

# **Regulatory Analysis for Regulatory Basis: Regulatory Improvements for Power Reactors Transitioning to Decommissioning**

NRC-2015-0070; RIN 3150-AJ59

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## **U.S. Nuclear Regulatory Commission**

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## ABBREVIATIONS AND ACRONYMS

ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act of 1954, as amended
AMP	aging management program
ANPR	advance notice of proposed rulemaking
BLS	Bureau of Labor Statistics
BWR	boiling-water reactor
CFH	certified fuel handler
CFR	<i>Code of Federal Regulations</i>
COL	combined license
CPI-U	Consumer Price Index for all urban consumers
CSP	cyber security plan
DBA	design basis accident
DBT	design-basis threat
DCE	decommissioning cost estimate
DCSS	dry cask storage system
DOE	U.S. Department of Energy
DP	decommissioning plan
DTF	decommissioning trust fund
EA	environmental assessment
EAL	emergency action level
ECL	emergency classification level
EIS	environmental impact statement
EOS	Emergency Operations Facility
EP	emergency preparedness
EPA	U.S. Environmental Protection Agency
EPZ	emergency planning zones
ERDS	Emergency Response Data System
ERO	Emergency Response Organization
ETE	evacuation time estimate
FEMA	Federal Emergency Management Agency
FFD	Fitness for Duty
FR	<i>Federal Register</i>
FTE	full-time equivalent
GEIS	Generic Environmental Impact Statement
GL	generic letter

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HAB	hostile action-based
IFMP	Irradiated Fuel Management Plan
IMP	insider mitigation program
IOEP	independent spent fuel storage installation-only emergency plan
IP	inspection plan
ISFSI	independent spent fuel storage installation
IT	information technology
LAR	license amendment request
LLW	Low-Level Radioactive Wastes
LTP	License Termination Plan
MOU	memorandum of understanding
NAICS	North American Industry Classification System
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NLO	Non-Licensed Operator
NOUE	notification of unusual event
NPP	nuclear power plant
NPV	net present value
NRC	Nuclear Regulatory Commission
NUREG	NRC technical report
OMB	Office of Management and Budget
ORO	Offsite Response Organization
PA	Protected Area
PAA	Price-Anderson Act
PAGS	protective action guides
PAR	protective action recommendation
PDEP	permanently defueled emergency plan
PERT	program evaluation and review technique
PS	physical security
PSDAR	Post-Shutdown Decommissioning Activities Report
PSEP	Post-Shutdown Emergency Plan
PWR	pressurized-water reactor
QAP	Quality Assurance Program
RAI	Request for Additional Information
RB	Regulatory Basis
RCS	reactor coolant system

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REP	radiological emergency preparedness
RG	regulatory guide
SAE	site area emergency
SSC	structures, systems, and components
SSCE	site-specific cost estimate
SER	safety evaluation report
SFP	spent fuel pool
SOC	standard occupational classification (code)
SOC	statement of considerations
SRM	staff requirements memorandum
TMI-2	Three Mile Island Unit 2
TSC	Technical Support Center
UA	Unescorted Access
UAA	Unescorted Access Authorization
VA	Vital Area

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## ABSTRACT

This document presents an update to the regulatory analysis for the regulatory basis document, “Regulatory Improvements for Reactors Transitioning to Decommissioning” (Ref. 1), referred to herein as “regulatory basis.” This update considers comments received for the preliminary draft regulatory analysis (Ref. 2) that was issued for public comment on May 9, 2017. The regulatory analysis has evaluated alternatives in the following areas of decommissioning:

- Emergency Preparedness
- Physical Security
- Cyber Security
- Fitness for Duty - Drug and Alcohol Testing
- Fitness for Duty - Fatigue Management
- Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers
- Decommissioning Funding Assurance
- Offsite and Onsite Financial Protection Requirements and Indemnity Agreements
- Application of the Backfit Rule
- Aging Management
- Level of Post-Shutdown Decommissioning Activities Report Review by the NRC
- Maintaining the Decommissioning Options
- Timeframe Associated with Decommissioning
- The Role of External Stakeholders in Decommissioning
- Clarification of the Spent Fuel Management Requirements
- Record Retention Requirements
- Low-Level Waste Transportation Investigation, Tracing, and Reporting Requirements

In this regulatory analysis, the NRC staff presents the costs, benefits and other economic impacts to industry, government and society from the staff recommendations considered in the regulatory basis.

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## EXECUTIVE SUMMARY

In its staff requirements memorandum (SRM) on SECY-14-0118, “Request by Duke Energy Florida, Inc., for Exemptions from Certain Emergency Planning Requirements,” dated December 30, 2014 (Ref. 3), the Commission directed the Nuclear Regulatory Commission (NRC) staff to proceed with rulemaking on decommissioning of power reactors. The Commission further stated that this rulemaking should address the decommissioning issues discussed in SECY-00-0145, “Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning,” dated June 28, 2000 (Ref. 4), which include the following:

- The graded approach to emergency preparedness.
- Lessons learned from the plants that have already gone (or are currently going) through the decommissioning process.
- The advisability of requiring a licensee’s Post-Shutdown Decommissioning Activities Report (PSDAR) to be approved by the NRC.
- The appropriateness of maintaining the three existing options for decommissioning (DECON, SAFSTOR, and ENTOMB) and the timeframes associated with those options.
- The appropriate role of State and local governments and nongovernmental stakeholders in the decommissioning process.
- Other issues deemed relevant by the NRC staff.

The key findings are as follows:

- In the regulatory basis, the staff concluded that there is sufficient justification to proceed with rulemaking in the areas of Emergency Preparedness, Physical Security, Cyber Security, Fitness for Duty – Drug and Alcohol Testing, Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers, Decommissioning Funding Assurance, Offsite and Onsite Financial Protection Requirements and Indemnity Agreements and Application of the Backfit Rule. Further, the staff is recommending rulemaking to:
  - 1) Clarify and update the regulations in Title 10 of the Code of Federal Regulations (10 CFR) 50.54(bb); 10 CFR 50.82, “Termination of License;” 10 CFR 52.110, “Termination of License;” and 10 CFR 72.218, “Termination of Licenses,” as they relate to requirements for a licensee to consider or plan how it is going to manage spent fuel at the site before it decommissions the structures, systems, and components that support moving, unloading, and shipping of spent fuel.
  - 2) Amend 10 CFR 51.53, “Postconstruction Environmental Reports,” and 10 CFR 51.95, “Postconstruction Environmental Impact Statements,” to clarify that the discussion in the associated environmental requirements about the need for a license amendment before decommissioning activities may commence applies only to nonpower reactors, as specified in 10 CFR 50.82(b), in accordance with the 1996 changes to the decommissioning regulations.



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- 3) Change the NRC regulations in order to minimize the need for regulatory exemptions related to recordkeeping and record retention requirements during decommissioning.
  - 4) Change the NRC regulations in order to minimize the need for regulatory exemptions related to LLW transportation investigation requirements during both operation and decommissioning at all nuclear facilities covered by the requirements of 10 CFR Part 20, "Standards for Protection Against Radiation."

The NRC staff evaluated the impact of these changes and has estimated their net benefits, which are summarized in Table 1 below.

Table 1 Decommissioning Areas with Sufficient Justification to Proceed to Rulemaking

Area of Decommissioning	Preferred Alternative	Total Net Benefit (Cost) <sup>a,b</sup> (2017 million dollars, 7% NPV <sup>c</sup> )
Emergency Preparedness	EP-2	\$6.15
Physical Security	PS-2	\$0.34
Cyber Security	CS-3	(\$0.20)
Fitness for Duty - Drugs & Alcohol	DA-2	\$5.81
Minimum Staffing and Training Requirements – CFH <sup>d</sup>	CFH-3	\$0.27
Decommissioning Trust Funds	DTF-2	\$0.07
Offsite and Onsite Financial Protection	FP-2	\$0.26
Application of Backfitting Protection	BF-3	(\$0.22)
Clarifying the Spent Fuel Management Requirements	SFM-3	(\$0.32)
Record Retention Requirements	R-2	\$0.85
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$0.62

<sup>a</sup> These estimates are based on inputs and are subject to change.

<sup>b</sup> The total net benefit results are sensitive to the timing of when costs and benefits occur and to the discount rate for these decommissioning areas.

<sup>c</sup> NPV is defined as net present value.

<sup>d</sup> CFH is defined as certified fuel handler

- The NRC staff's regulatory basis has found that there is sufficient basis to fulfill the Commission's direction in SRM-SECY-14-0118 and proceed with rulemaking to address certain regulatory requirements in these areas associated with power reactors transitioning to decommissioning.
- In the regulatory basis, the NRC staff concludes that regulatory activities other than rulemaking—such as guidance development—should be used to address concerns regarding aging management, the level of NRC review and approval of the PSDAR, options for decommissioning, the timeframe associated with decommissioning, and the role of external stakeholders in the decommissioning process. The NRC staff evaluated the impact of these changes and has estimated their net benefits, which are summarized in Table 2 below.

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Table 2      Decommissioning Areas that Benefit from Additional Guidance Development

Area of Decommissioning	Preferred Alternative	Total Net Benefit (Cost) (2017 million dollars, 7% NPV <sup>b</sup> )
Aging Management	AMP-2	(\$0.02)
Level of PSDAR Review by NRC	DAR-2	(\$0.38)
Maintaining the Decommissioning Options <sup>a</sup>	O-2	(\$0.22)
Timeframe Associated with Decommissioning	T-2	(\$0.23)
Role of External Stakeholders in Decommissioning	GOV-2	(\$0.24)

<sup>a</sup> The elimination of the ENTOMB decommissioning option was previously considered in the 1988 decommissioning rule statement of considerations (53 FR 24018). In that rulemaking, the Commission decided to retain the ENTOMB decommissioning option.

<sup>b</sup> NPV = Net Present Value

- Decision Rationale: This document serves to assist the NRC staff to finalize the regulatory basis for the decommissioning rulemaking and to decide which alternative of each area of decommissioning to pursue for regulatory action.

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## 1 INTRODUCTION

This document presents the Nuclear Regulatory Commission's (NRC's) regulatory analysis for the regulatory basis document, "Regulatory Improvements for Power Reactors Transitioning to Decommissioning" (Ref. 1). After the terrorist attacks of September 11, 2001, the NRC discontinued work on a rulemaking to revise its requirements for decommissioning and redirected resources toward higher priority work related to safeguards and security. Because no reactors were planning to shut down at that time, the Commission decided there was no immediate need to complete the rulemaking. However in 2013, four power reactor units permanently shut down and defueled, without significant advance notice or preplanning. These licensees and the reactors that shut down were: Duke Energy Florida (Crystal River Unit 3 Nuclear Generation Plant,) Dominion Energy Kewaunee (Kewaunee Power Station,) and Southern California Edison (San Onofre Nuclear Generating Station Units 2 and 3.). Furthermore, on December 29, 2014, Entergy Nuclear Operations, Inc., shut down Vermont Yankee Nuclear Power Station (Vermont Yankee), and on January 12, 2015, the licensee certified that Vermont Yankee had permanently ceased operation and removed fuel from the reactor vessel.<sup>1</sup> Both the decommissioning reactor licensees and the NRC expended substantial resources processing licensing actions for these power reactors during their transition period to a decommissioning status. These licensing actions come in the form of requests for exemptions and license amendments to reduce requirements no longer needed to protect public health and safety and the common defense and security for permanently shutdown reactors.

To date the NRC has not identified any safety or security concerns in the current regulatory framework for decommissioning power reactors. However, insights from the recent licensing activities associated with decommissioning power reactors suggest several areas can be improved. By revising its regulations to achieve a long-term regulatory framework for decommissioning, the NRC can reduce the filing and processing of individual licensing actions and make the decommissioning process less costly and more efficient and predictable. The NRC staff has determined the appropriate approaches for making regulatory changes that reduce the number of licensing actions needed during decommissioning and has documented its conclusions in the regulatory basis.

### 1.1 Background

Detailed regulations for the decommissioning of nuclear power reactors were not included in the NRC's rules before 1988. In that year, the NRC published a final rule in Volume 53 of the

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<sup>1</sup> Furthermore, the Omaha Public Power District board of directors shut down Fort Calhoun Station on October 24, 2016. Oyster Creek Nuclear Generating Station will shut down in November 2019, and the Pilgrim Nuclear Power Station plans to shut down on May 31, 2019. Entergy announced plans to close Indian Point Nuclear Power Station in 2021 and Palisades Nuclear Generating Station in 2022, while Pacific Gas and Electric Company announced plans to close Diablo Canyon Nuclear Power Station, Units 1 and 2 in 2025. This set of sites reflects the adjustment in the number of operating power reactors that will be made in the regulatory analysis for the proposed rule. The costs and benefits of the rule would be further affected if the number of facilities that decommission change.

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*Federal Register* (FR), page 24018 (Ref. 5), establishing decommissioning requirements for various types of licensees. By the early 1990s, the NRC recognized a need for more changes to power reactor decommissioning regulations and published a proposed rule to amend its regulations for reactor decommissioning in 1995 (Ref. 6). In 1996, the NRC amended its regulations for reactor decommissioning to clarify ambiguities, make generically applicable procedures that had been used on a case-by-case basis, and allow for greater public participation in the decommissioning process (Ref. 7). However, as an increasing number of power reactor licensees began decommissioning their reactors in the 1990s, it became apparent that the NRC should consider rulemaking on specific topics to improve the efficiency and effectiveness of the decommissioning process.

In a series of Commission papers issued between 1997 and 2001, the NRC staff provided options and recommendations to the Commission to address regulatory improvements related to power reactor decommissioning. In the staff requirements memorandum (SRM) to SECY-99-168, "Improving Decommissioning Regulations for Nuclear Power Plants" (Ref. 8), the Commission directed the NRC staff to proceed with a single, integrated, risk-informed decommissioning rule, addressing the areas of emergency preparedness (EP), insurance, safeguards, staffing and training, and backfitting. The objective of this rulemaking was to clarify and remove certain regulations for decommissioning power reactors as informed by the reduction in radiological risk to public health and safety and the common defense and security compared to the radiological risk found in operating reactors.

During reactor decommissioning, the principal safety concern is the storage of spent fuel in the spent fuel pool (SFP) or an independent spent fuel storage installation (ISFSI). Based on NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants" (Ref. 9), a few months after the reactor has been permanently shut down, the only accident that might lead to a significant radiological release at a decommissioning reactor is a zirconium fire from an SFP accident. The zirconium fire scenario is a postulated, but highly unlikely, beyond-design-basis accident that involves a major loss of water inventory from the SFP, resulting in a significant heatup of the spent fuel, thus leading to substantial zirconium cladding oxidation and fuel damage. The analyses of spent fuel heatup scenarios that might result in a zirconium fire take into consideration the decay heat of the irradiated fuel stored in the SFP and the exothermic reactions of the zirconium with oxygen, water, or both. Therefore, the probability of a zirconium fire scenario continues to decrease as a function of the time that the decommissioning reactor has been permanently shut down. With the permanent cessation of reactor operations and the permanent removal of the fuel from the reactor core, the risk of an accident at decommissioning plants and the number of events that can have significant offsite consequences are significantly reduced. As a result of the shutdown and removal of fuel from the reactor vessel, the reactor, reactor coolant system, and supporting systems no longer operate and, therefore, have no function. Hence, postulated accidents involving failure or malfunction of the reactor, reactor coolant system, or supporting systems are no longer applicable for a power reactor that has decommissioned.

On June 28, 2000, the NRC staff submitted SECY-00-0145 (Ref. 4) to the Commission, proposing an integrated decommissioning rulemaking plan that would amend regulations in the areas of emergency preparedness, insurance, safeguards, staffing and training, and backfit for licensees who certified, pursuant to 10 CFR 50.82(a), that they have permanently ceased facility operation(s) and have permanently removed fuel from the reactor vessel. The rulemaking plan was contingent on the completion of a zirconium fire risk study provided in NUREG-1738 (Ref. 9), on the accident risks at decommissioning reactor SFPs. NUREG-1738 could not completely rule out the possibility of a zirconium fire after extended spent fuel decay times. However,

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NUREG-1738 did demonstrate that storage of spent fuel in a high-density configuration in SFPs is safe, and that the risk of accidental release of a significant amount of radioactive material to the environment is extremely low.

Because of uncertainty in the NUREG-1738 conclusions about the risk of SFP fires, the NRC staff faced a challenge in developing a generic decommissioning rule for EP, physical security, and insurance. To seek additional Commission direction, on June 4, 2001, the NRC staff submitted to the Commission SECY-01-0100, "Policy Issues Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools" (Ref. 10). However, based on the reactor security implications of the terrorist attacks of September 11, 2001, and the results of NUREG-1738, the NRC redirected its rulemaking priorities to focus on programmatic regulatory changes related to safeguards and security.

In the SRM to SECY-14-0118, "Request by Duke Energy Florida, Inc., for Exemptions from Certain Emergency Planning Requirements," dated December 30, 2014 (Ref. 3), the Commission directed the NRC staff to proceed with rulemaking on reactor decommissioning and set an objective of early 2019 for its completion. The Commission also stated that this rulemaking should address the following:

- Issues discussed in SECY-00-0145, such as the graded approach to EP.
- Lessons learned from the plants that have already (or are currently) going through the decommissioning process.
- The advisability of requiring a licensee's post shutdown decommissioning activity report to be approved by the NRC.
- The appropriateness of maintaining the three existing options (DECON, SAFSTOR, and ENTOMB) for decommissioning and the timeframes associated with those options.
- The appropriate role of state, local governments, and nongovernmental stakeholders in the decommissioning process.
- Any other issues deemed relevant by the NRC staff.

In SECY-15-0014, "Anticipated Schedule and Estimated Resources for a Power Reactor Decommissioning Rulemaking," (Ref. 11), the NRC staff committed to proceed with a rulemaking on reactor decommissioning with the goal of submitting a final rule to the Commission by the end of FY 2019. NRC staff issued for public comment a draft regulatory basis (Ref. 12) on March 15, 2017 and a preliminary draft regulatory analysis (Ref. 2) on May 9, 2017 for public comments. Based on the public comments, NRC staff has updated and issued the regulatory basis (82 FR 55954; November 27, 2017) (Ref. 13) and updated the preliminary draft regulatory analysis. These documents are the basis for this regulatory analysis.

## **1.2 Statement of the Problem**

Once a licensee enters the decommissioning phase, certain regulations that applied during the operating phase no longer apply during decommissioning due to the shutdown condition of the plant. During its review of the overall decommissioning regulations, the NRC staff identified areas where the existing regulations and guidance could be updated or clarified to be more consistent with, or more appropriately reflect, the requirements necessary to maintain reasonable assurance of adequate protection of public health and safety and the common defense and security at a decommissioning power reactor. These areas and the Commission-

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directed topics are discussed in more detail below with staff recommendations to address the potential changes.

In developing the regulatory basis (Ref. 1), the NRC staff explored multiple alternatives for each area of decommissioning, including developing guidance, pursuing rulemaking, and maintaining the status quo. Pursuant to 10 CFR 50.12, "Specific Exemptions," the Commission may grant exemptions from regulations if the Commission determines the exemptions are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security, and when special circumstances are present, such as when application of the regulation is not necessary to achieve the underlying purpose of the rule. Experience has demonstrated that licensees for decommissioning power reactors seek multiple exemptions and license amendments per site to establish a long-term licensing framework for decommissioning. By issuing a decommissioning rule, the NRC would be able to modify its regulations commensurate with the reduced accident risk associated with permanently shutdown and defueled reactors and maintain safety and security at sites transitioning to decommissioning, without the need to grant specific exemptions or issue license amendments related to certain subject matters (e.g., EP, training, and decommissioning financial assurance).

### **1.3 Objectives**

Specifically, the objectives for the decommissioning rulemaking are:

- Continue to provide reasonable assurance of adequate protection of public health and safety and the common defense and security at decommissioning power reactor sites.
- Ensure that the requirements for decommissioning power reactors are clear and appropriate.
- Codify those issues that are found to be generically applicable to all decommissioning power reactors and have resulted in the need for exemptions or license amendments.
- Identify, define, and resolve additional areas of concern related to the regulation of decommissioning power reactors.

### **1.4 Appendices in the Regulatory Basis**

The following list shows how the sections of this regulatory analysis document correspond with the appendices of the regulatory basis (RB).

- Section 4.0 corresponds to Appendix H of the RB.
- Section 5.1 corresponds to Appendix A of the RB.
- Section 5.2 corresponds to Appendix B of the RB.
- Section 5.3 corresponds to Appendix C of the RB.
- Section 5.4 corresponds to Appendix D of the RB.
- Section 5.5 corresponds to Appendix K of the RB.
- Section 5.6 corresponds to Appendix E of the RB.
- Section 5.7 corresponds to Appendix F of the RB.
- Section 5.8 corresponds to Appendix G of the RB.
- Section 5.9 corresponds to Appendix I of the RB.
- Section 5.10 corresponds to Appendix J of the RB.

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## **2 DECOMMISSIONING INPUTS**

The purpose of this section is to define the inputs that support the definition of the alternatives and cost-benefit analysis.

### **2.1 Decommissioning Levels**

The following decommissioning levels are defined in Appendix A of the regulatory basis and are summarized here.

#### **2.1.1 Level 1 – Post Shutdown Emergency Plan (PSEP)**

Level 1 commences after the NRC's docketing of the licensee's certifications of permanent cessation of operations and permanent removal of fuel from the reactor vessel pursuant to 10 CFR 50.82, "Termination of license," or 10 CFR 52.110, "Termination of license." During Level 1, the only accident that might lead to a significant radiological release at a decommissioning reactor is a zirconium fire from a SFP accident since the probability of a zirconium fire scenario decreases as a function of the time that the decommissioning reactor has been permanently shut down. The NRC staff anticipates licensees will remain in Level 1 for a period of at least 10 months for a boiling-water reactor (BWR) or 16 months for a pressurized-water reactor (PWR). During this time period, an appropriate level of EP is maintained to respond to applicable design basis accidents and to ensure a prompt response to the low-likelihood possibility that a rapid drain down of the SFP could cause a subsequent zirconium fire and release in less than 10 hours.

#### **2.1.2 Level 2 – Permanently Defueled Emergency Plan (PDEP)**

During this level, partial DECON or SAFSTOR could allow long-term storage of spent fuel in the spent fuel pool without significant impact on the facility decommissioning plan. The NRC staff anticipates that spent fuel in this decommissioning level will be stored in the pool for at least five years after the spent fuel is moved from the reactor vessel to the SFP.

#### **2.1.3 Level 3 – All Spent Fuel Transferred to an Independent Spent Fuel Storage Installation (ISFSI)**

After a sufficient decay period, long-term spent fuel storage outside the spent fuel pool becomes a possibility. The decision for a licensee to transfer all fuel to an onsite ISFSI is based, in part, on such plant-specific factors as the timing and method of plant decommissioning, the preexistence of a licensed ISFSI, and the anticipated start of fuel shipments to a U.S. Department of Energy (DOE) long-term storage repository. To evaluate the potential effects of alternatives considered in this analysis, the NRC assumed that the spent fuel is stored in an onsite ISFSI for 16 years before the spent fuel is transmitted to either an offsite ISFSI or a permanent geologic repository. This is based on Crystal River's plan for transferring all the spent fuel to a DOE long-term storage repository (Ref. 14).

#### **2.1.4 Level 4 – All Spent Fuel and Radioactive Material Removed from Site**

After all the spent fuel has been removed from the site, the estimated inventory that remains is primarily attributable to activated reactor components and structural materials awaiting dismantlement and decontamination. There are no credible accident sequences that can result in significant offsite radiological consequences. As a result, the potential accidents that could



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occur during the decommissioning of a nuclear power reactor in Level 4 have negligible offsite and onsite consequences.

## **2.2 Decommissioning Experience of Recent Plants**

Between early 2013 and the end of 2014, the licensees of five power reactor units, as listed in Table 3, permanently ceased operation. Economics associated with low wholesale electricity prices, the costs of capital improvements, or the costs of major facility repairs were the primary reasons leading to the decisions to permanently shut down these reactors. These were the first reactors to transition to decommissioning since 1998 – an interval of nearly 15 years without a power reactor permanently shutting down. These reactors shutdown without significant advance notice or preplanning.

During approximately a three-year period, over 70 decommissioning related licensing actions and other regulatory actions were processed for the five decommissioning reactor units. This period of increased licensing activity for plants shutting down is commonly referred to as the decommissioning transition process. These decommissioning transition licensing actions establish the long-term regulatory framework for decommissioning reactors, and are based, in large part, on the reduced risks to public health and safety and the common defense and security posed by the facility. For decommissioning reactors, the number of potential accidents is fewer and risks of radiological releases are reduced when compared to an operating reactor. Therefore, decommissioning licensees request certain amendments to their licenses and certain exemptions from the NRC's operating regulations that reflect this reduction in risk.

Table 3 and Table 4 summarize the licensing activities associated with the five reactor units that recently went through the decommissioning transition process.

Table 3 Licensing Activity Summary for Recent Permanently Shutdown Reactors

Site	Permanent Shutdown Date	Decommissioning Strategy <sup>a</sup>	Public Meetings and Briefings	Licensing Actions
Kewaunee	May 2013	SAFSTOR	3	22
Crystal River Unit 3	February 2013	SAFSTOR	3	16
SONGS, Units 2 and 3	June 2013	DECON	8	15
Vermont Yankee	December 2014	SAFSTOR	2	26
<b>Totals</b>			<b>16</b>	<b>79</b>

<sup>a</sup> Decommissioning strategies are discussed in Section 3.2 of this document.

Table 4 Licensing Actions Summary for Recent Permanently Shutdown Reactors

Site	Exemptions	Amendments	Order Rescissions	Other	Total
Kewaunee	9	4	3	6	22
Crystal River Unit 3	5	5	2	4	16
SONGS, Units 2 and 3	6	4	2	3	15
Vermont Yankee	9	7	4	6	26
<b>Totals</b>	<b>29</b>	<b>20</b>	<b>11</b>	<b>19</b>	<b>79</b>

### 3 IDENTIFICATION OF AFFECTED ATTRIBUTES

The NRC developed an inventory of impacted attributes that can be found in Chapter 5 of the NRC's "Regulatory Analysis Technical Evaluation Handbook" (Ref. 15). These attributes are as follows:

- Industry Implementation: This attribute accounts for the one-time projected net economic effect on the affected licensees to implement the rulemaking objectives that are considered in the regulatory basis
- Industry Operation: This attribute accounts for the projected net economic effect caused by routine and recurring activities that were considered in the regulatory basis for all affected licensees. The economic effect includes procedural and administrative activities to process license amendments and exemptions.
- NRC Implementation: This attribute accounts for the one-time projected net economic effect on the NRC to place the recommended alternative into operation.
- NRC Operation: This attribute accounts for the projected net economic effect on the NRC caused by routine and recurring activities after the recommended action is implemented. The economic effect includes procedural and administrative activities to process license amendments and exemptions.
- Other Government: This attribute is an impact which measures the net economic effect of the recommended action on the federal government (other than the NRC) and state and local governments resulting from the action's implementation or operation.

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- General Public: This attribute accounts for out-of-pocket costs paid by members of the general public as a result of implementation or operation of recommended action.
  - Environmental Considerations: This attribute accounts for environmental improvements resulting from the implementation of the recommended alternative relative to the regulatory baseline, which were not addressed through use of a generic or programmatic environmental impact statement or environmental assessment.
  - Regulatory Efficiency: This attribute accounts for regulatory and compliance improvements resulting from the implementation of the recommended alternative relative to the regulatory baseline.

Attributes not expected to be affected include the following: public health (accident and routine), occupational health (accident and routine), offsite property, onsite property, general public, improvements in knowledge, antitrust considerations, safeguards and security considerations, and other considerations.

#### **4 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES FOR REGULATORY APPROACHES TO DECOMMISSIONING**

The 1996 rulemaking that amended 10 CFR 50.82, "Termination of license," provided licensees with simplicity and flexibility in implementing the decommissioning process, increased opportunities for the public to become informed about licensees' decommissioning activities, and established a level of NRC oversight commensurate with the level of safety concerns expected during decommissioning activities. During its review of these decommissioning regulations, the staff identified areas where the existing regulations could be updated or clarified to be more consistent with, or more appropriately reflect, the requirements necessary to maintain reasonable assurance of adequate protection of public health and safety and the common defense and security at a decommissioning power reactor. These areas are discussed in more detail below with NRC staff recommendations to address potential changes through alternatives. Further information on the issues below and further staff considerations can be found in the regulatory basis (Ref.1).

##### **4.1 The Level of PSDAR Review by the NRC**

The current rule in 10 CFR 50.82(a)(4)(i) requires that prior to or within two years following permanent cessation of operations, the licensee must submit a Post Shutdown Decommissioning Activities Report (PSDAR) that contains a description of the planned decommissioning activities, a schedule for their accomplishment, the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by previously issued environmental impact statements, and a site-specific decommissioning cost estimate (DCE), including the projected cost of managing irradiated fuel. The PSDAR serves several purposes: (1) informs the public of the licensee's planned decommissioning activities; (2) assists in the scheduling of NRC resources necessary for the appropriate oversight activities; (3) ensures that the licensee has considered the costs of the planned decommissioning activities and provided an estimate of those costs, and (4) ensures that the environmental impacts of the planned decommissioning activities are bounded by those considered in existing environmental impact statements.

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In addition, the 1996 rulemaking required that all power reactor licensees submit an application for termination of the license, which would be accompanied or preceded by a License Termination Plan (LTP) that must be submitted at least two years prior to the termination of the license date. The LTP and its associated license amendment request require NRC approval and contain many of the details previously found in the Decommissioning Plan (DP), which was required prior to the 1996 rulemaking. Under 10 CFR 50.82(a)(9)(ii), the LTP must include: (1) a site characterization; (2) identification of remaining dismantlement activities; (3) plans for site remediation; (4) detailed plans for the final radiation survey; (5) a description of the end use of the site, if restricted; (6) an updated site-specific estimate of remaining decommissioning costs; (7) a supplement to the environmental report, pursuant to 10 CFR 51.53, describing any new information or significant environmental change associated with the licensee's proposed termination activities; and (8) identification of parts, if any, of the facility or site that were released for use under 10 CFR 50.83, "Release of part of a power reactor facility or site for unrestricted use," before approval of the LTP.

The NRC staff examined whether the regulatory or technical bases for any of the above statements has changed since the promulgation of the 1996 decommissioning rule, and explored the opportunity to incorporate additional enhancements or overall improvements to the regulatory framework. The NRC considered and evaluated four alternatives: no action, guidance development and enhancement, rulemaking for specific issues, and rulemaking to require PSDAR approval by the NRC. A description of each alternative is provided below.

#### **4.1.1 Alternative DAR-1 (No Action)**

The no-action alternative would retain the current decommissioning regulations regarding NRC review of the PSDAR before commencing major decommissioning activities, the level of detail contained in the PSDAR, the submission of an update to the PSDAR under certain circumstances, and NRC review without approval of the PSDAR.

#### **4.1.2 Alternative DAR-2 (Guidance Development / Enhancement)**

Under this alternative, several NRC guidance documents related to the decommissioning process would be updated as a result of this rulemaking effort. These guidance updates would provide an opportunity to address the concerns identified by the public regarding the level of detail, review process, and NRC approval of the PSDAR without the need for formal rulemaking as described above. While these concerns do not represent a safety or compliance issue, in order to better inform the public regarding the decommissioning process at specific facilities, Regulatory Guide (RG) 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report" (Ref. 16), would be updated to encourage licensees to add additional detail on topics already required to be included in the PSDAR in the areas that are of greatest interest to those impacted by the decommissioning process as described in Appendix H, Section 2.2.2 to the regulatory basis. The NRC would publish this updated guidance as a draft RG 1.185, Revision 2, for public review and comment prior to finalizing the guidance document.

In addition to updating the guidance on PSDAR preparation in RG 1.185, Revision 1, and the overall decommissioning process as described in RG 1.184, Revision 1, "Decommissioning of Nuclear Power Reactors," issued October 2013 (ADAMS Accession No. ML13144A840), the NRC staff could revise the Decommissioning GEIS, which was last updated in 2002. Potential revisions could entail (1) including experience from recent decommissioning facilities, (2) incorporating the conclusions of NUREG-2157, Volumes 1 and 2, "Generic Environmental

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Impact Statement for Continued Storage of Spent Nuclear Fuel,” issued September 2014 (ADAMS Accession No. ML14198A440), which is also known as the Continued Storage GEIS, (3) revisiting the Decommissioning GEIS findings based on updated information including comments received on the rulemaking, and (4) revising as necessary to reflect the outcome of the current rulemaking activities. In addition, the staff would incorporate best practices and lessons learned from environmental reviews conducted for other NRC applications. The staff would also evaluate the process for implementing the Decommissioning GEIS and make any necessary enhancements to the document. The staff would revise the Decommissioning GEIS on a separate schedule from this rulemaking because of the additional public interactions and engagement with other Federal agencies that occur during a NEPA review.

The NRC could also update IMC 2561 and the associated Inspection Procedure (IP) 71801, “Decommissioning Performance and Status Review at Permanently Shutdown Reactors,” dated August 11, 1997, to appropriately address the NRC’s inspection and oversight responsibilities related to 10 CFR 50.82(a)(6)(ii). The changes to these documents would be discussed with the affected NRC inspection and oversight staff, and all proposed changes would be provided for feedback and comment to the appropriate NRC inspection and oversight organizations before implementation of any changes.

#### **4.1.3 Alternative DAR-3 (Rulemaking for Specific Issues)**

In this alternative, the staff would pursue rulemaking in one or more specific areas related to the review of the PSDAR. Supplemental requirements could include provisions for: (1) a requirement for licensees to respond to stakeholder comments received during the PSDAR review process, (2) required periodic updates to the PSDAR (e.g., every five years), (3) required NRC review and approval of the licensee’s evaluation of environmental impacts associated with site-specific decommissioning activities, and (4) clarification of the current requirements that licensees must evaluate the environmental impacts associated with site-specific decommissioning activities before performing the activities. Some stakeholders have identified these areas as shortcomings in the current PSDAR review process.

New language would be added, as warranted, to 10 CFR 50.82(a)(4) and 10 CFR 50.82(a)(5) to address one or more of the following aspects of the PSDAR review process:

- Require that stakeholder comments received on the PSDAR, including State and local government input and feedback, be specifically dispositioned by the licensee. The licensee would be required to address any comments formally provided (through revision of or supplement to the PSDAR) before the PSDAR could be implemented
- All PSDARs must be updated on a five year basis in order to include the additional decommissioning details that do not resolve themselves until later in the process (e.g., site characterization and remediation plans), as well as to provide overall schedule, work planning, and final site disposition updates.
- Require the PSDAR discussion that provides the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate previously issued environmental impact statements to be submitted to the NRC for review and approval.
- Modify the rule language in 10 CFR 50.82(a)(4) to clarify that licensees must evaluate the environmental impacts of planned decommissioning activities in the PSDAR and

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whether the impacts are bounded by previous federally issued environmental review documents. Currently, the rule language indicates that the licensee must provide the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate previously issued environmental impact statements. The rule change would clarify that licensees must evaluate the environmental impacts and determine whether they are bounded. If unbounded impacts are identified, then, consistent with 10 CFR 50.82(a)(6)(ii), the licensee can address those impacts before the associated activity occurs instead of being required to address those impacts at the PSDAR stage.

#### **4.1.4 Alternative DAR-4 (Rulemaking to Require PSDAR Review and Approval)**

In this alternative, the NRC would pursue rulemaking to change the regulations in 10 CFR 50.82 to require NRC review and approval of the PSDAR, similar to the requirements that existed before the 1996 decommissioning rule was implemented. Specifically, these additional regulations would require that the PSDAR be provided as a license amendment request, which would include an opportunity for members of the public to request a hearing on the PSDAR, as well as a formal review and approval of the PSDAR and full environmental review by the NRC. Until these reviews were complete, and the PSDAR formally approved by an accompanying NRC safety evaluation and an environmental analysis, the licensee would not be permitted to enter into any major decommissioning activities except as allowed by the requirements of 10 CFR 50.59. In addition, because the NRC would be performing a licensing action to approve the PSDAR, the NRC would conduct an environmental review in accordance with the National Environmental Policy Act (NEPA) and other environmental statutes.

Under this alternative, the NRC would require that the PSDAR be submitted as a license amendment request in accordance with 10 CFR 50.90, "Application for Amendment of License, Construction Permit, or Early Site Permit." This means that the PSDAR would be subject to the same level of review as other license amendment requests. Specifically:

- the licensee would submit the PSDAR for review by the NRC;
- the document would be noticed in the *Federal Register* for a public comment period, and stakeholders would be able to request a hearing on all or portions of the PSDAR;
- the PSDAR would include an environmental report;
- the NRC would review the document to ascertain whether it contains enough detail on the decommissioning process to ensure that the activities would not have a negative impact on public health and safety; and
- the NRC would conduct a safety evaluation and an environmental review giving the conclusions of the agency's assessment of the PSDAR and, if approved, allowing the licensee to begin major decommissioning activities.

#### **4.1.5 Assumptions**

The NRC staff has made the following assumptions for the cost-benefit analysis:

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- For Alternative DAR-2, assume that the NRC will spend the same amount of time updating IMC 2561 as updating RG 1.184 and RG 1.185.
  - For Alternative DAR-3, assume that industry will spend the same amount of time to evaluate the environmental impacts associated with the site specific decommissioning activities as the NRC to complete a NEPA analysis.
  - For Alternative DAR-3, assume that industry will spend twice the amount of time to update the PSDAR as for the NRC to review the updated PSDAR.
  - For Alternative DAR-4, assume twelve hours for the industry to complete the environmental report for the PSDAR and six hours for the NRC to review that report.
  - For Alternative DAR-4, assume that industry will spend twice the amount of time to complete the PSDAR amendment process and respond to requests for additional information (RAIs) as the NRC to review the amendment and submit RAIs.

#### **4.1.6 Affected Attributes**

Industry Implementation: Under Alternatives DAR-2 through DAR-4, licensees would commit additional resources to respond to the updates to RG 1.184 and RG 1.185. For Alternative DAR-3, industry will commit additional resources to evaluate the environmental impacts associated with the site specific decommissioning activities. For Alternative DAR-4, industry would commit additional resources to write the environmental report for the PSDAR and complete the PSDAR amendment process. For Alternatives DAR-2 through DAR-4, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Under Alternatives DAR-2 through DAR-4, licenses would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking. Under Alternative DAR-3, industry would commit additional resources to update the PSDAR every five years.

NRC Implementation: Under Alternatives DAR-2 through DAR-4, the NRC would commit additional resources to update IMC 2561, RG 1.184 and RG 1.185. For Alternatives DAR-3 and DAR-4, the NRC would expend resources to implement the rulemakings.

NRC Operation: Under Alternatives DAR-2 through DAR-4, the NRC would spend less time on conference calls with industry due to enhanced clarity in guidance and/or rulemaking. Under Alternative DAR-3, the NRC would commit additional resources to review the industry update to the PSDAR every five years.

Other Government: Under Alternatives DAR-2 through DAR-4, the state and local governments would commit additional resources to provide comments for updating the RG 1.185 and rulemaking documents. Under Alternatives DAR-3 and DAR-4 the state and local governments would commit additional resources to provide input into the PSDAR process. For Alternatives DAR-2 through DAR-4, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternatives DAR-2 through DAR-4, the general public would commit additional time to provide comments for updating the RG 1.185 and rulemaking documents.

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Under Alternatives DAR-3 and DAR-4 the general public would commit additional time to provide input into the PSDAR process and hence allow for greater public participation. For Alternatives DAR-2 through DAR-4, the general public would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Environmental: Under Alternative DAR-3, one of the suggested changes would amend the rule language to state that at the PSDAR stage, licensees must evaluate the environmental impacts associated with site-specific decommissioning activities and determine whether they are bounded by previously issued federal environmental documents. This change would clarify the requirements that ensure that the licensee does not perform decommissioning activities that would result in significant impacts not previously reviewed. This regulatory change would have no impact on the NRC staff, and licensees could continue to resolve any unbounded impacts before the performance of the associated decommissioning activity by requesting a license amendment or an exemption, by not performing the activity, or by modifying the activity to avoid causing the significant environmental impact. Further, this change would more closely align the licensee's environmental analysis to the occurrence of the impact. This would reduce the burden on decommissioning licensees because they would no longer need to develop a statement at the time of PSDAR submittal concluding that all of the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate previously issued environmental impact statements.

## **4.2 Maintaining the Decommissioning Options**

Licensees currently have three options for decommissioning power reactor facilities, although they are not required or codified by regulation. These options were first identified in the 1988 Decommissioning GEIS and defined as follows:

- **DECON:** The equipment, structures, and portions of the facility and site that contain radioactive contaminants are promptly removed or decontaminated to a level that permits termination of the license shortly after cessation of operations.
- **SAFSTOR:** The facility is placed in a safe, stable condition and maintained in that state (safe storage) until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact, but the fuel has been removed from the reactor vessel, and radioactive liquids have been drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thus reducing the quantity of contaminated and radioactive material that must be disposed of during decontamination and dismantlement. The definition of SAFSTOR also includes the decontamination and dismantlement of the facility at the end of the storage period.
- **ENTOMB:** Radioactive systems, structures, and components are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license.

The choice of decommissioning method is left entirely to the licensee, provided that the decommissioning method can be performed in accordance with the NRC's regulations. The NRC would require the licensee to reevaluate its decision on the method for decommissioning



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chosen if it: (1) could not be completed as described, (2) could not be completed within 60 years of the permanent cessation of plant operations, (3) included activities that would endanger the health and safety of the public by being outside of the NRC's health and safety regulations, or (4) would result in a significant impact to the environment. The licensee's choice is communicated to the NRC and the public in the PSDAR. To date, all NRC licensees that are decommissioning or have decommissioned power reactors have used either DECON or SAFSTOR. Several sites have performed some incremental decontamination and dismantlement during the storage period of SAFSTOR – a combination of SAFSTOR and DECON – as personnel, money, or other factors become available.

The NRC staff examined whether the regulatory or technical bases for the NRC's rationale towards the three decommissioning methods has changed since the promulgation of the 1996 decommissioning rule and the 2002 update of the Decommissioning GEIS, and explored the opportunity to incorporate additional enhancements or overall improvements to the regulatory framework. The NRC considered and evaluated three options: no action, guidance development and enhancement, and rulemaking to codify the decommissioning approaches. A description of each alternative is provided below.

#### **4.2.1 Alternative O-1 (No Action)**

The no-action option would retain the provisions of the current decommissioning regulations and guidance documents with regard to the decommissioning methods available to licensees, the flexibility for licensees to choose which decommissioning option they wish to implement and on what timeline, and the ability to move between SAFSTOR and DECON as resources or other factors dictate as long as license termination is accomplished within the 60-year period, unless an alternative schedule is explicitly approved by the NRC.

#### **4.2.2 Alternative O-2 (Guidance Development / Enhancement)**

In this alternative, the NRC staff would update guidance documents to address the various methods to decommission power reactors. Specifically, RG 1.184, "Decommissioning of Nuclear Power Reactors," would be updated to include an additional discussion of SAFSTOR and DECON, and to provide enhanced guidance to licensees regarding the potential merits and disadvantages of entering into long term SAFSTOR versus pursuing immediate DECON of certain systems and components at the facility. In addition, the staff would remove the discussion of the ENTOMB option from the existing guidance documents for power reactor decommissioning to the extent practical as this method is not realistically feasible for current U.S. power reactors, and the timeframe for decommissioning completion using the ENTOMB method is generally inconsistent with the current regulations. To reflect this information, the staff would also update RG 1.185, Revision 1, and the Decommissioning GEIS to include provisions for including additional information on the chosen decommissioning strategy in the PSDAR.

In order to better inform the public regarding the decommissioning process at specific facilities, RG 1.184 would be updated to encourage licensees to add additional detail to the PSDAR, DCE, and Irradiated Fuel Management Plan (IFMP) regarding the option selected for decommissioning, the motivation for selecting that option, and what impact that decision has on long term storage of spent fuel.

To benefit the NRC staff and stakeholders, licensees could include additional detail in the PSDAR, DCE, and IFMP on the following topics:

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- The decision making process behind the selection of SAFSTOR or DECON as the decommissioning method and the associated timeline, as well as an overview of the conditions under which DECON will begin at the facility.
  - For the DECON method, how the facility would optimize worker safety, institutional knowledge, and cost, while minimizing opportunities for contamination to migrate offsite.
  - If known, the potential future uses of the site and the overall plan for final disposition of the structures and other components at the facility (i.e., will parts of the site be released early in accordance with 10 CFR 50.83, will the site be made available for industrial use, will the buildings and other structures be left in place, or will the site become a “green field”), as well as the associated timeliness.

As previously noted, the NRC’s updates of the existing guidance would remove ENTOMB as an option because it is not feasible for U.S. nuclear power reactors and is not consistent with the required timeframe to complete decommissioning. The removal of the ENTOMB option is consistent with previous discussions between the NRC, internal and external stakeholders, and members of the international regulatory community. In general, while all these parties recognize entombment, they also know that its application is limited to special situations; thus, it may not be appropriate to maintain it as a prescribed strategy within the typical regulatory framework. To that end, the IAEA is revising its decommissioning safety position, wherein entombment would no longer be considered as desirable as immediate and deferred dismantlement (i.e., DECON and SAFSTOR). The revised IAEA safety position would recognize that entombment is not a “strategy” or a solution for normal planned shutdown, but should be considered a solution only under exceptional circumstances (such as severe accidents) for existing facilities and would be considered on a case-by-case basis.

#### **4.2.3 Alternative O-3 (Rulemaking to Codify the Decommissioning Approaches)**

In this alternative, the NRC staff would pursue rulemaking to codify the methods available for decommissioning and establish requirements for each option to decommission. Specifically, these additional regulations would outline the types of activities that may be undertaken under both DECON and SAFSTOR, as well as the associated timelines and expectations for switching between the two methods. Under this alternative the NRC staff would pursue rulemaking to formally define the available decommissioning methods in 10 CFR 50.82, as well as to establish the level of activity and timelines expected to be associated with each method. In addition, licensees would be required to inform the NRC of which decommissioning method they intend to use, and provide additional notice if that selection is changed as decommissioning progresses.

#### **4.2.4 Assumptions**

The NRC staff has made the following assumptions for the cost-benefit analysis:

- For Alternative O-3, assume that industry will document the change of decommissioning method in 1-3 pages.

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#### **4.2.5 Affected Attributes**

Industry Implementation: Under Alternatives O-2 through O-3, licensees would commit additional resources to respond to the updates to RG 1.184 and RG 1.185. Under Alternatives O-2 through O-3 licenses would commit additional resources to include additional details in the PSDAR, DCE, and IFMP. For Alternative O-3, industry will commit minor resources to add a 1-2 page document that would describe the change of decommissioning method during decommissioning (i.e. from DECON to SAFTOR or vice versa). For Alternatives O-2 and O-3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Under Alternatives O-2 through O-3, licenses would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking.

NRC Implementation: Under Alternatives O-2 through O-3, the NRC would commit additional resources to update RG 1.184 and RG 1.185. For Alternative O-3, the NRC would expend resources to complete the rulemaking.

NRC Operation: Under Alternatives O-2 through O-3, the NRC would spend less time on conference calls with industry due to enhanced clarity in guidance and/or rulemaking.

Other Government: Under Alternatives O-2 through O-3, the state and local governments would commit additional resources to provide comments for updating the regulatory guidance and rulemaking documents.

General Public: Under Alternatives O-2 through O-3, the general public would commit additional time to provide comments for updating the regulatory and rulemaking documents.

#### **4.3 Timeframe Associated with Decommissioning**

The regulation 10 CFR 50.82(a)(3) states that decommissioning will be completed within 60 years of permanent cessation of operations. The Commission must approve completion of decommissioning beyond 60 years and will consider this extension only when necessary to protect public health and safety. Factors that the NRC will consider in evaluating an alternative that provides for completion of decommissioning beyond 60 years after permanent cessation of operations include unavailability of waste disposal capacity and other site-specific factors affecting the licensee's capability to carry out decommissioning. This includes the presence of other nuclear facilities at the site. The NRC would consider these factors as part of its review process if a decommissioning licensee requested an exemption from the 60-year timeframe.

The 60-year timeline described in the NRC decommissioning regulations was established as part of the original decommissioning regulations promulgated in 1988. As part of the current rulemaking activity, the staff considered whether the decommissioning timeline should be adjusted, given the advances in dismantlement and decontamination technologies since the decommissioning regulations were last updated.

The NRC staff has examined whether the regulatory or technical bases for any of the above statements has changed since the promulgation of the 1988 and 1996 decommissioning rules, and explored the opportunity to incorporate enhancements or overall improvements to the

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regulatory framework. The NRC considered and evaluated three alternatives: no action, guidance development and enhancement, and rulemaking to change the timeframe for decommissioning. A description of each alternative is provided below.

#### **4.3.1 Alternative T-1 (No-Action)**

The no-action alternative would retain the provisions of the current decommissioning regulations and guidance documents with regard to the decommissioning timeframe available to licensees.

#### **4.3.2 Alternative T-2 (Guidance Development/Enhancement)**

In this alternative, the NRC staff would update guidance documents to address the timeframe available to decommission power reactors. RG 1.184 would be updated to include a discussion of the basis for the 60-year decommissioning timeline, including what framework was used to establish the initial timeframe, why the assumptions used to support the 1988 decommissioning rule remain valid today (even considering advances in dismantlement and decontamination technologies), and a provision that the health and safety of the public is maintained within the current regulatory framework.

Furthermore, the staff will update several NRC guidance documents related to the decommissioning process to address the concerns identified by the public regarding the timeframe available for decommissioning without the need for formal rulemaking. Specifically, several of the comments received on the Advanced Notice of Proposed Rulemaking (ANPR) for Regulatory Improvements for Decommissioning Power Reactors (Ref. 17) focused on the motivation of licensees for selecting the long term SAFSTOR option over immediate DECON, the lack of detail provided by licensees to support their proposed decommissioning timeline and to justify why site dismantlement and decontamination at an earlier date is not technically feasible or desirable. The comments also showed a general consensus among external, non-industry stakeholders that movement of the spent fuel into dry storage as soon as technically feasible represents a safety improvement at the site. In order to better inform the public and other stakeholders about the decommissioning process at specific facilities, RG 1.184 and RG 1.185 would be updated to encourage licensees to add additional detail to the PSDAR, DCE, and IFMP, as needed, regarding the timeframe proposed for decommissioning, the considerations for selecting that option, what circumstances would prompt a change in the decommissioning timeline (e.g., movement between SAFSTOR and DECON), and what impact that decision has on long term storage of spent fuel.

#### **4.3.3 Alternative T-3 (Rulemaking to Alter Decommissioning Timeframe)**

In this alternative, the NRC staff would pursue rulemaking to decrease the time allowed to complete decommissioning at facilities that are not collocated with operating reactor units and establish requirements for expediting decommissioning to the extent practical at each facility. Specifically, the staff would revise 10 CFR 50.82(a)(3) and the financial regulations for decommissioning to reduce the time limit to complete decommissioning at a reactor facility once the last reactor unit has been permanently shut down, unless the licensee can demonstrate that delaying decommissioning has an overall net positive benefit to public health and safety. If this alternative is selected as part of the regulatory basis and proposed rule for this rulemaking, the NRC staff will conduct additional analyses of the decommissioning data provided by NUREG/CR-0130 and NUREG/CR-0672, EPRI, and other industry groups to determine the appropriate revised timeframe for completion of decommissioning.

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#### 4.3.4 Assumptions

The NRC staff has made the following assumptions for the cost-benefit analysis:

- Assume that industry will spend one-tenth of the time as the NRC to update NUREG/CR-0130 and NUREG/CR-0672.
- For Alternative T-3, assume that the 60-year timeframe for decommissioning would be reduced by rulemaking, to the timeframe that is commensurate with the DECON method.

#### 4.3.5 Affected Attributes

Industry Implementation: Under Alternatives T-2 through T-3, licensees would commit additional resources to respond to the updates to RG 1.184 and RG 1.185. For Alternative T-3, industry will commit additional resources to assist the NRC in updating NUREG/CR-0130 and NUREG/CR-0672. Alternative T-3 may result in a burden to licensees that do not have sufficient funding to complete earlier decommissioning because they will have to make up for the lack of funding in order to do so. For Alternatives T-2 and T-3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Under Alternatives T-2 through T-3, licenses would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking.

NRC Implementation: Under Alternatives T-2 through T-3, the NRC would commit additional resources to update RG 1.184 and RG 1.185. For Alternative T-3, the NRC will commit additional resources to implement the rulemaking. For Alternative T-3, the NRC would expend additional resources to update NUREG/CR-0130 and NUREG/CR-0672.

NRC Operation: Under Alternatives T-2 through T-3, the NRC would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking.

Occupational Health (Routine): Under Alternative T-1, the staff notes that the overall radiological dose and waste volumes created during the immediate decommissioning process (i.e., DECON) may no longer be as high as those determined by NUREG/CR-0130 and NUREG/CR-0672 because of the use of new dismantlement and remediation technologies since the publication of those documents. Under Alternative T-3, the timeframe for decommissioning would be reduced. This will result in additional nuclear radiation exposure to workers responsible for removing contaminated equipment and structures versus if they were performing these same tasks at a plant that would have implemented a longer SAFSTOR decommissioning method in the status quo alternative. This is due to that fact that less time would be allotted for the radiation to decay to lower levels. However, the NRC staff determined that these changes were not significant enough to meaningfully enhance public health and safety should the decommissioning timeframe be shortened. Furthermore, decommissioning can and has been completed safely under the SAFSTOR and DECON process using the current regulatory timeframe. As such, maintaining the current 60-year limit for decommissioning will continue to meet the safety and regulatory requirements envisioned by the 1988 and 1996 rules, will have no additional impact on future plants intending to transition to a decommissioning status, and will ensure adequate protection of public health and safety.

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Other Government: Under Alternatives T-2 through T-3, the state and local governments would commit additional resources to provide comments for updating the regulatory guidance and rulemaking documents. In Alternative T-3, the reduced decommissioning timeframe will increase the state and federal tax revenues.

General Public: Under Alternatives T-2 through T-3, the general public would commit additional time to provide comments for updating the regulatory and rulemaking documents. In Alternative T-3, the reduced decommissioning timeframe will increase the gross domestic product and gross output of the local economies for where decommissioning facilities are located in. Under Alternatives T-2 and T-3, the public and other stakeholders would become better informed regarding the decommissioning process at specific facilities and would have access to documentation that explains the NRC's decommissioning process.

#### **4.4 Role of External Stakeholders in Decommissioning**

Although the NRC does not have the authority to direct governmental and non-governmental entities (other than NRC licensees) to participate in the decommissioning of a facility, the NRC regulations currently offer the public an opportunity to review licensee submittals and provide input during many stages of the decommissioning process. Specifically, 10 CFR 50.82(a)(4) and 10 CFR 50.82(a)(9) require the NRC to publish a notice of the receipt of the licensee's PSDAR and LTP, make the PSDAR and LTP available for public comment, schedule public meetings in the vicinity of the licensed facility to discuss the PSDAR and the LTP, and publish a notice of the meetings in the *Federal Register* and another forum readily accessible to individuals in the vicinity of the site. The staff also routinely engages with State and local government stakeholders by participating, as requested, in meetings or through other interactions with these governmental bodies (e.g., the public utility commission, the coastal commission, environmental and radiological control boards).

In addition, for many years the NRC has strongly recommended that licensees involved in decommissioning activities form a community committee or other advisory organization aimed at fostering communication and information exchange between the licensee and the public. By actively engaging the community and obtaining local citizen views and concerns regarding the decommissioning process and spent fuel storage issues, licensees can maintain better relations with the local citizens. In Appendix M, "Overview of the Restricted Use and Alternate Criteria Provisions of 10 CFR Part 20, Subpart E" of NUREG-1757 (Ref. 18), the NRC provides guidance on creating a site-specific community advisory board. Appendix M does not require licensees to create a community advisory board, but provides recommendations for methods of soliciting public advice, as well as useful guidance and suggestions for effective public involvement in the decommissioning process, that can be adopted by any licensee. Although not a regulatory requirement, all decommissioning licensees to date have created some form of community advisory board, with membership and activity levels commensurate with the overall level of interest in the decommissioning activities at the facility.

Based on an evaluation of the authority given to the NRC by the Atomic Energy Act of 1954, as amended (AEA), the NRC has no basis to mandate participation in the decommissioning process by any non-licensee stakeholders. Such interactions are determined on a case-by-case basis among the licensee and other stakeholders as necessary to address the specific decommissioning situation at each facility. However, the NRC staff did explore the opportunity to incorporate additional enhancements or improvements to the role of State and local governments, members of the public, and other external stakeholders in the decommissioning process. The NRC considered and evaluated three alternatives: (1) no

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action, (2) guidance development and enhancement, and (3) rulemaking to mandate creation of a community advisory board. A description of each alternative follows.

#### **4.4.1 Alternative GOV-1 (No-Action)**

The no-action option would retain the provisions of the current decommissioning regulations and guidance documents with regard to external stakeholder involvement in the decommissioning process, the role of State and local government entities in decommissioning decisions. Licensees would maintain a similar level of regulatory involvement with their individual States as was present when the facility was operating (e.g., continued compliance with State environmental requirements for non-radiological effluent releases and continued interactions with the State radiological control board on decommissioning issues and site remediation plans).

#### **4.4.2 Alternative GOV-2 (Guidance Development/Enhancement)**

In this alternative, the NRC staff would update guidance documents to expressly address the creation of community advisory boards at decommissioning power reactors. Specifically, the NRC would update RG 1.184 and RG 1.185 to discuss best practices for membership, the anticipated level of community advisory board activity and involvement in the decommissioning process, and ways in which to leverage the community advisory board to assist in making decommissioning decisions, if licensees chose to create a community advisory board.

Under this alternative, the NRC could update RG 1.184 and RG 1.185 to provide additional details on aspects for which the NRC staff has needed to engage with licensees to obtain a more complete understanding as part of the agency's ongoing oversight of the decommissioning process. The NRC could also address concerns identified by stakeholders on the need for additional external stakeholder input into the decommissioning process, without the need for formal rulemaking. The NRC would update RG 1.184 and RG 1.185 to indicate that licensees that are planning to create a community committee should add additional detail to the PSDAR regarding the creation of the community advisory board, the proposed minimum membership of that board, and the ways in which the board will be leveraged to promote public involvement in the decommissioning and decision making process. Alternatively, the PSDAR should discuss why the licensee did not consider a community advisory board necessary or prudent for the site and under what conditions it would reconsider such an advisory board as decommissioning progresses (e.g., would the licensee consider implementing a community advisory board when the facility moves from SAFSTOR to DECON).

#### **4.4.3 Alternative GOV-3 (Rulemaking to Mandate Advisory Boards)**

In this alternative, the NRC staff would pursue rulemaking to: (1) codify a requirement that all licensees entering into the decommissioning process create a community advisory board and (2) establish provisions for minimum membership levels, the extent that board input will be taken into consideration during the decommissioning process, the level of independence the board will have to implement decisions regarding decommissioning activities at the facility, and the ability of the board to request meetings with the licensee and other stakeholders, including the NRC, to discuss topics that may be of significant interest during decommissioning. In addition, the NRC would require licensees to provide periodic (likely annual) updates to the NRC on board activities, the topics discussed at board meetings, the decisions made as they relate to ongoing decommissioning of the plant, and the overall progress and status of decommissioning at the facility.

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#### **4.4.4 Assumptions**

The NRC staff has made the following assumptions for the cost-benefit analysis:

- For Alternative GOV-3, there would be one community advisory board meeting per year.

#### **4.4.5 Affected Attributes**

Industry Implementation: Under Alternatives GOV-2 and GOV-3, licensees would commit additional resources to respond to the updates to RG 1.184 and RG 1.185. For Alternatives GOV-2 and GOV-3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Under Alternatives GOV-2 and GOV-3, licenses would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking. Under Alternative GOV-3, licensees would expend additional resources to provide updates on the decommissioning process and address concerns at the community advisory board meetings.

NRC Implementation: Under Alternatives GOV-2 and GOV-3, the NRC would commit additional resources to update RG 1.184 and RG 1.185. For Alternative GOV-3, the NRC would expend resources to implement the rulemaking.

NRC Operation: Under Alternatives GOV-2 and GOV-3, the NRC would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking. For Alternative GOV-3, the NRC will commit additional resources to participate at the community advisory board meetings and address issues and concerns on the decommissioning process.

Other Government: Under Alternatives GOV-2 and GOV-3, the state and local governments would commit additional resources to provide comments for updating the regulatory guidance and rulemaking documents. Under Alternative GOV-3, the state and local governments would commit additional resources participating in the community advisory boards. Alternative GOV-3 may reduce public safety costs that may otherwise arise due to public protests.

General Public: Under Alternatives GOV-2 and GOV-3, the general public would commit additional time to provide comments for updating the regulatory and rulemaking documents. Under Alternative GOV-3, the general public would commit additional time participating in the community advisory boards. Alternative GOV-3 may reduce potential lawsuit costs that may otherwise arise due to non-participation in the decommissioning process by the public.

#### **4.5 Clarifying the Spent Fuel Management Requirements**

During its review of the overall decommissioning regulations, the NRC staff identified areas where the existing regulations could be updated or clarified to be more consistent with, or more appropriately reflect, the requirements necessary to maintain reasonable assurance of adequate protection of public health and safety and the common defense and security at a decommissioning power reactor. One of these areas was the cross-references between the spent fuel management requirements in 10 CFR 72.218, 10 CFR 50.54(bb), 10 CFR 50.82, and 10 CFR 52.110. Specifically, 10 CFR 72.218(a) notes that the 10 CFR 50.54(bb) spent fuel management program must include a plan for removal of the spent fuel stored under the general license from the reactor site. The plan must show how the spent fuel will be managed



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before starting to decommission systems and components needed for moving, unloading, and shipping this spent fuel. The requirement in 10 CFR 72.218(b) notes that an application for termination of a reactor operating license submitted under 10 CFR 50.82 or 10 CFR 52.110 must also describe how the spent fuel stored under the general license will be removed from the reactor site. Although 10 CFR 72.218 provides what information must be specifically included in the 10 CFR 50.54(bb) spent fuel management program and the 10 CFR 50.82 and 10 CFR 52.110 applications for license termination, the requirements in 10 CFR 50.54(bb), 10 CFR 50.82, and 10 CFR 52.110 do not contain this information.

