# Draft Regulatory Analysis for Proposed Rulemaking: "Incorporation by Reference of Institute of Electrical and Electronics Engineers Standard 603-2009"

NRC-2011-0089; RIN 3150-AI98

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

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# ABBREVIATIONS AND TERMS

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|---|---|
| 10 CFR | Title 10 of the *Code of Federal Regulations* |
| ADAMS | Agencywide Documents Access and Management System |
| ALWR | advanced light-water reactor |
| AR | alternative request |
| BLS | U.S. Bureau of Labor Statistics |
| BWR | boiling water reactor(s) |
| CFR | *Code of Federal Regulations* |
| CPI-U | consumer price index for all urban customers |
| *de novo* | from the beginning |
| DG | draft guide |
| EPRI | Electric Power Research Institute |
| FR | *Federal Register* |
| FRN | *Federal Register* notice |
| FSAR | final safety analysis report |
| FY | fiscal year |
| I&C | instrumentation and control |
| IBR | incorporate (or incorporation) by reference |
| IEEE Std | Institute of Electrical and Electronics Engineers Standard |
| LAR | license amendment request |
| NAICS | North American industry classification system code |
| No. | number |
| NPV | net present value |
| NRC | U.S. Nuclear Regulatory Commission |
| NTTAA | National Technology Transfer and Advancement Act of 1995 |
| OMB | U.S. Office of Management and Budget |
| Pert | program evaluation and review technique |
| PPS | plant protection system |
| PWR | pressurized water reactor(s) |
| Ref. | reference |
| Rev. | revision |
| RG | regulatory guide |
| RPS | reactor protection system |
| SOC | standard occupational classification code |
| SRM | staff requirements memorandum |
| Std | standard |
| TVA | Tennessee Valley Authority |

## 1. INTRODUCTION

This document presents the draft regulatory analysis for the subject proposed rule (U.S. Nuclear Regulatory Commission (NRC) Agencywide Documents Access and Management System (ADAMS) Accession No. ML113191306) and implementing guidance in the NRC's Draft Regulatory Guide (DG) 1251, "Criteria for the Power, Instrumentation, and Control Portions of Safety Systems for Nuclear Power Plants" (ADAMS Accession No. ML112160394). The proposed rule would amend the regulations to incorporate by reference (IBR) the Institute of Electrical and Electronics Engineers Standard (IEEE Std) 603-2009, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," with conditions.

Section II, Background, of the proposed rule explains the NRC's practice for using the relevant IEEE standards. The NRC last updated its regulations after IEEE published Std 603-1991. Subsequently, IEEE has published Std 603-1998 and Std 603-2009. The proposed rule would update Section 50.55a(h) of Title 10 of the *Code of Federal Regulations* (10 CFR) to incorporate by reference IEEE Std 603-2009.

## 2. STATEMENT OF THE PROBLEM AND OBJECTIVE

The objective of the proposed rule is to incorporate a nuclear industry consensus standard, IEEE Std 603-2009, into the NRC regulations to establish minimal functional and design requirements for nuclear power plant protection and safety systems. This action is consistent with the provisions of the National Technology Transfer and Advancement Act of 1995, Pub. L. 104-113 (NTTAA), which encourages Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to agency development of standards affecting an industry.

This action also follows the NRC policy of evaluating whether the latest versions of consensus standards are suitable for regulations or regulatory guides.

Development of an IEEE voluntary consensus standard and its incorporation into the NRC regulations is a three-step process: (1) the standard is drafted, (2) consensus on publishing the standard is reached, and (3) the NRC adopts the standard. This process is described in more detail in Section III, Discussion, of the proposed rule.

The NRC reviewed changes to IEEE Std 603-2009. The NRC concluded, in accordance with the process for reviewing changes to IEEE consensus standards, that IEEE Std 603-2009 is technically adequate, follows current NRC regulations, and is approved for use subject to specified conditions.

The proposed rule would apply IEEE Std 603-2009 to future nuclear power plants, including final design approvals, design certifications, and combined licenses approved by the NRC under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." Furthermore, the licensee of an operating nuclear power plant may continue to meet the requirements stated in the edition or revision of IEEE Std 279 (Ref. 20) in effect on the formal date of its application for a construction permit or may, at its option, use IEEE Std 603-2009, provided the licensee complies with all applicable requirements for making changes to its nuclear power plant's licensing basis. However, after the effective date of the rule, applications for system-level replacements of protection systems and safety systems in operating nuclear power plants and for the implementation of significant changes in safety system technology would be required to meet the requirements stated in IEEE Std 603-2009.

The IEEE Std 603-2009 specifies requirements for safety systems in nuclear power plants. A "safety system" is considered to be a minimum set of interconnected components, modules, signal processors, and equipment that accomplishes one or more safety functions (e.g., equipment relied upon to remain functional during and after design-basis accidents). "Safety system" is a broad-based and all-encompassing term, embracing protection systems in addition to other electrical systems. Thus, the term "protection system" is not synonymous with the term "safety system." The proposed rule would not change the scope of the safety systems covered in the final safety analysis report (FSAR) for operating nuclear power plants.

## 3. IDENTIFICATION AND ANALYSIS OF ALTERNATIVE APPROACHES

Given the existing data and information, the NRC considers a rule change to be the most effective way to carry out the updated IEEE standards. The no-action alternative would result in IEEE Std 603-2009 not being incorporated into 10 CFR 50.55a(h). The no-action alternative approach would cause licensees that desire to use the updated standards to seek exemptions or other relief.

The NRC considered four alternatives for changing regulations to IBR IEEE Std 603-2009. Two alternatives would IBR IEEE Std 603-2009 without conditions. One of those alternatives would require licensees and applicants to meet the criteria in IEEE Std 603-2009, without consideration of the criteria in IEEE Std 279 or in earlier versions of IEEE Std 603. Essentially, this option would require licensees to re-license complete safety systems when only a single component of a system is modified, which could result in licensees not upgrading safety systems with new components as obsolete components wear out. The other alternative would approve, but not require, licensees and applicants to meet the criteria in IEEE Std 603-2009 without conditions.

The other two alternatives would IBR IEEE Std 603-2009 with conditions. One of those alternatives would require licensees and applicants to meet the criteria in IEEE Std 603-2009 with conditions under certain circumstances. The fourth would approve, but not require, licensees and applicants to meet the criteria in IEEE Std 603-2009 with conditions. The conditions for using IEEE Std 279 and versions of IEEE Std 603 have been included in 10 CFR 50.55a(h)(2) of the proposed rule to clarify the applicability of IEEE Std 603-2009 and earlier standards for licensees of operating plants and approved designs, design applications, and combined licenses that modify or replace protection system or safety system equipment or functions. Despite the conditions, the proposed rule would not change the scope of the systems addressed in the FSAR for operating nuclear power plants. Furthermore, the conditions would identify the appropriate standards to use for equipment qualification, which are not identified in IEEE Std 603-1991.

### 3.1. Alternative 1: No Action

Under Alternative 1, the "no-action" alternative represents the non-rulemaking alternative. The no-action alternative would not revise the NRC's regulations to IBR a more recent revision of IEEE Std 603, "Standard Criteria for Safety Systems for Nuclear Power Generating Stations" and the correction sheet dated March 10, 2015, to establish functional and design requirements for power, instrumentation, and control systems for nuclear power plants The no-action alternative would cause licensees and applicants that desire to use IEEE Std 603-2009 to

request and receive approval from the NRC for the use of alternatives under 10 CFR 50.55a(z).[1] The NRC does not recommend that the Commission consider this alternative for the following reasons:

- Licensees and applicants would need to submit requests for alternatives under 10 CFR 50.55a(z) in order to use IEEE 603-2009 since it would not be incorporated by reference in 10 CFR 50.55a. This process may result in increased regulatory burden to licensees, applicants, and the NRC.

- The NRC's role as an effective regulator could be diminished because the agency's regulations would not include the latest consensus standards developed by IEEE.

- This alternative does not meet the spirit of NTTAA, which encourages Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry.

- The IEEE 603-1991, currently incorporated by reference in the *Code of Federal Regulations,* does not provide criteria that are sufficient for designs based on computer-based technology.

### 3.2. Alternative 2: Incorporate by Reference IEEE 603-2009

Alternative 2 would IBR IEEE-603-2009 into the *Code of Federal Regulations*. This rulemaking alternative would allow licensees and applicants to implement this standard without seeking prior NRC approval. This alternative continues NRC's process of periodic rulemakings to IBR in IEEE standards.

The NRC recommends that the Commission consider this alternative for the following reasons:

- Pursuing this alternative meets the NRC goal of ensuring the protection of public health and safety and the environment by continuing to provide NRC approval of new IEEE standards that allow the use of the most current methods and technology. In addition, it would reduce regulatory burden by eliminating the need for licensees to submit plant specific requests for alternatives in accordance with 10 CFR 50.55a(z) and for the NRC to review those submittals.

- This alternative supports the NRC's goal of maintaining an open regulatory process by informing the public about, and by having the opportunity for the public to participate in, the regulatory process.

- This alternative supports the NRC's commitment to participate in the national consensus standard process and conforms to NTTAA requirements.

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[1] All U.S. operating nuclear power plant units have analog control systems. Many nuclear plant licensees have at least partially upgraded their control systems, both safety related and non-safety related, from analog to digital technology. Many plants have installed digital technology in at least a small portion of their safety related I&C systems, even if only to support operator indications. Duke Energy converted its three Oconee units to employ digital instrumentation and control systems for a substantial portion of its safety-related systems between years 2011 and 2013. (Ref. 16)

- The periodic rulemakings to update the regulations by IBR the new and revised standards of the IEEE creates additional burden on the NRC. This burden is offset by the reduction in the number of plant-specific alternative requests that the NRC would evaluate. Section 4 of this analysis provides a discussion of the costs and benefits of this alternative relative to the regulatory baseline (alternative 1).

Under this alternative, the NRC evaluated four IBR subalternatives discussed below.

### 3.3. Alternative 2a: IBR IEEE 603-2009 without conditions and allow

Under this rulemaking alternative, the NRC would approve, but not require, licensees and applicants to meet the criteria in IEEE Std 603-2009 without conditions.[2]

### 3.4. Alternative 2b: IBR IEEE 603-2009 without conditions and require

Under this rulemaking alternative, the NRC would require licensees and applicants to meet the criteria in IEEE Std 603-2009, without consideration of the criteria in IEEE Std 279 or in earlier versions of IEEE Std 603. Essentially, this option would require licensees to re-license complete safety systems when only a single component of a system is modified, which could result in licensees not upgrading safety systems with new components as obsolete components wear out.

### 3.5. Alternative 2c: IBR IEEE 603-2009 with conditions and allow

Under this rulemaking alternative, the NRC would approve, but not require, licensees and applicants to meet the criteria in IEEE Std 603-2009 with conditions. The conditions for using IEEE Std 279 and versions of IEEE Std 603 are included in 10 CFR 50.55a(h)(2) of the proposed rule and in DG-1251 to clarify the applicability of IEEE Std 603-2009 and earlier standards for licensees of operating plants and approved designs, design applications, and combined licenses that modify or replace protection system or safety system equipment or functions. Despite the conditions, the proposed rule would not change the scope of the systems addressed in the FSAR for operating nuclear power plants. Furthermore, the conditions would identify the appropriate standards to use for equipment qualification, which are not identified in IEEE Std 603-1991.

### 3.6. Alternative 2d: IBR IEEE 603-2009 with conditions and require

Under this rulemaking alternative, the NRC would require licensees and applicants to meet the criteria in IEEE Std 603-2009 with conditions under certain circumstances that have been included in 10 CFR 50.55a(h)(2) of the proposed rule.

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[2] The NRC analyzes IEEE-603-2009 provisions that are a) acceptable without conditions, b) generally acceptable with conditions, or c) not approved. When the NRC generally approves an IEEE standard with conditions, there may be additional regulatory burden on licensees to meet the conditioned standard. The conditions would specify the additional activities that must be performed, the limits on the activities specified in the standard, and/or the information needed to provide clarity. The NRC's evaluation of IEEE 603-2009 and the reasons for the NRC's proposed conditions are identified in section III, "Discussion," of the proposed rule *Federal Register* notice (FRN) and in DG-1251. The conditioned IEEE standard provisions would have additional resource burden on licensees.

## 4. ANALYSIS OF BENEFITS AND COSTS

This section identifies the components of the public and private sectors, commonly referred to as "attributes," expected to be affected by the rulemaking. The proposed rule would be applicable to pressurized water reactors (PWRs), boiling water reactors (BWRs), and future nuclear power plant design certifications. The NRC believes that nuclear power plant licensees and new reactor power plant design developers will be the primary beneficiaries. The staff developed an inventory of the affected attributes using the list provided in Chapter 5 of the NRC's "Regulatory Analysis Technical Evaluation Handbook."[3]

The sign convention used in this analysis is 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)).

### 4.1. Identification of Affected Attributes

This rulemaking is expected to affect the following attributes. Their impacts are quantified where possible. An uncertainty analysis is provided in Section 5.2 of this analysis to report benefit and cost estimate confidence levels and to identify those variables that most affect the variation in the results distribution. Impacts to public health (accident), regulatory efficiency, and consistency with NTTAA are considered qualitatively.

- Public Health (Accident) — The subalternatives without conditions would decrease the probability of an accident because it would ensure that plant safety systems are designed to remain functional during and after design-basis accidents. Therefore, the proposed rule would prevent a reduction in the margin of safety or the introduction of a new failure mode.

  The proposed rule, in relation to approving the IBR alternatives, would decrease the probability of an accident because the criteria in IEEE Std 603-2009 address safety issues associated with major changes to the underlying bases of protection and safety systems that could impair dependability and reliability from potential new system-level failure modes.

- Industry Implementation — For any of the subalternatives, industry stakeholders may use resources to follow the rule development, attend public meetings, and provide comments on the proposed rule during the public comment period.

- NRC Implementation — For any of the subalternatives, the NRC incurs a cost to develop the final rule and to update corresponding guidance in RG 1.153. The proposed rule and updated RG would reflect the updated IEEE standards outlined in the previous sections.

- Industry Operation — Reactor protection and safety systems in the United States must be designed in accordance with 10 CFR 50.55a(h), which IBR the requirements stated in IEEE Std 603-1991, including the correction sheet dated January 30, 1995. Nuclear

[3] NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook," U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, 1997. (Ref. 9)

power plants with construction permits issued before January 1, 1971, are excluded from this requirement and instead must either demonstrate that their protection and safety systems are consistent with their licensing bases, or meet the requirements of IEEE Std 603-1991. NRC licensees may apply for deviations from these requirements, including deviations that have been incorporated into newer versions of IEEE standards, subject to NRC approval in accordance with 10 CFR 50.55a(z). These requests are termed "alternative requests" (ARs).

Under any of the subalternatives, a licensee of an operating nuclear power plant submitting a license amendment request (LAR) to carry out a safety system upgrade using digital equipment would no longer be required to submit an AR under 10 CFR 50.55a(z), which would provide a net benefit (i.e. averted cost) to the licensee.

