THIS PRELIMINARY DRAFT DOCUMENT HAS NOT BEEN SUBJECT TO ALL LEVELS OF NRC MANAGEMENT REVIEW AND APPROVAL.

Preliminary Draft Regulatory Analysis for Regulatory Basis: Regulatory Improvements for Decommissioning

NRC-2015-0070; RIN 3150-AJ59

U.S. Nuclear Regulatory Commission

May 2017

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
ADAMS Accession No. ML16271A511

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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	*Code of Federal Regulations*
COL	combined license
CSP	cyber security plan
CPI-U	Consumer Price Index for all urban consumers
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
EP	emergency preparedness
EPA	U.S. Environmental Protection Agency
EIS	environmental impact statement
EOS	Emergency Operations Facility
ERDS	Emergency Response Data System
ERO	Emergency Response Organization
ETE	evacuation time estimate
EPZ	emergency planning zones
FFD	fitness for duty
FEMA	Federal Emergency Management Agency
FR	*Federal Register*
FTE	full-time equivalent
GE	general emergency
GEIS	Generic Environmental Impact Statement
GL	generic letter

HAB	hostile-action based
IMP	insider mitigation program
IFMP	Irradiated Fuel Management Plan
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
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
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
RB	Regulatory Basis
RCS	reactor coolant system
REP	radiological emergency preparedness
RG	regulatory guide
SAE	site area emergency

SER	safety evaluation report
SFP	spent fuel pool
SOC	standard occupational classification (code)
SOC	statement of considerations
SRM	staff requirements memorandum
SSEP	safety and important-to-safety, security, and emergency preparedness
TSC	Technical Support Center

ABSTRACT

In its draft regulatory basis document, “Regulatory Improvements for Reactors Transitioning to Decommissioning” (Ref. 1), referred to herein as “Regulatory Basis,” the Nuclear Regulatory Commission (NRC) evaluates whether to pursue rulemaking, develop guidance, or take no action for 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 Certified Fuel Handlers
- Decommissioning Trust Fund
- Offsite and Onsite Financial Protection Requirements and Indemnity Agreements
- Application of Backfitting Protection
- Aging Management

The areas in which the NRC staff has determined that there is sufficient regulatory basis to continue with rulemaking are:

- Emergency Preparedness
- Physical Security
- Decommissioning Trust Fund
- Offsite and Onsite Financial Protection Requirements and Indemnity Agreements
- Application of Backfitting Protection

Further, the NRC staff is recommending rulemaking to:

- Clarify spent fuel management requirements
- Clarify the environmental requirements in 10 CFR Part 50 and 10 CFR Part 51

The NRC staff’s draft regulatory basis suggests that alternatives other than rulemaking, such as the development of regulatory guidance, can be pursued to address the following regulatory areas:

- 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

The NRC staff’s draft regulatory basis indicates that additional public input is needed prior to finalizing recommendations in the following regulatory areas:

- Cyber Security
- Fitness for Duty - Drug and Alcohol Testing
- Fitness for Duty - Fatigue Management
- Minimum Staffing and Training Requirements for Certified Fuel Handlers (CFHs)
- Aging Management

This document presents the preliminary draft regulatory analysis of the draft regulatory basis for the evaluated alternatives in the above areas of decommissioning. In the regulatory analysis, the costs, benefits and other impacts are presented in order to determine the economic impact to industry, government and society from the staff recommendations considered in the regulatory basis.

The NRC staff prepared this preliminary draft regulatory analysis to support decision making for rulemaking, which includes an evaluation of possible regulatory improvements for reactors transitioning to decommissioning. Neither senior NRC management nor the Commission has reviewed and approved any specific elements of this document, and as such, the content of this analysis is subject to change.

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" (Ref. 2), 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" (Ref. 3), which include the following:

- The graded approach to emergency preparedness.
- 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 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 draft regulatory basis, the staff concludes that it has sufficient justification to proceed with rulemaking in the areas of emergency preparedness, physical security, decommissioning trust fund offsite and onsite financial protection requirements and indemnity agreements, and application of the Backfit Rule. Further, the staff is recommending rulemaking to: (1) require that the PSDAR contain a description of how the spent fuel stored under a general independent spent fuel storage installation license will be removed from the reactor site in accordance with the regulatory requirements in Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.82, 10 CFR 50.54(bb), 10 CFR 52.110, and/or 10 CFR 72.218 and (2) amend 10 CFR 51.53 and 10 CFR 51.95 to clarify that the requirement for a license amendment before decommissioning activities may commence applies only to non-power reactors, as specified in 10 CFR 50.82(b), in accordance with the 1996 changes to the decommissioning regulations. The NRC staff evaluated the impact of these changes and has estimated their net benefits, which are summarized in Table ES-1 below.

Table ES-1 Decommissioning Areas with Sufficient Justification to Proceed to Rulemaking

Area of Decommissioning	Preferred Alternative	Total Net Benefit [a] (2016 million dollars, 7% NPV[d])
Emergency Preparedness	EP-3	$5.42
Physical Security	PS-2	$0.38
Decommissioning Trust Fund	DTF-2	$0.12
Offsite and Onsite Financial Protection	FP-2	($0.19) [b]
Application of Backfitting Protection	BF-3	($0.65)
Clarifying the Spent Fuel Management Requirements	SFM-3	-- [c]
Clarifying the Environmental Requirements	ENV-2	-- [c]

[a] These estimates are based on preliminary inputs and are subject to change.
[b] The total net benefit results are sensitive to the timing of when costs and benefits occur and to the discount rate for these two decommissioning areas. The net benefit result changes from net cost when using a 7 percent discount rate to a net benefit when using a 3 percent discount rate.
[c] The costs and benefits of this alternative are not quantified in the preliminary draft regulatory analysis.
[d] NPV is defined as net present value.

- The NRC staff preliminary draft evaluation 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.

- At this time, the NRC staff has determined that additional public input is needed prior to finalizing recommendations related to cyber security, drug and alcohol testing, certified fuel handler training and minimum staffing requirements, aging management, and fatigue management. The NRC received comments in these areas from the advance notice of proposed rulemaking (ANPR) and intends to seek specific public input on these topics as part of the public comment request on the entire draft regulatory basis. The staff evaluated the impact of these changes and has estimated their net benefits, which are summarized in Table ES-2 below.

Table ES-2 Decommissioning Areas Requiring Additional Public Input

Area of Decommissioning	Alternatives	Total Net Benefit [a] (2016 million dollars, 7% NPV)
Cyber Security	CS-2	($74.8)
	CS-3	($11.8)
Drug and Alcohol Testing	DA-2	($0.21) [b]
Fatigue Management	F-2	($0.91)
	F-3	($1.57)
Minimum Staffing and Training Requirements for Certified Fuel Handlers	CFH-2	($0.03)
	CFH-3	($0.23) [b]
Aging Management	AMP-2	($0.23)

[a] These estimates are based on preliminary inputs and are subject to change.
[b] The total net benefit results are sensitive to the timing of when costs and benefits occur and to the discount rate for these two decommissioning areas. The net benefit result changes

from net cost when using a 7 percent discount rate to a net benefit when using a 3 percent discount rate.

- In the draft regulatory basis, the NRC staff concludes that regulatory activities other than rulemaking—such as guidance development—should be used to address concerns regarding the appropriate role of State and local governments in the decommissioning process, the level of NRC review and approval of the PSDAR, and the 60-year limit for power reactor decommissioning. The NRC staff evaluated the impact of these changes and has estimated their net benefits, which are summarized in Table ES-3 below.

Table ES-3 Decommissioning Areas that Benefit from Additional Guidance Development

Area of Decommissioning	Preferred Alternative	Total Net Benefit (2016 dollars, 7% NPV)
Level of PSDAR Review and Approval	DAR-2	-- [b]
Appropriateness of Maintaining the Three Decommissioning Options	O-2 [a]	
60 Year Timeframe	T-2	
Role of State and Local Government and Non-Governmental Stakeholders	GOV-2	

[a] 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.

[b] The costs and benefits of this alternative are not quantified in the preliminary draft regulatory analysis.

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

1 INTRODUCTION

This document presents the preliminary draft regulatory analysis for the draft regulatory basis document, "Regulatory Improvements for Reactors Transitioning to Decommissioning" (Ref. 1). Detailed regulations for the decommissioning of nuclear power reactors were not included in the Nuclear Regulatory Commission (NRC) rules before 1988. In that year, the NRC published a final rule in Volume 53 of the *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 the 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 being 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 based on 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.