Before 1996, the reactor decommissioning regulations required a licensee to submit a detailed DP before the licensee could begin dismantlement or any major decommissioning activities. As such, the requirement included in 10 CFR 72.218(b) for “an application for termination of a reactor operating license,” is intended to describe a detailed DP. As discussed in the SOC for the 1989 proposed ISFSI general license rule (Ref. 19) this plan would have to include an explanation of when and how the spent fuel will be moved, unloaded, and shipped prior to starting decommissioning. However, the 1996 decommissioning rule removed the requirement for a detailed DP for dismantlement and decommissioning, and the requirement for the licensee to consider and document, or for the NRC to review and approve, how to manage and remove the spent fuel offsite before decommissioning the structures, systems, and components that support moving, unloading, and shipping of spent fuel.

The 1996 rulemaking added other new requirements, including that a PSDAR must be submitted before or within 2 years following permanent cessation of operations, and for an LTP to be submitted 2 years before license termination for NRC review and approval. However, by the time of LTP submittal, most of the 10 CFR Part 50 or 10 CFR Part 52 facilities may have already been dismantled and decommissioned under 10 CFR 50.59 and the LTP may consist of only a dose assessment and a final status survey plan to demonstrate that the residual radioactivity that remains on site meets the dose limits for license termination and site release.

In addition, 10 CFR 72.218(a) notes that the 10 CFR 50.54(bb) spent fuel management program must include a plan for removal of the spent fuel stored under the general license from the reactor site. The plan must show how the spent fuel will be managed before starting to decommission systems and components needed for moving, unloading, and shipping this spent fuel. The requirements in 10 CFR 50.54(bb) also direct licensees (either 5 years before license expiration or 2 years following shutdown, whichever comes first) to submit for NRC “review and preliminary approval” their program for the management, including the provision of funding, until DOE takes title to, and possession of, the spent nuclear fuel. However, the requirements of 10 CFR 50.54(bb) currently apply mostly to the financial requirements of storing and managing spent nuclear fuel, and there is no corresponding requirement to establish how the fuel should be managed until the fuel is removed from the site under the general license, before the licensee decommissions the systems needed to move, unload, and ship the spent fuel at the facility. This is a disparity between the 10 CFR Part 50, 10 CFR Part 52, and 10 CFR Part 72 regulatory frameworks.

The staff explored the opportunity to incorporate additional enhancements or overall improvements into the regulatory process for spent fuel management, such as guidance revisions or development, to ensure (1) that licensees undergoing the decommissioning process are taking adequate actions to maintain the appropriate systems and capabilities for spent fuel management and handling, (2) regulatory clarity, and (3) efficiency, transparency, and openness in the decommissioning process. The NRC considered and evaluated three

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alternatives: (1) no action, (2) guidance development and enhancement, and (3) rulemaking to clarify the spent fuel management requirements. A description of each alternative follows.

#### **4.5.1 Alternative SFM-1 (No-Action)**

The no-action alternative would retain the provisions of the current decommissioning regulations and guidance documents related to spent fuel management and handling capabilities during decommissioning, and would make no changes or clarifications to the requirements in 10 CFR 50.82, 10 CFR 50.54(bb), 10 CFR 52.110, or 10 CFR 72.218.

#### **4.5.2 Alternative SFM-2 (Guidance Development/Enhancement)**

In this alternative, the NRC staff would update or create guidance documents to expressly address the need for decommissioning licensees to consider or plan how to manage spent fuel at the site before they decommission the structures, systems, and components (SSCs) that support moving, unloading, and shipping of spent fuel. Specifically, RG 1.184 and RG 1.185 would be updated to include a discussion of best practices for creating a spent fuel management plan that addresses the potential need for fuel handling after the facility has entered into the decommissioning and dismantlement process. In order to increase transparency in the decommissioning process, guidance would be provided to licensees regarding the need for additional detail in the decommissioning documents to discuss any plans to address the potential need to handle the spent fuel while it is in dry storage, whether it be as part of a future maintenance activity, to address a concern with the storage system itself, or to promote future permanent removal of the spent fuel from the reactor site.

#### **4.5.3 Alternative SFM-3 (Rulemaking to clarify Spent Fuel Management Requirements and Decommissioning Documentation)**

In this alternative, the NRC staff would pursue rulemaking to clarify and update the regulations in 10 CFR 50.82, 10 CFR 50.54(bb), 10 CFR 52.110, and 10 CFR 72.218 as they relate to requirements for a licensee to consider or plan how it is going to manage and remove spent fuel at the site before it decommissions the SSCs that support moving, unloading, and shipping of spent fuel. Specifically, language would be added to 10 CFR 50.54(bb), 10 CFR 50.82(a)(4) or 10 CFR 52.110(d), or a combination, requiring that the IFMP or PSDAR describe how the licensee will manage spent fuel at the site before it starts to decommission systems and components needed for moving, unloading, and shipping the spent fuel. In addition, the NRC could clarify the language in 10 CFR 72.218(b) to refer to the PSDAR, rather than the LTP, during the decommissioning process. The NRC could also modify the language in 10 CFR 72.218 to remove the specific reference to a plan for removal of the spent fuel from the site and instead focus on the safe management of spent fuel at the site until title to, and possession of, the fuel is transferred to DOE. Alternatively, the NRC could delete 10 CFR 72.218 when it adds the spent fuel management planning requirements to 10 CFR Part 50.

#### **4.5.4 Assumptions**

The NRC staff has made the following assumptions for the cost-benefit analysis:

- Assume that no new regulatory guidance would be developed and that only guidance documents RG 1.184 and 1.185 would be updated to account for spent fuel management requirements.

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#### **4.5.5 Affected Attributes**

Industry Implementation: Under Alternatives SFM-2 and SFM-3, licensees would commit additional resources to respond to the updates to RG 1.184 and RG 1.185. Under Alternative SFM-3, licensees would commit minor resources to include the spent fuel management summary in the PSDAR. For Alternatives SFM-2 and SFM-3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Under Alternatives SFM-2 and SFM-3, licenses would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking.

NRC Implementation: Under Alternatives SFM-2 and SFM-3, the NRC would commit additional resources to update RG 1.184 and RG 1.185. For Alternative SFM-3, the NRC would expend resources to implement the rulemaking.

NRC Operation: Under Alternatives SFM-2 and SFM-3, the NRC would spend less time on conference calls due to enhanced clarity in guidance and/or rulemaking.

Other Government: Under Alternatives SFM-2 and SFM-3, the state and local governments would commit additional resources to provide comments for updating the regulatory guidance and rulemaking documents.

General Public: Under Alternatives SFM-2 and SFM-3, the general public would commit additional time to provide comments for updating the regulatory and rulemaking documents.

#### **4.6 Record Retention Requirements**

The following regulations contain the existing requirements for recordkeeping and record retention at operating nuclear power plants and ISFSIs:

- General Design Criterion 1 of Appendix A to 10 CFR Part 50, "Quality Standards and Records," requires licensees to retain certain records throughout the life of the unit.
- Criterion XVII, "Quality Assurance Records," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, requires licensees to retain certain records consistent with regulatory requirements for a duration established by the licensees.
- 10 CFR 50.59(d)(3) requires licensees to maintain records until termination of a license issued under 10 CFR Part 50.
- 10 CFR 50.71(c) requires licensees to maintain certain records consistent with various elements of the NRC regulations, facility technical specifications, and other licensing bases documents.
- 10 CFR 72.72(d) requires licensees to duplicate certain records of spent fuel and high-level radioactive waste and store them in a separate location sufficiently remote from the original records so that a single event would not destroy both sets.

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Licensees that are transitioning to decommissioning frequently request exemptions from certain parts of these recordkeeping regulations that require the retention of records until termination of the license. Licensees that have previously been granted these exemptions used the justification that, when the associated SSCs are removed from the licensing basis documents, the SSCs will no longer serve any NRC-regulated function. Therefore, the need to retain the records will be eliminated.

In addition, several licensees have requested an exemption from the requirements of 10 CFR 72.72(d), which mandates that certain records of spent fuel and high-level radioactive waste in storage be kept in duplicate in a separate location sufficiently remote from the original records that a single event would not destroy both sets of records. Licensees seeking this exemption use the justification that they will store the ISFSI spent fuel records using the same procedures and processes used for the facility spent fuel (and other) records, which are typically stored in accordance with the NRC-approved quality assurance program (QAP).

The NRC considered and evaluated two alternatives: (1) no action and (2) rulemaking to change the applicability of the recordkeeping requirements for nuclear plants that have certified permanent shutdown and removal of fuel and have formally entered the decommissioning process. A description of each alternative follows.

#### **4.6.1 Alternative R-1 (No-Action)**

The no-action alternative would retain the status quo and all provisions of the current recordkeeping and record retention regulations found in 10 CFR 50.71(c); 10 CFR Part 50, Appendix A, General Design Criterion 1; 10 CFR Part 50, Appendix B, Criterion XVII; 10 CFR 50.59(d)(3), and 10 CFR 72.72(d). Under this alternative, decommissioning licensees would still need to apply for exemptions under 10 CFR 50.12 and 10 CFR 72.7 to remove the record retention requirements for SSCs that no longer serve any NRC-regulated function. The NRC staff would continue to review and approve these exemptions on a case-by-case basis.

#### **4.6.2 Alternative R-2 (Rulemaking to Decrease Record Retention Requirements during Decommissioning)**

Through this rulemaking effort, the NRC will seek to change the NRC regulations to minimize the need for regulatory exemptions related to recordkeeping and record retention requirements during decommissioning. Once the NRC receives notifications of permanent cessation of operation and permanent removal of fuel from the reactor vessel, under 10 CFR 50.82(a)(1)(i) and 10 CFR 50.82(a)(1)(ii), it will allow decommissioning licensees to eliminate records associated with SSCs that no longer serve any NRC-regulated function. The NRC will allow this change as long as appropriate change mechanisms, such as the 10 CFR 50.59 evaluation process or NRC-approved technical specification changes, are used to assess the removal of those records to determine that elimination of the records will have no adverse impact to public health and safety.

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### 4.6.3 Assumptions

The NRC staff assumes that a licensee will request exemptions from certain parts of record keeping regulations at the time it certifies under 10 CFR 50.82, "Termination of License," that it has: (1) permanently ceased operation and (2) permanently removed fuel from the reactor vessel. The NRC staff also assumes that in the future, the industry, the states and the general public will provide comments on Alternative R-2 during the proposed rulemaking stage.

### 4.6.4 Affected Attributes

Industry Implementation: Under Alternative R-2, the exemptions that licensees typically submit from record keeping requirements would be reduced, resulting in a one-time benefit (i.e., averted cost) to industry for licensees that enter decommissioning after issuance of the rule. For Alternative R-2, the industry would commit additional resources to participate in the public meeting and commenting periods for the proposed rulemaking stage.

NRC Implementation: For Alternative R-2, the NRC would incur a one-time cost in order to develop the rule. For Alternative R-2, the exemptions from record keeping requirements would be reduced, which would result in a benefit (i.e., averted cost) to the NRC due to lack of reviewing these exemption requests.

Other Government: Under Alternative R-2, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the proposed rulemaking stage.

General Public: Under Alternative R-2, the general public would commit additional resources to participate in the public meeting and commenting periods for the proposed rulemaking stage.

## 4.7 Transportation Investigation, Tracing and Reporting Requirements

10 CFR Part 20, "Standards for Protection Against Radiation," Appendix G, "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests," Section III.E, contains requirements for investigating rail shipments of low-level radioactive wastes (LLW) if the shipper has not received notification of receipt within 20 days after transfer. In addition, Section III.E requires licensees to report such missing shipments to the NRC. Licensees that are involved in the decommissioning process often request an exemption from certain parts of these requirements related to the 20-day receipt notification window. Licensees that have previously been granted these exemptions typically extended the investigation notification window to 45 days using the justification that operational experience indicates that while the 20-day receipt notification window is adequate for waste shipments by truck, rail shipments may take more than 20 days to reach their destination resulting from delays in the route that are outside the licensee's control (e.g., rail cars waiting in switchyards waiting to be included in a train to the disposal facility).

The NRC is considering rulemaking to minimize the need for licensees to seek exemptions from the investigation requirements for LLW by extending the receipt of notification period from 20 days to 45 days after transferring LLW from an operating or decommissioning facility by rail, as required by 10 CFR Part 20. The NRC considered and evaluated two alternatives: (1) no action and (2) rulemaking to extend the receipt notification window to 45 days after transferring LLW by

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rail from any operating or decommissioning nuclear facility under 10 CFR Part 20. A description of each alternative follows.

#### **4.7.1 Alternative TR-1 (No-Action)**

The no-action alternative would retain the status quo and all provisions of the current investigation requirements for LLW transportation in 10 CFR Part 20, Appendix G, Section III.E. Under this alternative, both operating and decommissioning licensees would still need to apply for exemptions under 10 CFR 20.2301 in order to extend the receipt notification window to 45 days after transferring LLW from decommissioning nuclear plants by rail. The NRC staff would continue to review and approve these exemptions on a case-by-case basis.

#### **4.7.2 Alternative TR-2 (Rulemaking to Change Low Level Waste Transportation Investigation Timeframe Requirements)**

Through this rulemaking effort, the NRC will seek to change its regulations to minimize the need for regulatory exemptions related to investigation requirements for LLW transportation during both operation and decommissioning at all nuclear facilities under 10 CFR Part 20. Specifically, the NRC will allow these licensees to extend the receipt notification window to 45 days after transferring LLW from the nuclear facility by rail. This change will continue to meet the underlying purpose of 10 CFR Part 20, Appendix G, Section III.E, which requires licensees to investigate, trace, and report radioactive shipments that have not reached their destination, for unknown reasons.

#### **4.7.3 Assumptions**

The NRC staff assumes that a licensee will request exemptions from certain parts of transportation investigation requirements at the time it certifies under 10 CFR 50.82, "Termination of License," that it has: (1) permanently ceased operation and (2) permanently removed fuel from the reactor vessel. The NRC staff also assumes that in the future, the industry, the states and the general public will provide comments on Alternative T-2 during the proposed rulemaking stage.

#### **4.7.4 Affected Attributes**

Industry Implementation: Under Alternative T-2, the exemptions that licensees typically submit from transportation investigation requirements would be reduced, resulting in a one-time benefit (i.e., averted cost) to industry for licensees that enter decommissioning after issuance of the rule. For Alternative T-2, the industry would commit additional resources to participate in the public meeting and commenting periods for the proposed rulemaking stage.

NRC Implementation: For Alternative T-2, the NRC would incur a one-time cost in order to develop the rule. For Alternative T-2, the exemptions from transportation investigation requirements would be reduced, which would result in a benefit (i.e., averted cost) to the NRC due to lack of reviewing these exemption requests.

Other Government: Under Alternative T-2, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the proposed rulemaking stage.

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General Public: Under Alternative T-2, the general public would commit additional resources to participate in the public meeting and commenting periods for the proposed rulemaking stage

## **5 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES FOR SPECIFIC DECOMMISSIONING TOPICS**

The NRC staff considered the following general approaches to address the regulatory problem identified in Section 1.2 unless identified otherwise in the specific decommissioning topic description:

- Alternative 1: Take No Action
- Alternative 2: Amend the decommissioning requirements through rulemaking
- Alternative 3: Address decommissioning issues through means other than amending the regulations (e.g., regulatory guides, generic communications, or other regulatory actions)

Under Alternative 3, the NRC would not amend the decommissioning regulations. This alternative differs from the Take No Action alternative (Alternative 1) because it would attempt to address the decommissioning areas through other means. However, a review indicates that this approach is not feasible because this option would not eliminate the need to grant specific exemptions or issue license amendments related to certain subject matters (e.g., EP, training, and decommissioning financial assurance). Given the existing data and information, the Alternative 3 approach was eliminated and the NRC considers a rule change to be the most efficient way to implement the decommissioning of power reactors. Eight areas of decommissioning are considered individually. Each area of decommissioning includes the alternatives to pursue for rulemaking, the assumptions for the alternatives, and the identification of attributes that are impacted.

### **5.1 Emergency Preparedness**

The emergency preparedness (EP) requirements in 10 CFR 50.47, “Emergency plans,” and Appendix E, “Emergency Planning and Preparedness for Production and Utilization Facilities,” to 10 CFR Part 50 continue to apply to a nuclear power reactor after permanent cessation of operations and removal of fuel from the reactor vessel. Currently, no explicit regulatory provisions distinguish EP requirements for a power reactor that has permanently ceased operations from those for an operating power reactor. To establish a level of EP commensurate with the risk at a decommissioning site, exemptions from the regulatory EP requirements are typically requested early in the decommissioning process and are granted on a case-by-case basis after a thorough review.

The NRC has previously approved exemptions from the emergency planning regulations in 10 CFR 50.47 and Appendix E to 10 CFR Part 50 at permanently shutdown and defueled power reactor sites. The agency granted these exemptions based, in part, on the NRC’s determination that there would be no applicable design-basis events at a decommissioning licensee’s facility that could result in an offsite radiological release exceeding the limits established by the U.S. Environmental Protection Agency’s (EPA’s) early phase protective action guides (PAGs) of 1 rem at the exclusion area boundary.

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The NRC also relied on analyses that showed that a beyond-design-basis zirconium fire in the SFP is highly unlikely. This conclusion was based on the amount of time necessary before the spent fuel could reach the zirconium ignition temperature during a SFP draindown event (Ref. 9). Based on reasonably conservative adiabatic heatup calculations, a minimum of 10 hours for the time to heatup to zirconium ignition temperature has been used as part of the basis to support the approval of exemptions from portions of the EP regulations. The 10 hour period allows for the licensee to take onsite mitigation measures or, if necessary, for offsite authorities to take appropriate response actions using an all-hazards approach emergency management plan.

Between 1987 and 1999, the NRC issued exemptions from EP requirements for ten licensees. In recent EP exemptions issued in 2014 and 2015 from four decommissioning licenses<sup>2</sup> the NRC required the licensees to have sufficient trained personnel on shift, and equipment and procedures to implement their site-specific preplanned mitigation strategies within a 2-hour timeframe. These mitigation strategies are required by a license condition until the spent fuel is removed from the SFP. Licensees that have been granted EP exemptions must maintain an onsite emergency plan addressing the classification of an emergency, notification of emergencies to licensee personnel and offsite authorities, and coordination with designated offsite government officials following an event declaration so that, if needed, offsite authorities may implement appropriate response actions. The EP exemptions also relieve the licensee from the requirements of 10 CFR 50.47 and Appendix E to 10 CFR Part 50 as they pertain to offsite radiological emergency preparedness (REP), including the requirement to maintain the 10 mile plume exposure pathway and the 50-mile ingestion pathway emergency planning zones (EPZs).

In addition, licensees must pay fees to the Federal Emergency Management Agency (FEMA) and the participating states and localities to fund their activities, which support the offsite radiological EP program. FEMA regulations in 44 CFR Part 350, "Review and Approval of State and Local Radiological Emergency Plans and Preparedness" (Ref. 20), address the review and approval of offsite response organizations' emergency plans and procedures for responding to radiological emergencies at commercial nuclear power plants. Under 44 CFR Part 354, "Fee for Services to Support FEMA's Offsite Radiological Emergency Preparedness Program" (Ref. 21), FEMA establishes the methodology to assess and collect user fees. The fees are to recover the obligated amounts for the radiological EP program. FEMA has established both site-specific and flat fees. The site-specific component is related to plume exposure pathway exercises (Ref. 22). Pursuant to 44 CFR 354.4(e), licensees are required to pay these fees until FEMA receives a copy from the NRC of its approved exemptions from 10 CFR 50.54(q) requirements stating that offsite radiological emergency planning and preparedness are no longer required at a particular commercial nuclear power plant site. Following the receipt of these approved exemptions, FEMA will no longer assess a user fee for that site from the beginning of the next fiscal year.

Because there are no explicit regulatory provisions distinguishing EP requirements for a nuclear power reactor that has permanently ceased operations from those for an operating power reactor, the staff is considering whether to amend the EP requirements in 10 CFR Part 50, including 10 CFR 50.47, 10 CFR 50.54(q), (s), and (t), and Appendix E to 10 CFR Part 50. The

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<sup>2</sup> The recent exemptions for emergency planning have been granted for Kewaunee Power Station (Ref. 47), Crystal River Unit 3 Nuclear Generating Plant (Ref. 48), San Onofre Nuclear Generating Station, Units 2 and 3 (Ref. 49), and Vermont Yankee Nuclear Power Station (Ref. 50).



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objectives of this rulemaking are to: (1) define the level of EP appropriate for a decommissioning nuclear power plant site from the time of permanent cessation of operations until such time as no EP would be required and (2) minimize the need for licensees to request, and the staff to review, exemptions from emergency preparedness regulations for relief from requirements that are no longer necessary.

#### **5.1.1 Alternative EP-1 (No-action alternative)**

Under the no-action alternative, the EP requirements in 10 CFR 50.47, 10 CFR 50.54(q), and Appendix E to 10 CFR Part 50 would remain unchanged and would continue to apply to a nuclear power reactor after permanent cessation of operations and removal of fuel from the reactor vessel. Every nuclear power reactor licensee must establish and maintain emergency plans and preparedness in accordance with these regulations. The regulations include standards for both onsite and offsite emergency response plans. These regulations and the planning basis for EP are based upon an anticipated prompt response to a wide spectrum of events. But for a decommissioning site, the number of accidents that can have significant offsite consequences is greatly reduced and dominated by the zirconium fire scenario. This is a postulated, but highly unlikely, beyond-design-basis accident that involves a major loss of water inventory from the SFP, resulting in a significant heatup of the spent fuel, and culminating in substantial zirconium cladding oxidation and fuel damage. The current regulations do not address that considerably more time is available to respond to a postulated zirconium fire incident than is available to respond to many postulated operating reactor accidents.

Because certain EP requirements designed for operating reactors impose regulatory burden on licensees undergoing decommissioning that is not necessary to protect the public health and safety, licensees generally request exemptions from these requirements. Under the current exemption process described in NSIR/DPR-ISG-02 (Ref. 23), exemptions to offsite EP requirements must be supported by a number of analyses, including a site-specific analysis demonstrating that fuel stored in the SFP would not reach the zirconium ignition temperature in less than 10 hours following a beyond-design-basis accident that involves a major loss of water inventory from the SFP. These exemption requests require extensive analysis by the licensee and review by the NRC for each application. The no-action alternative would not relieve the burden imposed on both licensees and the NRC resulting from this case-by-case EP exemption process. In addition, while the exemption process could be further enhanced, this process would not result in the efficiency gains possible through Alternative EP-2. By continuing to assess EP exemptions for individual licensees, licensees and the NRC would continue to expend resources to prepare and process exemption requests. The RG 1.184 gives an overview of the current decommissioning process and illustrates that the majority of the administrative burden incurred by licensees and the NRC is in the first several years of decommissioning.

The NRC's approval of the requests for exemption from certain requirements of 10 CFR 50.47 and Appendix E to 10 CFR Part 50 allows licensees to initiate the process of establishing a permanently defueled emergency plan (PDEP) and a permanently defueled emergency action level (EAL) scheme. A licensee could submit the PDEP to the NRC for prior review and approval and the NRC would document its determination on the PDEP in a safety evaluation report (SER). The NRC approval of the PDEP would document that the licensee has maintained reasonable assurance that adequate protective measures can and will be taken in a radiological emergency and would provide an approved emergency plan as a licensing basis against which future changes could be compared. Alternatively, a licensee could determine that the adoption of the PDEP would not constitute a reduction in effectiveness of the emergency

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plan per 10 CFR 50.54(q) because of the change in the licensing basis for the plant resulting from the granting of the exemption request, and as such, the licensee could opt to implement the change without prior NRC review and approval. With respect to the permanently defueled EAL scheme, its adoption is considered to be a scheme change, and per the requirements of Section IV.B.2 of Appendix E to 10 CFR Part 50, the licensee would submit it to the NRC for prior review and approval as a license amendment request pursuant to 10 CFR 50.90.

### **5.1.2 Alternative EP-2 (Rulemaking to amend regulations to provide a graded approach to emergency preparedness / emergency plan changes between levels with NRC approval)**

In this alternative, the NRC would pursue rulemaking to propose a graded approach to EP that is commensurate with the reductions in radiological risk at the four stages (or levels) of decommissioning listed in Section 2.1: (1) permanent cessation of operations and defueling – all fuel is removed from the reactor vessel (PSEP), (2) sufficient decay of fuel in the SFP such that it would not reach ignition temperature within 10 hours under adiabatic heatup conditions (PDEP), (3) transfer of all fuel to dry storage (ISFSI, and (4) removal of all fuel from the site. The levels and proposed areas of EP requirements are discussed below. This alternative differs from Alternative EP-1 because the reduction of EP requirements occurs in Alternative EP-1 only if exemptions are requested by the nuclear power plant licensees and approved by the NRC.

Under this alternative, the NRC and FEMA must establish a notification process that would replace the existing NRC/FEMA process for terminating the assessment of FEMA user fees following the receipt from the NRC of its approved exemptions from pertinent 10 CFR 50.47(b) and Appendix E to 10 CFR Part 50 requirements stating that offsite radiological emergency planning and preparedness are no longer required at a particular commercial nuclear power plant site after the spent fuel has cooled for a period of 10 months for BWRs or 16 months for PWRs. This change also requires FEMA to perform a rulemaking to amend 44 CFR 354.4(e), “Discontinuation of charges,” to reflect this new process.

#### **Level 1: Post Shutdown Emergency Plan**

Licensees would enter Level 1 after the NRC’s docketing of the licensee’s certifications of permanent cessation of operations and permanent removal of fuel from the reactor vessel pursuant to 10 CFR 50.82 or 10 CFR 52.110, “Termination of license.” For a decommissioning site, the spectrum of accidents that can have significant offsite consequences is greatly reduced and is dominated by the unlikely occurrence of a zirconium fire.

The purpose of Level 1 is to provide a transition period in which to ensure that an appropriate level of EP is maintained to respond to applicable design basis accidents and to ensure a prompt response to the very unlikely draindown of the SFP and subsequent zirconium fire and release, in less than 10 hours. The NRC staff anticipates that licensees will remain in Level 1 for a period of 10 months (BWR) or 16 months (PWR). During this time, the licensee may be relieved of the regulatory burden of requirements that are not needed to support an appropriate level of EP as preparations are made to implement a Level 2 PDEP. The following discussion addresses current requirements that could be amended in Level 1 to support a transition to a Level 2 PDEP while still providing for adequate protection of the public health and safety during this transition period.

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### *Staffing and Emergency Response Organization*

In Level 1, the spectrum of credible accidents and operational events requiring a response from the Emergency Response Organization (ERO) is reduced as compared to an operating plant, and the principle public safety concern involves the potential radiological risks associated with the storage of spent fuel onsite in the SFP. The reactor, reactor coolant system (RCS), and reactor support systems are no longer in operation and have no function related to the storage of spent fuel. Therefore, postulated accidents involving a failure or malfunction of the reactor, RCS, or reactor support systems are no longer applicable. As such, certain ERO positions and emergency functions as detailed in NUREG-0654/FEMA-REP-1, Revision 1, Table B-1, may not be applicable or necessary in Level 1. Commensurate with the reduced spectrum of credible accidents, the NRC staff is considering changes to the guidance on ERO staffing levels for Level 1. This new guidance would be developed as part of Alternative EP-2.

### *Emergency Classification Levels and Emergency Action Levels*

Section IV.C of Appendix E to 10 CFR Part 50 requires that emergency classes include four emergency classification levels (ECLs) defined by the NRC in NUREG-0654/FEMA-REP-1, Revision 1: (1) Notification of Unusual Event, (2) Alert, (3) Site Area Emergency, and (4) General Emergency. All of these ECLs still apply in Level 1. Although there may be no credible event that could result in significant radiological release beyond the site boundary when a facility enters Level 1, the purpose of Level 1 is to ensure that adequate EP is in place to ensure a prompt response even if a highly-unlikely event should occur. As such, the NRC staff concludes that maintaining ECLs up to a General Emergency would ensure that other expected actions, such as the issuance of a protective action recommendation (PAR) would occur in a timely manner to protect public health and safety. This does not represent a material change in requirements from Alternative EP-1.

### *Evacuation Time Estimate Studies*

Section IV.3 of Appendix E to 10 CFR Part 50 requires licensees to use evacuation time estimates (ETEs) in the formulation of PARs and to provide the ETEs to State and local governmental authorities for use in developing offsite protective action strategies. Licensees must update ETEs on a periodic basis in accordance with the requirements in 10 CFR 50.47(b)(10) and Sections IV.4, IV.5, and IV.6 of Appendix E to 10 CFR Part 50. In the 2011 EP Final Rule (76 FR 72560; November 23, 2011), the NRC amended its regulations regarding ETEs to require licensees to periodically assess changes to the EPZ population. Licensees are required to update their ETE analysis after every decennial census and at any time during the decennial period if the EPZ permanent resident population increases such that it causes the longest ETE value for specific zones to increase by 25 percent or 30 minutes, whichever is less.

The NRC staff concludes that updates to the ETE during Level 1 would provide limited benefit for the enhancement of protective action strategies or offsite evacuation planning. Even if the criteria for updating the ETE analysis were met within the Level 1 timeframe, updating an ETE report may take several months of analysis. After the ETE is updated, the regulations in Section IV.6 of Appendix E to 10 CFR Part 50 require an additional 180 days before an updated ETE can be used to inform PARs and offsite protective action strategies. The additional time and effort needed to develop and implement a revised protective action strategy may exceed the time that a facility would spend in Level 1 and would also be counter to the purpose of Level 1 as a transition period during the decommissioning process. Additionally, based on the

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NRC staff's review of submitted ETEs, population changes within a period comparable to the Level 1 timeframe are unlikely to impact ETEs enough to affect the formulation of protective action strategies. Because formal offsite REP planning and pre-planned PARs for evacuations in response to a radiological emergency are not requirements of Level 2 (see discussion below), updates to the ETE during Level 1 would provide almost no benefit. For all of these reasons, the NRC staff concludes that the regulatory requirements in 10 CFR 50.47(b)(10) and Sections IV.4, IV.5, and IV.6 of Appendix E to 10 CFR Part 50 to periodically update ETEs should no longer be required in Level 1. Existing ETE analyses would remain effective within the emergency plan until no longer required in Level 2.

#### *Annual Dissemination of Public Information*

Section IV.D.2 of Appendix E to 10 CFR Part 50 currently requires licensees to make annual dissemination of basic emergency planning information to the public within the plume exposure pathway EPZ. Several commenters stated that this requirement should no longer apply to decommissioning sites. Section II.G of NUREG-0654/FEMA-REP-1, Revision 1, contains criteria for the information that should be included in the annual dissemination of public information, including educational information on radiation, points of contact, protective measures, and information for special needs populations. During the period of plant operation, EPZ residents will have had adequate opportunity to become aware of this information and much of this information is likely to remain unchanged from year to year. Starting in Level 2, and consistent with the removal of requirements for formal offsite REP for decommissioning sites (including the removal of EPZ requirements), the NRC would not require annual dissemination of public information. However, for Level 1, the change in the plant's operating status and the ensuing changes to the EP program prompt the need to provide a final dissemination of information to the public. This final dissemination would explain the decommissioning process and the resultant changes to the onsite and offsite EP that are likely to occur over the next several years. The NRC staff intends to provide guidance on what the final annual dissemination of public information should include. This new guidance would be developed as part of Alternative EP-2.

#### *Drill and Exercise Program*

Section IV.F of Appendix E to 10 CFR Part 50 and 10 CFR 50.47(b)(14) include requirements for periodic drills and exercises for licensees. Given the low probability of design basis accidents (DBAs) or other highly unlikely events that could result in exceeding the EPA PAGs, as well as the available time to initiate mitigation measures consistent with plant conditions, the previously routine progression to a General Emergency in power reactor site scenarios is not applicable to a decommissioning site. Therefore, the licensee would not be expected to demonstrate response to as wide a spectrum of events as it was during its operating phase. Beginning in Level 1, exercise scenarios could be reduced commensurate with the permanent cessation of power reactor operations and removal of fuel from the reactor vessel to reflect a smaller suite of potential accident scenarios.

Section IV.F.2.c of Appendix E to 10 CFR Part 50 also requires that offsite REP plans for each site be exercised biennially with full participation by each offsite authority having a role under the radiological emergency plan. Depending upon when the licensee starts the decommissioning process, a full participation exercise could potentially be required during Level 1. As the risk of an accident resulting in a radiological release offsite is significantly reduced in Level 1 and because regulatory standards for offsite REP programs would not be a requirement of Level 2, there would be limited safety benefit to performing full-scale participation

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exercises simulating a release with offsite consequences during the time a licensee is in Level 1. The NRC staff anticipates that it will need to clarify further through regulation or guidance the timing and scope of full participation exercises and drills in relation to the licensee's 8-year exercise cycle and the timeline for decommissioning. The NRC will make any potential changes to the timing and scope of exercise and drill requirements in consultation with FEMA. This new regulation or guidance would be developed as part of Alternative EP-2.

### *Hostile Action Requirements*

In the 2011 EP Final Rule, the NRC amended its regulations to include enhancements to EP in response to a hostile action event. In Appendix E to 10 CFR Part 50, Section IV.B.1 includes providing EALs for hostile action, Section IV.E.8.d includes alternative facilities for the staging of ERO personnel during hostile action, Section IV.I provides for protective actions for onsite personnel during hostile action, and Section IV.F.2.c.4 and Section IV.F.2.i include hostile action scenarios in drills and exercises. These EP requirements related to hostile action are separate and distinct from physical protection regulations in 10 CFR Part 73. As discussed below, hostile action requirements would not apply to decommissioning sites that have progressed to Level 2. The NRC staff has determined that maintaining provisions for hostile action within onsite and offsite radiological emergency plans is prudent given the condition of the facility in Level 1. As such, the NRC staff is proposing to maintain EP requirements related to hostile action during Level 1. However, consistent with the above discussion on exercise and drill requirements, the NRC staff concludes that continuing with full-participation hostile-action-based (HAB) exercises would provide limited safety benefit to a facility that is decommissioning. The NRC staff recommends to remove the HAB exercise requirement from the 8-year exercise cycle starting in Level 1, although security-based EALs would remain in place as potential initiating events for exercises and drills. The removal of the full-participation HAB exercise requirement would be performed as part of Alternative EP-2.

### *Emergency Response Data System*

Section VI of Appendix E to 10 CFR Part 50 outlines a set of system, testing, and implementation requirements for the Emergency Response Data System (ERDS). These systems transmit near real-time electronic data directly between the licensee's onsite computer system and the NRC Operations Center. Section VI.2 of Appendix E provides that nuclear power facilities that are shut down permanently or indefinitely are not required to provide hardware to interface with the NRC receiving system. Under this alternative, licensees in Level 1 would need to maintain a capability to provide meteorological, radiological, and SFP data (e.g., level, flow, and temperature data) to the NRC within a reasonable timeframe, but they would no longer be required to maintain an ERDS in accordance with current regulations. The staff assumes that this does not represent a material change in how the ERDS is implemented for Alternative EP-1.

### Level 2: Permanently Defueled Emergency Plan

For plants that have permanently shut down and defueled (Level 1), the recommended EP approach is based primarily on conditions that: (1) a postulated radiological release would not exceed the EPA PAGs at the exclusion area boundary for DBAs applicable to a permanently shutdown and defueled reactor, and (2) sufficient time would exist to take prompt mitigative actions in response to a postulated zirconium fire accident scenario in the SFP and, if warranted, for offsite officials to take appropriate response actions to protect public health and

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safety. The NRC staff is considering two regulatory alternatives to specify when the transition to a Level 2 PDEP may occur: (1) transition after a specified amount of cooling time in Level 1, or (2) transition after an alternative timeframe based on a site-specific analysis that shows the fuel cannot heat up to clad ignition temperature within 10 hours under adiabatic conditions.

The NRC staff's analysis of spent fuel decay times provided information on fuel heatup time to 900°C as a function of cooling time for both PWR and BWR assemblies. The analysis also included sensitivities to the mass of the racks and the fuel configuration in the SFP. Based on this analysis, the NRC staff concludes that after a cooling period of 10 months for BWRs or 16 months for PWRs, the spent fuel cannot reasonably heat up to clad ignition temperature within 10 hours. The recommended regulations would provide for transition to Level 2 after the specified time given above has passed with potential conditions. The NRC staff may also provide licensees with the option to submit a site-specific analysis proposing an alternative cooling period, but such analyses would be subject to NRC review and approval before a transition to Level 2. The regulations would specify an acceptable cooling time in order to relieve licensees of the regulatory burden of providing a site-specific analysis. The following discussion addresses the requirements that would be necessary to provide for adequate protection of the public health and safety at facilities in Level 2.

#### *Staffing and Emergency Response Organization*

The NRC staff is proposing to maintain minimum emergency response staffing requirements for licensees in Level 2. The recommended emergency response staffing can be found in Appendix A, Table 2 to the regulatory basis (Ref. 1).

In addition, licensees in Level 2 would be required to include the following in their emergency plans:

- Specification of the onsite emergency organization of plant staff personnel for all shifts and its relation to the responsibilities and duties of the normal staff complement
- Designation of an individual who shall be on shift at all times and who shall have the authority and responsibility to immediately and unilaterally initiate any emergency actions
- Establishment of the functional responsibilities assigned to the emergency coordinator.

At facilities in Level 2, the augmenting staff would need to include engineering capability appropriate for SFP accident mitigation, but may be otherwise reduced.

Section IV.A.9 of Appendix E to 10 CFR Part 50 requires licensees to conduct a detailed staffing analysis demonstrating that on-shift personnel assigned emergency plan implementation functions are not assigned responsibilities that would prevent the timely performance of their assigned functions as specified in the emergency plan. In the 2011 EP Final Rule (76 FR 72560), the NRC concluded that the staffing analysis requirement was not necessary for non-power reactor licensees due to the small staffing levels required to operate the facility. For this same reason, licensees in Level 2 would no longer be required to perform this analysis under this alternative.

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### *Emergency Classification Levels and Emergency Action Levels*

Section IV.C.1 of Appendix E to 10 CFR Part 50 requires that emergency action levels are based, in part, on onsite and offsite radiation monitoring data. Under this alternative, only the ECLs of Notification of Unusual Event and Alert would apply to licensees in Level 2. Offsite radiation monitoring would be performed as the need arises. Consistent with the discussion on Level 1, EALs associated with power reactor operations (e.g., reactor vessel water level, core temperature, and containment radiation levels) and EALs related to mitigation systems not associated with the SFP would no longer be applicable in Level 2. This new guidance would be developed as part of Alternative EP-2.

### *Emergency Assessment, Classification, and Declaration*

Section IV.C.2 of Appendix E to 10 CFR Part 50 requires licensees to maintain the capability to assess, classify, and declare an emergency condition within 15 minutes. A decommissioning power reactor has a low likelihood of a credible accident resulting in radiological releases requiring offsite protective measures and the event progression is much slower compared to operating reactors. For these reasons, the NRC staff concludes that licensees in Level 2 would not be required to assess, classify, and declare an emergency condition within 15 minutes. The NRC staff is still determining the exact timeframe that it will require for emergency declaration for licensees in Level 2 and will provide that information at the proposed rule stage; however, the staff has concluded that this time should not exceed 60 minutes. The change to the timing for this reporting requirement would be developed as part of Alternative EP-2. The staff assumes that the relaxation of this timing requirement from 15 minutes to a time that should not exceed 60 minutes would result in an inconsequential cost burden reduction from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

### *Offsite Radiological Emergency Response Plans*

The transition to Level 2 would be conditioned upon the presumption, as supported by analyses, that the licensee is wholly capable of and responsible for mitigating the consequences of an event. Licensees must also demonstrate that adequate physical security remains to protect the spent fuel and that the onsite staff can perform adequate mitigation strategies.

In its review of several exemption requests, the NRC has concluded that as long as a period of at least 10 hours is available to initiate mitigation measures or to implement appropriate response actions offsite, formal offsite radiological emergency plans required under 10 CFR Part 50 are not necessary for permanently shutdown and defueled nuclear power reactor licensees. The transition to Level 2 would be conditioned upon the presumption, as supported by analyses, that the licensee is wholly capable of and responsible for mitigating the consequences of an event and that the licensee is not reliant upon Offsite Response Organizations (OROs) for offsite REP to mitigate the consequences of an event. Licensees must also demonstrate that adequate physical security remains to protect the spent fuel and that adequate mitigation strategies can be performed by the onsite staff. The NRC staff concludes that, for entry into Level 2, site conditions must provide at least 10 hours to initiate mitigation measures or to implement appropriate response actions offsite and, therefore, regulatory standards for offsite radiological emergency plans would no longer be necessary for adequate protection of public health and safety.

Many communities have comprehensive all-hazards response or comprehensive emergency management plans in place to supplement these capabilities. Offsite response organizations

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will continue to take actions to protect public health and safety as they would at any other industrial site, and under this alternative, the NRC would expect licensees and OROs to establish memoranda of understanding (MOU) for firefighting, law enforcement, and ambulance/medical services. As currently required under Sections IV.A.6 and A.7 of Appendix E to 10 CFR Part 50, licensee emergency plans would still be required to identify local offsite services and assistance expected from governmental agencies. This approach is consistent with requests from several commenters that the NRC maintain requirements for licensees to have formal agreements with OROs in place for emergency response. The staff contends that this clarification to the offsite radiological emergency response plans does not represent a material change in how licensees meet the EP requirements from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

#### *Notification Requirement to State and Local Governmental Agencies*

Section IV.D.3 of Appendix E to 10 CFR Part 50 currently requires licensees to have the capability to notify OROs of an emergency declaration within 15 minutes. Under this alternative, licensees in Level 2 would be required to promptly notify OROs and to make this notification no later than 1 hour after declaration of an emergency. Because of the low probability of DBAs or other credible events that would be expected to exceed the EPA PAGs and the available time to initiate mitigation measures consistent with plant conditions or, if necessary, to implement protective actions, the NRC staff concludes that 60 minutes provides sufficient time for ORO notification in Level 2. The NRC staff assumes that changing the notification time from “within 15 minutes” to no later than an hour would result in an inconsequential cost burden reduction from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

#### *Public Alert and Notification Systems*

Section IV.D.3 of Appendix E to 10 CFR Part 50 requires licensees to demonstrate that appropriate governmental authorities have the capability to make a public alerting and notification decision promptly on being informed of an emergency condition. Because of the low probability of DBAs or other credible events that would be expected to exceed the limits of EPA PAGs offsite and the available time for event mitigation, the public alert and notification system would not be required for licensees in Level 2. Similarly, exercises of this system, as required under Section IV.F.2 of Appendix E to 10 CFR Part 50 would no longer be required for licensees in Level 2. Several commenters opposed a revision to the public alert and notification system requirements because of a decommissioning site’s reduced response capabilities. In this alternative, licensees in Level 2 would still be required to maintain the capability to notify responsible State and local governmental agencies within 60 minutes after declaring an emergency, and sufficient time would be available to inform the public and implement protective actions, if necessary. The NRC staff assumes that the recommended change does not represent a material change in how the public alert and notification system is maintained and exercised from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

#### *Plume Exposure Pathway and Ingestion Pathway Emergency Planning Zones*

Emergency Planning Zones (EPZs) are defined as the areas for which planning is needed to assure prompt and effective actions can be taken to protect the public in the event of an incident. The requirements of 10 CFR Part 50 state that the EPZs associated with each nuclear



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power plant must be defined both for the shorter-term plume exposure pathway and the longer-term ingestion exposure pathway. Because of the low probability of DBAs or other credible events that would be expected to exceed the EPA PAGs offsite, and the available time to initiate mitigation measures consistent with plant conditions, the potential offsite consequences would not warrant maintaining the plume exposure pathway and ingestion exposure pathway EPZs in Level 2. If necessary, sufficient time would be available for OROs to implement appropriate response actions even for the worst case severe accident. Therefore, EPZs would not need to be maintained in Level 2.

### *Offsite Radiological Protective Action Recommendations*

Licensees must develop a range of protective actions for the plume exposure pathway EPZ for emergency workers and the public per the requirements in 10 CFR 50.47(b). Licensees in Level 2 would not need to develop preplanned PAR strategies for any emergency workers that may have to respond to the site for firefighting, law enforcement, and ambulance/medical services. For Level 2, preplanned offsite protective actions to ensure a prompt response to a radiological emergency on site are not necessary given the time available for OROs to implement appropriate response actions. Although the likelihood is extremely low for events that would result in doses in excess of the EPA PAGs to the public beyond the owner-controlled area boundary based on the permanently shutdown and defueled status of the reactor, the NRC would still require licensees in Level 2 to determine whether a radiological release is occurring. If a release is occurring, then the licensee staff would be required to communicate that information to offsite authorities within 60 minutes (see the discussion above on Level 2 notification requirements) for their consideration in taking appropriate response actions.

Licensees in Level 2 would still be required to provide protective actions for any emergency workers who may have to respond to the site for firefighting, law enforcement, and ambulance/medical services. Additionally, licensees in Level 2 would still be required to protect the health and safety of members of the public present within the owner-controlled area in case of a radiological emergency. The NRC staff assumes that this does not represent a material change in how the licensee maintains the range of protective actions for the plume exposure pathway EPZ for emergency workers and the public from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

### *Evacuation Time Estimate Studies*

Licensees must develop and update Evacuation Time Estimates (ETEs) in accordance with 10 CFR 50.47(b) and Section IV.3 of Appendix E to 10 CFR Part 50. Section IV.3 requires licensees to use ETEs in the formulation of Protective Action Recommendations (PARs) and to provide ETEs to State and local governmental authorities for use in developing offsite protective actions strategies. Consistent with the determination for EPZs and PARs, maintaining ETEs would no longer be required in Level 2. The NRC staff assumes that this does not represent a material change in how the licensee develops and updates ETEs from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

### *Emergency Facilities and Equipment*

Section IV.E of Appendix E to 10 CFR Part 50 requires licensees to maintain and describe adequate provisions for emergency facilities and equipment, including equipment at the site for

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personnel monitoring, equipment for radiological assessment, facilities and supplies for decontaminating onsite individuals, first aid facilities and medical supplies, arrangements for qualified medical service providers and the transportation of contaminated injured individuals, and arrangements for the treatment of individuals injured in support of licensed activities. These requirements have not been exempted in previous exemption requests, and the NRC staff has determined that facilities in Level 1 and Level 2 would still need to maintain these capabilities. The NRC staff assumes that this does not represent a material change in how the licensee maintains and describes adequate provisions for emergency facilities and equipment from Alternative EP-1.

*Technical Support Center (TSC), Operations Support Center (OSC), Emergency Operations Facility (EOF) Designated Staff*

Consistent with the removal of requirements for formal offsite REP for decommissioning sites (including the removal of EPZ requirements), specific requirements for TSC, OSC, and EOF designated staff would no longer be applicable to licensees in Level 2. Because of the low probability of DBAs or other credible events that would be expected to exceed the EPA PAGs offsite and the available time to initiate mitigation measures consistent with plant conditions, or if necessary, to implement response actions, licensees in Level 2 would not need to maintain the TSC, OSC, and EOF designated staff, or offsite field dose assessment teams. The NRC staff assumes that elimination of the TSC, OSC, and EOF designated staff, and offsite field assessment teams does not represent a material change in burden from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

*Hostile Action Requirements*

Licensees in Level 2 would be required to identify ORO resources that would respond to a security event, and the assistance licensees expect from those resources would be maintained in PDEPs. For physical security, risk insights can be used to determine which targets are important to protect against sabotage. A level of security commensurate with the consequences of a sabotage event is required and is evaluated on a site-specific basis. The severity of the consequences declines as fuel ages and, thereby, removes over time the underlying concern that a sabotage attack, under the current definition, could cause offsite radiological consequences. Therefore, enhancements to EP in response to hostile action, such as alternative facilities for the staging of ERO personnel, protection of onsite personnel, and challenging drills and exercises involving hostile action, are not warranted for facilities in Level 2. The NRC staff assumes that the treatment of hostile action requirements does not represent a material change from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

*Drill and Exercise Program*

In addition to the recommended changes to the drill and exercise program starting in Level 1, some of the principal functional areas that must be incorporated into drills (e.g., protective action recommendation development, assessment of offsite impact of radiological releases) would no longer be applicable in Level 2. The NRC staff intends to provide guidance for the conduct of drills and exercises for decommissioning sites. This new guidance would be developed as part of Alternative EP-2. The NRC staff assumes that the functional areas that are incorporated in drills and performed for Alternative EP-1 will be reflected in the guidance developed as part of Alternative EP-2 and therefore that this will not represent a material change in burden from

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Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

#### *Offsite Response Organization Participation in Drills and Exercises*

Section IV.F of Appendix E to 10 CFR Part 50 and 10 CFR 50.47(b)(14) include requirements for periodic EP drills and exercises for licensees. Paragraph IV.F.2.c of Appendix E to 10 CFR Part 50 requires offsite REP plans for each site to be exercised biennially with full participation by offsite authorities having a role under the radiological response plan. Consistent with the removal of regulatory requirements for offsite REP for decommissioning sites (including the removal of EPZ requirements), ORO participation in radiological drills and exercises would no longer be required for licensees in Level 2, although licensees in Level 2 would be required to offer OROs the opportunity to participate. The NRC staff assumes that relaxing ORO participation in radiological drills and exercises from mandatory participation to an opportunity to participate (i.e., voluntary participation) does not represent a material change from Alternative EP-1 after the NRC grants the exemption request from applicable requirements in 10 CFR 50.47 and Appendix E to Part 50.

#### Level 3: All Spent Fuel Transferred to an Independent Spent Fuel Storage Installation

A licensee with an ISFSI that terminates its 10 CFR Part 50 or 10 CFR Part 52 license must first obtain a specific 10 CFR Part 72 license. Accordingly, the licensee would then transition to the EP requirements for dry cask storage already provided in 10 CFR 72.32. A licensee maintaining its 10 CFR Part 50 or 10 CFR Part 52 license may opt to make changes to its EP program to align it with the requirements of 10 CFR 72.32 once all spent fuel is transferred to an ISFSI. Under this alternative, these two categories of licensees in Level 3 (i.e., 10 CFR Part 72 specific licensees and 10 CFR Part 50 or 10 CFR Part 52 licensees with 10 CFR Part 72 general licenses) would be subject to the same requirements as currently exist under 10 CFR 72.32. Because the technical basis for the requirements in 10 CFR 72.32 already exists, the regulatory basis document does not address the technical basis for the EP requirements under Level 3.

#### Level 4: All Spent Fuel and Radioactive Material Removed from Site

Once all spent fuel and sources of radioactivity have been permanently removed from the site, a licensee can terminate its EP program because the site no longer poses any risk of a radiological release.

#### Additional Amendments for Emergency Preparedness

##### *Applicability of 10 CFR 50.54(s)(2)(ii) and (s)(3)*

Every 10 CFR Part 50 or 10 CFR Part 52 license includes as a condition of the license the requirements of 10 CFR 50.54(s)(2)(ii) and (s)(3), regarding findings and determinations of reasonable assurance. The relationship between the NRC and FEMA concerning findings of reasonable assurance of offsite EP is based on the AEA; the Energy Reorganization Act of 1974, as amended; the NRC Authorization Act of 1980; the NRC's regulations; an MOU between the two agencies; and case law. The conclusion consistently reached over the years is that the NRC has the authority and responsibility to make licensing findings on the overall adequacy of onsite and offsite radiological emergency planning and preparedness. Commensurate with the Commission's responsibility to make such findings, the Commission

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has the authority to collect, review, and evaluate any information it needs to support its findings on EP. If available, the NRC must consider FEMA findings and determinations regarding the status of offsite EP.

The NRC staff is proposing that if the NRC determines that reasonable assurance of offsite radiological EP is not required, then such findings and determinations by FEMA would not be needed in order for the NRC to make determinations regarding reasonable assurance under 10 CFR 50.54(s)(2)(ii). Therefore, the NRC staff is considering changes to clarify that 10 CFR 50.54(s)(3) applies to offsite emergency plans only when regulations require reasonable assurance of offsite radiological EP. This amendment would be generally applicable and not specific to decommissioning sites (e.g., it would apply in the future to the regulatory framework for small modular reactors or other new reactor technologies that do not require offsite radiological EP). As a result, FEMA fees would no longer apply. The NRC staff did not identify any material change in burden for this provision between that required for Alternative EP-1 after the NRC grants the exemption request and for Alternative EP-2.

#### *Notifications under 10 CFR 50.72*

The regulations in 10 CFR 50.72 provide notification requirements and stipulations for a number of 1-hour, 4-hour, and 8-hour reports by the licensee to the NRC. With regard to EP, 10 CFR 50.72(a)(1)(i) requires that licensees report any emergency declarations to the NRC within 1 hour. Additionally, 10 CFR 50.72(b)(3)(xiii) requires a report within 8 hours for “any event that results in a major loss of emergency assessment capability, offsite response capability, or offsite communications capability (e.g., significant portion of control room indication, Emergency Notification System, or offsite notification system).” The NRC staff does not anticipate any amendments to these regulations as they apply to decommissioning sites. The 1-hour reporting requirement of 10 CFR 50.72 is consistent with the recommended regulations for notification requirements for licensees in Level 2. The 8-hour reporting requirement of 10 CFR 50.72(b)(3)(xiii) will also continue to apply; however, because many of these capabilities may not be requirements of a PDEP, the NRC staff intends to provide additional guidance in NUREG-1022, “Event Reporting Guidelines, 10 CFR 50.72 and 50.73,” or a similar document, to clarify how the regulation applies to facilities in decommissioning. This new guidance would be developed as part of Alternative EP-2.

#### *Change Process under 10 CFR 50.54(q)*

Licensees are required by 10 CFR 50.54(q)(2) to follow and maintain the effectiveness of an emergency plan that meets the standards in 10 CFR 50.47(b) and the requirements in Appendix E to 10 CFR Part 50. In addition, Section 50.54(q) contains the conditions under which the licensee may make changes to its emergency plan without prior application to and approval by the NRC, provided that the changes do not reduce the effectiveness of the plan and that the plan, as changed, continues to meet the standards in 10 CFR 50.47(b) and the requirements in Appendix E to 10 CFR Part 50.

It is the NRC’s intention that this rulemaking effort would establish clear regulatory requirements for EP, reducing the need to request certain exemptions and license amendments. As such, the NRC staff is considering modifications to the regulations in 10 CFR 50.54(q) that would establish the process for (1) transitions between regulatory EP standards and (2) changes to emergency plans subject to the graded EP standards. The NRC staff does not anticipate any EP-related changes to 10 CFR 50.59 as a result of this rulemaking alternative.

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### *Plan Changes for Transitions between Levels*

For transitions between levels, the NRC would require licensees to establish emergency plans that meet the regulatory EP standards for the next level. The NRC staff is considering two options: (1) submit plan changes to the NRC for approval, or (2) provide a change process for licensees to make changes to the plan without prior NRC approval.

Option 1: Using the license amendment process under 10 CFR 50.90, "Application for Amendment of License, Construction Permit, or Early Site Permit," the licensee would submit, for NRC prior review and approval, a revised emergency plan that describes the licensee commitments and plan features to meet one of the graded levels (i.e., Post-Shutdown Emergency Plan, PDEP, or ISFI Only Emergency Plan). The NRC would review and document its review of this submission in a safety evaluation report. This would establish NRC documentation that the licensee has maintained reasonable assurance and would provide a documented, approved emergency plan as a licensing basis against which future changes could be compared.

Under the requirements of 10 CFR 50.54(q), the NRC has depended upon the licensee to review changes to its emergency plans against the current NRC-approved plan. This option would provide for regulatory certainty, public hearing rights under 10 CFR 50.91, "Notice for Public Comment; State Consultation," and a documented baseline emergency plan against which reviews of future changes could be made. This option could also facilitate EP program inspections by providing certainty on the approved plan. However, these benefits would come at the cost of the additional licensee and NRC staff hours and expenses associated with the license amendment process, but they would not necessarily increase the margin of safety.

Option 2: The licensee would be able to make changes to its emergency plan using the 10 CFR 50.54(q) process (or a similar change process) but would not need to consider whether the change is a reduction in effectiveness or request a license amendment, provided that the change is enacted to comply with the EP requirements corresponding to the licensee's level of decommissioning. Licensees making changes to their emergency plans to commit to the EP requirements of a decommissioning level would not be required to determine the reduction in effectiveness for these changes. Instead, the Commission would have already made this determination through its promulgation of the regulations on the graded EP standards and associated emergency planning functions. This regulatory approach does not go beyond the authority currently granted to licensees to make changes to their emergency plan under 10 CFR 50.54(q)(3). Although hearing rights associated with the license amendment process would no longer be available for each of these individual changes, the public would have had the opportunity to comment on the EP requirements themselves in response to the proposed rule and the drafts of the supporting guidance documents. If the licensee were to seek additional authority to that provided by the rulemaking, the licensee would need to request exemptions from the applicable EP regulations.

### *Plan Changes within a Level*

For emergency plan changes within each level after the plan has been implemented for Level 1 (Post-Shutdown Emergency Plan) and Level 2 (PDEP), licensees would be required to follow and maintain the effectiveness of the plan, consistent with 10 CFR 50.54(q)(2), and comply with the 10 CFR 50.54(q) change process. Therefore, licensees would be allowed to make changes to these emergency plans without prior application to and approval by the NRC, provided that the changes would not reduce the effectiveness of the plan and that the plan, as changed,

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would continue to meet the EP regulatory standards for the applicable level. Under 10 CFR 50.54(q)(5), licensees would be required to submit to the NRC a report of each such change within 30 days. Licensees would have to submit changes that would reduce the effectiveness of the plan for prior NRC review and approval in accordance with 10 CFR 50.54(q)(4) so that the NRC could make the requisite reasonable assurance determination. For emergency plan changes within Level 3 (ISFSI-Only Emergency Plan), the licensee would have to meet the emergency plan change requirements comparable to 10 CFR 72.44(f). The requirements in 10 CFR 72.32(a)(14) for a 60-day ORO comment period would also apply if the plan changes affect the OROs expected to respond in case of an accident. The NRC would provide additional guidance in RG 1.219, or a similar document, to assist the licensee in making its reduction in effectiveness determination. The recommended approach to transitioning between levels and making emergency plan changes within the levels would provide an efficient and effective regulatory change process and would promote consistent and predictable implementation and enforcement.

#### *Program Element Review under 10 CFR 50.54(t)*

Under 10 CFR 50.54(t), licensees must conduct reviews of EP program elements either: (1) at intervals not to exceed 12 months, or (2) as necessary, based on an assessment by the licensee against performance indicators, and as soon as reasonably practicable after a change occurs in personnel, procedures, equipment, or facilities that potentially could adversely affect EP. If a licensee chooses the second option, it must still review all program elements at least once every 24 months. The NRC received ANPR comments both supporting and opposing revisions to paragraph 10 CFR 50.54(t), including comments asserting that licensees should be allowed to conduct reviews every 24 months and comments suggesting that the NRC should remove the requirement to review adequacy of interfaces with State and local governments. Considering the expected duration and intended purpose of Level 1 and the anticipated changes to emergency plans for Level 2, the NRC staff concludes that it would be appropriate to ensure that this audit is conducted as soon as reasonably practicable after a licensee has implemented its Level 2 emergency plan.

Because of the reduced spectrum and low probability of potential accident scenarios at a permanently shutdown and defueled power reactor, and in order to support the transition to a PDEP and ensure a practicable timeframe for review, the NRC staff is considering an amendment to the regulation such that, starting in Level 1, licensees would be able to conduct program element reviews under 10 CFR 50.54(t) at intervals not to exceed 24 months (rather than at intervals not to exceed 12 months) without conducting an assessment against performance indicators. This regulatory approach would align the first such review for a PDEP to shortly after the plan has been implemented and would eliminate the potential to expend resources during Level 1 in reviewing transitional program elements.

#### Updates to Regulatory Guides and NUREGs

Under Alternative EP-2, the NRC would develop new EP-specific guidance. Draft guidance documents would be issued with the proposed rule and final guidance documents would be issued with the final rule. The following EP guidance documents may be updated or relevant portions included in a new guidance document specific to decommissioning facilities:

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- RG 1.219, “Guidance on Making Changes to Emergency Plans for Nuclear Power Reactors”<sup>3</sup>
  - NSIR/DPR-ISG-01, “Interim Staff Guidance, Emergency Planning for Nuclear Power Plants”
  - NUREG-1022, “Event Reporting Guidelines, 10 CFR 50.72 and 50.73”
  - Inspection Procedure (IP) 82501, “Decommissioning Emergency Preparedness Program Evaluation”
  - IP 82401, “Decommissioning Emergency Preparedness Scenario Review and Exercise Evaluation”

### 5.1.3 Assumptions

The NRC staff has made the following assumptions for the cost-benefit analysis:

- In Alternative EP-1, all nuclear power plant licensees would file exemption requests and amendment requests from pertinent 10 CFR 50.47(b) and Appendix E to 10 CFR Part 50 requirements so that they may obtain the benefits described in Alternative EP-2 above.
- For Alternative EP-2, each licensee would not submit a site-specific analysis, but instead would wait the pre-determined time, which will be specified by rulemaking, before transitioning from Level 1 to Level 2.
- For Alternative EP-2, the NRC staff assumes that the notification requirements performed for Alternative EP-1 will be reflected in guidance.
- For Alternative EP-2, the staff assumes that staffing and emergency response organization requirements do not represent a material change in burden from Alternative EP-1 after the NRC grants the exemption requests.
- For Alternative EP-2, the staff assumes in this analysis that the new guidance would not reflect how ECLs and EALs are implemented and therefore do not represent a material change in burden from Alternative EP-1 after the NRC grants the exemption requests.

