Regulatory Analysis for the Proposed Rule: Alternative Physical Security Requirements for Advanced Reactors

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Abstract

The U.S. Nuclear Regulatory Commission's (NRC's) current physical security regulations and guidance for power reactors are based on requirements that may not be appropriate for small modular reactors (SMRs) and non-light water reactors (non-LWRs), hereafter referred to as advanced reactors. In 2018, the Commission approved the NRC's recommendation to initiate a limited-scope rulemaking to revise physical security regulations and issue new guidance for advanced reactors. The proposed rule and guidance could affect commercial nuclear power advanced reactors that are licensed after the effective date of the final rule. Eligible advanced reactor applicants and licensees would have the option to implement certain alternative physical security requirements in the proposed rule when developing their physical security programs in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 73, "Physical Protection of Plants and Materials." This document presents a regulatory analysis of the benefits and costs of the proposed rule requirements and the associated regulatory guidance documents relative to the baseline case (i.e., the no-action alternative).

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Abbreviations

10 CFR	Title 10 of the *Code of Federal Regulations*
ADAMS	Agencywide Documents Access and Management System
BLS	Bureau of Labor Statistics (U.S. Department of Labor)
CFR	*Code of Federal Regulations*
CRGR	Committee to Review Generic Requirements
DBT	design-basis threat
DG	draft regulatory guide
FR	*Federal Register*
LWR	light-water reactor
NEI	Nuclear Energy Institute
NEIMA	Nuclear Energy Innovation and Modernization Act
non-LWR	non-light-water reactor (a nuclear power reactor using a coolant other than water)
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
NUREG	an NRC technical report designation
OMB	Office of Management and Budget
PERT	program evaluation and review technique
SECY	Secretary of the Commission
SMR	small modular reactor
SOC	standard occupational classification (code)
SRM	staff requirements memorandum

Executive Summary

This document provides the regulatory analysis for the U.S. Nuclear Regulatory Commission's (NRC's) proposed limited-scope physical security rule for advanced reactors,[1] which would allow eligible advanced reactor applicants and licensees to implement certain alternative physical security requirements set forth in the proposed rule. This regulatory analysis summarizes the current physical security framework for commercial nuclear power reactors, describes regulatory issues that motivated rulemaking for advanced reactors, evaluates the alternative physical security requirements for advanced reactors, and summarizes the results of this analysis.

This limited-scope rule would propose voluntary, performance-based physical security alternatives to meet the intended functions of the following prescriptive requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage":

- 10 CFR 73.55(e)—physical barriers
- 10 CFR 73.55(e)(9)(v)(D) and (e)(9)(vi)—vital areas
- 10 CFR 73.55(i)(2) and (i)(4)(iii)— secondary alarm stations
- 10 CFR 73.55(k)(3) through (k)(5)(ii) and 10 CFR 73.55(k)(8)(ii)—onsite armed response personnel

The NRC's assessment of quantitative cost considerations shows that the limited-scope rulemaking is justified because the quantified benefits of the proposed rule exceed the costs to licensees and the NRC. Furthermore, the NRC's qualitative assessment of impact considerations shows that the limited-scope rulemaking is justified because it provides regulatory predictability and identifies a voluntary, performance-based alternative to the prescriptive requirements mentioned above that efficiently addresses the potentially unique security needs of advanced reactors. The NRC concludes there is sufficient justification to proceed with the rule given the qualitative and quantitative cost and benefits.

This regulatory analysis discusses two alternatives—Alternative 1, the no-action alternative, and Alternative 2, a limited scope rulemaking. For Alternative 2, the NRC analyzed the costs and benefits of the rule requirements and development of the regulatory guidance documents, DG-5072, "Guidance for Alternative Physical Security Requirements for Small Modular Reactors and Non-Light-Water Reactors," and DG-5071, "Target Set Identification and Development for Nuclear Power Reactors" (nonpublic). This regulatory analysis makes the key findings identified below. Both alternatives provide a means for licensees to achieve substantial benefits in avoided costs for a second onsite alarm station and personnel costs for armed responders onsite at all times. However, the proposed rule alternative is shown to provide a more predictable regulatory path for achieving this objective.

<u>Proposed Rule Cost Analysis</u>. The NRC estimates that the rule would result in net (i.e., accounting for both costs and benefits) averted costs to industry of approximately $340,000. Relative to the regulatory baseline, the net costs to the NRC are approximately

[1] Within the context of this document, the term "advanced reactors" refers to non-light-water reactors (non-LWRs) and light-water small modular reactors (SMRs).

($260,000), with quantified costs due to rulemaking. Table ES-1 shows the total costs and benefits to industry and the NRC of proceeding with the rule. The rule alternative would result in net averted costs to industry and the NRC of approximately $80,000. Each of these totals represent the net present values (NPVs) calculated using a 7-percent discount rate.

Table ES-1 Total Costs and Benefits for Alternative 2

Attribute	Costs		
	Undiscounted	7% NPV	3% NPV
Total Industry Costs:	$0	$0	$0
Total NRC Costs:	($530,000)	($460,000)	($500,000)
Total Costs:	($530,000)	($460,000)	($500,000)
Attribute	**Benefits**		
	Undiscounted	7% NPV	3% NPV
Total Industry Benefits:	$450,000	$340,000	$390,000
Total NRC Benefits:	$270,000	$200,000	$240,000
Total Benefits:	$720,000	$540,000	$630,000
Attribute	**Net Benefits (Costs)**		
	Undiscounted	7% NPV	3% NPV
Industry Net:	$450,000	$340,000	$390,000
NRC Net:	($260,000)	($260,000)	($260,000)
Total Net:	$190,000	$80,000	$130,000

Note: NPV is expressed in 2021 dollars. There may be differences among tables due to rounding.

According to Executive Order 12866, "Regulatory Planning and Review," dated September 30, 1993, an economically significant regulatory action is one that would have an annual effect on the economy of $100 million or more. This proposed rulemaking does not reach this threshold.

Qualitative Benefits. Alternative 2 would establish alternative physical security requirements in 10 CFR 73.55 for advanced reactors. By regulating physical security through rulemaking instead of through a case-by-case 10 CFR 73.5 exemption or 10 CFR 73.55(r) alternative measures processes, the NRC would provide greater regulatory predictability for industry stakeholders and provide opportunities for stakeholder input into the alternative requirements. Additionally, creating appropriate alternative security requirements within the regulatory framework, rather than relying on the exemption or alternative measures processes, may increase public confidence in the NRC's role as an effective regulator adapting to new technology and new regulatory needs. The analysis of both Alternative 1 and Alternative 2 shows that averted costs result from reducing the number of armed responders, implementing physical barrier alternatives and vital area designations, and changing requirements for a redundant secondary alarm station on site. The averted costs (savings) of these physical security components could be significant (greater than $200 million using a 7-percent discount rate to $400 million using a 3-percent discount rate), based largely on the personnel reductions in armed responders and the moving of the secondary alarm station offsite. While this regulatory analysis presents these savings, the cost estimate does not include them because licensees could use either alternative to achieve these savings—there is no net difference.

Uncertainty Analysis. The regulatory analysis contains an uncertainty analysis that shows that the estimated mean averted cost for this rule is $80,000 with an 83.1-percent confidence that the proposed rule is cost beneficial using a 7-percent discount rate.

Decision Rationale. Relative to the no-action baseline, the NRC has shown that the quantified results indicate the rule alternative is likely to be cost beneficial. Additionally, from a qualitative standpoint, the rule alternative would result in increased regulatory predictability and greater public confidence in the NRC's ability to adapt to new technologies. By taking into account advanced reactor design features, the NRC provides a method that could allow an applicant or licensee to justify a reduction in the number of armed responders, alternatives for physical barriers, vital area redesignation, and an allowance for an offsite redundant secondary alarm station, while maintaining high assurance of public health and safety and the common defense and security. Alternative 2 creates a repeatable process for industry to consistently realize the cost savings that are incurred during plant operations from each of these elements. The resulting savings from the reduction of armed responders and the secondary alarm station, and an efficient, repeatable process far exceed the implementation costs. The NRC has concluded that the rule alternative is justified when considering the quantitative and qualitative factors.

1. Introduction

This document presents the regulatory analysis for the proposed rule to provide alternative physical security requirements for advanced reactors[2] and develop the new regulatory guidance document DG-5072, "Guidance for Alternative Physical Security Requirements for Non-Light-Water-Reactors and Small Modular Reactors," and DG-5071, "Target Set Identification and Development for Nuclear Power Reactors" (nonpublic). This regulatory analysis summarizes the current physical security framework for commercial nuclear power reactors, describes regulatory issues that have motivated the NRC to pursue rulemaking in this area, evaluates various alternatives to address physical security for advanced reactors, and identifies the background documents related to these issues.

The current fleet of commercial nuclear power reactors is subject to the physical security requirements in 10 CFR 73.55. The NRC's security regulatory framework applicable to these reactors requires the development of a physical protection program that provides high assurance[3] that activities involving special nuclear material would not be inimical to the common defense and security and would not constitute an unreasonable risk to the public health and safety. To achieve this objective, a licensee's physical protection program must protect against the design basis threat of radiological sabotage.[4] The NRC staff anticipates that advanced reactor technologies, including advances in designs and engineered safety features, may differ substantially from the designs and operations of large LWRs. As a result of these anticipated technological advances, certain of the physical security requirements in 10 CFR 73.55 may not be appropriate for advanced reactors. This proposed rule would establish a set of alternative physical security requirements that may more appropriately meet the security needs of eligible advanced reactor applicants and licensees commensurate with the risks associated with advanced reactors.

This regulatory analysis considers whether to provide a set of alternative physical security requirements that eligible advanced reactors licensed under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," or 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" Could elect to use. This limited-scope rule would apply the insights from advances in designs and safety research, retain the NRC's overall security regulatory framework, and provide acceptable alternatives to comply with physical security requirements.