As the ARs (and their subsequent costs) for design certifications and future operating reactors have been prepared and submitted to the NRC already, those costs are considered sunk costs and are not considered as part of the regulatory analysis.

- NRC Operation — For any of the subalternatives under alternative 2, the NRC would avert implementation costs under the proposed rule because fewer licensees would be required to submit an AR to perform a safety system upgrade. When the NRC receives an LAR to carry out a safety system upgrade using digital equipment, this draft regulatory analysis assumes that the licensee will likely request, under 10 CFR 50.55a(z), permission to use the criteria stated in IEEE Std 603-2009 instead of IEEE Std 603-1991. This AR requires extra NRC staff time to evaluate the digital safety system's design and qualification criteria relative to the criteria stated in IEEE Std 603-1991. Under the proposed rulemaking, these alternative requests to allow the use of IEEE Std 603-2009 would no longer be required, which would result in a net benefit (i.e. averted cost) for the NRC for operating reactors. However, for the subalternatives involving imposition of conditions, the NRC expects that there may be some ARs submitted if a licensee seeks an alternative to one or more of the conditions in the rule.

  AR applications for design certifications and new reactors that were previously submitted to and reviewed by the NRC are considered sunk costs and are not included in this draft regulatory analysis.

- Regulatory Efficiency — For all of the subalternatives considered, the proposed action would reduce the number of ARs prepared and submitted by licensees and design certification holders, and thereby enhance regulatory efficiency. Without the proposed rule, regulated entities upgrading digital equipment are required to submit an AR under 10 CFR 50.55a(z) if they wish to use IEEE Std 603-2009. The averted costs to the NRC and the industry reflect the quantitative benefit of the proposed rule related to regulatory efficiency.

  For all the subalternatives considered, the proposed action to IBR IEEE 603-2009 would increase regulatory efficiency because the IEEE standards and NRC regulations would be consistent. This resulting consistency would be greater for those alternatives that IBR the IEEE standards without conditions (i.e., Subalternatives 2a and 2b). Furthermore, all four subalternatives would be consistent with the NTTAA, which encourages Federal regulatory agencies to consider adopting voluntary consensus standards instead of agencies developing of standards.

- Other Considerations: Consistency with NTTAA — For all of the subalternatives considered, the proposed action adopts voluntary consensus standards as an alternative to *de novo* agency development of standards.

Attributes that are not expected to be affected by this rulemaking include: public health (routine); occupational health (accident and routine); offsite and onsite property; other government; general public; improvements in knowledge; antitrust considerations; safeguards and security considerations; and environmental considerations.

## 4.2. Analytical Method

This section describes the process used to evaluate benefits and costs associated with the proposed rule. The benefits of the proposed rule include any desirable changes in affected attributes (e.g., monetary savings, improved safety, improved security) while the costs include any undesirable changes in affected attributes (e.g., monetary costs, increased exposures). This draft regulatory analysis was developed following the guidance contained in NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," (Ref. 8) and NUREG/BR-0053, "United States Nuclear Regulatory Commission Regulations Handbook," (Ref. 7).

The analysis evaluates four attributes—industry implementation and NRC implementation and industry operation and NRC operation—on a quantitative basis. Quantitative analysis requires a baseline characterization of the affected universe, including characterization of factors such as the number of affected entities and the application process that licensees would use as a result of the proposed rule. Sections 4.2.1 through 4.2.4 describe the analytical method and assumptions used in the quantitative and qualitative analysis of these attributes.

### 4.2.1. Baseline for Analysis

This draft regulatory analysis measures the incremental costs of each alternative to a "baseline" that reflects anticipated behavior in the event the NRC undertakes no additional regulatory action (Alternative 1, the "no-action" alternative). As part of the regulatory baseline used in this analysis, the NRC staff assumes full licensee compliance with existing NRC regulations. This alternative is equivalent to the status quo and serves as a baseline against which other alternatives may be measured. Section 5 presents the estimated incremental benefits and costs of each alternative relative to this baseline.

### 4.2.2. Affected Entities

The proposed rule (Alternative 2 and its subalternatives) would apply to the design of protection and safety systems for currently operating nuclear power reactors, as well as designs for future nuclear power reactors, and would affect different classes of NRC licenses and regulatory approvals. Each of the affected classes of licenses is discussed in the following paragraphs.

Construction Permits

Currently, there are three construction permits in effect: the Tennessee Valley Authority (TVA) Watts Bar Nuclear Plant, Unit 2, which is active and the TVA Bellefonte Nuclear Plant, Units 1 and 2, which are in deferral status. The proposed rule would apply to the Watts Bar Nuclear

Plant, Unit 2, and the Bellefonte Nuclear Plant, Units 1 and 2, but only if the construction permit holder makes changes or modifications to, or replaces the plant's protection system or safety system (as reviewed and approved in the construction permit application and described in the preliminary safety analysis reports) under 10 CFR 50.55a(h)(3) of the proposed rule. As discussed 10 CFR 50.55a(h)(2)(ii), the NRC is not requiring either Watts Bar Nuclear Plant, Unit 2, or Bellefonte Nuclear Plant, Units 1 and 2, to meet current requirements applicable to newly licensed nuclear power plants.

The proposed rule would apply to all newly applied for construction permits.

Operating Licenses

The proposed rule (Alternative 2 and its subalternatives) would apply to the 99 operating nuclear power reactors licensed under 10 CFR Part 50, but only insofar as the plant's currently approved protection system or safety system may be modified or replaced in the future and therefore is subject to 10 CFR 50.55a(h)(3) of the proposed rule.

Currently, there is only one application for an operating license in process before the NRC; this application is for TVA's Watts Bar Nuclear Plant, Unit 2. The proposed rule would apply to Watts Bar Nuclear Plant, Unit 2, operating license, except for matters that were previously approved in the Watts Bar Nuclear Plant, Unit 2, construction permit. Thus, the "mandatory compliance" provisions of the proposed rule, 10 CFR 50.55a(h)(3), would apply to the Watts Bar Nuclear Plant, Unit 2, operating license only if the construction permit holder proposes to modify or replace the protection or safety systems.

The proposed rule would apply to all new applications for operating licenses.

Combined Licenses

The proposed rule (Alternative 2 and its subalternatives) would apply to a combined license that does not reference a standard design certification or manufacturing license. Currently, there are no manufacturing licenses issued under 10 CFR Part 52, and no combined licenses issued that do not reference a standard design certification.[4]

The proposed rule would apply to current (as of the date of the final IEEE rulemaking) and future combined licenses referencing a standard design certification or manufacturing license, but only if the combined license applicant or holder either: 1) seeks an exemption or departure from the referenced design certification rule's safety system, or 2) modifies or replaces the safety system and therefore is subject to 10 CFR 50.55a(h)(3) of the proposed rule. The NRC notes that the NRC's approval of a certified design includes all aspects of the reactor's design that must be designed to the relevant IEEE standard under 10 CFR 50.55a(h), and the combined license applicant and holder has no further responsibility to address the adequacy of the electrical design for the safety system. Hence the proposed rule does not directly apply to such combined license applicants and holders. As of this rulemaking, there are combined

[4] The combined licenses issued by the NRC for the Vogtle Electric Generating Plant, Units 3 and 4, and the combined licenses issued for the Virgil C. Summer, Units 2 and 3, reference the AP1000 standard design certification rule, 10 CFR Part 52, Appendix D, as amended) (76 FR 82079; December 30, 2011). A combined license was issued to DTE Electric Company on May 1, 2015, for the Enrico Fermi Nuclear Plant Unit 3 referencing the Economic Simplified Boiling Water Reactor design certification.

licenses for the Vogtle Electric Generating Plant, Units 3 and 4, and the combined licenses issued for the Virgil C. Summer, Units 2 and 3, both of which reference the AP1000 standard design certification rule as well as a combined license for Enrico Fermi Nuclear Plant Unit 3 which references the Economic Simplified Boiling Water Reactor standard design.

The proposed rule would also apply to any portion of a safety system (within the meaning of 10 CFR 50.55a and IEEE Std 603-2009) of currently-issued combined licenses referencing design certifications that are outside the scope of the referenced design certification (including exemption and departure requests). For those portions of safety systems outside the scope of the referenced standard design certification, the combined license would be subject to the "mandatory compliance" provisions in 10 CFR 50.55a(h)(3) of the proposed rule.

The proposed rule would apply to future combined license applicants that reference a standard design certification or manufacturing license, in the same manner as current holders of combined licenses referencing a standard design certification, as explained in the previous paragraphs.

Standard Design Certifications

The proposed rule (Alternative 2 and its subalternatives) would apply to the currently approved standard design certifications in 10 CFR Part 52, Appendices A through E (and any future standard design certification that may be approved before the issuance of the final 10 CFR 50.55a rulemaking incorporating by reference IEEE Std 603-2009), but only if the design of the safety system for the certification is modified or changed in a subsequent amendment to the design certification rule.

The proposed rule would apply to all standard design certification applications active at the time of the final 10 CFR 50.55a rulemaking incorporating by reference IEEE Std 603-2009 and the correction sheet dated March 10, 2015, as well as all future applications for standard design certifications.

Manufacturing Licenses

There are no current applicants for, or holders of, manufacturing licenses under 10 CFR Part 52, Subpart F. The proposed rule would apply to future applications for manufacturing licenses.

Applicability Period of the Proposed Rule

The proposed rule applicability period was derived as follows:

- Reactors That Are in Commercial Operation—The proposed rule applicability period is estimated to be 24 years. For each reactor unit, the NRC identified the license expiration date.[5] The NRC staff then used that license expiration date to calculate the remaining operating life. The NRC assumed that all operating licenses go to term with

[5] Based on information obtained from NRC, NUREG-1350, Volume 26, "2014-2015 Information Digest (NUREG-1350, Volume 26), Appendix H: "U.S. Commercial Nuclear Power Reactor Operating Licenses - Expiration by Year, 2013–2049," June 2014. Available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/, last accessed on April 16, 2015. (Ref. 5)

the exception of: (1) early terminations already announced (i.e., Vermont Yankee terminated commercial operation in December 2014 and Oyster Creek plans to terminate commercial operation in 2019), and (2) license renewal applications already under consideration (i.e., Indian Point Nuclear Generating) are assumed that they will be granted. Using the calculated remaining operating license term for each site, the average remaining operating license term was calculated.

- New Reactors under Construction—The proposed rule applicability period for this type of site is estimated to be 60 years. This estimate is based on the sum of the initial 40-year license term and one 20-year license renewal.

#### 4.2.3. Sign Conventions

The sign convention used in this analysis is 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)).

#### 4.2.4. Discount Rates

In accordance with guidance from the U.S. Office of Management and Budget (OMB) Circular No. A-4 (Ref. 18) and NUREG/BR-0058 (Ref. 8), present-worth calculations are used to determine how much society would need to invest today to ensure that the designated dollar amount is available in a given year in the future. By using present-worth values, costs and benefits, regardless of when the cost or benefit is incurred in time, are valued to a reference year for comparison. The choice of a discount rate, and its associated conceptual basis, is a topic of ongoing discussion within the federal government. Based on OMB Circular No. A-4 and consistent with NRC past practice and guidance, present-worth calculations are presented using three-percent and seven- percent real discount rates. A three percent discount rate approximates the real rate of return on long-term government debt, which serves as a proxy for the real rate of return on savings to reflect reliance on a social rate of time preference discounting concept. A seven percent discount rate approximates the marginal pretax real rate of return on an average investment in the private sector, and is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector. A seven-percent rate is consistent with an opportunity cost of capital[6] concept to reflect the time value of resources directed to meet regulatory requirements.

#### 4.2.5. Cost/Benefit Inflators

To evaluate the costs and benefits consistently, the analysis inputs are inflated into 2015 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. The formula to determine the amount in 2015 dollars is

$$\frac{\mathrm{CPIU}_{2015}}{\mathrm{CPIU}_{\mathrm{Value\ Year}}} * \mathrm{Value}_{\mathrm{Value\ Year}} = \mathrm{Value}_{2015}$$

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

Values of CPI-U used in this cost-benefit analysis are summarized in Table 1.

**Table 1—Consumer Price Index—All Urban Consumers Inflator**

| Base Year | CPI-U Inflator for Year 2015 |
|---|---|
| 2000 | 1.3748 |
| 2011 | 1.0524 |
| 2012 | 1.0311 |
| 2013 | 1.0162 |
| 2014 | 1.0000 |
| 2015 | 1.0000 |

Source: United States Bureau of Labor Statistics, *CPI Detailed Report, December 2014. "Table 24. Historical Consumer Price Index for All Urban Consumers (CPI-U): U.S. City Average, All-Items,"* December, 2014. Web. 27 Jan. 2015. http://www.bls.gov/cpi/tables.htm. (Ref. 2)

### 4.2.6. Cost Estimating Methodology and Accuracy

To estimate the costs associated for each subalternative, the NRC used a work breakdown structure approach to deconstruct the alternative requirements into required activities. For each required activity, the NRC further sub-divided the work across labor categories (i.e., executive, manager, staff, clerical, licensing). The NRC estimated the required level of effort for each labor category for each required activity in order to develop the cost estimate.

The NRC gathered data from several sources to develop the level of effort and unit cost estimates. For all licensee labor, the hourly wage rates for various industry labor categories are based on the U.S. Bureau of Labor Statistics (BLS) May 2013 Occupational Employment and Wages data (Ref. 1) and are inflated to 2015 dollars using the BLS Consumer Price Index (CPI). Depending on the industry and the occupation, an appropriate mean hourly labor wage is selected. The wage is then increased using a multiplier of 2.0 to account for benefits (insurance premiums, pension, and legally required benefits) to calculate the burdened labor rate.

NRC labor rates are determined by the calculation methodology in NUREG/CR-4627, "Generic Cost Estimates," (Ref. 10). This methodology considers only variable costs that are directly related to the implementation, operation, and maintenance of the analyzed activity. Currently, the NRC hourly labor rate is calculated to be $124 based on actual FY2014 incomes, fringe benefits, and other indirect expenses. Table 2 presents the labor rates used in this analysis.

**Table 2—Labor Rate Estimates by Labor Category**

| Labor Category | Mean Wage Rate (A) | Labor Multiplier (B) | CPI-U Inflator (C) | Burdened Hourly mean wage (2015 dollars) (D = A x B x C) |
|---|---|---|---|---|
| Executive | $79.79 | 2 | 1.016 | $162.17 |
| Managers | $49.69 | | | $101.00 |
| Technical Staff | $39.00 | | | $79.26 |
| Admin Staff | $25.53 | | | $51.90 |
| Licensing Staff | $54.11 | | | $109.97 |
| NRC | | | | $124.00 |

[a] The mean wage rate for industry labor categories are calculated as the average of the mean hourly wage (in the Electric Power Generation, Transmission, and Distribution Industry) for applicable standard occupational classification (SOC) codes from the U.S. Bureau of Labor Standards (BLS) (Ref. 1). Calculation details are provided in Appendix B.

[b] The NRC staff labor rates are estimated to be $124 per hour and are calculated based on actual labor and benefit costs from the prior fiscal year detailed by office and grade (Ref. 11).