### 5.1.4 Affected Attributes

Industry Implementation: Under Alternative EP-2, the number of requests for exemptions that licensees typically submit from EP requirements would be reduced, resulting in a one-time benefit (i.e., averted cost) to industry for plants that enter decommissioning after issuance of the rule. . Additionally the licenses would commit additional resources to participate in the public meetings and commenting periods for the regulatory basis and proposed rulemaking.

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<sup>3</sup> RG 1.219 was updated in July 2016 to clarify the applicability of the 10 CFR 50.54(q) change process to facilities that have permanently ceased operation. Additional updates may be needed to this regulatory guide to address the graded approach for decommissioning described in this document.

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Industry Operation: Under Alternative EP-2, licensees might avoid recurring FEMA fees due to the time period between when the fuel in the SFP has sufficiently decayed such that it would not reach ignition temperature within 10 hours under adiabatic heatup conditions and the finalization of the exemption from emergency preparedness.

NRC Implementation: To implement Alternative EP-2, the NRC incurs a one-time cost in order to develop the rule and to update the guidance in RG 1.219, NSIR/DPR-ISG-01, NUREG-1022, IP 82501, and IP 82401. For Alternative EP-2, the number of exemptions from and amendments to 10 CFR 50.47(b) and Appendix E to 10 CFR Part 50 requirements would be reduced, which would result in a benefit (i.e., averted cost) to the NRC due to lack of reviewing these exemptions and amendments.

Other Government: To implement Alternative EP-2, the NRC and FEMA would establish a notification process that replaces the existing NRC/FEMA process for terminating the assessment of FEMA user fees. The FEMA would also incur one-time costs to develop and issue a final rule to amend 44 CFR 354.4(e), "Discontinuation of charges," to reflect this new process. Under Alternative EP-2 the state, local governments and FEMA would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternative EP-2, the general public would commit additional time to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

## **5.2 Physical Security**

Whether they hold a license under 10 CFR Part 50 or 10 CFR Part 52, nuclear power reactor licensees are subject to various security requirements in 10 CFR Part 73, "Physical Protection of Plants and Materials." Such requirements include those in Appendix B to Part 73, "General Criteria for Security Personnel," Appendix C, "Safeguards Contingency Plans," 10 CFR 73.54, "Protection of digital computer and communication systems and networks," and 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage." If the power reactor site has an associated independent spent fuel storage installation (ISFSI) under the general license granted by 10 CFR 72.210, "General license issued," the licensee must protect the ISFSI in accordance with 10 CFR 72.212, "Conditions of general license issued under § 72.210."

Under the existing regulations, each nuclear power reactor licensed under 10 CFR Part 50 or 10 CFR Part 52 remains subject to the requirements in 10 CFR 73.55 to maintain a Commission-approved physical security plan, training and qualification plan, safeguards contingency plan, and cyber security plan. The regulations in 10 CFR 73.55(b)(3) require the physical protection program to be designed to prevent significant core damage and spent fuel sabotage. The regulations further require the licensee to have a physical protection program that ensures that the capabilities to detect, assess, interdict, and neutralize threats (up to and including the design-basis threat (DBT) of radiological sabotage, as stated in 10 CFR 73.1, "Purpose and scope") are maintained at all times. The regulations in 10 CFR 73.55(b)(3) also require that the licensee's physical protection program provides defense in depth through the integration of systems, technologies, programs, equipment, supporting processes, and implementing procedures to ensure the program's continued effectiveness.



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During the initial transition from operation to decommissioning, the reactor is permanently shutdown and the spent fuel is permanently moved from the reactor vessel to a SFP. Although the potential adversary targets are fewer, and in fewer locations, the licensee is currently responsible for identifying and analyzing the “new” site-specific conditions to account for possible adversary approaches consistent with the changes in facility configuration. At this step in the process, licensees with reactors in the decommissioning process have submitted to the NRC various changes and requests for exemptions from the NRC security requirements under 10 CFR 73.5, “Specific Exemptions,” requests for license amendments under 10 CFR 50.90, and security plan changes under 10 CFR 50.54(p). In accordance with 10 CFR 50.54(p)(2), a licensee may make security plan changes that do not decrease the effectiveness of the security plan without prior NRC approval. Licensees must provide a report of the security plan change to the NRC within 2 months of the change.

Currently, there are no regulatory provisions distinguishing physical security requirements for a power reactor that has permanently ceased operation from those for an operating power reactor. As a result, decommissioning reactor licensees and the NRC staff have expended resources for processing security-related licensing actions, such as exemption and license amendment requests. Licensees that have transitioned to decommissioning have sought and received NRC approval of exemptions and amendments to reduce physical security requirements no longer needed or no longer relevant because the configuration of the site has changed and the risk consequences presented by a decommissioning plant are much less than when it was operating.

Additionally, licensee and NRC staff resources are also spent reviewing security plan changes to ensure all revisions either do not reflect a decrease in effectiveness or are submitted to the NRC for review and approval prior to implementation in accordance with 10 CFR 50.54(p). The lack of a regulatory definition for “a decrease in effectiveness” and how licensees demonstrate there is no decrease complicates this process, therefore NRC staff is proposing to amend the current regulation to provide clarity for licensees and staff for security plan changes.

### **5.2.1 Alternative PS-1 (No-action alternative)**

The no-action alternative would retain the current physical security regulatory structure for power reactor licensees during operation and decommissioning. Each nuclear power reactor licensed under 10 CFR Part 50 or 10 CFR Part 52 will continue to remain subject to the current requirements in 10 CFR 73.55 to maintain a Commission approved physical security plan, training and qualification plan, safeguards contingency plan, and cyber security plan. Under this alternative, the NRC would continue to process requests from licensee undergoing decommissioning for exemptions from certain requirements and license amendments for the security commitments in existing license conditions.

### **5.2.2 Alternative PS-2 (Rulemaking)**

Under this alternative, the NRC would streamline the decommissioning process by allowing licensees to make changes to NRC-required security programs during decommissioning that reflect the reduced number of target sets and therefore a reduction in both risk and potential radiological consequences, without having to request either an exemption or amendment. These changes include commonly requested exemptions and amendments made by decommissioning licensees and typically approved by the NRC. Under this alternative, the NRC will continue to review security plan change reports submitted by licensees and will continue to provide oversight of licensee security programs at decommissioning power reactors through a

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security inspection program that verifies the licensees' compliance with applicable regulatory requirements.

In addition, this alternative would pursue rulemaking to implement recommended changes, which are discussed in detail below, to the physical security requirements for decommissioning power reactors. Once a licensee certifies under 10 CFR 50.82, "Termination of License," that it has: (1) permanently ceased operation and (2) permanently removed fuel from the reactor vessel, and these certifications have been docketed by the NRC, changes to the operations of the plant will support a step-down in the physical security requirements currently imposed on operating reactors through regulations and orders. The following areas of physical security will be considered for modification in the rulemaking:

- **NRC-conducted force-on-force inspections.** The NRC staff recommends that, once licensees have filed and the NRC has docketed the certifications of permanent cessation of operations and permanent removal of fuel from the reactor vessel under 10 CFR 50.82 or 10 CFR 52.110, the NRC will notify licensees by letter that they are no longer subject to NRC-conducted force-on-force inspections. The NRC staff is not recommending any changes to the regulations for this notification process.
- **Suspension of security measures.** The NRC staff is proposing to amend 10 CFR 73.55(p) to permit a certified fuel handler (CFH), as defined in 10 CFR 50.2, "Definitions," to approve the temporary suspension of security measures during certain emergency conditions or during severe weather at decommissioning nuclear power reactors whose 10 CFR 50.82(a) certifications have been docketed. Currently, the security requirements in 10 CFR 73.55(p)(1)(i) provide that a "licensee may suspend any security measures under this section in an emergency when this action is immediately needed to protect the public health and safety.... This suspension of security measures must be approved as a minimum by a licensed senior operator before taking this action." Similarly, 10 CFR 73.55(p)(1)(ii) provides that a licensee may suspend security measures during "severe weather when the suspension of affected security measures is needed to protect the personal health and safety of security force personnel.... This suspension of security measures must be approved, as a minimum, by a licensed senior operator, with input from the security supervisor or manager, before taking this action." The licensee for a nuclear power reactor that has permanently ceased operations and no longer has fuel in the reactor vessel may no longer employ or have on site a licensed senior operator. As currently written, these provisions are not clear as to whether the suspension of security measures to protect the public or the security personnel in the instance of severe weather could be accomplished at a decommissioning reactor without first requesting an exemption. The NRC staff recommends to modify the regulatory language to clarify that a licensed senior operator or CFH can make this decision.
- **Protection against Significant Core Damage.** Under 10 CFR 73.55(b)(3), a nuclear power reactor licensee's physical protection program must be designed, in part, to prevent significant core damage. A nuclear power reactor that has permanently ceased operations no longer has fuel in the reactor vessel. Therefore, there is no potential for an emergency shutdown to prevent significant core damage or a radiological release because there is no core that would pose a radiological risk. Accordingly, licensees no longer need to protect against significant core damage once all fuel is in the SFP or in a dry cask storage system (DCSS). Training of security personnel for this condition is also no longer warranted. Therefore, the NRC staff is proposing to relieve licensees of a nuclear power reactor in decommissioning from the requirement in 10 CFR 73.55(b)(3)

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that the physical protection program be designed to prevent significant core damage. All other conditions in this regulation would remain in effect.

- **Training for loss of ultimate heat sink.** A nuclear power reactor that has permanently ceased operations and no longer has fuel in the reactor vessel would not undergo an emergency shutdown to prevent core damage or a radiological release. This means that the ultimate heat sink is no longer necessary once all fuel is in the SFP or in a DCSS and that any operational training to address loss of the ultimate heat sink is no longer necessary. Consequently, the security order requirement for operational training for this condition is no longer necessary.

Therefore, the NRC staff is proposing to provide licensees with a nuclear power reactor in decommissioning status with relief from the requirement in Section B.1.a of Security Order EA-02-026 (Ref. 24). All other conditions in this order would remain in effect. The NRC staff is not recommending any changes to the regulations for this issue.

- **Protection of the control room.** Under 10 CFR 73.55(e)(9), licensees are required to protect the reactor control room as a vital area. A vital area is defined in 10 CFR 73.2 as any area which contains vital equipment; under 10 CFR 73.2, vital equipment means any equipment, system, device, or material, the failure, destruction, or release of which could directly or indirectly endanger the public health and safety by exposure to radiation. The NRC also considers the equipment or systems that would be required to function to protect public health and safety following such a failure, destruction, or release to be vital. The role of the reactor control room at an operating plant is described in 10 CFR Part 50, Appendix A, General Design Criterion 19. General Design Criterion 19 specifies that the control room must be a protected space from which actions can be taken to operate the nuclear power plant safely and without interruption under normal or accident conditions.

For a permanently shutdown and defueled facility, the vital equipment associated with operating the reactor vessel is no longer needed and the remaining vital equipment (e.g., associated with SFP cooling) may no longer be needed or may be relocated to a vital area separate from the control room. Once a reactor has permanently ceased operations, the need for a reactor control room is eliminated if all of the vital equipment is removed and if the area does not serve as the vital area boundary for other vital areas. The NRC staff is proposing to define the reactor control room as a vital area until the NRC has certified the permanent cessation of operations and permanent removal of fuel from the reactor vessel pursuant to 10 CFR 50.82 or 10 CFR 52.110, and the licensee has certified that all vital equipment has been removed from the control room and the area does not serve as the vital area boundary for other vital areas.

- **Communications with the control room.** Under Section 73.55(j)(4)(ii), the NRC requires that a system for continuous communication capabilities with the control room must terminate in the central and secondary alarm stations to ensure effective command and control during both normal and emergency conditions. One purpose of this requirement is to ensure that communications are maintained between security operations and reactor operators who are normally located in the control room. A nuclear power reactor that has permanently ceased operations and no longer has fuel in the reactor vessel may no longer have reactor operators or a control room; therefore, the NRC staff is proposing replacing the requirement for maintaining continuous communications between the alarm stations and the control room with a requirement for

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communications to be maintained between the alarm stations and the CFH or senior onshift licensee representative, or both. This change would ensure that a decommissioning facility maintains communications between safety and security functions.

- **Number of armed responders.** In accordance with 10 CFR 73.55(k), licensees must establish and maintain at all times properly trained, qualified, and equipped personnel required to interdict and neutralize threats up to and including the DBT of radiological sabotage as defined in 10 CFR 73.1. Under 10 CFR 73.55(k)(5), NRC licensees are responsible for determining the minimum number of armed responders necessary to satisfy the general performance objective and requirements in 10 CFR 73.55(b) and to document this number in their security plans. The regulations also provide that the licensee have at least 10 armed responders for operating reactors. The NRC staff recognizes that, during operations and decommissioning, a licensee is permitted to reassess the minimum number of armed responders needed to implement the site protective strategy consistent with the performance objectives and design requirements in 10 CFR 73.55(b) to prevent radiological sabotage. If the minimum number of armed responder is less than (10), the licensee would submit this reassessment to the NRC for review and approval in accordance with 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit," and must demonstrate how the physical protection program continues to prevent radiological sabotage to ensure that each site has the appropriate number of armed responders needed to maintain safeguards effectiveness with assurance. Therefore, the NRC staff has concluded that given the variety of site specific conditions for each site, licensees may continue to use existing processes to reassess the minimum number of armed responders for their facilities. The NRC staff is not proposing any changes to the current regulations for armed responders, since existing regulatory processes are sufficient to address this issue.
- **Safeguards Effectiveness.** All reactor licensees have several options for making changes to the site security plans required under 10 CFR 50.34 "Contents of Applications; Technical Information." Consistent with 10 CFR 50.54(p)(1), licensees must submit a license amendment request under 10 CFR 50.90 for any change that decreases the effectiveness of their security plans. The license amendment request must fully describe the proposed change and the technical basis for the change. The license amendment request is subject to NRC review and approval. Consistent with 10 CFR 50.54(p)(2), licensees may make changes to their security plans without prior Commission approval if the change does not decrease the safeguards effectiveness of the plan. Licensees are required to provide a report of the changes to the Commission within 2 months following the change. Finally, licensees may request specific exemptions from security requirements in accordance with 10 CFR 73.5, "Specific exemptions." Specific exemptions may address, among other things, changes in site conditions arising from decommissioning. The NRC must review and approve all exemptions before licensees can implement the changes.

Operating reactor licensees that are in decommissioning status currently use the 10 CFR 50.54(p)(2) process to implement changes to their site security plans (e.g., removal or relocation of alarms and barriers). After the licensee has implemented the changes to its security plan and submitted the required report of the changes, the NRC staff reviews these reports to ensure that the licensee has properly adhered to the

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requirements of 10 CFR 50.54(p)(2) and has not implemented a change that decreases the safeguards effectiveness of its security plans.

The NRC staff notes that the 10 CFR 50.54(p)(2) change process is complicated for both licensees and NRC staff because the regulations do not define the term “decrease in safeguards effectiveness.” This contrasts with the treatment of emergency plans in 10 CFR 50.54(q), which does define the similar concept of “reduction in effectiveness.” Accordingly, the NRC is proposing the addition of the following definition to 10 CFR 50.2 or 10 CFR 50.54(p)(2) (note that the *italicized* text is new):

***Safeguards Effectiveness***—*A decrease in the safeguards effectiveness of a security plan is a change or series of changes to the security plan that reduces or eliminates the licensee’s ability to perform or maintain the security capability that was previously performed or provided by the changed element or component without compensating changes to other security plan elements or components.*

In addition, the NRC staff is proposing the addition of the following language in 10 CFR 50.54 (note that the *italicized* text is new):

(p)(2) The licensee may make changes to the plans referenced in paragraph (p)(1) of this section, without prior Commission approval if the changes do not decrease the safeguards effectiveness of the plan. The licensee shall maintain a record of each security plan change made without prior Commission approval for a period of 3 years from the date of the change, and shall submit, as specified in § 50.4 or § 52.3 of this chapter, a report containing a description of each change within 2 months after the change is made. *Once the NRC has docketed a licensee’s submissions of certification of permanent cessation of operations and permanent removal of fuel from the reactor vessel pursuant to § 50.82 or § 52.110 of this chapter, the licensee shall describe the changes made to the security plan in the required report and include a summary of the analysis completed to determine that safeguard effectiveness has been maintained.*

- **Transition to physical security requirements applicable to an ISFSI.** Power reactor licensees that operate an ISFSI may hold either a general or specific license for the ISFSI. Under 10 CFR 72.212(b)(9), general licensed ISFSIs are subject to the same physical security requirements in 10 CFR 73.55 as power reactors, with some exceptions. By contrast, licensees that hold a specific license under 10 CFR Part 72 are subject to the physical security requirements of 10 CFR 73.51, “Requirements for the physical protection for spent nuclear fuel and high-level radioactive waste,” which are less stringent than the 10 CFR 73.55 requirements.

During the decommissioning process, power reactor licensees with a general license ISFSI will transition to a phase when all the spent fuel has been removed from the SFP and placed in a DCSS. At this point, the security measures needed to protect the facility from radiological sabotage decrease significantly. Once the reactor ceases to operate, certain requirements in 10 CFR 73.55, (e.g., protection against significant core damage) are no longer necessary because there is no fuel in the reactor core. General ISFSI licensees must submit license amendments and requests for regulatory exemptions to

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obtain relief from the more stringent requirements. The NRC has previously exempted decommissioning licensees that have placed all fuel in a DCSS from the requirements of 10 CFR 73.55, and has allowed the licensees to commit to following the ISFSI-specific physical security requirements in 10 CFR 73.51 which reflect a level of physical protection significantly less than that required at operating power reactors and decommissioned facilities with fuel in the SFP.

The NRC staff is recommending changes to 10 CFR Part 72 and 10 CFR Part 73 to transition a general license ISFSI to the requirements in 10 CFR 73.51 when the power reactor facility enters decommissioning status.

### **5.2.3 Assumptions**

The NRC staff assumes the following for cost-benefit analysis of Physical Security:

- All nuclear power plant licensees will file exemption and amendment requests to reduce their physical security requirements that are commensurate with the benefits for the recommended rulemaking.
- Docketing of the certifications submitted under 10 CFR 50.82 meets the requirements for stepping down the physical security requirements.

### **5.2.4 Affected Attributes**

Industry Implementation: Under Alternative PS-2, licensees would not need to apply for exemptions and amendments for reducing their physical security requirements. This would result in a one-time benefit (i.e., averted cost) for industry. Under Alternative PS-2, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

NRC Implementation: To implement Alternative PS-2, the NRC would incur a one-time cost relative to the status quo for developing the rule. Under Alternative PS-2, licensees would not need to apply for exemptions and amendments to reduce their physical security requirements, which results in a benefit (i.e., averted cost) for the NRC due to lack of reviewing these exemptions and amendments.

Other Government: Under Alternative PS-2, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternatives PS-2, the general public would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Regulatory Efficiency: The current regulatory process of removing certain 10 CFR Part 73 requirements through exemptions and the process of changing license conditions related to physical security by amendments introduces regulatory burden to licensees and the NRC. Under Alternative PS-2, licensees that proceed through decommissioning would no longer need to submit physical security exemption requests, license amendment requests, or order withdrawal requests to the NRC to receive certain relaxation from physical security

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requirements. This would allow licensees to complete their decommissioning operations without diverting resources to submit these requests.

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### 5.3 Cyber Security

The NRC sets forth the current cyber security requirements for power reactors in 10 CFR 73.54, "Protection of digital computer and communication systems and networks." The NRC established these requirements as part of a 2009 final rule, "Power Reactor Security Requirements" (74 FR 13926; March 27, 2009). As stated in the rule's *Federal Register* notice, the rule's requirements became effective on May 26, 2009.

The preamble to 10 CFR 73.54 states, in part, that by November 23, 2009, each nuclear power reactor licensee "currently licensed to operate" must submit to the NRC a cyber security plan (CSP) for review and approval. The preamble further states that the requirements in 10 CFR 73.54 are applicable to current "applicants for an operating license or combined license" and mandates such applicants to amend their applications to include a CSP.

Under 10 CFR 73.54(a), applicants and licensees must provide "high assurance" that their digital computer and communication systems and networks associated with safety and important-to-safety, security, and emergency preparedness (SSEP) functions "are adequately protected against cyber attacks, up to and including" the design-basis threat described in 10 CFR 73.1. Nuclear power reactor operating licenses reference approved CSPs as license conditions. These license conditions continue to apply until the license is terminated. As discussed further below, a licensee may apply for a license amendment under 10 CFR 50.90 to remove its CSP license condition.

As an initial step in the decommissioning process, a reactor licensee must submit written certifications that it has decided to permanently cease operations and has permanently removed all fuel from its reactor vessel, in accordance with 10 CFR 50.82(a)(1)(i) and (ii) for power reactor licensees under 10 CFR Part 50, or 10 CFR 52.110(a)(1) and (2) for 10 CFR Part 52 combined license holders. As stated in 10 CFR 50.82(a)(2) and 10 CFR 52.110(b), upon the NRC's docketing of these certifications, the license no longer authorizes operation of the reactor or the placement or retention of fuel in the reactor vessel.

Once the NRC has docketed a licensee's 10 CFR 50.82 or 10 CFR 52.110 certifications, 10 CFR 73.54 no longer applies to that license because the licensee is no longer authorized to operate a nuclear power plant. However, the licensee must still comply with its CSP license condition until the license condition is removed from the license or the license is terminated. Furthermore, a reactor licensee that has submitted its 10 CFR 50.82(a)(1) or 10 CFR 52.110(a) certifications may still have fresh fuel in its SFP. As discussed in the spent fuel analyses in Appendix A of the regulatory basis (Ref. 1), the NRC staff has concluded that after a cooling period of 10 months for BWRs or 16 months for PWRs, there is little chance that the spent fuel in the SFP could heat up to clad ignition temperature within 10 hours and lead to a zirconium fire for postulated SFP draindown scenarios and configurations with restricted heat transfer. The NRC staff has further concluded that once the spent fuel has sufficiently decayed, the potential consequences of a cyber attack are significantly reduced, because there are no design basis events at a decommissioning plant that could result in an offsite radiological release exceeding the limits established by the EPA. With the significant reduction in radiological risk for a power reactor undergoing decommissioning, the NRC recognizes that the consequences of a cyber attack are reduced.

Despite the reduction in risk associated with a decommissioning power reactor, the NRC staff has determined that, until all spent fuel in the SFP is sufficiently decayed such that a spent fuel fire is highly unlikely, reactor licensees should be required to maintain reasonable assurance



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that their critical digital assets remain protected against cyber attacks. Further, notwithstanding that 10 CFR 73.54 no longer applies once a licensee's 10 CFR 50.82 or 10 CFR 52.110 certifications are docketed, licensees are still subject to their CSP license conditions until they are removed from the license pursuant to a 10 CFR 50.90 amendment request or the license is terminated. Accordingly, licensees that are decommissioning but still have nuclear fuel in their SFPs will remain subject to their CSP license condition until that condition is removed from the license pursuant to a 10 CFR 50.90 amendment request. If a license amendment request is not submitted and approved, in whole or in part, the existing CSP would remain in force even after the submittal and docketing of the 10 CFR 50.82(a)(1) and 10 CFR 52.110(a) certifications. The NRC is currently following normal processes to evaluate any license amendment request asking for the removal of these cyber security license conditions on a case-by-case basis. The NRC staff is evaluating three alternatives to address the issues associated with cyber security requirements for decommissioning power reactors and these alternatives are presented below.

### **5.3.1 Alternative CS-1 (No-action alternative)**

Under the no-action alternative, the NRC would not change the current cyber security requirements set forth in 10 CFR 73.54. These requirements are applicable to 10 CFR Part 50 licensees and applicants, and to applicants and holders of combined licenses in accordance with 10 CFR 52.79(a)(36)(iii). Once a licensee has filed the certifications required by either 10 CFR 50.82(a)(1)(i) and (ii) or 10 CFR 52.110(a) and those certifications have been docketed by the NRC, the licensee is no longer authorized to operate a nuclear power reactor. Therefore, by its terms, 10 CFR 73.54 does not apply to such licensees, because they are no longer licensed to operate a nuclear power reactor.

Although the cyber security rule no longer applies to a licensee that has filed the certifications required by 10 CFR 50.82(a)(1)(i) and (ii) or 10 CFR 52.110(a) and those certifications have been docketed by the NRC, the license still incorporates the licensee's CSP as a license condition. As such, a licensee must abide by its CSP until the licensee submits a license amendment request to remove the CSP from its license. If a license amendment request is not submitted and approved, in whole or in part, the existing CSP would remain in force even after the submittal and docketing of the 10 CFR 50.82(a)(1) or 10 CFR 52.110(a) certifications. Under the no-action alternative, the NRC expects that licensees would continue to submit license amendment requests to have the CSP rescinded once the spent fuel has sufficiently decayed.

### **5.3.2 Alternative CS-2 (Rulemaking to remove all cyber security requirements when spent fuel has been transferred to ISFSI)**

Under this alternative, the NRC would pursue a rulemaking to recommend that the cyber security requirements in 10 CFR 73.54 would continue to apply to decommissioning power reactors until all the fuel is transferred to dry cask storage. Under this alternative, a licensee would still have a license condition requiring a CSP until (1) the licensee has transferred all spent fuel to dry cask storage, and (2) the NRC approves a license amendment to remove the CSP license condition. Alternatively, this rulemaking alternative could include removal of the CSP license condition at the time all fuel is transferred to the dry cask storage. This removal of license conditions would be consistent with the approach being considered by the Commission in the mitigation of beyond-design-basis events rulemaking (SECY-16-0142, "Draft Final Rule—Mitigation of Beyond-Design-Basis Events," dated December 15, 2016 (ADAMS Accession No. ML16301A005)).

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### **5.3.3 Alternative CS-3 (Rulemaking to remove all cyber security requirements when spent fuel has sufficiently decayed)**

Under this alternative, the NRC would pursue a rulemaking to recommend that the cyber security requirements in 10 CFR 73.54 would continue to apply to licensees of decommissioning power reactors that have submitted their 10 CFR 50.82(a)(1) or 10 CFR 52.110(a) certifications until such time that all spent fuel in the SFP has sufficiently decayed (i.e., 10 months for BWRs and 16 months for PWRs). After these periods of time, the fuel in the SFP will have sufficiently decayed such that a period of 10 hours is available to initiate mitigation measures in a postulated zirconium fire scenario. Under this alternative, the NRC staff expects that decommissioning reactor licensees would request license amendments to remove the CSP license condition once their spent fuel has sufficiently decayed. Alternatively, this rulemaking alternative could include removal of the CSP license condition at the time all fuel is transferred to dry cask storage. This removal of license conditions would be consistent with the approach being considered by the Commission in the mitigation of beyond-design-basis events draft final rule.

### **5.3.4 Affected Attributes**

Industry Implementation: Under Alternatives CS-2 and 3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: In Alternative CS-2, licensees would remain subject to cyber security protection requirements until all spent fuel is in dry cask storage. In Alternative CS-3, licensees would remain subject to cyber security protection requirements until the fuel in the spent fuel pool has sufficiently cooled (i.e., 10 months for BWRs and 16 months for PWRs). These two alternatives will result in additional costs to industry annually due to labor hours expended to implement cyber security requirements.

NRC Implementation: To implement Alternatives CS-2 and 3 the NRC would incur a one-time cost relative to the status quo for developing the rule.

Other Government: Under Alternatives CS-2 and 3, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternatives CS-2 and 3, the general public would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

## **5.4 Fitness for Duty—Drug and Alcohol Testing**

The requirement in 10 CFR 26.3(a) lists those licensees that are required to comply with designated subparts of 10 CFR Part 26, including “[l]icensees who are authorized to operate a nuclear power reactor under 10 CFR 50.57, and holders of a combined license under 10 CFR Part 52 after the Commission has made the finding under 10 CFR 52.103(g)....” In accordance with this language, 10 CFR Part 26 does not apply to a holder of a power reactor license issued under 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” that is no longer authorized to operate a nuclear power reactor because the NRC has docketed the certifications required under 10 CFR 50.82(a)(1) (i.e., a decommissioning Part 50

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reactor licensee). However, 10 CFR Part 26 continues to apply to holders of combined licenses issued under 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” throughout decommissioning. Therefore, there is an inconsistency in the application of FFD requirements to Part 50 and Part 52 licensees during decommissioning. As a result of this inconsistency, 10 CFR Part 26 does not apply to 10 CFR Part 50 licensees once the NRC has docketed their 10 CFR 50.82(a)(1) certifications. However, 10 CFR Part 52 licensees are required to maintain a full FFD program during decommissioning. Therefore, the NRC staff intends to clarify this inconsistency by making it clear that 10 CFR Part 26 does not apply to 10 CFR Part 52 licensees once the NRC has docketed their 10 CFR 52.110(a) certifications.

Nevertheless, under 10 CFR 73.55(b)(9), licensees must implement an insider mitigation program (IMP) that incorporates elements of a 10 CFR Part 26 FFD program. However, section 73.55(b)(9) does not specify what those elements are. The purpose of a licensee’s IMP is to help ensure that individuals granted unescorted access authorization (UAA) or unescorted access (UA) remain trustworthy and reliable and do not pose a threat to the facility. The staff recognizes that the IMP requirements, including the appropriate elements of the 10 CFR Part 26 program, apply to all personnel granted UAA or UA to the protected area (PA) or vital area (VA) equally. This construct makes sense for operating facilities that contain many target sets of potential interest to an adversary. However, the hazard and potential event consequences associated with decommissioning facilities have significantly decreased in comparison to those associated with the operating facilities. The spent fuel pool becomes the primary focus of the licensee’s security mission to protect against the DBT adversary as most (if not all) of the other target sets are no longer relevant when a nuclear power reactor is no longer operational. Therefore, the NRC staff intends to clarify the 10 CFR Part 73 IMP rule language by establishing an appropriate set of FFD provisions to be incorporated into the IMP to help confirm that individuals granted UAA or UA to the PA or VA are trustworthy and reliable (as demonstrated, in part, by the avoidance of substance abuse).

The staff also notes that 10 CFR Part 73, Appendix B (section I.B.1.b.(4)) contains requirements addressing drug or alcohol addiction issues for security personnel. Section I.B.2.a of the same appendix requires that security personnel “demonstrate mental alertness and the capability to exercise good judgement.” Although not specifically used as the basis for this recommended rulemaking, continuation of drug and alcohol testing will support the licensee’s continued adherence to these provisions of 10 CFR Part 73, Appendix B.

#### **5.4.1 Alternative DA-1 (No-action alternative)**

The no-action alternative would not address the inconsistency in the scope of 10 CFR Part 26 and its application to 10 CFR Part 50 and 10 CFR Part 52 licensees during decommissioning. Therefore, 10 CFR Part 26 would not apply to 10 CFR Part 50 licensees during decommissioning, but would continue to apply to 10 CFR Part 52 licensees during decommissioning. This alternative would also not clarify the appropriate 10 CFR Part 26 FFD elements to be incorporated into a licensee’s IMP. Licensees would continue to determine which elements of their 10 CFR Part 26 program to include in their IMPs, as required by 10 CFR 73.55(b)(9)(ii)(B). The NRC staff has observed that recently decommissioned reactor licensees generally continue to implement all of the elements of 10 CFR Part 26, with the exception of Subparts I and K.

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#### **5.4.2 Alternative DA-2 (Rulemaking to require Fitness for Duty program elements that support IMP for power reactors)**

Alternative DA-2 would entail a rulemaking to amend 10 CFR 26.3 to correct the inconsistency in the application of 10 CFR Part 26 to 10 CFR Part 50 and 10 CFR Part 52 during decommissioning. This would ensure that similarly situated nuclear power reactor facilities are treated the same. The rulemaking would also clarify the FFD program elements under 10 CFR Part 26 that support a licensee's IMP. This clarification would apply to both 10 CFR Part 50 and 10 CFR Part 52 facilities, but becomes particularly important during decommissioning of 10 CFR Part 50 reactor facilities, as the 10 CFR Part 26 FFD program requirements are currently no longer applicable to these facilities.

Under this alternative, the inconsistency regarding application of 10 CFR Part 26 between 10 CFR Part 50 and Part 52 licensees during decommissioning would be corrected. In addition, the NRC would require that all nuclear power reactor licensees implement the same FFD program elements to support their IMP under the provisions of 10 CFR 73.55(b)(9)(ii)(B). It is the intent of the rulemaking effort to rework the structure of the IMP requirements to allow for a graded application of 10 CFR Part 26 elements to various populations at licensee sites, commensurate with the reduced potential for insiders to affect radiological sabotage at decommissioning sites and the reduced hazard presented by the spent fuel. These changes would ensure that FFD program elements that are necessary to maintain reasonable assurance that individuals at reactor sites, particularly at decommissioning sites, remain trustworthy and reliable are implemented consistently throughout the industry. These changes will also reduce the number of individuals that are subjected to the FFD elements that satisfy the IMP requirements over the decommissioning time frame.

#### **5.4.3 Assumptions**

In the status quo, the NRC staff assumes that at decommissioning, licensees will continue to implement a full FFD program, with the exception of Subparts I and K, in order to meet the requirements of 10 CFR 73.55(b)(9).

For Alternative DA-2, the NRC staff assumes that the staffing level at a nuclear power plant in the beginning of decommissioning is about 20% of its full staffing level when fully operating. This is based on the fact that the decommissioning Vermont Yankee nuclear power plant has had 150 workers after the start of decommissioning (Ref. 25), whereas the Davis-Besse nuclear power plant currently has a staff level of 700 workers (Ref. 26).

For Alternative DA-2, the NRC staff assumes that 10% of the staffing level at a decommissioned nuclear power plant will have access to the vital area.

For Alternative DA-2, the NRC staff assumes that 30% of the staffing level at a decommissioned nuclear power plant will have access to the protected area.

#### **5.4.4 Affected Attributes**

Industry Implementation: To implement Alternative DA-2, industry would incur a one-time cost in making minor changes in their drug and alcohol testing procedures to account for the IMP requirements during decommissioning. Under Alternative DA-2, the industry would commit

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additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Alternative DA-2 will rework the structure of the IMP requirements to allow for a graded application of 10 CFR Part 26 elements. As a result, the number of individuals tested randomly for drugs and alcohol will be reduced for certain segments of the site's decommissioning population. This will result in the industry's drug and alcohol testing program costs being reduced during decommissioning.

NRC Implementation: To implement Alternative DA-2, the NRC incurs a one-time cost relative to the status quo for the rulemaking process. These costs include the preparation of the proposed and final rule.

NRC Operation: Clarifying the regulations will reduce the burden on the NRC in the administration of reporting requirements for drug and alcohol testing under Alternative DA-2.

Other Government: Under Alternative DA-2, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternative DA-2, the general public would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

## **5.5 Fitness for Duty—Fatigue**

Currently, the requirements of 10 CFR Part 26, Subpart I, "Managing Fatigue," apply to all 10 CFR Part 50 licensees authorized to operate a nuclear power plant and all holders of a combined license under 10 CFR Part 52 after the Commission makes its 10 CFR 52.103(g) finding. Licensees' compliance with Subpart I within the scope of an overall FFD program provides reasonable assurance that the effects of fatigue and degraded alertness on an individual's ability to safely and competently perform his or her duties are managed commensurate with maintaining public health and safety. The fatigue management provisions also reduce the potential for security officer fatigue to adversely affect the common defense and security.

For power reactor licensees, the scope of 10 CFR Part 26 is limited in 10 CFR 26.3(a) to those licensees that are authorized to operate under 10 CFR 50.57 and to holders of combined licenses (COLs) under 10 CFR Part 52 after the Commission makes its 10 CFR 52.103(g) finding. Once the NRC docket the certifications of permanent shutdown and removal of fuel from the reactor vessel under 10 CFR 50.82(a) (or if the Commission orders the licensee to cease operations), the 10 CFR Part 50 licensee is not authorized to operate and is outside the scope of 10 CFR Part 26. Therefore, 10 CFR Part 26, including the fatigue management provisions of Subpart I, does not directly and explicitly apply to 10 CFR Part 50 licensees that are no longer authorized to operate, which includes decommissioning reactor licensees. However, these provisions do apply to holders of a COL holders under 10 CFR Part 52 after the Commission has made the finding under 10 CFR 52.103(g).

Furthermore, in SRM-COMSECY-04-0037, "Staff Requirements - COMSECY-04-0037 - Fitness-For-Duty Orders to Address Fatigue of Nuclear Facility Security Force Personnel," the Commission disapproved the issuance of orders concerning FFD program enhancements to

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address fatigue concerns for security force personnel at decommissioning reactors. Instead, the Commission determined that program enhancements should be pursued as a separate rulemaking activity with additional public interactions.

The NRC staff recognizes that the spectrum of possible accidents is significantly smaller, and the risk of an offsite radiological release is significantly lower at a decommissioning nuclear power reactor than at an operating power reactor. As previously discussed, the NRC staff concludes that, after a cooling period of 10 months for BWRs or 16 months for PWRs, the spent fuel cannot reasonably heat up to clad ignition temperature within 10 hours of a significant draindown event in the SFP. This time after shutdown corresponds to the decommissioning plant's transition from Level 1 to Level 2 as previously described in Section 2.1 of this document. Once the spent fuel has reached this level of decay, the potential consequences of an accident or security event are further reduced because a Level 2 decommissioning plant has no design-basis events that could result in an offsite radiological release exceeding the limits established by the EPA.

Recognizing the significant reduction in radiological risk and consequences of an accident or security event for a decommissioning reactor, the staff is considering whether to apply fatigue management provisions to limited individuals (i.e., security personnel and CFHs) because these individuals perform functions having the potential to be significant to the protection of public health and safety or the common defense and security. Because of the continuous reduction in decay heat levels and associated reduction in radiological risks, the fatigue management provisions for both functions would apply only to the time period when decay heat levels are sufficiently high to potentially cause offsite effects.

To establish an appropriate level of fatigue management at decommissioning sites, the NRC staff is proposing the following alternatives: no-action, voluntary industry initiatives, and rulemaking to address this issue.

#### **5.5.1 Alternative F-1 (No-action alternative)**

The no-action alternative would retain the FFD provisions of the current regulations. The fatigue management provisions contained in 10 CFR Part 26, Subpart I, would continue to not apply to decommissioning licensees under 10 CFR Part 50. However, these provisions would continue to apply to holders of a COL under 10 CFR Part 52 after the Commission has made the finding under 10 CFR 52.103(g). The NRC assumes for this analysis that Part 50 decommissioning sites will maintain a fatigue management program of some kind for their security officers as part of their security plan and will have site administrative requirements to limit the work hours for plant personnel and to maintain plant staffing levels that avoids heavy routine use of overtime consistent with their corporate practices. Therefore, the no-action alternative would continue to maintain the differences in fatigue management requirements for personnel located at 10 CFR Part 50 decommissioning sites as compared to personnel located at 10 CFR Part 52 decommissioning sites.

#### **5.5.2 Alternative F-2 (Voluntary industry initiatives to account for fatigue at decommissioning power reactors)**

Under this alternative, the NRC staff would consider voluntary industry initiatives for managing fatigue at decommissioning power reactors. The voluntary initiatives would continue until such time that the fuel in the SFP has decayed so that 10 hours is available to initiate mitigation measures in the event of a zirconium fire scenario (i.e., 10 months for BWRs and 16 months for

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PWRs). In comparison to Alternative F-1, Alternative F-2 has the potential to clarify the NRC's fatigue guidelines for 10 CFR Part 50 decommissioning plants and provides a mechanism in which the staff and industry representatives could align on these measures.

The Nuclear Energy Institute (NEI) submitted NEI 15-08, "Managing Personnel Fatigue at Decommissioning Reactors," for NRC staff review and potential endorsement on November 3, 2015 (Ref. 27). NEI 15-08 proposes administrative work hour controls on security personnel when unforeseen problems require significant amounts of overtime. The document also addresses policy requirements and approval for deviations from the guidelines. The NRC staff responded to NEI in a letter (Ref. 28), declining to fully review or endorse NEI 15-08 but stating that the NRC considered the submitted document informational and may use elements of the document in support of the proposed decommissioning rulemaking effort. This guidance is based on the requirements of Generic Letter (GL) 82-12, "Nuclear Power Plant Staff Working Hours," with specific changes to some work hour rules corresponding to relaxations contained within the overall programmatic requirements in Subpart I to 10 CFR Part 26. The NEI's proposed guidelines would apply to personnel performing assigned security-related job duties but are silent on CFHs.

The NRC in its statement of considerations (SOC) for the 2008 Part 26 final rule (73 FR 16966) concludes that with the exception of orders limiting the work hours of security personnel, the NRC's former regulatory framework of GL 82-12 did not include consistent or readily enforceable requirements to address worker fatigue. The 2008 SOC additionally states that the regulatory framework based on GL 82-12 included requirements that were inadequate and incomplete for effective fatigue management. The conclusions reached in development of the 2008 SOC were primarily focused on operating reactors, although decommissioning Part 52 license holders are also included in the rule. Therefore, this alternative would require the staff to perform an in-depth analysis of the adequacy of GL 82-12 and NEI 15-08 for managing fatigue at 10 CFR Part 50 decommissioning sites and hold a series of public meetings to discuss the analysis, align on concepts, and determine what would be acceptable guidance to the staff.

### **5.5.3 Alternative F-3 (Rulemaking to codify fitness for duty fatigue requirements for decommissioning power reactors)**

Under this alternative, the NRC would pursue rulemaking to codify fatigue management requirements for security personnel and CFHs at decommissioning power reactors. The NRC could amend Part 26 to be applicable to security personnel and CFHs for Part 50 and Part 52 decommissioning power reactors until such time that the fuel in the SFP has decayed so that 10 hours is available to initiate mitigation measures in the event of a zirconium fire scenario (i.e., 10 months for BWRs and 16 months for PWRs), as discussed in Section 4.2 of this document. This time after shutdown corresponds to the transition from Level 1 to Level 2, as described in Section 2.1 of this document.

### **5.5.4 Assumptions**

The NRC staff has made the following assumptions for the cost benefit analysis of the Fitness for Duty – Fatigue area of decommissioning:

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- The NRC staff assumes that the fatigue management program resulting from voluntary industry initiatives and rulemaking (i.e., Alternatives F-2 and F-3) would only apply to the security and CFH personnel at decommissioning sites.
  - The NRC would take one-half the time to review the industry initiatives as the industry would take to develop them.
  - A licensee would require about the same time to re-write their fatigue management documents that are specific to each nuclear power plant as it would to contribute to the update of a regulatory guide.

### **5.5.5 Affected Attributes**

Industry Implementation: To implement Alternatives F-2 and F-3, each licensee would re-write their fatigue management documents that are specific to each nuclear power plant. This would result in a one-time cost to the licensees for them to voluntarily commit to the implementation of initiatives or comply with the new regulation for fatigue management. Under Alternatives F-2 and F-3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Under Alternatives F-2 and F-3, when a nuclear power plant certifies under 10 CFR 50.82 that it has permanently ceased operation and has removed fuel from the reactor vessel, the licensee would maintain a FFD fatigue management program during decommissioning. This would result in costs to industry for 10 months for BWRs and 16 months for PWRs.

NRC Implementation: To implement Alternative F-3, the NRC incurs a one-time cost relative to the status quo for developing the rule, for updating RG 5.73, "Fatigue Management for Nuclear Power Plant Personnel," and for reviewing and endorsing the NEI 03-12 security template.

NRC Operation: Under Alternative F-3, the NRC incurs a cost for inspecting FFD fatigue management programs at nuclear power sites that have decommissioned and are within the first 10 months of decommissioning for BWRs and the first 16 months of decommissioning for PWRs.

Other Government: Under Alternatives F-2 and 3, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternatives F-2 and F-3, the general public would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

## **5.6 Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers**

The NRC nuclear power plant regulations do not address minimum licensed operator staffing levels or training requirements for a facility undergoing decommissioning. This absence of requirements or guidance on staffing levels has the potential to create uncertainty as to what constitutes an acceptable minimum shift complement during any phase of decommissioning.



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Licensees have been requesting amendments to their technical specifications to eliminate the need to maintain licensed operators on the staff during decommissioning. In place of the licensed operators, decommissioning plant licensees have required the presence of a CFH and an additional non-licensed operator (NLO) as the minimum staffing necessary for each shift. Furthermore, decommissioning plants are discontinuing the associated licensed operator training programs.

The current regulations for operating reactors require specific staffing levels for licensed operators for each shift, as well as control room staffing requirements and commensurate training requirements for licensed operators. Section 50.54(m) of the Commission's regulations governs the number of senior reactor operators required to be present at the facility based on the number of units operating, the number of units on site, and the number of control rooms. The regulation includes several statements that indicate that it applies only to operating reactors. Therefore, 10 CFR 50.54(m) does not apply to permanently shutdown and defueled reactor licensees, such as those that have submitted the certifications required under 10 CFR 50.82(a)(1) or 10 CFR 52.110(a). The NRC's docketing of these certifications removes the licensee's authority to operate the reactor or emplace or retain fuel in the reactor vessel. Consequently, no regulations provide staffing requirements for decommissioning reactor licensees.

In place of licensed operators, decommissioning plant licensees have required the presence of a CFH, a NLO who has been qualified in accordance with a fuel handler training program approved by the Commission—and an additional NLO as the minimum staffing for each shift. A CFH at a permanently shutdown and defueled nuclear power reactor undergoing decommissioning is an individual who has the requisite knowledge and experience to evaluate plant conditions and make judgements about what actions are necessary to protect the public health and safety.

Because the CFH is defined as a NLO, the NRC staff has evaluated the CFH training program in accordance with 10 CFR 50.120, "Training and qualification of nuclear power plant Personnel," which includes a requirement in 10 CFR 50.120(b)(2) that the training program must be derived from a systems approach to training, as defined in 10 CFR 55.4, and must provide for the training and qualification of certain categories of nuclear power plant personnel, including the NLO category. The NRC staff notes that, although the definition for a CFH in 10 CFR 50.2 indicates that a fuel handler training program requires Commission approval, the regulations do not have specific requirements that describe what constitutes an acceptable program besides those requirements in 10 CFR 50.120, which apply to all NLOs. Because a training program for a NLO subject to 10 CFR 50.120 does not require Commission approval, unless that NLO is a CFH, the NRC staff has determined that an acceptable fuel handler training program suitable to qualify a CFH should ensure that the trained individual (1) has requisite knowledge and experience in the safe conduct of decommissioning activities, (2) has requisite knowledge and experience in the safe handling and storage of spent fuel, and (3) is capable of evaluating plant conditions and exercising prudent judgment for emergency action decisions.

Hence the NRC staff recommends revising the definition of a CFH in 10 CFR 50.2 to establish these three criteria for an acceptable fuel handler training program. This would eliminate the need for licensees to seek Commission approval of their training programs. Use of the criteria would be optional; licensees could still seek Commission approval for fuel handler training programs suitable to qualify a CFH. The NRC staff can inspect the implementation of training programs suitable to qualify NLOs and CFHs using existing inspection procedures, such as

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IP 41501, "Review of Training and Qualification Programs," dated April 27, 2016. The NRC staff is evaluating three alternatives to account for the acceptable fuel handler training program.

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### **5.6.1 Alternative CFH-1 (No-action alternative)**

This alternative would retain the current wording of the staffing and CFH-related regulations. The interpretation of the operator staffing requirements in 10 CFR 50.54(m) and training requirements in 10 CFR 50.120 could justify discontinuing the training and use of licensed operators after permanent cessation of operations and removal of fuel from the reactor. The regulations state, in part, that, “[t]he training program must be periodically evaluated and revised as appropriate to reflect ... changes to the facility, procedures, regulations.” The regulations at 10 CFR 50.54(y) require that, when a licensee takes reasonable action that departs from a license condition or a technical specification, the action shall be approved “by a licensed senior operator, or, at a nuclear power reactor facility for which the certifications required under 10 CFR 50.82(a)(1) or 52.110(a) have been submitted, by either a licensed senior operator or a certified fuel handler, prior to taking the action.” This language is sufficiently broad to allow decommissioning reactors to use CFHs instead of licensed operators. The no-action alternative would not result in any significant additional cost or burden if decommissioning technical specifications were kept for staffing requirements consistent with current practice. However, because the regulations do not require a licensee to commit to specific NLO staffing levels for permanently shutdown and defueled reactors, there is the possibility that future license amendments related to NLO staffing could propose different staffing requirements than those established by current practice. Notwithstanding this possibility, the NRC staff would continue to review, on a case-by-case basis, the staffing requirements proposed in the license amendment requests submitted by the licensees to provide reasonable assurance of adequate protection of public health and safety.

### **5.6.2 Alternative CFH-2 (Voluntary industry initiatives for staffing and training for permanently shutdown and defueled reactors and clarify related definitions)**

In this alternative, the NRC staff would consider reviewing voluntary industry initiatives that may provide guidance on the responsibilities of the CFH, minimum staffing for a decommissioning nuclear reactor licensee, and the structure and content of a fuel handler training program that can be used to qualify a CFH that the NRC staff would find acceptable. This alternative would not eliminate the need for licensees to submit license amendment requests that would allow them to use NLOs and CFHs instead of licensed operators and senior operators for operator shift staffing at a decommissioning plant. If voluntary industry initiatives are consistent with existing regulatory practices, the NRC does not anticipate any burden or increased cost beyond what is currently expected for decommissioning plants.

### **5.6.3 Alternative CFH-3 (Rulemaking to change the regulations for staffing and training for permanently shutdown and defueled reactors and clarify related definitions)**

Under this alternative, the NRC staff would undertake a rulemaking to clarify the requirements for the staffing and training of NLOs, including CFHs, at decommissioning power reactors. This rulemaking would revise the definition of “certified fuel handler” in 10 CFR 50.2, which would retain the existing definition of the CFH and add a voluntary alternative to: (1) clarify the management role of the CFH in a manner consistent with 10 CFR 50.54(y), (2) eliminate the need for a licensee to seek the Commission’s approval for fuel handler training programs suitable to qualify a CFH, (3) add a provision that would require the training program to address the safe conduct of decommissioning activities, safe handling and storage of spent fuel, and appropriate response to plant emergencies, and (4) create consistency with the existing requirements in 10 CFR 50.120 for training NLOs.

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With regard to the staffing requirements for a decommissioning nuclear reactor licensee this alternative would provide guidance regarding acceptable minimum staffing by CFHs and NLOs, in a format similar to the minimum staffing requirements for licensed operators and senior operators described in the table in 10 CFR 50.54(m). The recommended voluntary alternative minimum staffing levels would be consistent with established precedents that the NRC staff has approved on a case-by-case basis for decommissioning reactors. The NRC staff would recommend that there be a CFH for each control room established at a permanently shutdown reactor site and a NLO for each permanently shutdown reactor unit on the site or, as discussed in Appendix B of the regulatory basis, the licensee-designated vital area that has been relocated and is separate from the control room. The NRC staff would recommend that such voluntary alternative minimum staffing requirements apply during Level 1 (the post shutdown emergency plan) and Level 2 (the permanently defueled emergency plan) stages of decommissioning. Therefore, the CFH and NLO positions would not be required after all spent fuel has been transferred to dry storage (i.e., Level 3, ISFSI only emergency plan). Additional guidance may be considered in the future to support the implementation of a recommended voluntary alternative for minimum staffing requirements by NLOs and CFHs.

#### **5.6.4 Assumptions**

The NRC staff has made the following assumptions for the cost benefit analysis:

- The development of voluntary industry initiatives would require the same amount of time as the NRC would take to develop a new Regulatory Guide.
- The NRC would take one-half the time to review the industry initiatives as the industry would take to develop them.
- All licensees would choose to use the definition of a CFH that the rulemaking alternative would provide when they establish their fuel handler training programs.

#### **5.6.5 Affected Attributes**

Industry Implementation: Under Alternative CFH-2, industry would develop an industry initiative that pertains to minimum staffing of non-licensed operators and fuel handler programs suitable to qualify CFHs at decommissioning sites. This would result in a one-time cost to industry for the development and implementation of these industry initiatives. Under Alternative CFH-3, licensees would still need to submit license amendment requests that would replace licensed operators with shift staffing consisting of CFHs and non-licensed operators, for managing the spent fuel at a nuclear power site and conducting decommissioning activities. However, Alternative CFH-3 would eliminate the need for a licensee to seek the Commission's approval for fuel handler training programs suitable to qualify a CFH. The elimination of this approval process would result in a one-time benefit (i.e., averted cost) for industry. Under Alternatives CFH-2 and 3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

NRC Implementation: To implement Alternative CFH-3, the NRC incurs a one-time cost relative to the status quo for developing the rule. In addition, under Alternative CFH-3, the NRC would no longer have to review fuel handler training programs for their suitability to qualify CFHs. However, the NRC staff will continue to review license amendment requests for changes to the section of licensees' technical specifications titled, "Administrative Controls."

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Regulatory Efficiency: Under Alternative CFH-3, licensees in decommissioning would not need to submit fuel handler training programs suitable to qualify CFHs for the Commission's approval. This would provide licensees with flexibility to complete their decommissioning operations, in that resources will not be expended to process these types of licensing actions.

Other Government: Under Alternatives CFH-2 and 3, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternatives CFH-2 and 3, the general public would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

## **5.7 Decommissioning Trust Fund**

The NRC requires nuclear power plant licensees to provide reasonable assurance that funds will be available for plant radiological decommissioning. An element of this assurance is the requirement for licensees to provide a minimum amount of decommissioning funds per the formula defined in 10 CFR 50.75(c). The table of minimum amounts formula (NRC minimum formula) was established in 1988 as a means to assure the bulk of funds needed for radiological decommissioning is available. The requirement in 10 CFR 50.75(c) also defines a process for adjusting the formula to current-year dollars. The NRC staff uses the formula and adjustment factors to assess the adequacy of the decommissioning trust funds (DTFs) established by the nuclear power plant licensees every two years.

The NRC staff is proposing changes to address the legitimate use of DTFs. The changes would clarify that the DTF can be used to pay for both radiological decommissioning expenses under 10 CFR 50.2 and spent fuel management and Part 72 specific-licensed ISFSI decommissioning. The primary intent of these changes would be to reduce the need for regulatory exemptions with respect to use of the DTF by licensees while ensuring that sufficient funding is available for NRC-required radiological decommissioning. Currently, DTF regulations do not address the costs associated with the unavailability of permanent spent fuel repositories. However, the lack of permanent spent fuel repositories requires licensees to provide long-term onsite storage of spent fuel in an ISFSI, incur spent fuel management expenses and, ultimately, decommission the ISFSIs. Overall, the NRC staff anticipates that the recommended changes would minimize the need for licensees to request exemptions from decommissioning funding regulations and that the changes would provide licensees with a greater degree of flexibility in the use of their DTFs.

When funds are commingled in the DTF and are not distinctly identified, the NRC does not have a mechanism to allow for the use of those funds for non-decommissioning purposes such as spent fuel management or for Part 72 specific-licensed ISFSI decommissioning outside of the exemption process. Because of these issues, licensees have sought and been granted exemptions from 10 CFR 50.75, "Reporting and recordkeeping for decommissioning planning," requirements to allow the use of monies from the DTFs that are not needed for radiological decommissioning to pay for expenses associated with spent fuel management. The reliance on exemptions creates regulatory uncertainties as well as burdens on licensees and the NRC. A licensee must expend resources to prepare the documentation and analysis that is required to obtain approval of the exemption request. The NRC staff must also divert resources from other agency activities to evaluate each request in order to determine whether the exemption request should be granted.

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Because of these issues, the NRC staff is evaluating whether to change the NRC regulations to allow licensees to use the DTF, to the extent that it exceeds the minimum value for radiological decommissioning as set forth in 10 CFR 50.75(c), to pay for limited miscellaneous expenses related to decommissioning, spent fuel management costs, and Part 72 specific-licensed ISFSI decommissioning as a part of, or in addition to, radiological decommissioning activities. This change would eliminate the need for licensees to request exemptions from regulations to use DTF monies for such activities. The objectives of this recommended change are to: (1) provide licensees with options for using DTF monies and the flexibility to consider site-specific conditions in maintaining their DTF; (2) create consistent standards for staff's use in determining whether licensees are compliant with the appropriate use of the DTF; and (3) minimize the need for licensees to submit exemption requests from decommissioning funding regulations. Three alternatives are considered to address the stated issues and to meet the regulatory objectives.

#### **5.7.1 Alternative DTF-1 (No-action alternative)**

Under the no-action alternative, the regulations to establish and use the DTF would remain unchanged. The regulation would not be amended to address commingling of funds in the DTF for spent fuel management, ISFSI decommissioning, or site restoration. In addition, DTF regulations would not be amended to address costs associated with the long-term onsite storage of spent fuel in an ISFSI, costs which stem from the unavailability of permanent spent fuel repositories. This being the case, licensees are likely to continue to request exemptions in order to address spent fuel management expenses and may also request exemptions to pay for ISFSI decommissioning and site restoration expenses on a case-by-case basis. For example, licensees could choose to submit an exemption request to allow the use of DTF funds for spent fuel management. The NRC staff would review the exemption request and grant the exemption on a finding of reasonable assurance that sufficient funding will remain available in the DTF to complete radiological decommissioning and upon a determination that the licensee meets the requirements in 10 CFR 50.12, "Specific exemptions."

#### **5.7.2 Alternative DTF-2 (Rulemaking to amend regulations to minimize exemptions and reduce the ambiguity in the decommissioning trust fund regulations)**

Under this alternative, the NRC staff recommends the following changes to current DTF regulations to minimize exemption requests and address the ambiguity in the DTF regulations:

- Amend the regulations at 10 CFR 50.82 to allow decommissioning funds collected and kept in an external trust as required in 10 CFR 50.75, to be used for spent fuel management as well as Part 50 and Part 72 specific-licensed ISFSI decommissioning. However, the decommissioning funds collected would be first applied to decommissioning activities as defined in 10 CFR 50.2. After the submission of the PSDAR, along with the certifications required under 10 CFR 50.82(a)(1)(i)-(ii), funds above those required for radiological decommissioning in compliance with 10 CFR 50.75, at the time of decommissioning may be used for spent fuel management and ISFSI decommissioning expenses. The licensee must continue to provide reasonable assurance that sufficient funds remain available for radiological decommissioning. Under these circumstances, licensees would not be required to seek a regulatory exemption under 10 CFR 50.12.
- Amend the regulations to modify the reporting requirements in 10 CFR 50.75(f)(1) to be consistent with the decommissioning funding assurance reporting requirements for

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ISFSIs in 10 CFR 72.30(c). This means that licensees would report the status of decommissioning funding on a triennial basis (every 3 years) instead of on a biennial frequency. Additionally, the NRC would remove the NRC approval requirement for ISFSI reports filed under 10 CFR 72.30(b) and (c).

- Amend the regulation at 10 CFR 50.75(b) to further clarify that licensees would maintain decommissioning funding assurance. Language would be added to address instances when the amount in the DTF falls below the regulatory amount required either by the NRC minimum formula as set forth in 10 CFR 50.75(c) or a licensee's site-specific cost estimate, thereby creating a "shortfall."<sup>4</sup> Licensees would have to correct shortfalls in a timely manner and provide evidence to the NRC during the next reporting cycle under 10 CFR 50.75(f). Current guidance provides that licensees may remedy shortfalls by utilizing the methods described in 10 CFR 50.75(e)(1). Conforming changes would be made to 10 CFR 50.82 as part of this rulemaking.
- Amend 10 CFR 50.75(h)(1)(B)(iv) to be consistent with 10 CFR 50.4, "Written communications," with respect to written notice of intent to make a disbursement or payment from the DTF. This change would require all notice materials be sent to the Document Control Desk instead of the Director of the Office of Nuclear Reactor Regulation, as licensees are now directed.
- Eliminate 10 CFR 50.75(f)(2) as it is duplicative of the language of 10 CFR 50.75(f)(1).

### 5.7.3 Assumptions

The assumptions used in the cost-benefit analysis for this decommissioning area are:

- For Alternative DTF-1, the NRC staff assumes that all operating nuclear power plant sites will submit exemption requests to use a portion of their DTFs for spent fuel management.

### 5.7.4 Affected Attributes

Industry Implementation: Under Alternative DTF-2 licensees would not need to apply for exemptions to use the DTF for spent fuel management. This would result in a one-time benefit (i.e., averted cost) to industry. Under Alternative DTF-2, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

Industry Operation: Under Alternative DTF-2, licensees would report financial assurances for decommissioning every 3 years instead of every 2 years. This would result in costs averted from the lower frequency of reporting. In addition, licensees who report a shortfall pursuant to 10 CFR 50.75(f) would have to correct the shortfall in a timely manner.

NRC Implementation: To implement Alternative DTF-2, the NRC incurs a one-time cost relative to the status quo for developing the rule. Under Alternative DTF-2, the NRC would avert the cost and resources to evaluate exemption requests to use DTF for spent fuel management.

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<sup>4</sup> Shortfall is defined as the difference between the amount of financial assurance provided by the licensee and the amount of financial assurance required.

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**NRC Operation:** Under Alternative DTF-2, the NRC would evaluate the submitted report of assurances for decommissioning against the funding in the DTF on a triennial basis instead of on a biennial basis. This would result in cost averted from the lower frequency of evaluating these reports.

**Regulatory Efficiency:** Under Alternative DTF-2, licensees would have sufficient internal controls, chart of accounts, and reporting tools to identify distinct funds in the DTF and the licensees' intention for their use would be identified and reflected in accounting practices. These controls and reporting mechanism leads to transparency regarding the intended use of decommissioning trust assets and establishes a clear and consistent regulatory structure. Under Alternative DTF-2, licensees would have more flexibility concerning funding of spent fuel management than currently exists with the status quo (Alternative DTF-1).