The NRC recognizes that the phrase "advanced reactors" is not consistently defined, including in some references cited in this regulatory analysis. However, for the purposes of this

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2 Ibid.

3 The Commission stated in staff requirements memorandum "SRM-SECY-16-0073 – Options and Recommendations for the Force-On-Force Inspection Program in Response to SRM-SECY-14-0088," dated October 5, 2016, that "the concept of 'high assurance' of adequate protection found in the NRC security regulations is equivalent to 'reasonable assurance' when it comes to determining what level of regulation is appropriate." The Commission re-iterated this point in "SRM-SECY-18-0076 – Options and Recommendation for Physical Security for Advanced Reactors," dated November 19, 2018.

4 Radiological sabotage as defined in Title 10 of the *Code of Federal Regulations* (10 CFR) 73.2, "Definitions," "means any deliberate act directed against a plant or transport in which an activity licensed pursuant to the regulations in this chapter [10 CFR Part 73, ""Physical Protection of Plants and Materials"] is conducted, or against a component of such a plant or transport which could directly or indirectly endanger public health and safety by exposure to radiation."

regulatory analysis, the term “advanced reactor” refers to commercial power reactors that are either non-LWRs or light-water SMRs. The non-LWRs comprise a variety of reactor types, including sodium-cooled reactors, gas-cooled reactors, and molten-salt-cooled reactors. The term “SMR” used in this document is as defined in 10 CFR 171.5, “Definitions,” as “the class of light-water power reactors having a licensed thermal power rating less than or equal to 1,000 MWt per module. This rating is based on the thermal power equivalent of a light-water SMR with an electrical power generating capacity of 300 MWe or less per module.”

2. Statement of the Problem and Objective

The current physical security requirements in 10 CFR 73.55 and associated guidance are based on requirements that may not be appropriate for advances in reactor designs and safety research and their application to the existing and future operation of advanced reactors. Through this proposed rulemaking, the NRC is proposing to amend its regulations to create alternative physical security requirements for advanced reactors under the current physical security framework for commercial nuclear power reactors licensed under 10 CFR Part 50 and 10 CFR Part 52.

In December 2016, the NRC developed and published “NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness” (NRC, 2016b), with a goal to further develop the NRC’s advanced reactor regulatory, technical, and policy infrastructure. This physical security rulemaking for advanced reactors represents an important facet of the NRC’s plan to be ready to review potential licensing applications for advanced reactors efficiently and effectively.

2.1 Background

The current physical protection program for commercial nuclear power reactors is designed to protect against the design-basis threat (DBT) of radiological sabotage. To achieve this, the physical protection program must protect those plant features needed to provide fundamental safety functions, such as maintaining reactor core cooling, in order to prevent significant core damage and spent fuel sabotage that could potentially result in a release of radioactive materials. When compared to operating large LWRs, many of the advanced reactor designs have smaller power outputs and a correspondingly smaller inventory of fission products available for potential release. In comparison to large LWRs, some advanced reactor designs may include attributes that could result in smaller and slower releases of fission products following the loss of certain safety functions. Accordingly, some designs may warrant different methods for meeting the NRC’s physical security requirements, commensurate with the potential radiological consequences resulting from radiological sabotage.

The NRC considered the need to modify the physical security requirements in 10 CFR 73.55 in SECY-18-0076, “Options and Recommendation for Physical Security for Advanced Reactors,” dated August 1, 2018 (NRC, 2018a). This SECY paper discusses much of the historical basis guiding the NRC’s physical security policies for advanced reactors, as well as the advanced reactor attributes that result in smaller and slower releases of fission products that could justify different physical security requirements.

Pursuant to Commission direction in the staff requirements memo (SRM)-SECY-18-0076, dated November 19, 2018 (NRC, 2018b)—which predates the Nuclear Energy Innovation and Modernization Act (NEIMA)—for the purposes of this regulatory analysis, the term “advanced reactor" refers to non-LWRs and light-water SMRs. This usage is included in, but not equivalent with, NEIMA's definition of "advanced nuclear reactor."

Current Physical Security Regulations

The NRC developed the existing security regulatory framework for at commercial nuclear power reactors to ensure that a licensee's physical protection program provides high assurance of adequate protection against the DBT of radiological sabotage. The Commission-approved DBT describes the type, composition, and capabilities of an adversary that a licensee can reasonably be expected to defend against. Development of the DBT is based on threat assessments of the tactics, techniques, and procedures used by international and domestic terrorist groups and organizations. The physical security requirements for licensees of commercial nuclear power reactors to protect against the DBT of radiological sabotage are found in 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage." The NRC describes the DBT used to design safeguards systems to protect against acts of radiological sabotage in 10 CFR 73.1, "Purpose and scope."

The 10 CFR Part 73 requirements for physical security for commercial nuclear power reactors and other types of licensed facilities include performance-based and prescriptive requirements. The performance-based requirements provide applicants and licensees with the flexibility to determine how to meet the established objectives of the requirement. The physical security requirements across different classes of licensees reflect a graded approach that applies the level of physical security commensurate with the radiological risk presented by the material at the facility. The physical security requirements for large LWRs, which use low enriched nuclear fuel, are established to protect against the DBT for radiological sabotage. Prescriptive requirements typically tell an applicant or licensee how to implement the requirement.

As described in SECY-18-0076, the NRC intends that this limited-scope rule provide advanced reactors with alternatives to specific requirements and develop associated guidance related to physical security, while providing high assurance of adequate protection that is commensurate with the potential consequences to public health and safety and the common defense and security from the possession and use of special nuclear material at these facilities. Based on stakeholder interactions, this rulemaking focuses on the existing regulatory requirements in:

- 10 CFR 73.55(b), requiring that the physical protection program for advanced reactors prevent significant core damage and spent fuel sabotage;
- 10 CFR 73.55(i)(4)(iii), requiring a central alarm station and a redundant secondary alarm station on site;
- 10 CFR 73.55(e), containing requirements related to physical barriers and vital area designation; and
- 10 CFR 73.55(k)(1), (3) through (7), and (8)(ii) and Section VI of Appendix B and Section II.B.3.c.(iv) of Appendix C, relating to armed response personnel, interdiction, and neutralization.

The NRC has prepared draft guidance (DG-5071 (nonpublic) and DG-5072) to address implementation of the proposed rule's alternative physical security requirements and propose a methodology for assessing plant designs and source terms for comparison to the proposed consequence-oriented performance criteria.

2.2 Statement of the Problem

This section describes the regulatory issues stemming from the fact that advanced reactors are expected to differ substantially from and vary more than the existing reactor fleet. Differences may include the adoption of security by design through enhanced safety and security features, core size, fuel form, coolant type, source terms, and offsite dose consequences. These attributes, among others, potentially permit applicants and licensees to use security methods or approaches that differ from those for current large LWR operating reactors. However, the current security regulatory framework in 10 CFR 73.55 and associated guidance does not address these differing security methods or approaches, leading to a lack of regulatory certainty for advanced reactor applicants.

Given the anticipated differences between currently operating large LWRs and potential new advanced reactor designs, the NRC defined screening criteria to determine eligibility to use the alternative physical security requirements for advanced reactors that are technology inclusive. The NRC, with input from external stakeholders, further determined alternative measures that, without this rulemaking, would otherwise require use of the exemption or alternative measures processes to realize averted costs associated with scaling these requirements from a large LWR to an advanced reactor platform.

2.3 Objective

The objective of this regulatory action is to enhance predictability in the regulatory framework for advanced reactor applicants and licensees by enacting an alternative physical security framework that could provide flexibility in certain areas, such as the number of onsite armed responders and the need for a second onsite alarm station, while continuing to provide high assurance of adequate protection of public health and safety and the common defense and security. Specifically, the NRC's objective for this rule is to create alternative physical security requirements that will (1) enhance regulatory effectiveness by providing greater stability, predictability, and clarity in the licensing process for implementing physical security for advanced reactors; (2) reduce requests for exemptions from certain physical security requirements; (3) consider technological advancements in reactor designs and their associated design features impacting the possible loss of safety functions from malicious acts and any resulting consequences; and (4) provide alternatives for meeting certain physical security requirements under § 73.55 commensurate with the potentially lower risks posed by advanced reactors.

3. Identification and Preliminary Analysis of Alternative Approaches

This section analyzes the alternatives that the NRC considered with regard to the objective of enhancing the regulatory framework for applicants and licensees of advanced reactors and the NRC. The NRC identified two alternatives:

(1) Alternative 1 uses the existing regulatory framework with no changes to the current physical security requirements and no NRC efforts to develop guidance to support requests for proposed alternative measures or exemptions. The NRC would address requests for exemptions or alternative measures on a case-by-case basis.

(2) Alternative 2 amends the regulations through a limited-scope rule that keeps the current physical security framework while allowing eligible advanced reactors to elect to

implement alternatives to certain existing physical security requirements in 10 CFR 73.55.

3.1 Alternative 1—No Action

Alternative 1 is to maintain the status quo with no changes to the current physical security regulations. Applicants and licensees for operating or combined licenses may propose innovative methods or approaches for providing security for advanced reactor designs.

For example, applicants could request alternative measures in accordance with 10 CFR 73.55(r), “Alternative measures,” or seek an exemption in accordance with 10 CFR 73.5, “Specific exemptions.” Additionally, an advanced reactor developer or other entity could submit a topical report justifying specific alternative measures or exemptions for a specific design. This alternative would continue to address exemption and alternative measures requests for physical security on a case-by-case basis, along with the supporting analyses, training, contingency plans, etc.