The NRC applied several cost estimation methods in this analysis. Many costs were estimated using expert opinion, which relies on the NRC's professional knowledge and judgment. Some cost activities were estimated using extrapolation, which relies on actual past or current costs to estimate the future cost of similar activities. The NRC extrapolated the level of effort estimates from existing NRC documentation and licensee submittals to estimate the level of effort of the AR activities. For example, the NRC reviewed ARs already submitted by licensees to extrapolate the cost of this activity under the proposed rule. In addition, the NRC extrapolated cost-of-ownership estimates to shift them to the base year of 2015.

Finally, other costs were developed relying on the method of analogy, which compares similar activities in order to estimate costs. Cost activities that were estimated using the analogy method include the NRC effort required to issue the final rule and to review and approve ARs.

#### 4.2.7. Timeframes for Alternatives

The NRC assumes that the final rule for the selected subalternative will be issued and become effective in fiscal year (FY) 2016. The NRC assumes that the proposed rule and associated draft guidance would be issued for public comment in FY2015 and finalized in FY 2016. The NRC assumes that benefits and costs associated with this regulatory action would not extend beyond year 2038 by which time the majority of the current nuclear power plant units' operating licenses will expire.

#### 4.2.8. Base Year

The base year for this analysis is 2015 so the monetized benefits and costs in this analysis are expressed in 2015 dollars. Therefore, all quantified benefits and costs are inflated or discounted to FY 2015.

#### 4.2.9. Data

To the extent practicable, the draft regulatory analysis includes quantitative information and qualitative information (e.g., non-quantified information) on attributes affected by the rule

obtained from NRC staff. The NRC staff considered the potential differences between the new requirements and the current requirements and has incorporated available information into this draft regulatory analysis. The NRC staff used data from subject matter experts, knowledge gained from past rulemakings, industry announcements of plans to upgrade digital control systems, information from historical requests for alternatives under 10 CFR 50.55a(z) to collect data for this analysis.

## 4.3. Analysis

This analysis is based on NRC's assessment of the future business scenario for each subalternative. In each case, only industry and NRC implementation and operation costs were quantified. Furthermore, because all of the benefits are measured qualitatively in this analysis, only costs, including averted costs, are estimated in these subsections.

### 4.3.1. Industry Implementation

Alternative 2 and its subalternatives would IBR IEEE-603-2009 into the *Code of Federal Regulations*. This rulemaking alternative would allow licensees and applicants to implement this standard without seeking prior NRC approval. This alternative continues NRC's process of periodic rulemakings to IBR in IEEE standards.

The NRC assumes that NEI, digital equipment vendors, and current licensees would follow the development of this rule, provide feedback during public meetings, and comment on the documents when issued for public comment. Costs to perform these activities include procedural and administrative activities.

In addition, the NRC would interact with the public to develop and issue guidance for an acceptable approach to implement IEEE 603-2009 (currently developed as DG-1251). Development of this guidance would proceed in parallel with the rulemaking—the draft guidance document would be issued with the proposed rule for public comment and the final guidance document would be published with the final rule.

Table 3 presents the industry incremental costs to review and comment on the proposed rule. The NRC estimates that industry will incur an incremental one-time cost of approximately $81,000.

**Table 3—Industry Implementation – Rule and Guidance Review**

| Year | Activity | Labor Category | Hours | Hourly Rate | One-time Cost |
|---|---|---|---|---|---|
| 2015 | Review and provide feedback and comments on NRC proposed rule documents | Industry executives | 120 | $162 | ($19,460) |
| | | Industry managers | 150 | $101 | ($15,150) |
| | | Industry technical staff | 280 | $79 | ($22,191) |
| | | Industry administrative staff | 50 | $52 | ($2,595) |
| | | Industry licensing staff | 200 | $110 | ($21,993) |
| | | | | **Total:** | **($81,000)** |

* Total cost is rounded to nearest thousand dollars.

### 4.3.2. NRC Implementation

Adopting any of the rulemaking subalternatives 2a, 2b, 2c, or 2d would require the NRC to develop a final rule and update RG 1.153. The NRC assumes that the development of the final rule would take place over 2015 and 2016 and would require 2,000 hours and 1,500 hours, respectively. On the basis of $124 per NRC staff hour, Table 4 provides the estimated incremental one-time NRC implementation cost for development of a final rule and updating RG 1.153 is ($430,000) using a 3 percent discount factor or ($420,000) using a 7 percent discount factor.

**Table 4—NRC Implementation – Rulemaking**

| Year | Activity | Hours Required | Hourly Rate | Cost per year | | |
|---|---|---|---|---|---|---|
| | | | | Undiscounted | 3% NPV | 7% NPV |
| 2015 | Development of final rule and update RG 1.153 | 2000 | $124 | ($248,000) | ($248,000) | ($248,000) |
| 2016 | | 1500 | $124 | ($186,000) | ($180,583) | ($173,832) |
| | | | **Total:** | **($430,000)** | **($430,000)** | **($420,000)** |

* Costs are rounded to nearest thousand dollars.

### 4.3.3. Industry Operation

As a result of the rulemaking alternative, regulated entities would no longer be required to submit an AR under 10 CFR 50.55a(z) to perform a safety system upgrade using digital equipment. This results in an averted cost (i.e., a net benefit) to the licensee.

As noted previously, current licensees may continue to meet the requirements in the edition or revision of IEEE Std 279 in effect on the formal date of their application for a construction permit. A licensee may, at its option, develop safety systems that meet the requirements stated in IEEE Std 603-2009, provided it complies with all applicable requirements for making changes to its plant's licensing basis and meet the requirements for system-level replacements of protection systems and safety systems initiated after the date the rule becomes effective. Under the no action alternative, the NRC estimates that at least two ARs would be prepared and submitted over a three-year period and the licensee would expend 200 hours on each AR.

If IEEE Std 603-2009 is IBR by rulemaking, the NRC estimates that the number of AR submitted will decrease from two every three years to one every six years over the remaining operating license term. The NRC staff estimates that these post-rulemaking ARs will require the nuclear power industry approximately 500 hours to prepare. Table 5 presents the industry operation averted costs for preparing and submitting these AR to be $178,000 using a 3 percent discount factor and $110,000 using a 7 percent discount factor.

**Table 5—Industry Operation – Averted AR Costs to Prepare and Submit**

| Year | Activity | Number of AR | Cost per AR | Cost per year | | |
|---|---|---|---|---|---|---|
| | | | | Undiscounted | 3% NPV | 7% NPV |
| 2016 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $15,164 | $14,597 |
| 2017 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $14,722 | $13,642 |

| Year | Activity | Number of AR | Cost per AR | Cost per year | | |
|---|---|---|---|---|---|---|
| | | | | Undiscounted | 3% NPV | 7% NPV |
| 2018 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $14,294 | $12,750 |
| 2019 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $13,877 | $11,916 |
| 2020 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $13,473 | $11,136 |
| 2021 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $13,081 | $10,408 |
| 2022 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $12,700 | $9,727 |
| 2023 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $12,330 | $9,090 |
| 2024 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $11,971 | $8,496 |
| 2025 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $11,622 | $7,940 |
| 2026 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $11,283 | $7,420 |
| 2027 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $10,955 | $6,935 |
| 2028 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $10,636 | $6,481 |
| 2029 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $10,326 | $6,057 |
| 2030 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $10,025 | $5,661 |
| 2031 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $9,733 | $5,291 |
| 2032 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $9,450 | $4,945 |
| 2033 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $9,175 | $4,621 |
| 2034 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $8,907 | $4,319 |
| 2035 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $8,648 | $4,036 |
| 2036 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $8,396 | $3,772 |
| 2037 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $8,151 | $3,525 |
| 2038 | Averted alternative requests preparation and submission (base case) | 0.67 | $23,428 | $15,619 | $7,914 | $3,295 |
| 2016 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($8,829) | ($8,499) |
| 2017 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($8,572) | ($7,943) |

| Year | Activity | Number of AR | Cost per AR | Cost per year | | |
|---|---|---|---|---|---|---|
| | | | | Undiscounted | 3% NPV | 7% NPV |
| 2018 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($8,322) | ($7,423) |
| 2019 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($8,080) | ($6,938) |
| 2020 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($7,845) | ($6,484) |
| 2021 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($7,616) | ($6,060) |
| 2022 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($7,394) | ($5,663) |
| 2023 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($7,179) | ($5,293) |
| 2024 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($6,970) | ($4,947) |
| 2025 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($6,767) | ($4,623) |
| 2026 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($6,570) | ($4,320) |
| 2027 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($6,378) | ($4,038) |
| 2028 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($6,193) | ($3,774) |
| 2029 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($6,012) | ($3,527) |
| 2030 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($5,837) | ($3,296) |
| 2031 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($5,667) | ($3,080) |
| 2032 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($5,502) | ($2,879) |
| 2033 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($5,342) | ($2,691) |
| 2034 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($5,186) | ($2,515) |
| 2035 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($5,035) | ($2,350) |
| 2036 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($4,888) | ($2,196) |
| 2037 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($4,746) | ($2,053) |
| 2038 | Alternative requests preparation and submission (alternative) | 0.17 | $54,566 | ($9,094) | ($4,608) | ($1,918) |
| **Total Industry Operation Averted Cost:** | | | | **$150,000** | **$107,000** | **$74,000** |

* Total values are rounded to nearest thousand dollars.

It is important to note the experiences of one licensee who replaced their analog reactor protection system and engineered safeguards protection system under the regulatory baseline.

As described in a June 2013 presentation (Ref. 19), Table 6 provides the key milestones and metrics for one licensee to complete a digital upgrade license amendment request and approval. Based on this experience, the NRC staff believes that the improvements provided by alternative 2 would reduce this level of industry operation impact and provide additional averted costs for the preparation of additional supplements and for responding to RAIs, both of which were not quantified.

**Table 6—Example Digital Upgrade Project Metrics**

| **Parameter** | **Value** |
|---|---|
| General Information | |
| Duration of project for Unit 1 | 7 years (2005 – 2011) |
| Date of RPS/ESPS license amendment request | January 2008 |
| NRC acceptance review concerns | • Diversity and defense-in-depth assessment<br>• Bi-directional communications between safety and non-safety<br>• Software quality program<br>• Acceptability of hardware, software, and procedure changes<br>• Compliance with IEEE Std 1012 (Ref. 21)<br>• Software test tool questions |
| NRC approval of the digital RPS/ESPS | January 2010 |
| Key Metrics | |
| No. of pages of documentation shared to support NRC review | 70,000 pages |
| No. of NRC requests for additional information (RAIs) | 120 RAIs |
| No. of licensee prepared supplements to respond to RAIs | 18 supplements |
| Benefits Achieved | |
| 1. Overall system performance has met expectations.<br>▪ No negative Operating Experience<br>▪ No operational challenges<br>▪ No nuisance alarms<br>▪ No equipment failure concerns<br>▪ Maintenance activities have been performed without challenges<br>2. Obsolescence of equipment has been addressed<br>▪ Digital systems have replaced obsolete systems which had some performance problems<br>3. Improved redundancy has been realized<br>▪ Digital systems have enhanced system and plant reliability by installing redundancy to eliminate single point vulnerabilities<br>4. Improved plant reliability and system functionality<br>▪ Digital systems have enhanced system and plant reliability by installing redundancy to eliminate single point vulnerabilities<br>▪ Digital systems have allowed increased system monitoring and on-line functional check capabilities<br>▪ Digital systems have allowed for automation of certain plant activities such as turbine valve movement testing | |

[a] The data provided does not include those work activities to support and receive approval for cyber security.

### 4.3.4. NRC Operations

As a result of the rulemaking alternative, regulated entities would no longer be required to submit an AR under 10 CFR 50.55a(z) to perform a safety system upgrade using digital equipment, which would require NRC review and approval. The elimination of this review results in an averted cost (i.e., a net benefit) to the NRC.

The NRC estimates that under the no action alternative that at least two ARs would be eliminated over each three-year period for which the NRC would expend approximately 160 hours on each AR to review and issue a finding. If IEEE Std 603-2009 is IBR by rulemaking, the NRC estimates that the number of AR submitted will decrease from two every three years to one every six years. The NRC staff estimates that these post-rulemaking ARs will be more complex and will require approximately 400 hours to review and issue a finding for each AR. Table 7 presents the NRC operation averted costs for reviewing and approving these AR to be $75,000 using a 3 percent discount factor and $48,000 using a 7 percent discount factor.

**Table 7—NRC Operation – Averted AR Costs to Review**

| Year | Activity | Number of AR Reviews | Hours/AR | Hourly Rate | Cost per year | | |
|---|---|---|---|---|---|---|---|
| | | | | | Undiscounted | 3% NPV | 7% NPV |
| 2017 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $12,105 | $10,797 |
| 2018 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $11,752 | $10,091 |
| 2019 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $11,410 | $9,431 |
| 2020 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $11,077 | $8,814 |
| 2021 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $10,755 | $8,237 |
| 2022 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $10,442 | $7,698 |
| 2023 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $10,137 | $7,195 |
| 2024 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $9,842 | $6,724 |
| 2025 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $9,555 | $6,284 |
| 2026 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $9,277 | $5,873 |
| 2027 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $9,007 | $5,489 |
| 2028 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $8,745 | $5,130 |
| 2029 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $8,490 | $4,794 |
| 2030 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $8,243 | $4,480 |
| 2031 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $8,003 | $4,187 |
| 2032 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $7,769 | $3,913 |
| 2033 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $7,543 | $3,657 |
| 2034 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $7,323 | $3,418 |

| Year | Activity | Number of AR Reviews | Hours/AR | Hourly Rate | Cost per year | | |
|---|---|---|---|---|---|---|---|
| | | | | | Undiscounted | 3% NPV | 7% NPV |
| 2035 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $7,110 | $3,194 |
| 2036 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $6,903 | $2,986 |
| 2037 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $6,702 | $2,790 |
| 2038 | Alternative request review averted | 0.667 | 160 | $124 | $13,227 | $6,507 | $2,608 |
| 2017 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($7,565) | ($6,748) |
| 2018 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($7,345) | ($6,307) |
| 2019 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($7,131) | ($5,894) |
| 2020 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($6,923) | ($5,509) |
| 2021 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($6,722) | ($5,148) |
| 2022 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($6,526) | ($4,811) |
| 2023 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($6,336) | ($4,497) |
| 2024 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($6,151) | ($4,203) |
| 2025 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($5,972) | ($3,928) |
| 2026 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($5,798) | ($3,671) |
| 2027 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($5,629) | ($3,431) |
| 2028 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($5,465) | ($3,206) |
| 2029 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($5,306) | ($2,996) |
| 2030 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($5,152) | ($2,800) |
| 2031 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($5,002) | ($2,617) |
| 2032 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($4,856) | ($2,446) |
| 2033 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($4,715) | ($2,286) |
| 2034 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($4,577) | ($2,136) |
| 2035 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($4,444) | ($1,997) |
| 2036 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($4,314) | ($1,866) |
| 2037 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($4,189) | ($1,744) |
| 2038 | Alternative request review | 0.167 | 400 | $124 | ($8,267) | ($4,067) | ($1,630) |
| | | | | **Total:** | **$109,000** | **$75,000** | **$48,000** |

[a] Total values are rounded to the nearest thousand dollars.