At an operating reactor, the high temperature and pressure of the reactor coolant system, as well as the inventory of relatively short-lived radionuclides, contribute to both the risk and consequences of an accident. With the permanent cessation of reactor operation and the permanent removal of the fuel from the reactor core, the risk and consequences of accidents at decommissioning plants 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.

After the terrorist attacks of September 11, 2001, the NRC discontinued work on the decommissioning rulemaking because there was no immediate need to complete the rulemaking, as there were no reactors planning to shut down at that time, and redirected resources toward higher priority work related to safeguards and security. However in 2013, four power reactor units permanently shut down and defueled without significant advance notice or preplanning. These licensees and the associated shutdown reactors were Duke Energy Florida for Crystal River Unit 3 Nuclear Generation Plant; Dominion Energy Kewaunee for Kewaunee Power Station; and Southern California Edison for 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.[1] 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 exemptions and 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, the decommissioning process can be improved and made more efficient and predictable by reducing the processing of individual licensing actions and revising the NRC regulations to achieve a long-term regulatory framework for decommissioning. Therefore, the NRC staff intends to determine the appropriate approach for making regulatory changes that reduce the number of licensing actions needed during decommissioning and document its conclusions in the final regulatory basis. The NRC's assessment of insights from the recent licensing activities associated with decommissioning power reactors leads the NRC staff to preliminarily recommend that changes to existing requirements would make the decommissioning process more efficient and predictable by reducing the number of licensing actions needed for decommissioning power reactors.

1.1 Background

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.

On June 28, 2000, the NRC staff submitted SECY-00-0145 (Ref. 3) to the Commission, proposing an integrated decommissioning rulemaking plan. 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,

[1] Furthermore, the Omaha Public Power District board of directors shut down Fort Calhoun Station on October 24, 2016. Exelon plans to close Clinton Nuclear Generating Station on June 1, 2017 and the Quad Cities Generating Station will close on June 1, 2018, 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. 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 NRC's understanding of licensees' plans to decommission at the time this regulatory analysis was prepared. Subsequent to completing the analysis, the licensee for Clinton and Quad Cities reported that it now plans to continue to operate. Adjustments to the number of operating power reactors will be made in the analysis for the final regulatory basis. However, the costs and benefits of the rule would be further affected if the number of facilities that decommission change over time.

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. 2), 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.

1.2 Statement of the Problem

Once a licensee enters the decommissioning phase, certain regulations that did not apply during the operating phase govern the decommissioning process. These requirements establish a timeframe for completion of decommissioning, determine which types of activities require prior NRC approval before being implemented, govern the appropriate release criteria the site must meet to qualify for license termination, outline the appropriate use of decommissioning funds, and set up the enveloping environmental considerations for decommissioning in the GEIS, among other items. These regulations were last updated in the 1996 final rule, "Decommissioning of Nuclear Power Plants" (61 FR 39278), to include enhancements and lessons learned from earlier decommissioning activities.

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 current decommissioning requirements. These areas and the Commission-directed topics are discussed in more detail below with staff recommendations to address the potential changes.

In developing the draft regulatory basis (Ref. 1), the NRC staff explored different alternatives of the following areas of decommissioning to pursue in a rulemaking: emergency preparedness, physical security, cyber security, fitness for duty (FFD) drug and alcohol testing, FFD fatigue management, minimum staffing and training requirements for certified fuel handlers, decommissioning trust fund (DTF), offsite and onsite financial protection and indemnity agreements, application of backfitting protection, and aging management. 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 Draft Regulatory Basis

The following sections of this preliminary draft regulatory analysis document, corresponds with the following appendices of the draft regulatory basis (RB).

- Section 3.0 corresponds to Appendix H of the draft RB.
- Section 4.2 corresponds to Appendix A of the draft RB.
- Section 4.3 corresponds to Appendix B of the draft RB.
- Section 4.4 corresponds to Appendix C of the draft RB.
- Section 4.5 corresponds to Appendix D of the draft RB.
- Section 4.6 corresponds to Appendix K of the draft RB.
- Section 4.7 corresponds to Appendix E of the draft RB.
- Section 4.8 corresponds to Appendix F of the draft RB.
- Section 4.9 corresponds to Appendix G of the draft RB.
- Section 4.10 corresponds to Appendix I of the draft RB.
- Section 4.11 corresponds to Appendix J of the draft RB.

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 come from Appendix A of the draft regulatory basis.

2.1.1 Level 1 – Post Shutdown Emergency Plan (PSEP)

Level 1 commences after the permanently shutdown facility has completed the reactor vessel defueling. 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. 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. 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 Fuel Stored in 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 DOE long-term storage repository.

The assumed radiological hazard is a rupture of the borated water storage tank. The postulated tank rupture could release about 450,000 gallons of slightly radioactive water (i.e., primarily minute amounts of tritium and cesium) onto the plant grounds. Although the health effects are negligible, the cleanup costs are significant. The analysis assumes the removal and disposal of 18 inches of gravel and two feet of the underlying soil in the vicinity of spill. After terminating reactor operations, licensees store spent fuel onsite pending offsite transport to either an offsite ISFSI that is authorized to receive the spent fuel, or a permanent geologic repository licensed for disposal. 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. 52].

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, although considerable, is primarily attributable to activated reactor components and structural materials. There are no credible accident sequences that can result in significant offsite radiological consequences. As a result, the potential accidents that could 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 1, 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 recent reactor shutdowns were unexpected and involved minimal preplanning.

During an approximate 3-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 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 are less 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 1 and Table 2 summarize the licensing activities associated with the five reactor units that recently went through the decommissioning transition process.

Table 1 Licensing Activity Summary for Recent Permanently Shutdown Reactors

Site	Permanent Shutdown Date	Decommissioning Strategy [a]	Public Meetings and Briefings	Licensing Actions
Kewaunee	May 2013	SAFSTOR	3	21
Crystal River Unit 3	February 2013	SAFSTOR	3	15
SONGS, Units 2 and 3	June 2013	DECON	8	12
Vermont Yankee	December 2014	SAFSTOR	2	25
Totals			**16**	**73**

[a] Decommissioning strategies are discussed in Section 3.2 of this document.

Table 2 Licensing Actions Summary for Recent Permanently Shutdown Reactors

Site	Exemptions	Amendments	Order Rescissions	Other	Total
Kewaunee	8	4	3	6	21
Crystal River Unit 3	4	5	2	4	15
SONGS, Units 2 and 3	3	4	2	3	12
Vermont Yankee	8	7	4	6	25
Totals	**23**	**20**	**11**	**19**	**73**

3 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 draft regulatory basis (Ref.1).

3.1 The Level of PSDAR Review and Approval 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.

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 formal PSDAR approval by the NRC. A description of each alternative is provided below.

3.1.1 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 amendment to the PSDAR under certain circumstances, and NRC review without approval of the PSDAR.

3.1.2 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. 43), 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.

The NRC staff also recommends to include guidance that encourages licensees to provide an additional discussion of what considerations and site-specific issues would be addressed in the LTP when it is submitted because that document contains a greater level of detail than the PSDAR regarding remediation activities, final site disposition, and overall decommissioning completion. The guidance would also provide a reminder that the LTP can be submitted before the required minimum of two years in order to better inform the public of ongoing and upcoming decommissioning activities, and can be supplemented, as needed, if conditions or the level of activity changes at the facility. 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 enhancing the guidance on PSDAR preparation, the NRC staff recommends to update and revise the Decommissioning Generic Environmental Impact Statement (GEIS) (Ref. 45), which was last updated in 2002. Potential revisions to the Decommissioning GEIS could be to: (1) include experience from recent decommissioning facilities, (2) incorporate the conclusions of the Continued Storage GEIS, (3) revisit the Decommissioning GEIS findings based on updated information, and (4) revise as necessary to reflect the outcome of rulemaking.

3.1.3 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) specific State involvement in the PSDAR review process, (2) required periodic updates to the PSDAR (e.g., every five years), and/or (3) the licensee to conduct a comprehensive environmental review as part of the PSDAR 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:

- Request State and local government input and feedback on the PSDAR. Any comments formally provided would need to be individually addressed and resolved by the licensee (through revision or supplement of the PSDAR) before the PSDAR can 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 licensee to conduct a site-specific environmental analysis and appropriate consultations as part of its overall preparation and submittal of the PSDAR and submit this analysis to the NRC. Some topics, such as environmental justice would need to be addressed in all such environmental reviews. For other resources, the level of environmental review could be determined by the NRC staff based on site-specific criteria such as presence of groundwater contamination or new protected species not previously considered.