**Other Government:** Under Alternative DTF-2, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

**General Public:** Under Alternative DTF-2, the general public would commit additional time to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

## **5.8 Offsite and Onsite Financial Protection Requirements and Indemnity Agreements**

To implement the requirements under the Price-Anderson Act (PAA), codified in Section 170 of the Atomic Energy Act of 1954, as amended (AEA), the NRC requires nuclear power plant licensees to comply with regulations for offsite financial protection and indemnity agreements. All nuclear reactors are required to have and maintain offsite financial protection as set forth in 10 CFR 140.11, "Amounts of financial protection for certain reactors." The amounts of insurance required for each large operating reactor (i.e., has a rated capacity of 100,000 electrical kilowatts or more) are set forth in 10 CFR 140.11(a)(4), which are: (1) primary financial protection in the amount of \$450 million; and (2) secondary financial protection consisting of funds from a nuclear industry retrospective rating plan. The Commission executes and issues agreements of indemnity for large operating reactors pursuant to 10 CFR 140.20, "Indemnity agreements and liens." The general form of indemnity agreement to be entered into by the Commission with large operating reactors is provided at 10 CFR 140.92, "Appendix B-Form of indemnity agreement with licensees furnishing insurance policies as proof of financial protection," and 10 CFR 140.93, "Appendix C-Form of indemnity agreement with licensees furnishing proof of financial protection in the form of licensee's resources."

Apart from the PAA requirements, the NRC also requires nuclear power reactor licensees to maintain onsite property insurance. Specifically, 10 CFR 50.54(w) requires licensees to obtain property insurance for each reactor site in the amount of \$1.06 billion, or the maximum amount of coverage generally available from private sources, whichever is less, to stabilize and decontaminate the reactor and the reactor site in the event of an incident. Neither the PAA nor NRC's implementing regulations for large operating reactors explicitly addresses the concept of decommissioning. Likewise, the NRC's onsite insurance requirements do not address the status of facilities during the period of decommissioning or the reduction in risk that is presented by permanently shutdown reactors.



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Because of these issues, the NRC staff is evaluating whether to amend the NRC's financial protection regulations to address the unique aspects of a decommissioning reactor. This rule change would allow the licensees of large operating reactors that have permanently shut down a reduction in both offsite and onsite financial protection without the need for licensees to submit requests for regulatory exemptions from financial protection requirements. The objectives of this rulemaking would be to: (1) provide a process that maintains an adequate level of financial protection during decommissioning, and (2) minimize the need for licensees to request exemptions from financial protection requirements that are no longer needed.

In SECY 93-127, "Financial Protection Required of Licensees of Large Nuclear Power Plants during Decommissioning," (Ref. 29), the NRC staff concluded, "In the interim, exemptions could be granted for reductions in the amount of primary financial protection required to a level which would not prejudice the outcome of rulemaking. The staff believes that a level of \$100 million would be adequate." In the Staff Requirements Memorandum (SRM) to SECY-93-127 (Ref. 30), the Commission authorized the staff to approve, through specific exemptions from the requirements of 10 CFR 140.11(a)(4), termination of participation in the retrospective rating plan and reduction in primary financial protection from \$450 million to \$100 million, after a cooling period adequate to support air cooling of the fuel in a completely drained pool. Similarly, under status quo, and pursuant to the requirements provided in 10 CFR 50.54(w), licensees must have and maintain a minimum coverage limit for each reactor site in the lesser amount of either: \$1.06 billion, or whatever amount of insurance is generally available from private sources. In SECY-96-256, "Changes to Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors, 10 CFR 50.54(w)(1) and 10 CFR 140.11," (Ref. 31), the NRC staff recommended changes to the power reactor insurance regulations that would allow licensees to lower onsite insurance levels to \$50 million upon demonstration that the fuel stored in the SFP can be air-cooled. In its SRM to SECY-96-256 (Ref. 32), the Commission supported the staff's recommendation that, among other things, would allow permanently shutdown power reactor licensees to reduce onsite financial protection coverage to \$50 million when the licensee was able to demonstrate that the spent fuel could be air-cooled if the spent fuel pool was drained of water. The NRC has issued several exemptions from the requirements of 10 CFR 50.54(w) on the basis that the reduced onsite insurance coverage value of \$50 million satisfies the underlying purpose of the rule in funding stabilization of site conditions and cleanup costs associated with decontamination following the hypothetical rupture of a large onsite liquid radioactive waste tank. With the spent fuel adequately cooled by air in a drained spent fuel pool, the potential for a significant release from the spent fuel was considered negligible.

#### **5.8.1 Alternative FP-1 (No-action alternative)**

Under the no-action alternative, licensees will continue to abide by regulations in 10 CFR 140.11(a)(4), which require each reactor that is licensed to operate and has a rated capacity for electrical generation exceeding 100,000 electrical kilowatts to have \$450 million in primary financial protection to remedy a potential offsite release of nuclear material and to participate in the industry retrospective rating plan. Pursuant to 10 CFR 140.8, "Specific exemptions," the Commission may grant exemptions that it determines are authorized by law and otherwise are in the public interest.

#### **5.8.2 Alternative FP-2 (Rulemaking to codify the current exemption process)**

This alternative recommends to amend the offsite and onsite financial protection requirements based on the reduced risk of radiological release due to the anticipated reactor configurations and adopts reductions in financial protection based on two levels (level one and two) described

below. The amounts of financial protection provided in these two levels are consistent with exemptions that have been granted to decommissioned reactors in the past. The recommended insurance amounts would be based on the estimated cost of recovery from limiting hypothetical events for specific level one and two reactor configurations. Table 5 provides a summary of Level 1 and Level 2, which are described below:

Table 5 Two-Step Graded Approach

Level	Reactor Site Description	Offsite Requirement	Onsite Requirement
1	Operating or Permanently Ceased Operations and Permanently Defueled	\$450 million; participation in the industry retrospective rating plan	\$1.06 billion
2	Sufficiently Decayed Fuel; $\geq 1,000$ gallons of radioactive waste	\$100 million; withdrawal from the rating plan	\$50 million

#### Description of Level 1: Permanently Ceased Operations and Permanently Defueled

Licensees in Level 1 include operating reactors and decommissioning reactors that have docketed certifications of permanent cessation of operations and permanent removal of fuel from the reactor vessel pursuant to 10 CFR 50.82, "Termination of License," or 10 CFR 52.110, "Termination of License." In this level, a decommissioning reactor is defueled and permanently shut down, but the spent fuel in the SFP is still susceptible to a zirconium fuel cladding fire if the SFP is unexpectedly drained, although this is a very unlikely event. This decommissioning configuration encompasses the period from immediately after the core is removed from the reactor to just before the decay heat of the hottest assemblies is low enough that no rapid zirconium oxidation will take place. Licensees in Level 1 must maintain the full amounts of offsite and onsite insurance specified in 10 CFR 140.11(a)(4), and 10 CFR 50.54(w), respectively.

#### Description of Level 2: Sufficiently Decayed Fuel

In Level 2, the reactor is defueled and permanently shut down, and spent fuel in the SFP has decayed and cooled sufficiently that it cannot heat up to clad ignition temperature within 10 hours under adiabatic conditions. In this configuration, the spent fuel can be stored long term in the SFP. In addition, the site may possess a radioactive inventory of liquid radiological waste (radwaste), radioactive reactor components, and contaminated structural materials. The radioactive inventory during this configuration may change, depending on the licensee's proposed shutdown activities and schedule. The transition to Level 2 financial protection amounts could occur after a timeframe based on a site-specific analysis that demonstrates the fuel cannot heat up to clad ignition temperature within 10 hours under adiabatic conditions. In Level 2, the offsite requirements would be reduced from \$450 million in primary financial protection and participation in the industry retrospective rating plan to \$100 million and withdrawal from the industry retrospective rating plan. The Commission determined that the \$100 million was sufficient to cover offsite liability claims such as those incurred as a result of the 1979 Three Mile Island, Unit 2, accident.

If significant sources of radioactive material (i.e., greater than or equal to 1,000 gallons of radwaste) remain on site, then licensees should be required to maintain an adequate level of

onsite insurance coverage. In Level 2, onsite financial protection requirements would be reduced from \$1.06 billion to \$50 million. The \$50 million reflects the potential for a radiological incident resulting from the mobile sources of radioactivity at a permanently shutdown reactor site. A scenario involving the rupture of a large liquid radwaste storage tank (approximately 450,000 gallons) containing slightly radioactive water was selected as conceivable and a bounding scenario. For estimating cleanup costs, the limiting event considered costs associated with removal of soil contamination and potential contamination of the ground water table. That postulated event was estimated to result in an onsite waste cleanup cost of approximately \$50 million with negligible radiological consequences off site. In economic terms, it would surpass the cleanup costs associated with a fuel-handling incident, which has been taken into account in determining the upper-bound level of onsite insurance coverage required in Level 2.

### 5.8.3 Alternative FP-3 (Rulemaking to amend regulations to provide a four-step graded approach)

In SECY-93-127 and SECY-96-256, the NRC staff proposed a “four-step graded approach” that considers decreasing nuclear power plant risk with corresponding reductions in financial protection requirements. This graded approach expands the two-step graded approach described in Alternative FP-2 by including two further reductions in financial protection that correspond to reductions in risk during a plant’s decommissioning progression. The levels consider onsite consequences that may be triggered by an onsite event. The table below summarizes this alternative:

Table 6 Four-Step Graded Approach

Level	Description	Offsite Requirement	Onsite Requirement
1	Permanently Ceased Operations and Permanently Defueled	\$450 million; participation in the industry retrospective rating plan	\$1.06 billion
2	Sufficiently Decayed Fuel; $\geq 1,000$ gallons of radwaste	\$100 million; withdrawal from the rating plan	\$50 million
3	All Spent Fuel Transferred to an Onsite ISFSI or Removed From the Site; $\geq 1,000$ Gallons of Radwaste	\$50 million	\$50 million
4	All Spent Fuel Transferred to an Onsite ISFSI or Removed From the Site; $< 1,000$ Gallons of Radwaste	\$25 million	\$25 million/ eliminated

Description of Level 3: All Spent Fuel Transferred to an Onsite Independent Spent Fuel Storage Installation or Removed from Site;  $\geq 1,000$  Gallons of Radwaste Onsite

In Level 3, the reactor is permanently shut down and all spent fuel has been removed to an onsite or offsite independent spent fuel storage installation (ISFSI), or to a U.S. Department of Energy (DOE) high-level waste repository. The remaining onsite radioactive inventory depends

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on the reactor and reactor site decommissioning status and may include liquid radwaste, radioactive reactor components, and contaminated structural materials. In these circumstances, with no fuel in the SFP, the risk of an incident resulting in a release of radioactivity materials is greatly reduced from that of Level 2.

When spent fuel is no longer stored in the SFP, the potential for a radiological incident is primarily assumed to be in mobile sources of radioactivity at a permanently shutdown reactor site. Because the spent fuel has been removed from the SFP, the NRC recommends further reducing the required level of offsite financial protection to take into account only the mobile radioactive inventory that may remain on site. The offsite financial protection requirement would be reduced to \$50 million since the level of risk is considered less than in Level 2.

In Level 3, onsite financial protection recognizes there is no fuel in the SFP and the risk is dependent on the radioactive inventory remaining at the reactor site. As was the case for Level 2, the level of onsite financial protection would be based on the estimated amount needed to recover from the postulated onsite event of a rupture of a large (about 450,000 gallons) slightly contaminated liquid storage tank and cleanup from this event. Therefore, the onsite financial protection would be maintained at \$50 million.

Description of Level 4: All Spent Fuel Transferred to an Onsite Independent Spent Fuel Storage Installation or Removed from the Site; ≤ 1,000 gallons of radwaste onsite

A licensee in Level 4 is similarly situated as a licensee in Level 3, except that the reactor site no longer has any significant amount of mobile sources of radioactivity, such as contaminated liquids (less than 1,000 gallons). Therefore, the basis for the transition from Level 3 to Level 4 is the point at which less than 1,000 gallons of liquid radwaste are stored onsite. Because there are no significant amounts of mobile radioactive sources on site, there is no need to maintain the Level 3 amounts of offsite and onsite financial protection.

Under the PAA, offsite financial protection must be maintained for licenses issued under Sections 103 and 104 of the AEA. Under the NRC's regulations, and for the purpose of this rulemaking, this would include all power reactor licenses under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities;" licenses under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants;" and licenses under 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." Thus, while offsite consequences in Level 4 are considered negligible, offsite financial protection must be maintained until the NRC license is terminated. As provided in SECY-96-256, the Level 4 offsite requirement would be reduced to \$25 million because of the possibility for public liability claims arising from alleged offsite consequences stemming from an onsite nuclear incident.

Pursuant to SECY-96-256, for onsite financial protection, the postulated rupture of the much smaller radioactive storage tank of less than 1,000 gallons is estimated to have at least two orders of magnitude less impact than the rupture of the large tank, such that onsite cleanup costs would not necessitate the level of coverage specified in Level 3. Onsite coverage would be reduced to \$25 million. This amount is considered to be sufficient to cover cleanup activities of the smaller storage tank. Elimination of onsite insurance coverage could be warranted when a licensee has completed all decommissioning activities other than a confirmatory survey for license termination.

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#### 5.8.4 Assumptions

The assumption used in the cost-benefit analysis for this decommissioning area is:

- For Alternative FP-1, all nuclear reactor licensees will submit exemption requests for onsite and offsite financial protection should the rulemaking not go forward. These exemptions requests will be consistent with the reduction of offsite and onsite financial protection requirements described in levels one and two.
- For Alternatives FP-2 and FP-3, the NRC staff assumes that each decommissioning licensee will submit a site-specific analysis that demonstrates the spent fuel in a SFP cannot heat up to clad ignition temperature under adiabatic conditions and can be air cooled when the pool is drained of water. This will be used to justify a reduction in onsite and offsite financial protection.
- For Alternatives FP-2 and FP-3 the NRC staff assumes that the decommissioning financial protection and indemnity regulations will no longer apply following the site passing its confirmatory survey and the NRC terminates the plant license.
- For Alternatives FP-2 and FP-3, the NRC staff assumes that the recommended changes would eliminate the need for licensees to submit exemption requests from decommissioning financial protection and indemnity regulations.

#### 5.8.5 Affected Attributes

Industry Implementation: Under Alternatives FP-2 and FP-3, licensees would not need to apply for exemptions from offsite and onsite financial protection regulations. This results in a one-time benefit (i.e., averted cost) for each licensee. Licensees would still be required to submit a site-specific analysis that demonstrates the spent fuel in a SFP cannot heat up to clad ignition temperature under adiabatic conditions if they desire the reduced insurance amounts for offsite and onsite financial protection. The industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

NRC Implementation: To implement Alternatives FP-2 and FP-3, the NRC incurs a one-time cost relative to the status quo for developing the rule. Under these alternatives, exemptions would no longer be needed for licensees to receive approval for reduced financial protection. This results in the elimination of staff reviews for these exemption requests and leads to a benefit (i.e., averted cost) for the NRC.

Other Government: Under Alternatives FP-2 and FP-3, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

General Public: Under Alternatives FP-2 and FP-3, the general public would commit additional time to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

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## 5.9 Application of Backfitting Protection

The NRC uses its backfitting process to decide whether to impose new or revised regulatory requirements or staff positions on nuclear power reactor licensees or certain nuclear materials licensees. To ensure that these proposed changes are adequately defined and justified, the NRC imposes the changes only after a formal and systematic assessment of the proposed imposition. The intended result of the backfitting process is to prevent the NRC, after issuing a license or other approval, from arbitrarily changing the terms and conditions for operating under the approval and the regulations that existed at the time the NRC issued the approval.

For nuclear power reactor licensees, this process is set forth in 10 CFR 50.109, “Backfitting,” and in the issue finality provisions in 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants” (hereinafter collectively referred to as the “Backfit Rule”). The language of the Backfit Rule clearly applies to a licensee designing, constructing, or operating a nuclear power facility. For example, 10 CFR 50.109(a)(1) defines “backfitting” as:

[T]he modification of or addition to systems, structures, components, or design of a facility; or the design approval or manufacturing license for a facility; or the procedures or organization required to design, construct or operate a facility; any of which may result from a new or amended provision in the Commission’s regulations or the imposition of a regulatory staff position interpreting the Commission’s regulations that is either new or different from a previously applicable staff position.

The application of the Backfit Rule to decommissioning plants is not as clear. In SECY-98-253, “Applicability of Plant-Specific Backfit Requirements to Plants Undergoing Decommissioning” (ADAMS Legacy No. ML992870107), the NRC staff presented the Commission with a list of reasons underlying this uncertainty:

- The Backfit Rule has no end point when the rule no longer applies, “thereby implying that backfit protection continues into decommissioning and up to the point of license termination.”
- The term “operate” could reasonably be interpreted as including activities to decommission the reactor.
- The Backfit Rule was developed when the decommissioning of plants was not an active area of regulatory concern.
- The Backfit Rule’s definition of “backfitting” uses terms associated with the design, construction and operation of a facility, rather than its decommissioning, although the staff noted in SECY-98-253 that “prior to the 1996 decommissioning rule, the Commission regarded decommissioning as a phase of the plant’s life cycle which is different from the operational phase.”
- Two of the factors used in evaluating a backfit—costs of construction delay/facility downtime, and changes in plant/operational complexity – are targeted to power operation and “conceptually inappropriate in evaluating the impacts of a backfit on a decommissioning plant.”

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- The SOCs for the 1970<sup>5</sup>, 1985<sup>6</sup>, and 1988<sup>7</sup> final Backfit Rules did not discuss any aspect of decommissioning, focusing instead on construction and operation.
  - Proposed changes to decommissioning requirements usually focused on relaxing requirements or on whether a requirement applicable to an operating reactor continued to be applicable to a decommissioning plant. Thus, “the notion of a ‘substantial increase’ in protection to public health and safety from a backfit does not appear to be particularly useful [in decommissioning].”
  - The 1996 decommissioning final rule<sup>8</sup> did not directly respond to questions from the public on the applicability of the Backfit Rule to a decommissioning plant.

In SECY-98-253, the NRC staff requested Commission approval to amend, among other regulations, 10 CFR 50.109, so that the Backfit Rule would clearly apply to licensees in decommissioning. In this paper, the NRC staff also proposed that, until the rulemaking was finished, the staff would apply the Backfit Rule to plants undergoing decommissioning “to the extent practical.”

The Commission and NRC recognize that certain provisions of the Backfit Rule do not apply to power reactor licensees in decommissioning as discussed in Appendix I to the regulatory basis. Currently, the Backfit Rule guidance in Management Directive 8.4, “Management of Facility-Specific Backfitting Information Collection,” (Ref. 33) provides only that the Backfit Rule applies to decommissioning plants. However, because of the lack of clarity for backfitting in the decommissioning phase of a power reactor, the NRC is considering two alternatives for applying the Backfit Rule to licensees in decommissioning: (1) issuing new or revised guidance, and (2) conducting rulemaking. These alternatives, in addition to the no-action alternative are discussed below.

### **5.9.1 Alternative B-1 (No-action alternative)**

The NRC could continue to apply the Backfit Rule to licensees in decommissioning “to the extent practical.” This means that the NRC would not use the provisions of the Backfit Rule that concern reactors that are being designed, constructed, or operated because those provisions cannot be applied to a licensee of a reactor that has already terminated the design, construction, and operation phases of its reactor’s life. These provisions are, in part or in whole, the following sections of 10 CFR 50.109:

- 10 CFR 50.109(c)(5): Installation and continuing costs associated with the backfit, including the cost of facility downtime or the cost of construction delay;
- 10 CFR 50.109(c)(6): The potential safety impact of changes in plant or operational complexity, including the relationship to proposed and existing regulatory requirements; and
- Other references to reactor design, construction, or operation in 10 CFR 50.109.

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<sup>5</sup> 35 FR 5317, March 31, 1970

<sup>6</sup> 50 FR 38097, September 20, 1985

<sup>7</sup> 53 FR 20603, June 6, 1988

<sup>8</sup> 61 FR 39278, July 29, 1996

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This approach would require the NRC to refrain from applying certain provisions of the Backfit Rule to licensees in decommissioning if the NRC determines that the provisions cannot be practically applied to those licensees. The NRC staff would employ this process on a case-by-case basis, given the specific circumstances at a particular licensee's site. This approach could undermine the Backfit Rule's predictability and stability policies because of its case-by-case nature and resultant uncertainty in terms of applicability.

### **5.9.2 Alternative B-2 (Regulatory guidance development)**

The NRC's primary guidance document for licensees and other external stakeholders in the area of backfitting is NUREG-1409, "Backfitting Guidelines," dated July 31, 1990 (Ref. 34). This document describes the types of backfits, how backfitting determinations are made and justified, how generic and facility-specific backfits are imposed, and the appeal process. The NRC issued this NUREG before the Commission made significant changes to its regulations on issue finality and the application of backfitting provisions to nonreactor licensees, such as spent fuel storage installations and fuel cycle facilities. The primary guidance on backfitting for the NRC staff is found in Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection."

Updates to the guidance documents on backfitting are currently underway based on recent direction to the NRC staff. In a 2016 memorandum, "Tasking Related to Implementation of Agency Backfitting and Issue Finality Guidance," the NRC's Executive Director for Operations tasked the NRC staff to assess the adequacy and currency of the NRC's existing backfitting requirements, guidance, criteria, and procedures, including NUREG-1409 (ADAMS Accession No. ML16133A575). The resulting report from the Committee to Review Generic Requirements, "Committee to Review Generic Requirements Response to Tasking Related to Implementation of Agency Backfitting and Issue Finality Requirements and Guidance," dated June 27, 2017 (ADAMS Accession No. ML17174B161), and direction from the Executive Director for Operations, "Tasking in Response to Committee to Review Generic Requirements Report on the U.S. Nuclear Regulatory Commission's Implementation of Backfitting and Issue Finality Requirements," dated July 19, 2017 (ADAMS Accession No. ML17198C141), acknowledge the need for updates to guidance documents on backfitting. Furthermore, in SRM-COMSECY-16-0020, "Staff Requirements — COMSECY-16-0020 — Revision of Guidance Concerning Considerations of Cost and Applicability of Compliance Exception to Backfit Rule," dated November 29, 2016 (ADAMS Accession No. ML16334A462), the Commission directed updates to backfitting guidance related to the consideration of cost and applicability of the compliance exception to the Backfit Rule. These updates are expected to be provided to the Commission in April 2018 for its review and approval. In a subsequent effort, the NRC could update its guidance to include implementation of the status quo in terms of how to not apply the reactor design-, construction-, and operation-related provisions of the Backfit Rule to licensees in decommissioning.

### **5.9.3 Alternative B-3 (Conduct rulemaking to clarify how the NRC applies the Backfit Rule to licensees in decommissioning)**

The NRC could create a new part within 10 CFR Chapter I for decommissioning regulations, create a new subpart within 10 CFR Part 50, or amend 10 CFR 50.109 to provide licensees that have had their 10 CFR 50.82(a) certifications docketed by the NRC with the same backfitting protection as they had during their operating phase. A new backfitting provision for licensees in decommissioning would eliminate any confusion with the meaning of the words, "operate a



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facility,” in 10 CFR 50.109(a)(1) as compared to other uses of the term “operate” in 10 CFR Chapter I. The current 10 CFR 50.109(a) would be limited to licensees operating reactors, and the new provision would be limited to licensees in decommissioning.

#### **5.9.4 Affected Attributes**

Industry Implementation: To implement Alternative B-2, industry would participate in the development or revision of regulatory guidance by the NRC and to implement Alternative B-3, industry would participate in the development of the rulemaking. These would result in a one-time cost to industry for time spent on the reviews and participation in public meetings. For Alternatives B-2 and B-3, the industry would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

NRC Implementation: To implement Alternative B-2, the NRC incurs a one-time cost relative to the status quo for developing or revising regulatory guidance. To implement Alternative B-3, the NRC incurs a one-time cost relative to the status quo for developing and finalizing the rule.

Other Government: Under Alternatives B-2 and 3, the state and local governments would commit additional resources to participate in the public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

#### **5.10 Aging Management**

An initial operating license is issued for up to 40 years of plant operation. The regulations in 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants,” allow for a license renewal of up to 20 years. The regulations do not limit the number of 20-year renewal terms that may be issued. Therefore, a reactor and its SFP may be in operation for up to 80 years. The requirements in 10 CFR 50.82, “Termination of License,” allow the licensee up to 60 years to decommission the site, with a provision for extensions. A licensee may use 60 years to decommission, following 80 years of reactor operation. Therefore, the NRC staff is basing this evaluation on the potential for a SFP to operate for up to 140 years.

When a licensee enters decommissioning, it removes all fuel from the reactor vessel. That fuel is moved to the SFP, where it is stored with other fuel until it is either moved to an independent spent fuel storage installation (ISFSI) or completely removed from the site. Until all nuclear fuel is removed from the SFP, the SFP performs the same functions as it performs during commercial operation of the facility. This is highlighted in 10 CFR 50.51, “Continuation of License,” which states in paragraph (b) that each licensee for a plant that has permanently ceased operation shall continue to take actions to maintain the facility, including, where applicable, the storage, control and maintenance of spent fuel, in a safe condition beyond the license expiration date until the Commission notifies the licensee in writing that the license is terminated.

This regulation indicates a licensee has an obligation to protect the nuclear fuel, and by extension the structures, systems, and components it relies upon to meet that obligation throughout the decommissioning process until the fuel has been removed from the SFP. Therefore, the NRC staff does not believe any new regulations are required. To assure that spent fuel is maintained in a safe condition, the NRC is reviewing the need for revisions to its

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regulatory guidance for aging management, with respect to certain long-lived, passive structures and components (SCs) (e.g., neutron absorbing materials, SFP liner, SFP cooling system) required to maintain nuclear fuel in a safe condition during the decommissioning period while nuclear fuel is in the SFP. Two alternatives are being considered by the NRC staff to address this issue.

#### **5.10.1 Alternative AMP-1 (No-action alternative)**

Under the no-action alternative, there would be no changes to aging management requirements for decommissioning power reactors. An initial operating license is issued for up to 40 years of plant operation. A licensee may apply for and be granted a renewed license, which allows for an additional 20 years of plant operation. When a licensee applies for license renewal review in accordance with 10 CFR Part 54, the licensee typically considers the adequacy of existing performance or condition monitoring programs and activities to manage the effects of aging during the period of extended operation. For those SCs that meet the scoping criteria in 10 CFR 54.4, such programs are typically enhanced or new programs developed, which may include additional inspection or testing activities. License conditions imposed on the renewed operating license require that a summary description of the aging management activities and programs are incorporated in the updated final safety analysis report and that the resulting aging management programs (AMPs) and other aging management activities are implemented prior to and during the period of extended operation. These activities become part of the current licensing basis for the plant as defined in 10 CFR 54.3.

#### **5.10.2 Alternative AMP-2 (Develop regulatory guidance and ensure the adequacy of inspection programs)**

In this alternative, there would be no changes to requirements for decommissioning power reactors to implement aging management activities. However the NRC staff would issue regulatory guidance to explain adequate methods for implementing the regulations, and update the inspection procedures for decommissioning power reactors to ensure adequate and consistent oversight of aging management.

#### **5.10.3 Affected Attributes**

Industry Implementation: Under Alternative AMP-2, licensees would incur a one-time cost relative to the status quo to review the regulatory guidance (RG) document and to update plant procedures for inspecting passive and long-lived SCs supporting the SFP operation. The industry would commit additional resources to participate in the public meeting and commenting period for the regulatory guidance.

NRC Implementation: To implement Alternative AMP-2, the NRC would incur a one-time cost relative to the status quo to develop and issue the RG and to update the NRC inspection procedures.

Other Government: Under Alternative AMP-2, the state and local governments would commit additional resources to participate in the public meeting and commenting period for the regulatory guidance.

General Public: Under Alternative AMP-2, the general public would commit additional resources to participate in the public meeting and commenting period for the regulatory guidance.

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## **6 EVALUATION OF COSTS AND BENEFITS FOR AREAS OF DECOMMISSIONING CONSIDERED FOR RULEMAKING**

This section examines the costs and benefits expected to result from the alternatives of the decommissioning areas relative to the regulatory baseline (i.e. the no-action alternative). All costs and benefits are monetized, when possible. The total of costs and benefits are then summed to determine whether the difference between the costs and benefits results in a positive net benefit. In some cases, costs and benefits that are not monetized (because of the lack of quantized data) are qualitatively described.

### **6.1 Analytical Methodology**

This section describes the process used to evaluate costs and benefits associated with the alternatives, consistent with the guidance provided in NUREG/BR-0058, “Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission,” Revision 5 (Ref. 35). The benefits include desirable changes in affected attributes (e.g., monetary savings, reduced burden on licensees, streamlined process), while the costs include any undesirable changes in affected attributes (e.g., monetary costs).

This analysis evaluates eight attributes on a quantitative basis: industry implementation, industry operation, NRC implementation, NRC operation, other government, general public, environmental considerations and regulatory efficiency. Quantitative analysis requires a baseline characterization of the affected universe, including characterization of factors such as the number of affected entities, the areas of decommissioning, and the administrative processes and procedures that licensees or applicants would implement, or no longer implement, because of the alternatives under consideration. Costs to complete the decommissioning rulemaking effort in 2016 and 2017 are sunk costs and are not considered in this regulatory analysis.

#### **6.1.1 Regulatory Baseline**

This regulatory analysis measures the incremental impacts of the recommended rulemaking relative to a baseline that reflects anticipated behavior in the event NRC undertakes no additional regulatory actions (the no-action alternatives). As part of the regulatory baseline used in this analysis, the staff assumes full licensee compliance with existing NRC regulations.

#### **6.1.2 Discount Rates**

In accordance with guidance from the Office of Management and Budget (OMB) Circular No. A-4, “Regulatory Analysis” (Ref. 36), and NUREG/BR-0058, Revision 5 (Ref. 35), net present worth calculations are used to determine how much society would need to invest today to ensure that the designated dollar amount is available in a given year in the future. By using present worth values, costs and benefits, regardless of when the cost or benefit is incurred in time, are valued to a reference year for comparison. Based on OMB Circular No. A-4 and consistent with NRC past practice and guidance, present worth calculations are presented using 3-percent and 7-percent real discount rates.<sup>9</sup> 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

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<sup>9</sup> The rates presented in Appendix C to OMB Circular No. A-94 (Ref. 36) do not apply to regulatory analysis or cost-benefit analysis of public investment. These rates are used for lease-purchase and cost-effectiveness analysis, as specified in the Circular.

on savings to reflect reliance on a social rate of time preference discounting concept. A 7-percent discount rate approximates the marginal pretax real rate of return on an average investment in the private sector, and is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector. A 7-percent rate is consistent with an opportunity cost of capital<sup>10</sup> concept to reflect the time value of resources directed to meet regulatory requirements.

### 6.1.3 Cost/Benefit Inflators

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

$$\frac{\text{CPIU}_{2017}}{\text{CPIU}_{\text{Value Year}}} * \text{Value}_{\text{Value Year}} = \text{Value}_{2017}$$

Values of CPI-U used in this cost-benefit analysis are summarized in Table 7.

Table 7 Consumer Price Index—All Urban Consumers, U.S. City Average

Base Year	CPI-U Annual Average <sup>a</sup>	Forecast Percent Change of CPI-U from Previous Year <sup>b</sup>
2016	240.007	
2017	245.767	2.40%
2018	251.420	2.30%
2019	257.202	2.30%

<sup>a</sup> United States Bureau of Labor Statistics, “CPI Detailed Report,” April, 2017. Table 24, “Historical Consumer Price Index for All Urban Consumers (CPI-U): U.S. City Average, All-Items,” <http://www.bls.gov/cpi/tables.htm> (Ref. 37).

<sup>b</sup> United States Congressional Budget Office, “The Budget and Economic Outlook: 2017 to 2027.” Table 2-1, “CBO’s Economic Projections for Calendar Years 2017 to 2027,” January 2017, <https://www.cbo.gov/sites/default/files/115th-congress-2017-2018/reports/52370-outlookonecolumn.pdf> (Ref. 38).

### 6.1.4 Labor Rates

For regulatory analysis purposes, labor rates are developed and this approach is consistent with guidance set forth in NUREG/CR-4627, “Generic Cost Estimates” (Ref. 39), and general cost-benefit methodology. The NRC labor rate for fiscal year 2018 is \$131 per hour.<sup>11</sup>

<sup>10</sup> 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.

<sup>11</sup> The NRC labor rates presented here differ from those developed under the NRC’s license fee recovery program (10 CFR Part 170, “Fees for Facilities, Materials, Import and Export Licenses, and Other Regulatory Services under the Atomic Energy Act of 1954, as Amended”). The NRC labor rates for fee recovery purposes are set for cost recovery of the services rendered and, as such, include non-incremental costs (e.g., overhead, administrative, and logistical support costs).

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The estimated mean industry labor rate is \$133 per hour. The NRC staff derived these labor rates according to data provided by BLS. The NRC staff used the 2016 occupational employment and wages data, which provided labor categories and the mean hourly wage rate by job type and used the inflator discussed in Section 6.1.3 to inflate these labor rate data to 2017 dollars. The industry labor rates used in the analysis reflect total compensation, which includes health and retirement benefits (using a burden factor of 2.0). The NRC staff used the BLS data tables to select appropriate hourly labor rates for performing the estimated procedural, licensing, and utility-related work necessary during and following implementation of the recommended alternatives. In establishing this labor rate, wages paid for the individuals performing the work plus the associated fringe benefit component of labor cost (i.e., the time for plant management over and above those directly expensed) are considered expenses and are included. The NRC staff also verified that these labor rates are consistent with wage rates submitted by industry in recent severe accident mitigation alternatives cost estimates. Appendix A of this regulatory analysis provides a breakdown of the labor categories considered that may be required to implement rulemaking. The NRC staff performed an uncertainty analysis, which is discussed in Section 7.11.

### 6.1.5 Affected Entities

The following describes the nuclear power reactors that are affected by the decommissioning rule:

- Operating reactor sites: The NRC staff models 66 U.S. light-water nuclear power reactor sites in this analysis.<sup>12</sup> Note that in 2013 three sites had permanently shut down without significant advance notice or preplanning. These sites are Crystal River Nuclear Generation Plant, Kewaunee Power Station, and San Onofre Nuclear Generating Station.

On December 29, 2014, Entergy Nuclear Operations, Inc., shut down Vermont Yankee Nuclear Power Station, and on January 12, 2015, the licensee certified that Vermont Yankee had permanently ceased operation and removed fuel from the reactor vessel. Furthermore, the Omaha Public Power District board of directors shut down Fort Calhoun Station on October 24, 2016, Exelon plans to shut down Oyster Creek Nuclear Power Station in 2019, Pilgrim Nuclear Power Station will plan to shut down in 2019 and the Indian Point Nuclear Power Station will shut down in 2021. The Pacific Gas and Electric Company announced it plans to shut down Diablo Canyon Nuclear Power Plant in 2025.

These licensees who have identified their intention to permanently cease operations in the near future have indicated that they plan to continue to use the current transition process (i.e., establishing a decommissioning regulatory framework by requesting exemptions, license amendments, and rescinding orders, as needed). The NRC staff assumes that these licensees will not wait for the outcome of the decommissioning rulemaking before formulating their decommissioning licensing activities.

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<sup>12</sup> Based on information obtained from NUREG-1350, Volume 29, "Information Digest: 2017–2018," Appendix G, "U.S. Commercial Nuclear Power Reactor Operating Licenses—Expiration by Year, 2013–2049," issued August 2017 (Ref. 35).

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- Future operating reactor units: The NRC staff assumes that there are four future operating light-water nuclear power reactors that would be affected by the recommended rule and are considered in this analysis. The future nuclear power reactor units are Vogtle Electric Generating Plant, Units 3 and 4, assumed to begin operations in 2021 and 2022, respectively.<sup>13</sup>

Other potential new reactors licensed under 10 CFR Part 52 and small modular reactors are not included in this analysis. In the case that additional 10 CFR Part 52 applicants are issued licenses and are under construction, the regulatory analysis for the final rule will reflect that change.

### 6.1.6 Sign Conventions

The sign conventions used in this analysis for all favorable consequences for the alternatives are positive and all adverse consequences for the alternatives are negative. For example, additional costs above the regulatory baseline are shown as negative values, and benefits and averted costs are shown as positive values. Negative values are shown using parentheses (e.g., negative \$500 is displayed as (\$500)).

### 6.1.7 Base Year

The rulemaking is expected to be issued and effective in 2020. The monetized benefits and costs in this analysis are expressed in year 2017 dollars. Rulemaking-related implementation costs are assumed to be incurred in years 2018 and 2019. Non-rulemaking implementation costs are assumed to be incurred in year 2020. Ongoing and annual costs of operation related to the alternatives are assumed to begin in year 2021 unless otherwise stated and continue until no additional costs or benefits are incurred. These monetized future costs and benefits are then discounted back into year 2017 dollars.

### 6.1.8 Time Period of Analysis

To define the period of analysis covered by this regulatory analysis (i.e., the period over which costs and benefits would be incurred), the NRC used the remaining license term for each operating and COL licensee. These remaining license terms were obtained from NUREG-1350, vol.29, *NRC Information Digest* (Ref. 40). The license terms consist of an operating period and can be followed by a 60 year period for SAFSTOR or a 12.5 year period for DECON decommissioning. The NRC assumes that each operating site that has not renewed its license will apply for and receive one 20-year license renewal beyond the original 40-year license term. At the end of the operating period, the NRC assumes that each site would enter the decommissioning phase, and would in turn incur decommissioning site costs. There are two new reactors included in the analysis - Vogtle Units 3 and 4. The NRC assumes that both new reactors will apply for and receive one 20-year license renewal in addition to the original 40-year license. Based on these assumptions, the Vogtle nuclear site would incur costs associated with the final rule from 2020 through 2082.

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<sup>13</sup> Fermi Unit 3, Levy County Units 1 and 2, and South Texas Project, Units 3 and 4 are not included in this analysis because the NRC issued a combined license for these proposed new reactors but the licensees have no immediate plans to begin construction. If the construction plans change during this rulemaking, the regulatory analysis will be updated accordingly to reflect the costs and benefits of the rule from these additional units.

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### 6.1.9 Cost Estimation

In order to estimate the costs associated with the evaluated alternatives, the staff used a work breakdown structure approach to deconstruct each alternative into requirements that would need to be met. These requirements include avoidance of exemptions and/or amendments, additional processes that licensees would be required to complete (e.g., additional materials and drug testing) and other additional penalties (e.g., spent fuel management fees). Additionally, solicitation of licensee input on reduced staffing during decommissioning and extrapolation techniques (i.e., utilization of cost factors) were used to estimate the costs and benefits of each alternative.

The NRC staff gathered data from several sources (e.g., BLS, internal databases, publications, and periodicals) and professional opinion. This data was used to estimate activities such as the levels of effort required to prepare and submit exemption requests and license amendments, to review and process the exemptions and license amendments, to manage and track spent fuel management costs, and to complete materials tests. NRC working group members were also consulted to obtain expert opinion on the levels of effort (labor hours and staffing) to complete decommissioning activities. This expert opinion is based on NRC staff experience with oversight of operating and decommissioning power reactors and forms the basis for the many assumptions used to derive the cost estimates. In addition, the NRC staff used historical cost data to estimate the future cost of some requirements (e.g., drug and alcohol testing) using cost factors. For instance, to calculate the estimated averted costs of requests for exemptions and amendments and the preparation of the final rule, it was necessary for the NRC staff to extrapolate the labor hours responsible for the work based on past data. For steps in the regulatory alternatives with no or incomplete data, the staff based its cost estimates on similar steps for which data are available.

To incorporate uncertainty into the model, the staff employed a Monte Carlo simulation, which is an approach to uncertainty analysis where input variables are expressed as distributions. The simulation was run 10,000 times, and values used in simulations were chosen randomly from the distributions of the input variables provided in Appendix B to this document. The result was a distribution of values for the output variable of interest. Using Monte Carlo simulation, it is also possible to determine the input variables that have the greatest effect on the value of the output variable. Section 7.11 of this analysis provides a description of the Monte Carlo simulation methods and a presentation of the uncertainty analysis.

## 7 PRESENTATION OF RESULTS FOR AREAS OF DECOMMISSIONING CONSIDERED FOR RULEMAKING

This section presents the quantitative and qualitative results by attribute relative to the regulatory baseline. As described in the previous sections, costs and benefits are quantified where possible and can have either a positive or a negative algebraic sign, depending on whether the alternative has a favorable or adverse effect relative to the regulatory baseline (Alternative 1). A discussion is provided for those attributes that could not be represented in monetary values. Although this *ex ante* cost-benefit analysis<sup>14</sup> provides useful information that can be used when deciding whether to select an alternative, the analysis is based on estimates of the future costs and benefits. Whether the estimates hold in the future, the process of

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<sup>14</sup> An *ex ante* cost-benefit analysis is prepared before a policy, program, or alternative is in place and can assist in the decision about whether resources should be allocated to that alternative.

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conducting regulatory analyses has value in that it helps decision makers think in depth about specific alternatives and their associated results.

## **7.1 Industry Implementation**

The NRC staff estimates that amending some of the requirements in 10 CFR Part 50 that were mentioned previously (e.g., EP, physical security) would allow licensees to avert one-time costs because they would submit fewer exemptions and license amendment requests. However, the NRC staff had introduced new requirements for licensees (e.g. updating of fatigue management at decommissioning plants), which would result in additional costs. Discussion of both the averted and additional costs of each area of decommissioning is presented in the next two sections.

### **7.1.1 Averted Industry Implementation Costs**

The licensee submittal of an exemption or amendment request to the NRC can be expensive. In order to be exempt from, or to change how a licensee complies with the NRC's requirements (e.g., maintaining offsite emergency preparedness, using DTFs for spent fuel management, etc.) during its reactor's decommissioning phase, the licensee must submit an exemption request or a license amendment request to the NRC for review and approval. This analysis evaluates several alternatives for multiple areas of decommissioning, which could, if implemented, eliminate the need for decommissioning-related exemption and license amendment requests. These alternatives and areas of decommissioning are as follows:

- Under Alternative R-2 for the Record Retention decommissioning area, exemptions from the recordkeeping and record retention requirements would be reduced. This would result in a one-time benefit (i.e., averted cost) to industry for having to write fewer exemptions pertaining to these requirements.
- Under Alternative TR-2 for the Transportation Investigation decommissioning area, exemptions related to LLW transportation investigation requirements during both operating and decommissioning at nuclear facilities covered by the requirements of 10 CFR Part 20 would be reduced. This would result in a one-time benefit (i.e., averted cost) to industry for having to write fewer of these exemptions.
- Under Alternative EP-2 for the EP decommissioning area, exemptions from EP requirements and amendments to licensees regarding changes to the emergency plans would be reduced. This would result in a one-time benefit (i.e., averted cost) to industry from writing fewer exemption and amendment requests.
- Under Alternative PS-2 for the Physical Security decommissioning area, licensees would not need to apply for exemptions from the physical security requirements for suspension of security measures for the control room and ISFSI. This would result in a one-time benefit to industry from writing fewer exemptions.
- Under Alternative F-3 for Fitness for Duty - Fatigue, Part 52 licensees would not need to submit exemption requests to reduce their fatigue management requirements.
- Under Alternative CFH-3 for the Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers, licensees would not be required



to submit for Commission approval fuel handler training programs suitable to qualify CFHs. This would result in a one-time cost benefit to industry.

- Under Alternative DTF-2 for the DTF, licensees would not need to apply for exemptions to use the DTF for spent fuel management. This would result in a one-time cost benefit to industry.
- Under Alternatives FP-2 and FP-3 for Offsite and Onsite Financial Protection requirements and indemnity agreements, the exemptions for offsite and onsite financial protection requirements would be fewer due to the reductions in financial protection based on EP levels. This would result in a one-time benefit (i.e., averted cost) to industry from writing fewer exemptions.

Table 8 presents the averted implementation costs for all affected areas of decommissioning relative to the no-action alternatives (status quo). Where more than one alternative is listed, all of the listed alternatives have the same averted implementation costs. Note that the licensees that have already entered decommissioning (i.e., Crystal River, Vermont Yankee, San Onofre, Kewaunee and Fort Calhoun), and those that have submitted an intent to decommission before year 2020 (e.g. Oyster Creek) will not receive the full benefits from the avoidance of the exemption and amendment process during the decommissioning transition phase. This is because these licensees likely will have already submitted exemption or amendment requests to the NRC for processing before the final rulemaking becomes effective in year 2020.

Table 8 Averted Industry Implementation Costs

Areas of Decommissioning	Alternatives	Averted Industry Implementation Costs		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	\$ 20,015,000	\$ 4,712,000	\$ 10,204,000
Physical Security	PS-2	\$ 3,380,000	\$ 796,000	\$ 1,723,000
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ 663,000	\$ 146,000	\$ 328,000
Decommissioning Trust Fund	DTF-2	\$ 2,098,000	\$ 462,000	\$ 1,038,000
Offsite & Onsite Financial Protection	FP-2 & 3	\$ 1,499,000	\$ 353,000	\$ 764,000
Record Retention Requirements	R-2	\$ 761,000	\$ 621,000	\$ 696,000
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$ 572,000	\$ 467,000	\$ 523,000

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars.

\*\*\* NPV = net present value.

## 7.1.2 Additional Industry Implementation Costs

Although licensees would avert costs for the areas of decommissioning described in Section 6.1.1, additional one-time costs to the licensees would result for the following decommissioning areas:

- For Alternatives DAR-2, DAR-3, and DAR-4 for the “Level of PSDAR Review and Approval by the NRC” decommissioning area, licensees would commit additional resources to participate in the public meetings and write comments on the alternatives. For Alternative DAR-3, industry would commit additional resources to add the site specific environmental analysis to the PSDAR. For Alternative DAR-4, industry would commit additional resources to write the environmental report for the PSDAR and complete the PSDAR amendment process.

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- For Alternatives O-2 and O-3 for the “Appropriateness of Maintaining the Three Existing Options for Decommissioning” decommissioning area, licensees would commit additional resources to participate in the public meetings and write comments on the alternatives. For Alternative O-3, a licensee would commit additional resources to change its decommissioning process (e.g. from DECON to SAFSTOR or vice versa) by documenting the change in a brief document. Because the NRC staff expects few to no licensees would change their decommissioning process during decommissioning, the burden from changing this requirement is expected to be insignificant.
  - In Alternatives T-2 through T-3 for the “Maintaining the Decommissioning Options” decommissioning area, licensees would commit additional resources to participate in the public meetings and submit comments on the alternatives. For Alternative T-3, industry would commit additional resources to update NUREG/CR-0130 and NUREG/CR-0672. Alternative T-3 would result in a burden to licensees that do not have enough funding to complete an earlier decommissioning that complies with the reduced time frame. This change in burden is because some licensees may need to make up for the lack of funding in order to complete decommissioning within the shorter timeframe. For example, if a licensee has 60 years for the DTF to accrue funds, the licensee would have accrued more funds after 60 years than it would have accrued after 20 years, assuming similar rates of returns. Therefore, the difference in accrued funds has to be made up from other sources of funds to accommodate the shorter time frame for decommissioning.
  - For Alternatives SFM-2 and SFM-3 for the “Spent Fuel Management Requirements” decommissioning area, licensees would incur additional costs by participating in the public meetings and submitting comments on the alternatives. Under Alternative SFM-3, licensees would commit minor resources to include the spent fuel management summary in the PSDAR.
  - Alternative DA-2 for the “FFD—drug and alcohol testing during decommissioning” decommissioning area licensees would incur an additional one-time cost because licensees would have to modify the drug and alcohol testing procedures in order to comply with the amended regulation. In addition, licensees would incur additional costs by participating in the public meetings and submitting comments on the alternatives.
  - For Alternatives F-2 and F-3 for the “FFD-fatigue during decommissioning” decommissioning area, licensees would incur additional one-time costs because they will have to modify their fatigue management procedures to account for plant specific conditions. In addition, licensees would incur additional costs by participating in the public meetings and submitting comments on the alternatives.
  - For Alternative CFH-2 for the “Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers” area, licensees would incur a one-time cost to complete and submit the voluntary industry initiatives for staffing and training at permanently shutdown and defueled reactors and clarification of related definitions for NRC review and endorsement. In addition, licensees would incur additional costs by participating in the public meetings and submitting comments on the alternatives.
  - Alternative DTF-2 may result in additional costs to those licensees not under rate-setting regulations who report a shortfall in its DTF and are required to report compliance in the

next decommissioning report. The cost impacts of the recommend change to make up the shortfall within a timely manner was not modeled at this time. In addition, licensees would incur additional costs by participating in the public meetings and submitting comments on the alternatives.

- For Alternatives B-2 and B-3 for the “Application of Backfitting Protection” decommissioning area, licensees would incur an additional one-time cost because the licensees would review the update of NUREG-1409, participate in the public meetings, and submit comments on the NUREG and the alternatives.
- For Alternative AMP-2 for the “Aging Management” decommissioning area, licensees would incur an additional one-time cost contribute to review regulatory guidance documents for aging management, to participate in the public meetings, and to submit comments.

Note that the industry’s development of the voluntary initiatives for Alternative F-2 was completed by issuing NEI 15-08, “Managing Personnel Fatigue at Decommissioning Reactors,” (Ref. 41). The NRC staff modelled this guidance development as a sunk cost. Table 9 presents the additional implementation costs for all affected areas of decommissioning relative to the no-action alternatives (status quo). Where more than one alternative is listed in the table, each alternative has the same implementation costs. The costs for industry to write and submit comments are included as well for each of the alternatives presented.

Table 9 Additional Industry Implementation Costs

Areas of Decommissioning	Alternatives	Additional Industry Implementation Costs		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	\$ (50,000)	\$ (48,000)	\$ (49,000)
Physical Security	PS-2	\$ (25,000)	\$ (25,000)	\$ (25,000)
Cyber Security	CS-2 & 3	\$ (8,000)	\$ (8,000)	\$ (8,000)
Fitness for Duty, Drugs & Alcohol	DA-2	\$ (8,000)	\$ (8,000)	\$ (8,000)
Fitness for Duty, Fatigue	F-2 & 3	\$ (3,313,000)	\$ (884,000)	\$ (1,837,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-2	\$ (251,000)	\$ (213,000)	\$ (231,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ (11,000)	\$ (10,000)	\$ (10,000)
Decommissioning Trust Fund	DTF-2	\$ (41,000)	\$ (40,000)	\$ (41,000)
Offsite & Onsite Financial Protection	FP-2 & 3	\$ (13,000)	\$ (13,000)	\$ (13,000)
Backfit Protection	B-2	\$ (27,000)	\$ (26,000)	\$ (27,000)
Backfit Protection	B-3	\$ (27,000)	\$ (26,000)	\$ (27,000)
Aging Management	AMP-2	\$ (4,000)	\$ (3,000)	\$ (3,000)
Level of PSDAR Review by NRC	DAR-2	\$ (23,000)	\$ (22,000)	\$ (23,000)
Level of PSDAR Review by NRC	DAR-3	\$ (12,096,000)	\$ (4,054,000)	\$ (7,511,000)
Level of PSDAR Review by NRC	DAR-4	\$ (32,267,000)	\$ (7,433,000)	\$ (16,349,000)
Maintaining the Decommissioning Options	O-2 & 3	\$ (3,000)	\$ (3,000)	\$ (3,000)
Timeframe Associated with Decommissioning	T-2	\$ (7,000)	\$ (6,000)	\$ (6,000)
Timeframe Associated with Decommissioning	T-3	\$ (23,000)	\$ (20,000)	\$ (21,000)
Role of External Stakeholders in Decommissioning	GOV-2 & 3	\$ (20,000)	\$ (19,000)	\$ (19,000)
Clarification Spent Fuel Management	SFM-2	\$ (7,000)	\$ (6,000)	\$ (6,000)
Clarification Spent Fuel Management	SFM-3	\$ (16,000)	\$ (14,000)	\$ (15,000)

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars.

## 7.2 Industry Operation

This attribute accounts for the projected economic effect caused by routine and recurring activities in the alternatives on affected licensees. The staff estimates that by amending some

of the NRC's requirements that were mentioned previously (e.g., EP, physical security, etc.), licensees would be able to avert costs on a recurring basis (annually) during the decommissioning phase. However, the NRC has found that as a result of these changes to the NRC's regulations, licensees for power reactors would also be incurring costs annually during the decommissioning phase. The averted and additional costs that result on a recurring basis, annually or otherwise, are the operation costs. Discussion of the operation costs for each area of decommissioning is presented in the next two sections.

### 7.2.1 Averted Industry Recurring Costs

Recurring averted costs were modelled in the following areas of decommissioning:

- Under Alternative DA-2 for Drug and Alcohol Testing, the licensee's drug and alcohol testing program cost would be reduced for the length of the program during decommissioning due to the reduction in the number of individuals subject to the FFD elements necessary to satisfy IMP requirements.
- Under Alternative DTF-2 for the DTF, licensees would expend fewer resources to process decommissioning funding assurance reports because the annual reporting frequencies would be extended from every two years to every three years.
- All non-status quo alternatives in each area of decommissioning that fall under regulatory approaches (Section 3.0) would result in reduced licensee time in teleconference calls due to the clarity in regulation provided by these alternatives.

Table 10 presents the averted industry operation costs for all affected areas of decommissioning relative to the no-action alternatives (status quo). Note that only 58 nuclear power plant sites are accounted for in this attribute, because five sites (i.e., Crystal River, Kewaunee, San Onofre, Vermont Yankee and Ft. Calhoun) have already entered decommissioning and two sites (i.e. Oyster Creek and Pilgrim) will plan to decommission before the rulemaking takes effect. The Bellefonte site is not accounted for in this regulatory analysis due to the fact that construction of this site has ceased and its future remains uncertain.

Table 10 Averted Industry Operation Costs

Areas of Decommissioning	Alternatives	Averted Industry Operation Costs		
		Undiscounted	7% NPV	3% NPV
Fitness for Duty, Drugs & Alcohol	DA-2	\$ 26,379,000	\$ 5,472,000	\$ 12,445,000
Decommissioning Trust Fund	DTF-2	\$ 198,000	\$ 82,000	\$ 133,000
Level of PSDAR Review by NRC	DAR-2,3 & 4	\$ 52,000	\$ 12,000	\$ 27,000
Maintaining the Decommissioning Options	O-2 & 3	\$ 52,000	\$ 12,000	\$ 27,000
Timeframe Associated with Decommissioning	T-2 & 3	\$ 52,000	\$ 12,000	\$ 27,000
Role of External Stakeholders in Decommissioning	GOV-2 & 3	\$ 52,000	\$ 12,000	\$ 27,000
Clarification Spent Fuel Management	SFM-2 & 3	\$ 52,000	\$ 12,000	\$ 27,000

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars

### 7.2.2 Additional Industry Recurring Costs

The following decommissioning changes would increase the annual licensee cost burden. Discussion of these additional recurring costs are identified below:

- 
- Under Alternative DAR-3 for the Level of PSDAR Review and Approval by the NRC, licensees would expend additional resources to update the PSDAR every five years.
  - Under Alternative GOV-3, Role of State and Local Governments and Non-Governmental stakeholders, licensees would expend additional resources to provide updates on the decommissioning process and address stakeholder concerns at the community advisory board meetings that are held throughout the year.
  - Under Alternative CS-2 for Cyber Security, licensees would expend additional information technology (IT) labor hours to implement cyber security protection until all of the spent fuel is transferred to an ISFSI or is shipped offsite. When compared to the regulatory baseline, this results in cyber security protection costs.
  - Under Alternatives F-2 and F-3 for FFD—Fatigue Management, licensees would incur incremental costs to continue the fatigue management program for an additional 10 months for BWRs and an additional 16 months for PWRs.

Table 11 presents the additional industry operational costs for these alternatives.

Table 11 Additional Industry Operation Costs

Areas of Decommissioning	Alternatives	Additional Industry Operation Costs		
		Undiscounted	7% NPV	3% NPV
Fitness for Duty, Fatigue	F-2 & 3	\$ (4,036,000)	\$ (995,000)	\$ (2,093,000)
Cyber Security	CS-2	\$ (340,761,000)	\$ (55,783,000)	\$ (147,308,000)
Level of PSDAR Review by NRC	DAR-3	\$ (8,571,000)	\$ (1,522,000)	\$ (3,851,000)
Role of External Stakeholders in Decommissioning	GOV-3	\$ (4,106,000)	\$ (942,000)	\$ (1,728,000)

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars

### 7.3 NRC Implementation

By amending the NRC's requirements that were mentioned previously, the NRC staff believes that licensees would be able to avert costs expended to apply for exemptions and amendments. As a result, the NRC would avert the cost to process these exemption and amendment requests. However, to achieve these savings, the NRC would incur a cost to develop the final rule and the associated RGs. The following sections discuss the averted and incurred NRC implementation costs for rulemaking and guidance development.

#### 7.3.1 Averted NRC Implementation Costs

When the NRC processes an exemption or license amendment request, resources are expended to perform the review, resolve technical issues, document the evaluation, and respond to the licensee. As a result of this rulemaking, the licensees would submit fewer exemption and license amendment requests and as a result the NRC would avert the time to process these submittals. This would lead to averted costs for the NRC and result in a one-time benefit. Exemption and license amendment requests that were submitted and processed (e.g., Crystal River, Vermont Yankee, San Onofre, and Kewaunee) and those that are expected to be submitted and processed before the effective date of the rule are not included in this analysis. Table 12 displays the NRC averted implementation costs for processing exemption and license amendment requests.

Table 12 Averted NRC Implementation Costs

Areas of Decommissioning	Alternatives	Averted NRC Implementation Costs		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	\$ 10,611,000	\$ 2,498,000	\$ 5,409,000
Physical Security	PS-2	\$ 2,256,000	\$ 531,000	\$ 1,150,000
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ 1,413,000	\$ 311,000	\$ 699,000
Decommissioning Trust Fund	DTF-2	\$ 1,119,000	\$ 246,000	\$ 554,000
Offsite & Onsite Financial Protection	FP-2 & 3	\$ 745,000	\$ 175,000	\$ 380,000
Record Retention Requirements	R-2	\$ 406,000	\$ 331,000	\$ 371,000
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$ 305,000	\$ 249,000	\$ 279,000

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars.

#### 7.3.2 Additional NRC Implementation Costs

The decommissioning final rule would impose implementation costs on the NRC. These costs include procedural and administrative activities, include finalizing the regulatory basis, responding to public comments, reviewing voluntary industry initiatives, developing and issuing the proposed rule and draft guidance documents, and developing and issuing the final rule and

guidance documents. These one-time costs include updating NUREG documents and begin in 2017 with the regulatory basis and are assumed to end in 2020 with the development and issuance of the final rule. The regulatory analysis does not include estimates to perform ongoing decommissioning licensing activities. Table 13 shows the estimated cost for developing and issuing the final rule and associated RGs and NUREGs for each area of decommissioning. Note that the processing of the PSDAR as an amendment in Alternative DAR-4 of The Level of PSDAR Review and Approval by the NRC decommissioning area is included as a NRC implementation cost.

Table 13 Additional NRC Implementation Costs

Areas of Decommissioning	Alternatives	Additional NRC Implementation Costs		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	\$ (1,018,000)	\$ (953,000)	\$ (989,000)
Physical Security	PS-2	\$ (1,018,000)	\$ (953,000)	\$ (989,000)
Cyber Security	CS-2 & 3	\$ (205,000)	\$ (192,000)	\$ (199,000)
Fitness for Duty, Drugs and Alcohol	DA-2	\$ (173,000)	\$ (162,000)	\$ (168,000)
Fitness for Duty, Fatigue	F-2	\$ (128,000)	\$ (108,000)	\$ (119,000)
Fitness for Duty, Fatigue	F-3	\$ (189,000)	\$ (177,000)	\$ (184,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ (189,000)	\$ (177,000)	\$ (184,000)
Decommissioning Trust Fund	DTF-2	\$ (788,000)	\$ (738,000)	\$ (765,000)
Offsite & Onsite Financial Protection	FP-2 & 3	\$ (262,000)	\$ (245,000)	\$ (254,000)
Backfit Protection	B-2	\$ (128,000)	\$ (119,000)	\$ (124,000)
Backfit Protection	B-3	\$ (197,000)	\$ (184,000)	\$ (191,000)
Aging Management	AMP-2	\$ (18,000)	\$ (17,000)	\$ (18,000)
Level of PSDAR Review by NRC	DAR-2	\$ (385,000)	\$ (348,000)	\$ (368,000)
Level of PSDAR Review by NRC	DAR-3	\$ (416,000)	\$ (345,000)	\$ (376,000)
Level of PSDAR Review by NRC	DAR-4	\$ (17,584,000)	\$ (4,290,000)	\$ (9,065,000)
Maintaining the Decommissioning Options	O-2	\$ (257,000)	\$ (232,000)	\$ (245,000)
Maintaining the Decommissioning Options	O-3	\$ (364,000)	\$ (333,000)	\$ (350,000)
Timeframe Associated with Decommissioning	T-2	\$ (257,000)	\$ (232,000)	\$ (245,000)
Timeframe Associated with Decommissioning	T-3	\$ (619,000)	\$ (548,000)	\$ (587,000)
Role of External Stakeholders in Decommissioning	GOV-2	\$ (257,000)	\$ (217,000)	\$ (238,000)
Role of External Stakeholders in Decommissioning	GOV-3	\$ (364,000)	\$ (317,000)	\$ (343,000)
Clarification Spent Fuel Management	SFM-2	\$ (257,000)	\$ (217,000)	\$ (238,000)
Clarification Spent Fuel Management	SFM-3	\$ (364,000)	\$ (317,000)	\$ (343,000)
Record Retention Requirements	R-2	\$ (108,000)	\$ (101,000)	\$ (104,000)
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$ (108,000)	\$ (101,000)	\$ (104,000)

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars

## 7.4 NRC Operation

This attribute accounts for the projected economic effect caused by routine and recurring activities in the recommended alternatives by the NRC. The staff estimates that by improving the regulations governing decommissioning power reactors, there would be additional and averted costs on an annual basis. Costs that are incurred annually are due to the expense of NRC resources to provide oversight. The following areas of decommissioning are affected where the NRC could avert or save costs on a recurring basis:

- All non-status quo alternatives in each area of decommissioning that fall under regulatory approaches (Section 3.0) will result in reduced NRC time in teleconference calls due to the clarity in regulation provided by these alternatives.
- Alternative DAR-3 for The Level of PSDAR Review and Approval by the NRC would result in additional resources spent by the NRC to review the update of the PSDAR submittal every five years.