### 4.3.5. Regulatory Efficiency

Alternative 2 relative to the regulatory baseline (alternative 1) would increase regulatory efficiency as licensees that wish to use IEEE-603-2009 would not require alternative requests from NRC regulations. For all of the subalternatives considered, the proposed action would reduce the number of ARs prepared and submitted by licensees and design certification holders, and thereby enhance regulatory efficiency. Without the proposed rule, regulated entities upgrading digital equipment are required to submit an AR under 10 CFR 50.55a(z). The averted costs to the NRC and the industry reflect the quantitative benefit of the proposed rule related to regulatory efficiency. This would provide licensees with flexibility and would decrease licensee's uncertainty when preparing to upgrade digital control systems.

Furthermore for all the subalternatives considered, the proposed action to IBR IEEE 603-2009 would increase regulatory efficiency because the IEEE standards and NRC regulations would be consistent. This resulting consistency would be greater for those subalternatives that IBR the IEEE standards without conditions (i.e., Subalternatives 2a and 2b).

Alternative 2 would make licensee upgrade plans more readily reviewable by the NRC. The conditions for using IEEE Std 279 and versions of IEEE Std 603 included in 10 CFR 50.55a(h)(2) of the proposed rule and the associated DG-1251 to clarify the applicability of IEEE Std 603-2009 and earlier standards for licensees of operating plants and approved designs, design applications, and combined licenses that modify or replace protection system or safety system equipment or functions provides guidance that will directly decrease the cost of digital system upgrades to licensees through reduced probability of licensing delays.

### 4.3.6. Consistency with NTTAA

Alternative 2 (all subalternatives) is consistent with the provisions of the NTTAA, which encourages Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry. Section 12(d)(3) of the NTTAA, and implementing guidance in OMB Circular A-119 (February 10, 1998) (Ref. 23), requires each Federal government agency (should it decide that regulation is necessary) to use a voluntary consensus standard instead of developing a government unique standard. An exception to using a voluntary consensus standard is allowed where the use of such a standard is inconsistent with applicable law or is otherwise impractical. The NTTAA requires Federal agencies to use industry consensus standards to the extent practical; it does not require Federal agencies to endorse a standard in its entirety. Neither the NTTAA nor the OMB Circular A-119 prohibit an agency from adopting a voluntary consensus standard while taking exception to specific portions of the standard, if those portions are deemed to be "inconsistent with applicable law or otherwise impractical." Furthermore, taking specific exceptions furthers the Congressional intent of Federal reliance on voluntary consensus standards because it allows the adoption of substantial portions of consensus standards without the need to reject the standards in their entirety because of limited provisions that are not acceptable to the agency.

In Alternative 2 and its subalternatives, the NRC proposes to amend its regulations to IBR a more recent revision of IEEE Std 603. The IEEE Std 603-2009 is a national consensus standard developed by participants with broad and varied interests, in which all interested parties (including the NRC and licensees and designers of nuclear power plants) participate. In Staff Requirements Memorandum (SRM)-SECY-99-029 (Ref. 24), the Commission indicated its intent that a rulemaking identify all parts of an adopted voluntary consensus standard that are

not adopted and justify not adopting such parts. The parts of IEEE Std 603-2009 that the NRC proposes to not adopt, partially adopt, or clarify to meet the NRC's regulations are identified in Section III, Discussion, of the proposed rule and in DG-1251. The justification for conditioning or not adopting parts of IEEE Std 603-2009 as set forth in this proposed rule, satisfies the requirements of NTTAA, Section 12(d)(3), OMB Circular A–119, and the Commission's direction in the SRM.

### 4.3.7. Drivers for Future Digital System Upgrades

Alternative 2 would apply to current (as of the date of the final IEEE rulemaking) and future operating nuclear power reactors licensed under 10 CFR Part 50 or Part 52 only if the combined license applicant or holder either: (1) seeks an exemption or departure from the referenced design certification rule's safety system, or (2) modifies or replaces the safety system and therefore is subject to 10 CFR 50.55a(h)(3) of the proposed rule.[7] At this time, there are no known licensees that meet this criteria and estimates for future licensee upgrades of these systems are uncertain as reflected the "Specific Requests for Comments" in the FRN.

Alternative 2 creates a regulatory framework that could accelerate the pace at which licensees upgrade nuclear plant instrumentation and control (I&C) systems. This would provide regulatory certainty for upgrading systems from analog instrumentation to digital instrumentation allowing licensees to take advantage of the benefits of these digital system upgrades. These benefits include operation and maintenance cost reduction through decreased obsolescence, fewer licensee event reports, additional performance benefits, and increased safety.

EPRI has studied the concern of aging I&C systems installed in operating nuclear plants that are (1) difficult to maintain and repair, (2) require excessive labor hours for surveillance and testing, and (3) contribute to unnecessary plant trips (Ref. 3). Operating nuclear plant licensees are aware of these trends and are developing strategies for maintaining and replacing aging and obsolete I&C equipment to balance the need for high reliability against the budget constraints of a highly competitive business environment. EPRI technical report TR-1001413 (Ref. 4) discusses the nuclear power industry practice of developing strategic plans for I&C obsolescence. The investigations revealed that most obsolescence-related problems studied were attributable to a few components and subsystems[8] that need special treatment if they are to provide dependable service over the long term. In some cases, alternate components can be substituted; in others, replacements have to be designed, manufactured, and qualified for safety-related applications. This report recommends that nuclear power plant operators evaluate their plant-specific Cost-of-Ownership Reports and make either a maintain or a plan-for-replacement decision for their reactor protection system (RPS) or plant protection system (PPS), as applicable. EPRI further recommends that if the decision is to continue to maintain their current system, that they consider ordering the identified quantities of Need-to-Buy components in the Cost-of-Ownership Report. Table 8 provides select Utilities'

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[7] The NRC notes that the NRC's approval of a certified design includes all aspects of the reactor's design that must be designed to the relevant IEEE standard under 10 CFR 50.55a(h), and the combined license applicant and holder has no further responsibility to address the adequacy of the electrical design for the safety system. Hence alternative 2 including its subalternatives does not directly apply to such combined license applicants and holders.

[8] EPRI found that the obsolescence problems experienced in the Reactor Protection System and the PPS were focused in the following equipment: (1) power supplies, (2) nuclear instrumentation, (3) man-machine interface, (4) relays, and (5) selected modules.

Cost-of-Ownership estimates for different time periods. Table 8 reflects Need-to-Buy costs estimated in year 2000 to extend the life of the system for the selected time period. Over time as component availability changes from readily available (i.e., Type 0) to an obsolete (i.e., Type 3) component the situation gets worse because the scarcity of replacements increases the price or if not available, the replacement part may require a change in form factor, custom re-design, and full re-qualification.[9]

**Table 8–Cost-of-Ownership as of Year 2015 (Component types 0, 1, and 2 only)**

| Representative Plants | System | 5 Years | 10 Years | 20 Years | 30 Years |
|---|---|---|---|---|---|
| Single unit site A | RPS | $4,062,126 | $5,077,657 | $7,108,720 | $9,139,783 |
| Single unit site B | RPS | $1,925,040 | $2,406,300 | $3,368,821 | $4,331,341 |
| Three unit site C | PPS | $13,278,734 | $16,598,417 | $23,237,784 | $29,877,151 |
| Single unit site D | RPS | $3,075,869 | $3,844,836 | $5,382,770 | $6,920,705 |
| Two unit site E | RPS | $3,503,957 | $4,379,946 | $6,131,924 | $7,883,903 |
| Single unit site F | RPS | $8,782,917 | $10,978,646 | $15,370,104 | $19,761,562 |
| Single unit site G | PPS | $8,373,949 | $10,467,436 | $14,654,411 | $18,841,385 |
| Two unit site H | PPS | $8,219,648 | $10,274,560 | $14,384,384 | $18,494,208 |

[a] These values are based on the cost-of-ownership values provided in EPRI TR-1001413 with the values inflated to 2015 dollars and the estimates shifted 15 years from year 2000 to year 2015 using linear regression.

[b] This table may overestimate the availability of replacement parts, which would result in the cost-of-ownership to be underestimated.

Upgrading from obsolete analog I&C to digital technology offers many new capabilities that can improve reliability and plant performance, but cost-benefit justifications to determine whether to maintain aging equipment, replace critical components, or replace entire systems have proven problematic in the current business environment. Another perspective on this issue is provided by a company which operates a fleet of nuclear power plants. This company recognizes that I&C obsolescence is exacerbated by the fact that most nuclear plants have or are in the process of extending their operating licenses by 20 years. This requires that strategies be developed for managing I&C obsolescence and phasing in new technology, which is ultimately unavoidable (Ref. 16), but that much can be done to optimize the upgrade process and the ways in which new technology is utilized to improve plant reliability and operability.

### 4.3.8. NRC Staff Non-Concurrences

NRC staff individuals expressed concerns that resulted in four non-concurrences on the proposed rulemaking package (Ref. 12, 13, 14, and 15). The staff's detailed evaluation of the concerns and the final position and outcome is included in Section C of each of the non-concurrence packages.

[9] EPRI categorized RPS and PPS components according to their Availability Type. The Availability Type definitions are (1) Type 0: not currently obsolete and still readily available, (2) Type 1: expected to be obsolete soon, but a limited quantity is still available either through the Original Equipment Manufacturer (OEM) or through various distribution and parts brokerage firms, (3) Type 2: obsolete but alternate components can be located which require further documentation and/or testing prior to use an approved alternate, and (4) Type 3: obsolete and the alternate part(s) require a change in the form factor or mechanical footprint and a redesign of the parent assembly.

The first non-concurrence, NCP 2014-001, expresses concerns about the impacts of NRC-proposed restrictions on data communications for new reactors, and the effects of having different requirements for new reactors than those for operating reactors. The staff believes, based upon experience gained from staff review of the data communications aspects of new reactors, that there will be added regulatory certainty if the proposed restrictions are expressly stated in the regulation. For these reasons, the staff disagrees with the non-concurrence, and believes that the NRC can issue the proposed rulemaking for public comment.

The second non-concurrence, NCP 2014-003, also focuses on the restrictions on data communications in the proposed rule. It asserts that the restrictions will not have the intended effect of increasing regulatory certainty, but will have the opposite effect because of the potential need for significant changes to platforms or systems to meet the conditions in the proposed regulatory language. This will likely result in many applicant and licensee requests for NRC approval, under 10 CFR 50.55a(z), of alternatives to the proposed regulatory restrictions on data communications. To mitigate this concern, the staff is considering enhancing the guidance of Chapter 7, "Instrumentation and Controls," of NUREG-0800, "Standard Review Plan" (Ref. 5). However, the staff believes that the benefits of added regulatory predictability and increased licensing certainty outweigh the potential negative consequences described in the non-concurrence. For these reasons, the staff disagrees with the non-concurrence, and believes that the NRC can issue the proposed rulemaking for public comment.

The third non-concurrence, NCP 2014-004, advocated re-examination of the fundamental approach in the proposed rule. The non-concurrence proposed a two-tiered approach to address generic safety system requirements and technology-specific requirements instead of the approach in the proposed rule. The non-concurrence argued that new technology and the level of complexity of current and future I&C systems may contribute to common cause failures that are not addressed in the proposed rule and could defeat system diversity. The NRC is currently addressing some of the concerns raised by the non-concurrence in other NRC activities. For example, the NRC is developing a regulatory information summary on embedded digital devices. Also, NRC research activities are examining hazards analysis methods, and this effort is informing the development of the Design Specific Review Standard and possibly future Standard Review Plan revisions. Moreover, as a result of this non-concurrence, the staff removed a draft requirement from the proposed rule related to diversity, and is taking steps to pursue a separate rulemaking effort that will address the diversity and defense-in-depth concerns described in the non-concurrence. For these reasons, the staff disagrees with the apparent position of the non-concurrence that a re-examination and change in the fundamental approach in the proposed rule is appropriate, and believes that the NRC can issue the proposed rulemaking for public comment.

The fourth non-concurrence, NCP 2015-001, disagreed with the decision to not include a requirement related to diversity for digital systems in the proposed rule (originally considered by the staff working group during the drafting of the proposed regulation). The non-concurrence asserted that the non-inclusion of the diversity requirement will leave a regulatory gap and create ambiguity regarding the requirements for this technical area. The staff agrees that the criteria, which are derived from SRM-SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs" (Ref. 25), should be the subject of rulemaking. However, after internal discussion and in response to NCP 2014-004, the staff decided to remove the requirements related to diversity and defense-in-depth from this proposed rule and instead address diversity and defense-in-depth considerations in a separate rulemaking (to be provided to the Commission for approval). The staff believes the current regulatory infrastructure (including the criteria in SRM-SECY-93-087)

provides an adequate regulatory basis in the interim (before the rulemaking addressing diversity and defense-in-depth is completed) for the NRC to require applicants and licensees in both operating and new reactor reviews to address diversity and defense-in-depth. For these reasons, the staff disagrees with the non-concurrence, and believes that the NRC can issue the proposed rulemaking for public comment.

## 5. PRESENTATION OF RESULTS

This section organizes the analytical results into four sections. Section 5.1 presents results on the benefits and costs of the proposed rule as a whole. Section 5.2 evaluates the uncertainties in the benefit and cost estimate and identifies those uncertain variables that most affect the variation in the results. Section 5.3 discusses disaggregation of the requirements in the proposed rule, as well as disaggregated results for each of the regulatory requirements that comprise the proposed rule. Section 5.3 addresses the applicability of a safety goal evaluation to the proposed rule.

### 5.1. Quantified Net Benefits

Table 9 summarizes the estimated incremental benefits and costs of the alternative relative to the regulatory baseline. The quantitative costs for the alternative outweigh the benefits by a range from approximately ($329,000) using a 3 percent discount factor to ($379,000) using a 7 percent discount factor. These costs are associated with four affected attributes—industry implementation and operation, and NRC implementation and operation.

**Table 9—Estimated Incremental Net Benefit (Cost)**

| Category | Undiscounted | 3% NPV | 7% NPV |
|---|---|---|---|
| **Rulemaking Costs** | | | |
| Industry Cost | ($81,000) | ($81,000) | ($81,000) |
| NRC Cost | ($430,000) | ($430,000) | ($420,000) |
| *Subtotal* | *($511,000)* | *($511,000)* | *($501,000)* |
| **Alternative Requests** | | | |
| Total Industry Cost | $150,000 | $107,000 | $74,000 |
| Total NRC Cost | $109,000 | $75,000 | $48,000 |
| *Subtotal* | *$259,000* | *$182,000* | *$122,000* |
| **Total Costs** | | | |
| Total Industry Benefit (Cost) | $69,000 | $26,000 | ($7,000) |
| Total NRC Benefit (Cost) | ($321,000) | ($355,000) | ($372,000) |
| **Total Net Benefit (Cost)** | **($252,000)** | **($329,000)** | **($379,000)** |
| | | | |
| **Average Cost per unit** | $700 | $300 | ($100) |

* Values are rounded to the nearest thousand dollars.
** Average cost per unit is rounded to the nearest hundred dollars.