3.1.4 Alternative DAR-4 (Rulemaking to Require PSDAR Review and Approval)

In this alternative, the NRC would pursue rulemaking to codify requirements for review and approval of the PSDAR that would revert to the more formal process used prior to the implementation of the 1996 decommissioning rule. Specifically, these additional regulations would require that the PSDAR be provided as a license amendment request, which would

include an opportunity for 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 licensee would submit the PSDAR as a license amendment request in accordance with 10 CFR 50.90. The PSDAR would be subjected to the same level of review as other license amendment requests. Specifically: (1) the PSDAR would be formally submitted and accepted for review by the NRC; (2) the document would be noticed in the *Federal Register* for a public comment period and opportunity for the public to request a hearing on all or portions of the PSDAR; (3) the PSDAR would need to include an environmental report and the NRC would have to conduct a NEPA analysis (i.e., Environmental Assessment (EA) or Environmental Impact Statement (EIS)) and conduct appropriate consultations (e.g., under the National Historic Preservation Act); (4) the NRC would review the document to ensure it contains enough detail on the decommissioning process to confirm that the activities would not have a negative impact on public health and safety and the environment; and (5) the NRC would compile a safety evaluation and NEPA document giving the conclusions of the review of the PSDAR and, if approved, allowing the licensee to commence major decommissioning activities. The use of this alternative would preclude licensees from beginning active decontamination or dismantlement procedures, or any other major activities, until the PSDAR is approved by the NRC.

3.1.5 Costs and Benefits

Table 3 lists activities and nonquantified costs and benefits for implementing each PSDAR alternative relative to the status quo (Alternative DAR-1).

Table 3 PSDAR Alternatives Costs and Benefits Summary

Alternative	Activities	Costs	Benefits
DAR-2	Update RG 1.185 and NUREG-0586 (GEIS).	Low to moderate costs: • Moderate NRC incremental costs to revise guidance documents • Low incremental Industry costs	Leads to improvements in decommissioning documents submitted to NRC. Provides overall regulatory transparency and openness.
DAR-3	Promulgation of new rule language. State and local government input and feedback on the PSDAR.	Moderate costs: • Moderate NRC incremental costs to amend rule language, issue the proposed and final rules and supporting guidance documents, and	Allows for greater public participation through feedback on the PSDAR and during NEPA process. Provides overall regulatory transparency and openness.

Alternative	Activities	Costs	Benefits
	Periodic update of PSDAR (e.g., every 5 years) by industry. NRC site specific NEPA analysis for the PSDAR.	perform periodic reviews of PSDAR • Low to moderate Industry costs to prepare and submit PSDAR updates and support NEPA review process	
DAR-4	Promulgation of new rule language. Industry provide PSDAR as a license amendment request. Industry provide environmental report to PSDAR. NRC site specific NEPA analysis for the PSDAR.	Moderate to significant costs: • Moderate to significant NRC incremental costs to amend rule language, issue the proposed and final rules and supporting guidance documents, support earlier NEPA review and potential hearing • Moderate to significant Industry costs to prepare and submit PSDAR as an amendment, support earlier NEPA and potential hearing	Allows for greater public participation through the offering of a hearing process for the PSDAR, as well as during the NEPA process. Provides overall regulatory transparency and openness.

3.2 The Appropriateness of Maintaining the Three Existing Options for Decommissioning

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 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.

3.2.1 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.

3.2.2 Alternative O-2 (Guidance Development / Enhancement)

In this alternative, the NRC staff would update or create 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 pursing immediate DECON of at least certain systems and components at the facility. In addition, discussion of the ENTOMB option would be removed from the existing guidance documents to the extent practical since it is not practically feasible for current U.S. power reactors, and the timeframe for completion is inconsistent with the current regulations. In order to capture this information, RG 1.185 and the Decommissioning GEIS would also be updated to include provisions for capturing additional information regarding the decommissioning strategy chosen in the PSDAR.

In order to better inform the public regarding 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 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.

Areas where additional detail could be included are:

- The decision making process behind the selection of SAFSTOR or DECON as the decommissioning method, and a detailed overview of the conditions under which DECON will commence at the facility.

- For the DECON method, how the facility would optimize worker and community safety, cost, institutional knowledge, and socioeconomic impacts, while minimizing opportunities for contamination to migrate offsite.

- The cost over time of the decommissioning method selected, specifically in regard to the potential escalation of dismantlement costs and waste disposal fees.

- If available, 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 the site be made available for industrial use, will the buildings and other structures be left in place, will the site become a "green field"), as well as the associated timelines.

- The ENTOMB option would be removed as an option from the existing guidance, given that it is not practically feasible for nuclear power reactors and not consistent with the required timeframe to compete decommissioning.

This last item on whether to remove the ENTOMB alternative for decommissioning was discussed in the SOC of the June 1988 decommissioning final rule, "General Requirements for Decommissioning Nuclear Facilities" (53 FR 24018), in which the Commission provided the following explanation for retaining the ENTOMB option for decommissioning:

> It is the Commission's belief that the ENTOMB alternative for decommissioning should not be specifically precluded in the rule because there may be instances in which it would be an allowable alternative in protecting public health and safety and common defense and security. By not prohibiting ENTOMB, the rule is more flexible in enabling NRC to deal with these instances. These instances might include smaller reactor facilities, reactors which do not run to the end of their lifetimes, or other situations where long-lived isotopes do not build up to significant levels or where there are other site specific factors affecting the safe decommissioning of the facility, as for example, presence of other nuclear facilities at the site for extended periods. In addition there is potential for variations on the ENTOMB option where, for example, some decontamination has already been performed, thereby making the ENTOMB option more viable.
> …
> [C]oncerns were expressed by the commenters that the ENTOMB option would cause environmental damage due to the presence of long-lived radionuclides which would be radioactive beyond the life of any concrete structure, that it is inconsistent with the definition of decommissioning requiring unrestricted release, and that some reactors are located in highly populous areas. In addition, the Supplementary Information to the proposed rule indicated, in general, that there may be difficulties with the use of ENTOMB, in particular in demonstrating that

> the radioactivity in the entombed structure had decayed to levels permitting unrestricted release of the property in a period on the order of 100 years. In response, the rule contains requirements that a licensee must submit an alternative for decommissioning to the NRC for approval and that consideration will be given to an alternative which provides for completion of decommissioning beyond 60 years only when necessary to protect health and safety. This provides the Commission with both sufficient leverage and flexibility to ensure that if the ENTOMB option is chosen by the licensee it will only be used in situations where it is reasonable and consistent with the definition of decommissioning which requires that decommissioning lead to unrestricted release. As indicated above, analysis of ENTOMB indicates that it can be carried out safely and with minimal environmental effect for the time periods presented in this Supplementary Information and in the guidance under preparation. However, based on the difficulties with ENTOMB described in the Supplementary Information to the proposed rule and by the commenters, use of ENTOMB by a licensee would be carefully evaluated by NRC.

The NRC staff will reexamine the potential impacts of this alternative pending comments received on the draft regulatory basis relative to the use of the ENTOMB option at commercial power reactors.

3.2.3 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.

3.2.4 Costs and Benefits

Table 4 lists activities and nonquantified costs and benefits for alternatives from implementing three options for decommissioning power reactor facilities relative to the status quo (Alternative O-1).

Table 4 Maintaining Decommissioning Option Alternatives Costs and Benefits Summary

Alternative	Activities	Costs	Benefits
O-2	Update RG 1.184, RG 1.185 and NUREG-0586 (GEIS). Remove the ENTOMB discussion from existing guidance documents	Low to moderate costs: • Moderate NRC incremental costs to revise guidance documents • Low incremental Industry costs	Leads to enhancement of decommissioning documents submitted to NRC. Provide overall regulatory transparency and openness.

Alternative	Activities	Costs	Benefits
		• Reduced flexibility in site decommissioning	
O-3	Promulgation of new rule language. RG updates as a result of rulemaking. Additional Industry submissions/information submitted.	Moderate to significant costs: • Moderate to significant NRC incremental costs to amend rule language, issue the proposed and final rule and supporting guidance documents, and review/respond to additional submissions • Moderate to significant Industry costs to address new regulatory requirements and submit additional information / documentation • Reduced flexibility in site decommissioning	Leads to enhancement of decommissioning documents submitted to NRC. Provide overall regulatory transparency and openness.