- Alternative GOV-3 for the Role of State and Local Governments and Non-Governmental Stakeholders will result in additional resources spent by the NRC to meet with stakeholders in the community advisory board once each year.
- Under Alternative DA-2 for FFD – Drug and Alcohol Testing, the NRC would avert costs for the administration of reporting requirements due to the applicability of drug and alcohol testing on a reduced population at a decommissioning plant.
- Under Alternative F-3 for FFD - Fatigue, the NRC would expend additional resources and incur costs in order to provide oversight for the fatigue portion of the 10 CFR Part 26 regulations in the decommissioning phase.

Table 14 Averted NRC Operation Costs

Areas of Decommissioning	Alternatives	Averted NRC Operation Costs		
		Undiscounted	7% NPV	3% NPV
Fitness for Duty, Drugs & Alcohol	DA-2	\$ 501,000	\$ 104,000	\$ 236,000
Decommission Trust Fund	DTF-2	\$ 211,000	\$ 87,000	\$ 142,000
Level of PSDAR Review by NRC	DAR-2,3 & 4	\$ 28,000	\$ 7,000	\$ 14,000
Maintaining the Decommissioning Options	O-2 & 3	\$ 28,000	\$ 7,000	\$ 14,000
Timeframe Associated with Decommissioning	T-2 & 3	\$ 28,000	\$ 7,000	\$ 14,000
Role of External Stakeholders in Decommissioning	GOV-2 & 3	\$ 28,000	\$ 7,000	\$ 14,000
Clarification Spent Fuel Management	SFM-2 & 3	\$ 28,000	\$ 7,000	\$ 14,000

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars

Table 15 Additional NRC Operation Costs

	Alternatives	Additional NRC Operation Costs		
		Undiscounted	7% NPV	3% NPV
Level of PSDAR Review by NRC	DAR-3	\$ (4,570,000)	\$ (812,000)	\$ (2,054,000)
Role of External Stakeholders in Decommissioning	GOV-3	\$ (5,474,000)	\$ (1,256,000)	\$ (2,303,000)
Fitness for Duty, Fatigue	F-3	\$ (53,000)	\$ (13,000)	\$ (28,000)

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars

## 7.5 Regulatory Efficiency

The recommended rulemaking alternatives relative to the regulatory baseline would increase regulatory efficiency for the following areas of decommissioning: Emergency Preparedness, Physical Security, Decommissioning Trust Fund, and Offsite and Onsite Financial Protection Requirements and Indemnity Agreements. This is because these changes would significantly reduce the number of license amendment and exemption requests that the licensees would need to prepare and submit during the decommissioning transition phase. This would significantly reduce the labor hours required by the licensees to develop and submit the amendment and/or exemption requests to the NRC and by the NRC to review these requests. For all areas of decommissioning, the rulemaking alternatives would add clarity to what licensees can and cannot do during decommissioning and, as a result, would enable the NRC to better maintain and administer regulatory activities over the decommissioning process.

## 7.6 Public Health (Accident & Routine) and Safeguards and Security Considerations

As stated in the regulatory basis document (Ref. 1), the need for a power reactor decommissioning rulemaking is not based on safety or security concerns. However it should be



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noted that for Alternative T-3, the 60-year Timeframe Associated with Decommissioning, rulemaking to reduce the decommissioning time frame to less than 60 years may result in more radioactive exposure to the personnel responsible for dismantling the nuclear power facility. This is because less time would be allowed for radioactivity contaminated structures to decay to lower radiation levels.

## **7.7 Other Government**

All areas of decommissioning considered in this analysis would result in additional burden to other federal, state and local government agencies because these agencies would commit additional resources to participate in public meetings and submit comments on documents published for public comment (e.g., the regulatory basis and proposed rule package).

In Alternative T-3, Rulemaking to Codify the Decommissioning Timeframe, the NRC is considering rulemaking to reduce the decommissioning time frame to less than 60 years, which could potentially increase tax revenue to the states and federal government assuming alternate commercial use of the decommissioned property. The commercial use of the decommissioned property could increase the expected gross domestic product compared to a site that is undergoing decommissioning. For example, according to a comment made by a member of the public, the expedited decommissioning of the Vermont Yankee site using the direct DECON method is estimated to result in a combined federal and Vermont state tax revenue increase of \$42 million using a 7 percent discount rate (Ref. 42). This estimate is based on a pro forma for a solar power generator that is constructed and placed into operation following the completion of all decommissioning activities. Currently, the NRC staff is unaware of other decommissioning nuclear facilities owners' plans for future commercial use of their sites.

Also in Alternative T-3, the reduction of the decommissioning time frame to less than 60 years will result in a burden to licensees that do not have sufficient funding to complete an earlier decommissioning. Some of this burden may be passed to the states in order to assist funding these decommissioning facilities so that they may meet the shorter time frame for decommissioning required by the amended rule.

In Alternative GOV-3, Rulemaking to Codify State/Local/Non-Government involvement, the state and local governments would commit additional resources to participate in the community advisory boards. The resources would include sending staff members to the community advisory boards in an effort to provide feedback to the licensee on the decommissioning process. This would enable open communication between the licensee, state and local governments and allow for transparency of the decommissioning process. This may also influence the expediting of decommissioning within the funding limits of the DTF.

In Alternative EP-2, Rulemaking to amend regulations to provide a graded approach to emergency preparedness / emergency plan changes between levels with NRC approval, FEMA must establish a notification process that would replace the existing NRC/FEMA process for terminating the assessment of FEMA user fees following the receipt from the NRC of its approved exemptions from pertinent 10 CFR 50.47(b) and Appendix E to 10 CFR Part 50 requirements stating that offsite radiological emergency planning and preparedness are no longer required at a particular commercial nuclear power plant site after the spent fuel has cooled for a period of 10 months for BWRs or 16 months for PWRs. This change also requires FEMA to perform a rulemaking to amend 44 CFR 354.4(e), "Discontinuation of charges," to reflect this new process. Table 16 shows the costs to other government entities as a result of

the decommissioning alternatives in this regulatory basis that are solely due to participation in the public meetings and submission of comments during the rulemaking process.

Table 16 Costs to Other Government

Areas of Decommissioning	Alternatives	Total Costs (Other Government)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2 & 3	\$ (59,000)	\$ (58,000)	\$ (59,000)
Physical Security	PS-2	\$ (9,000)	\$ (9,000)	\$ (9,000)
Cyber Security	CS-2 & 3	\$ (1,000)	\$ (1,000)	\$ (1,000)
Fitness for Duty, Fatigue	F-2 & 3	\$ (1,000)	\$ (1,000)	\$ (1,000)
Minimum Staffing and Training Requirements	CFH-2 & 3	\$ (4,000)	\$ (4,000)	\$ (4,000)
Decommissioning Trust Fund	DTF-2 & 3	\$ (23,000)	\$ (22,000)	\$ (23,000)
Offsite & Onsite Financial Protection	FP-2	\$ (7,000)	\$ (7,000)	\$ (7,000)
Backfit Protection	B-2 & 3	\$ (6,000)	\$ (6,000)	\$ (6,000)
Aging Management	AMP-2	\$ (2,000)	\$ (2,000)	\$ (2,000)
Level of PSDAR Review by NRC	DAR-2,3 & 4	\$ (22,000)	\$ (21,000)	\$ (21,000)
Maintaining the Decommissioning Options	O-2 & 3	\$ (3,000)	\$ (3,000)	\$ (3,000)
Timeframe Associated with Decommissioning	T-2 & 3	\$ (6,000)	\$ (6,000)	\$ (6,000)
Role of External Stakeholders in Decommissioning	GOV-2 & 3	\$ (18,000)	\$ (18,000)	\$ (18,000)
Clarification Spent Fuel Management	SFM-2 & 3	\$ (6,000)	\$ (6,000)	\$ (6,000)

## 7.8 General Public

Some areas of decommissioning considered in this analysis will result in additional burden to the general public because they would commit additional time to participate in public meeting and commenting periods for the regulatory basis and proposed rulemaking stages.

For Alternative T-3, Rulemaking to Alter the Decommissioning Timeframe, site owners could increase the gross domestic product and the gross output of their decommissioned sites if expenditures are accelerated by the nuclear licensees so that they are compelled to complete the decommissioning of the site earlier. According to a comment made by a member of the public, expedited decommissioning of Vermont Yankee using the direct DECON method could result in the increase of the GDP by \$187 million and an increase in the gross output by \$307 million based on a 7 percent discount rate (Ref. 42). This estimate is based on a pro forma for a solar power generator that is constructed and placed into operation following the completion of all decommissioning activities, a project that other decommissioning nuclear facilities may not perform.

As a result of reducing the time frame to decommission, licensees that have initially chosen the SAFSTOR method may be compelled to decommission earlier than the allowed 60-year period. These licensees may not have accrued sufficient funding to complete an earlier decommissioning mandated by Alternative T-3, and as a result would have to make up for the shortfall using additional funds to complete decommissioning. Some of this burden may be passed to the states or the general public in order to fund the expediting of the decommissioning of these facilities. This burden could include tax increases or electric rate hikes for the general public.

In Alternative GOV-3, Rulemaking to Codify State/Local/Non-Government involvement, the general public would commit additional time to participate in the community advisory boards in

an effort to provide feedback to the licensee and receive updates on the decommissioning process. This would enable open communication between the licensee and general public and allow for transparency of the decommissioning process. As a result, public protests at the plant site and potential lawsuits may be reduced. Table 17 shows the costs to other government entities as a result of the decommissioning alternatives in this regulatory basis.

Table 17 Costs to the General Public

Areas of Decommissioning	Alternatives	Total Costs (General Public)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2 & 3	\$ (4,000)	\$ (3,000)	\$ (4,000)
Physical Security	PS-2	\$ (1,000)	\$ (1,000)	\$ (1,000)
Decommissioning Trust Fund	DTF-2 & 3	\$ (6,000)	\$ (6,000)	\$ (6,000)
Aging Management	AMP-2	\$ (3,000)	\$ (3,000)	\$ (3,000)
Level of PSDAR Review by NRC	DAR-2,3 & 4	\$ (5,000)	\$ (5,000)	\$ (5,000)
Level of PSDAR Review by NRC	DAR-4	\$ (5,000)	\$ (5,000)	\$ (5,000)
Maintaining the Decommissioning Options	O-2 & 3	\$ (1,000)	\$ (1,000)	\$ (1,000)
Timeframe Associated with Decommissioning	T-2 & 3	\$ (1,000)	\$ (1,000)	\$ (1,000)
Role of External Stakeholders in Decommissioning	GOV-2 & 3	\$ (4,000)	\$ (4,000)	\$ (4,000)
Clarification Spent Fuel Management	SFM-2 & 3	\$ (1,000)	\$ (1,000)	\$ (1,000)

## 7.9 Environmental Considerations

As stated in the regulatory basis document (Ref. 1), under Alternative DAR-2, guidance related to PSDARs could be revised to specify that the following environmental considerations consider additional information:

- If available, site characterization information and potential dismantlement, decontamination, and remediation activities that will be undertaken, including a discussion of the results of any preliminary surveys or other environmental characterization activities done before the submission of the PSDAR, as well as a proposed plan for final site status and uses (e.g., industrial use, “green field”).
- The licensee’s evaluation of the environmental impacts of the site specific decommissioning activities (e.g., remediation activities, removal of large components) and planned site modifications. Currently, RG 1.185, Revision 1, states that (1) licensees should compare the potential environmental impacts associated with decommissioning to similar impacts given in the final environmental statement for the plant (as supplemented), the Decommissioning GEIS, and site-specific environmental assessments, (2) the comparison to impacts in the GEIS should recognize the unique nature of the site, and (3) licensees should focus on those resources not covered by previous site-specific NEPA analyses. The NRC could update the guidance documents to include more detail on how to evaluate the environmental impacts that require site specific analysis or that involve other Federal statutes such as the Endangered Species Act and the National Historic Preservation Act, as well as to recommend that the licensee provide a summary of its analysis and its results in the PSDAR.

The updated guidance documents could also recommend that licensees provide information on how they would comply with all Federal, State, and local regulations in effect during

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decommissioning, such as those on nonradiological effluent releases, waste management, and environmental monitoring, in support of the PSDAR's discussion of environmental impacts. The environmental analyses that would bound the environmental impacts associated with site specific decommissioning activities generally assumed compliance with State and Federal regulations. Therefore, in determining if a decommissioning activity is bounded by previous analyses that relied on compliance with State and Federal regulations, the licensee should state whether it will continue to comply with applicable State and Federal regulations, which would strengthen the basis for determining whether environmental impacts are bounded. These updates to guidance documents under Alternative DAR-2 will result in additional time spent by the NRC, Industry, Other Government and the General Public to contribute to the updates.

Under Alternative DAR-3, the required NRC review and approval of the licensee's evaluation of environmental impacts associated with site-specific decommissioning activities would result in additional burden to the NRC and industry due to the additional time spent by the licensee to evaluate the environmental impacts and the NRC to review these evaluations. No benefit is expected to result from the evaluation of environmental impacts associated with site-specific decommissioning activities. Additionally Alternative DAR-3 recommends to modify the rule language in 10 CFR 50.82(a)(4) to clarify that licensees must evaluate the environmental impacts of planned decommissioning activities in the PSDAR and whether the impacts are bounded by previous federally issued environmental review documents. The rule change would clarify that licensees must evaluate the environmental impacts and determine whether they are bounded. If unbounded impacts are identified, then, consistent with 10 CFR 50.82(a)(6)(ii), the licensee can address those impacts before the associated activity occurs instead of being required to address those impacts at the PSDAR stage. This rulemaking alternative would not require that the licensee submit the environmental analysis to the NRC for review and approval, however the licensee would be spending additional time to evaluate these environmental impacts for boundedness.

### **7.10 Disaggregation**

The NRC completed a screening review in accordance with the guidance in Section 4.3.2, "Criteria for the Treatment of Individual Requirements," of NUREG/BR-0058, for the areas of decommissioning containing an alternative that includes rulemaking:

- Emergency Preparedness
- Physical Security
- Cyber Security
- FFD – Drug and Alcohol Testing
- FFD – Fatigue Management
- Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers
- Decommissioning Funding Assurance
- Offsite and Onsite Financial Protection Requirements and Indemnity Agreements

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- Application of the Backfit Rule
  - The Level of PSDAR Review and Approval by the NRC
  - The Appropriateness of Maintaining the Three Existing Options for Decommissioning
  - The 60-Year Timeframe Associated with Decommissioning
  - The Role of State and Local Governments and Non-Governmental Stakeholders
  - Clarifying the Spent Fuel Management Requirements
  - Record Retention Requirements
  - Low-Level Waste Transportation Investigation, Tracing, and Reporting Requirements

In the screening review, the analysis evaluated each requirement of each area of decommissioning and found that the requirements considered separately would not mask the inclusion of other unnecessary requirements.

### **7.11 Uncertainty Analysis**

To determine the robustness of the costs and net benefits contained within this document, the staff examined how the values estimated for benefits and costs change due to uncertainties associated with the staff's analytical assumptions and input data. The NRC used Monte Carlo simulations to examine the impact of uncertainty on the estimated costs and benefits of each area of decommissioning and performed the simulations using the @Risk software package by Palisade Corporation.<sup>15</sup>

Monte Carlo simulations involve introducing uncertainty into the analysis by replacing the point estimates of the variables used to estimate costs and benefits with probability distributions. By defining input variables as probability distributions as opposed to point estimates, the effect of uncertainty on the results of the analysis (i.e., the benefits and costs) can be modeled. The probability distributions were chosen to represent the different variables in the analysis and are defined by a bounded range of estimates. These bounded ranges of estimates were determined from data collected via the agencywide documents access and management system (ADAMS) and the NRC staff's professional judgment.

The probability distributions are also defined by summary statistics. These summary statistics include the minimum and maximum of program evaluation and review technique (PERT)<sup>16</sup> and uniform distributions. For these distributions, the NRC staff used collected input to set the

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<sup>15</sup> Information about this software is available online at [www.palisade.com](http://www.palisade.com).

<sup>16</sup> A 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.

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minimum and maximum values of the PERT and uniform distributions. Lastly, the NRC selected the output variables for the Monte Carlo simulations, which are the estimated monetary costs and benefits. The Monte Carlo simulations included 10,000 iterations and resulted in a monetary range of costs and benefits for each alternative of each area of decommissioning under consideration in the regulatory basis. Additionally, @Risk was used to generate a tornado chart via the Monte Carlo simulations. The tornado chart identifies the input factors (cost drivers) that are ranked by effect on total cost. The results of the uncertainty analysis for the costing of each area of decommissioning are presented in the following sections.

### 7.11.1 Level of PSDAR Review by the NRC

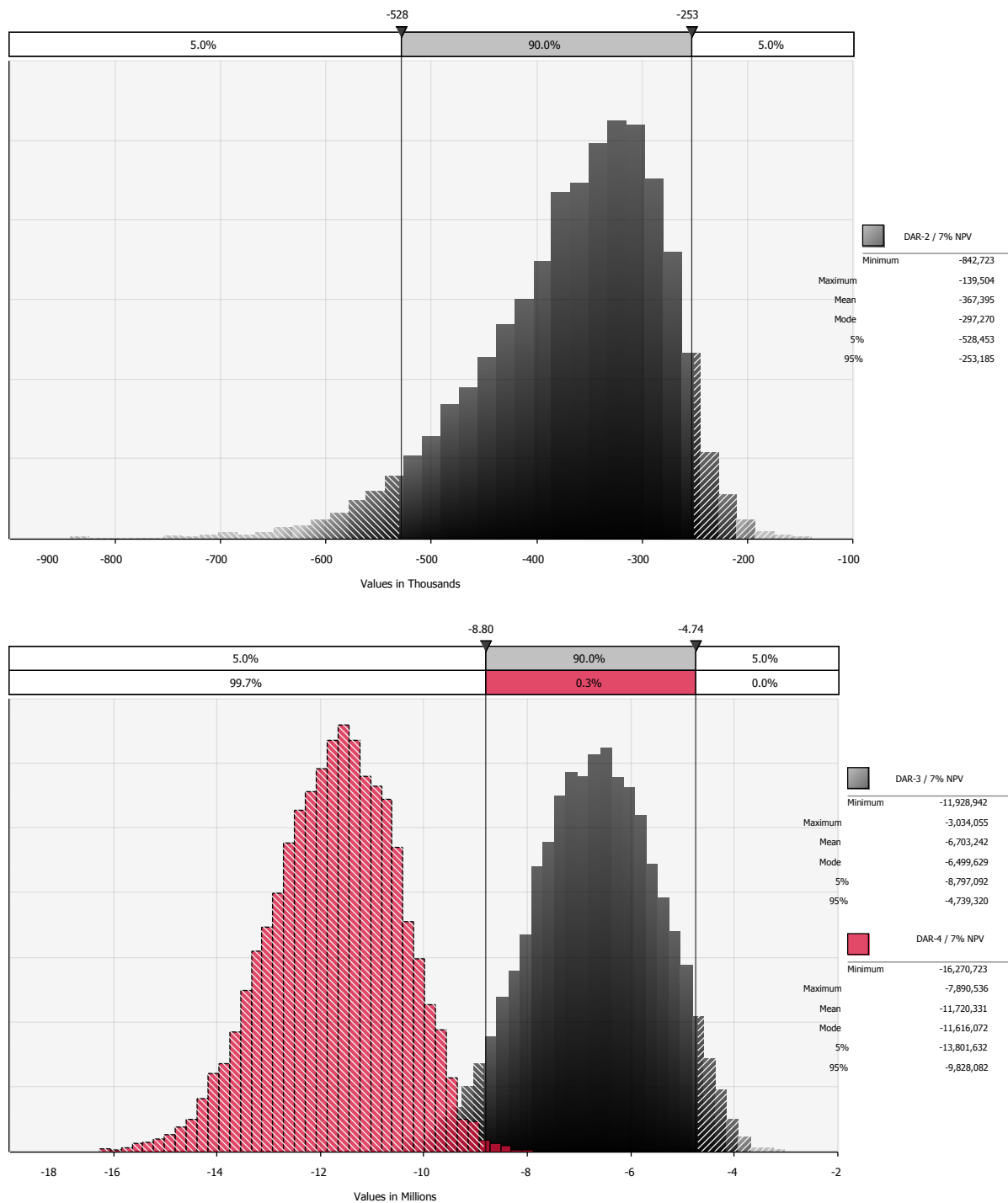


Figure 1 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cost Input variables (Alternatives DAR-2 to DAR-4)

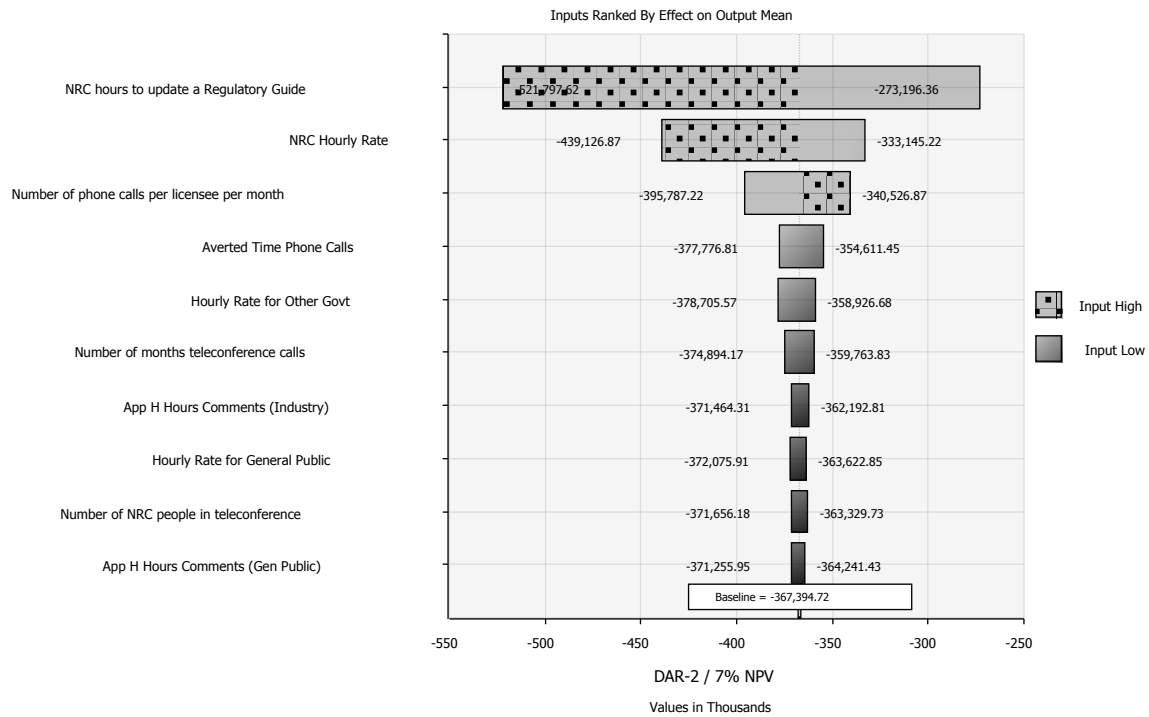


Figure 2 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative DAR-2)

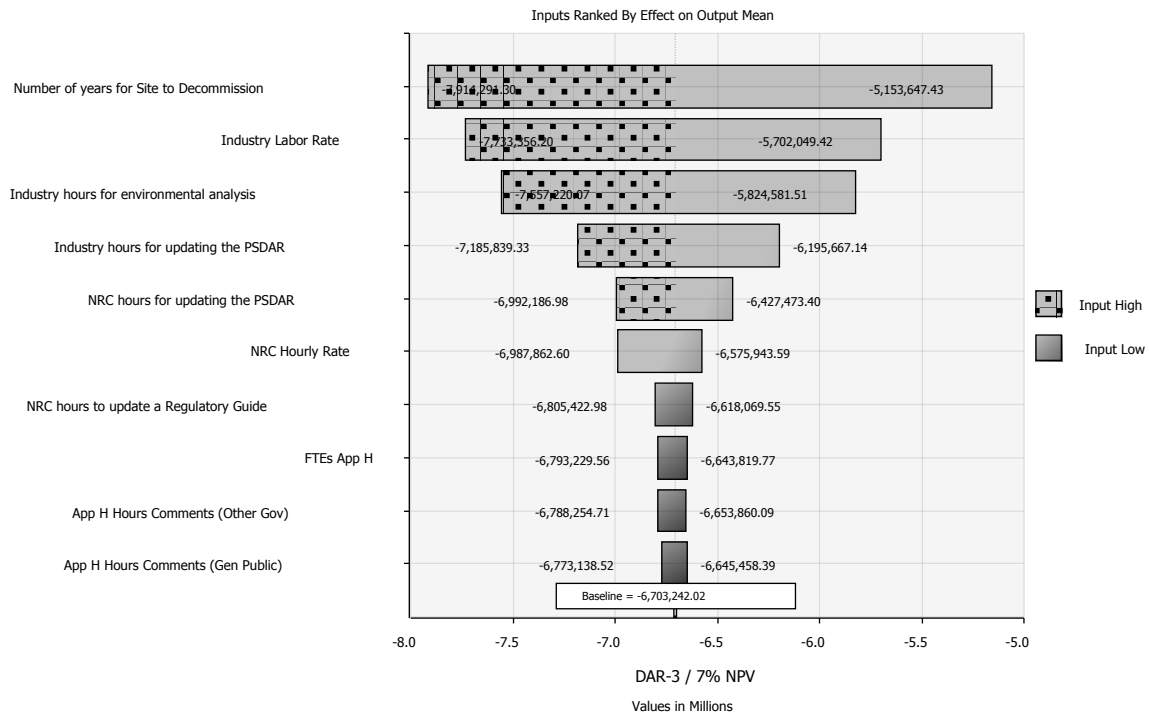
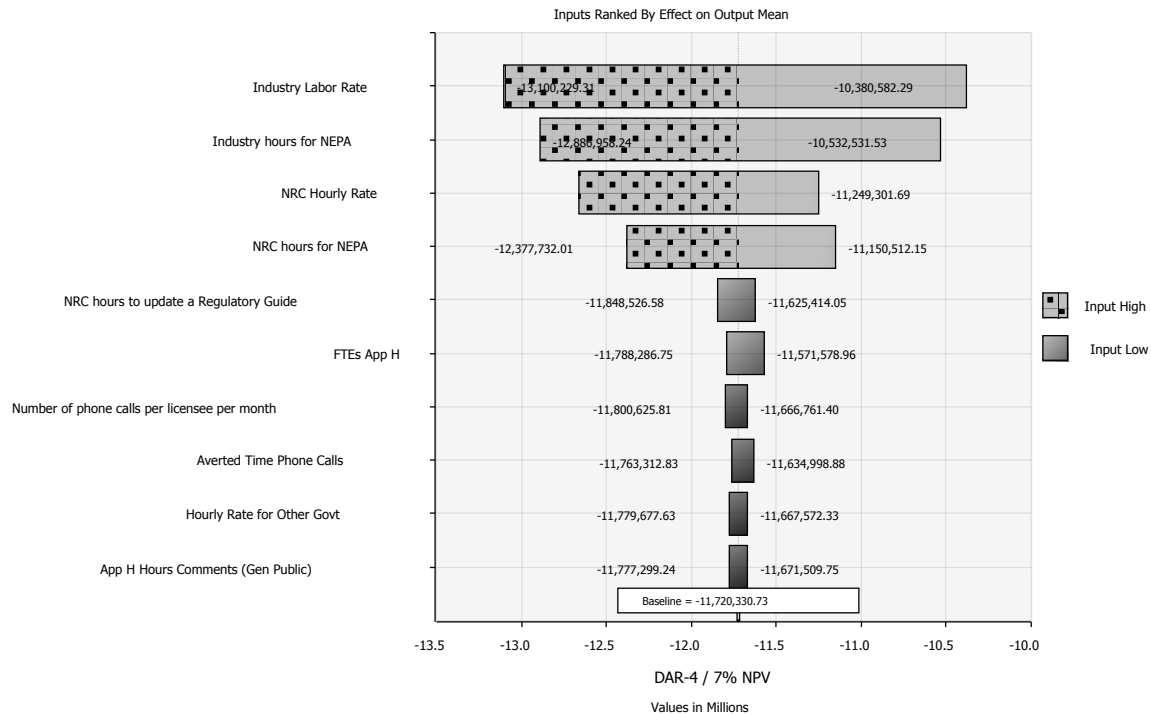


Figure 3 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative DAR-3)





**Figure 4 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative DAR-4)**

The regulatory changes to the PSDAR Review and Approval area of decommissioning (Alternative DAR-2) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$843,000) to (\$140,000) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of NRC hours to update the regulatory guides.

The regulatory changes to the PSDAR Review and Approval area of decommissioning (Alternative DAR-3) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$11.9 million) to (\$3.0 million) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of years that a site would take to decommission.

The regulatory changes to the PSDAR Review and Approval area of decommissioning (Alternative DAR-4) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$16.3 million) to (\$7.9 million) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the industry labor rate for the PSDAR.

### 7.11.2 Maintaining the Decommissioning Options

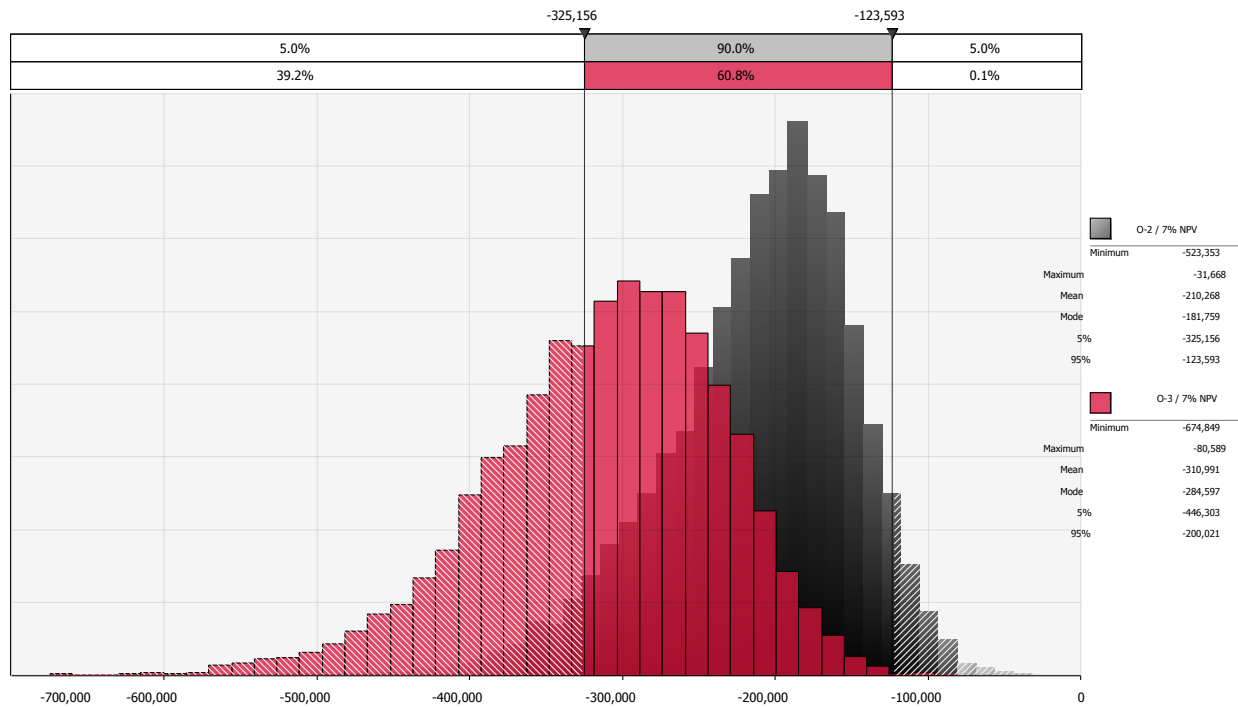


Figure 5 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cost Input variables (Alternatives O-2 to O-3)

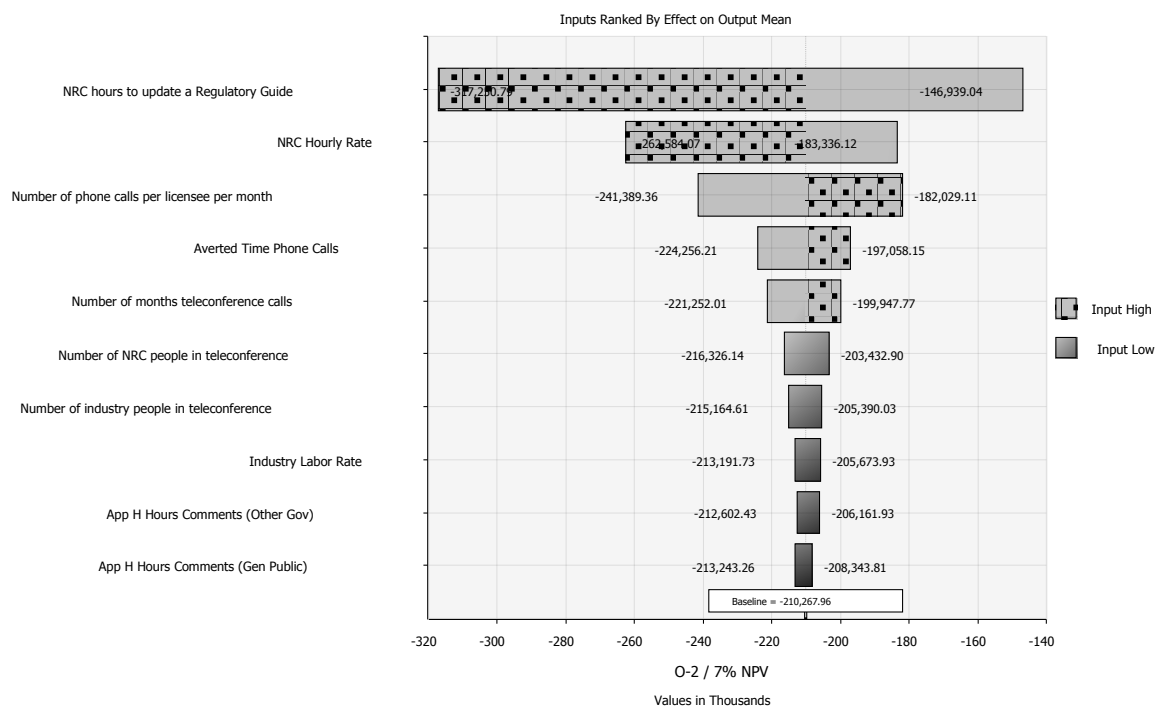


Figure 6 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative O-2)

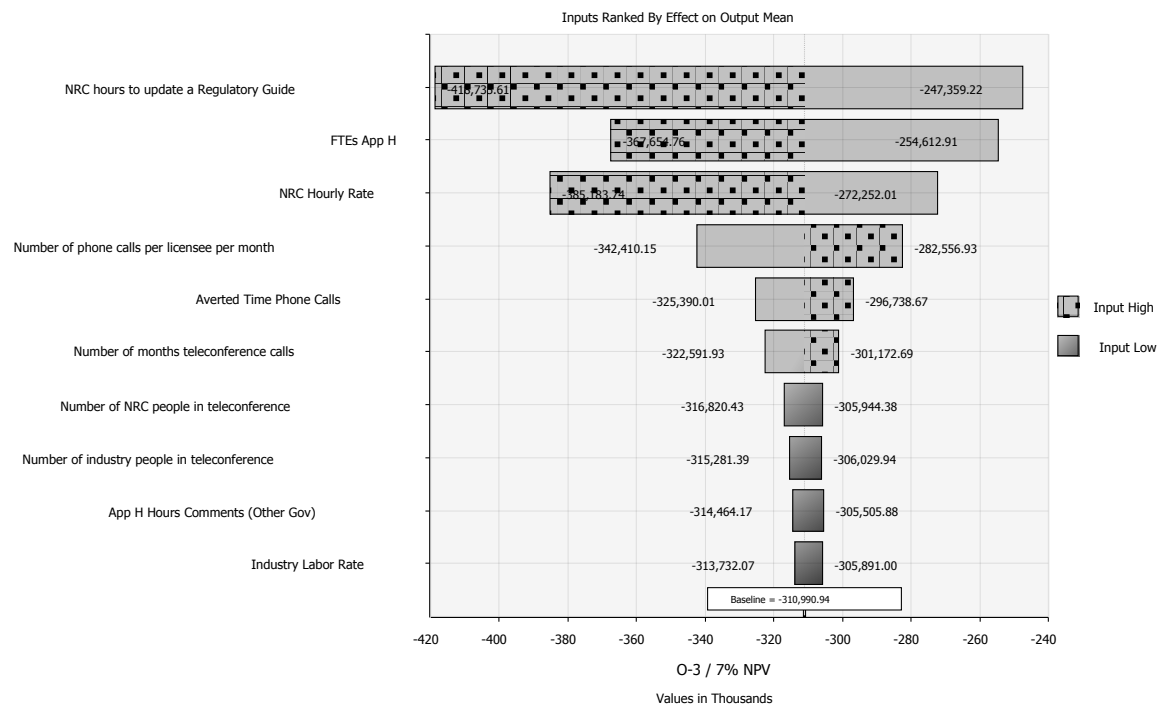


Figure 7 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative O-3)

The regulatory changes to Alternative O-2 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$523,000) to (\$32,000) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of NRC hours to update the regulatory guides.

The regulatory changes to Alternative O-3 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$675,000) to (\$81,000) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of NRC hours to update the regulatory guides.

### 7.11.3 Timeframe Associated with Decommissioning

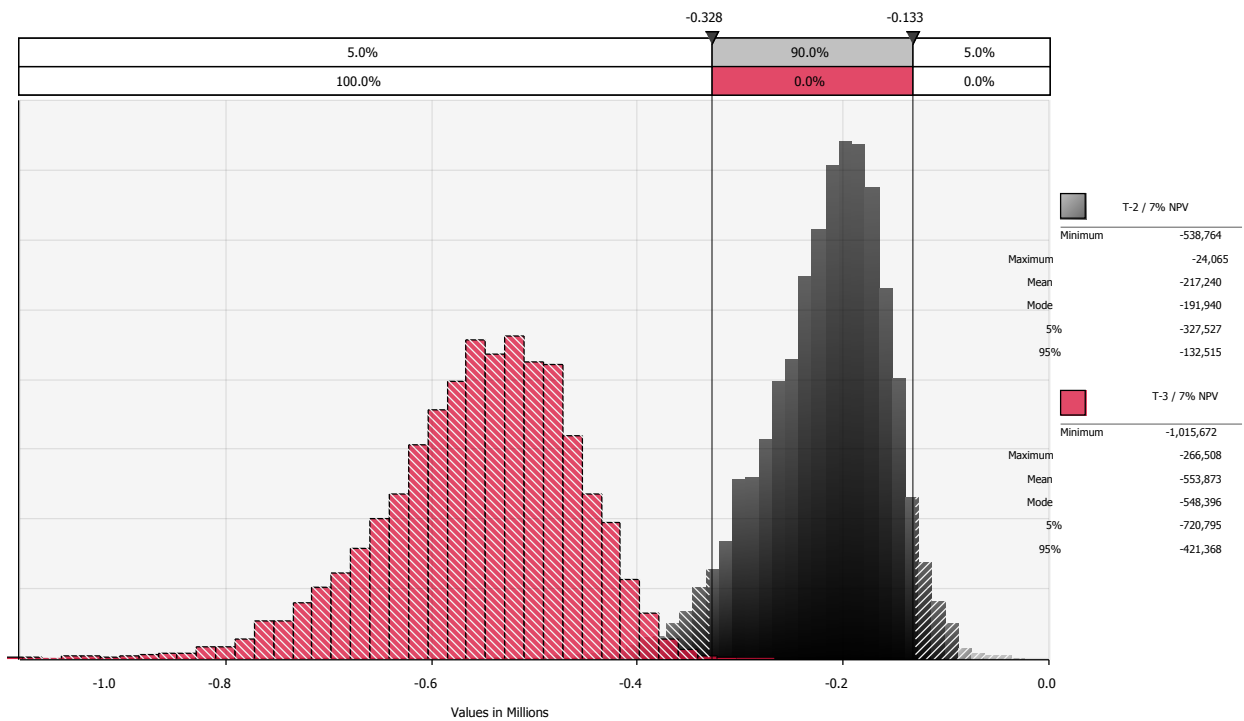


Figure 8 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cost Input variables (Alternatives T-2 to T-3)

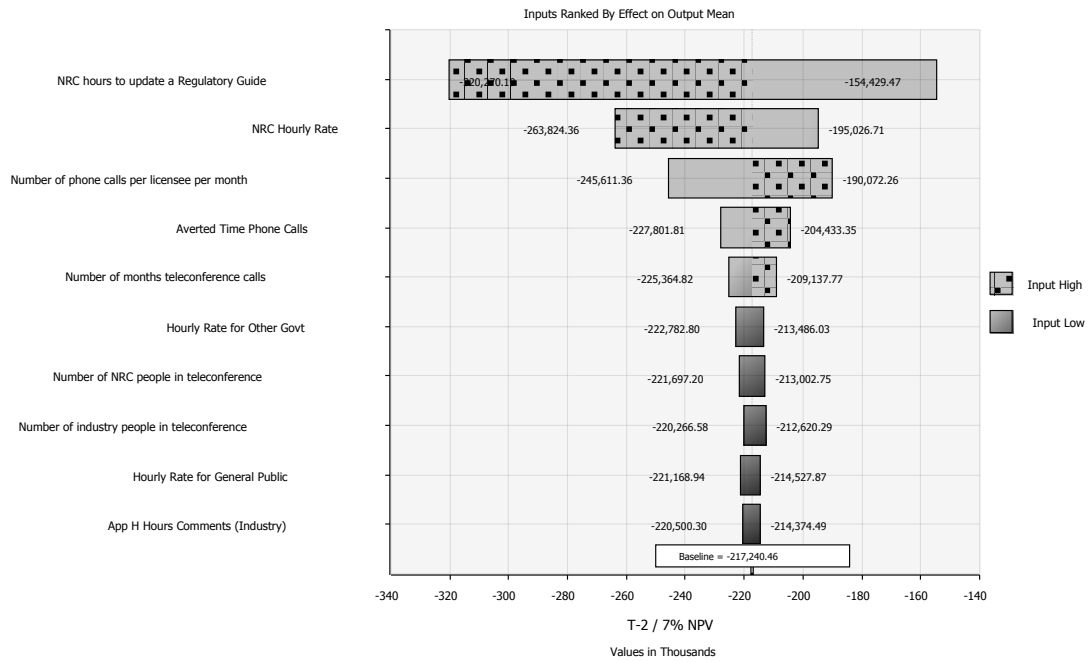


Figure 9 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative T-2)

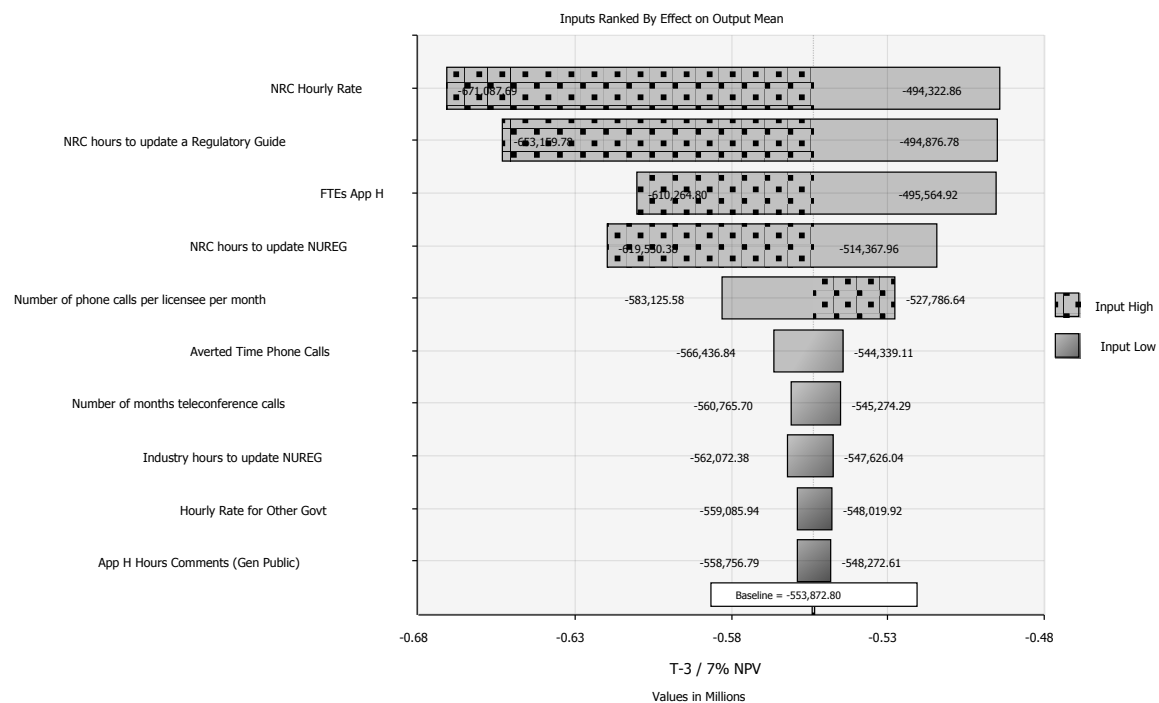


Figure 10 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative T-3)

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The regulatory changes to Alternative T-2 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$539,000) to (\$24,000) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of NRC hours to update the regulatory guides.

The regulatory changes to Alternative T-3 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$1.02 million) to (\$0.27 million) at 7 percent NPV. The cost drivers that have the greatest influence on total cost for this alternative are the NRC labor rate and the number of hours for the NRC to update the regulatory guides that are associated with this alternative.

## 7.11.4 The Role of External Stakeholders in Decommissioning

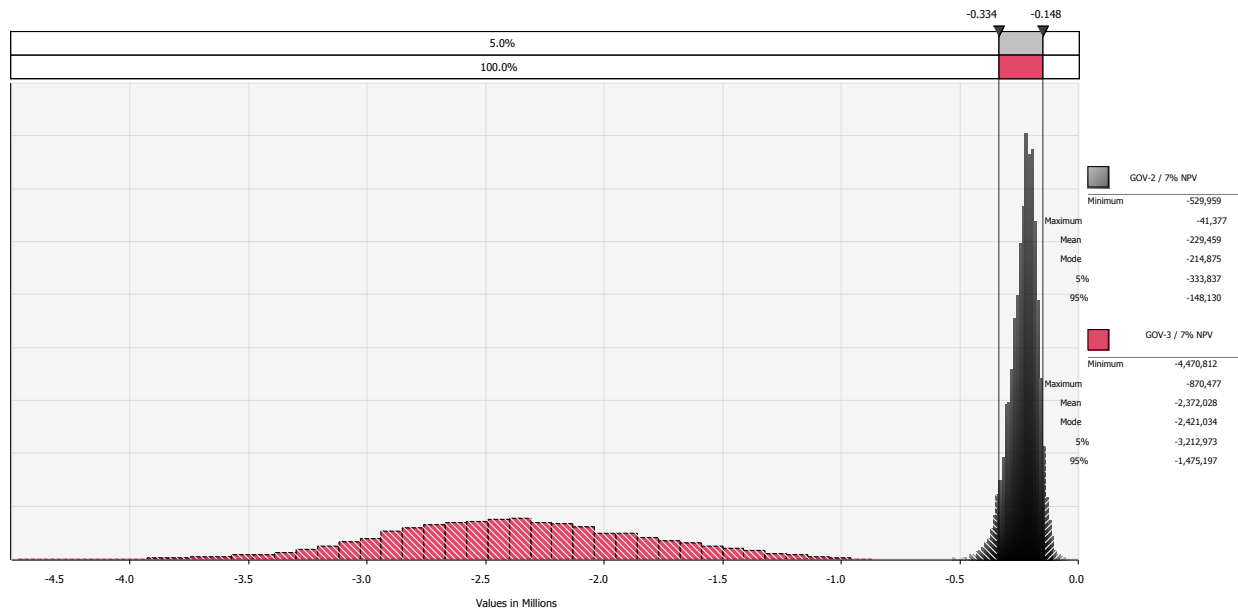


Figure 11 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cost Input variables (Alternatives GOV-2 to GOV-3)

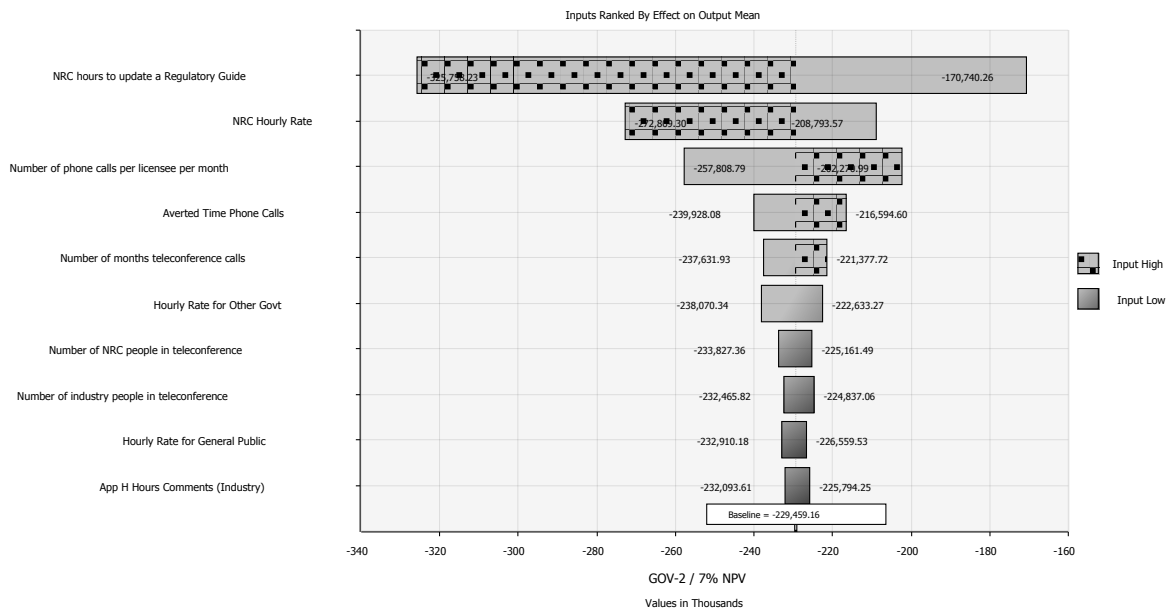


Figure 12 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative GOV-2)



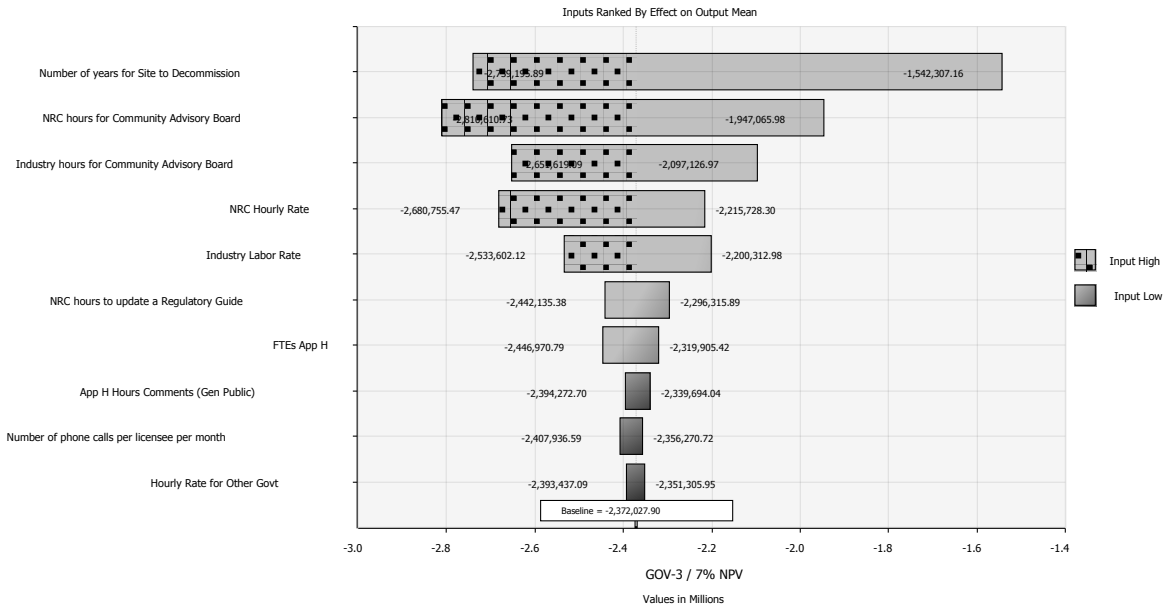


Figure 13 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative GOV-3)

The regulatory changes to Alternative GOV-2 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$530,000) to (\$41,000) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of NRC hours to update the regulatory guides.

The regulatory changes to Alternative O-3 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$4.47 million) to (\$0.87 million) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number years a nuclear site would take to fully decommission.

## 7.11.5 Clarifying the Spent Fuel Management Requirements

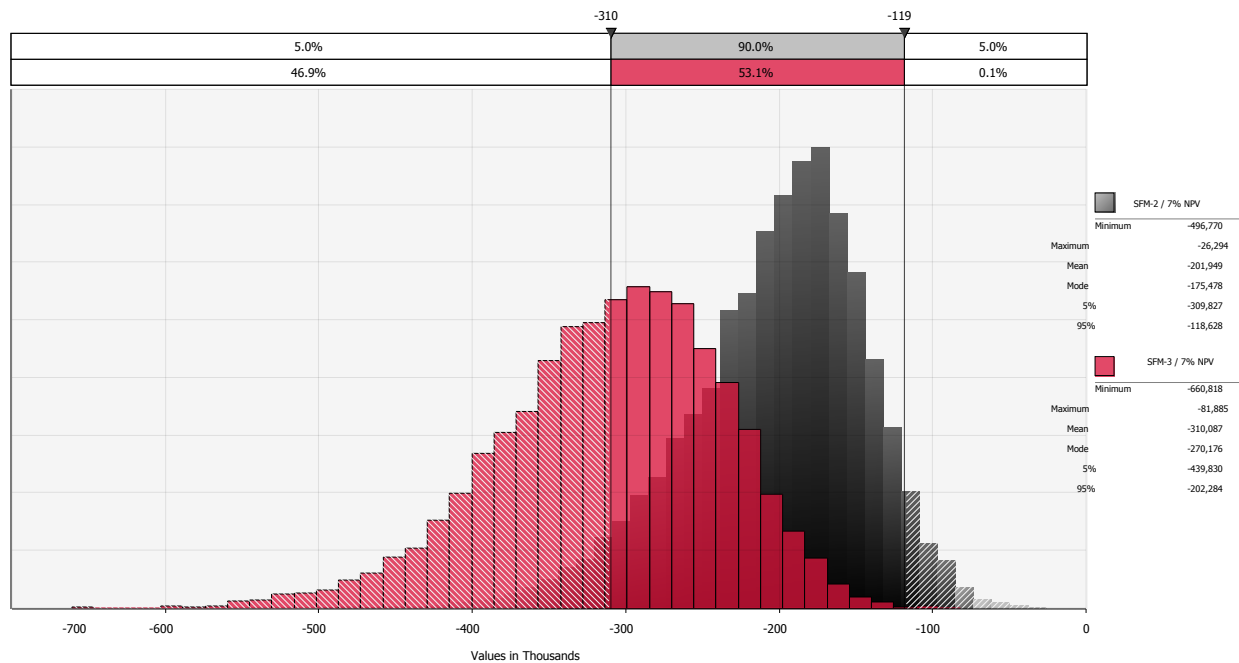


Figure 14 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cost Input variables (Alternatives SFM-2 to SFM-3)

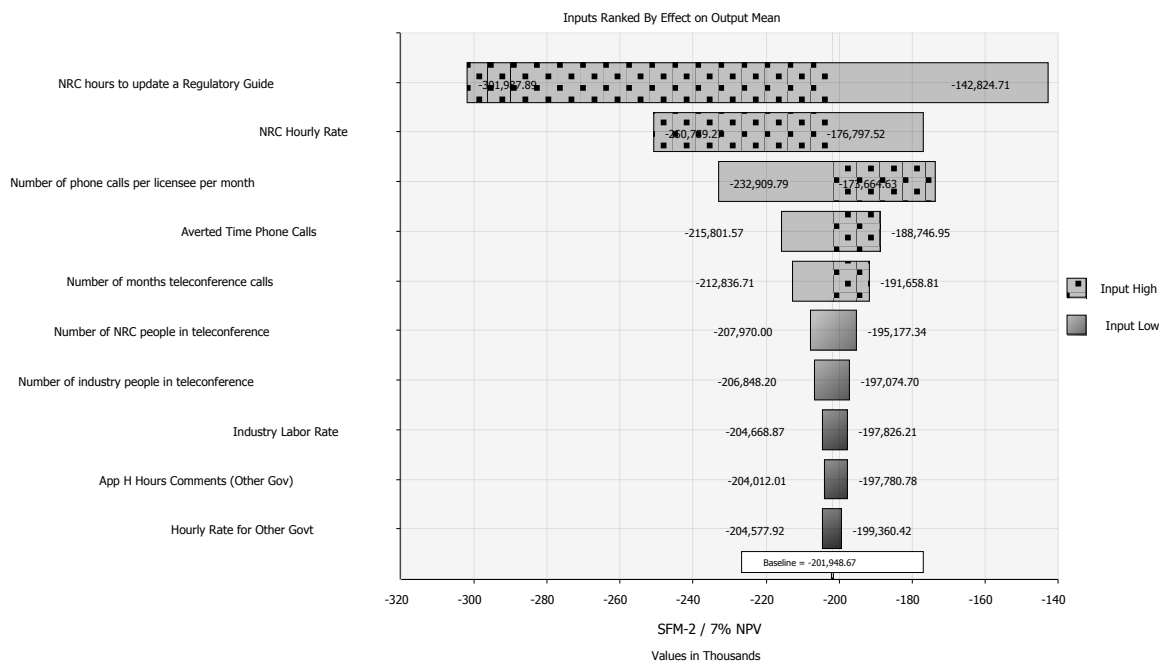


Figure 15 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative SFM-2)

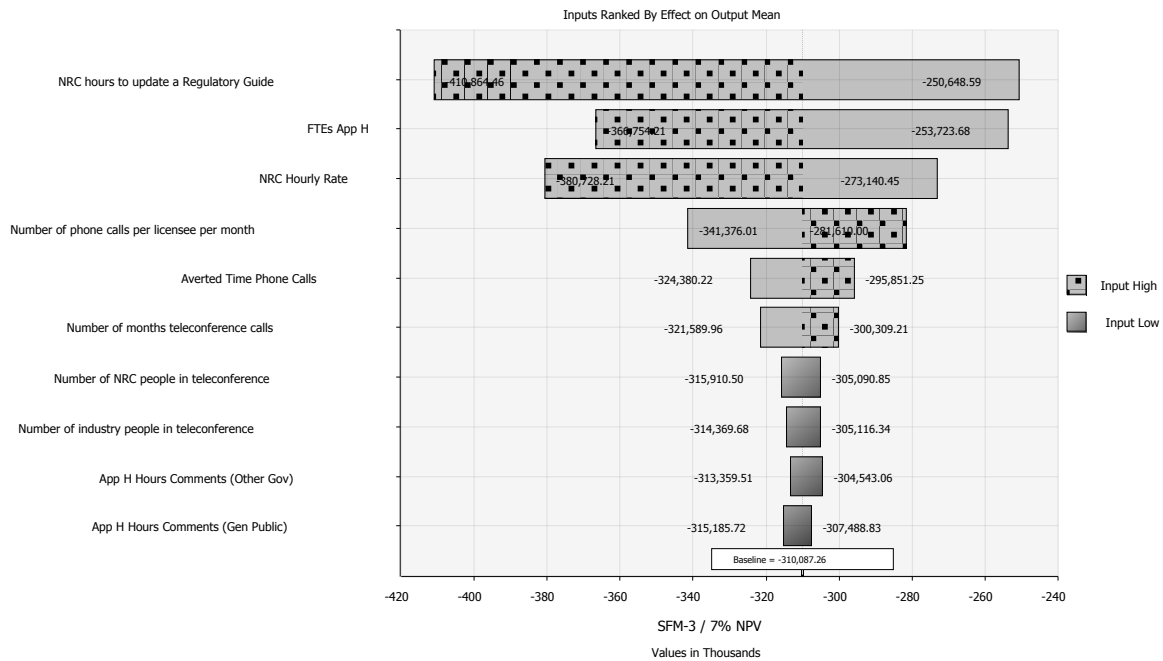


Figure 16 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative SFM-3)

The regulatory changes to Alternative SFM-2 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$497,000) to (\$26,000) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of NRC hours to update the regulatory guides.

The regulatory changes to Alternative O-3 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$661,000) to (\$82,000) at 7 percent NPV. The cost driver that has the greatest influence on total cost for this alternative is the number of NRC hours to update the regulatory guides.

