)" http://www.nrc.gov/info-finder/reactor/ with data current as of April 4, 2018 (last accessed on May 22, 2018) as supplemented by recent licensee announcements.
Proposed rule applicability period (years)			
Proposed rule applicability term	N/A	years	ASME Code editions remain in effect until newer ones are incorporated by reference.
Labor rates			
Industry engineer or plant supervisor	$132	Dollars per hour	Labor rates used are from the Bureau of Labor Statistics (BLS) Employer Costs for National Compensation Survey dataset, 2017 values. These hourly rates were inflated to 2018 dollars using values of the Consumer Price Index for All Urban Consumers. A multiplier of 2.4, which includes fringe and indirect management cost, was then applied and resulted in the displayed labor rates.
Managers	$152	Dollars per hour	BLS tables

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Technical staff	$111	Dollars per hour	BLS tables
Administrative staff	$82	Dollars per hour	BLS tables
Licensing staff	$148	Dollars per hour	BLS tables
Industry plant technician	$105	Dollars per hour	BLS tables
NRC engineer	$131	Dollars per hour	NRC, Rulemaker@nrc.gov, “NRC Labor Rates for Use in Regulatory Analyses,” 2017