3.3 The 60-year 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. Completion of decommissioning beyond 60 years will be approved by the Commission only when necessary to protect public health and safety. Factors that will be considered by the Commission in evaluating an alternative that provides for completion of decommissioning beyond 60 years of permanent cessation of operations include unavailability of waste disposal capacity and other site-specific factors affecting the licensee's capability to carry out decommissioning, including the presence of other nuclear facilities at co-located sites.

The current timeframe available for decommissioning 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. Based on an initial assessment of the technical bases that established the 60-year decommissioning timeframe in the 1988 rulemaking, as well as the lessons learned from reactor decommissioning activities, there appear to be no additional safety improvements to be gained by changes in this area.

The NRC staff did examine 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 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.

3.3.1 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.

3.3.2 Alternative T-2 (Guidance Development/Enhancement)

In this alternative, the NRC staff would update or create guidance documents to address the timeframe available to decommission power reactors. Specifically, 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.

Further, several NRC guidance documents related to the decommissioning process could be updated 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 ANPR focused on the motivation of licensees for selecting the long term SAFSTOR option over immediate DECON, and 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.

3.3.3 Alternative T-3 (Rulemaking to Codify the Decommissioning Timeframe)

In this alternative, the NRC staff would pursue rulemaking to decrease the time allowed to complete decommissioning at facilities that are not co-located with operating reactor units and establish requirements for expediting decommissioning to the extent practical at each facility. Specifically, 10 CFR 50.82(a)(3) and the financial regulations for decommissioning would be revised to implement a reduced time limit to complete decommissioning at a reactor facility once the last reactor unit has been permanently shutdown, unless the licensee can demonstrate that delaying decommissioning has an overall net positive benefit to the public health and safety. If this alternative is selected as part of the final regulatory basis for this rulemaking, the NRC staff would conduct additional analyses on the decommissioning data provided by NUREG/CR-0130, “Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station,” NUREG/CR-0672, “Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station,” the Electric Power Research Institute (EPRI), the Nuclear Energy Institute (NEI), and other industry groups to determine the appropriate revised timeframe for completion of decommissioning.

3.3.4 Costs and Benefits

The following table lists additional costs, cost savings and non-cost benefits for implementing alternatives T-2 and T-3 relative to the status quo (T-1).

Table 5 Decommissioning Phase Duration Alternatives Costs and Benefits Summary

Alternative	Activities	Costs	Benefits
T-2	Update RG 1.184 and RG 1.185.	Low to moderate costs: • Moderate NRC incremental costs to revise guidance documents • Low incremental Industry costs	Leads to enhancement in decommissioning documents submitted to NRC. Provides overall regulatory transparency and openness.
T-3	Promulgation of new rule language. RG updates as a result of rulemaking. Additional Industry submissions/information submitted.	Moderate to significant costs: • Moderate to significant NRC incremental costs to conduct additional technical analyses to support a new decommissioning timeframe, amend rule language, issue the proposed and final rule and supporting guidance documents, and review/respond to additional submissions • Moderate to significant Industry costs to address new regulatory requirements and submit additional information / documentation	Allows for greater public participation. Provides overall regulatory transparency and openness.

3.4 The Role of State and Local Governments and Non-Governmental Stakeholders

Although the NRC does not have the authority or the jurisdiction 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, in accordance with 10 CFR 50.82(a)(4) and 10 CFR 50.82(a)(9), the NRC is required 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 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. The NRC's guidance related to creating a site-specific community advisory board can be found in NUREG-1757, Appendix M, "Overview of the Restricted Use and Alternate Criteria Provisions of 10 CFR Part 20, Subpart E" (Ref. 44). 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, to date all decommissioning licensees 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 and jurisdiction given to the NRC by the Atomic Energy Act of 1954, as amended (AEA), there is no basis for the NRC to mandate participation in the decommissioning process by any non-licensee stakeholders. Such interactions must be negotiated on a case by case basis among the licensee, the NRC staff, and the members of the public 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 and members of the public, in the decommissioning process. The NRC considered and evaluated three alternatives: no action, guidance development and enhancement, and rulemaking to mandate creation of a community advisory board. A description of each alternative follows below.

3.4.1 Alternative GOV-1 (No-Action)

The no-action option would retain the provisions of the current decommissioning regulations and guidance documents with regard to the NRC's expectations for external public involvement in the decommissioning process, the role of State and local government entities in decommissioning decisions, and the overall assumption that decommissioning licensees 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, interactions with the State radiological control board on decommissioning issues and site remediation plans).

3.4.2 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, RG 1.184 and RG 1.185 would be updated to include a discussion of best practices for creating a community advisory board at decommissioning facilities, including suggested 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. Additionally in order to better inform the public about the decommissioning process at nuclear power plants, RG 1.184 and RG 1.185 would be updated 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.

3.4.3 Alternative GOV-3 (Rulemaking to Codify State/Local/Non-Government involvement)

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 the decommissioning process. In addition, the NRC would require licensees and/or community advisory boards to provide periodic (likely annual) updates to the NRC regarding the activities of the board, the topics discussed at board meetings, the decisions made as they relate to ongoing activities at the plant, and the overall progress and status of decommissioning at the facility.

3.4.4 Costs and Benefits

The following table lists additional costs, cost savings and non-cost benefits for implementing alternatives GOV-2 and GOV-3 relative to the status quo (GOV-1).

Table 6 Role of Governmental and Non-Governmental Entities Alternatives Costs and Benefits Summary

Alternative	Activities	Costs	Benefits
GOV-2	Update RG 1.184 and RG 1.185.	Low to moderate costs: • Moderate NRC incremental costs to revise guidance documents • Low incremental Industry costs	Leads to enhancement in decommissioning documents submitted to NRC. Provides overall regulatory transparency and openness.
GOV-3	Promulgation of new rule language. RG updates as a result of rulemaking. Additional Industry actions related to committees. Potential additional government and NGO actions.	Moderate to significant costs: • Moderate to significant NRC incremental costs to amend rule language, issue the proposed and final rule and supporting guidance documents, and review/respond to additional submissions • Moderate to significant Industry and government / NGO costs to address new regulatory requirements	Allows for greater public participation.. Provides overall regulatory transparency and openness.

Alternative	Activities	Costs	Benefits
		and submit additional information / documentation	

3.5 Clarifying the Spent Fuel Management Requirements

The NRC staff found that 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 need to be clarified. 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 before starting to decommission systems and components needed for moving, unloading, and shipping this spent fuel. In 10 CFR 72.218(b), an application for termination of a reactor operating license submitted under 10 CFR 50.82 or 10 CFR 52.110 must also contain a description of 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 license termination plan, the requirements in 10 CFR 50.54(bb), 10 CFR 50.82, and 10 CFR 52.110 do not contain this information.

Prior to 1996, the reactor decommissioning regulations required a licensee to submit a detailed Decommissioning Plan (DP) before the licensee could begin dismantlement or any major decommissioning activities. The 10 CFR 72.218(b) reference to the 10 CFR 50.82 and 10 CFR 52.110 application for termination of a reactor operating license was intended to apply to the detailed DP that was previously (prior to 1996) required to be submitted to the NRC for review and approval. As discussed in the SOC for the 1989 proposed ISFSI general license rule [Ref. 53] 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 change 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 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 prior to or within two years following permanent cessation of operations, and that an LTP must be submitted two years prior to license termination for NRC review and approval. Following the 1996 rulemaking, the 10 CFR 72.218(b) reference to 10 CFR 50.82 and 10 CFR 52.110 refers primarily to the LTP. However, by the time of LTP submittal, most of the 10 CFR Part 50 or 10 CFR Part 52 facilities, including any support facilities for moving, unloading, and shipping spent fuel, 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 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. Also 10 CFR 50.54(bb) requires licensees (either five years before license expiration or

two years following shutdown, whichever comes first) to submit for NRC "review and preliminary approval" its program for management, and providing funding for the management, of spent fuel until DOE takes title to, and possession of, the spent nuclear fuel. However, currently the requirements of 10 CFR 50.54(bb) pertain 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, prior to the licensee decommissioning the systems needed to move, unload, and ship the spent fuel at the facility. This is a disconnect 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, such as guidance revisions or development, to ensure that licensees undergoing the decommissioning process are taking adequate actions in regard to maintaining the appropriate systems and capabilities for spent fuel management and handling capabilities. The NRC considered and evaluated three alternatives: no action, guidance development and enhancement, and rulemaking to clarify the spent fuel management requirements. A description of each alternative follows below.