## 7.11.6 Record Retention Requirements

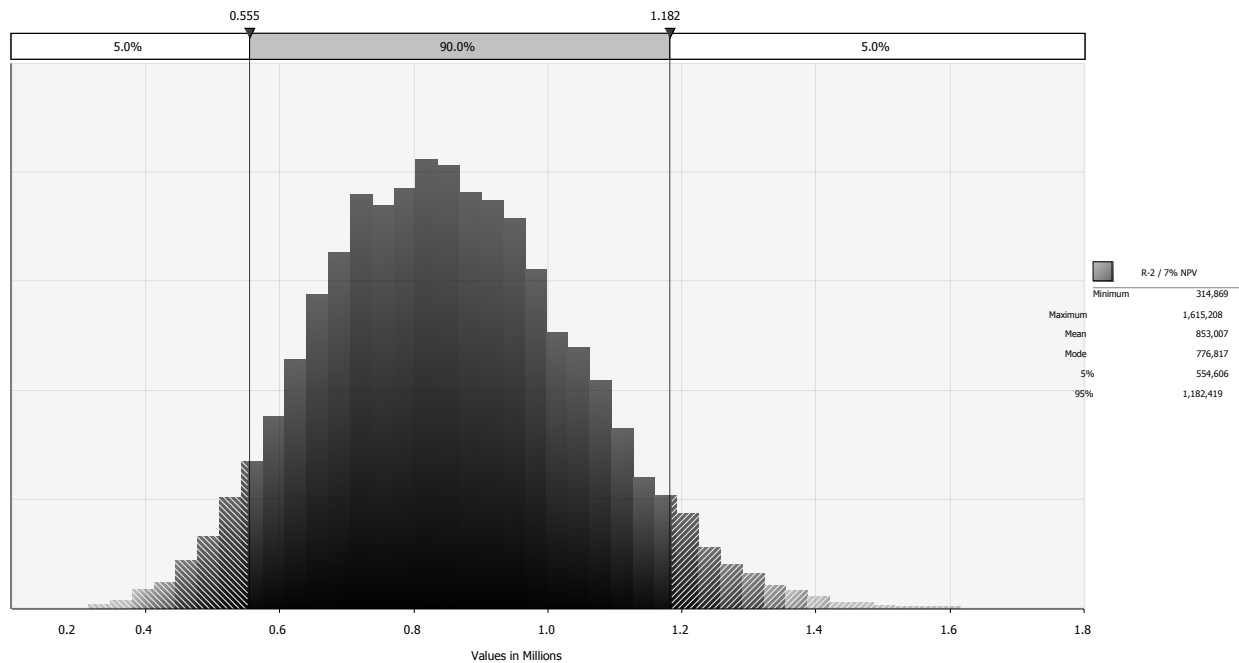


Figure 17 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cost Input variables (Alternatives R-2)

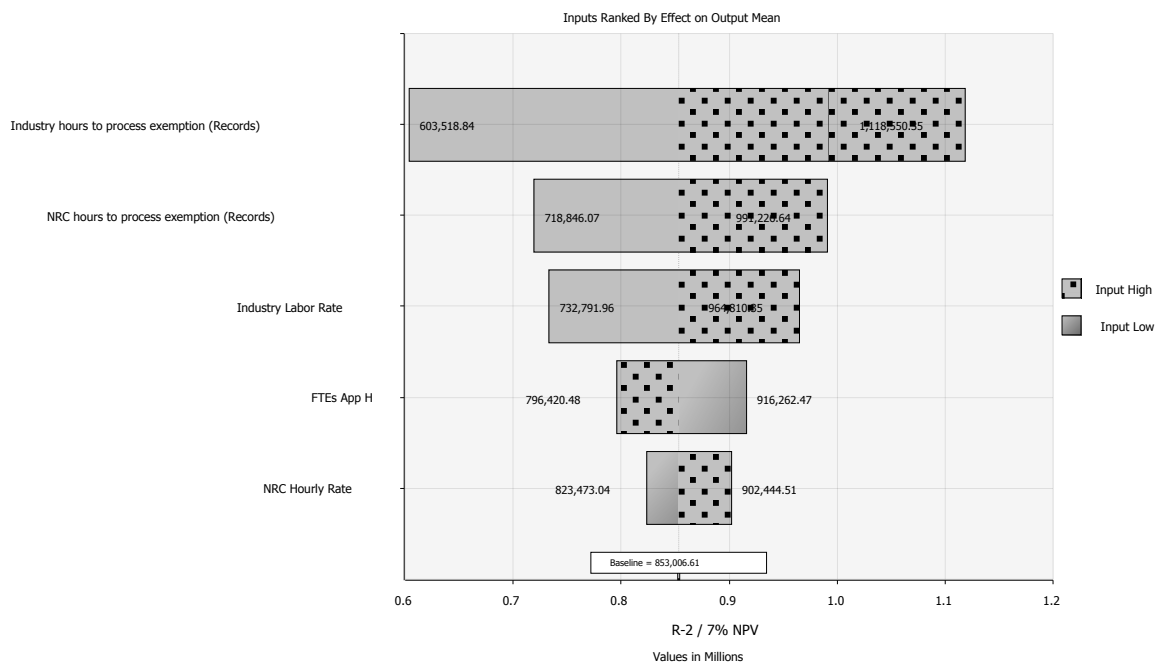


Figure 18 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative R-2)

The regulatory changes to Alternative R-2 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range

of (\$1.62 million) to (\$0.31 million) at 7 percent NPV. The cost drivers that have the greatest influence on total cost for this alternative are the number of hours the NRC and Industry would take to process exemptions.

### 7.11.7 Transportation Investigation, Tracing, and Reporting Requirements

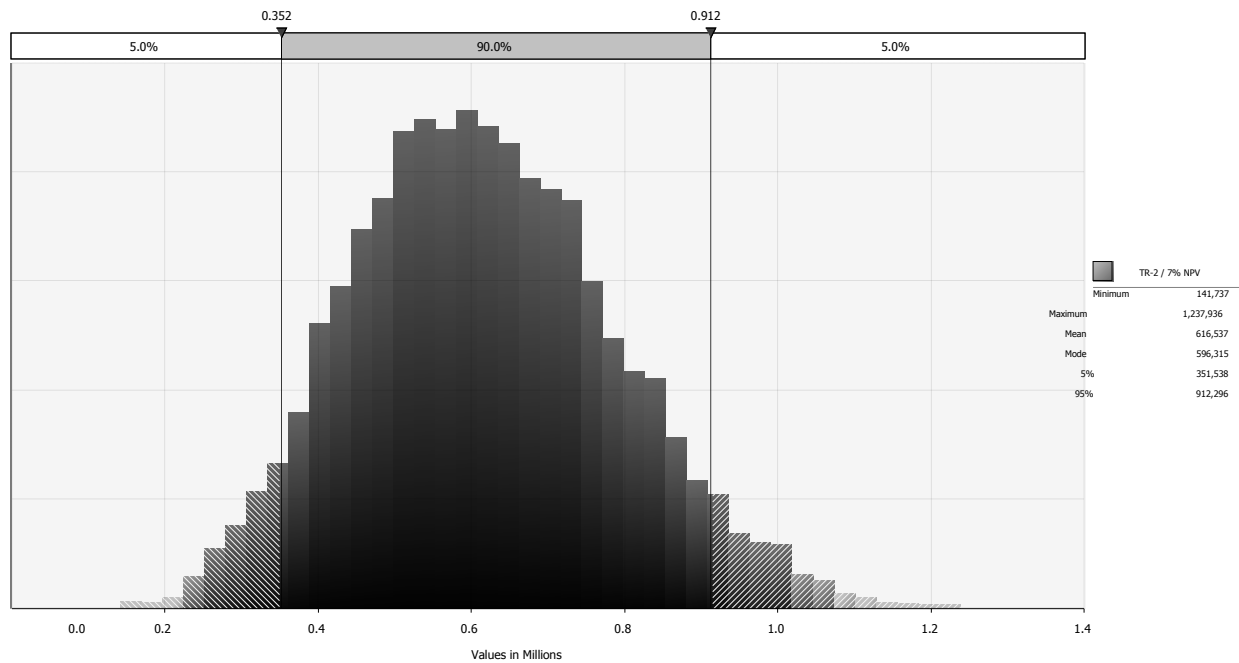


Figure 19 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cost Input variables (Alternatives TR-2)

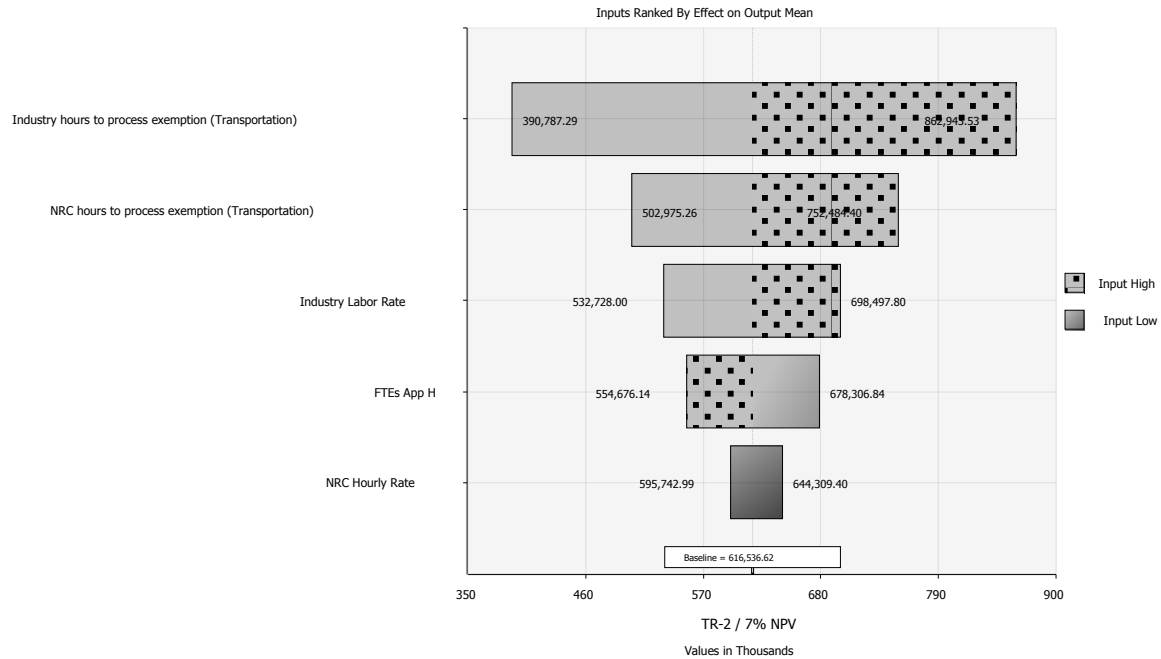


Figure 20 Tornado Chart Showing the Variation of Total Cost due to each Cost Driver (Alternative TR-2)

The regulatory changes to Alternative TR-2 will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$1.24 million) to (\$0.14 million) at 7 percent NPV. The cost drivers that have the greatest influence on total cost for this alternative are the number of hours the NRC and Industry would take to process exemptions.

## 7.11.8 Emergency Preparedness

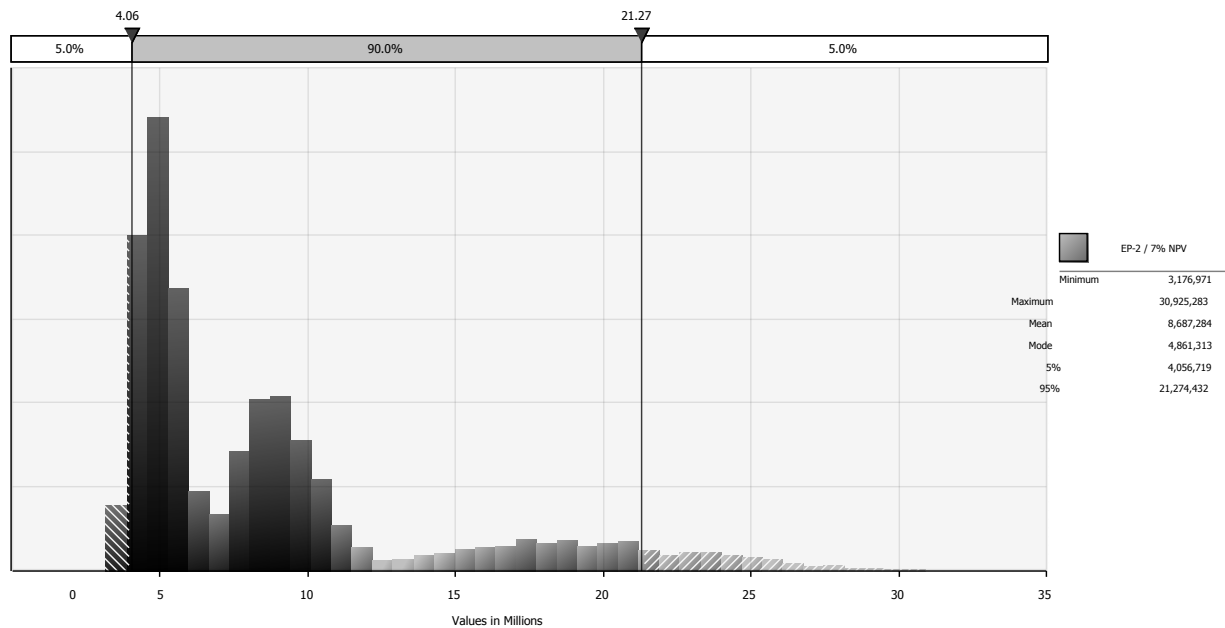


Figure 21 Variation of Industry Cost due to the Uncertainty in the Emergency Preparedness Cost Drivers (Alternative EP-2)

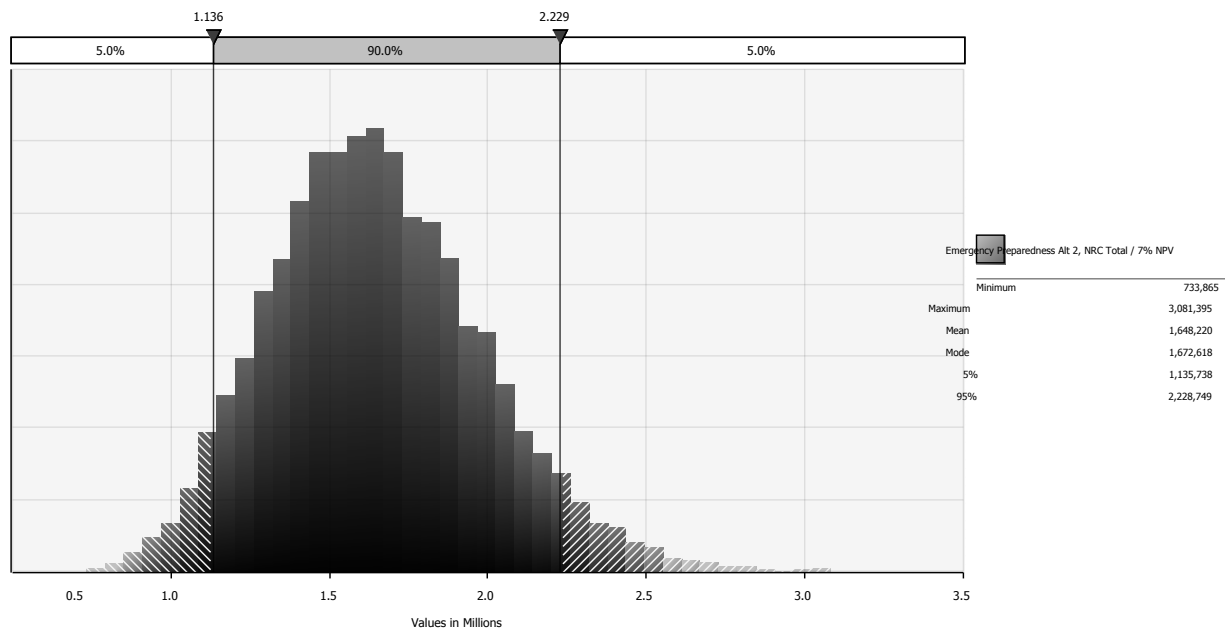


Figure 22 Variation of NRC Cost due to the Uncertainty in the Emergency Preparedness Cost Drivers (Alternative EP-2)

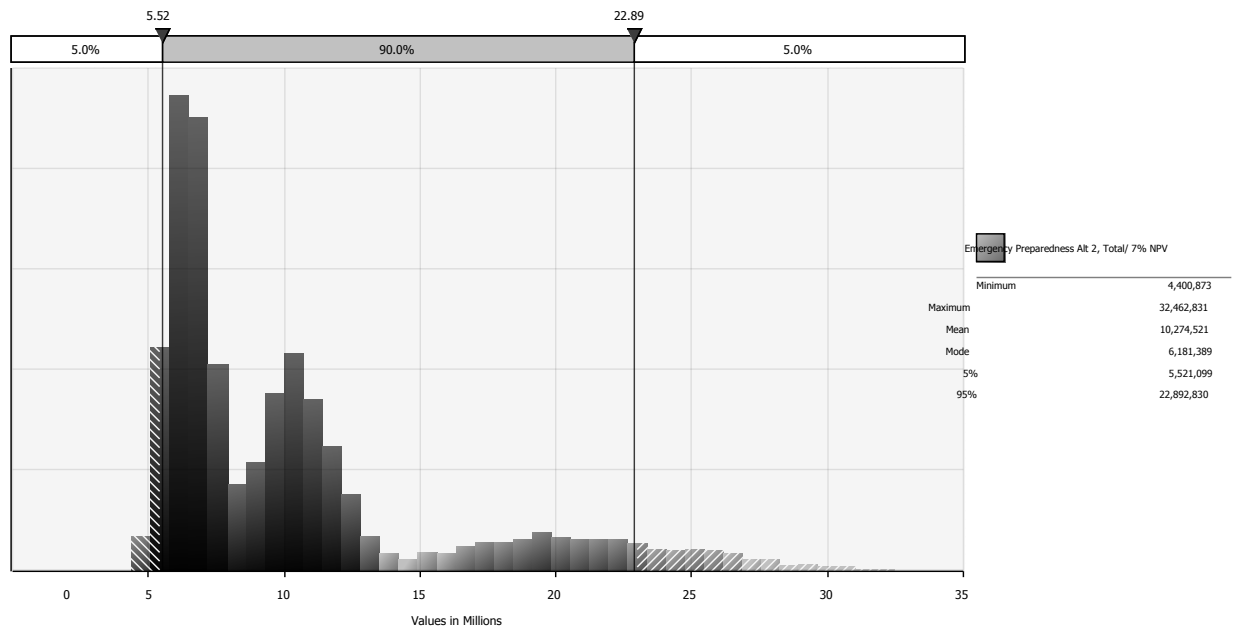


Figure 23 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Emergency Preparedness Cost Drivers (Alternative EP-2)

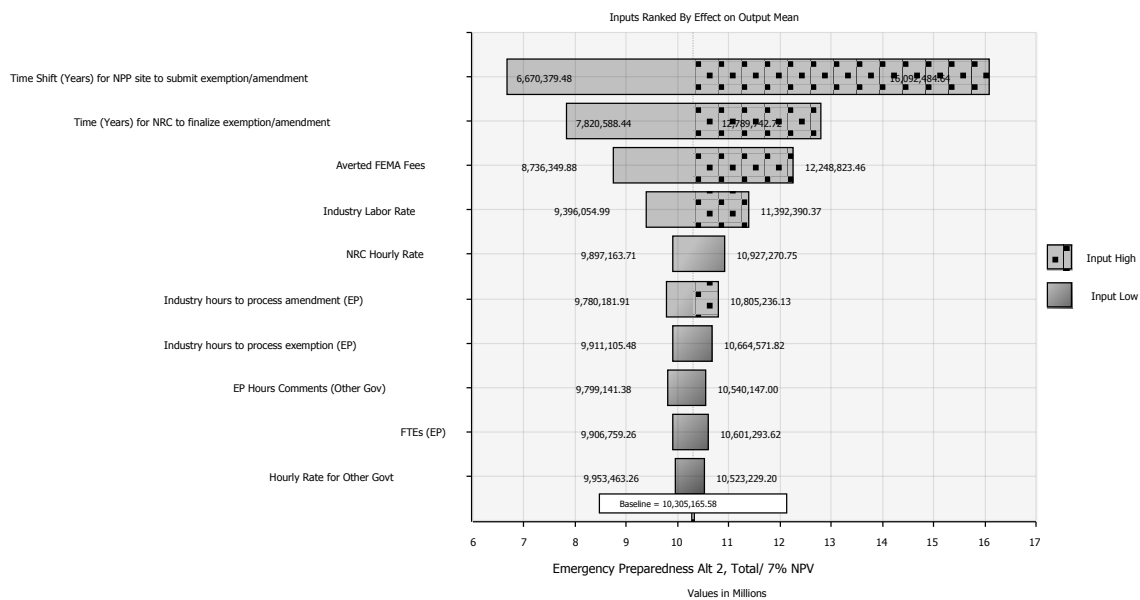


Figure 24 Tornado Chart Showing the Variation of Total Cost due to each Emergency Preparedness Cost Driver (Alternative EP-2)

As shown in Figure 21 through Figure 24, the regulatory changes to the emergency preparedness area of decommissioning for EP-2 would result in averted costs to the nuclear power industry, NRC, other governments and the general public and the NRC over the decommissioning period in the range of \$4.40 million to \$32.46 million (7 percent NPV). The cost drivers that have the greatest influence are the time at which the licensee submits an



exemption or amendment to the NRC for processing (i.e., 1 year before, during, or 1 year after decommissioning) and the time it takes the NRC to finalize the exemption or amendment. Note that the time at which an exemption from offsite emergency preparedness is submitted to the NRC may or may not lead to averted FEMA fees after Level 2. This depends on whether or not the exemption is submitted at or before the starting time of decommissioning. Nevertheless, this possible averted cost is represented by the uncertainty analysis.

### 7.11.9 Physical Security

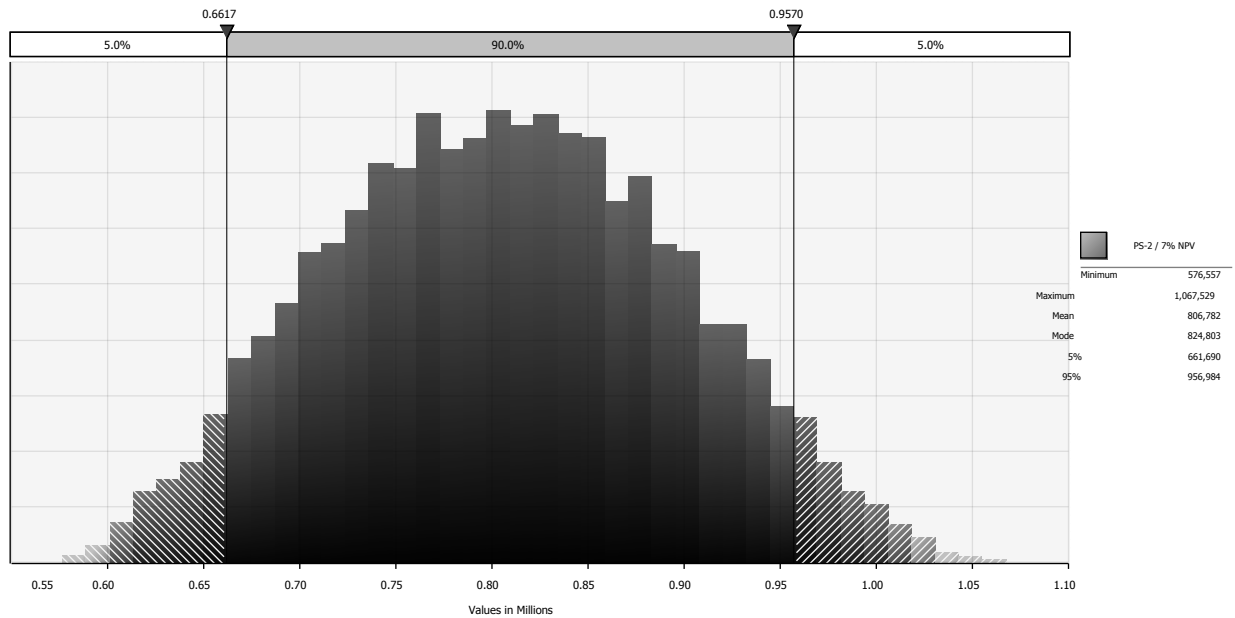


Figure 25 Variation of Industry Cost due to the Uncertainty in the Physical Security Cost Drivers (Alternative PS-2)

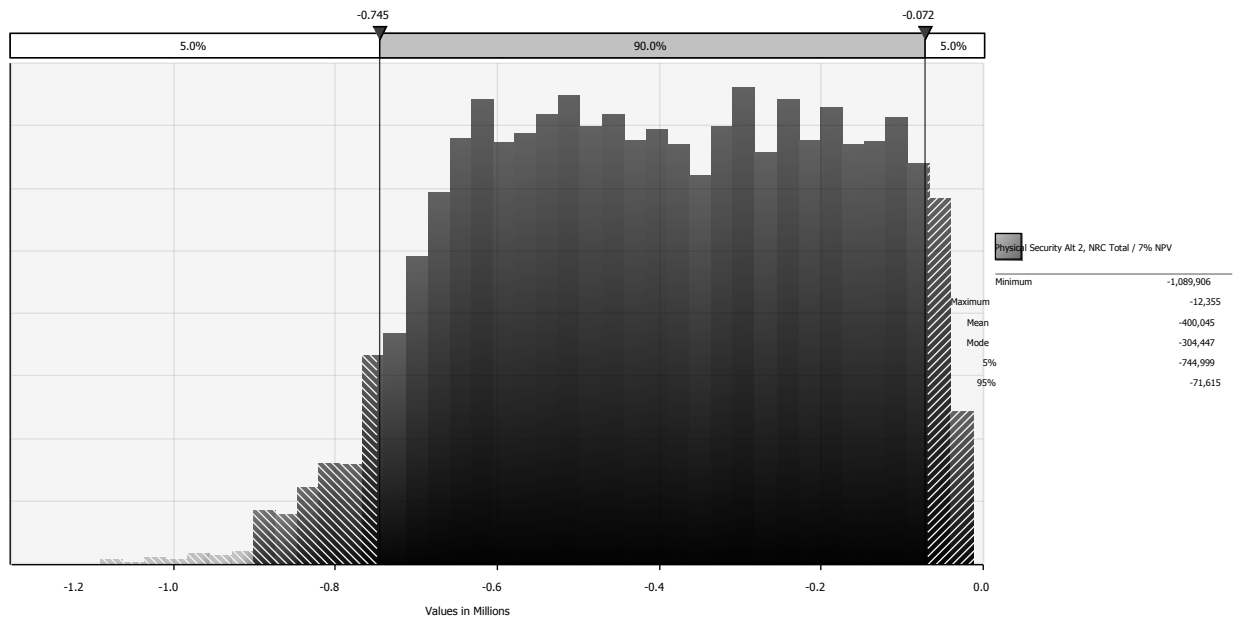


Figure 26 Variation of NRC Cost due to the Uncertainty in the Physical Security Cost Drivers (Alternative PS-2)

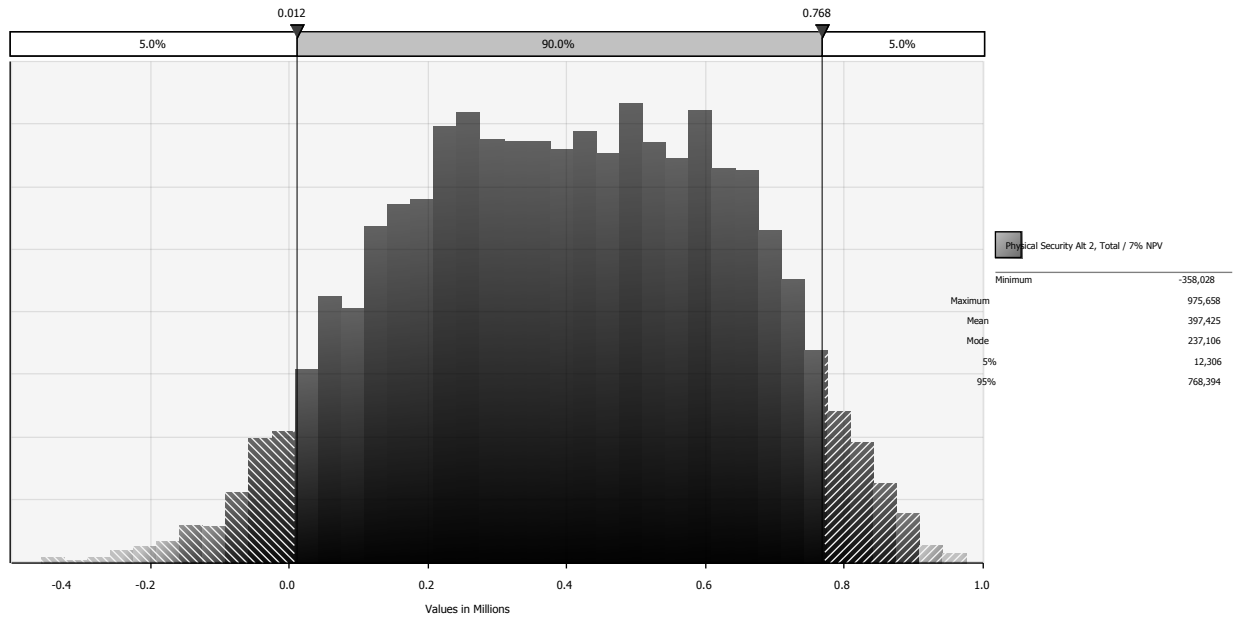


Figure 27 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Physical Security Cost Drivers (Alternative PS-2)

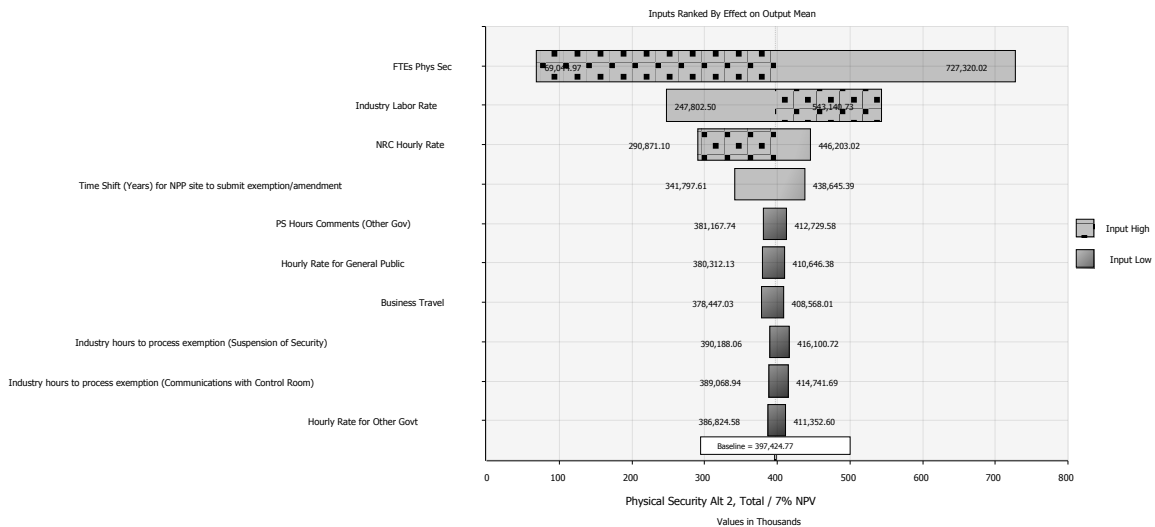


Figure 28 Tornado Chart Showing the Variation of Total Cost due to each Physical Security Cost Driver (Alternative PS-2)

As shown in Figure 25 through Figure 28, the regulatory changes to the physical security area of decommissioning will result in additional or averted costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$358,000) to \$976,000 (7 percent NPV). The cost drivers that have the greatest influence are the number of NRC full-time equivalents (FTEs) to implement rulemaking for this area of

decommissioning and the nuclear power industry labor rate for hours averted to process amendments.

### 7.11.10 Cyber Security

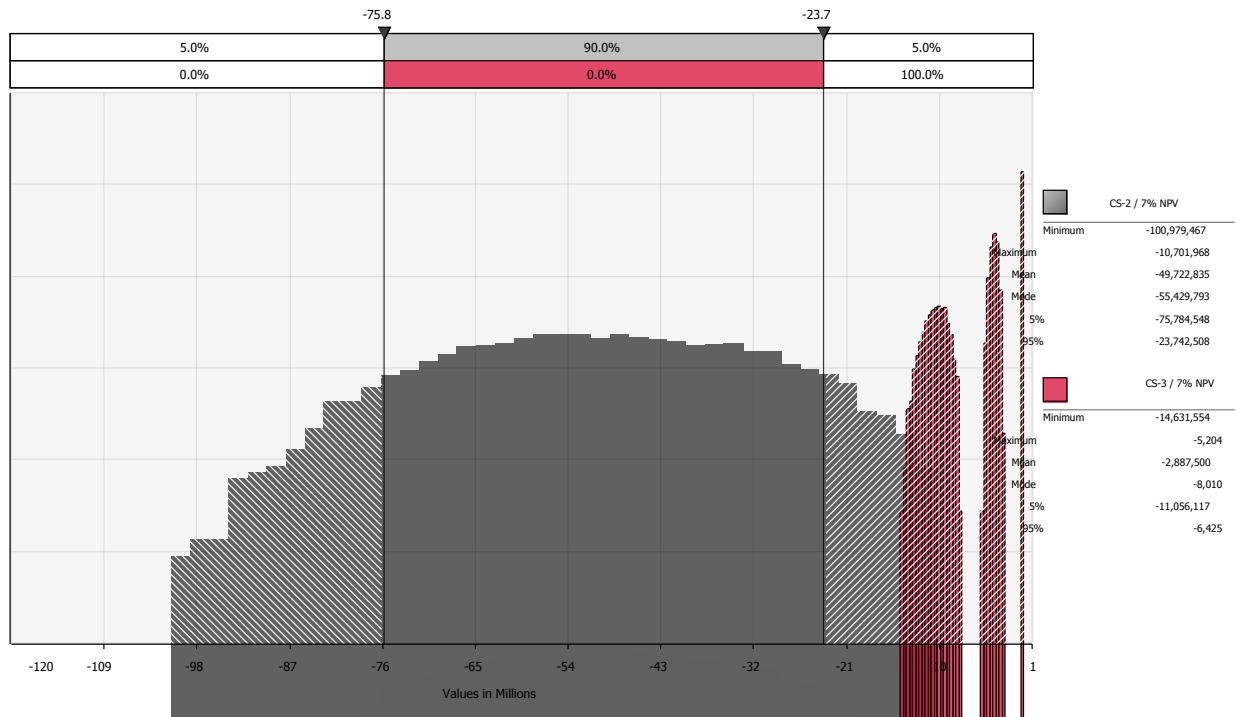


Figure 29 Variation of Industry Cost due to the Uncertainty in the Cyber Security Cost Drivers (Alternatives CS-2 & 3)

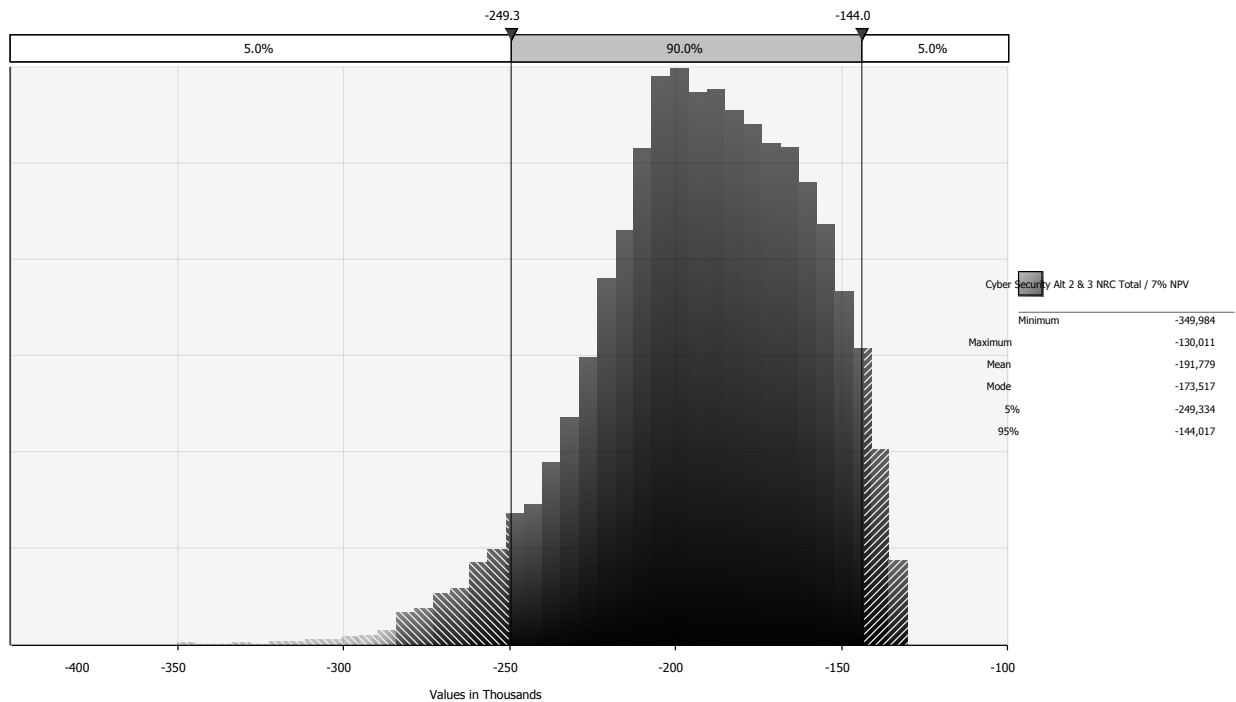


Figure 30 Variation of NRC Cost due to the Uncertainty in the Cyber Security Cost Drivers (Alternatives CS-2 & 3 have the same NRC cost and distribution)

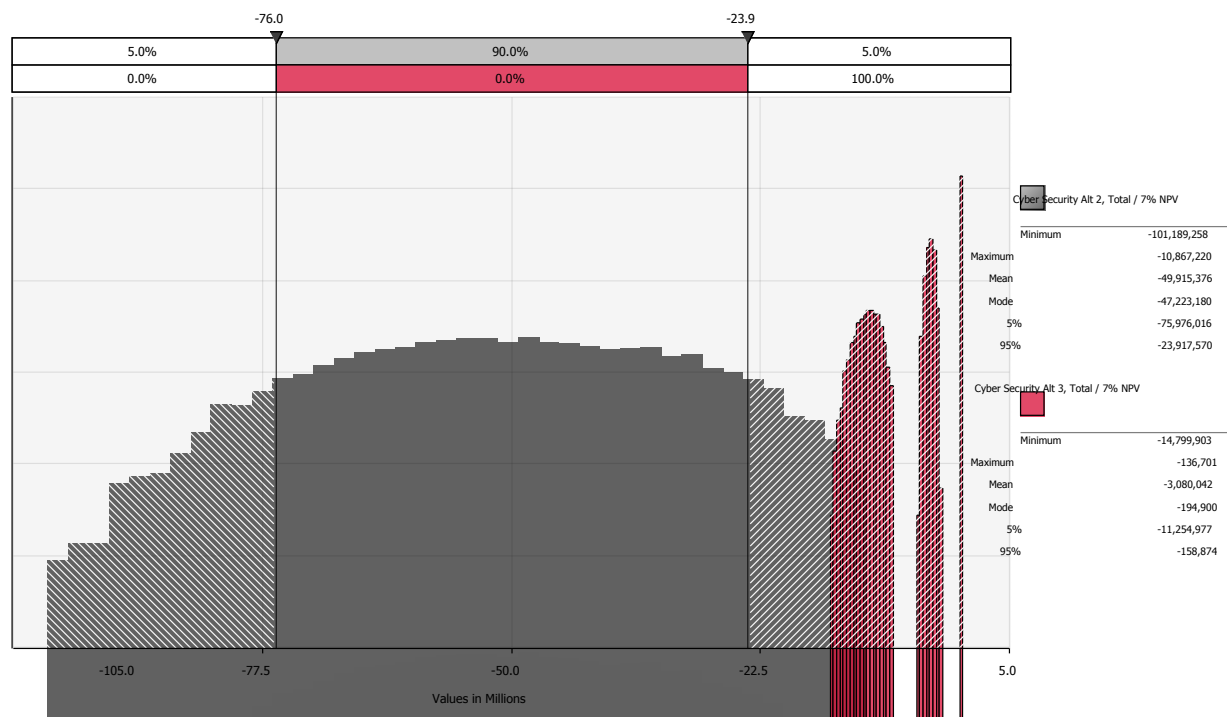


Figure 31 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Cyber Security Cost Drivers (Alternatives CS-2 & 3)

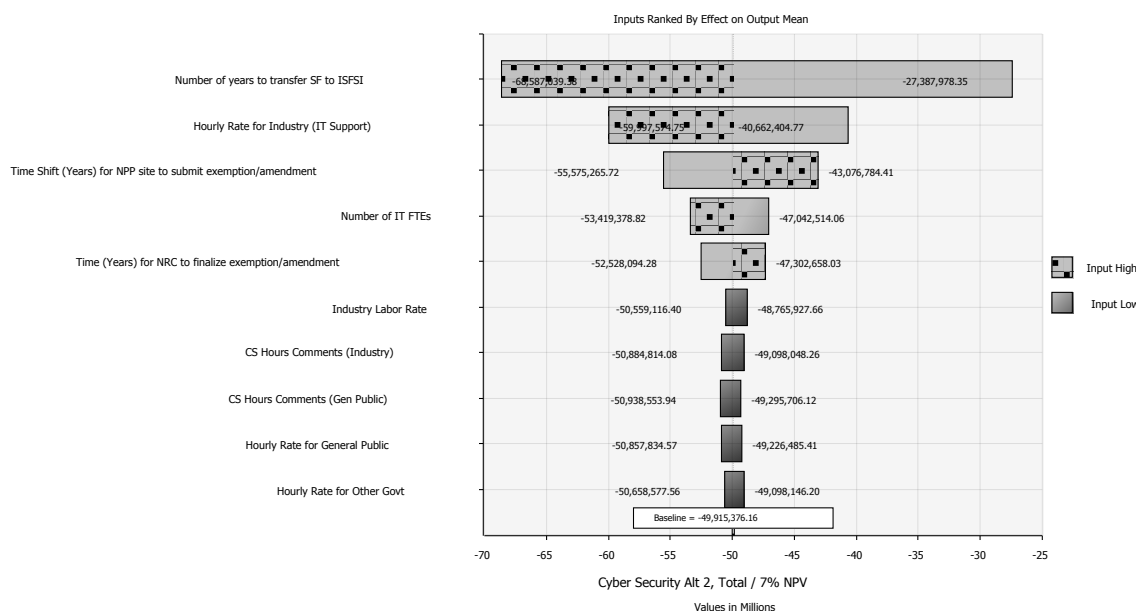


Figure 32 Tornado Chart Showing the Variation of Total Cost due to each Cyber Security Cost Driver (Alternative CS-2)

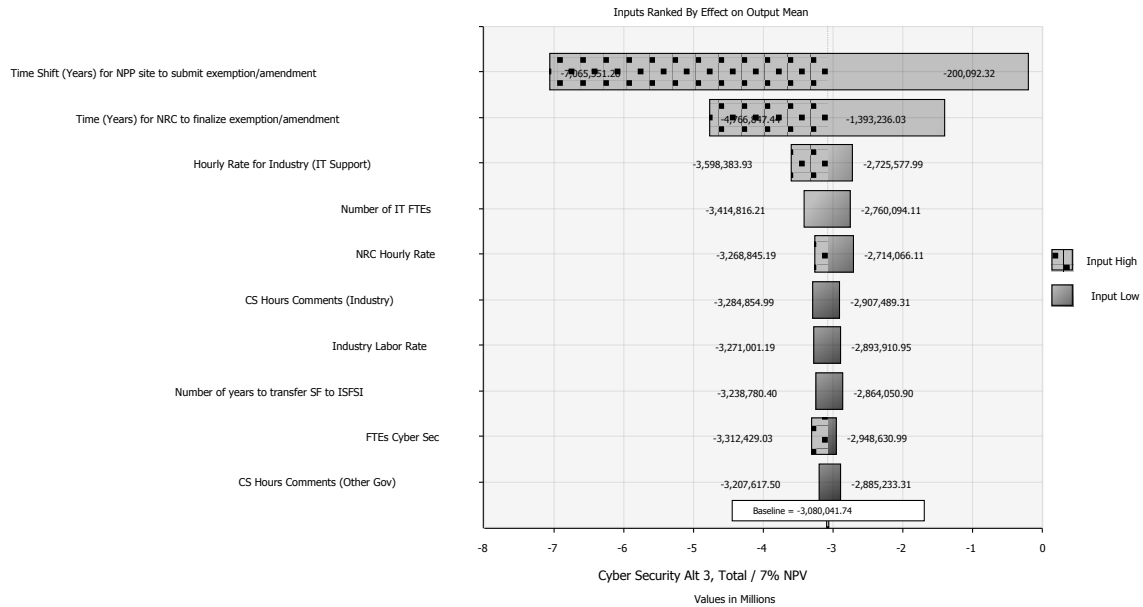


Figure 33 Tornado Chart Showing the Variation of Total Cost due to each Cyber Security Cost Driver (Alternative CS-3)

As shown in Figure 29 through Figure 33, the regulatory changes to the cyber security area of decommissioning (Alternative CS-2) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$101.2 million) to (\$10.9 million) at 7 percent NPV. The cost drivers that have the greatest influence on total cost are the number years to transfer all spent fuel to ISFSI and the hourly rate of IT staff personnel responsible for cyber security.

The recommended regulatory changes to the cyber security area of decommissioning (Alternative CS-3) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$14.8 million) to (\$0.14 million) at 7 percent NPV. The cost drivers that have the greatest influence are the time at which the licensee submits an exemption or amendment to the NRC for processing (i.e., 1 year before, during, or 1 year after decommissioning) and the time it takes the NRC to finalize the exemption or amendment.

## 7.11.11 Fitness for Duty—Drug and Alcohol Testing

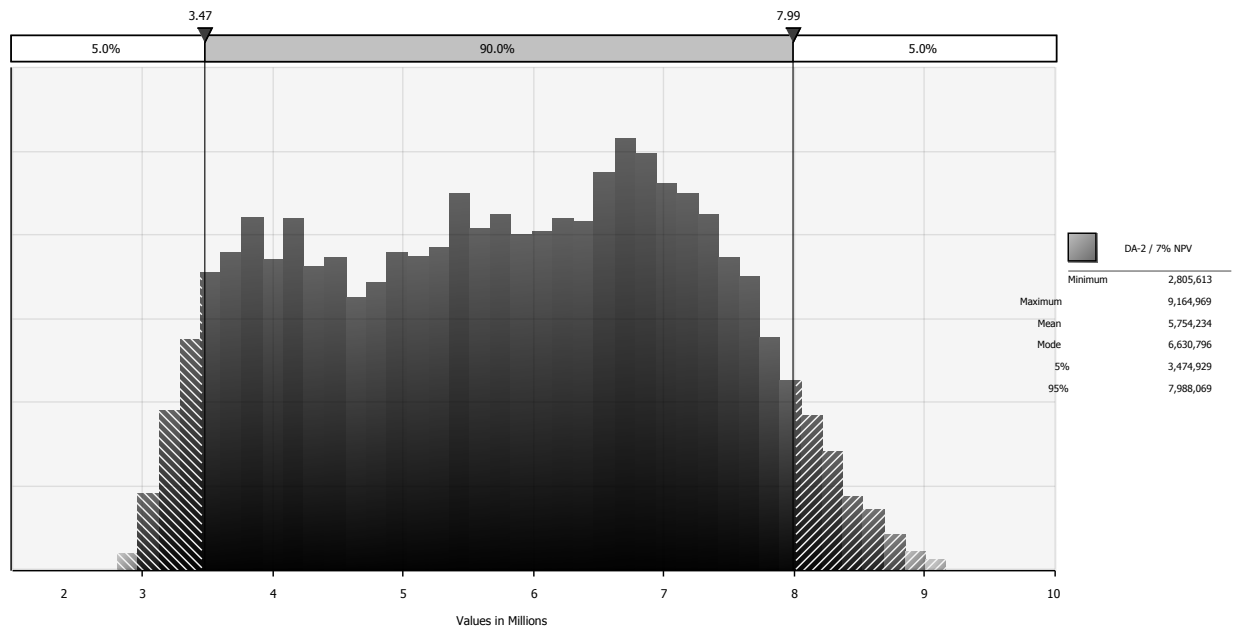


Figure 34 Variation of Industry Cost due to the Uncertainty in the Drug and Alcohol Testing Cost Drivers (Alternatives DA-2)

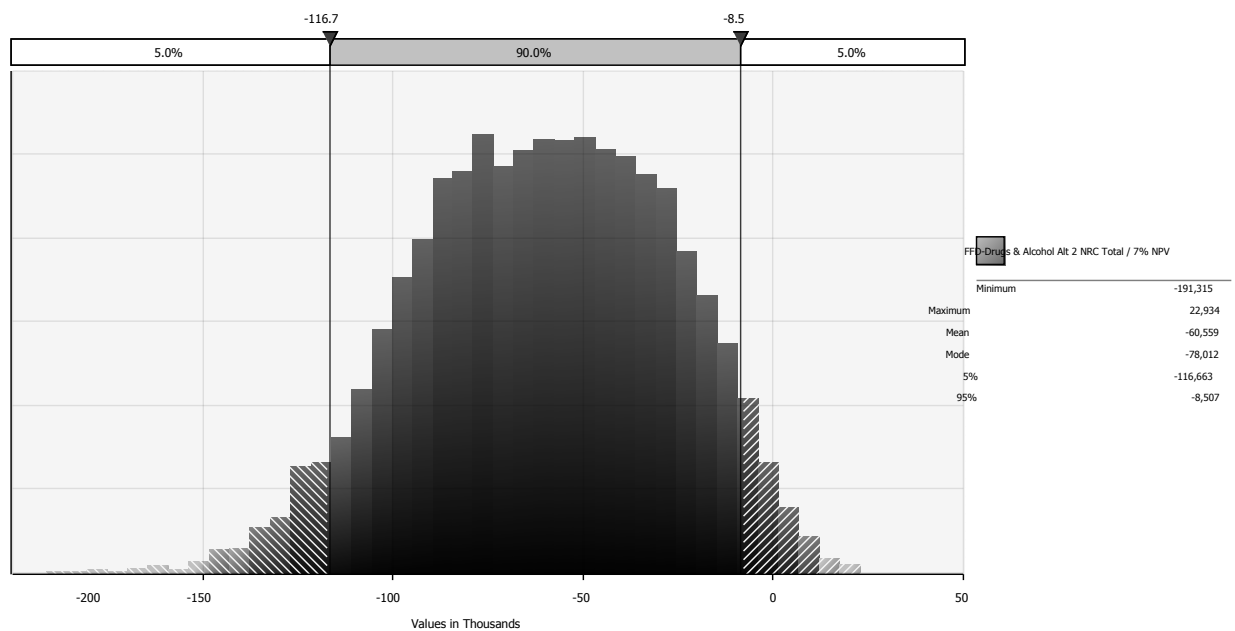


Figure 35 Variation of NRC Cost due to the Uncertainty in the Drug and Alcohol Testing Cost Drivers (Alternatives DA-2)

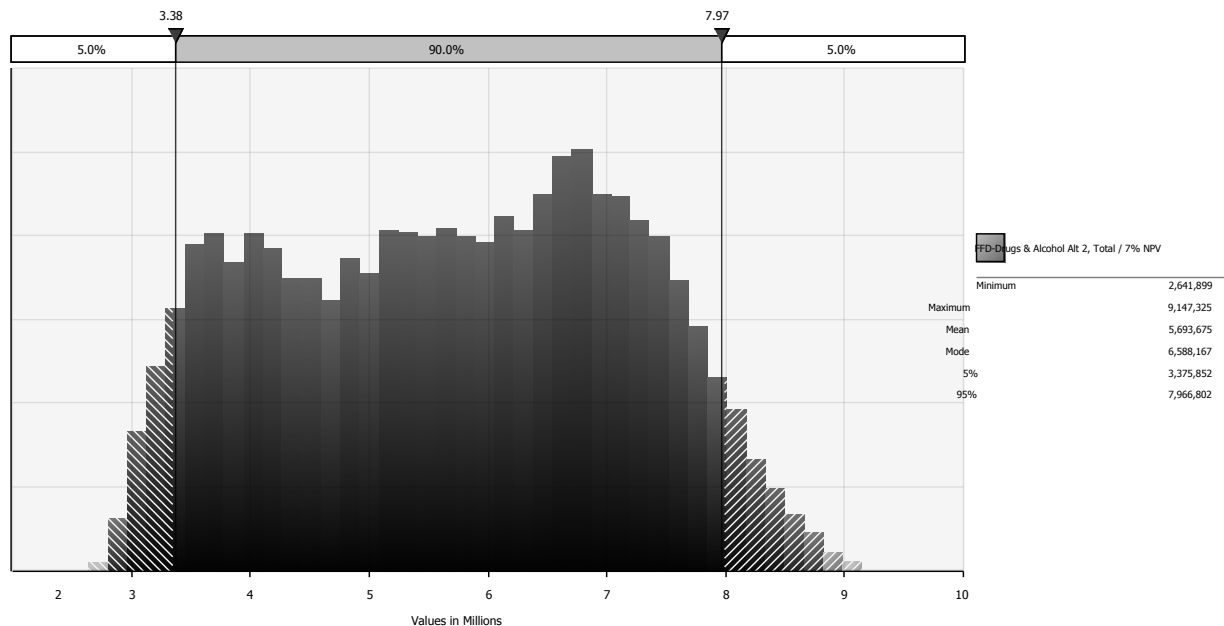


Figure 36 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Drug and Alcohol Testing Cost Drivers (Alternatives DA-2)

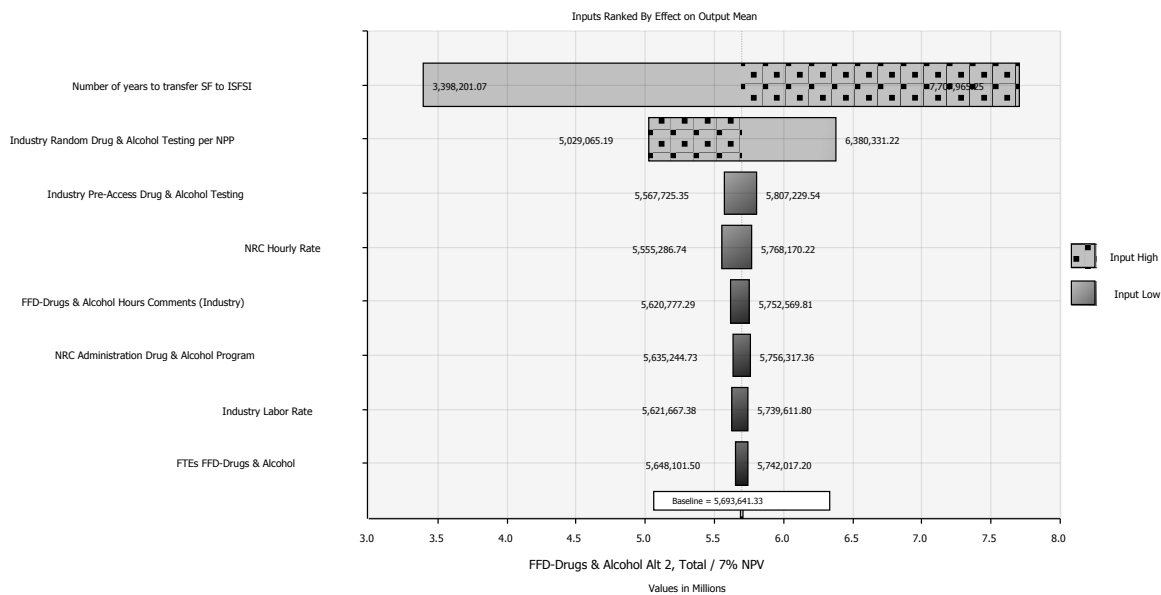


Figure 37 Tornado Chart Showing the Variation of Total Cost due to each Drug and Alcohol Testing Cost Driver (Alternative DA-2)

As shown in Figure 34 through Figure 37, the regulatory changes to the FFD-drug and alcohol testing area of decommissioning (Alternative DA-2) will result in averted costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of \$2.6 million to \$9.1 million using a 7 percent NPV. The cost drivers that have the greatest influence on total cost are the number of years to transfer spent fuel to ISFSI and the random drug and alcohol testing.