The NRC estimates that 50 armed responders would be required to provide the minimum number of 10 responders per shift with an estimated annual cost of $100,000 per responder. An onsite secondary alarm station is estimated to cost at least $1 million to build and tens of thousands of dollars per year to maintain. Staffing the secondary alarm station would require approximately five full-time equivalents at a similar rate of $100,000 annually. An offsite secondary alarm station could serve multiple sites and avert some of these costs to each covered site. Therefore, a licensee that receives NRC approval for an exemption or implementation of an alternative measure under 10 CFR 73.55(r) that reduces the required number of onsite armed responders or alarm station staff or that changes the onsite secondary alarm station would benefit from substantial averted costs. Additional savings could be realized in areas such as training programs, weapons, and administrative costs.

3.2 Alternative 2—Limited-Scope Rulemaking

Alternative 2 is a limited-scope rulemaking that retains the current physical security requirements framework but provides advanced reactors with alternatives to specific physical security-related regulations and guidance. Alternative 2 would relieve applicants, licensees, and the NRC of the costs imposed by the case-by-case exemption and alternative measures processes and promote regulatory predictability in the NRC’s licensing processes.

The proposed rule establishes a consequence-based eligibility criterion for advanced reactors and a performance-based approach to address alternatives to the requirements for the minimum number of onsite armed responders, onsite armed responders performing interdiction and neutralization functions, physical barriers, secondary alarm station location, and vital area designations for secondary alarm stations.

Under Alternative 2, an advanced reactor applicant would prepare a consequence analysis as part of the application process under 10 CFR Part 50 or 10 CFR Part 52. The NRC would require applicants proposing physical security alternatives to demonstrate in their applications that implementation of the alternative physical security requirement would still enable the applicant’s physical protection program to protect against the DBT of radiological sabotage. Under Alternative 1, an equivalent analysis would need to be submitted to justify the exemption and alternative measures requests.

As discussed, Alternative 1 and Alternative 2 include significant averted costs related to the reduction in the number of armed responders, physical barrier alternatives, vital area redesignation, and changes to the onsite secondary alarm station as described in Alternative 1. Because the NRC assumed that these savings could be achieved by both alternatives, the averted costs resulting from these physical security alternatives are not included in the incremental net benefits when comparing the two alternatives. If, in fact, this assumption is wrong and greater averted costs would result under the proposed rule, the rule becomes more cost beneficial. Furthermore, the rule approach would outline the approach needed for applicants to have their application approved with fewer requests for additional information to achieve these averted costs.

4. Estimation and Evaluation of Costs and Benefits

This section presents the process for evaluating the costs and benefits that are expected to result from each proposed alternative relative to the regulatory baseline (Alternative 1). All costs and benefits are monetized, when possible. The total costs and benefits are then summed to determine whether the difference between the costs and benefits results in a positive benefit. In some cases, costs and benefits are not monetized because meaningful quantification is not possible. Instead, Section 5.9.2 of this regulatory analysis addresses these costs and benefits qualitatively, in accordance with Appendix A, "Qualitative Factors Assessment Tools," to NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," draft final Revision 5, issued January 2020 (NRC, 2020).

4.1 Identification of Affected Attributes

This section identifies the components of the public and private sectors, commonly referred to as attributes, that the alternatives identified in Section 3 are expected to affect. The alternatives would apply to licensees and applicants for advanced reactors, so advanced reactor licensees and applicants are the primary beneficiaries of this rule. The NRC developed an inventory of the impacted attributes using the list in NUREG/BR-0058, Chapter 5, "Details of a Cost-Benefit Analysis."

The rule would affect five attributes:

(1) Industry Operation. This attribute accounts for the projected net economic effect on all affected entities caused by routine and recurring activities required by the proposed alternative. These activities include the reduction of exemption or alternative measures requests, or the requirement for applicants and licensees to prepare and maintain a consequence analysis.

(2) NRC Implementation. This attribute accounts for the projected net economic effect on the NRC to place the proposed alternative into operation. The NRC's implementation of the proposed alternative includes the agency's cost to develop and issue the rule and any regulatory guides that support the rule.

(3) NRC Operation. This attribute accounts for the projected net economic effect caused by routine and recurring NRC activities required by the proposed alternative after implementation of the proposed rule. These activities include the review of consequence analyses, reviews of license submittals containing exemption or alternative measures requests, case-by-case alternative requests, and supporting materials.

(4) Safeguards and Security Considerations. This attribute accounts for whether the existing level of physical security is adequate and what effects the proposed action has on achieving an adequate level of security. These activities include the review of whether the technical justification provided in Alternative 1 or the risk-informed framework provided in Alternative 2 that is used to reduce the minimum number of onsite armed responders for interdiction/neutralization or to change an onsite secondary alarm station, physical barriers, or vital areas, achieve adequate levels of security.

(5) Regulatory Certainty. This attribute accounts for regulatory and compliance improvements resulting from the implementation of Alternative 2 relative to the regulatory baseline. Alternative 2 would continue the best practice of regulation through rulemaking instead of exemption requests, where practical. This rulemaking would reduce the effort that industry expends generating exemption requests and considering alternative means to accomplish the goals of the current regulation. In addition, this rule reduces the complexities resulting from a case-by-case evaluation of physical security alternative measures and exemptions. Additionally, applicants and licensees gain efficiencies in developing licensing applications, security plans, and other supporting documentation. The NRC will gain efficiencies in the review of these applications and security plans because of the improved regulatory framework, predictability, and clarity established by the rule.

(6) Public Confidence. This attribute accounts for the increase in public confidence in the NRC's ability to adapt to new technology and new regulatory needs, the opportunities for stakeholder input into the alternative physical security requirements, and maintenance of the NRC's role as an effective industry regulator.

Attributes that are not expected to be affected under any of the alternatives include public health (accident), public health (routine), occupational health (accident), occupational health (routine), offsite property, onsite property, industry implementation, other government, general public, and environmental considerations.

4.2 Analytical Methodology

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

Of the six affected attributes, the analysis evaluates three of the attributes—(1) industry operation, (2) NRC implementation, and (3) NRC operation—on a quantitative basis. Quantitative analysis requires a baseline characterization of the affected society, including factors such as the number of affected entities, the nature of the activities currently performed, and the types of systems and procedures that applicants or licensees would consider or would no longer implement because of the proposed alternatives. Where possible, the NRC calculated costs for these attributes are modeled using cost distributions to quantify the uncertainty in these estimates. The NRC evaluated the remaining three attributes—(1) safeguards and security considerations, (2) regulatory certainty, and (3) public confidence—on a qualitative basis because the benefits related to consistent policy application are not quantifiable or because the data necessary to quantify and monetize the impacts on these attributes are not available.

The NRC documents its assumptions throughout this regulatory analysis. Appendix A to this regulatory analysis summarizes the key quantitative assumptions and inputs.

4.2.1 Regulatory Baseline

This regulatory analysis provides the incremental impacts of the proposed rule relative to the regulatory baseline that reflects anticipated behavior if the NRC does not undertake regulatory action. The regulatory baseline assumes compliance with existing NRC requirements, including current regulations and relevant orders, and the submission of exemption and alternative measure request processes. Section 5 of this regulatory analysis presents the estimated costs and benefits of the alternatives relative to this baseline.

4.2.2 Affected Entities

The NRC is aware of 13 planned advanced reactors that would be affected by the proposed rule. The names, companies, technologies, locations, and other identifying information is considered proprietary at this time and is not being provided. Currently, the NRC anticipates that license applications for 11 of these 13 advanced reactors will be submitted between 2024 and 2027, which will be after the rule goes into effect in 2024. These 11 reactors are the drivers of the averted exemption or alternative measures request processes in this regulatory analysis. Due to uncertainty regarding how the other two applicants will act, the staff chose not to model the remaining two applicants. The NRC considered the incremental impact of the proposed rule for other entities, including Tribal, State, and local government organizations, but it does not expect such entities to be affected.

4.2.3 Base Year

All monetized costs are expressed in 2021 dollars, and the analysis assumes publication of the final rule in 2024. The analysis assumes that ongoing costs of operation related to the alternative being analyzed will begin no earlier than 30 days after publication of the final rule in the NRC’s regulations unless otherwise stated.

The NRC assumes that the agency will incur one-time implementation costs for the development of the rule and supporting guidance documents unless otherwise noted. The NRC has estimated recurring annual operating expenses. The values for annual operating expenses are modeled as a constant expense for each year of the analysis horizon.

4.2.4 Discount Rates

In accordance with NUREG/BR-0058, net present value (NPV) calculations are used to determine how much society would need to invest today to ensure that the designated dollar amount is available in a given year in the future. By using NPVs, costs and benefits are valued to a reference year for comparison regardless of when the cost or benefit is incurred in time. The choice of a discount rate and its associated conceptual basis is a topic of ongoing discussion within the Federal Government. Based on Office of Management and Budget (OMB) Circular No. A-4, “Regulatory Analysis,” dated October 9, 2003 (OMB, 2003), and consistent with NRC past practice and guidance, present-worth calculations in this analysis use 3-percent and 7-percent real discount rates. A 3-percent discount rate approximates the real rate of return on long-term Government debt, which serves as a proxy for the real rate of return on savings to reflect reliance on a social rate of time preference discounting concept.[5] A 7-percent discount rate approximates the marginal pretax real rate of return on an average investment in the private sector and is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector. A 7-percent rate is consistent with an opportunity cost[6] of capital concept to reflect the time value of resources directed to meet regulatory requirements.

4.2.5 Cost/Benefit Inflators

The NRC estimated the analysis inputs from sources as referenced in Appendix A, which are provided in 2021 dollars.