3.5.1 Alternative SFM-1 (No-Action)

The no-action alternative would retain the provisions of the current decommissioning regulations and guidance documents with regard to the NRC's expectations for 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.

3.5.2 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 and remove spent fuel from the site before they decommission the structures, systems, and components that support moving, unloading, and shipping of spent fuel. Specifically, RG 1.184 and/or 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 equipment to be available after the facility has entered into the decommissioning and dismantlement process.

3.5.3 Alternative SFM-3 (Rulemaking to clarify spent fuel management requirements)

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 from the site before it decommissions the structures, systems, and components that support moving, unloading, and shipping of spent fuel. Specifically, language would be added to 10 CFR 50.82(a)(4) and 10 CFR 52.110(d) requiring that the PSDAR or other decommissioning document, such as the IFMP, contain a description of how the spent fuel stored under a general ISFSI license will be removed from the reactor site. In addition, language would be added to 10 CFR 50.54(bb) to establish that the program for managing spent fuel during decommissioning must take into consideration how the spent fuel will be managed before starting to decommission systems and components needed for moving, unloading, and shipping the spent fuel. The language in 10 CFR 72.218(b) would also be clarified to refer to the PSDAR, rather than the LTP, and 10 CFR 72.218 would also be made applicable to specific ISFSI licensees.

3.5.4 Costs and Benefits

The following table lists additional costs, cost savings and non-cost benefits for implementing alternatives SFM-2 and SFM-3 relative to the status quo (SFM-1).

Table 7 Spent Fuel Management Requirement Alternatives Costs and Benefits Summary

Alternative	Activities	Costs	Benefits
SFM-2	Update RG 1.184 and RG 1.185.	Low costs: • Low NRC incremental costs to revise guidance documents • Low incremental Industry costs to conform with regulatory guidance	Leads to enhancement of decommissioning documents submitted to NRC. Provides overall regulatory transparency and openness.
SFM-3	Promulgation of new rule language. RG updates as a result of rulemaking. Additional Industry actions to provide additional information on SFM requirements in decommissioning documents.	Moderate costs: • Moderate NRC incremental costs to amend rule language and issue the proposed and final rule and supporting guidance documents • Low to moderate Industry costs to conform with regulatory requirements and submit additional information / documentation	Allows for greater public participation. Clarifies current area of confusion in the spent fuel management requirements. Provides overall regulatory transparency and openness.

3.6 Clarifying the Environmental Requirements

As part of its overall review of the decommissioning regulations, the staff identified that some of the regulations in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," imply that a license amendment is required before decommissioning activities may commence at power reactors, which appears to be in conflict with the current regulations in 10 CFR 50.82. Specifically, 10 CFR 50.82 was revised in 1996 to no longer require that a license amendment be approved by the NRC before a licensee could begin decommissioning activities. In its place, a PSDAR is submitted within two years of permanent shutdown, which requires NRC review but not approval before major decommissioning activities can commence. In addition, the PSDAR does not require the licensee to supplement, or the NRC to review, the environmental report for the decommissioning facility. Instead, the 1996 SOC explained that the environmental impacts of decommissioning should be bounded by previous environmental analyses, and therefore licensees only had to document in the PSDAR the reasons the proposed activities are bounded by existing analyses of environmental impacts. The NRC considered and evaluated two alternatives: no action and rulemaking to clarify the environmental requirements. A description of each alternative follows below.

3.6.1 Alternative ENV-1 (No-Action)

The no-action alternative would retain the provisions of the current decommissioning regulations and guidance documents with regard to the NRC's expectations for the environmental requirements for decommissioning of nuclear reactors.

3.6.2 Alternative ENV-2 (Rulemaking to amend the Environmental Requirements)

In this alternative, the NRC would amend 10 CFR 51.53 and 10 CFR 51.95 to clarify that the discussion in the associated environmental requirements regarding the need for a license amendment before decommissioning activities commence applies only to non-power reactors, in accordance with the 1996 changes to the decommissioning regulations. This change would be consistent with the SOC for the 1996 decommissioning final rule (61 FR at 39290), in which the Commission explained that the language addressing license amendments in these two sections concerns non-power reactors only.

3.6.3 Costs and Benefits

The following table lists additional costs, cost savings and non-cost benefits for implementing alternative ENV-2 relative to the status quo (ENV-1).

Table 8 Environmental Requirements Alternatives Costs and Benefits Summary

Alternative	Activities	Costs	Benefits
ENV-2	Promulgation of new rule language. RG updates as a result of rulemaking. No additional Industry actions since change is a clarification of existing requirements.	Low to Moderate costs: • Low to Moderate NRC incremental costs to amend rule language and issue the proposed and final rule and supporting guidance documents • No expected Industry costs	Allows for greater public participation. Clarifies current area of confusion in the environmental requirements. Provides overall regulatory transparency and openness.

4 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 2.2:

- 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 Actions alternative (Alternative 1) because it would attempt to address the decommissioning areas through other means. However, a preliminary 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.

4.1 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. 12). 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 mandated changes.

- Industry Operation: This attribute accounts for the projected net economic effect caused by routine and recurring activities required by the proposed alternatives on 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 proposed 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 proposed 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 proposed action on the federal government (other than the NRC) and state and local governments resulting from the action's implementation or operation.

- Regulatory Efficiency: This attribute accounts for regulatory and compliance improvements resulting from the implementation of the proposed alternative relative to the regulatory baseline.

Attributes not expected to be affected under the alternatives 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.

4.2 Emergency Preparedness

The emergency preparedness (EP) requirements of 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, there are no explicit regulatory provisions distinguishing 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 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 based on the determination that there are 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. The NRC has also relied on analyses that have shown that the possibility of the spent fuel in the spent fuel pool (SFP) reaching the point of a beyond-design-basis zirconium fire is highly unlikely based on the amount of time before the spent fuel could reach the zirconium ignition temperature during a SFP draindown event (Ref. 9). Based upon reasonably conservative adiabatic heatup calculations, a minimum of 10 hours for the heatup time has been used to support approving exemptions from portions of the EP regulations. This 10 hour heatup time allows for onsite mitigation measures to be taken by the licensee or, if necessary, appropriate response actions to be taken by offsite authorities utilizing an all-hazards type emergency management plan. Between 1987 and 1999, the NRC issued exemptions from EP requirements for ten licensees. In the four most recent EP exemptions issued between 2014 and 2015,[2] the licensees were required to have sufficient trained personnel on-shift, and equipment and procedures to implement their site-specific preplanned mitigation strategies within a two-hour timeframe; these mitigation strategies are required by a license condition until such time as 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 relieve the licensee from the requirement to maintain formal offsite radiological emergency preparedness (REP), including the 10-mile plume exposure pathway and the 50-mile ingestion pathway emergency planning zones (EPZs).

In addition, licensees pay fees to the Federal Emergency Management Agency (FEMA) and the participating states and localities to maintain 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. 15), 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. 16), 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

[2] The recent exemptions for emergency planning have been granted for Kewaunee Power Station (Ref. 37), Crystal River Unit 3 Nuclear Generating Plant (Ref. 38), San Onofre Nuclear Generating Station, Units 2 and 3 (Ref. 39), and Vermont Yankee Nuclear Power Station (Ref. 40).

(Ref. 17). Pursuant to 44 CFR 354.4(d), licensees are required to pay these fees until FEMA receives a copy 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. 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 evaluating whether to amend the NRC's emergency preparedness regulations in 10 CFR Part 50, specifically 10 CFR 50.47, 10 CFR 50.54(q), (s), and (t), and Appendix E to 10 CFR Part 50, to establish an appropriate level of emergency planning and preparedness for a nuclear power plant site at which all reactors have been permanently shut down and defueled. The 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.

4.2.1 Alternative EP-1 (No-action alternative)

Under the no-action alternative, the EP requirements in 10 CFR 50.47 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 spectrum of accidents that can have significant offsite consequences is greatly reduced and dominated by the zirconium fire scenario – 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 also do not address that considerably more time is available to respond to a postulated zirconium fire incident than is available for many postulated operating reactor accidents.

Because certain of the 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. 54] exemptions to offsite EP requirements must be supported by a site-specific analysis demonstrating that fuel stored in the SFP would not reach the zirconium ignition temperature in less than 10 hours. This requires 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 and is unlikely to benefit from further gains in efficient application of the EP exemption process. For this alternative, the NRC assumes that licensees whose plants are entering decommissioning would request EP exemptions and would incur the burden reductions associated with the exemptions from EP requirements.