## 7.11.12 Fitness for Duty—Fatigue

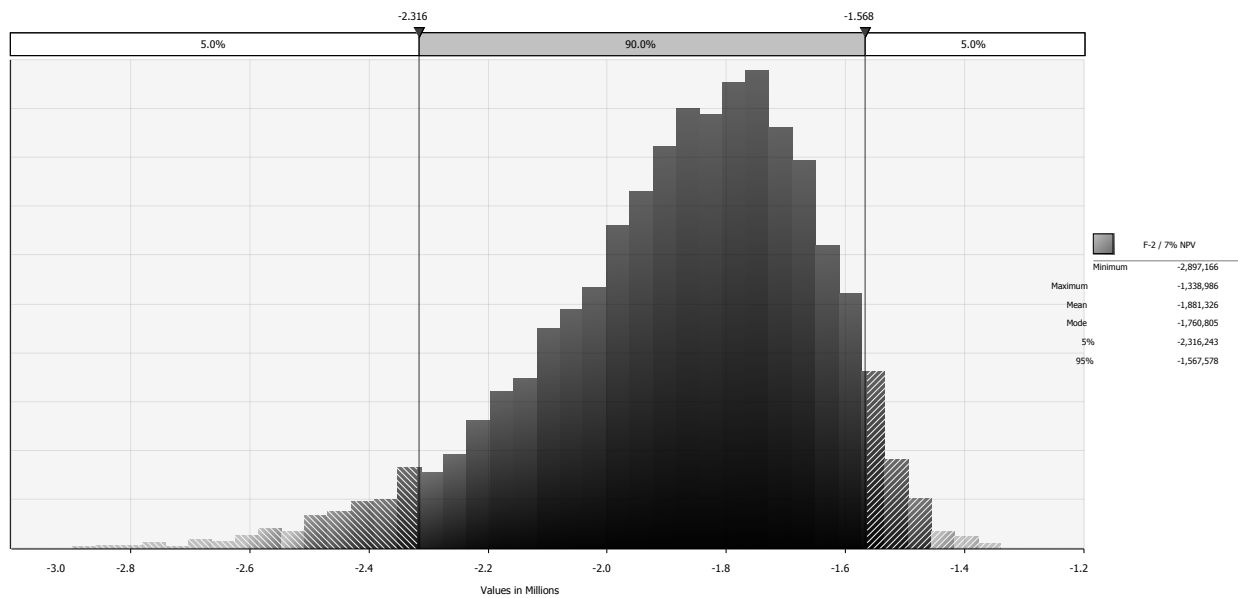


Figure 38 Variation of the Industry Cost due to the uncertainty in the Fatigue Cost Drivers (Alternatives F-2 and 3)

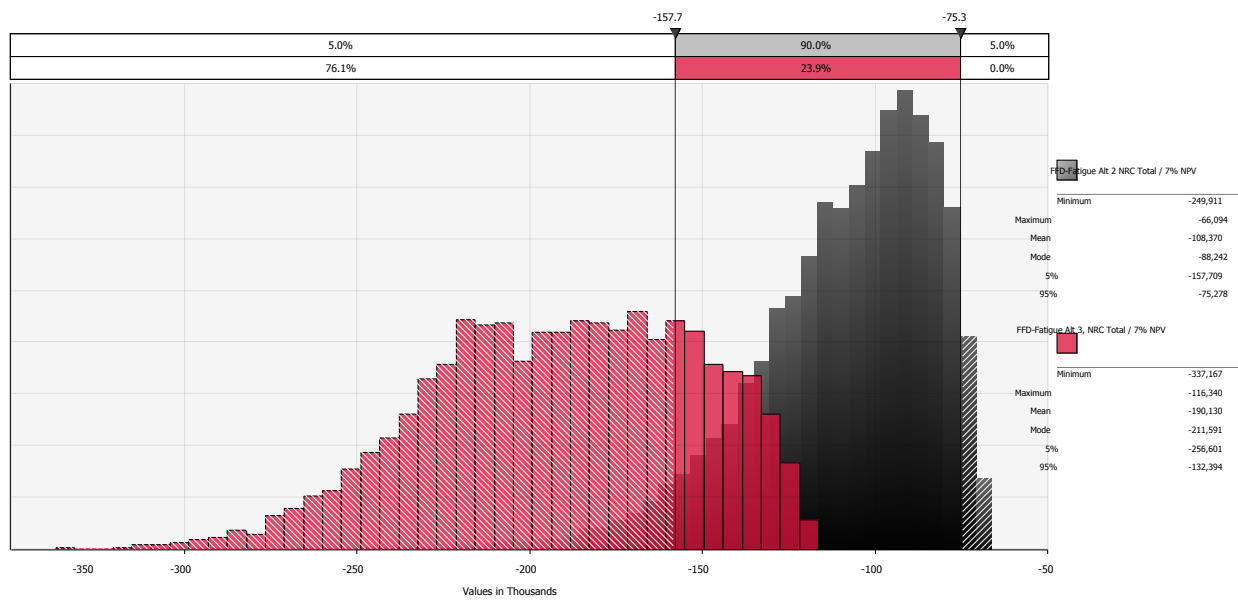


Figure 39 Variation of the NRC Cost due to the uncertainty in the Fatigue Cost Drivers (Alternative F-3)



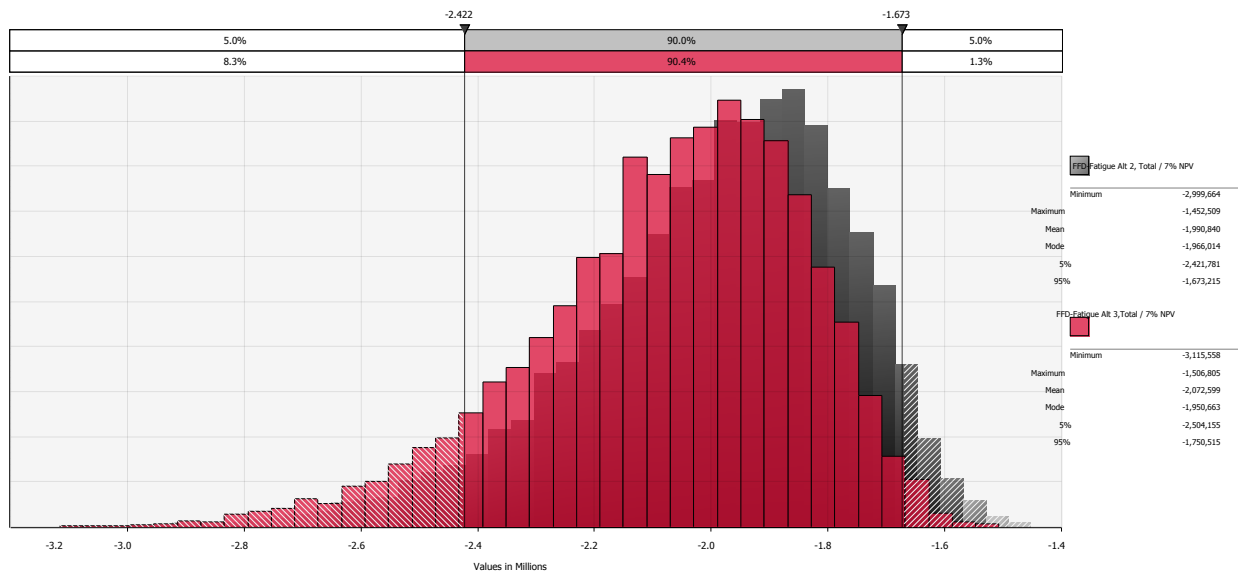


Figure 40 Variation of the Total Cost (Industry, NRC, Other Governments and General Public) due to the uncertainty in the Fatigue Cost Drivers (Alternatives F-2 and 3)

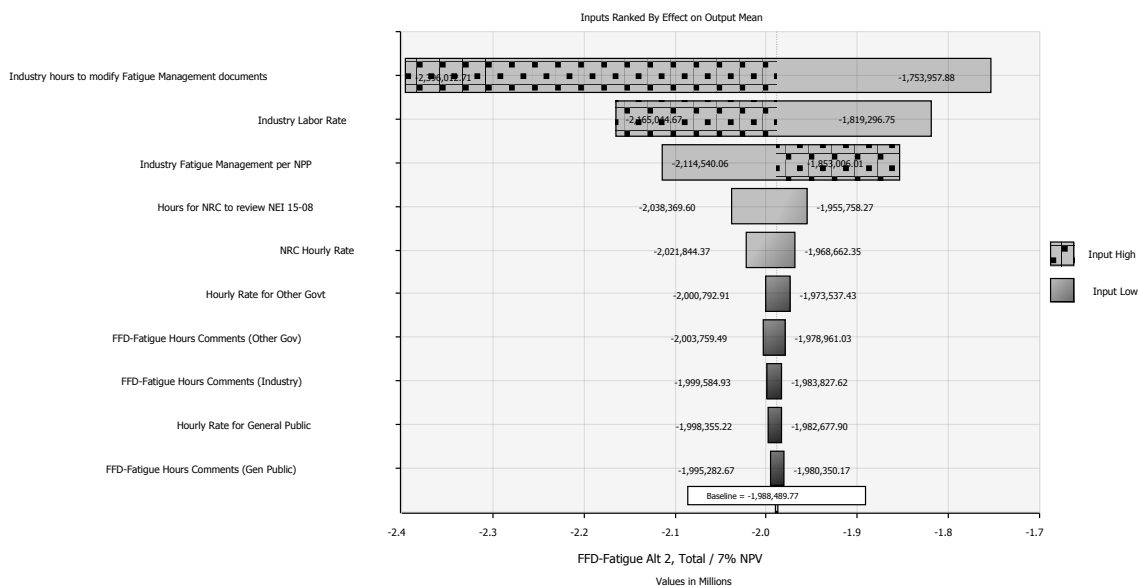
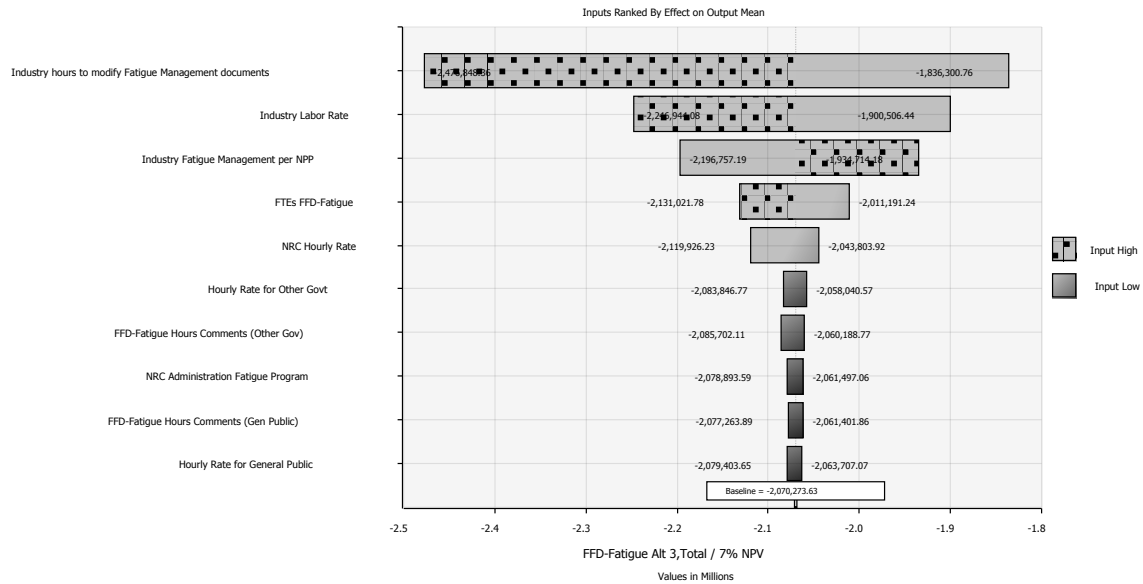


Figure 41 Tornado Chart Showing the Variation of Total Cost due to each Fatigue Cost Driver (Alternative F-2)



**Figure 42 Tornado Chart Showing the Variation of Total Cost due to each Fatigue Cost Driver (Alternative F-3)**

As shown in Figure 38 through Figure 42, the regulatory changes to the FFD—fatigue area of decommissioning (Alternative F-2) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period of approximately (\$3.00 million) to (\$1.45 million) using a 7 percent NPV. The cost driver that has the greatest influence is the number of hours spent by industry to modify the documents for fatigue management.

The regulatory changes to the FFD—fatigue area of decommissioning (Alternative F-3) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period of approximately (\$3.12 million) to (\$1.51 million) using a 7 percent NPV. The cost driver that has the greatest influence on total cost is the number of hours spent by industry to modify the documents for fatigue management.

### 7.11.13 Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers

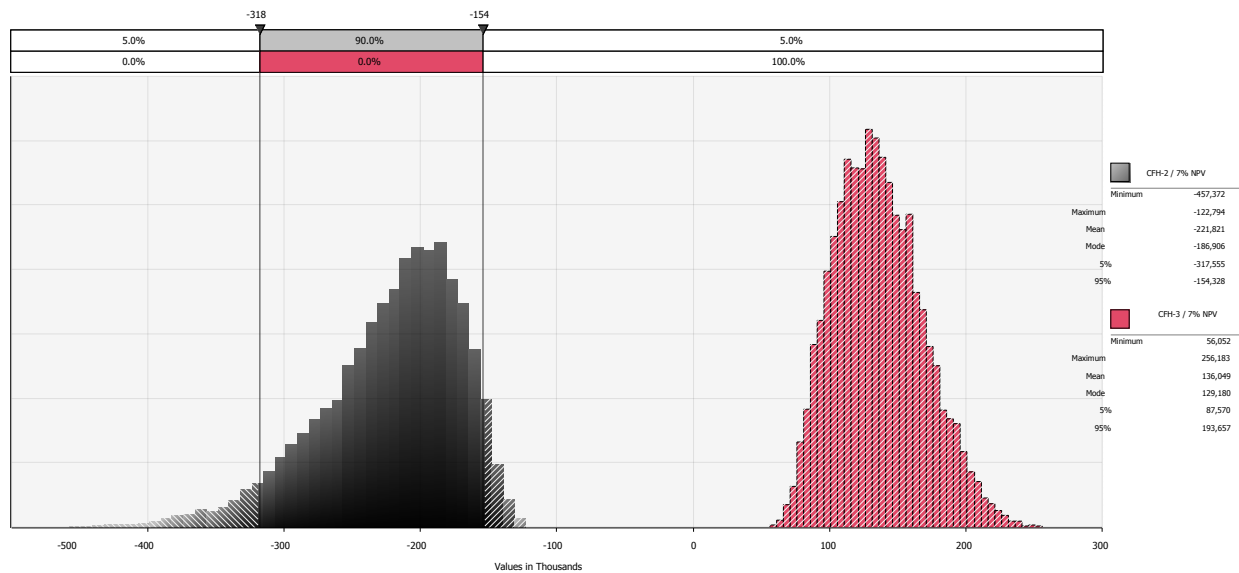


Figure 43 Variation of Industry Cost due to the Uncertainty in the Certified Fuel Handler Cost Drivers (Alternatives CFH-2 and 3)

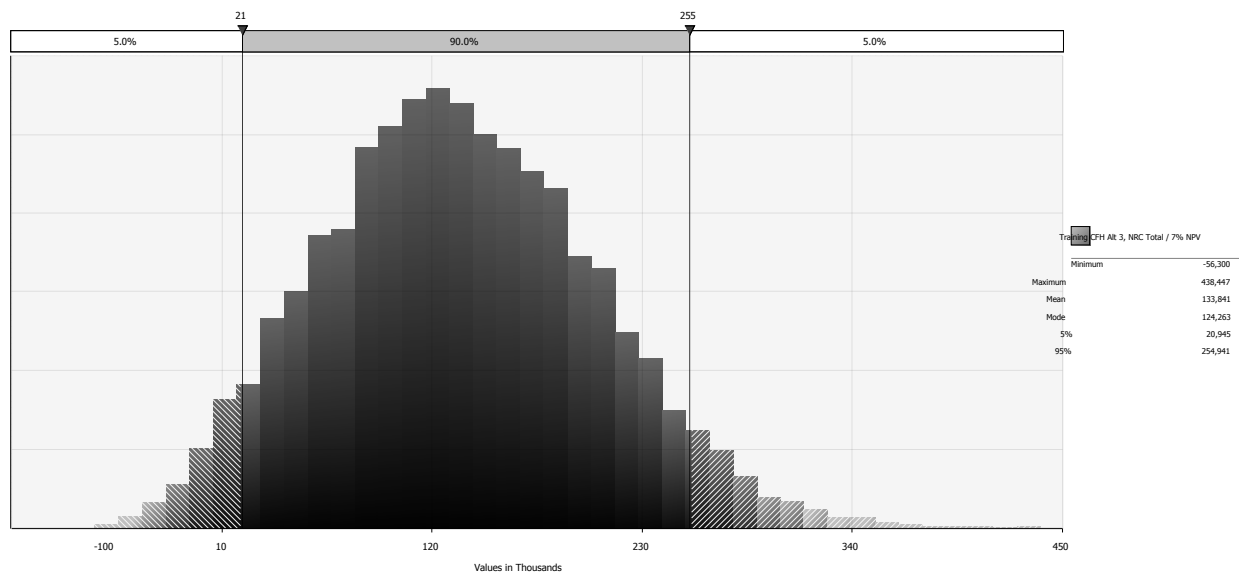


Figure 44 Variation of NRC Cost due to the Uncertainty in the Certified Fuel Handler Cost Drivers (Alternatives CFH-3)

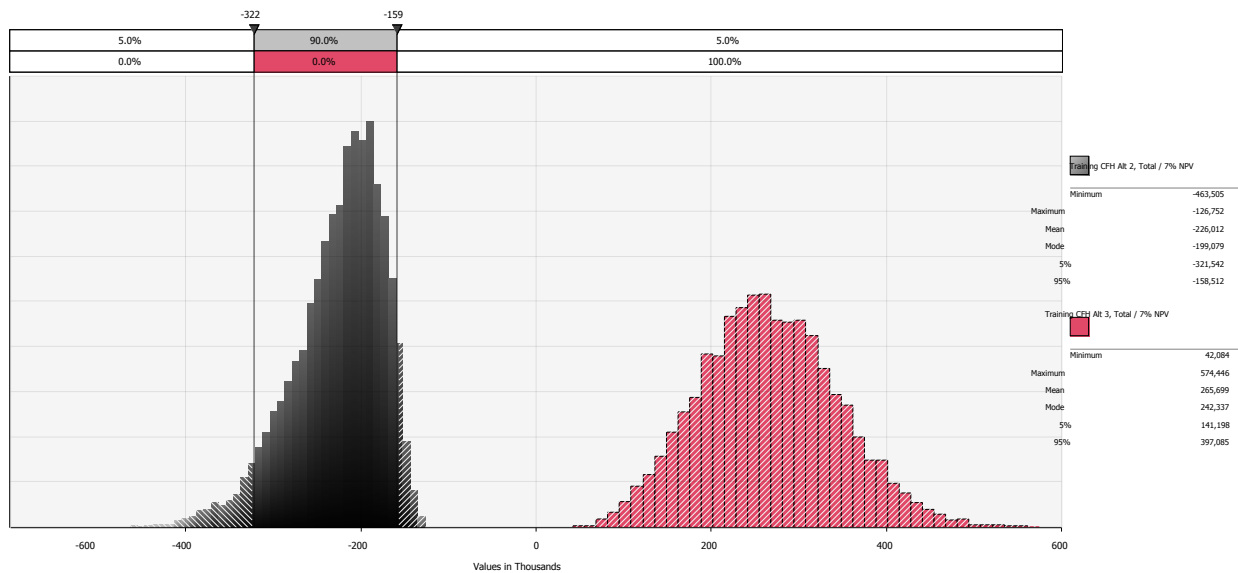


Figure 45 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Certified Fuel Handler Cost Drivers (Alternatives CFH-2 and 3)

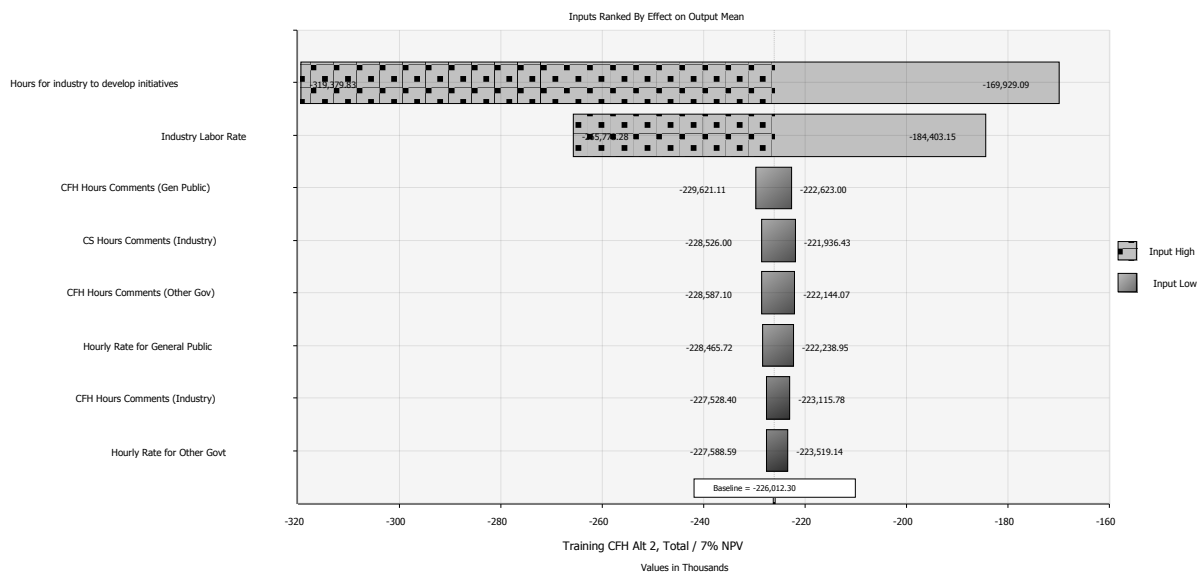


Figure 46 Tornado Chart Showing the variation of Total Cost due to each Certified Fuel Handlers Cost Driver (Alternative CFH-2)

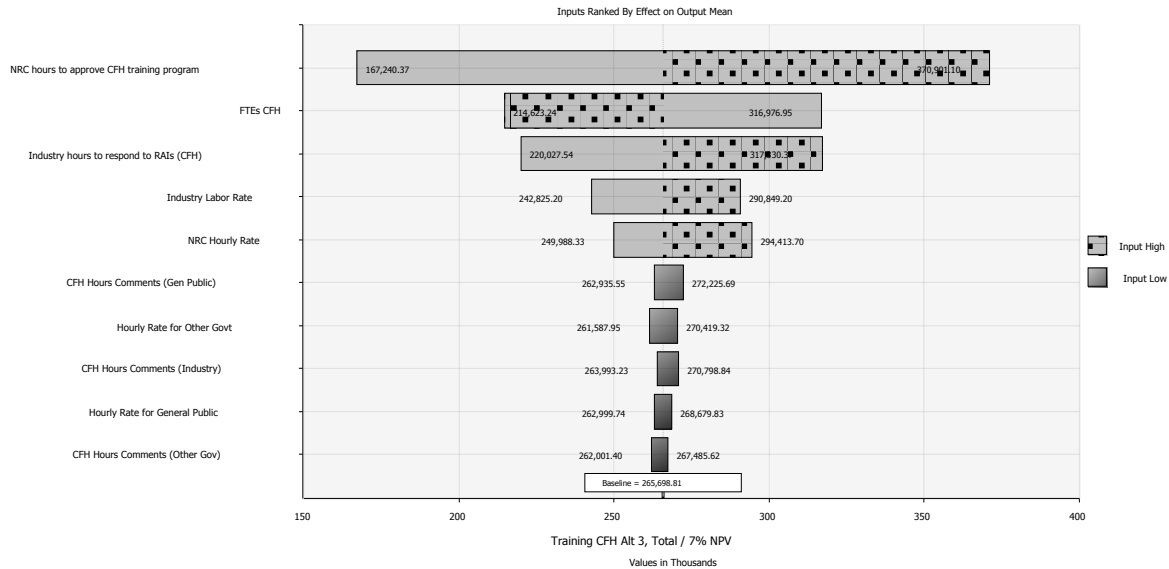


Figure 47 Tornado Chart Showing the variation of Total Cost due to each Certified Fuel Handlers Cost Driver (Alternative CFH-3)

As shown in Figure 43 through Figure 47, the voluntary industry initiatives for the minimum staffing and training requirements for certified fuel handlers area of decommissioning (Alternative CFH-2) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$463,000) to (\$127,000) using a 7 percent NPV. The cost driver that has the greatest influence on total cost is the number of hours for industry to develop the regulatory initiatives.

The regulatory changes to the minimum staffing and training requirements for certified fuel handlers area of decommissioning (Alternative CFH-3) will result in averted costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of \$42,000 to \$574,000 using a 7 percent NPV. The cost drivers that have the greatest influence on total cost for this area of decommissioning are the number of hours for NRC to approve a CFH training program and the number of FTEs required to implement rulemaking for this area of decommissioning.

## 7.11.14 Decommissioning Trust Fund

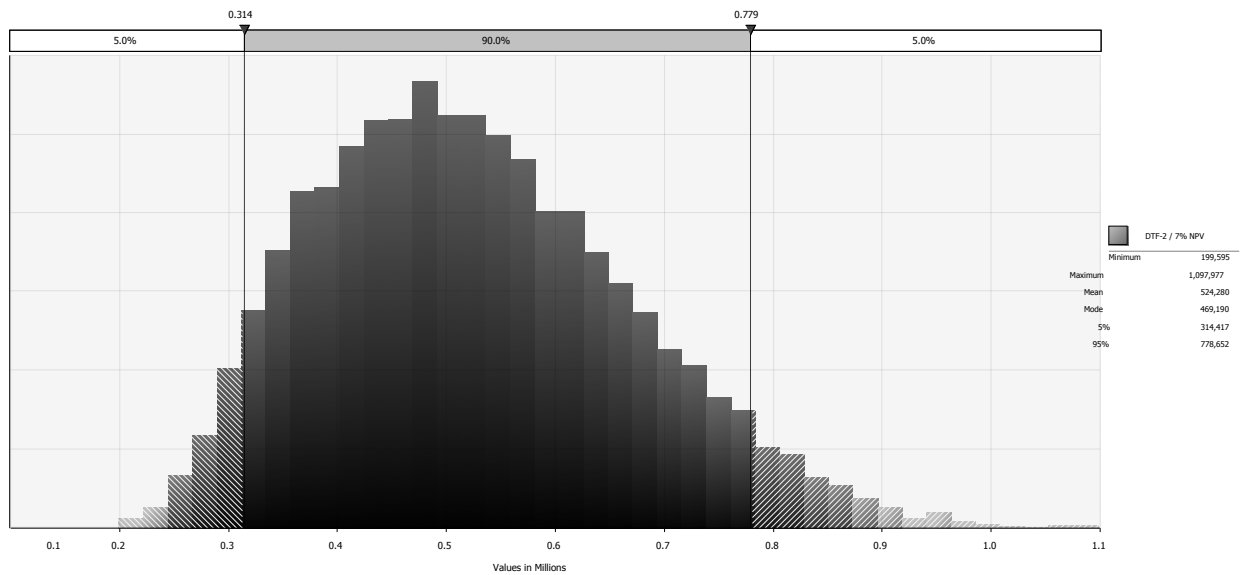


Figure 48 Variation of Industry Cost due to the Uncertainty in the Decommissioning Trust Fund Cost Drivers (Alternatives DTF-2)

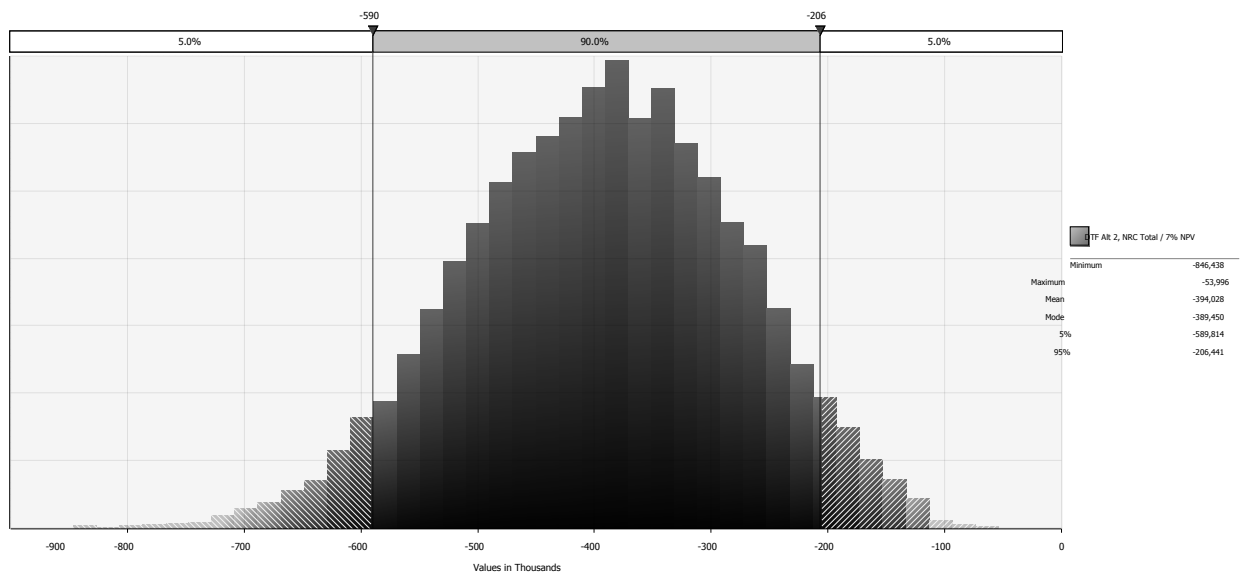


Figure 49 Variation of NRC Cost due to the Uncertainty in the Decommissioning Trust Fund Cost Drivers (Alternatives DTF-2)

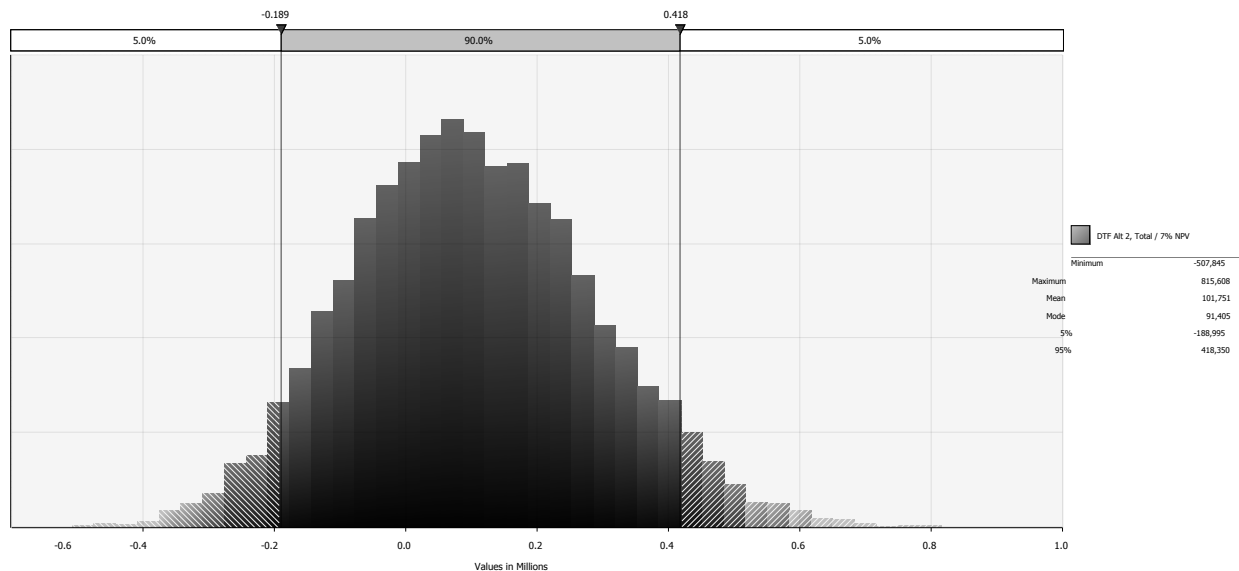


Figure 50 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Decommissioning Trust Fund Cost Drivers (Alternatives DTF-2)

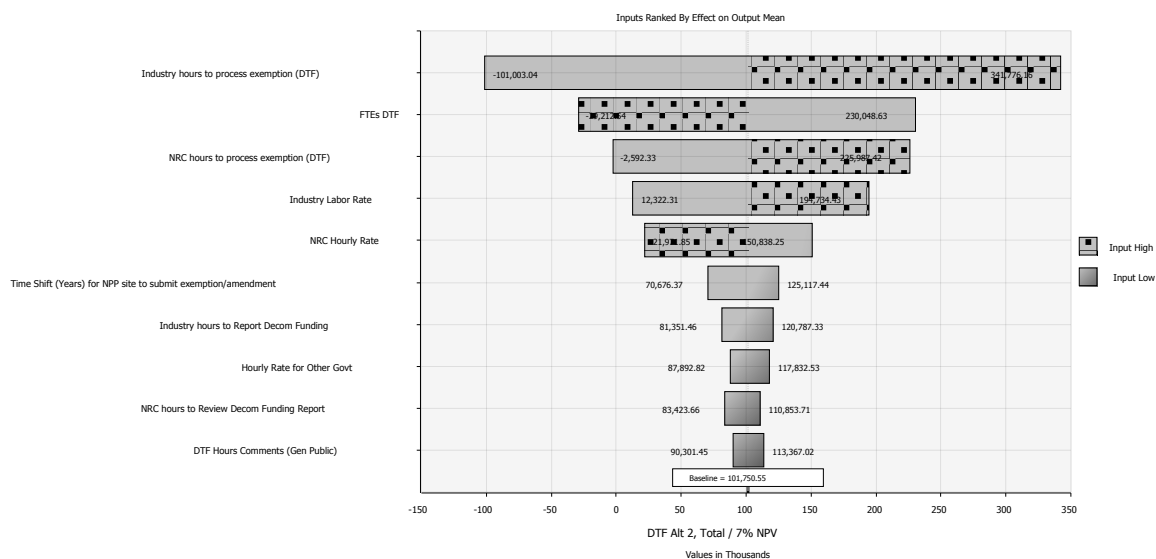


Figure 51 Tornado Chart Showing the Variation of Total Cost due to each Decommissioning Trust Fund Cost Driver (Alternatives DTF-2)

As shown in Figure 48 through Figure 51, the regulatory changes to the DTF area of decommissioning (Alternative DTF-2) will result in additional or averted costs to the nuclear power industry, NRC, other governments and the general public NRC over the decommissioning period in the range of (\$508,000) to \$816,000 using a 7 percent NPV. The cost driver that has the greatest influence is the number of hours for industry to process an amendment.

### 7.11.15 Offsite and Onsite Financial Protection Requirements and Indemnity Agreements

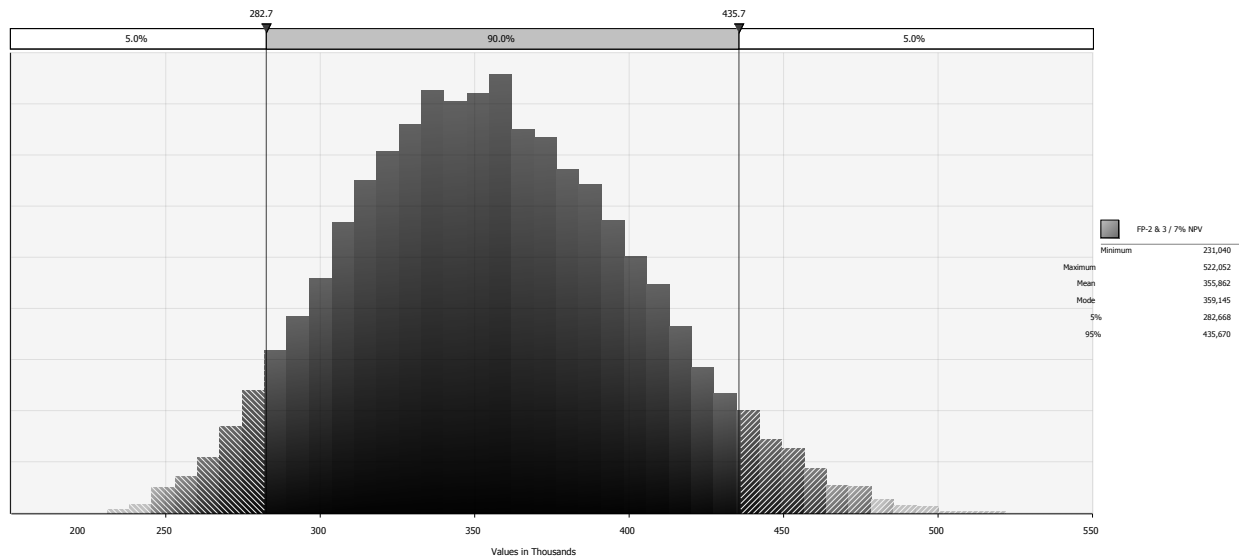


Figure 52 Variation of Industry Cost due to the Uncertainty in the Financial Protection Cost Drivers (Alternative FP-2 and 3)

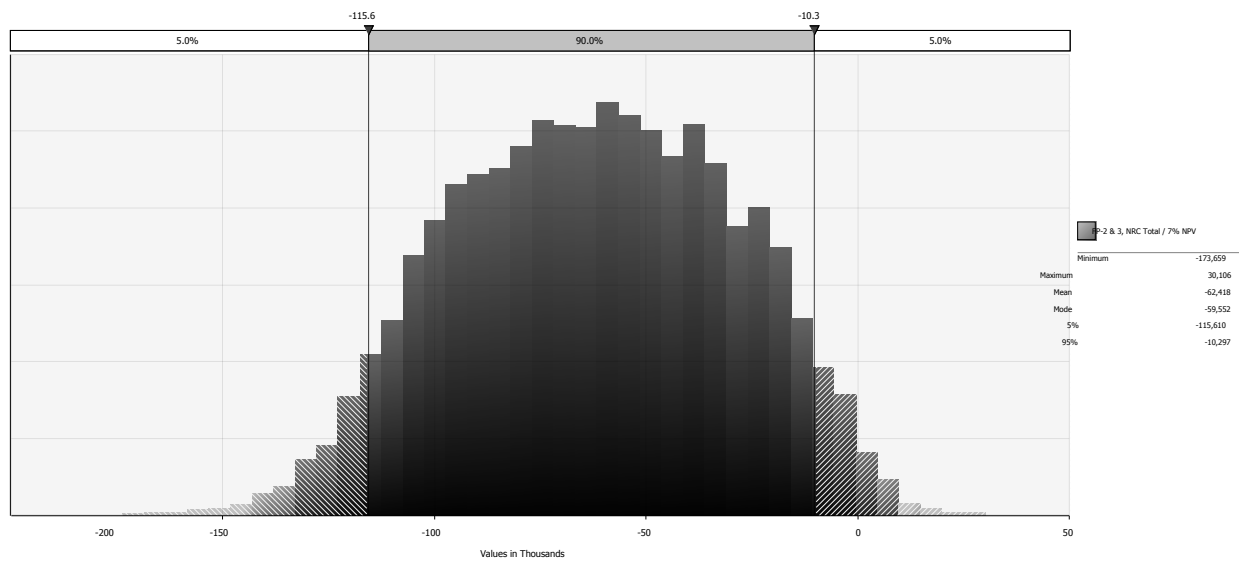


Figure 53 Variation of NRC Cost due to the Uncertainty in the Financial Protection Cost Drivers (Alternative FP-2 and 3)



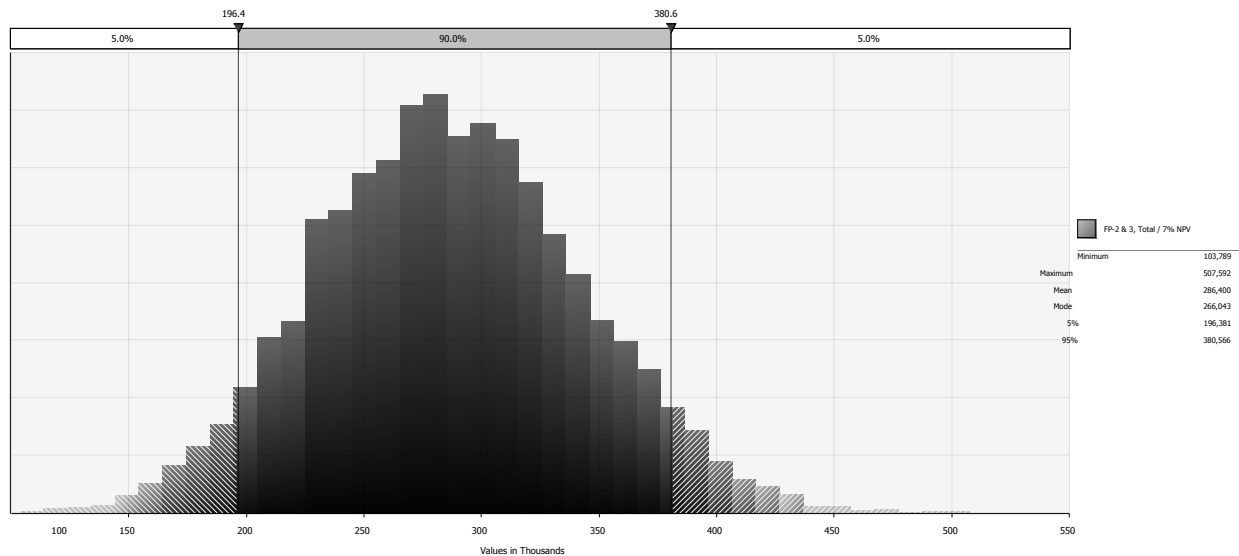


Figure 54 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Financial Protection Cost Drivers (Alternative FP-2 and 3)

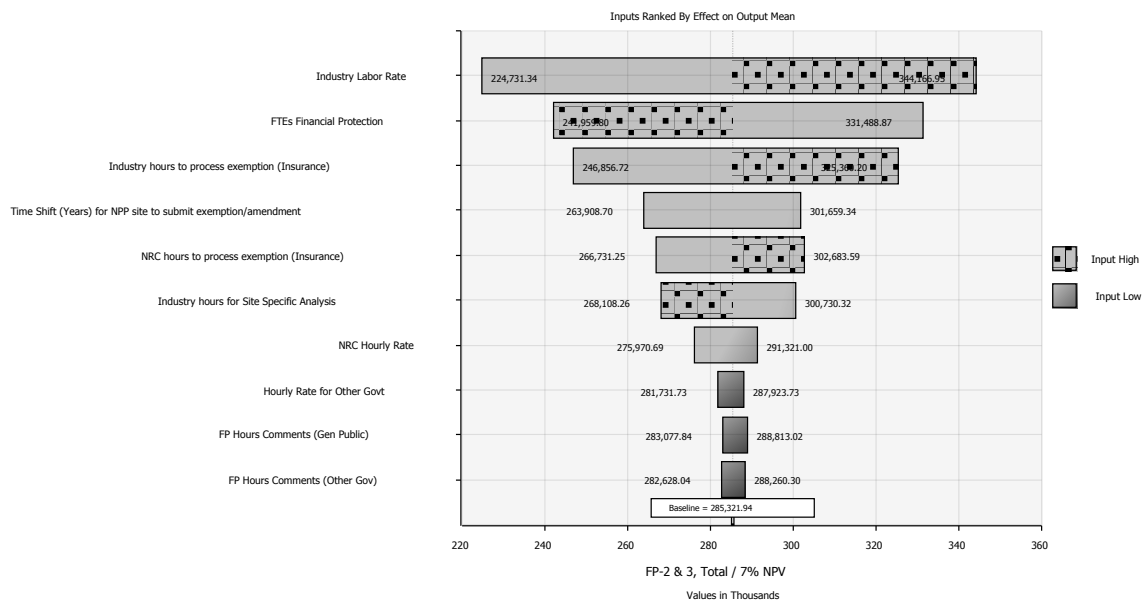


Figure 55 Tornado Chart Showing the Variation of Total Cost due to each Financial Protection Cost Driver (Alternative FP-2 and 3)

As shown in Figure 52 through Figure 55, the regulatory changes to the offsite and onsite financial protection area of decommissioning (Alternative FP-2) will result in averted costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of \$104,000 to \$508,000 using a 7 percent NPV. The cost drivers that have the greatest influence on total cost are the nuclear power industry labor rate and the number of NRC FTEs to implement rulemaking for this area of decommissioning.

## 7.11.16 Application of Backfitting Protection

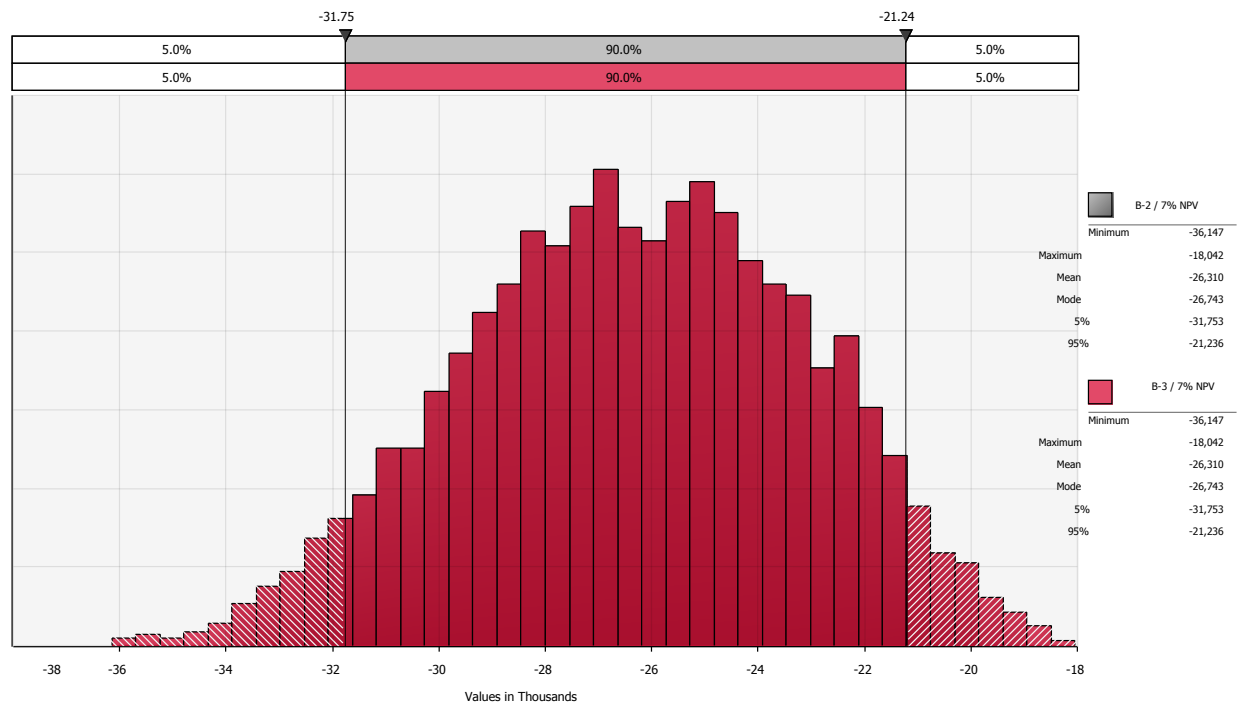


Figure 56 Variation of Industry Cost due to the Uncertainty in the Backfitting Cost Drivers (Alternatives B-2 and B-3)

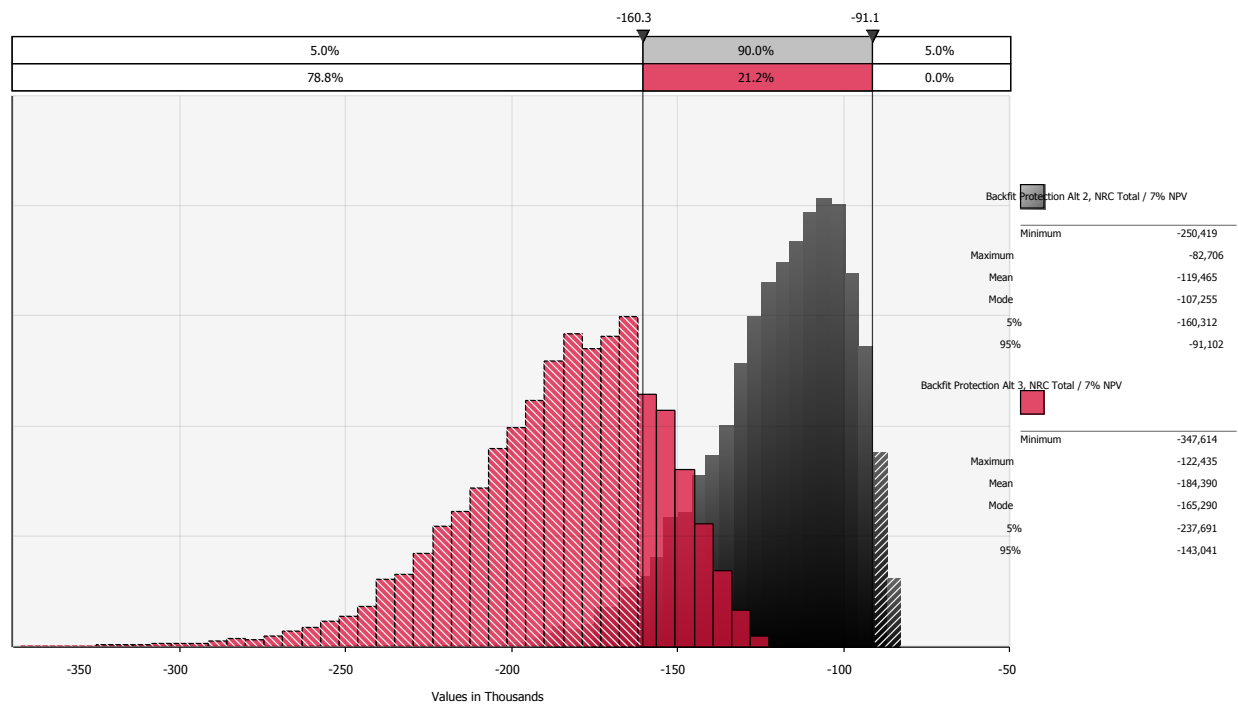


Figure 57 Variation of NRC Cost due to the Uncertainty in the Backfitting Cost Drivers (Alternatives B-2 and 3)

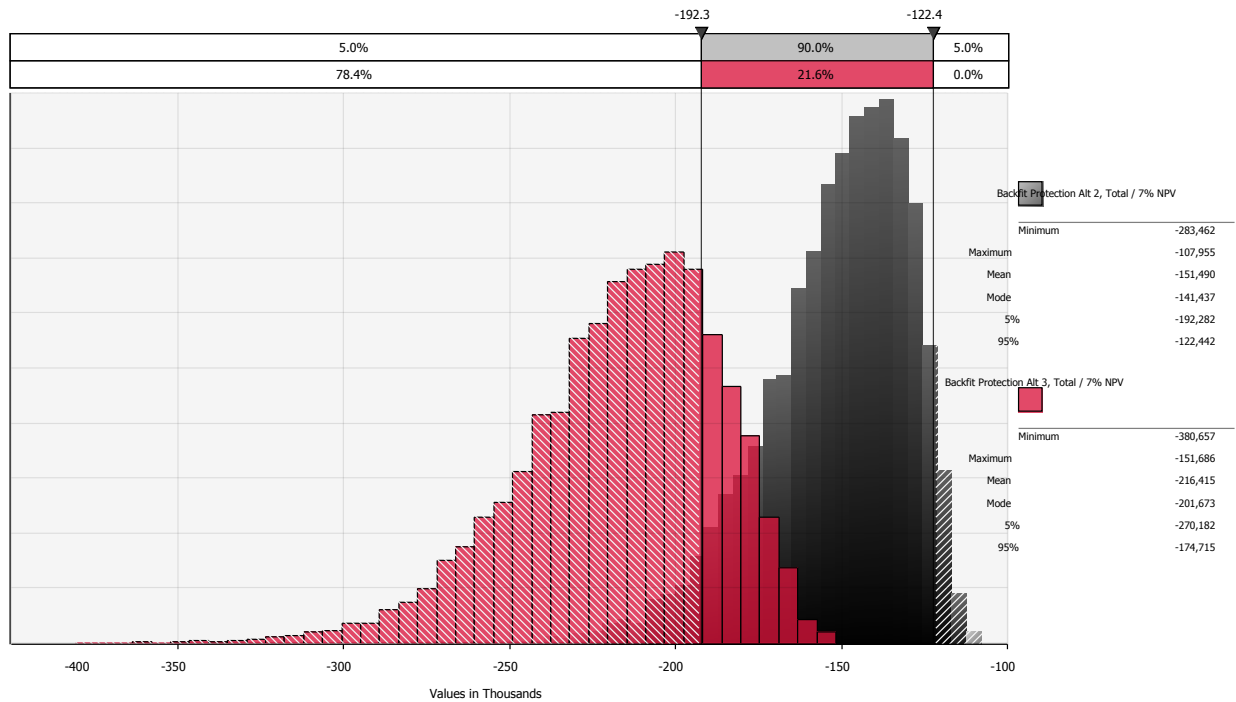


Figure 58 Variation of Total Cost due to the Uncertainty in the Backfitting Cost Drivers (Alternatives B-2 and 3)

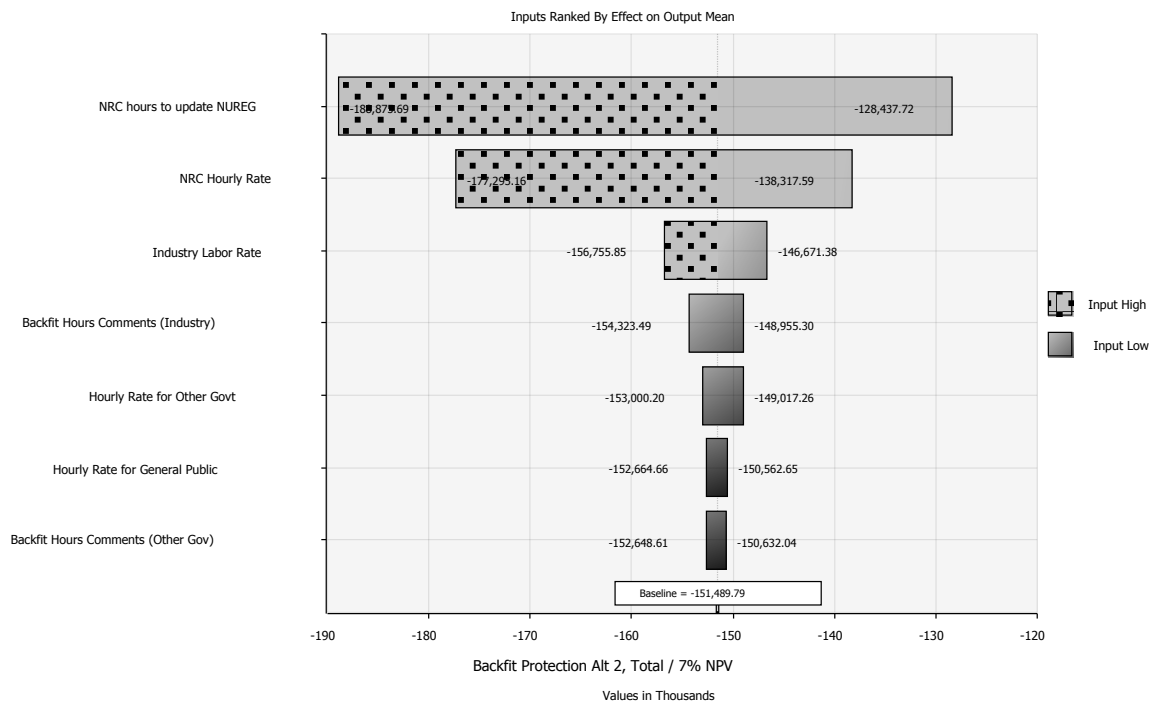


Figure 59 Tornado Chart Showing the Variation of Total Cost due to each Backfitting Cost Driver (Alternative B-2)

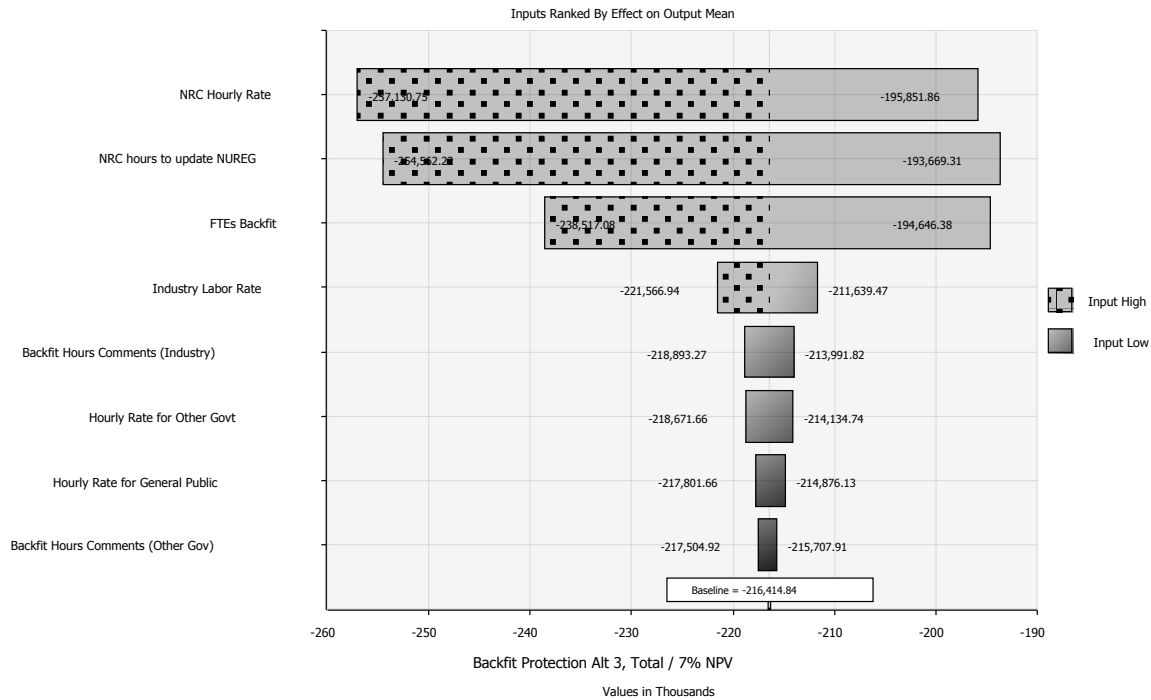


Figure 60 Tornado Chart Showing the Variation of Total Cost due to each Backfitting Cost Driver (Alternative B-3)

As shown in Figure 56 through Figure 60, the regulatory changes to the backfitting protection area of decommissioning (Alternative B-2) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$283,000) to (\$108,000) using a 7 percent NPV. The cost drivers that have the greatest influence for Alternative B-2 are the number of hours it takes for the NRC to update NUREG-1409 and the NRC hourly labor rate.

In addition, the regulatory changes to the backfitting protection area of decommissioning (Alternative B-3) will result in costs to the nuclear power industry, NRC, other governments and the general public over the rulemaking period that is in the range of (\$381,000) to (\$152,000) using a 7 percent NPV. The cost drivers that have the greatest influence for Alternative B-2 are the number of hours it takes for the NRC to update NUREG-1409 and the NRC hourly labor rate.

## 7.11.17 Aging Management

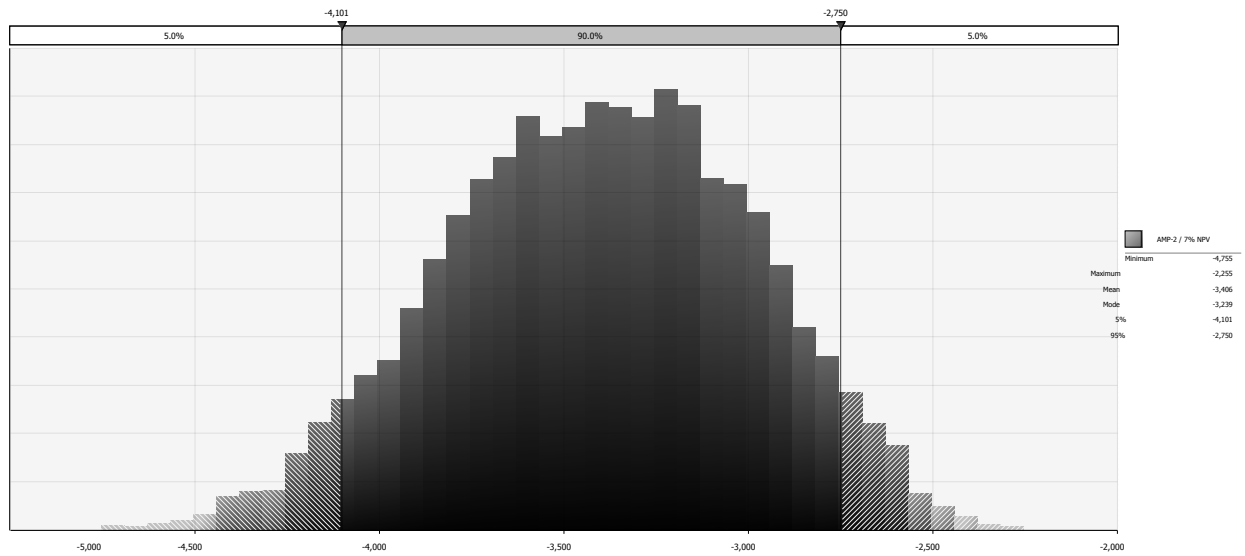


Figure 61 Variation of Industry Cost due to the Uncertainty in the Aging Management Program Cost Drivers (Alternatives AMP-2)

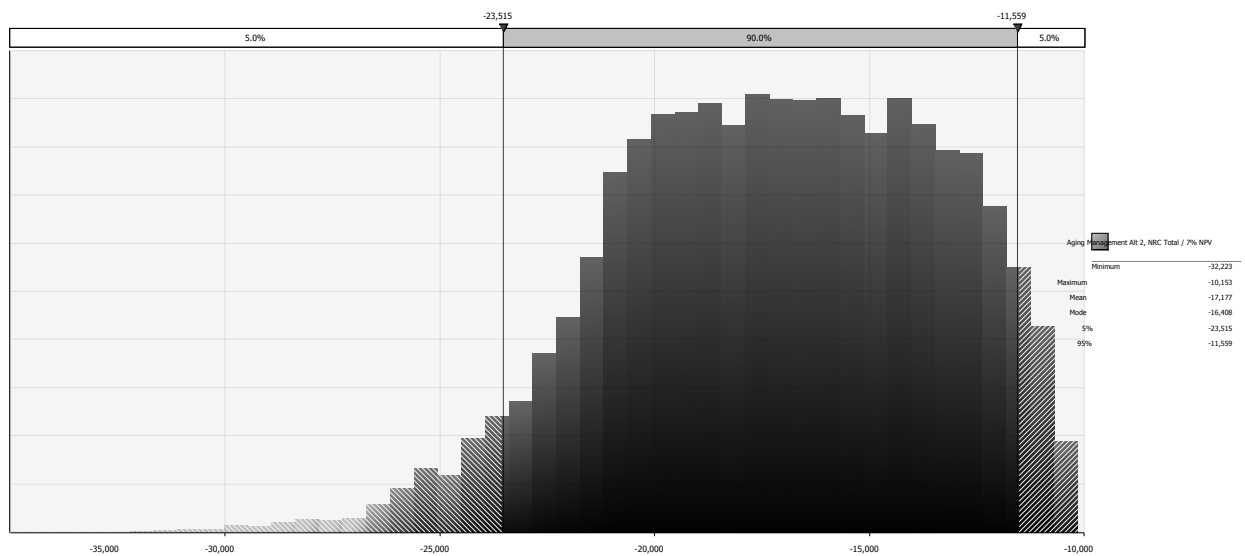


Figure 62 Variation of NRC Cost due to the Uncertainty in the Aging Management Program Cost Drivers (Alternatives AMP-2)

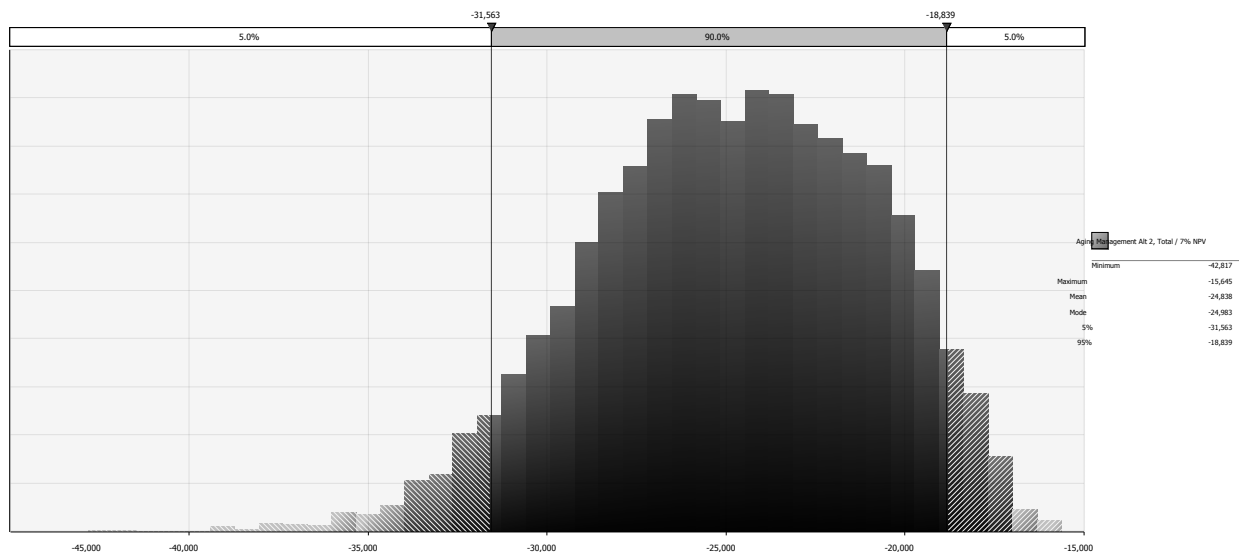


Figure 63 Variation of Total Cost (Industry, NRC, Other Governments and General Public) due to the Uncertainty in the Aging Management Program Cost Drivers (Alternatives AMP-2)

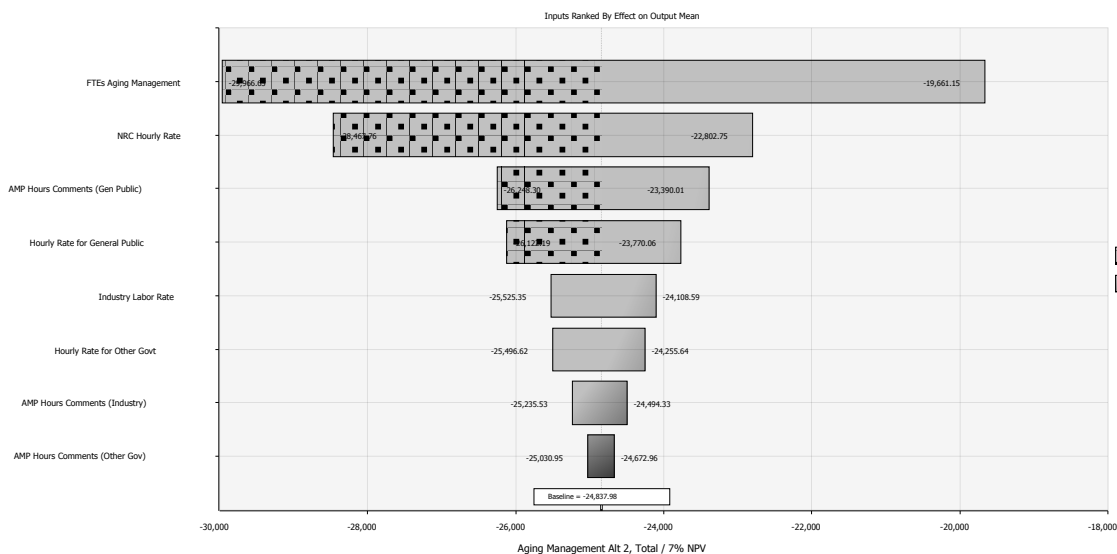


Figure 64 Tornado Chart Showing the Variation of Total Cost due to each Aging Management Program Cost Driver (Alternative AMP-2)

As shown in Figure 61 through Figure 64, the regulatory changes to the aging management area of decommissioning (Alternative AMP-2) will result in costs to the nuclear power industry, NRC, other governments and the general public over the decommissioning period in the range of (\$43,000) to (\$16,000) using a 7 percent NPV. The cost drivers that have the greatest influence on total cost are the number of NRC FTEs to implement this area of decommissioning.