The NRC estimated the analysis inputs using the CPI-U and labor rates reported by the BLS. To evaluate the costs and benefits consistently, the NRC converted these inputs into base-year (2021) dollars using the CPI-U, where appropriate. Using the CPI-U, the NRC converted prior-year dollars to 2021 dollars using the following formula:

$$\frac{CPI - U_{2021}}{CPI - U_{Prior\ Year}}\ x\ Value_{Prior\ Year} = Value_{2021}$$

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

Table 1 CPI-U Inflator

Base Year	CPI-U Annual Average[a]
2020	258.81
2021	270.97

[a] BLS, 2021a

4.2.6 Labor Rates

For the purposes of this regulatory analysis, the NRC developed labor rates that include only labor and material costs that are directly related to the implementation and operation and maintenance of the proposed rule requirements. This approach is consistent with the guidance in NUREG/CR-3568, “A Handbook for Value-Impact Assessment,” issued December 1983 (NRC, 1983), and general cost-benefit methodology. The current NRC labor rate for analyses is $143 per hour.

The regulatory analysis used data from the Bureau of Labor Statistics (BLS), “SOC Code: Standard Occupational Classification Code” (BLS, 2021b), which provides labor categories and the mean hourly wage rate by job type. The labor rates used in the analysis reflect total hourly

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

6 “Opportunity cost” represents what is foregone by undertaking a given action. If the applicant or licensee personnel were not engaged in producing exemption requests, they would be engaged in other work activities. Throughout the analysis, the NRC estimates the opportunity cost of performing these incremental tasks as the industry personnel’s pay for the designated unit of time.

compensation, including wages and nonwage benefits (using a burden factor of 2.4, which is applicable for contract labor and conservative for regular utility employees). The NRC used the BLS data tables to select appropriate hourly labor rates for performing the estimated procedural, licensing, and utility-related work necessary during and following implementation of the proposed alternative, calculating a mean wage based on the average wage and the 25th and 75th percentile wages from BLS. This labor rate includes wages paid for the individuals performing the work plus the associated fringe benefit component of labor cost (i.e., the time for plant management over and above those directly expensed).

Table 2 summarizes the BLS labor categories the NRC used to estimate industry labor costs to implement this proposed rule, and Appendix A lists the industry labor rates and other supporting input data used in the analysis. This analysis assumes industry personnel, not contractors, will perform the modeled activities. The NRC performed an uncertainty analysis, which is discussed in Section 5.7.

Table 2 Position Titles and Occupations

Position Title (in This Regulatory Analysis)	Standard Occupational Classification (SOC Code)
Executive	Top Executives (111000)
Managers	Management Occupations (110000)
	Supervisors of Protective Service Workers (331000)
	General and Operations Managers (111021)
	First-Line Supervisors of Mechanics Installers and Repairers (491011)
	First-Line Supervisors of Production and Operating Workers (511011)
Technical Staff	Nuclear Engineers (172161)
	Nuclear Technicians (194051)
	Electrical and Electronic Equipment Mechanics, Installers, and Repairers (492000)
	Nuclear Power Reactor Operators (518011)
Administrative Staff	Office Clerks, General (439061)
Licensing Staff	Lawyers (231011)
	Paralegals and Legal Assistants (232011)
Security Staff	Security Guards (339032)

Source: BLS Statistics (BLS, 2021b).

4.2.7 Sign Conventions

In this analysis, all favorable consequences for the alternative are positive and all adverse consequences for the alternative are negative. Negative values are shown using parentheses (e.g., negative $500 is displayed as ($500)).

4.2.8 Analysis Horizon

The NRC did not use an analysis horizon in this regulatory analysis because no operating costs require an analysis horizon for the cost estimation. The NRC expects the submittal of applications for 11 of the 13 advanced reactors in the 2024–2027 period, with three applications in 2024, three applications in 2025, four applications in 2026, and one in 2027. These applicants are the drivers for the 11 averted exemption or alternative measures request processes in the cost model. This regulatory analysis does not model the applications that are expected before the issuance of the final rule.

4.2.9 Cost Estimation

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

The NRC gathered data from several sources and consulted members of the staff working group that drafted the proposed rule to develop level of effort and unit cost estimates. The NRC applied several cost estimation methods in this analysis. Additionally, the NRC used its collective professional knowledge and judgment to estimate many of the costs and benefits. For example, to calculate the costs for preparation of the final rule and accompanying regulatory guidance, the NRC used data from past rulemaking efforts. To calculate the estimated averted costs of exemption or alternative measures request processes, the NRC used data from previous exemption request submittals to determine the labor categories of the staff who would perform the work and to estimate the amount of time required under each category to complete the work. If data were not available, the NRC used the level of effort method to estimate future costs based on similar steps in the process for which data were available. Additionally, the NRC used the expert-opinion method to fill data gaps when one or more experts were the only available sources of information. The NRC accounted for a total of 11 advanced reactors in the cost estimate, with the remaining two applicants expected to apply before the final rule is issued excluded due to uncertainty in how they would act.

To evaluate the effect of uncertainty in the model, the NRC used a Monte Carlo simulation, which is an approach to uncertainty analysis that expresses input variables as distributions. Section 5.7 describes the Monte Carlo simulation methods in more detail and presents the results.

4.3 Data

This analysis discusses the data and assumptions used in evaluating the quantifiable impacts associated with the proposed alternative. The NRC has no ongoing review of license applications or preapplication submittals of topical reports for advanced reactors related to physical security, so the NRC does not have a specific example of a proposed alternative to or exemption from the 10 CFR 73.55 requirements to base its estimates. As a substitute, the NRC used input from subject-matter experts, knowledge gained from past rulemakings, and information obtained during public meetings and from correspondence to collect data for this analysis. Quantitative and qualitative information were obtained from the NRC and from comments on the regulatory basis. The NRC considered the potential differences between the new requirements and the current requirements and incorporated the proposed incremental changes into this regulatory analysis.

5. Presentation of Results

This section presents the quantitative and qualitative results by attribute for Alternative 2, relative to the regulatory baseline (Alternative 1). As described in the previous sections, costs and benefits are quantified where possible and are shown to be either positive or negative depending on whether the proposed alternative has a favorable or adverse effect relative to

Alternative 1. Those attributes that are not easily represented in monetary values are discussed in qualitative terms. This "ex ante cost-benefit analysis"[7] provides useful information that the NRC can use to decide whether to select an alternative, even if the analysis is based on estimates of the future costs and benefits.

The potential benefits and costs of the alternatives are analyzed for (1) advanced reactor applicants and licensees and (2) the NRC. The analyses in this section are based on the NRC's assessment and input from stakeholders.

This section presents the incremental benefits and costs that the NRC, applicants, and licensees would incur from the rulemaking action. Incremental benefits and costs are calculated values and impacts that are above the baseline condition. The baseline condition for this rulemaking action includes the benefits and costs to comply with the current security regulation in 10 CFR Part 73 and particularly 10 CFR 73.55 (as applicable), or an alternative approved by the NRC through an exemption or 10 CFR 73.55(r) alternative measures request. Based on the NRC's assessment, the incremental benefits and costs for this rulemaking action include the following:

- incremental averted costs to reduce the need for certain applicants to request and the NRC to review exemption or 10 CFR 73.55(r) alternative measures requests from physical security regulations and develop the accompanying technical justification

- incremental costs to the NRC to prepare and issue the final rule and associated guidance documents

This cost estimate compares Alternative 1 (exemption or 10 CFR 73.55(r) alternative measures requests associated with the current regulatory baseline) to Alternative 2 (rulemaking). Both alternatives have considerable averted costs when compared to compliance with the current physical security regulations because both alternatives allow licensees to provide a measure for protection against radiological sabotage other than the one required, such as the reduction in the number of onsite armed responders, and potentially impact the onsite secondary alarm station.

Alternative 1 (regulatory baseline) allows applicants and licensees to request alternative security measures through current regulations. The regulatory baseline would continue to require the use of exemptions and alternative measures requests to realize some averted costs (such as reduction to the minimum number of armed responders for interdiction/neutralization and changes to a second alarm station on site, physical barriers, and vital areas). Alternative 2 (proposed limited-scope rule) identifies five current physical security requirements that could play a diminished role in providing physical security for advanced reactors while at the same time contributing significantly to capital and/or operating costs.

Of the five alternative physical security requirements proposed through this limited-scope rulemaking, the greatest averted costs (savings) are related to the reduction in the number of armed responders required to implement a licensee's physical protection program. The NRC estimated that advanced reactor applicants and licensees could reduce their staffing by 1 to 50

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

armed responders through the use of certain proposed alternative physical security requirements. Assuming one full-time equivalent spends 1,510 hours per year, the NRC determined the savings per advanced reactor to be approximately 22,000 hours per year or approximately 15 full-time equivalents. Over the initial 40-year license term of an advanced reactor under both Alternatives 1 and 2, this alternative security requirement is estimated to result in net averted costs to industry that range from $203 million (7-percent NPV) to $377 million (3-percent NPV), based on the expected future applicants used in this analysis. The other four alternative security measures also result in further savings, but when compared to the magnitude of savings associated with the reduction in the number of armed responders, their savings are not statistically significant. The NRC notes that because these savings are realized under both alternatives, this analysis does not use these averted costs further, particularly not in the net costs and benefits calculations.

The NRC expects that public comment and feedback on the proposed rule and related guidance would allow further refinement of the benefits and costs described in this analysis.

5.1. Industry Operation

Alternative 2 would provide eligible advanced reactor applicants and licensees an alternative to certain of the current physical security requirements in 10 CFR 73.55. As mentioned above, certain existing regulatory requirements in 10 CFR 73.55 that may not be appropriate for advanced reactors result in significant costs to advanced reactor applicants and licensees that may be averted through this rulemaking.

For example, the proposed physical security alternative requirements that could allow a licensee to have fewer onsite armed responders and alter the onsite secondary alarm station represent significant averted costs, which under the status quo applicants and licensees cannot attain without NRC approval of either an alternative measures request under 10 CFR 73.55(r) or an exemption request. In Alternative 2, these applicants and licensees would not incur the incremental costs associated with the exemption request or the 10 CFR 73.55(r) process under the current regulations. Costs that are averted are the costs of preparing the exemption requests or the 10 CFR 73.55(r) requests and responding to the NRC's requests for additional information through multifaceted interactions, such as correspondence, teleconferences, and meetings.