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. With respect to the PDEP, a licensee could submit it to the NRC for prior review and approval and the NRC would review and document its determination on the PDEP in a safety evaluation report (SER). The NRC approval of the PDEP would establish NRC documentation that the licensee has maintained reasonable assurance that adequate protective measures can and will be taken in a radiological emergency and would provide a documented, 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 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.

4.2.2 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 levels of decommissioning listed in section 2.1 above: (1) permanent cessation of operations and defueling – all fuel is removed from the reactor vessel (PSEP), (2) fuel in the SFP has sufficiently decayed such that it would not reach ignition temperature within 10 hours under adiabatic heatup conditions (PDEP), (3) all fuel is in dry storage (IOEP), and (4) all fuel is removed 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, licensees will still be required to follow the 10 CFR 50.90 license amendment process to submit, for prior NRC review and approval, a revised emergency plan that describes the licensee commitments and plan features to meet one of the levels (i.e., PSEP, PDEP, or IOEP). The NRC would review and document its review of this submission in an SER. 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. A detailed analysis between Alternatives EP-1 and EP-2 is provided below.

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. 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 (PSEP)

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.

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 (NOUE), (2) Alert, (3) Site Area Emergency (SAE), and (4) General Emergency (GE). All of these ECLs would still apply in Level 1. While 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 the health and safety of the public. 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 protective action recommendations and to provide the

ETEs to State and local governmental authorities for use in developing offsite protective action strategies. The NRC staff concludes that updates to the ETE during Level 1 would provide limited benefit for the enhancement of protective action strategies and/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 at least an additional 180 days before an updated ETE can be used to inform protective action recommendations and offsite protective action strategies. The additional time and effort it takes 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 NRC staff's review of submitted ETEs, population changes within a time 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 protective action recommendations 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. This does not represent a material change in how licensees meet the EP requirements from Alternative EP-1.

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. 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 annual dissemination of public information would not be required. However, for Level 1, the change in operating status of the plant and the ensuing changes to the EP program prompt the need to provide a final annual 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 should be included in the final annual dissemination of public information. 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. Because of the low probability of design basis accidents (DBAs) or other events that could result in exceeding the EPA PAGs, and because of 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. Beginning in Level 1, exercise scenarios could be commensurately reduced with the permanent cessation of power reactor operations 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 Radiological Emergency Preparedness (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, there exists a potential for a full participation exercise to be required during Level 1. As the risk of an accident resulting in a radiological release offsite is significantly reduced in Level 1 and since formal offsite REP programs are not a requirement of Level 2, there would be limited safety benefit to performing full-scale participation exercises simulating a release with offsite consequences during the time a licensee is in Level 1. The NRC staff anticipates a need to further clarify 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. This new regulation or guidance would be developed as part of Alternative EP-2.

Hostile Action Requirements

Section IV.F.2.c.4 and Section IV.F.2.i of Appendix E to 10 CFR Part 50, 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 starting in Level 2. Although the rationale for excluding hostile action requirements from Level 2 could be applied to Level 1, 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 full-participation HAB 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 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. In 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 would no longer be required to maintain an ERDS per 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 (PDEP)

For plants that have permanently shut down and defueled (Level 1), the proposed 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 shut down 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 the public health and safety. The NRC staff is considering two conditions to specify when the transition to a Level 2 PDEP may occur: (1) after a specified amount of cooling time in Level 1, or (2) after a 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. 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. Therefore, the recommended regulations would provide for transition to Level 2 after the specified time given above has passed. 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 review and approval by the NRC prior to a transition to Level 2. The details regarding these issues would be determined during the proposed rule phase of this rulemaking. 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. For this preliminary draft regulatory analysis, the staff assumes that each licensee would submit a site-specific analysis similar to the analyses submitted under Alternative EP-1. As a result, this does not represent a material change in burden from Alternative EP-1.

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 to the draft regulatory basis (Ref. 1).

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

- The onsite emergency organization of plant staff personnel for all shifts and its relation to the responsibilities and duties of the normal staff complement;
- 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; and
- 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.

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 associated with 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 exact timeframe that will be required for emergency declaration for licensees in Level 2 is still under consideration by the NRC staff and will be provided at the proposed rule stage; however, the NRC staff concludes 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.

Offsite Radiological Emergency Response Plans

The NRC has concluded in its review of several exemption requests that as long as a minimum of 10 hours is available to initiate mitigation measures or to take appropriate response actions, 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 on-site 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 take appropriate response actions offsite and, therefore, formal offsite radiological emergency plans would no longer be necessary for adequate protection of the public health and safety.

Many communities have comprehensive all-hazard response or comprehensive emergency management plans in place to supplement these capabilities. Offsite response organizations will continue to take actions to protect the health and safety of the public as they would at any other industrial site, and under this alternative, memoranda of understanding (MOU) between licensees and OROs would still be expected to be established 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, licensees would still be required to identify local offsite services and assistance expected from governmental agencies in their emergency plans. The staff

assumes 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.

Notification Requirement to State and Local Governmental Agencies

Section IV.D.3 of Appendix E to 10 CFR Part 50 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. 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.

Public Alert and Notification Systems

Section IV.D.3 of Appendix E to 10 CFR Part 50 requires licensees to maintain a public alert and notification system. 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. The NRC staff assumes that this does not represent a material change in how the public alert and notification system is maintained and exercised from Alternative EP-1.

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 power plant must be defined both for the shorter-term plume exposure pathway and the longer-term ingestion pathway. Because of the low probability of design-basis accidents 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 pathway EPZs in Level 2. The NRC staff assumes that this does not represent a material change in how the licensee maintains the plume exposure pathway and ingestion pathway EPZs from Alternative EP-1.

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 still be required to provide protective actions for any emergency workers that 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.

Evacuation Time Estimate Studies

Licensees must develop and update Evacuation Time Estimates (ETEs) per the requirements in 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.

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 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), requirements for TSC, OSC, and EOF designated staff would also no longer be required by 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 take protective actions, licensees in Level 2 would not need the TSC, OSC, or EOF designated staff, or offsite field 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.

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 could cause offsite radiological consequences. The NRC staff assumes that the treatment of hostile action requirements does not represent a material change from Alternative EP-1.

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 proposed guidance developed as part of Alternative EP-2 and therefore that this will not represent a material change in burden from Alternative EP-1.

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 requirements for formal 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.

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 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 Part 50 or 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—Part 72 specific licensees and Part 50 or 52 licensees with 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 draft 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 recommended changes to regulations for emergency preparedness that apply to decommissioned power reactors

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

The requirements of 10 CFR 50.54(s)(2)(ii) and (s)(3), regarding findings and determinations of reasonable assurance, are conditions of every 10 CFR Part 50 license. The relationship between the NRC and FEMA concerning findings of reasonable assurance of offsite EP is based on the Atomic Energy Act of 1954, as amended; the Energy Reorganization Act of 1974, as amended; the NRC Authorization Act of 1980; NRC's regulations; an MOU between the two

agencies; and case law. However, the NRC staff is proposing that if formal offsite REP is not required by regulation, 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 only when offsite REP programs are required by regulation. This amendment would be generally applicable and not specific to decommissioning sites (e.g., it may apply if formal offsite REP programs are not required for small modular reactors or other new reactor technologies). 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 and for Alternative EP-2.

Notifications under 10 CFR 50.72

The regulations in 10 CFR 50.72 provide immediate notification requirements and stipulations for a number of one-hour, four-hour, and eight-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 one-hour reporting requirement of 10 CFR 50.72 is consistent with the recommended regulations for notification requirements for licensees in Level 2. The eight-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. The NRC staff assumes that the notification requirements performed for Alternative EP-1 will be reflected in the proposed guidance developed as part of Alternative EP-2 and therefore will not represent a material change in burden from Alternative EP-1.

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. Section 50.54(q) also contains the conditions by 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.

For emergency plan changes between levels, the licensee would use the 10 CFR 50.90 license amendment process to submit, for prior NRC review and approval, a revised emergency plan which describes the licensee commitments and plan features to meet one of the levels (i.e., PSEP, PDEP, or IOEP). The NRC would review and document its review of this submission in an SER. This would establish NRC documentation that the licensee maintained reasonable assurance and would provide a documented, approved emergency plan as a licensing basis against which future changes could be compared. This requirement would provide for regulatory certainty, public hearing rights, and a documented baseline emergency plan. However, these benefits would come at the cost of the additional licensee and NRC staff hours

and expense associated with the license amendment process, and would not necessarily increase the margin of safety.