## 7.12 Summary

This regulatory analysis identifies and integrates costs and benefits that will emerge from implementing the areas of decommissioning that contain rulemaking and guidance alternatives.

### 7.12.1 Quantified Net Benefit

Tables 18 and 19 show the estimated total net cost for the alternatives relative to the regulatory baseline (no-action alternatives) for each area of decommissioning.

Table 18 Total Net Benefits and Costs for Industry

Areas of Decommissioning	Alternatives	Net Industry Costs		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	\$ 19,965,000	\$ 4,664,000	\$ 10,154,000
Physical Security	PS-2	\$ 3,355,000	\$ 771,000	\$ 1,698,000
Cyber Security	CS-2	\$ (340,769,000)	\$ (55,791,000)	\$ (147,316,000)
Cyber Security	CS-3	\$ (8,000)	\$ (8,000)	\$ (8,000)
Fitness for Duty, Drugs and Alcohol	DA-2	\$ 28,082,000	\$ 5,868,000	\$ 13,310,000
Fitness for Duty, Fatigue	F-2	\$ (7,348,000)	\$ (1,878,000)	\$ (3,930,000)
Fitness for Duty, Fatigue	F-3	\$ (7,348,000)	\$ (1,878,000)	\$ (3,930,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-2	\$ (251,000)	\$ (221,000)	\$ (238,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ 652,000	\$ 136,000	\$ 318,000
Decommissioning Trust Fund	DTF-2	\$ 2,255,000	\$ 504,000	\$ 1,131,000
Offsite & Onsite Financial Protection	FP-2 & 3	\$ 1,486,000	\$ 340,000	\$ 751,000
Backfit Protection	B-2	\$ (27,000)	\$ (26,000)	\$ (27,000)
Backfit Protection	B-3	\$ (27,000)	\$ (26,000)	\$ (27,000)
Aging Management	AMP-2	\$ (4,000)	\$ (3,000)	\$ (3,000)
Level of PSDAR Review by NRC	DAR-2	\$ 29,000	\$ (10,000)	\$ 4,000
Level of PSDAR Review by NRC	DAR-3	\$ (20,615,000)	\$ (5,564,000)	\$ (11,336,000)
Level of PSDAR Review by NRC	DAR-4	\$ (32,214,000)	\$ (7,420,000)	\$ (16,322,000)
Maintaining the Decommissioning Options	O-2 & 3	\$ 49,000	\$ 9,000	\$ 23,000
Timeframe Associated with Decommissioning	T-2	\$ 46,000	\$ 6,000	\$ 20,000
Timeframe Associated with Decommissioning	T-3	\$ 22,000	\$ (14,000)	\$ (2,000)
Role of External Stakeholders in Decommissioning	GOV-2	\$ 33,000	\$ (7,000)	\$ 7,000
Role of External Stakeholders in Decommissioning	GOV-3	\$ (4,074,000)	\$ (949,000)	\$ (1,721,000)
Clarification Spent Fuel Management	SFM-2	\$ 46,000	\$ 6,000	\$ 20,000
Clarification Spent Fuel Management	SFM-3	\$ 37,000	\$ (1,000)	\$ 12,000
Record Retention Requirements	R-2	\$ 761,000	\$ 621,000	\$ 696,000
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$ 572,000	\$ 467,000	\$ 523,000

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars.

Table 19 Total Net Benefits and Costs for NRC

Areas of Decommissioning	Alternatives	Net NRC Costs		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	\$ 9,592,000	\$ 1,545,000	\$ 4,421,000
Physical Security	PS-2	\$ 1,238,000	\$ (422,000)	\$ 161,000
Cyber Security	CS-2 & 3	\$ (205,000)	\$ (192,000)	\$ (199,000)
Fitness for Duty, Drugs & Alcohol	DA-2	\$ 327,000	\$ (58,000)	\$ 68,000
Fitness for Duty, Fatigue	F-2	\$ (128,000)	\$ (108,000)	\$ (119,000)
Fitness for Duty, Fatigue	F-3	\$ (242,000)	\$ (190,000)	\$ (211,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ 1,224,000	\$ 134,000	\$ 516,000
Decommissioning Trust Fund	DTF-2	\$ 542,000	\$ (404,000)	\$ (70,000)
Offsite & Onsite Financial Protection	FP-2 & 3	\$ 483,000	\$ (70,000)	\$ 126,000
Backfit Protection	B-2	\$ (128,000)	\$ (119,000)	\$ (124,000)
Backfit Protection	B-3	\$ (197,000)	\$ (184,000)	\$ (191,000)
Aging Management	AMP-2	\$ (18,000)	\$ (17,000)	\$ (18,000)
Level of PSDAR Review by NRC	DAR-2	\$ (357,000)	\$ (341,000)	\$ (354,000)
Level of PSDAR Review by NRC	DAR-3	\$ (4,958,000)	\$ (1,150,000)	\$ (2,416,000)
Level of PSDAR Review by NRC	DAR-4	\$ (17,556,000)	\$ (4,284,000)	\$ (9,051,000)
Maintaining the Decommissioning Options	O-2	\$ (229,000)	\$ (225,000)	\$ (231,000)
Maintaining the Decommissioning Options	O-3	\$ (336,000)	\$ (326,000)	\$ (336,000)
Timeframe Associated with Decommissioning	T-2	\$ (229,000)	\$ (225,000)	\$ (231,000)
Timeframe Associated with Decommissioning	T-3	\$ (592,000)	\$ (542,000)	\$ (573,000)
Role of External Stakeholders in Decommissioning	GOV-2	\$ (229,000)	\$ (210,000)	\$ (224,000)
Role of External Stakeholders in Decommissioning	GOV-3	\$ (5,810,000)	\$ (1,567,000)	\$ (2,632,000)
Clarification Spent Fuel Management	SFM-2	\$ (229,000)	\$ (210,000)	\$ (224,000)
Clarification Spent Fuel Management	SFM-3	\$ (336,000)	\$ (311,000)	\$ (329,000)
Record Retention Requirements	R-2	\$ 298,000	\$ 230,000	\$ 267,000
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$ 197,000	\$ 148,000	\$ 175,000

\* There may be discrepancies in calculations due to rounding.

\*\* All values are in 2017 dollars.

### 7.12.2 Qualitative Costs and Benefits

In addition to regulatory efficiency, the alternatives provide additional costs and benefits as described below. These costs and benefits have not yet been quantified into monetary values:

#### *Emergency Preparedness:*

Alternative EP-2: The NRC and FEMA would establish a notification process that would replace the current NRC/FEMA process for terminating the assessment of FEMA user fees following the receipt from the NRC of approved exemptions from pertinent 10 CFR 50.47(b) and Appendix E to 10 CFR Part 50 requirements stating that offsite radiological emergency planning and preparedness are no longer required at a particular commercial nuclear power plant site. The FEMA would also incur one-time costs to develop and issue a final rule to amend 44 CFR 354.4(e), "Discontinuation of charges," to reflect this new process.

#### *Decommissioning Trust Fund:*

Under Alternative DTF-2, licensees not under rate-setting regulations who report a shortfall pursuant to 10 CFR 50.75(f) would be required to make up the shortfall (from the minimum regulatory required amount as set forth in 10 CFR 50.75(c) or by the licensee's site-specific decommissioning cost estimate) within a timely manner. This requirement for making up DTF shortfalls would affect individual licensees differently, depending on the amount and cause of the DTF shortfall and the time period that the licensee would otherwise have had to make up the shortfall under the current regulatory framework. The greater the amount of money that must be funded to overcome the shortfall, the more significant the impact will be on the licensee. The



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combination of these two requirements could aggravate the licensee's financial condition if the licensee is unable to recover decommissioning costs through electrical generation rates and fees or through reductions in their operating plant budget. If the funding period were too short, licensees not under rate-setting regulations who report a shortfall would be placed at a competitive disadvantage, potentially leading to insolvency and premature shutdown of plants. The premature shutdown of a plant could result in a dramatic shortfall between the funds needed to decommission the plant and the funds that have been collected. Other possible effects of accelerated shortfall funding are interference with licensees' business planning or negative tax consequences.

*Timeframe Associated with Decommissioning:*

Alternative T-3: In this alternative, rulemaking to reduce the decommissioning time frame to less than 60 years may result in more radioactive exposure to the personnel responsible for dismantling the nuclear power facility. This is because there would be less time for radiological contamination to naturally decay to lower radiation levels. As a result this could lead to additional costs (e.g., shielding, remote handling) to protect personnel who are dismantling the decommissioned facility and are compelled by rulemaking to complete all decommissioning activities in less than 60 years.

During the public comment period for the draft regulatory basis, some commenters recommended that the SAFSTOR decommissioning option be removed because the 60-year limit for decommissioning is too long and results in extended socioeconomic impacts to the surrounding community throughout this period. The commenters recommended prompt decommissioning, decontamination, and return of property to unrestricted use, which could increase tax revenue to the states and federal government. For example, according to a comment made by a member of the public, expedited decommissioning of Vermont Yankee via the direct DECON method will result in a combined federal and Vermont state tax revenue to increase by \$42 million, the GDP to increase by \$187 million, and the gross output to increase by \$307 million with all figures at the 7% NPV (Ref. 42). These monetary figures however, include the construction and operation of a solar power generator following decommissioning, an activity for which other decommissioning nuclear facilities (present or future) may not follow.

Nuclear power licensees that have chosen the SAFSTOR method of decommissioning could be impacted financially if they were compelled to decommission earlier by this rulemaking. This financial impact is due to lack of sufficient funding in the licensee's DTF in order to accelerate decommissioning from the initial longer SAFSTOR method to the shorter timeframe that would be imposed by the rulemaking. As a result, some of this financial burden may be passed to the states in order to assist funding the accelerated decommissioning of these facilities. This burden can in turn be passed down to the general public in the form of tax hikes.

*The Role of State and Local Governments and Non-Governmental Stakeholders:*

Alternative GOV-3: In this alternative the licensees, NRC, state and local governments and members of the general public would commit additional resources to participate in community advisory boards. These resources include time spent by staff members from various state and local government agencies and members of the general public to provide feedback to licensees on the decommissioning process. Additional time would be spent by licensees and the NRC in order to address this feedback. All of this would facilitate open communication between licensees, NRC, state and local governments and general public and allow for transparency of the decommissioning process. As a result, public protests at decommissioning plant sites and

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potential lawsuits involving licensees may be reduced. Additionally a community advisory board may influence the expediting of decommissioning within the funding limits of the DTF and return a plant site to greenfield sooner than initially planned.

### **7.13 Safety Goal Evaluation**

Safety goal evaluations are applicable to regulatory initiatives considered to be generic safety enhancement backfits subject to the substantial additional protection standard in 10 CFR 50.109(a)(3).

The power reactor decommissioning rulemaking may amend certain decommissioning regulations that would allow licensees to avoid submissions of exemption and license amendment requests and would clarify certain regulations that pertain to decommissioning activities. The NRC staff expects that a rule addressing these areas would not enhance the safety of these facilities and would result in a reduction in burden to comply with the decommissioning regulations.

However, there are some alternatives being evaluated that would add new requirements and the direct and indirect costs of implementing these changes would need to be justified in view of the increased protection required to satisfy the backfit criteria of 10 CFR 50.109(a)(3).

## **8 DECISION RATIONALE FOR AREAS OF DECOMMISSIONING**

This section discusses which alternative for each area of decommissioning would be most cost beneficial to the nuclear power industry, local, state, and US governments and general public. The NRC staff has established a decision rationale for each area of decommissioning with respect to the regulatory basis and this section will present these decision rationales, their costs, and their benefits.

### **8.1 Decision Rationale for Current Regulatory Approach to Decommissioning**

This subsection presents the decision rationales for the current regulatory approach to decommissioning per NRC staff recommendations found in the regulatory basis and the qualitative discussion of costs and benefits for these recommendations.

#### **8.1.1 Cost Benefit Analysis Summary**

Table 20 provides the quantified and non-quantified costs and benefits for each alternative in each area of decommissioning for regulatory approaches to decommissioning. These costs include burden to other federal governments, state governments, local governments and the general public due to public commenting periods.

Table 20 Summary of Totals

Areas of Decommissioning (Regulatory Approaches)	Alternatives	Total Costs	
		7% NPV	3% NPV
Level of PSDAR Review by NRC	DAR-2	\$ (377,000)	\$ (376,000)
Level of PSDAR Review by NRC	DAR-3	\$ (6,739,000)	\$ (13,778,000)
Level of PSDAR Review by NRC	DAR-4	\$ (11,730,000)	\$ (25,399,000)
Maintaining the Decommissioning Options	O-2	\$ (220,000)	\$ (212,000)
Maintaining the Decommissioning Options	O-3	\$ (321,000)	\$ (316,000)
Role of External Stakeholders in Decommissioning	T-2	\$ (227,000)	\$ (218,000)
Role of External Stakeholders in Decommissioning	T-3	\$ (563,000)	\$ (582,000)
Role of External Stakeholders in Decommissioning	GOV-2	\$ (239,000)	\$ (239,000)
Role of External Stakeholders in Decommissioning	GOV-3	\$ (2,537,000)	\$ (4,375,000)
Clarification Spent Fuel Management	SFM-2	\$ (212,000)	\$ (211,000)
Clarification Spent Fuel Management	SFM-3	\$ (320,000)	\$ (324,000)
Record Retention Requirements	R-2	\$ 851,000	\$ 963,000
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$ 615,000	\$ 698,000
<b>Nonmonetary Costs &amp; Benefits</b>			
<b>Regulatory Efficiency:</b> These alternatives would enable the NRC to better maintain and administer regulatory activities over the decommissioning process and ensure that the requirements for decommissioning power reactors are clear and appropriate.			
<b>Safety and Common Defense:</b> These alternatives would continue to provide reasonable assurance of adequate protection of the public health, safety, and common defense and security at nuclear power reactor sites that have started decommissioning.			
<b>Other:</b> See section 7.12.2			

### 8.1.2 Level of PSDAR Review by the NRC

Given the NRC's desire to reduce unnecessary regulatory burden and improve the regulatory process for decommissioning nuclear power plants, the NRC staff recommends Alternative DAR-2 (Guidance Development or Enhancement), as well as a portion of Alternative DAR-3 (Rulemaking for Specific Issues).

Implementation of DAR-2 would allow the NRC staff and stakeholders to access more detailed information in the PSDARs for those licensees choosing to follow the enhanced guidance. This would not reduce the flexibility provided by the use of a PSDAR instead of a decommissioning plan for decommissioning nuclear power plants or impose unnecessary burdens on licensees and the NRC staff to create and review additional documents that do not have any net positive impact on public health and safety.

The NRC staff also recommends a portion of Alternative DAR-3, which would clarify, through rulemaking, that licensees must evaluate the environmental impacts associated with site-specific decommissioning activities and determine whether such impacts are bounded by appropriate previously issued environmental impact statements, at the PSDAR stage, rather than making a determination that all such impacts are bounded. Licensees would still be prohibited from conducting a decommissioning activity that would result in a significant environmental impact not previously reviewed per 10 CFR 50.82(a)(6)(ii) (the licensee would need to submit a license amendment or exemption request, and if approved by the NRC, would then be able to conduct the activity). The guidance updates envisioned under DAR-2 would also include additional guidance for addressing environmental impacts not bounded by appropriate previously issued environmental impact statements at the PSDAR or deferring those discussions until later in the decommissioning process.

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### **8.1.3 Maintaining the Decommissioning Options**

Based on the assessment performed in this analysis and the consideration of the 1996 rulemaking, lessons learned, and public comments on the ANPR, the NRC staff's conclusion is that the direct and indirect costs to amend the regulations for this area and to implement the changes described in Alternative O-3 would not result in a quantitative showing that the benefits exceed the costs. Of the two remaining alternatives, Alternative O-1 – No Action and Alternative O-2 – Guidance Development/Enhancement, only Alternative O-2 provides administrative changes and guidance revisions that would encourage licensees to add additional detail to the PSDAR, DCE, and IFMP regarding the option selected for decommissioning, the motivation for selecting that option, and what impact that decision has on long term storage of spent fuel. The NRC staff also plans to include enhanced guidance to licensees regarding the potential merits and disadvantages of entering into long term SAFSTOR versus pursuing immediate DECON of at least certain systems and components at the facility.

As a result, Alternative O-2 would provide the public with access to more detailed information in the PSDAR, DCE, and IFMP for those licensees choosing to implement the enhanced guidance than that provided by Alternative O-1, without reducing the flexibility provided by the current decommissioning regulations, or imposing unnecessary burdens on licensees and NRC staff through the rulemaking process. Furthermore, most of the costs to implement Alternative O-2 are for the NRC to update RG 1.184.

### **8.1.4 Timeframe Associated with Decommissioning**

Based on the assessment performed in this analysis and the consideration of the 1988 and 1996 rulemakings, lessons learned, and other technical data that informed previous decommissioning rulemaking activities regarding the 60-year timeframe to complete decommissioning, as well as an assessment of the ongoing decommissioning activities taking place under the current requirements, the NRC staff's conclusion is that the direct and indirect costs to amend the regulations for this area and to implement the changes described in Alternative T-3 would not result in a quantitative showing that the benefits exceed the costs. Of the two remaining alternatives, Alternative DAR-1 – No Action and Alternative T-2 – Guidance Development/Enhancement, only Alternative T-2 provides administrative changes and guidance revisions that would encourage licensees to add additional detail to the PSDAR, DCE, and IFMP, as needed, regarding the timeframe proposed for decommissioning, what circumstances would prompt a change in the decommissioning timeline (i.e., movement between SAFSTOR and DECON), and what impact that decision has on long term storage of spent fuel.

As a result, Alternative T-2 would provide the public with access to more detailed information in the PSDAR, DCE, and IFMP than that provided by Alternative T-1, without reducing the flexibility provided by the current decommissioning regulations, or imposing unnecessary burdens on licensees and NRC staff through the rulemaking process. Furthermore, most of the costs to implement Alternative T-2 are for the NRC to update RG 1.184 and RG 1.185.

### **8.1.5 The Role of External Stakeholders in Decommissioning**

Based on the assessment performed in this analysis and the consideration of the 1988 and 1996 rulemakings, lessons learned, and other information that informed previous decommissioning rulemaking and guidance activities regarding the need to establish

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requirements for the implementation of community advisory boards, the staff's conclusion is that the direct and indirect costs to amend the regulations for this area and to implement the changes described in Alternative GOV-3 would not result in a quantitative showing that the benefits exceed the costs. Of the two remaining alternatives, Alternative GOV-1 – No Action and Alternative GOV-2 – Guidance Development/Enhancement, only Alternative GOV-2 provides administrative changes and guidance revisions that would encourage licensees that are planning to create a community committee to add additional detail to the PSDAR regarding the creation of the community advisory board, the proposed minimum membership of that board, and the ways in which the board will be leveraged to promote public involvement in the decommissioning and decision making process.

As a result, Alternative GOV-2 would provide more guidance on best practices for engaging the community during the decommissioning process than that provided by Alternative GOV-1, without reducing the flexibility provided by the current decommissioning regulations, or imposing unnecessary burdens on licensees and the NRC staff through the rulemaking process. Alternative GOV-2 also avoids the mandated creation of additional procedures, committees, and the associated documents that do not have any net positive impact on the public health and safety. Furthermore, most of the costs to implement Alternative GOV-2 are for the NRC to update RG 1.184 and RG 1.185.

#### **8.1.6 Clarifying the Spent Fuel Management Requirements**

Based on the assessment performed in this analysis and the consideration of the 1996 rulemaking, lessons learned, and other information that informed previous decommissioning rulemaking and guidance activities regarding spent fuel management and handling capabilities during decommissioning, the NRC staff has determined two alternatives for this decommissioning area.

Alternative SFM-2: This alternative would provide additional guidance and an enhanced level of detail for the PSDAR, IFMP, and DCE regarding management and removal of spent fuel from the site before the structures, systems, and components that support moving, unloading, and shipping of spent fuel have been decommissioned and dismantled. The staff believes that with this guidance, both the NRC and licensees would save resources in the future since the additional detail in the guidance would result in a more streamlined and predictable process to manage information submitted as part of other decommissioning documents. The increased level of detail in the guidance under Alternative SFM-2 would reduce or potentially eliminate the NRC staff's need to engage in site-specific interactions with the licensee to clarify information regarding the management of spent fuel during decommissioning. Additionally, Alternative SFM-2 would enhance the opportunity for public participation in the decommissioning process, as well as expanding overall regulatory transparency and openness. However, Alternative SFM-2 would not address the identified inconsistencies within the regulations.

Alternative SFM-3: This alternative would amend 10 CFR 50.82, 10 CFR 50.54(bb), 10 CFR 52.110, and 10 CFR 72.218 to clarify and update the regulations as previously described to provide regulatory clarity, as well as enhance overall regulatory transparency and openness. The NRC staff estimates that this change would have a small impact on both licensees and the NRC staff since it would only require the NRC staff to take rule language that is already present in other sections of 10 CFR Chapter I and move it into the appropriate portions of 10 CFR 50.82, 10 CFR 50.54(bb), and 10 CFR 52.110. In addition, decommissioning licensees would need to expend a relatively small amount of time and effort to provide the additional level of detail and information suggested under the adjusted requirements

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for spent fuel management and handling capabilities during decommissioning since most of these considerations are already being taken into account at decommissioning facilities.

With these regulation changes and the guidance enhancements detailed in Alternative SFM-2 above, the NRC staff believes that both the NRC and licensees would save resources in the future since the clarified regulations and additional detail in the guidance would reduce or potentially eliminate the NRC staff's need to engage in site-specific interactions with the licensee to clarify information regarding the management of spent fuel during decommissioning. Additionally, Alternative SFM-3 would enhance the opportunity for public involvement in the decommissioning process, as well as expanding overall regulatory transparency and openness. Furthermore, Alternative SFM-3 resolves the identified inconsistencies within the regulations. Hence the NRC staff recommends Alternative SFM-3 to clarify the spent fuel management requirements.

### **8.1.7 Record Retention Requirements**

Based on the assessment of the costs and benefits for changing decommissioning recordkeeping and record retention requirements, the NRC staff recommends Alternative R-2. Under this alternative, decommissioning licensees would have a decreased burden resulting from not having to develop and submit exemptions and would achieve greater record storage efficiency throughout the decommissioning process. While some NRC resources would need to be expended in the near term to revise the regulations, the reduction in recordkeeping and record retention exemption requests would reduce the NRC staff's time necessary to process and review these exemptions during decommissioning in the long term. Although these changes would not directly affect public health and safety, the increased clarity of the requirements associated with recordkeeping and record retention during decommissioning would increase the overall transparency of the decommissioning process.

### **8.1.8 Transportation Investigation, Tracing, and Reporting Requirements**

Given the NRC's desire to maintain safety, reduce unnecessary regulatory burden, and improve efficiency and effectiveness in the regulatory process for decommissioning nuclear power plants, the NRC staff recommends Alternative TR-2. Under this alternative, licensees would have a decreased burden resulting from not having to develop and submit the subject exemption requests and would achieve greater efficiency throughout the LLW transportation process. While some NRC resources would need to be expended in the near term to revise the 10 CFR Part 20, Appendix G regulation, the reduction in requests for exemptions from the LLW transportation investigation, tracing, and reporting requirements would reduce the NRC staff's time necessary to process and review these exemptions. Although these changes would not directly affect public health and safety, the reduction in administrative burden associated with the LLW transportation investigation, tracing, and reporting requirements, during both facility operation and decommissioning, would increase the overall efficiency of the regulatory process.

## **8.2 Decision Rationale for Specific Decommissioning Topics**

For all areas of decommissioning, a quantitative cost benefit analysis was completed to inform the staff which alternatives provide the most cost beneficial solutions. The following subsections present the decision rationales for each area of decommissioning along with a quantitative and qualitative description of the alternatives.

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The regulatory analysis finds that there is a quantitative and qualitative basis for pursuing decommissioning rulemaking as recommended in the regulatory basis, based on the following:

Emergency Preparedness:

- This decommissioning item provides the opportunity for significant averted costs over Alternative EP-1, the no-action alternative.
- Regulatory burden on nuclear power plant licensees is reduced by eliminating the need to submit requests for exemptions and license amendments for EP requirements that pertain to operating reactors. This also reduces the need for the NRC to review these exemption and amendment submittals.

Physical Security:

- This decommissioning item provides the opportunity for significant averted costs over Alternative PS-1, the no-action alternative.
- Regulatory burden on nuclear power plant licensees is reduced by eliminating the need to submit security-related exemption and license amendment requests for nuclear power reactors during their transition period to a decommissioning status. This also reduces the need for the NRC to review these exemptions and amendment submittals.

Decommissioning Trust Fund:

- The need for future exemption requests is reduced given that clear regulatory requirements would be in place to assure adequate funding for decommissioning earlier in a facility's lifecycle. These changes to the regulatory framework would align with the current decommissioning environment where commingling of funds in the DTF is allowed under guidance but silent in regulation.
- Regulatory efficiency is improved through minimizing uncertainty associated with estimating decommissioning costs such that a licensee would be required to plan for, and provide assurances for, funding decommissioning to a site-specific cost estimate earlier in the facility's lifecycle. Shortfalls would be addressed in a timely manner by licensees with greater transparency on these actions.
- Provides greater transparency of a licensee's decommissioning costs and plans for funding at licensing, and throughout operations and decommissioning, while also providing a measure of flexibility for the use of funds in the DTF.

Offsite and Onsite Financial Protection:

- Regulatory burden on nuclear reactor licensees is reduced by eliminating the need to submit requests for exemptions for reductions in onsite and offsite financial protection. This will also reduce the need for the NRC to review these exemption submittals.

Application of Backfitting:

- This decommissioning item would clarify how the Backfit Rule applies to licensees in decommissioning. This would lead to less time spent on a generic or plant specific backfit analysis that pertains to decommissioning.

The regulatory basis recommends that rulemaking go forward for the following areas of decommissioning - EP, physical security, DTF, backfitting, and offsite and onsite financial protection requirements and indemnity agreements. Relative to the regulatory baseline, the NRC would realize additional costs to implement the rulemaking, however this regulatory analysis shows that the above areas will result in quantitative and/or qualitative benefits as

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discussed below. In addition, the rulemaking alternatives would help ensure that the NRC's actions are effective, efficient, realistic, and timely by eliminating the need for the NRC review of exemption and amendment requests for decommissioning.



## 8.2.1 Cost Benefit Analysis Summary

The following table provides the quantified and non-quantified costs and benefits for each alternative in each area of decommissioning for specific decommissioning topics. These costs include burden to the federal government, state governments, local governments and the general public due to public commenting periods.

Table 21 Summary of Totals

Areas of Decommissioning (Specific Topics)	Alternatives	Total Costs	
		7% NPV	3% NPV
Emergency Preparedness	EP-2	\$ 6,148,000	\$ 14,513,000
Physical Security	PS-2	\$ 340,000	\$ 1,850,000
Cyber Security	CS-2	\$ (55,984,000)	\$ (147,515,000)
Cyber Security	CS-3	\$ (200,000)	\$ (208,000)
Fitness for Duty, Drugs & Alcohol	DA-2	\$ 5,809,000	\$ 13,377,000
Fitness for Duty, Fatigue	F-2	\$ (1,988,000)	\$ (4,050,000)
Fitness for Duty, Fatigue	F-3	\$ (2,070,000)	\$ (4,142,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-2	\$ (225,000)	\$ (243,000)
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ 265,000	\$ 829,000
Decommissioning Trust Fund	DTF-2	\$ 71,000	\$ 1,032,000
Offsite & Onsite Financial Protection	FP-2 & 3	\$ 264,000	\$ 870,000
Backfit Protection	B-2	\$ (152,000)	\$ (157,000)
Backfit Protection	B-3	\$ (216,000)	\$ (224,000)
Aging Management	AMP-2	\$ (25,000)	\$ (25,000)
<b>Nonmonetary Benefits</b>			
<b>Regulatory Efficiency:</b> These alternatives would enable the NRC to better maintain and administer regulatory activities over the decommissioning process and ensure that the requirements for decommissioning power reactors are clear and appropriate.			
<b>Safety and Common Defense:</b> These alternatives would continue to provide reasonable assurance of adequate protection of the public health, safety, and common defense and security at nuclear power reactor sites that have started decommissioning.			
<b>Other:</b> See section 7.12.2			

## 8.2.2 Emergency Preparedness

The NRC staff is recommending rulemaking Alternative EP-2 over the no-action alternative (status quo), because it would provide regulatory certainty for emergency preparedness requirements for permanently shutdown and defueled facilities. Also, in status quo, decommissioning power reactor licensees would need to submit exemption and amendment requests in order to reduce their emergency preparedness requirements throughout the decommissioning process. This would result in regulatory burden and costs to the licensees and the NRC during the decommissioning process from resources being expended to process the exemption and amendment requests. Additionally, Alternative EP-2 would provide a graded approach to reduce emergency preparedness requirements at decommissioning sites. Finally, the cost benefit analysis as detailed in Table 21 shows that this alternative is cost beneficial. The NRC staff recommends that an amendment of the regulations to provide a graded approach to EP, Alternative EP-2 would be the best course of action. Additionally, the NRC staff recommends to pursue option 2 for the emergency plan change process to transition between the EP levels. This alternative would provide a regulatory process for licensees to reduce their EP requirements corresponding to the licensee's level of decommissioning without the need to consider whether the change is a reduction in effectiveness.

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### **8.2.3 Physical Security**

The NRC staff is recommending rulemaking Alternative PS-2 over the no-action alternative (status quo) because the risk of offsite consequences due to accidents is reduced at a decommissioning reactor when compared to that at an operating reactor. Given the reduced risk of offsite consequences, the NRC staff has concluded that existing physical security requirements can be stepped down commensurate with the reduced level of risk. Also regulatory burden on nuclear power plant licensees would be reduced by eliminating the need to submit requests for exemptions and license amendments for reducing their physical security-related requirements during decommissioning. This alternative will also reduce the need for the NRC to review these exemptions and amendment submittals and is shown to be cost beneficial.

### **8.2.4 Cyber Security**

The NRC staff is recommending rulemaking Alternative CS-3. Under this alternative, the NRC staff would undertake a rulemaking to only allow the removal of cyber security requirements from a power reactor licensee's license once spent fuel in the SFP has sufficiently decayed. This change to existing regulation would provide clarity as to the degree of cyber security that needs to be maintained during each stage of the decommissioning process, while ensuring that safety concerns (e.g., a postulated zirconium fire scenario) are properly addressed in a manner that provides reasonable assurance of adequate protection of public health and safety, and the common defense and security.

### **8.2.5 Fitness for Duty—Drug and Alcohol Testing**

The NRC staff is recommending rulemaking Alternative DA-2. The cost benefit analysis shows that rulemaking Alternative DA-2 results in cost savings to industry and NRC, as detailed in Table 21. The benefit derived from pursuing this alternative is regulatory clarity on which elements or requirements of the FFD program defined in Part 26 would be applicable to a decommissioning power reactor.

### **8.2.6 Fitness for Duty—Fatigue**

With respect to rulemaking Alternative F-3, the NRC staff shows in appendix K of the regulatory basis document (Ref.1) that there is insufficient basis to recommend a cost-justified rulemaking that would provide a substantial increase in the protection of public health and safety. Operating experience has not revealed safety significant issues at decommissioning sites concerning fatigue, and licensees have maintained some level of fatigue management at decommissioning sites in accordance with their security plans.

Furthermore, the staff is not recommending voluntary industry initiatives, Alternative F-2, because the NRC determined that the voluntary initiative proposed by the industry, as reflected in NEI 15-08, was inadequate and incomplete for effective fatigue management, and both industry and the NRC would likely incur significant costs to align on an adequate fatigue management program. In conclusion, the NRC staff recommends the no action Alternative F-1 to extend the applicability of 10 CFR Part 26, Subpart I, for decommissioning licensees.

### **8.2.7 Minimum Staffing and Training Requirements for Non-Licensed Operators, Including Certified Fuel Handlers**

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The cost-benefit analysis shows that Alternative CFH-2 results in costs to both industry and the NRC and Alternative CFH-3 results in a benefit to both industry and the NRC, as detailed in Table 21. The benefit derived from pursuing Alternative CFH-2 is clarification on minimum staffing for a decommissioning nuclear reactor licensee that has submitted the certifications required by 10 CFR 50.82(a)(1) or 52.110(a), and the structure and contents of a fuel handler training program that can be used to qualify a CFH that would be acceptable to the NRC staff. The benefit derived from pursuing rulemaking Alternative CFH-3 is the elimination of the need for a licensee to seek Commission approval for fuel handler training programs and specification of the minimum staffing requirements in 10 CFR 50.54(m) for a decommissioning nuclear reactor licensee. This rulemaking alternative would reduce resources expended by both the licensee and the NRC on licensing amendments involving minimum staffing at decommissioning plants and eliminate the need for licensees to seek Commission approval of CFH training programs. Therefore the NRC staff recommends proceeding with the rulemaking Alternative CFH-3. This recommendation is also consistent with feedback received from the public on the regulatory basis.

### **8.2.8 Decommissioning Trust Fund**

Alternative DTF-2 have the following benefits over the no-action alternative (status quo):

- The need for future exemption requests is reduced given that clear regulatory requirements would address the concept of commingling as described in NRC Regulatory Information Summary (RIS) 2001-07 (Ref.44). Presently, licensees would need to file for an exemption to utilize the commingling concept when they don't follow NRC guidance.
- The reporting requirements for decommissioning funding assurance under 10 CFR 50.75(f)(1) and (f)(2) would be changed from a biennial to a triennial reporting period to align with the reporting requirements for ISFSIs in 10 CFR 72.30(c). This would reduce the burden on the licensees for reporting.
- Rulemaking would allow for greater transparency of a licensee's decommissioning costs and plans for funding at licensing, and throughout operations and decommissioning, while also providing a measure of flexibility for the use of funds in the DTF. This would minimize the uncertainty associated with estimating decommissioning costs such that a licensee would be able to plan for, and provide assurances for, funding decommissioning earlier in the facility's lifecycle. Shortfalls would be addressed in a timely manner by licensees with greater transparency on these actions.

As detailed in Table 21, Alternative DTF-2 presents a cost benefit at 7 percent NPV and at 3 percent NPV. The NRC staff therefore recommends proceeding with the rulemaking Alternative DTF-2.

### **8.2.9 Offsite and Onsite Financial Protection Requirements and Indemnity Agreements**

The NRC staff is recommending rulemaking Alternative FP-2 over the no-action alternative (status quo) because the risk of offsite and onsite consequences due to a potential nuclear occurrence is reduced at a decommissioning reactor when compared to that at an operating reactor and the amounts of financial protection provided in Levels 1 and 2 are consistent with

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exemptions that have been granted to reactors that have decommissioned. Given the reduced risk of offsite and onsite consequences, the NRC staff has concluded that existing insurance requirements can be stepped down commensurate with the reduced level of risk and graded to emergency preparedness. Also regulatory burden on nuclear reactor licensees is reduced by eliminating the need to submit exemptions for reduction to onsite and offsite financial protection. This will also reduce the need for the NRC to review these exemption submittals. As detailed in Table 21, Alternative FP-2 presents a cost at 7 percent NPV and a benefit at 3 percent NPV. This is because the current rulemaking costs are large enough to overcome the future benefits of licensees not having to file exemptions from insurance requirements. This will also depend on the discount rate in the NPV. The technical bases for the amounts of financial protection provided in Levels 3 and 4 have not been thoroughly reviewed by staff or fully vetted with stakeholders and therefore, at this time, the staff does not recommend Alternative FP-3.

#### **8.2.10 Application of Backfitting Protection**

The NRC staff is recommending rulemaking Alternative BF-3 over Alternatives B-1 (status quo) and B-2. The cost benefit analysis however shows that both Alternatives B-2 and B-3 result in costs to both industry and the NRC. The guidance developed in Alternative B-2 would be used on a case-by-case basis in fact-dependent circumstances and may lead to lack of clarity in the Backfit Rule for decommissioning plants.

The benefit derived from pursuing rulemaking Alternative B-3 is regulatory clarity for how the Backfit Rule would apply to decommissioning plants. This may lead to less time spent by industry and the NRC for determining what regulatory action applied to a decommissioning licensee is or is not a backfit.

#### **8.2.11 Aging Management**

The NRC staff recommends guidance Alternative AMP-2. The issuance of guidance that recommends methods for demonstrating how the effects of aging will be managed for passive, long-lived SCs will reduce the level of regulatory uncertainty and burden associated with case-by-case reviews of aging management and provide the acceptable approaches for meeting the regulatory requirements already included in 10 CFR Part 50. The cost benefit analysis shows that Alternative AMP-2 results in minimal costs to industry, NRC, state and local government and the general public. The benefit derived from pursuing Alternative AMP-2 is the potential to clarify the NRC's guidance for aging management of the passive and long-lived SCs supporting the spent fuel pool operation during decommissioning.

### **8.3 NRC Staff Recommendations for Rulemaking**

The following table summarizes the staff recommended alternatives for rulemaking along with their incremental costs. The total incremental cost for the recommended alternatives is also displayed.

Table 22 Summary of Totals for the Recommended Alternatives

Areas of Decommissioning	Alternatives	Total Costs	
		7% NPV	3% NPV
Level of PSDAR Review by NRC	DAR-2/DAR3*	\$ (377,000)	\$ (376,000)
Maintaining the Decommissioning Options	O-2	\$ (220,000)	\$ (212,000)
Timeframe Associated with Decommissioning	T-2	\$ (227,000)	\$ (218,000)
Role of External Stakeholders in Decommissioning	GOV-2	\$ (239,000)	\$ (239,000)
Clarification Spent Fuel Management	SFM-3	\$ (320,000)	\$ (324,000)
Record Retention Requirements	R-2	\$ 851,000	\$ 963,000
Transportation Investigation, Tracing and Reporting Requirements	TR-2	\$ 615,000	\$ 698,000
Emergency Preparedness	EP-2	\$ 6,148,000	\$ 14,513,000
Physical Security	PS-2	\$ 340,000	\$ 1,850,000
Cyber Security	CS-3	\$ (200,000)	\$ (208,000)
Fitness for Duty, Drugs & Alcohol	DA-2	\$ 5,809,000	\$ 13,377,000
Fitness for Duty, Fatigue	F-1	\$ -	\$ -
Minimum Staffing and Training Requirements NLO/CFH	CFH-3	\$ 265,000	\$ 829,000
Decommissioning Trust Fund	DTF-2	\$ 71,000	\$ 1,032,000
Offsite & Onsite Financial Protection	FP-2	\$ 264,000	\$ 870,000
Backfit Protection	B-3	\$ (216,000)	\$ (224,000)
Aging Management	AMP-2	\$ (25,000)	\$ (25,000)
<b>Total:</b>		\$ 12,540,000	\$ 32,305,000
<b>Nonmonetary Benefits</b>			
<b>Regulatory Efficiency:</b> These alternatives would enable the NRC to better maintain and administer regulatory activities over the decommissioning process and ensure that the requirements for decommissioning power reactors are clear and appropriate.			
<b>Safety and Security:</b> These alternatives would continue to provide reasonable assurance of adequate protection of the public health and safety, and common defense and security at nuclear power reactor sites that have started decommissioning.			
* Portion of DAR-3 recommended			

Should the recommended alternatives go forward for rulemaking, the cost benefit analysis shows that these alternatives are over-all cost beneficial to the nuclear power industry, federal, state and local governments and the general public and that such a rulemaking would result in a net averted cost from \$12.5 million (7-percent NPV) to \$32.3 million (3-percent NPV). Most of the cost savings are attributable to the relief of exemptions and amendments that licensees would typically submit to the NRC for review and approval during decommissioning. The additional costs are due primarily to rulemaking, updating documents associated with the rulemaking (i.e. regulatory guidance and NUREGs) and the submission of and response to public comments.

## 9 GUIDANCE AND NUREG DOCUMENTS SUBJECT TO REVISION

The NRC has identified that the following guidance documents may need to be revised based on decisions made to pursue regulatory actions, including rulemaking, which affect specific decommissioning topics:

- RG 1.219, "Guidance on Making Changes to Emergency Plans for Nuclear Power Reactors"
- RG 1.179, "Standard Content and Format of License Termination Plans for Nuclear Power Reactors"

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- RG 1.184, “Decommissioning of Nuclear Power Reactors”
  - RG 1.185, “Standard Format and Content for Post-Shutdown Decommissioning Activities Report (PSDAR)”
  - RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning”
  - RG 4.22, “Decommissioning Planning During Operations”
  - RG 5.71, “Cyber Security Programs for Nuclear Facilities”
  - RG 5.73, “Fatigue Management for Nuclear Power Plant Personnel”
  - RG 5.66, “Access Authorization for Nuclear Power Plants”
  - RG 5.77, “Insider Mitigation Program”
  - NUREG-0586, “Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities”
  - NUREG-1022, “Event Reporting Guidelines 10 CFR 50.72 and 50.73”
  - NUREG-1496, “Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities”
  - NUREG-1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants”
  - NUREG-1628, “Staff Responses to Frequently Asked Questions Concerning Decommissioning of Nuclear Power Plants”
  - NUREG-1700, “Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans”
  - NUREG-1727, “NMSS Decommissioning Standard Review Plan”
  - NUREG-1757, “Consolidated Decommissioning Guidance”
  - NSIR/DPR-ISG-01, “Interim Staff Guidance: Emergency Planning for Nuclear Power Plants”
  - Inspection Procedure 82501, “Decommissioning Emergency Preparedness Program Evaluation”
  - Inspection Procedure 82401, “Decommissioning Emergency Preparedness Scenario Review and Exercise Evaluation”

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6. 60 FR 37374, "Decommissioning of Nuclear Power Reactors: Proposed Rule," July 20, 1995.
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## APPENDIX A: INDUSTRY LABOR RATES

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

Position Title	Occupation (SOC Code)	Hourly Mean Wage (2016 dollars)	Hourly 10th Percentile Wage (2016 dollars)	Hourly 90th Percentile Wage (2016 dollars)	Source
Executive	Top Executives (111000)	\$81.33	\$52.80	\$125.28	<a href="http://www.bls.gov/oes/current/oes111011.htm">http://www.bls.gov/oes/current/oes111011.htm</a>
	Chief Executives (111011)	\$105.20	\$73.89	\$149.78	<a href="http://www.bls.gov/oes/current/oes_nat.htm#11-0000">http://www.bls.gov/oes/current/oes_nat.htm#11-0000</a>
	<b>Average</b>	<b>\$93.27</b>	<b>\$63.35</b>	<b>\$137.53</b>	
Managers	First-Line Supervisors of Production and Operating Workers (511011)	\$46.29	\$30.55	\$59.47	<a href="http://www.bls.gov/oes/current/oes511011.htm">http://www.bls.gov/oes/current/oes511011.htm</a>
	First-Line Supervisors of Mechanics Installers and Repairers (491011)	\$46.85	\$39.74	\$57.08	<a href="http://www.bls.gov/oes/current/oes491011.htm">http://www.bls.gov/oes/current/oes491011.htm</a>
	Industrial Production Managers (113051)	\$64.32	\$51.56	\$75.20	<a href="http://www.bls.gov/oes/current/oes113051.htm">http://www.bls.gov/oes/current/oes113051.htm</a>
	General and Operations Managers (111021)	\$78.14	\$52.03	\$94.75	<a href="http://www.bls.gov/oes/current/oes111021.htm">http://www.bls.gov/oes/current/oes111021.htm</a>
	<b>Average</b>	<b>\$58.90</b>	<b>\$43.47</b>	<b>\$71.63</b>	
Technical Staff	Nuclear Engineers (172161)	\$49.65	\$40.90	\$59.10	<a href="http://www.bls.gov/oes/current/oes172161.htm">http://www.bls.gov/oes/current/oes172161.htm</a>
	Computer Support Specialists (151150)	\$36.65	\$28.14	\$51.16	<a href="http://www.bls.gov/oes/">http://www.bls.gov/oes/</a>
	Nuclear Technicians (194051)	\$39.70	\$32.40	\$47.32	<a href="http://www.bls.gov/oes/current/oes194051.htm">http://www.bls.gov/oes/current/oes194051.htm</a>
	Nuclear Power Reactor Operators (518011)	\$44.76	\$38.56	\$51.17	<a href="http://www.bls.gov/oes/current/oes518011.htm">http://www.bls.gov/oes/current/oes518011.htm</a>
	Industrial Machinery Mechanics (499041)	\$34.20	\$26.23	\$42.87	<a href="http://www.bls.gov/oes/current/oes499041.htm">http://www.bls.gov/oes/current/oes499041.htm</a>
	<b>Average</b>	<b>\$40.99</b>	<b>\$33.25</b>	<b>\$50.32</b>	
Admin Staff	Office and Administrative Support Occupations (430000)	\$27.82	\$19.29	\$35.09	<a href="http://www.bls.gov/oes/current/naics4_221100.htm#43-0000">http://www.bls.gov/oes/current/naics4_221100.htm#43-0000</a>
	First-Line Supervisors of Office and Administrative	\$43.63	\$31.92	\$55.27	<a href="http://www.bls.gov/oes/current/oes431011.htm">http://www.bls.gov/oes/current/oes431011.htm</a>

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Position Title	Occupation (SOC Code)	Hourly Mean Wage (2016 dollars)	Hourly 10th Percentile Wage (2016 dollars)	Hourly 90th Percentile Wage (2016 dollars)	Source
	Support Workers (431011)				
	Office Clerks General (439061)	\$23.72	\$16.02	\$29.57	<a href="http://www.bls.gov/oes/current/oes439061.htm">http://www.bls.gov/oes/current/oes439061.htm</a>
	<b>Average</b>	<b>\$31.72</b>	<b>\$22.41</b>	<b>\$39.98</b>	
Licensing Staff	Paralegals and Legal Assistants (232011)	\$33.71	\$27.81	\$38.71	<a href="http://www.bls.gov/oes/current/oes232011.htm">http://www.bls.gov/oes/current/oes232011.htm</a>
	Lawyers (231011)	\$78.71	\$54.46	\$94.45	<a href="http://www.bls.gov/oes/current/oes231011.htm">http://www.bls.gov/oes/current/oes231011.htm</a>
	<b>Average</b>	<b>\$56.21</b>	<b>\$41.14</b>	<b>\$66.58</b>	
Total	<b>Average</b>	<b>\$56.44</b>	<b>\$40.98</b>	<b>\$73.16</b>	
	<b>Burdened labor rate</b>	<b>\$135.44</b>	<b>\$98.34</b>	<b>\$175.60</b>	
	<b>Burdened labor rate (2017 Dollars)</b>	<b>\$138.70</b>	<b>\$100.70</b>	<b>\$179.81</b>	

- (1) For this analysis, the NRC staff estimated that the 90th percentile is approximately 30 percent greater than the mean.
- (2) The North American Industry Classification System (NAICS) uses a production-oriented conceptual framework to group establishments into industries based on the activity in which they are primarily engaged. Further details about the NAICS framework is provided on the BLS web pages (Ref. 45).
- (3) The Standard Occupational Classification (SOC) system is used by Federal agencies to classify workers into occupational categories. Further details about the SOC system is provided on the BLS web pages (Ref. 46).

## APPENDIX B: UNCERTAINTY ANALYSIS VARIABLES

Values of low, most likely and high were derived from similar historical cost data and expert opinion of the NRC staff.

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
<b>2017 Hourly Rate for industry</b>	\$138.77	PERT	\$100.08	\$138.16	\$179.91
<b>2017 Hourly Rate for industry (IT Support)</b>	\$93.70	PERT	\$870.03	\$91.21	\$127.32
<b>2017 NRC Labor Rate</b>	\$148.00	PERT	\$130.00	\$131.00	\$234.00
<b>2017 Other Government Labor Rate</b>	\$78.62	PERT	\$24.50	\$79.91	\$127.57
<b>2017 General Public Labor Rate</b>	\$61.32	PERT	\$27.53	\$57.36	\$110.96
Industry Effort Comments	Mean value	Distribution Type	Low	Most Likely (Base)	High
<b>EP Hours Comments:</b>	180.2	PERT	154.5	180.2	205.9
<b>PS Hours Comments:</b>	91.7	PERT	78.6	91.7	104.8
<b>CS Hours Comments:</b>	28.5	PERT	24.4	28.5	32.5
<b>FFD-D&amp;A Hours Comments:</b>	28.5	PERT	24.4	28.5	32.5
<b>FFD-F Hours Comments:</b>	19.0	PERT	16.3	19.0	21.7
<b>CFH Hours Comments</b>	37.9	PERT	32.5	37.9	43.4
<b>DTF Hours Comments:</b>	148.6	PERT	127.4	148.6	169.8
<b>FP Hours Comments:</b>	47.4	PERT	40.6	47.4	54.2
<b>Backfit Hours Comments:</b>	98.0	PERT	84.0	98.0	112.0
<b>AMP Hours Comments:</b>	12.6	PERT	10.8	12.6	14.5
<b>App H Hours Comments:</b>	237.1	PERT	203.2	237.1	271.0
Other Govt. Effort Comments	Mean value	Distribution Type	Low	Most Likely (Base)	High
<b>EP Hours Comments:</b>	378.3	PERT	324.2	378.3	432.3
<b>PS Hours Comments:</b>	57.6	PERT	49.4	57.6	65.8
<b>CS Hours Comments:</b>	5.0	PERT	4.3	5.0	5.7
<b>FFD-D&amp;A Hours Comments:</b>	2.5	PERT	2.1	2.5	2.9
<b>FFD-F Hours Comments:</b>	7.5	PERT	6.4	7.5	8.6
<b>CFH Hours Comments</b>	27.6	PERT	23.6	27.6	31.5
<b>DTF Hours Comments:</b>	147.8	PERT	126.7	147.8	168.9
<b>FP Hours Comments:</b>	45.1	PERT	38.6	45.1	51.5
<b>Backfit Hours Comments:</b>	37.6	PERT	32.2	37.6	42.9
<b>AMP Hours Comments:</b>	10.0	PERT	8.6	10.0	11.5
<b>App H Hours Comments:</b>	390.8	PERT	335.0	390.8	446.6
Gen Public Effort Comments	Mean value	Distribution Type	Low	Most Likely (Base)	High

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
EP Hours Comments:	29.2	PERT	4.1	29.2	54.3
PS Hours Comments:	4.6	PERT	0.6	4.6	8.6
CS Hours Comments:	1.5	PERT	0.2	1.5	2.9
FFD-D&A Hours Comments:	1.5	PERT	0.2	1.5	2.9
FFD-F Hours Comments:	1.5	PERT	0.2	1.5	2.9
CFH Hours Comments	1.5	PERT	0.2	1.5	2.9
DTF Hours Comments:	50.7	PERT	7.1	50.7	94.3
FP Hours Comments:	3.1	PERT	0.4	3.1	5.7
Backfit Hours Comments:	0.0	PERT	0.0	0.0	0.0
AMP Hours Comments:	23.0	PERT	3.2	23.0	42.9
App H Hours Comments:	116.7	PERT	16.3	116.7	217.1
Number of years remaining to implement rulemaking	3	NONE			
NRC Rulemaking Contract Support	\$(150,000)	NONE			
NRC Cost (rulemaking)	\$(6,060,439)	NONE			
NRC Cost (rulemaking) per year	\$(2,020,146)	NONE			
Number of NRC hours per year spent on this rulemaking effort	13312	RISK UNIFORM	8606		18018
Number of NRC hours per year spent on EP portion of rulemaking	2293	RISK UNIFORM	1420		3167
Number of NRC hours per year spent on Phys Security portion of rulemaking	2293	RISK UNIFORM	1420		3167
Number of NRC hours per year spent on Cyber Security portion of rulemaking	462	RISK UNIFORM	355		568
Number of NRC hours per year spent on FFD – Drug & Alcohol Testing, portion of rulemaking	391	RISK UNIFORM	355		426
Number of NRC hours per year spent on FFD – Fatigue, portion of rulemaking	426	RISK UNIFORM	284		568
Number of NRC hours per year spent on CFH portion of rulemaking	426	RISK UNIFORM	284		568
Number of NRC hours per year spent on DTF portion of rulemaking	1775	RISK UNIFORM	1420		2130
Number of NRC hours per year spent on Offsite and Onsite	589	RISK UNIFORM	469		710

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
Financial Protection portion of rulemaking					
Number of NRC hours per year spent on Backfit portion of rulemaking	156	RISK UNIFORM	99		213
Number of NRC hours per year spent on Aging Management portion of rulemaking	120	RISK UNIFORM	80		160
Number of NRC hours per year spent on Appendix H portion of rulemaking	1938	RISK UNIFORM	710		3167
Number of NRC hours per year for others (PRMB, RES, OGC, DORL (lessons learned)) spent on this rulemaking	2442	RISK UNIFORM	1710		3175
Number of nuclear power plant (NPP) sites that will enter the decommissioning transition phase after the rulemaking becomes effective	58	NONE			
Number of years from T <sub>0</sub> , to transfer all SF to dry cask storage in ISFSI	10	INTEGER UNIFORM	5	10	15
Number of years from T <sub>0</sub> , when all SF is transferred to DOE (beyond ISFSI)	26	INTEGER UNIFORM	21	26	31
Number of years from T <sub>0</sub> to site dismantlement (SAFSTOR/ENTOMB)	50	INTEGER UNIFORM	40	50	60
Number of years for site to decommission (DECON)	12	INTEGER UNIFORM	8	12	16
Number of years for site to decommission (DECON/SAFSTOR/ENTOMB)	34	INTEGER UNIFORM	8	34	60
Number of years for spent fuel management	21	INTEGER UNIFORM	4	26	38
IT staff personnel required to implement Cyber Security protection	3.3	INTEGER UNIFORM	3	3	4
Cost Impact to develop site specific cost estimate for DTF	\$(333,333)	PERT	\$(300,000)	\$(300,000)	\$(500,000)
Hours industry to process exemption (EP)	1428.6	PERT	1246.8	1419.7	1646.2
Hours NRC to process exemption (EP)	714.3	PERT	623.4	709.8	823.1
Hours industry to process amendment (EP)	1043.6	PERT	632.2	1039.0	1473.6

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
Hours NRC to process amendment (EP)	521.8	PERT	316.1	519.5	736.8
Hours industry to process exemption (suspension of security)	20.0	PERT	18.2	20.0	21.8
Hours NRC to process exemption (suspension of security)	10.0	PERT	9.1	10.0	10.9
Hours industry to process exemption (core damage)	20.0	PERT	18.2	20.0	21.8
Hours NRC to process exemption (core damage)	10.0	PERT	9.1	10.0	10.9
Hours industry to process exemption (communications with control room)	40.0	PERT	36.4	40.0	43.6
Hours NRC to process exemption (communications with control room)	16.0	PERT	14.6	16.0	17.4
Hours industry to process amendment (reduction of control room)	100.0	PERT	93.0	100	107.0
Hours NRC to process amendment (reduction of control room)	40.0	PERT	37.2	40	42.8
Hours industry to process amendment (applying Part 72 to ISFSI)	300.0	PERT	279.0	300	321.0
Hours NRC to process amendment (applying Part 72 to ISFSI)	150.0	PERT	139.5	150	160.5
Hours industry to process amendment (Cyber Security)	70.5	PERT	24.0	68.3	126.0
Hours NRC to process amendment (Cyber Security)	34.7	PERT	12.0	33.3	63.0
Number of hours for NRC to update a Regulatory Guide	866.7	PERT	600	700	1800
Number of hours for industry to modify Fatigue Management documents	433.3	PERT	300	350	900
Number of NRC hours to review NEI 15-08	866.7	PERT	600	700	1800



Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
Number of hours for industry to develop voluntary initiatives	1733.3	PERT	1200	1400	3600
Number of NRC hours to develop voluntary initiatives	866.7	PERT	600	700	1800
Hours for industry to respond to RAI CFH Training Program	82.3	PERT	45.0	79.7	130.0
Hours NRC to approve CFH Training Program	164.6	PERT	90.0	159.4	260.0
Hours industry to process exemption (DTF)	260.6	PERT	107.0	243.7	482.2
Hours NRC to process exemption (DTF)	130.3	PERT	53.5	121.8	241.1
Hours for industry to update Site Specific Cost Estimate	7.0	PERT	4.0	7.0	10.0
Hours for NRC to review update to Site Specific Cost Estimate	7.0	PERT	4.0	7.0	10.0
Hours for industry to report decommissioning funding assurance per report	6.7	PERT	4.0	7.0	8.0
Hours for NRC to review single report on decommissioning funding assurance	6.7	PERT	4.0	7.0	8.0
Hours industry to process exemption (Insurance)	200.7	PERT	171.8	199.4	234.6
Hours NRC to process exemption (Insurance)	100.3	PERT	85.9	99.7	117.3
Number of hours for industry to update a NUREG	86.3	PERT	67.5	75	150
Number of hours for NRC to update a NUREG	862.5	PERT	675	750	1500
Number of hours for NRC review of Aging Management Program	3.8	PERT	3.0	3.8	4.5
Hours for industry to complete site specific analysis for the adiabatic heatup of fuel assembly	14.5	PERT	8.7	13.9	22.3
Hours for NRC to review site specific analysis for the adiabatic heatup of fuel assembly	7.2	PERT	4.4	7.0	11.1
Hours for industry to update PSDAR	160.0	PERT	80.0	160.0	240.0

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
Hours for NRC to review update of the PSDAR	80.0	PERT	40.0	80.0	120.0
Hours for industry to complete full environmental analysis for decommissioning	1500.0	PERT	1000.0	1500.0	2000.0
Hours for NRC to complete NEPA analysis	1500.0	PERT	1000.0	1500.0	2000.0
Hours for Industry to prepare and submit PSDAR amendment	4000.0	PERT	3000.0	4000.0	5000.0
Hours for NRC to review PSDAR amendment	2000.0	PERT	1500.0	2000.0	2500.0
Hours for industry to provide updates and interact with community advisory board annually	10.0	PERT	5.0	10.0	15.0
Hours for NRC to review Industry updates and interact with community advisory board annually	12.5	PERT	5.0	12.5	20.0
Hours for state/local government to interact with community advisory board annually	10.0	PERT	5.0	10.0	15.0
Hours for industry to summarize the spent fuel management and put this summary in the PSDAR	1.1	PERT	0.8	1.1	1.5
Hours industry to process exemption (App H - Records)	94.5	PERT	38.7	91.6	162.0
Hours NRC to process exemption (App H - Records)	47.2	PERT	19.4	45.8	81.0
Hours industry to process exemption (App H - Transportation)	71.1	PERT	22.0	67.6	134.0

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
Hours NRC to process exemption (App H - Transportation)	35.5	PERT	11.0	33.8	67.0
Averted Time for teleconference calls (App H) in hours	0.3	PERT	0.1	0.3	0.5
Number of teleconference calls per licensee per month for status updates and to resolve issues (App H)	1.0	DUNIFORM	1.0		3.0
Number of Industry people in the teleconference calls (App H)	8.0	DUNIFORM	6.0		10.0
Number of NRC people in the teleconference calls (App H)	4.0	DUNIFORM	2.0		6.0
Number of months for the teleconference calls	3.0	DUNIFORM	2.0		4.0
FEMA fees averted	\$1,036,815	PERT	\$514,005	\$946,665	\$1,917,863
Average cost of business travel per week:	\$950.00	PERT	\$600	\$950	\$1,300
Industry One-Time Cost (Pre-Access Drug & Alcohol Testing) per NPP	\$(168,628)	PERT	\$(202,353)	\$(168,628)	\$(134,902)
Industry Annual Cost (Manage Drug & Alcohol Testing) per NPP	\$(345,479)	PERT	\$(414,575)	\$(345,479)	\$(276,383)
Industry Annual Cost (Manage Fatigue) per operating NPP	\$(498,214)	PERT	\$(597,857)	\$(498,214)	\$(398,571)
NRC Annual Cost (Administration Drug & Alcohol Testing) per NPP	\$(6,556)	PERT	\$(7,867)	\$(6,556)	\$(5,245)
NRC Annual Cost (Administration Fatigue) per operating NPP	\$(6,556)	PERT	\$(7,867)	\$(6,556)	\$(5,245)
Time Shift (years) for NPP site to submit exemptions/amendments	0	DISCRETE UNIFORM	-1	0	1
Time for NRC (in years) to finalize exemptions/amendments	1	DISCRETE UNIFORM	1	2	

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