The data on future license applications are based on the NRC's current knowledge of the affected entities' plans and the expected timing of the license applications. Table 3 shows these averted costs, using the NRC forecasts for the timing and number of exemption or the 10 CFR 73.55(r) requests supplemented with proprietary information provided to the NRC. The NRC estimates that each applicant would need on average of 345 person-hours to prepare and submit one of the aforementioned requests, and that the weighted hourly labor rate for personnel preparing these documents is $118 per hour. The NRC anticipates that 11 advanced reactors would take advantage of these changes to the regulations, and therefore 11 requests are averted in the cost estimate for the proposed rule. Table 3 shows that industry will see averted costs of approximately $336,000 (7-percent NPV) and $395,000 (3-percent NPV). Appendix A provides a detailed table showing all the input values that the NRC used in this regulatory analysis.

Table 3 Industry Operation: Averted Costs for Exemption or Alternative Measures Requests

Year	Activity	Number of Affected Entities	Per Entity		Net Benefit (Cost)		
			Labor Hours	Weighted Hourly Rate	Undiscounted	7% NPV	3% NPV
2024	Exemption / Alternative Measures Requests for Physical Security	3	345	$118	$122,000	$100,000	$112,000
2025		3	345	$118	$122,000	$93,000	$108,000
2026		4	345	$118	$163,000	$116,000	$140,000
2027		1	345	$118	$41,000	$27,000	$34,000
				Total:	**$448,000**	**$336,000**	**$395,000**

Note: Values are in base year 2021 dollars, rounded to the nearest $10,000.

The process for developing a physical security program involves the identification of target sets and a determination of how to protect these target sets. Certain analyses are necessary to complete these steps. The proposed rule requirements result in the reactor developer or licensee performing a similar analysis to the status quo for the safety analysis that determines the target sets (if applicable) and the security analysis that demonstrates how the target sets will be protected under the proposed security posture. In addition, for any achievable target set that is compromised by an adversary, a licensee or applicant would perform a consequence analysis to demonstrate that the dose reference values in the eligibility criterion are not exceeded. The NRC did not quantify this optional analysis because the NRC's position is that a licensee or applicant would only opt to perform the analysis if the business case indicated savings from the proposed security alternatives exceeded the cost of the analysis.

5.2. Total Industry Costs

The rulemaking alternative (Alternative 2) results in estimated net averted costs to industry that range from $340,000 using a 7-percent NPV to $390,000 using a 3-percent NPV, when compared to Alternative 1, as shown in Table 4.

Table 4 Total Industry Costs

Attribute	Net Benefits (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation Totals:	$0	$0	$0
Industry Operation Totals:	$450,000	$340,000	$390,000
Industry Net:	**$450,000**	**$340,000**	**$390,000**

Note: Values are in 2021 dollars, rounded to the nearest $1,000.

5.3. NRC Implementation

The NRC's development and implementation of physical security regulations for advanced reactors through a final rulemaking stage would result in incremental costs to the NRC. After publishing the proposed rule, the NRC would incur costs associated with public comment resolution, preparation of the final rule, finalizing the regulatory guidance document, and preparing other supporting documentation for the rulemaking (e.g., the *Federal Register* notice). NRC costs to develop the regulatory basis, proposed rule, and draft guidance are sunk costs that are not taken into consideration for decision making and therefore are not included.

Table 5 estimates the costs for each action at a labor rate of $143 per hour. There will be some costs incurred in 2024, the year the final rule is expected to be issued, but for simplicity this table shows all costs are incurred in 2023.

Table 5 NRC Implementation: Rulemaking Costs

Year	Activity	Number of Actions	Hours	Weighted Hourly Rate	Net Benefits (Costs)		
					Undiscounted	7% NPV	3% NPV
2023	Finalize/Issue Regulatory Guide	1	805	$143	($115,000)	($101,000)	($109,000)
2023	Develop/Issue Final Rule	1	2,875	$143	($411,000)	($359,000)	($388,000)
				Total:	**($526,000)**	**($460,000)**	**($496,000)**

Note: Values are in 2021 dollars, rounded to the nearest $10,000.

5.4. NRC Operation

The NRC will realize averted costs (benefit) from the expected 11 exemption requests that industry will not submit (under Alternative 2 when compared to Alternative 1) and, therefore, the NRC will not review. Table 6 shows these averted costs, assuming 173 hours of effort for each request, and a labor rate of $143 per hour.

Table 6 NRC Operation: Exemption Request Reviews

Year	Activity	Number of Requests	Hours	Weighted Hourly Rate	Net Benefits (Costs)		
					Undiscounted	7% NPV	3% NPV
2024	Review exemption request	3	173	$143	$74,000	$60,000	$68,000
2025	Review exemption request	3	173	$143	$74,000	$56,456	$66,000
2026	Review exemption request	4	173	$143	$99,000	$70,350	$85,000
2027	Review exemption request	1	173	$143	$25,000	$16,437	$21,000
				Total:	**$271,000**	**$204,000**	**$239,000**

Note: Values are in 2021 dollars, rounded to the nearest $10,000.

5.5. Safeguards and Security Considerations

This attribute accounts for whether the existing level of safeguards and security is adequate and what effects the proposed action has on achieving an adequate level of security. The NRC reviewed the technical approach of the regulatory baseline and the risk informed framework provided in Alternative 2 that could be used to reduce the number of onsite armed responders, allow reliance on law enforcement or offsite armed responders to fulfill interdiction and neutralization functions if there are no armed response personnel onsite, use means other than physical barriers to accomplish delay and access control functions, and change the location and designation of the secondary alarm station to achieve a level of security commensurate with the risks associated with advanced reactor designs that meet the proposed rule's eligibility criterion. The staff concludes that Alternative 2 provides an equivalent level of security to what could be achieved by the use of exemptions and requests for alternative measures under the regulatory baseline. The key difference is that the proposed rule and associated guidance will provide eligible advanced reactor applicants and licensees with a clear and defined set of alternative physical security requirements they can elect to implement. The NRC's proposed framework to allow an applicant or a licensee to elect to use one or more of the alternative physical security requirements is based on the NRC's determination that these alternative requirements will provide a level of protection equivalent to the current security requirements they replace. The NRC has concluded that the alternative requirements in the proposed rule will continue to provide high assurance that activities involving special nuclear material are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety.

5.6. Total NRC Costs

Combined, these costs and averted costs show estimated net costs to the NRC as a result of this rulemaking of ($260,000) using a 7-percent NPV and a 3-percent NPV, as shown in Table 7.

Table 7 Total NRC Costs

Attribute	NRC Net Benefits (Costs)		
	Undiscounted	7% NPV	3% NPV
NRC Implementation Total	($530,000)	($460,000)	($500,000)
NRC Operation Total	$270,000	$200,000	$240,000
NRC Net	**($250,000)**	**($260,000)**	**($260,000)**

Note: Values are in base year 2021 dollars, rounded to the nearest $10,000.

5.7. Total Costs

Relative to Alternative 1, the NRC concludes that the averted incremental costs to the applicants and licensees do not justify the incremental costs for this rulemaking action (Alternative 2), based on the quantitative cost estimate. Table 8 shows a net averted cost for the quantitative factors discussed above.

Table 8 Total Net Benefits (Costs)

Attribute	Total Net Benefits (Costs)		
	Undiscounted	7% NPV	3% NPV
Industry Implementation	$0	$0	$0
Industry Operation	$450,000	$340,000	$390,000
Industry Total	*$450,000*	*$340,000*	*$390,000*
NRC Implementation	($530,000)	($460,000)	($500,000)
NRC Operation	$270,000	$200,000	$240,000
NRC Total	*($250,000)*	*($260,000)*	*($260,000)*
Total Net	***$190,000***	***$80,000***	***$140,000***

Note: There may be small differences between tables and in totals as a result of rounding.

The net averted costs to industry and the NRC if the rulemaking alternative is pursued range from $80,000 using a 7-percent NPV to $140,000 using a 3-percent NPV, with costs due to rulemaking. The rulemaking alternative would apply to any future advanced reactor applicants and licensees and would result in averted costs for reductions in exemption requests.

5.8. Uncertainty Analysis

The NRC completed a Monte Carlo uncertainty analysis for this regulatory analysis. The Monte Carlo approach answers the question, "What distribution of net benefits and costs results from multiple draws of the probability distribution assigned to key variables?"

5.8.1. Uncertainty Analysis Assumptions

Because this regulatory analysis is based on estimates of values that are sensitive to plant-specific cost drivers and plant dissimilarities, the NRC provides the following analysis of the variables that have the greatest amount of uncertainty. To perform this analysis, the NRC conducted a Monte Carlo simulation analysis using the @Risk software program.[8]

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

The probability distributions chosen to represent the different variables in the analysis were bounded by the range-referenced input and the NRC's professional judgment. When defining the probability distributions for use in a Monte Carlo simulation, summary statistics are needed to characterize the distributions. These summary statistics include the (1) minimum, most likely, and maximum values of a program evaluation and review technique (PERT) distribution,[9] (2) the minimum and maximum values of a uniform distribution, and (3) the specified integer values of a discrete population. The NRC used the PERT distribution to reflect the relative spread and skewness of the distribution defined by the three estimates.

Table 9 identifies the data elements, the distribution and summary statistic, and the mean value of the distribution that were used in the uncertainty analysis.