One reason that the alternative is not cost beneficial is the costs associated with the one-time NRC costs associated with developing and publishing the proposed and final rule, developing and publishing the draft and final regulatory guidance, and rulemaking activities required to address internal and public comments regarding IBR the IEEE 603-2009 standard. The analysis shows that both industry and NRC will benefit from alternative 2, which results in reducing the number of ARs that would have otherwise been prepared, submitted, reviewed,

and approved if the alternative is not implemented and there is evidence that the regulatory baseline cost will continue to rise because of analog I&C equipment obsolescence. Furthermore, the data provided in Table 6 of this draft regulatory analysis indicate that there is a significant opportunity for the alternative 2 improvements in regulations and guidance to reduce the number of NRC-generated RAIs for a major digital upgrade project thereby eliminating the need for licensees to prepare and submit multiple supplements. Based on this evidence, the NRC staff believes that the improvements provided by alternative 2 would reduce this level of industry and NRC operation impact. Lastly, the draft regulatory analysis shows that the avoided AR costs makes the alternative cost-beneficial for industry for the undiscounted and 3 percent net present value cases and just marginally not cost-beneficial (i.e., negative $7,000) for the 7 percent net present value.

Table 10 summarizes the estimated incremental benefits and costs of the alternative relative to the regulatory baseline. The proposed rule (alternative 2) would result in an estimated averted cost of between $122,000 and $182,000 at a 7-percent and a 3-percent discount rate, respectively. Overall, the net benefit is an estimated cost of between ($379,000) and ($329,000) at a 7-percent and a 3-percent discount rate, respectively. However, analog I&C equipment obsolescence could significantly increase as parts become unavailable thereby increasing industry's operation and maintenance costs. The NRC staff is seeking additional information on this issue and the status of replacement parts.

**Table 10—Summary of Overall Benefits and Costs (Quantitative and Qualitative)**

| | Values – Averted Costs (2015 Dollars) and Qualitative Benefits | Impacts – Costs (2015 Dollars) and Qualitative Costs |
|---|---|---|
| **Alternative 2: Proposed Rule** | **Total Implementation Costs Averted:** $0<br><br>**Industry Operation Costs Averted:**<br>$74,000 using a 7% discount rate<br>$107,000 using a 3% discount rate<br><br>**NRC Operation Costs Averted:**<br>$48,000 using a 7% discount rate<br>$75,000 using a 3% discount rate<br><br>**Total Operation Costs Averted:**<br>$122,000 using a 7% discount rate<br>$182,000 using a 3% discount rate<br><br>**Net Benefit (Cost):**<br>($379,000) using a 7% discount rate<br>($329,000) using a 3% discount rate<br><br>**Qualitative Benefits**<br>**Regulatory Efficiency –** The proposed alternative would result in enhanced regulatory efficiency as licensees that wish to use IEEE-603-2009 would not be required to prepare and submit alternative requests by NRC regulations. For all of the subalternatives considered, the proposed action would reduce the number of ARs prepared and submitted by licensees and design certification holders, and thereby enhance regulatory efficiency. Without the proposed rule, regulated entities upgrading digital equipment are required to submit an AR under 10 CFR 50.55a(z). The averted costs to the NRC and the industry reflect the quantitative benefit of the proposed rule related to regulatory efficiency. This would provide licensees with flexibility and would decrease licensee's uncertainty | **Industry Implementation Costs: (**$81,000)<br><br>**NRC Implementation Costs:**<br>($420,000) using a 7% discount rate<br>($430,000) using a 3% discount rate<br><br>**Total Implementation Costs:**<br>($501,000) using a 7% discount rate<br>($511,000) using a 3% discount rate<br><br>**Total Operation Costs**: $0<br><br>**Qualitative Costs**<br>**Licensee Plans for Future Digital System Upgrades** – Alternative 2 would apply to current and future operating nuclear power reactors licensed under 10 CFR Part 50 or Part 52 only if the combined license applicant or holder either: (1) seeks an exemption or departure from the referenced design certification rule's safety system, or (2) modifies or replaces the safety system and therefore is subject to 10 CFR 50.55a(h)(3) of the proposed rule. At this time, there are no known licensees that meet this criteria and estimates for future licensee upgrades of these systems are uncertain as reflected the "Specific Requests for Comments" in the FRN. Should licensees decide not to upgrade these systems, the averted cost estimates will not be realized.<br><br>**Non-concurrence NCP 2014-001** – This non-concurrence expresses concerns about the impacts of NRC-proposed restrictions on data communications for new reactors, and the effects of having different requirements for new reactors than |

| | Values – Averted Costs (2015 Dollars) and Qualitative Benefits | Impacts – Costs (2015 Dollars) and Qualitative Costs |
|---|---|---|
| | when preparing to upgrade digital control systems.<br><br>Furthermore for all the subalternatives considered, the proposed action to IBR IEEE 603-2009 would increase regulatory efficiency because the IEEE standards and NRC regulations would be consistent. This resulting consistency would be greater for those subalternatives that IBR the IEEE standards without conditions (i.e., Subalternatives 2a and 2b)<br><br>The costs averted to the NRC and the industry reflects the quantitative benefit of the proposed action related to regulatory efficiency. This draft regulatory analysis identified no additional regulatory efficiency gains or costs.<br><br>**Consistency with NTTAA** – Alternative 2 (all subalternatives) is consistent with the provisions of the NTTAA, which encourages Federal regulatory agencies to consider adopting voluntary consensus standards as an alternative to *de novo* agency development of standards affecting an industry. Neither the NTTAA nor the OMB Circular A-119 prohibit an agency from adopting a voluntary consensus standard while taking exception to specific portions of the standard, if those portions are deemed to be "inconsistent with applicable law or otherwise impractical." Furthermore, taking specific exceptions furthers the Congressional intent of Federal reliance on voluntary consensus standards because it allows the adoption of substantial portions of consensus standards without the need to reject the standards in their entirety because of limited provisions that are not acceptable to the agency.<br><br>In Alternative 2 and its subalternatives, the NRC proposes to amend its regulations to IBR a more recent revision of IEEE Std 603. The IEEE Std 603-2009 is a national consensus standard developed by participants with broad and varied interests, in which all interested parties (including the NRC and licensees and designers of nuclear power plants) participate. | those for operating reactors.<br><br>**Non-concurrence NCP 2014-003** – This non-concurrence focuses on the restrictions on data communications in the proposed rule. It asserts that the restrictions will not have the intended effect of increasing regulatory certainty, but will have the opposite effect because of the potential need for significant changes to platforms or systems to meet the conditions in the proposed regulatory language.<br><br>**Non-concurrence NCP 2014-004** – This non-concurrence advocates re-examination of the fundamental approach in the proposed rule. The non-concurrence proposed a two-tiered approach to address generic safety system requirements and technology-specific requirements instead of the approach in the proposed rule. The non-concurrence argued that new technology and the level of complexity of current and future instrumentation and control systems may contribute to common cause failures that are not addressed in the proposed rule and could defeat system diversity.<br><br>**Non-concurrence NCP 2015-001** – This non-concurrence disagrees with the decision to not include a requirement related to diversity for digital systems in the proposed rule and asserts that the non-inclusion of the diversity requirement will leave a regulatory gap and create ambiguity regarding the requirements for this technical area. |

* Values are rounded to the nearest thousand dollars.

## 5.2. Uncertainty Analysis

As this entire analysis is based on estimates of values and unknown amounts of risk, it is useful to run a sensitivity analysis of the variables in which there is the greatest amount of uncertainty. A Monte Carlo Sensitivity Analysis was completed with the assistance of @Risk, a software program specially designed for completing this type of analysis. The Monte Carlo approach provides an answer to the question: what distribution of net benefits results from multiple draws of the probability distribution assigned to key variables. Performing formal uncertainty analysis is a General Accountability Office recommended best practice (Ref. 26), which can provide valuable information for policy-makers evaluating proposed regulations. First, findings regarding uncertainty in a net benefits estimate can provide a context for interpreting an estimate of the expected value of a proposed regulation's net benefits. Second, consideration of uncertainties in underlying inputs, and how those uncertainties interact, can lead to an estimate of the expected value of a regulation's net benefits that differs from the estimate that would be produced if uncertainty in underlying inputs was not accounted for and single values were used for each input in calculating net benefits.

### 5.2.1. Uncertainty Analysis Assumptions

The Monte Carlo analysis requires the identification of the variables that are uncertain. In this analysis, those variables are: (1) the time taken for industry representative to review and comment on proposed rule document, (2) the number and amount of time to prepare and process AR if the rule is or is not promulgated, (3) NRC implementation costs of developing and issuing the proposed and final rules and regulatory guides, (4) the hours required for the NRC to respond to a AR, and (5) labor categories and rates for individuals assigned to perform this work. A Program Evaluation and Review Technique (PERT) distribution[10] is used to model the data inputs. Table 5-2 summarizes the variable assumptions in the analysis.

**Table 11—Uncertainty Analysis Variables**

| Uncertainty Variable Description | Value | Distribution | Low Estimate | Best Estimate | High Estimate |
|---|---|---|---|---|---|
| Base year | 2015 | | | | |
| **Industry Implementation (one-time)** | | | | | |
| Review and provide feedback and comments on NRC proposed rule documents | | | | | |
| Industry executives | 120 hours | Pert | 40 | 120 | 150 |
| Industry managers | 150 hours | Pert | 50 | 150 | 225 |
| Industry technical staff | 280 hours | Pert | 95 | 280 | 420 |
| Industry administrative staff | 50 hours | Pert | 20 | 50 | 100 |
| Industry licensing staff | 200 hours | Pert | 70 | 200 | 300 |
| **Industry Operation (recurring)** | | | | | |
| Prepare alternative requests (base case) | | | | | |
| Frequency of alternative requests (AR) | 0.67 AR/year | Pert | 0.33 | 0.67 | 1.00 |
| Prepare and process an AR (base case) | $23,428 | Pert | $19,914 | $23,428 | $35,143 |
| Prepare alternative requests (alternative case) | | | | | |
| Frequency of alternative requests (AR) | 0.17 AR/year | Pert | 0.1 | 0.17 | 0.33 |
| Prepare and process an AR (alternative case) | $54,566 | Pert | $46,381 | $54,566 | $81,850 |
| **NRC Implementation (one-time)** | | | | | |
| Rulemaking | | | | | |
| Publish proposed rule and guidance | 2,000 hours | Pert | 1600 | 2000 | 4260 |
| Develop and issue final rule and guidance | 1,500 hours | Pert | 1250 | 1500 | 2556 |
| **NRC Operation (recurring)** | | | | | |
| Process submitted alternative requests (base case) | | | | | |
| Review and process an AR - base case | 160 hours | Pert | 120 | 160 | 320 |
| Process submitted alternative requests (alternative case) | | | | | |

[10] A Program Evaluation and Review Technique (PERT) distribution is a special form of the beta distribution with a minimum and maximum value specified. The shape parameter is calculated from the defined *most likely* value. The PERT distribution is similar to a Triangular distribution, in that it has the same set of three parameters. Technically, it is a special case of a scaled Beta (or Beta General) distribution. It can generally be considered as superior to the Triangular distribution when the parameters result in a skewed distribution, 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 some modelling purposes where it is desired to capture tail or extreme events.

| Uncertainty Variable Description | Value | Distribution | Low Estimate | Best Estimate | High Estimate |
|---|---|---|---|---|---|
| Review and process an AR - alternative case | 400 hours | Pert | 320 | 400 | 1000 |
| **Labor rates** | | | | | |
| Industry executives | $162/hour | Pert | $109.45 | $162.17 | $196.24 |
| Industry managers | $101/hour | Pert | $75.37 | $101.00 | $122.65 |
| Industry technical staff | $79/hour | Pert | $65.57 | $79.26 | $92.63 |
| Industry administrative staff | $52/hour | Pert | $36.49 | $51.90 | $65.51 |
| Industry licensing staff | $110/hour | Pert | $74.79 | $109.97 | $131.72 |
| NRC | $124/hour | Pert | $120 | $124 | $125 |

### 5.2.2. Uncertainty Analysis Results

Five thousand simulations were run. Figures 1 through 8 show the distributions of the estimated benefits and costs.

Figure 1 presents the industry incremental costs to review and comment on the proposed rule. The distribution shows that industry will incur an incremental one-time cost of between ($63,000) and ($93,000) at a 90-percent confidence level with a mean value of ($78,000).

**Figure 1—Industry Implementation Costs**

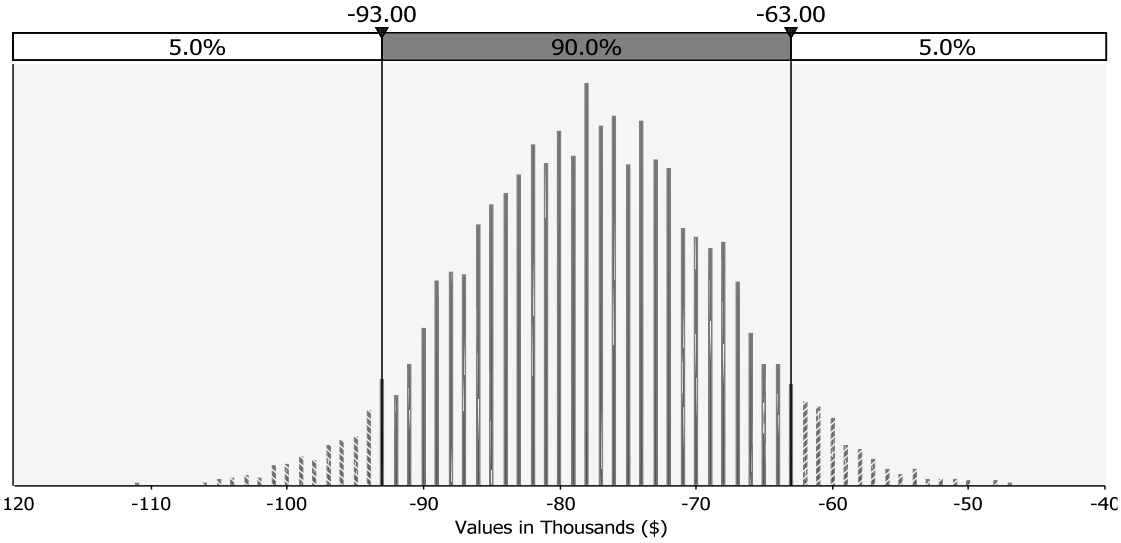


Figure 2 presents the industry operation costs for preparing and submitting ARs based on a 7-percent discount factor. The distribution shows that industry will incur a cost of between ($17,000) and $148,000 at a 90-percent confidence level with a mean value of $66,000 based on a 7-percent discount factor. Figure 2 also shows that there is a 90.2-percent chance that industry operation averted costs (i.e., benefit) are greater than zero.