For emergency plan changes within each level after the plan has been implemented for Level 1 (PSEP) or 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, would continue to meet the EP regulatory standards for the applicable level. Licensees would be required to submit to the NRC a report of each such change within 30 days under 10 CFR 50.54(q)(5). Changes that would reduce the effectiveness of the plan would be required to be submitted for prior NRC review and approval per 10 CFR 50.54(q)(4) so that the NRC could make the requisite reasonable assurance determination. For emergency plan changes within Level 3 (IOEP), depending on whether a general or specific Part 72 license is in place, the licensee would have to meet the emergency plan change requirements of 10 CFR 50.54(q) or 10 CFR 72.44(f). Additional guidance would be provided in RG 1.219, "Guidance on Making Changes to Emergency Plans for Nuclear Power Reactors," or a similar document, to assist the licensee in making its reduction in effectiveness determination. This new guidance would be developed as part of Alternative EP-2. The staff assumes that the effectiveness determination process used for Alternative EP-1 will be reflected in the proposed guidance developed as part of Alternative EP-2 and therefore will not represent a material change in burden from Alternative EP-1.

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, all program elements must still be reviewed 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 without conducting an assessment against performance indicators (rather than at intervals not to exceed 12 months). 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:

- RG 1.219, "Guidance on Making Changes to Emergency Plans for Nuclear Power Reactors"[3]
- 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"

4.2.3 Alternative EP-3 (Rulemaking to amend regulations to provide a graded approach to emergency preparedness / emergency plan changes between levels without NRC approval)

This alternative is identical to Alternative EP-2 except that 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 provided that the change is enacted to comply with the EP requirements corresponding to the licensee's level of decommissioning.

Under this alternative, licensees making changes to their emergency plan to commit to the EP requirements of a decommissioning level would not be required to perform reduction in effectiveness determinations for these changes. Instead, this determination would have already been made by the Commission through its promulgation of the regulations regarding the graded EP standards and associated emergency planning functions. License amendment requests would not be necessary provided that the licensee is making changes to the emergency plan to comply with the EP requirements corresponding to the licensee's level of decommissioning. Although hearing rights associated with the license amendment process would no longer be available for each of these individual changes, the public would have been given 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 be required to request exemptions from the applicable EP regulations. Under Alternative EP-3, license amendment requests to commit to the EP requirements corresponding to the licensee's level of decommissioning and the licensee's need to perform reduction in effectiveness determinations would not be necessary.

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.

[3] 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.

This change also requires FEMA to perform a rulemaking to amend 44 CFR 354.4(e), "Discontinuation of charges," to reflect this new process.

4.2.4 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 alternatives EP-2 and EP-3, 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 alternatives EP-2 and EP-3, the staff assumes that staffing and emergency response organization requirements do not represent a material change in burden from Alternative EP-1.

- For alternatives EP-2 and EP-3, the staff assumes in this analysis that the new guidance would reflect how ECLs and EALs are implemented in Alternative EP-1 and therefore do not represent a material change in burden from Alternative EP-1.

- The following recommended changes to the regulations that are detailed in alternatives EP-2 and EP-3 are typically included in EP exemptions. The timing of the benefits that would be received from the EP exemptions coincides with the timing of the benefits that would be received from Alternatives EP-2 and EP-3:

    - Drill and Exercise Program
    - Emergency Assessment, Classification, and Declaration
    - Emergency Classification Levels and Emergency Action Levels
    - Emergency Facilities and Equipment
    - Emergency Response Data System
    - Evacuation Time Estimate Studies
    - Hostile Action Requirements
    - Notification Requirement to State and Local Governmental Agencies
    - Offsite Radiological Emergency Response Plans
    - Offsite Radiological Protective Action Recommendations
    - Offsite Response Organization Participation in Drills and Exercises
    - Public Alert and Notification Systems

- Plume Exposure Pathway and Ingestion Pathway Emergency Planning Zones
- Staffing and Emergency Response Organization
- Technical Support Center (TSC), Operations Support Center (OSC), Emergency Operations Facility (EOF) Designated Staff

4.2.5 Affected Attributes

Industry Implementation: Under Alternatives EP-2 and EP-3, licensees would not need to apply for exemptions from EP requirements. This would result in a one-time benefit (i.e., averted cost) to industry for plants that enter decommissioning after issuance of the rule. Under Alternative EP-3, licensees would not need to submit licensing amendment requests to commit to the EP requirements corresponding to the licensee's level of decommissioning and would not need to perform reduction in effectiveness determinations to support these requests.

Industry Operation: Under Alternatives EP-2 and EP-3, 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 and Alternative EP-3, the NRC incurs a one-time cost in order to develop either of the rules and to update the guidance in RG 1.219 (Ref. 19), NSIR/DPR-ISG-01, NUREG-1022, IP 82501, and IP 82401. For Alternative EP-2, exemptions from, and for Alternative EP-3, exemptions from and amendments to, pertinent 10 CFR 50.47(b) and Appendix E to 10 CFR Part 50 requirements would not be required, which would result in a benefit (i.e., averted cost) to the NRC.

Other Government: To implement Alternative EP-2 and Alternative EP-3, 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.

4.3 Physical Security

Nuclear power reactor licensees, whether they hold a license under 10 CFR Part 50 or 10 CFR Part 52, 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, the licensee must protect the ISFSI in accordance with 10 CFR 72.212, "Conditions of General License issued under 10 CFR 72.210." Generally, the power reactor physical security (PS) requirements in 10 CFR 73.55 and the NRC security orders that apply to licensees of operating nuclear power reactors also apply during decommissioning. While a licensee may have permanently ceased operating and removed all fuel from its reactor vessel,

this does not terminate its 10 CFR Part 50 license with the exception of cyber security requirements discussed more fully below, provide relief from these security requirements.

Under the existing regulations, each nuclear power reactor licensed under 10 CFR Part 50 or 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 as part of their license conditions. 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. This section further requires that the licensee's physical protection program ensure 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) is maintained at all times. Regulations in 10 CFR 73.55(b)(3) also require that the licensee's physical protection program provide defense-in-depth through the integration of systems, technologies, programs, equipment, supporting processes, and implementing procedures to ensure the program's continued effectiveness.

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. The NRC staff is recommending rulemaking to amend certain physical security requirements to allow for a step-down in security during decommissioning commensurate with the documented decreased security risk associated with cessation of reactor operations and the placement of all fuel into dry cask storage systems (DCSS). The NRC staff is proposing two alternatives to address the above physical security issues, which are described below.

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 is 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 in accordance with 10 CFR 50.54(p) or are submitted to the NRC for review and approval prior to implementation in accordance with 10 CFR 50.90, "Application for amendment of a license, construction permit, or early site permit." 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.

4.3.1 Alternative PS-1 (No-action alternative)

The no-action alternative would retain the current physical security regulatory structure for power reactor licensees. In this alternative the NRC would continue to process licensee requests for exemptions from certain requirements and license amendment requests to amend the security commitments in existing license conditions.

4.3.2 Alternative PS-2 (Rulemaking)

In this alternative, the NRC staff would pursue rulemaking to implement appropriate 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.** Currently, 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 pursuant to 10 CFR 50.82 or 10 CFR 52.110, the NRC notifies licensees by letter that they are no longer subject to NRC-conducted force-on-force inspections. The NRC staff is not recommending that any changes be made to this notification process.

- **Suspension of security measures.** The NRC staff is recommending to amend 10 CFR 73.55(p) to permit a certified fuel handler, as defined in 10 CFR 50.2, 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. 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 the appropriate regulations are now written, the suspension of the above security measures to protect the public or protect the security officer in the instance of severe weather could not be accomplished at a decommissioning reactor without first requesting an exemption.

- **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 and no longer has fuel in the reactor vessel would not undergo an emergency shutdown to prevent significant core damage or a radiological release; with no fuel in the reactor vessel, damage to the core poses no radiological risks. Accordingly, there is no longer a need for licensees to protect against significant core damage once all fuel is in the SFP or in a DCSS. Training of security personnel to prevent significant core damage 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) that the physical protection program be designed to prevent significant core damage. All other conditions in this section 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 there is no longer a need for the ultimate heat sink once all fuel is in the SFP or in DCSS and no longer a need for any operational training to address loss of the ultimate heat sink. Consequently, the security order requirement for operational training for this condition would no longer be needed.