Table 9 Uncertainty Analysis

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Licensee Submittal of Exemption Request					
Hourly rate	$118	PERT	$95	$119	$138
Hours to generate and submit	345	PERT	270	300	600
Review Exemption Request (NRC)					
NRC Hourly rate	$143				
Hours to review	173	PERT	135	150	250
<u>Final Rule Stage</u>					
Finalize/Issue Regulatory Guide (NRC)					

8 Information about the @Risk software is available at https://www.palisade.com.

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

Data Element	Mean Estimate	Distribution	Low Estimate	Best Estimate	High Estimate
Hours to finalize	805	PERT	630	700	1,400
Develop/Issue Final Rule (NRC)					
Hours to finalize	2,875	PERT	2,250	2,500	5,000

5.8.2. Uncertainty Analysis Results

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

For each figure below, the NRC ran Monte Carlo simulations in which the key variables were changed to assess the resulting effect on costs. The cost distributions illustrated in Figures 1 through 3 represent the incremental costs from the regulatory baseline of Alternative 1 (no-action alternative).

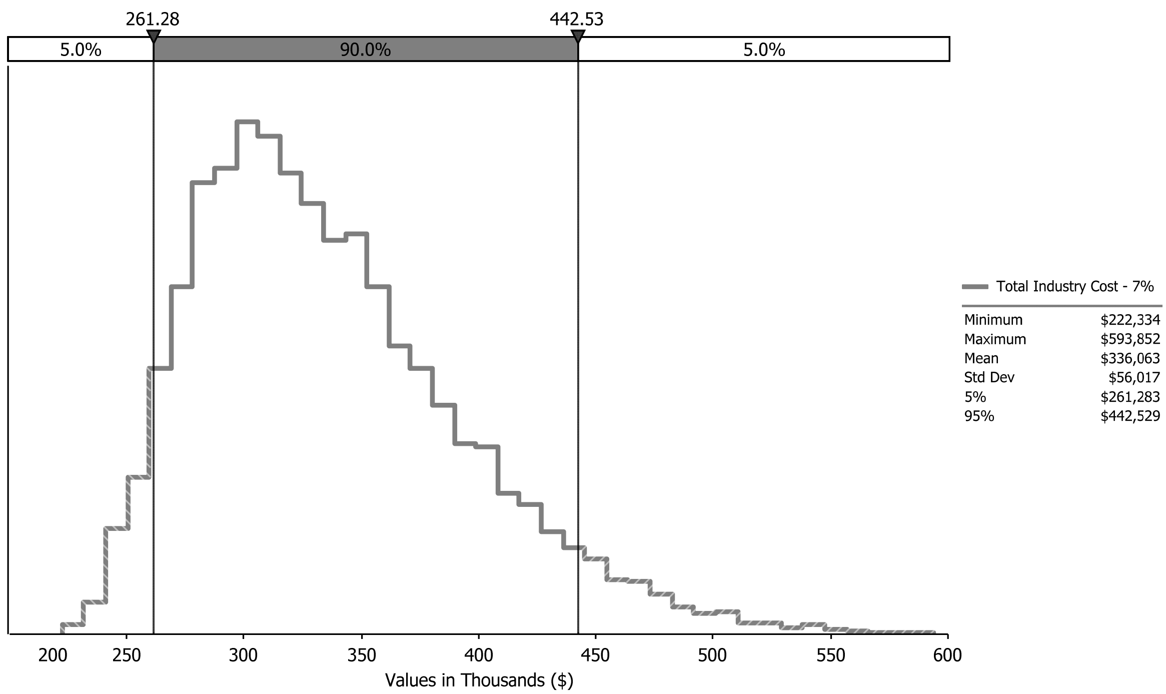

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Figure 1 Total Industry Costs (7-Percent NPV)—Alternative 2

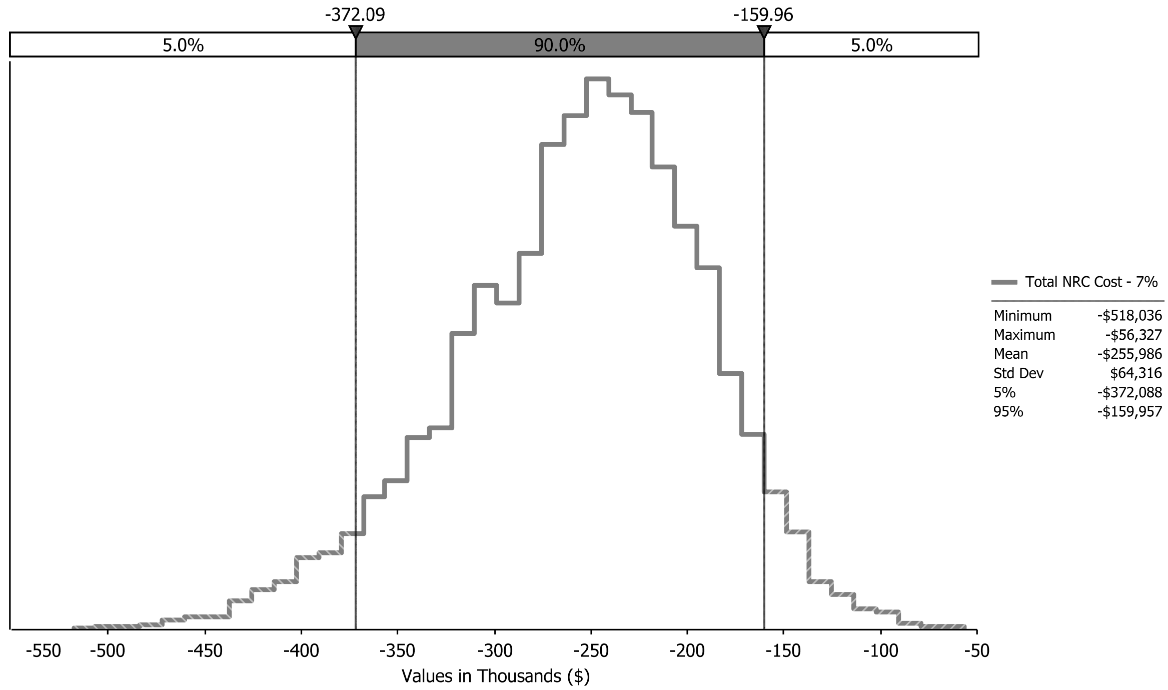

Figure 2 Total NRC Costs (7-Percent NPV)—Alternative 2

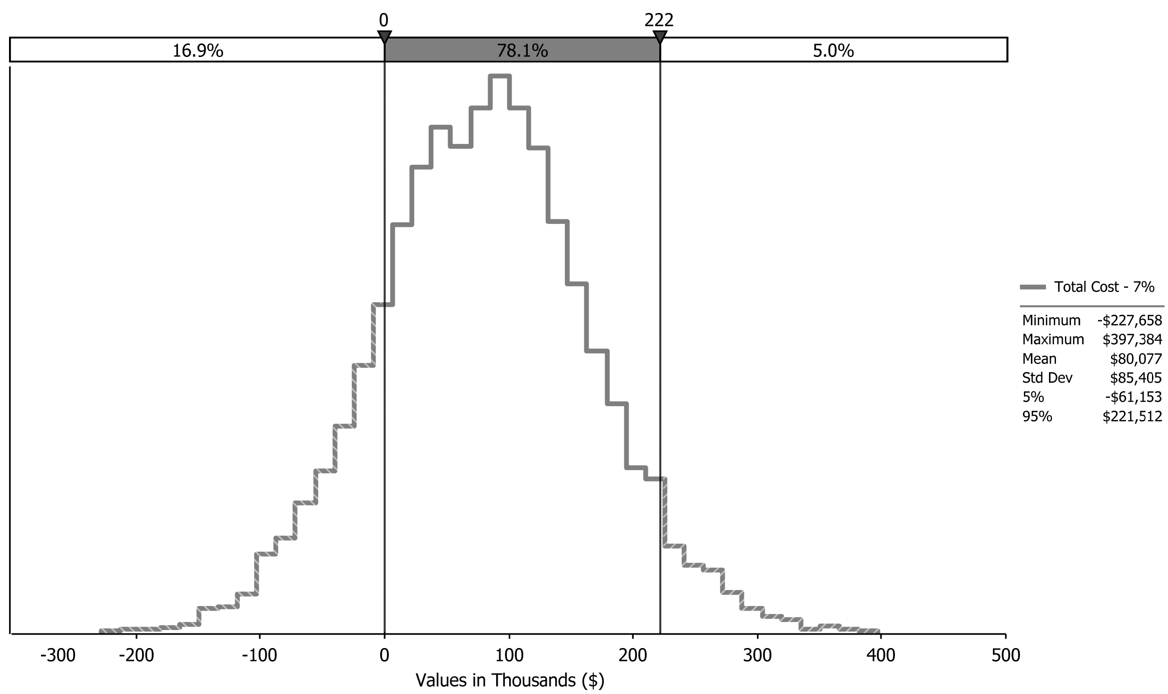

Figure 3 Total Costs (7-percent NPV)—Alternative 2

Table 10 presents descriptive statistics on the uncertainty analysis. Table 10 reflects the 5-percent and 95-percent values (below or above which 5 percent of the analysis results fall, respectively) that appear as numerical values on the top of the vertical lines in \