**Figure 2—Industry Operation (Averted Costs - 7% NPV)**

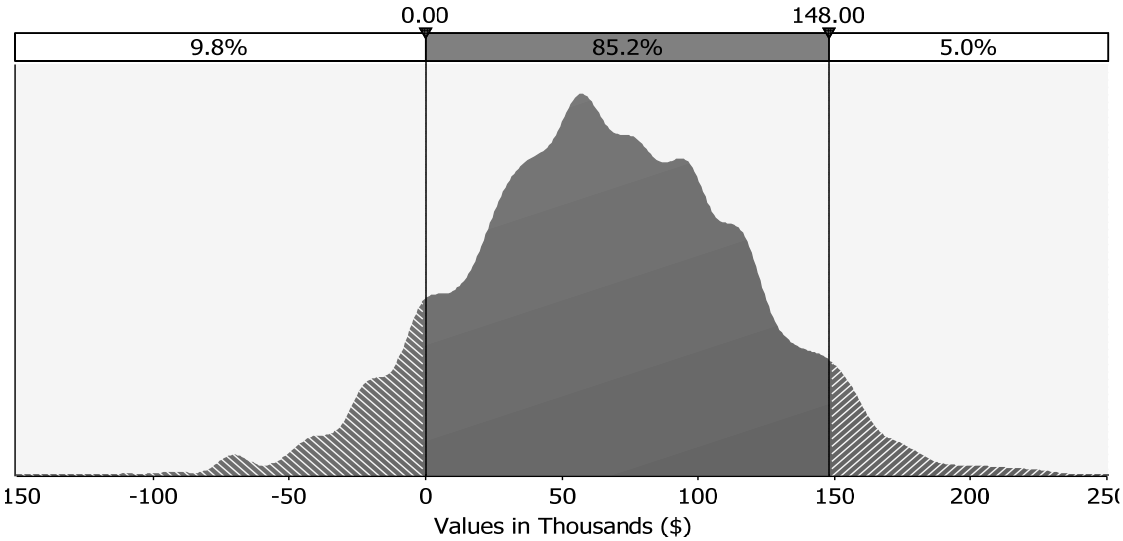



Figure 3 presents the industry operation costs for preparing and submitting ARs based on a 3-percent discount factor. The distribution shows that industry will incur a cost of between ($24,000) and $216,000 at a 90-percent confidence level with a mean value of $96,000 based on a 3-percent discount factor. Figure 3 also shows that there is a 90.3-percent chance that industry operation averted costs (i.e., benefit) are greater than zero.

**Figure 3—Industry Operation (Averted Costs - 3% NPV)**

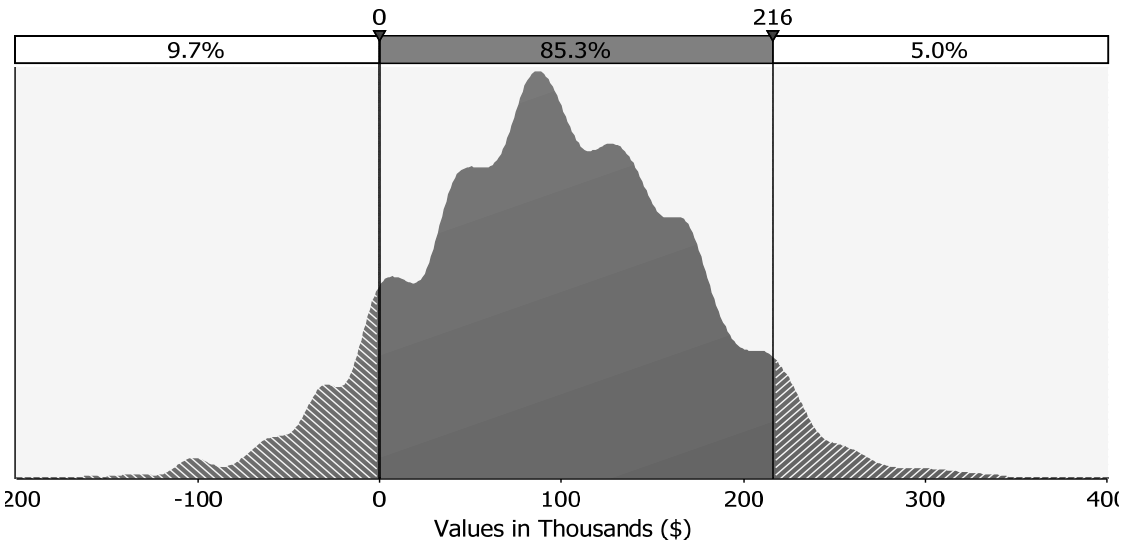


Figure 4 provides the estimated incremental one-time NRC implementation cost for development of the final rule and updating RG 1.153. The distribution shows that the NRC will incur a cost of between ($590,000) and ($390,000) at a 90-percent confidence level with a mean value of ($470,000). These implementation costs are the primary reason that the proposed alternative is not cost-beneficial.

**Figure 4—NRC Implementation**

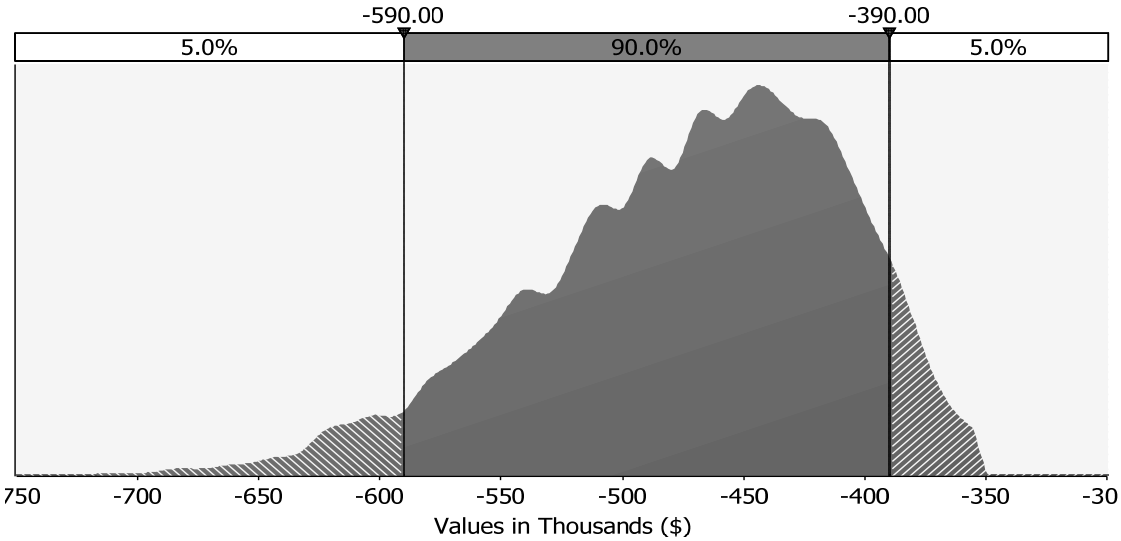



Figure 5 presents the NRC operation costs for reviewing and approving these ARs based on a 7-percent discount factor. The distribution shows that the NRC will incur a cost of between ($49,000) and $122,000 at a 90-percent confidence level with a mean value of $37,000 based on a 7-percent discount factor. Figure 5 shows that there is a 76.3-percent chance that NRC operation averted costs (i.e., benefits) are greater than zero.

**Figure 5—NRC Operation (Averted Costs - 7% NPV)**

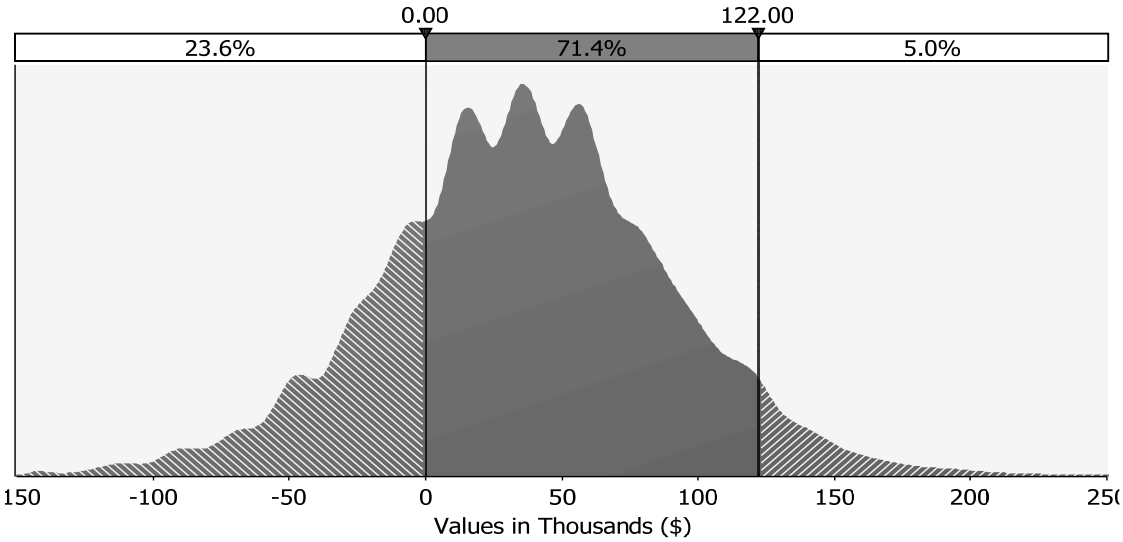


Figure 6 presents the NRC operation costs for reviewing and approving these ARs based on a 3-percent discount factor. The distribution shows that the NRC will incur a cost of between ($77,000) and $190,000 at a 90-percent confidence level with a mean value of $57,000 based on a 3-percent discount factor. Figure 6 shows that there is a 76.6-percent chance that NRC operation averted costs (i.e., benefits) are greater than zero.

**Figure 6—NRC Operation (Averted Costs - 3% NPV)**

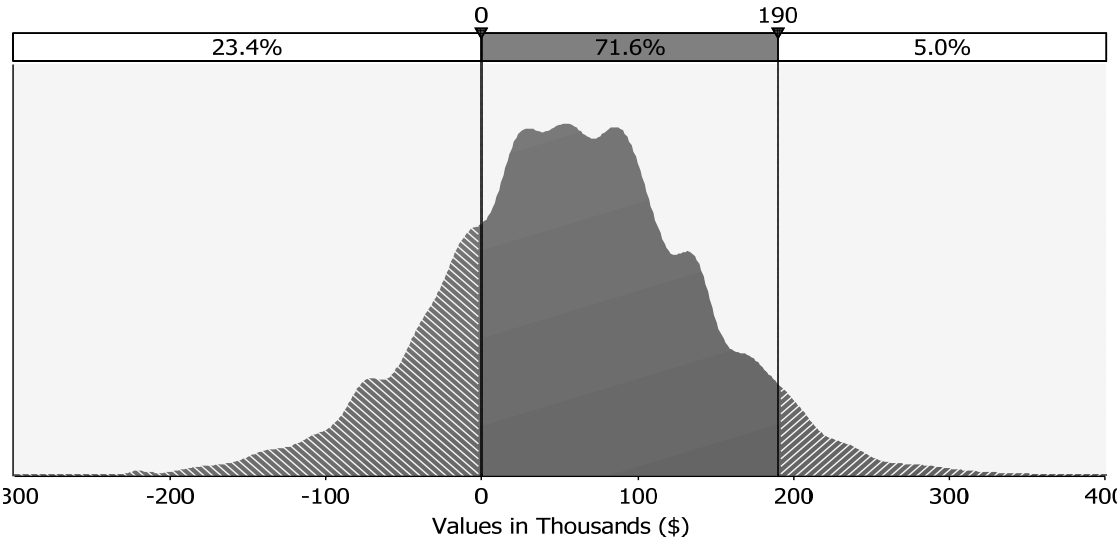



Figure 7 presents the total net benefit distribution using a 7-percent discount factor. The distribution shows that the alternative will incur a cost of between ($638,000) and ($272,000) at a 90-percent confidence level with a mean value of ($449,000) based on a 7-percent discount factor. Figure 7 also shows that there is a negligible chance that the total net benefit is greater than zero when using a 7-percent discount factor.

**Figure 7—Total Net Benefit (7% NPV)**

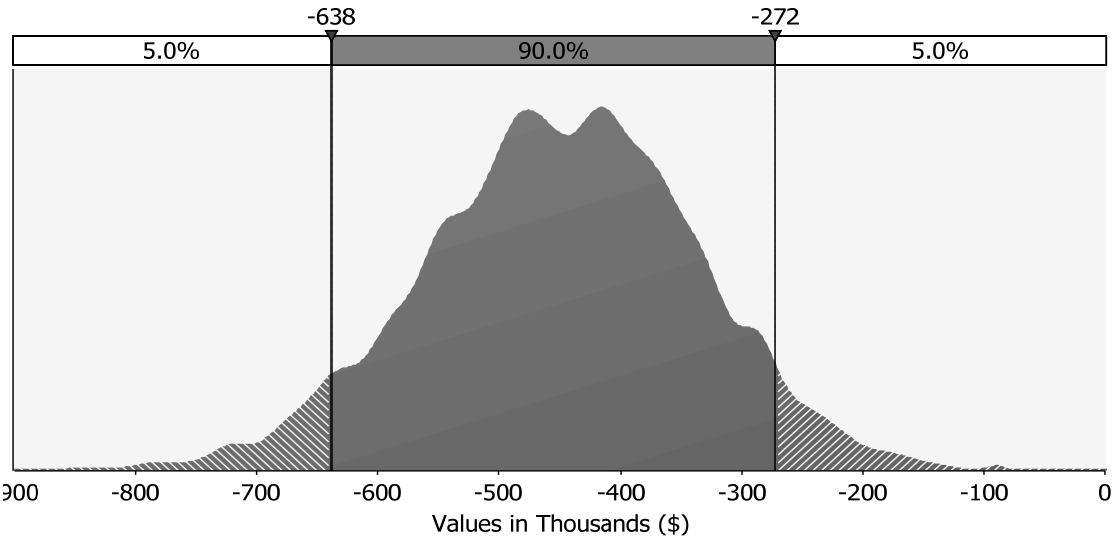
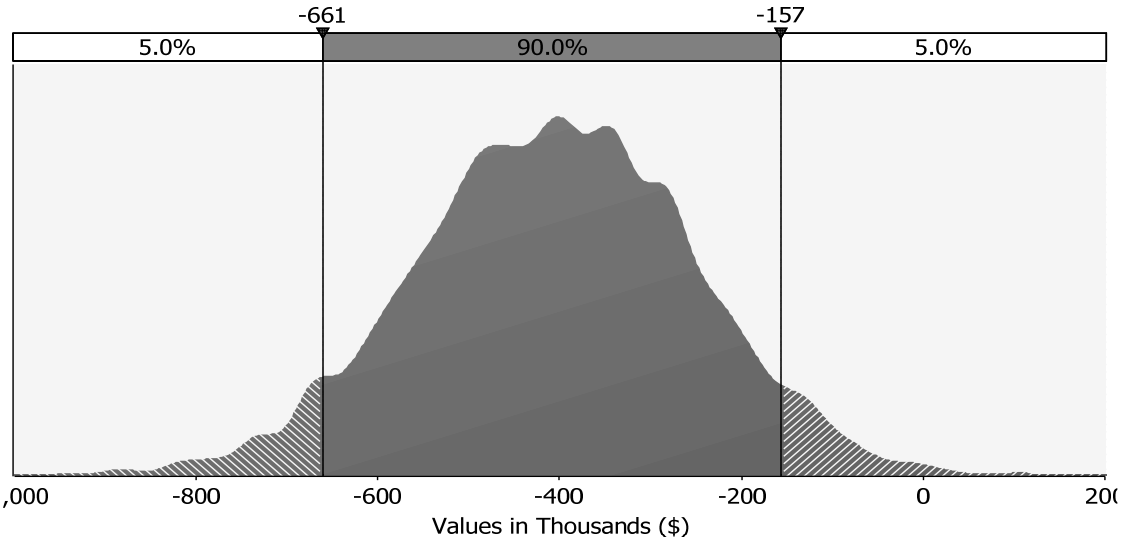


Figure 8 presents the total net benefit distribution using a 3-percent discount factor. The distribution shows that the alternative will incur a cost of between ($661,000) and ($157,000) at a 90-percent confidence level with a mean value of ($406,000) based on a 3-percent discount factor. Figure 8 also shows that there is less than a 0.3-percent chance that the total net benefit is greater than zero when using a 3-percent discount factor.