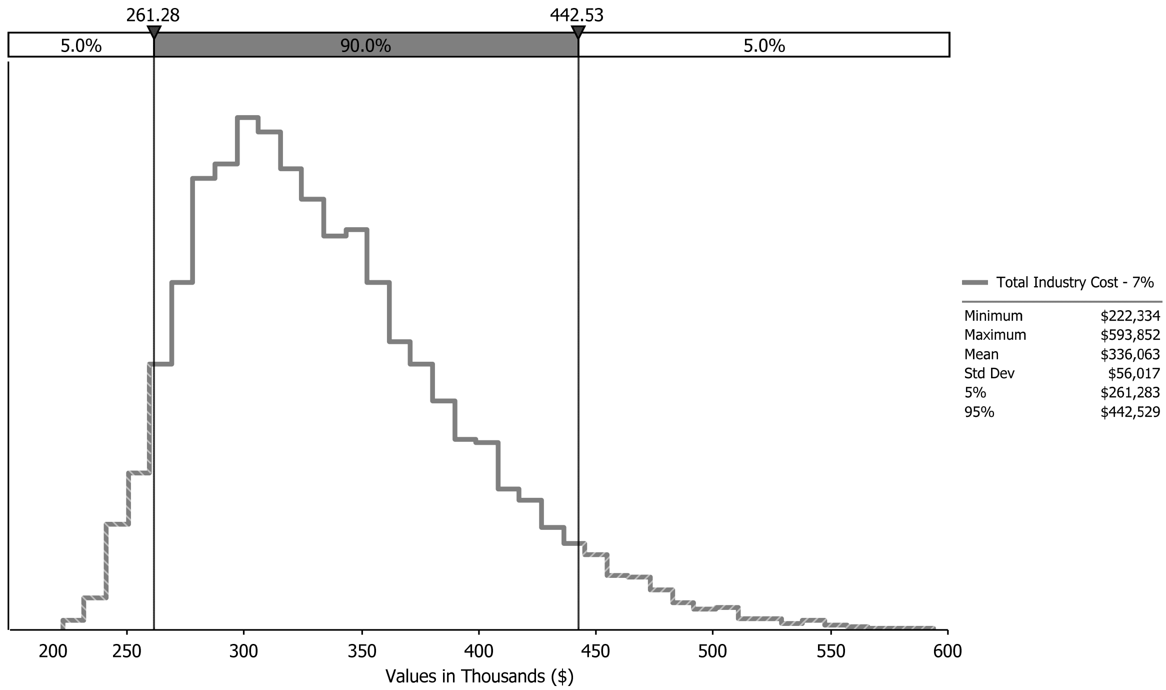

Figure 1 Figures 1 and 2 as the 0.05 and 0.95 values, respectively.

Table 10 Uncertainty Results Descriptive Statistics—7-Percent NPV

Uncertainty Result	Incremental Cost Benefit (2021 million dollars)					
	Minimum	**Mean**	**Std. Dev.**	**Maximum**	**5%**	**95%**
Total Industry Cost	$0.22	$0.34	$0.06	$0.59	$0.26	$0.44
Total NRC Cost	($0.52)	($0.26)	$0.06	($0.06)	($0.37)	($0.16)
Total Cost	($0.23)	$0.08	$0.09	$0.40	($0.06)	$0.22

Note: There may be small differences between tables as a result of rounding.

Examining the range of the resulting output distribution provided in Table 10 makes it possible to discuss the potential incremental costs and benefits of the regulatory basis more confidently.

Figure 4 shows a tornado diagram that identifies the key variables whose uncertainty has the largest impact on total costs (and averted costs) for this proposed rule. This figure ranks the variables based on their contribution to cost uncertainty. Two variables—(1) the hours for the NRC to develop and issue the final rule and (2) the hours for industry to prepare and submit exemption requests—drive the most uncertainty in the costs. The remaining key variables show diminishing variation.

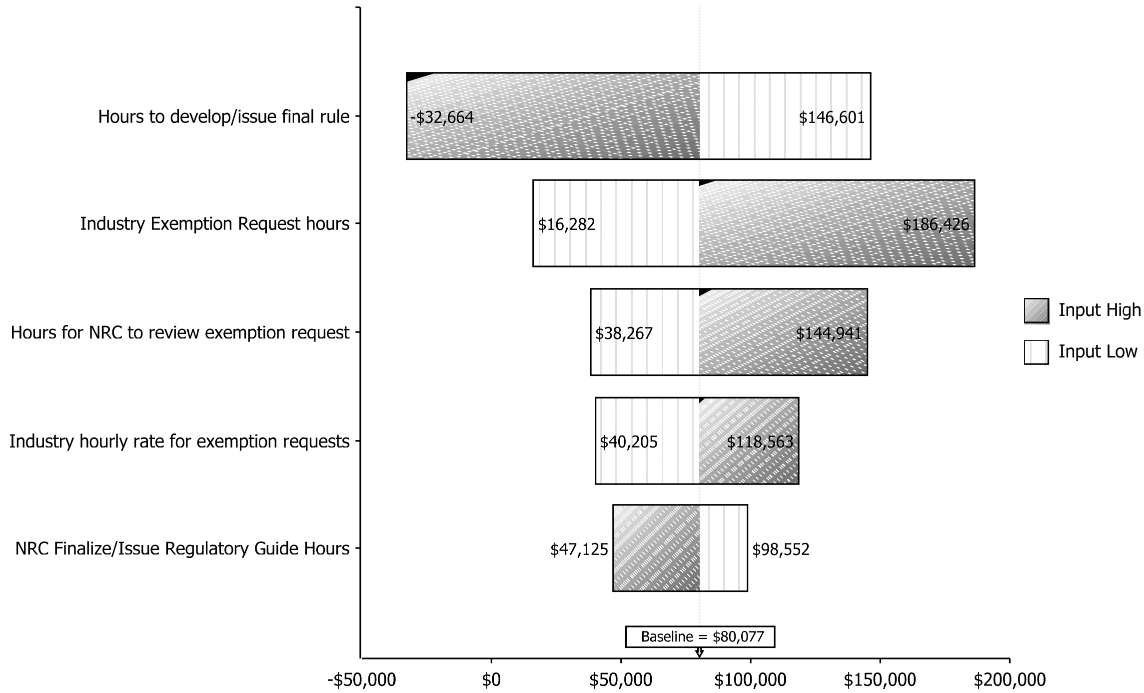

Figure 4 Tornado Diagram—Total Averted Costs—7-percent NPV

The net averted cost for industry and the NRC for this proposed rule has a mean value of $80,000 at a 7-percent discount rate (totals differ in the analysis due to rounding). Figure 3 shows an 83.1-percent likelihood that the rule will be cost beneficial.

5.9. Disaggregation

To comply with the guidance in NUREG/BR-0058, Section 4.3.2, "Criteria for the Treatment of Individual Requirements," the NRC performed a screening review to determine whether any elements of the proposed rule would be unnecessary to achieve the objectives of the rulemaking. The objective of this regulatory action is to enhance predictability in the regulatory framework for advanced reactor applicants and licensees and the NRC by enacting an alternative physical security framework that has flexible options for implementing physical security aspects, such as the number of onsite armed responders and the need for a second onsite alarm station, while continuing to provide adequate protection of public health and safety. Specifically, the NRC's objective for this rule is to create alternative physical security requirements that will (1) enhance regulatory effectiveness by providing greater stability, predictability, and clarity in the licensing process for implementing physical security for advanced reactors; (2) reduce requests for exemptions from certain physical security requirements; (3) consider technological advancements in reactor designs and their associated design features impacting the possible loss of safety functions from malicious acts and any resulting consequences; and (4) provide alternatives for meeting certain physical security requirements under § 73.55 commensurate with the potentially lower risks posed by advanced reactors.

If the proposed rule did not include any of these alternative requirements, the NRC expects advanced reactor applicants would still seek exemptions from certain existing physical security requirements in 10 CFR 73.55. Therefore, the NRC concludes that all elements of the proposed rule would be necessary to achieve the objective of the rulemaking.

5.10. Summary

This regulatory analysis identified both quantifiable and nonquantifiable costs and benefits that would result from conducting rulemaking to address physical security requirements for advanced reactors. Although quantifiable costs and benefits appear to be more tangible, the NRC urges decisionmakers not to discount costs and benefits that are unquantifiable. Such benefits or costs can be just as important as, or even more important than, benefits or costs that can be quantified and monetized.

5.10.1. Quantified Net Benefit

As shown in Table 8, the estimated incremental net benefit for Alternative 2 relative to the regulatory baseline (Alternative 1) range from approximately $80,000 using a 7-percent NPV to $140,000 using a 3-percent NPV.

5.10.2. Qualitative Benefits

In addition to the quantified net benefits, the following attributes would produce qualitative benefits for industry and the NRC, as summarized below.

5.10.2.1. Regulatory Certainty

A rule would establish a performance-based regulatory framework that would result in enhanced regulatory predictability in the licensing process by decreasing reliance on exemption requests. Addressing new security policy and technical issues that are broadly applicable to advanced reactors through exemptions, alternative measures, or license conditions would not be efficient or predictable. Relying on these processes would result in the NRC making important security decisions without the benefit of hearing the views of interested stakeholders. Therefore, rulemaking is the preferred alternative because it provides stability by establishing an alternative physical security framework rather than allowing the regulatory approach to vary from application to application.

The NRC attempts to avoid regulating by exemption when an issue can be addressed through generic actions such as rulemaking. The estimated benefits of the proposed rulemaking action include fewer exemption requests as compared to those under current regulations, and the availability of a more flexible, risk-informed, and performance-based physical security framework. This proposed rulemaking framework (1) enhances regulatory effectiveness by providing greater stability, predictability, and clarity in the licensing process for advanced reactors; 2) considers technological advancements in reactor designs and their associated design features; and 3) provides alternatives for meeting physical security requirements commensurate with the potentially lower risks posed by advanced reactors.

Absent a change to existing regulations, advanced reactor technologies will be subject to the existing physical security requirements delineated in 10 CFR 73.55, which would impose unnecessary regulatory costs on applicants and licensees that are not commensurate with the potentially lower risks posed by advanced reactors.

5.10.2.2. Increased Public Confidence

In addition to regulatory certainty, modifying the security requirements in 10 CFR 73.55 to address the unique technological features and security needs of advanced reactor designs, rather than relying on the exemption process, would increase public confidence in the NRC's ability to adapt to new technology and new regulatory needs, provide opportunities for stakeholders to comment on novel approaches to achieve physical security requirements, and maintain the NRC's role as an effective industry regulator. Public notice and comment during rulemaking provides the widest range of viewpoints for Commission consideration in the development of the final rule.

5.10.2.3. Consistency with Advanced Reactor Policy Statement

Promulgating new physical security regulations that are aligned with the potentially lower risk profiles of advanced reactor technologies supports the objective discussed in the Commission's "Policy Statement on the Regulation of Advanced Reactors" (73 FR 60612, October 14, 2008). The proposed rule would encourage reactor designers to incorporate safety and security requirements in the design process such that security issues can be effectively resolved through facility design and engineered security features, and the formulation of mitigation measures, with reduced reliance on human actions. Without rulemaking, advanced reactor developers and potential licensees would need to address regulatory uncertainties of resolving these matters on a case-by-case basis. These uncertainties complicate the ability of reactor developers and potential licensees to make design and business decisions. Case-by-case decision making through exemptions, alternative measures, or license conditions may not support the goals described in the Policy Statement on the Regulation of Advanced Reactors.

5.10.3. Qualitative Costs

The following attributes would produce qualitative costs for industry and the NRC, as summarized below.

5.10.3.1. Lack of a Broadly Focused Rule

Neither of the analyzed regulatory analysis alternatives defines a broad-scope rulemaking to assess and define physical security requirements for advanced reactor designs. Such an approach would likely require a performance-based approach defined in terms of different design features, including inherent design characteristics. Also, such an approach would better integrate performance-based requirements and incorporate the best available knowledge of security considerations into the reactor design process and could further reduce licensee submittal and NRC review costs. In the meantime, this proposed rule was developed to support current reactor developers making critical design decisions.

5.10.3.2. Impact of Potentially Nonvalid Analysis Assumptions

The NRC used three key assumptions in this regulatory analysis that might impact the cost beneficial nature of the proposed rule if not valid. The first assumption is that a similar analysis and supporting work would be required under the regulatory baseline to support the security alternatives for an advanced reactor applicant as the consequence analysis in the proposed rule. If this first assumption is not valid, the proposed rule would not be cost beneficial, because the consequence analysis would be a considerable additional cost not quantified in this regulatory analysis. The second assumption is that the same level of averted security requirements (number of armed responders, second alarm station, etc.) can be achieved under the regulatory baseline using the exemption and alternative measures request processes in the existing regulatory requirements as under the proposed rule language. If this second assumption is not valid, the likely difference is that a more cost beneficial security posture can be achieved under the proposed rule, making the proposed rule more cost beneficial. And the third assumption is that an applicant would only seek to use the consequence analysis to achieve a reduction in prescriptive security requirements if it would be cost beneficial to the applicant, which would make the rule less cost beneficial if not valid.

5.11. Safety Goal Evaluation

The proposed rule alternative would allow advanced reactor designers, licensees, and applicants to apply for licenses without including exemption requests to implement alternative physical security requirements. The NRC's safety goal evaluation only applies to regulatory initiatives that the agency considers to be a generic safety enhancement backfit subject to the substantial additional protection standard at 10 CFR 50.109(a)(3). This proposed rule for advanced reactors would not constitute backfitting or affect the issue finality of an approval issued under 10 CFR Part 52 because the rule would not be imposed upon applicants and licensees and would not prohibit applicants and licensees from following existing requirements. For these reasons, a safety goal evaluation is not appropriate for this regulatory analysis.

6. Decision Rationale

Table 11 provides the quantified and qualified costs and benefits for Alternative 2. The quantitative analysis used best estimate values.

Table 11 Summary of Totals

Net Monetary Savings or (Costs)—Total Present Value	**Qualitative Benefits or (Costs)**
Alternative 1: No Action—$0	None
Alternative 2: Conduct rulemaking to provide alternative physical security requirements for advanced reactors Industry: $340,000 using a 7% discount rate $390,000 using a 3% discount rate NRC: $250,000 at all discount rates Net Benefit (Cost): $80,000 using a 7% discount rate $140,000 using a 3% discount rate	<u>Benefits:</u> • **Regulatory Certainty:** By providing alternative physical security requirements for advanced reactors through rulemaking instead of through the exemption process, the NRC will establish a performance-based regulatory framework that would result in enhanced regulatory stability, predictability, and clarity in the licensing process. • **Increased Public Confidence:** In addition to regulatory certainty, addressing the potential differences between advanced reactors and large LWRs through rulemaking instead of the exemption request or alternative measures processes will increase public confidence in the NRC's ability to adapt to

Net Monetary Savings or (Costs)— Total Present Value	Qualitative Benefits or (Costs)
	new technology and new regulatory needs, provide opportunities for stakeholder input into the alternative physical security requirements, and maintain the NRC's role as an effective regulator. • **Consistency with Advanced Reactor Policy Statement:** The rule would encourage reactor designers to incorporate safety and security requirements in the design process such that security issues can be effectively resolved through facility design and engineered security features, and formulation of mitigation measures. Costs • **Lack of a Broadly Focused Rule:** Neither regulatory analysis alternative defines comprehensive physical security requirements for the variety of advanced reactor designs that would likely require a performance-based approach. This proposed rule was developed to support current reactor developers making critical design decisions while the NRC works on a broader rule for advanced reactors. • **Impact of Potentially Nonvalid Analysis Assumptions:** The NRC made three assumptions that if not valid could impact the cost beneficial conclusions for this rule.

Industry and the NRC would benefit from the proposed rulemaking (Alternative 2) primarily because of the averted costs resulting from applicants and licensees submitting fewer exemption requests, and the averted costs resulting from the NRC reviewing and processing fewer exemption requests. Table 11 shows that, relative to the regulatory baseline, Alternative 2 would result in net averted costs to industry that range from $340,000 using a 7-percent NPV to $390,000 using a 3-percent NPV. The NRC's net costs are approximately $260,000 at all discount rates. Thus, the total quantitative net averted cost of the rulemaking ranges from $80,000 using a 7-percent NPV to $140,000 using a 3-percent NPV.

In addition, Alternative 2 has several qualitative benefits that outweigh the identified qualitative costs and further support Alternative 2.

Based on the consideration of both quantified and qualitative costs and benefits, the regulatory analysis shows that the rulemaking is cost justified. In addition, industry has indicated a desire for a performance-based rule to allow alternative security measures, and the qualitative benefits outweighing the qualitative costs further justify the value of the rulemaking alternative's approach.

7. Implementation Schedule

The NRC assumes that the final rule would become effective 30 days after its publication in the *Federal Register* in 2024.

8. References

10 CFR Part 50. *U.S. Code of Federal Regulations*, "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter I, Title 10, "Energy."

10 CFR Part 52. *U.S. Code of Federal Regulations*, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 52, Chapter I, Title 10, "Energy."

10 CFR Part 73. *U.S. Code of Federal Regulations*, "Physical Protection of Plants and Materials," Part 73, Chapter I, Title 10, "Energy."

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NRC, "Target Set Identification and Development for Nuclear Power Reactors," Regulatory Guide 5.81, November 2010, ADAMS Accession No. ML102720056 (nonpublic).

NRC, "Rulemaking Plan on Emergency Preparedness for Small Modular Reactors and Other New Technologies," SECY160069, May 31, 2016a, ADAMS Accession No. ML16020A388.

NRC, "NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness," December 2016b, ADAMS Accession No. ML16356A670.

NRC, "Options and Recommendation for Physical Security for Advanced Reactors," SECY-18-0076, August 1, 2018a, ADAMS Package Accession No. ML18170A051.

NRC, “Staff Requirements—SECY-18-0076—Options and Recommendation for Physical Security for Advanced Reactors,” SRM-SECY-18-0076, November 19, 2018b, ADAMS Accession No. ML18324A478.

NRC, NUREG/BR-0058, draft final Revision 5, “Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission,” January 2020, ADAMS Package Accession No. ML19261A277.

NRC, Draft Regulatory Guide (DG)-5071, “Target Set Identification and Development for Nuclear Power Reactors,” April 2022, ADAMS Accession No. ML22021B529 (nonpublic).

NRC, Draft Regulatory Guide (DG)-5072, “Guidance for Alternative Physical Security Requirements for Small Modular Reactors and Non-Light-Water-Reactors,” April 2022, ADAMS Accession No. ML20041E037.

APPENDIX A—MAJOR ASSUMPTIONS AND INPUT DATA

Data Element	Best Estimate	Unit	Source or Basis of Estimate
Key Analysis Dates			
Final rule effective date	2024	year	NRC input
Analysis base year	2021	year	NRC input
Number of Entities			
Number of small modular reactor and nonlight-water reactors	11	units	Assumption by the NRC, based on proprietary information from industry
Labor Rates			
Technical staff	$126	Dollars per hour	Using labor rates from the "SOC Code: Standard Occupational Classification Code" data set (BLS, 2021b), with application of a multiplier of 2.4, which included fringe and indirect management costs, and application of the consumer price index for all urban consumers for 2021 (BLS, 2021a), and inflated using the CPI-U calculation in this regulatory analysis, resulting in the displayed labor rates; some of these labor rates are aggregates of multiple standard occupational classification codes.
Managers	$142	Dollars per hour	
Administrative staff	$59	Dollars per hour	
Licensing staff	$141	Dollars per hour	
Security guards	$64	Dollars per hour	
Contractors	$217	Dollars per hour	
NRC staff	$143	Dollars per hour	NRC calculation

SUBJECT: REGULATORY ANALYSIS FOR THE PROPOSED RULE: ALTERNATIVE PHYSICAL SECURITY REQUIREMENTS FOR ADVANCED REACTORS (RIN 3150-AK19) DATED:

ADAMS Accession Nos.: PKG: ML21334A003; SECY: ML21334A004; Draft Regulatory Analysis: ML21334A007 *concurred via e-mail

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