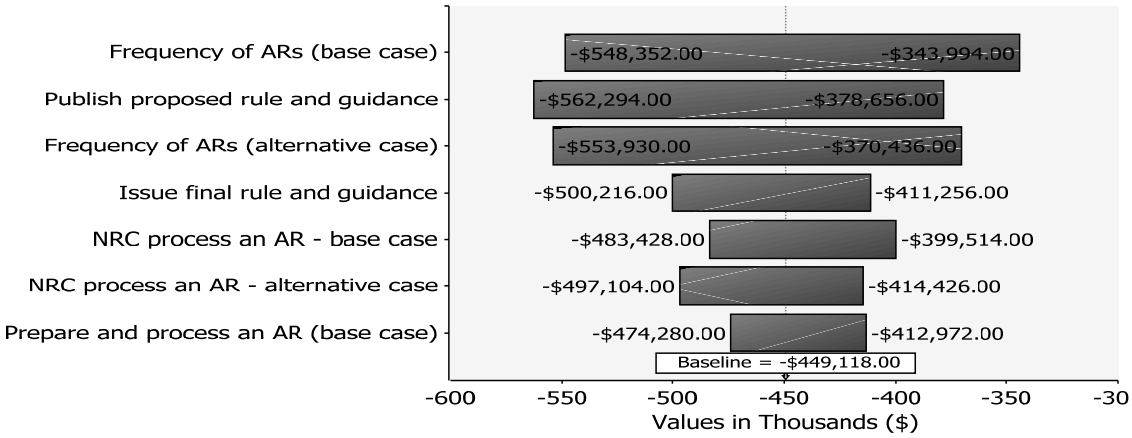
**Figure 8—Total Net Benefit (3% NPV)**




The analysis shows that industry and the NRC would realize averted costs (savings) in operation costs but that rulemaking associated costs for industry and NRC results in the costs exceeding the benefits when compared to the regulatory baseline.

Figure 9 shows a tornado diagram, which identifies seven factors whose uncertainty drives the largest impacts on the costs for the total net benefit output mean. The uncertainty regarding the number ARs that will be averted by implementing this regulatory action has the largest impact on the total net benefit results. The next two variables, NRC implementing activities to publish the proposed rule and guidance and the number of ARs that licensees would need to generate after this regulatory action is effective highlights the sensitivity that conditioning the IEEE standard and industry's ability to meet the requirements without requesting an AR has on the estimated total net benefit. The remaining four variables, NRC implementing activities to resolve public comments and issue the final rule and guidance, the hours required for the NRC to respond to a AR if the regulatory action is or is not implemented, and the hours required by a licensee to prepare, process, and submit an AR if the regulatory action is not implemented have lesser and comparable impacts on the total net benefit.

**Figure 9—Total Net Benefit (7% NPV) Inputs Ranked by Effect on Output Mean**




## 5.3. Uncertainty Analysis Summary

The uncertainty analysis found that the proposed rule would result in positive averted costs (e.g., savings) for industry and the NRC but the costs associated with rulemaking results in the costs exceeding the averted costs when compared to the regulatory baseline. Contributing to this conclusion is the low utilization of this rule. Table 12 provides pertinent descriptive statistics of the uncertainty analysis.

**Table 12—Uncertainty Results Descriptive Statistics (2015 dollars)**

| Uncertainty Result | Minimum | 5% | Median | Mode | Mean | 95% | Maximum |
|---|---|---|---|---|---|---|---|
| Industry Implementation Costs | ($111,000) | ($93,000) | ($78,000) | ($78,000) | ($77,753) | ($63,000) | ($47,000) |
| Industry Operation Costs Averted (7% Discount Rate) | ($115,000) | ($17,000) | $66,000 | $55,000 | $65,971 | $148,000 | $239,000 |
| Industry Operation Costs Averted (3% Discount Rate) | ($168,000) | ($24,000) | $96,000 | $101,000 | $96,254 | $216,000 | $348,000 |
| NRC Implementation Costs | ($720,000) | ($590,000) | ($470,000) | ($450,000) | ($473,902) | ($390,000) | ($350,000) |
| NRC Operation Costs Averted (7% Discount Rate) | ($148,000) | ($49,000) | $37,000 | $62,000 | $36,566 | $122,000 | $230,000 |
| NRC Operation Costs Averted (3% Discount Rate) | ($230,000) | ($77,000) | $57,000 | $37,000 | $56,860 | $190,000 | $357,000 |
| Total Net Benefit (7% Discount Rate) | ($864,000) | ($638,000) | ($447,000) | ($484,000) | ($449,118) | ($272,000) | ($78,000) |
| Total Net Benefit (3% Discount Rate) | ($958,000) | ($661,000) | ($403,000) | ($449,000) | ($405,931) | ($157,000) | $124,000 |

## 5.4. Disaggregation

To comply with the guidance provided in Section 4.3.2 ("Criteria for the Treatment of Individual Requirements") of the Regulatory Analysis Guidelines[11], the NRC conducted a screening review to determine if any of the individual requirements (or set of integrated requirements) of the

[11] NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, 2004. (Ref. 7)

proposed rule would be unnecessary to achieve the objectives of the rulemaking. The NRC identified the following objectives of the rulemaking: (1) IBR related standards, (2) provide updated rules for the design and construction of safety-related instrumentation and control systems, and (3) impose conditions on the use of the updated rules. Furthermore, the NRC concludes that each of the proposed rule's requirements would be necessary to achieve one or more objectives of the rulemaking. The results of this determination are set forth in Table 13.

**Table 13—Disaggregation**

| Individual Proposed Rule Requirements | Regulatory Goals for 10 CFR 50.55a | | |
|---|---|---|---|
| | 1) Incorporate by reference related standards | 2) Provide updated rules for design and construction | 3) Impose conditions on the use of update standard rules |
| 10 CFR 50.55a(a)(2)(iv) IEEE Std 603-2009 | X | X | X |
| 10 CFR 50.55a(h)(2)(i) Nuclear power plant construction permits issued before January 1, 1971 | | X | |
| 10 CFR 50.55a(h)(2)(ii) Nuclear power plant construction permits issued after January 1, 1971, but before May 13, 1999 | | X | |
| 10 CFR 50.55a(h)(2)(iii) Standard design certifications issued before May 13, 1999 | | X | |
| 10 CFR 50.55a(h)(2)(iv) Standard design certifications issued after May 13, 1999, but before the effective date of the final rule | | X | |
| 10 CFR 50.55a(h)(2)(v) Standard design certifications issued after the effective date of the final rule | | X | X |
| 10 CFR 50.55a(h)(2)(vi) Applications submitted after the effective date of the final rule for nuclear power plant construction permits and operating licenses under 10 CFR Part 50 | | X | X |
| 10 CFR 50.55a(h)(2)(vii) Nuclear power plant combined licenses and manufacturing licenses under 10 CFR Part 52 issued after the effective date of the final rule | | X | X |
| 10 CFR 50.55a(h)(2)(viii) Updated standards | X | X | X |
| 10 CFR 50.55a(h)(3) Modifications and replacements of protection systems and safety systems | | X | X |
| 10 CFR 50.55a(h)(4) System Integrity | | X | X |
| 10 CFR 50.55a(h)(5) Independence | | X | X |
| 10 CFR 50.55a(h)(6) Retaining safety function capability during maintenance bypass | | X | X |
| 10 CFR 50.55a(h)(7) Maintenance bypass | | X | X |
| 10 CFR 50.55a(h)(8) Documentation supporting compliance | | X | |

### 5.5. Safety Goal Evaluation

Safety goal evaluations are applicable only to regulatory initiatives considered to be generic safety enhancement backfits subject to the substantial additional protection standard at 10 CFR 50.109(a)(3). Some aspects of this rule may have generic safety impacts because they may affect the likelihood of core damage or spent fuel damage, which generally are the focus of a quantitative safety goal evaluation. However, the magnitude of this change is not readily quantifiable due to uncertainties discussed in Section 5.2. A more dominant effect of this rule is to reduce burden on the regulated entities and the NRC, resulting in cost savings for both. Because the change in safety associated with the rulemaking cannot easily be quantified, the regulatory changes cannot be compared to the NRC's safety goals.

## 6. DECISION RATIONALE FOR SELECTION OF THE PROPOSED ACTION

As shown in Table 9, Alternative 2 relative to the regulatory baseline is cost-benefit neutral for industry with an estimated net cost of ($7,000) based on a 7-percent net present value (NPV) to a net benefit of $26,000 based on a 3-percent NPV. The estimated incremental industry cost per reactor unit ranges from ($100) based on a 7-percent NPV to a net benefit per reactor unit of $300 based on a 3-percent NPV. Mean values from the uncertainty analysis provided in Table 12 also show that Alternative 2 relative to the regulatory baseline is cost-benefit neutral for industry with an estimated net cost of ($11,800) based on a 7-percent net present value (NPV) to a net benefit of ($18,500) based on a 3-percent NPV. For the NRC, alternative 2 is not quantitatively cost beneficial, although, as discussed below, there are significant benefits that were not quantified in this analysis. The quantified costs for the NRC range from an estimated net cost of ($372,000) based on a 7% NPV to a net cost of ($355,000) based on a 3% NPV. The NRC benefits from the proposed rulemaking alternative because of the averted cost savings resulting from the reduction of the number of alternative requests on a plant-specific basis under 10 CFR 50.55a(z).

One reason that the quantitative analysis shows that the alternative is not cost beneficial is the one-time NRC costs associated with developing and publishing the final rule, final regulatory guidance, and the rulemaking activities required to address internal and public comments regarding the IEEE 603-2009 standard. However, the regulatory analysis discusses several compelling reasons to move forward with the publishing of the proposed rule for public comment and completing the final rule.

Alternative 2 has 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 criteria in IEEE Std 603-2009 to address safety issues associated with major changes to the underlying bases of protection and safety systems that could impair dependability and reliability from potential new system-level failure modes, as discussed in Table 6. Based on experience, the NRC staff believes that the improvements provided by alternative 2 would reduce this level of industry operation impact and provide additional averted costs for the preparation of additional supplements and for responding to RAIs, both of which were not quantified.

Alternative 2 creates a regulatory framework that could accelerate the pace at which licensees upgrade nuclear plant I&C systems. This would provide regulatory certainty for upgrading systems from analog instrumentation to digital instrumentation allowing licensees to take advantage of the benefits of these digital system upgrades. These benefits include operation

and maintenance cost reduction through decreased obsolescence, fewer licensee event reports, additional performance benefits, and increased safety.

The nuclear industry is familiar with the well-established NRC practice of approving the use of certain IEEE standards in 10 CFR 50.55a through the rulemaking process of "incorporation by reference." This practice assures consistency across the industry and that the NRC will continue to support the use of the most updated and technically sound techniques developed by the IEEE to provide adequate protection to the public.

If the quantified costs and benefits were considered in isolation, the NRC would not proceed with this rulemaking because the total quantified benefits of the proposed regulation action are not equal to or exceed the costs of the proposed action. However, it is the NRC's judgment that the values (including the safety benefit, averted cost savings, and other non-quantified benefits) qualitatively considered above outweigh the identified impacts. Furthermore, the NRC staff expects that the public may identify additional benefits and averted costs during the public comment period, which the staff would use to refine these estimates. The staff believes that this approach is consistent with Commission direction in SRM-SECY-14-0087, "Qualitative Consideration of Factors in the Development of Regulatory Analyses and Backfit Analyses" (ADAMS Accession No. ML15063A568).

## 7. IMPLEMENTATION

The proposed rule will be published for public comment in the *Federal Register*. After that public comment period, the NRC staff will develop and publish a final rule in the *Federal Register*. The NRC staff assumes in this draft regulatory analysis that the final rule will be effective in 2016.

## 8. REFERENCES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3. EPRI Technical Report NSAC-153, "Instrumentation and Control Strategies for Power Plants: Volume 2: Problem Definition and Recommendations, December 1990.
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13. Non-Concurrence on Proposed Rule to Incorporate by Reference Institute of Electrical and Electronics Engineers Standard 603-2009 (NCP-2014-003), ADAMS Accession No. ML14280A367.

14. Non-Concurrence on Proposed Rule to Incorporate by Reference Institute of Electrical and Electronics Engineers Standard 603-2009 (NCP-2014-004), ADAMS Accession No. ML14281A145.

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# Appendix A: Backfitting and Issue Finality

## Backfitting and Issue Finality

The proposed rule's substantive provisions, in 10 CFR 50.55a(h), would apply to the design of protection and safety systems for currently-operating nuclear power reactors, as well as designs for future nuclear power reactors, and would affect different classes of NRC licenses and regulatory approvals. Backfitting and issue finality for each of the affected classes of licenses and regulatory approvals is not applicable as discussed in the following paragraphs.

Construction Permits

Currently, there are three construction permits in effect: the Tennessee Valley Authority (TVA) Watts Bar Nuclear Plant, Unit 2, which is active and the TVA Bellefonte Nuclear Plant, Units 1 and 2, which are in deferral status. The proposed rule would apply to the Watts Bar Nuclear Plant, Unit 2, and the Bellefonte Nuclear Plant, Units 1 and 2, but only if the construction permit holder makes changes or modifications to, or replaces the plant's protection system or safety system (as reviewed and approved in the construction permit application and described in the preliminary safety analysis reports) under 10 CFR 50.55a(h)(3) of the proposed rule. Inasmuch as such proposed changes, modifications, or replacements would be a voluntary action initiated by the construction permit holder, the imposition of the proposed rule's requirements in that circumstance does not constitute backfitting as defined in 10 CFR 50.109(a)(1). As discussed earlier in 10 CFR 50.55a(h)(2)(ii), the NRC is not requiring either Watts Bar Nuclear Plant, Unit 2, or Bellefonte Nuclear Plant, Units 1 and 2, to meet current requirements applicable to newly licensed nuclear power plants.

The proposed rule would apply to all newly-applied for construction permits. Imposition of the proposed rule does not constitute backfitting, inasmuch as the backfit rule does not protect either a current applicant or a future (prospective) applicant.

Operating Licenses

The proposed rule would apply to the 99 operating nuclear power reactors licensed under 10 CFR Part 50, but only insofar as the plant's currently-approved protection system or safety system may be modified or replaced in the future and therefore is subject to 10 CFR 50.55a(h)(3) of the proposed rule. Inasmuch as such proposed changes, modifications, or replacements would be a voluntary action initiated by the licensee, the imposition of the proposed rule's requirements in that circumstance does not constitute backfitting as defined in 10 CFR 50.109(a)(1).

Currently, there is only one application for an operating license in process before the NRC; this application is for TVA's Watts Bar Nuclear Plant, Unit 2. The proposed rule would apply to Watts Bar Nuclear Plant, Unit 2, operating license, except for matters that were previously approved in the Watts Bar Nuclear Plant, Unit 2, construction permit. Thus, the "mandatory compliance" provisions of the proposed rule, 10 CFR 50.55a(h)(3), would apply to the Watts Bar Nuclear Plant, Unit 2, operating license. Imposition of the proposed rule on Watts Bar Nuclear Plant, Unit 2, would not constitute backfitting, inasmuch as the backfit rule does not protect a current applicant. In addition, the "mandatory compliance" provisions of the proposed rule would not constitute backfitting inasmuch as those provisions apply to voluntary actions to change the plant's licensing basis that may be initiated by the licensee.

The proposed rule would apply to all new applications for operating licenses. Imposition of the proposed rule on future applications for operating licenses does not constitute backfitting,

inasmuch as the backfit rule does not protect a future (prospective) applicant. In addition, the "mandatory compliance" provisions in 10 CFR 50.55a(h)(3) of the proposed rule would not constitute backfitting inasmuch as those provisions apply to voluntary actions to change the plant's licensing basis that may be initiated by the licensee.

Combined Licenses

The proposed rule would apply to a combined license that does not reference a standard design certification or manufacturing license. Currently, there are no manufacturing licenses issued under 10 CFR Part 52, and no combined licenses issued that do not reference a standard design certification (the combined licenses issued by the NRC for the Vogtle Electric Generating Plant, Units 3 and 4, and the combined licenses issued for the Virgil C. Summer, Units 2 and 3, reference the AP1000 standard design certification rule, 10 CFR Part 52, appendix D, as amended) (76 FR 82079; December 30, 2011). The combined license issued to the Enrico Fermi Nuclear Plant Unit 3 references the Economic Simplified Boiling Water Reactor standard design. With respect to future combined license or manufacturing license applicants that do not reference a standard design certification or manufacturing license, the Backfit Rule and the issue finality provisions in 10 CFR Part 52 do not protect a future (prospective) applicant.

The proposed rule would apply to current (as of the date of the final IEEE rulemaking) and future combined licenses referencing a standard design certification or manufacturing license, but only if the combined license applicant or holder either: 1) seeks an exemption or departure from the referenced design certification rule's safety system, or 2) modifies or replaces the safety system and therefore is subject to 10 CFR 50.55a(h)(3) of the proposed rule. The NRC notes that the NRC's approval of a certified design includes all aspects of the reactor's design that must be designed to the relevant IEEE standard under 10 CFR 50.55a(h), and the combined license applicant and holder has no further responsibility to address the adequacy of the electrical design for the safety system. Hence the proposed rule does not directly apply to such combined license applicants and holders. As of this rulemaking, there are combined licenses for the Vogtle Electric Generating Plant, Units 3 and 4, and the combined licenses issued for the Virgil C. Summer, Units 2 and 3, both of which reference the AP1000 standard design certification rule as well as a combined license for Enrico Fermi Nuclear Plant Unit 3 which references the Economic Simplified Boiling Water Reactor standard design.

Imposition of the proposed rule in the first circumstance (seeking a departure or an exemption from a referenced design certification rule) does not constitute backfitting because seeking such a departure or exemption would be a voluntary action initiated by the applicant or licensee, and imposition of the proposed rule's requirements in this circumstance does not constitute backfitting as defined in 10 CFR 50.109(a)(1), nor is the proposed rule inconsistent with any of the issue finality provisions in 10 CFR 52.63, 52.83, 52.98 or the currently-approved design certifications in 10 CFR Part 52, appendices A through D.

The second circumstance (modifying or replacing a safety system) is also a voluntary action initiated by the applicant or licensee, and imposition of the proposed rule's requirements in this circumstance does not constitute backfitting as defined in 10 CFR 50.109(a)(1), nor is the proposed rule inconsistent with any of the issue finality provisions in 10 CFR 52.63, 52.83, 52.98 or the currently-approved design certifications in 10 CFR Part 52, appendices A through E.

The proposed rule would also apply to any portion of a safety system (within the meaning of 10 CFR 50.55a and IEEE Std 603-2009) of currently-issued combined licenses referencing

design certifications that are outside the scope of the referenced design certification (including exemption and departure requests). For those portions of safety systems outside the scope of the referenced standard design certification, the combined license would be subject to the "mandatory compliance" provisions in 10 CFR 50.55a(h)(3) of the proposed rule. This does not constitute backfitting, inasmuch as the proposed rule would not mandate changes to the currently-approved design of any safety systems outside the scope of the referenced design certification to comply with IEEE Std 603-2009 and the correction sheet dated March 10, 2015. Rather, only future, licensee-initiated changes to any safety systems outside the scope of the referenced design would be required to meet the requirements in IEEE Std 603-2009 and the correction sheet dated March 10, 2015, under any of the circumstances set forth in 10 CFR 50.55(h)(3). The NRC does not consider voluntary, licensee-initiated changes to the licensing basis to be "imposed," and such changes, therefore, do not constitute backfitting under 10 CFR 50.109(a)(1).

The proposed rule would apply to future combined license applicants that reference a standard design certification or manufacturing license, in the same manner as current holders of combined licenses referencing a standard design certification, as explained in the previous paragraphs. This 10 CFR 50.55a rulemaking mandating the use of IEEE Std 603-2009 and the correction sheet dated March 10, 2015, for future combined licenses, referencing standard design certifications, issued after the effective date of this rule does not constitute backfitting, because these requirements are prospective in nature and effect. The backfit rule and the issue finality provisions in 10 CFR Part 52 do not protect a future (prospective) applicant. The backfit rule and the issue finality provisions of 10 CFR Part 52 were not intended to apply to every NRC action that substantially changes the expectations of future applicants under 10 CFR Part 52.

Standard Design Certifications

The proposed rule would apply to the currently-approved standard design certifications in 10 CFR Part 52, appendices A through E (and any future standard design certification that may be approved before the issuance of the final 10 CFR 50.55a rulemaking incorporating by reference IEEE Std 603-2009), but only if the design of the safety system for the certification is modified or changed in a subsequent amendment to the design certification rule. Regardless of whether the amendment is sought by an applicant or is initiated by the NRC, the issue finality provisions of 10 CFR 52.63 would have to be satisfied as part of that amendment rulemaking. The proposed rule would apply to all standard design certification applications active at the time of the final 10 CFR 50.55a rulemaking incorporating by reference IEEE Std 603-2009 and the correction sheet dated March 10, 2015, as well as all future applications for standard design certifications. Imposition of the proposed rule on current or future standard design certification applicants does not constitute backfitting as defined in 10 CFR 50.109 nor is it inconsistent with 10 CFR 52.63 (the issue finality provisions applicable to design certifications in 10 CFR Part 52), because neither the backfit rule nor 10 CFR 52.63 protect a current or future (prospective) design certification applicant.

Manufacturing Licenses

There are no current applicants for, or holders of, manufacturing licenses under 10 CFR Part 52, subpart F. The proposed rule would apply to future applications for manufacturing licenses. Imposing the proposed rule on future applicants for manufacturing licenses does not constitute backfitting as defined in 10 CFR 50.109 nor is it inconsistent with 10 CFR 52.171 (issue finality provisions applicable to manufacturing licenses in 10 CFR Part 52) because

neither the backfit rule nor 10 CFR 52.171 protects a future (prospective) manufacturing license applicant.

Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors

The proposed rule would add a reference to sections 5.3 and 5.4 of IEEE Std 603-2009 in 10 CFR 50.69(b)(1)(v). Inasmuch as compliance with 10 CFR 50.69(b)(1)(v) would be a voluntary action initiated by the licensee or applicant, the imposition of the proposed rule's requirements in that circumstance does not constitute backfitting as defined in 10 CFR 50.109(a)(1).

Emergency Response Data Systems

The proposed rule would add additional isolation requirements for emergency response data systems in 10 CFR Part 50, appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

The proposed rule would not require licensees and applicants to address communication independence in addition to electrical independence for emergency response data systems for currently operating nuclear plants because communications from the emergency response data systems to safety systems does not exist in these plants. Therefore, no action is required of licensees to implement communication independence. Further, the proposed rule would not require holders of combined licenses, standard design certifications, and manufacturing licenses for the reasons stated in the above respective sections. Therefore, imposing the proposed rule on future applicants for combined licenses, standard design certifications, and manufacturing licenses.

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# Appendix B:  Industry Labor Rates

## B.1 Industry Labor Rates

### Utilities (Sector 22) – Industry: Electric Power Generation, Transmission and Distribution (NAICS code 221100)

| Position Title | Occupation (SOC code) | Hourly mean wage (2013 dollars) | Hourly 25th percentile wage (2013 dollars) | Hourly 75th percentile wage (2013 dollars) | Source |
|---|---|---|---|---|---|
| Executive | Top Executives (111000) | $64.01 | $42.38 | 78.43 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Chief Executives (111011) (1) | $95.57 | $65.32 | $114.68 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$79.79*** | ***$53.85*** | ***$96.56*** | |
| Managers | First-Line Supervisors of Production and Operating Workers (511011) | $40.11 | $30.41 | $50.48 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | First-Line Supervisors of Mechanics Installers and Repairers (491011) | $39.65 | $32.15 | $47.59 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | Industrial Production Managers(113051) | $57.97 | $44.25 | $69.47 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | General and Operations Managers (111021) (1) | $61.04 | $41.52 | $73.85 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$49.69*** | ***$37.08*** | ***$60.35*** | |
| Technical Staff | Nuclear Engineers(172161) | $48.77 | $40.32 | $56.52 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Nuclear Technicians(194051) | $37.25 | $30.76 | $43.57 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | Nuclear Power Reactor Operators (518011) | $39.55 | $34.02 | $45.14 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Industrial Machinery Mechanics (499041) | $30.41 | $23.95 | $37.08 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$39.00*** | ***$32.26*** | ***$45.58*** | |
| Administrative Staff | Office and Administrative Support Occupations (430000) | $22.96 | $16.04 | $28.69 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | First-Line Supervisors of Office and Administrative Support Workers (431011) | $33.98 | $25.02 | $42.58 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | Office Clerks General (439061) | $19.66 | $12.80 | $25.42 | http://www.bls.gov/oes/current/oes439061.htm |
| | ***Average*** | ***$25.53*** | ***$17.95*** | ***$32.23*** | |
| Licensing Staff | Paralegals and Legal Assistants (232011) | $30.12 | $24.51 | $35.91 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Lawyers (231011) (1) | $78.09 | $49.09 | $93.71 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$54.11*** | ***$36.80*** | ***$64.81*** | |

Footnotes:

(1) The BLS notes that this 75th percentile wage is equal to or greater than $90.00 per hour or $187,199 per year without specifying a value. For this analysis, the NRC staff estimated that the 75th percentile is approximately 20% greater than the mean.

(2) SOC code: Standard Occupational Classification code -- see http://www.bls.gov/soc/home.htm

(3) NAICS code: North American Industry Classification System code -- see http://www.bls.gov/bls/naics.htm

(4) Data extracted on April 29, 2015.

## B.1 Industry Labor Rates

### Utilities (Sector 22) – Industry: Electric Power Generation, Transmission and Distribution (NAICS code 221100)

| Position Title | Occupation (SOC code) | Hourly mean wage (2013 dollars) | Hourly 25th percentile wage (2013 dollars) | Hourly 75th percentile wage (2013 dollars) | Source |
|---|---|---|---|---|---|
| Executive | Top Executives (111000) | $64.01 | $42.38 | 78.43 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Chief Executives (111011) (1) | $95.57 | $65.32 | $114.68 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$79.79*** | ***$53.85*** | ***$96.56*** | |
| Managers | First-Line Supervisors of Production and Operating Workers (511011) | $40.11 | $30.41 | $50.48 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | First-Line Supervisors of Mechanics Installers and Repairers (491011) | $39.65 | $32.15 | $47.59 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | Industrial Production Managers(113051) | $57.97 | $44.25 | $69.47 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | General and Operations Managers (111021) (1) | $61.04 | $41.52 | $73.85 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$49.69*** | ***$37.08*** | ***$60.35*** | |
| Technical Staff | Nuclear Engineers(172161) | $48.77 | $40.32 | $56.52 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Nuclear Technicians(194051) | $37.25 | $30.76 | $43.57 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | Nuclear Power Reactor Operators (518011) | $39.55 | $34.02 | $45.14 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Industrial Machinery Mechanics (499041) | $30.41 | $23.95 | $37.08 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$39.00*** | ***$32.26*** | ***$45.58*** | |
| Administrative Staff | Office and Administrative Support Occupations (430000) | $22.96 | $16.04 | $28.69 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | First-Line Supervisors of Office and Administrative Support Workers (431011) | $33.98 | $25.02 | $42.58 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | Office Clerks General (439061) | $19.66 | $12.80 | $25.42 | http://www.bls.gov/oes/current/oes439061.htm |
| | ***Average*** | ***$25.53*** | ***$17.95*** | ***$32.23*** | |
| Licensing Staff | Paralegals and Legal Assistants (232011) | $30.12 | $24.51 | $35.91 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0000 |
| | Lawyers (231011) (1) | $78.09 | $49.09 | $93.71 | http://www.bls.gov/oes/current/naics4_221100.htm#11-0001 |
| | ***Average*** | ***$54.11*** | ***$36.80*** | ***$64.81*** | |

Footnotes:

(1) The BLS notes that this 75th percentile wage is equal to or greater than $90.00 per hour or $187,199 per year without specifying a value. For this analysis, the NRC staff estimated that the 75th percentile is approximately 20% greater than the mean.

(2) SOC code: Standard Occupational Classification code -- see http://www.bls.gov/soc/home.htm

(3) NAICS code: North American Industry Classification System code -- see http://www.bls.gov/bls/naics.htm

(4) Data extracted on April 29, 2015.

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| OFFICE | NRR/DPR/TL | NRR/DPR/PM | NRR/DPR/BC | NRR/DPR/DD | NRR/DPR/D |
|---|---|---|---|---|---|
| NAME | FSchofer | DDoyle | TInverso | AMohseni | LKokajko |
| DATE | 5/8/2015 | 5/11/2015 | 5/18/2015 | 5/26/2015 | 5/27/2015 |

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