  Therefore, the NRC staff is proposing to provide licensees with a nuclear power reactor in decommissioning with relief from the requirement in section B.1.a of Security Order EA-02-026 (Ref. 21). All other conditions in this order would remain in effect. Licensees would be notified by letter upon docketing of the 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 that the requirement to implement section B.1.a of Order EA-02-026 is rescinded in its entirety.

- **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 as any area which contains vital equipment. 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. Equipment or systems which would be required to function to protect public health and safety following such failure, destruction, or release are also considered to be vital. The role of the reactor control room at an operating plant as described in Part 50, Appendix A, Section (II), Criterion 19. 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 specific vital equipment associated with operating the reactor vessel is no longer needed. Any the remaining vital equipment may no longer be needed or may be relocated to a vital area separate from the control room. Accordingly, 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 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 licensee has submitted and the NRC has docketed the 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.

- **Communications with the control room.** Section 73.55(j)(4)(ii) requires that a system for continuous communication capabilities with the control room must terminate in both alarm stations to ensure effective command and control during both normal and emergency conditions. One purpose of this requirement is to ensure 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 a control room; therefore, the NRC staff is recommending that the requirement for continuous communications to be maintained between the alarm stations and the control room

should be replaced with a requirement for communications to be maintained between the alarm stations and the certified fuel handler and/or senior on-shift licensee representative once a nuclear power reactor has file the and the NRC has docketed the certifications required by 10 CFr 50.82. This change would ensure that the safety/security interface required by 10 CFR 73.58, "Safety/security interface requirements for nuclear power reactors," is maintained at a facility during decommissioning.

- **Number of armed responders.** The NRC staff recommends no 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 when it comes to 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 two months following the change. Finally, licensees may request specific exemptions for security requirements in accordance with 10 CFR 73.5, "Specific Exemptions." Specific exemptions may be requested by licensees to address, among other things, changes in site conditions arising from decommissioning. All exemptions must be reviewed and approved by the NRC prior to the changes being implemented.

  Upon the cessation of operations and removal of all fuel from the reactor core, licensees that are performing decommissioning activities may want to modify their physical protection programs to reflect changes in site conditions, including but not limited to: (1) changes to vital areas as defined in 10 CFR 73.2; (2) the reduced number of target sets; (3) the number of armed personnel necessary to protect the nuclear materials possessed at the facility; and (4) the location of physical barriers required to meet the requirements of 10 CFR 73.55.

  Operating reactor licensees that are decommissioning typically use the 10 CFR 50.54(p)(2) process to implement changes to their site security plans (e.g., removal of barriers, reduction of vital areas and armed response team members). After the licensee has implemented the changes to their security plans and submitted the required report of the changes, NRC staff practice is to review these reports to ensure that the licensee has properly adhered to the requirements of 10 CFR 50.54(p)(2) and not implemented a change that decreases the safeguards effectiveness of its security plans

  The NRC staff further notes that the 10 CFR 50.54(p)(2) change process is complicated for both licensees and NRC staff by the fact that the term "decrease in safeguards effectiveness" is not defined in regulations. This contrasts with the treatment of emergency plans in 10 CFR 50.54(q), which does contain a definition of the similar concept of "reduction in effectiveness." Accordingly, the NRC is considering adding the following definition to 10 CFR 50.2 or 10 CFR 50.54(p)(2):

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 function that was previously performed or provided by the changed element or component without compensating changes to other security plan elements or components.

- **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 must protect spent fuel in accordance with the provisions and requirements of the licensee's 10 CFR 73.55 physical security plan with enumerated conditions and 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 typically 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 spent fuel pool and placed in DCSS. At this point, the security measures needed to protect the facility from radiological sabotage decrease significantly. Once the reactor ceases to operate, many requirements in 10 CFR 73.55, (e.g., fitness-for-duty, target sets, and vital areas) are no longer needed because there is no fuel in the reactor core. General ISFSI licensees must submit license amendments and requests for regulatory exemptions to obtain relief from these requirements. The NRC has previously exempted decommissioning licensees who have placed all fuel into DCSS from the requirements of 10 CFR 73.55, and allowed the licensees to commit to following the specific license ISFSI physical security requirements in 10 CFR 73.51.

  The NRC staff is recommending changes to the provisions of 10 CFR Parts 72 and 73 to transition a general license ISFSI to the requirements of 10 CFR 73.51 when the power reactor facility has removed all fuel from the spent fuel pool and placed it in DCSS. The NRC staff is considering adding the following language to 10 CFR 72.212(b)(9) to effect this change:

  (vii) Upon docketing of the certifications of permanent cessation of operations and permanent removal of fuel from the reactor vessel pursuant to § 50.82 or § 52.110 of this chapter, and revision of the final facility safety analysis report to reflect that all spent fuel has been placed in dry storage at the facility (including a prohibition against storage of fuel in the spent fuel pool), the licensee shall provide for physical protection of the spent fuel under Subpart H of this part and § 73.51 of this chapter.

4.3.3 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.

4.3.4 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.

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.

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 recession requests to the NRC to receive certain relaxation from physical security requirements. This would allow licensees to complete their decommissioning operations without diverting resources to submit these requests.

4.4 Cyber Security

The current cyber security requirements for power reactors are set forth in 10 CFR 73.54, "Protection of digital computer and communication systems and networks." These requirements were established as part of a 2009 final rule, "Power Reactor Security Requirements," (74 FR 13926, March 27, 2009). As stated in this rule's statement of considerations (SOC), the rule's requirements became effective on May 26, 2009. The rule states that "each licensee currently licensed to operate a nuclear power plant under 10 CFR Part 50" must submit a cyber security plan for NRC review and approval by November 23, 2009. The rule further required that current applicants for an operating license or combined license who had submitted their applications to the Commission must amend their applications to include a CSP. The rule did not apply to those nuclear power rector licensees that had filed and had docketed the certifications required under 10 CFR 50.82 and 10 CFR 52.110 prior to the effective date of the rule because these licensees were not currently authorized to operate even though they still possessed a license.

Neither the rule's SOC nor the terms of 10 CFR 73.54 explicitly address the applicability of the cyber security requirements to a nuclear power plant licensee that permanently defuels and shuts down after the rule's effective date. As a result, there is a potential for inconsistency in

the application of the cyber security requirements to the licensee of a nuclear power plant that was in a decommissioning status as of May 26, 2009, and the licensee of a nuclear power plant that enters decommissioning after this date. Further, notwithstanding the NRC staff's view that 10 CFR 73.54 no longer applies once a licensee's 10 CFR 50.82 or 10 CFR 52.110 certifications are docketed, 10 CFR Part 50 and 52 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. Accordingly, licensees that are decommissioning will remain subject to their CSP license conditions absent NRC approval of an amendment request. The NRC is currently following its normal process to evaluate any license amendment requests submitted by the licensees requesting for the removal of these license conditions on a case-by-case basis.

Once the NRC has docketed a licensee's 10 CFR 50.82 or 10 CFR 52.110 certifications the licensee is no longer authorized to operate a nuclear power plant. However, a reactor licensee who has submitted its 10 CFR 50.82(a)(1) or 10 CFR 52.110(a) certifications may still have fresh nuclear 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 heatup to clad ignition temperature within 10 hours in postulated SFP draindown scenarios. Once the spent fuel has sufficiently decayed, the potential consequences of a cyber attack are significantly reduced, since 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.

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 above issues associated with cyber security requirements for decommissioning power reactors and these alternatives are presented below.

4.4.1 Alternative CS-1 (No-action alternative)

Under the no-action alternative, no changes would be made to the current cyber security requirements set forth in 10 CFR 73.54 for 10 CFR Part 50 and 10 CFR Part 52 licensees. 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 (b); and those certifications have been docketed by the NRC, the licensee is no longer licensed 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 authorized to operate a nuclear power reactor.

Nevertheless, the licensee's CSP is still incorporated into the license as a license condition.. As such, a licensee remains subject to its CSP license condition until the NRC approves a license amendment request to remove the CSP license condition 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) 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, similar to such requests submitted by Kewaunee and Crystal River (Ref. 1).

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

In this alternative, the NRC would pursue a rulemaking to propose 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, the licensees would still have a license condition requiring a CSP until (1) the NRC approves a license amendment to remove the CSP license condition, or (2) the NRC issues a rule that would remove the CSP license condition.

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

This alternative would pursue a rulemaking to propose that the cyber security requirements in 10 CFR 73.54 would continue to apply to decommissioning power reactors until such time that the fuel in the spent fuel pool has sufficiently cooled enough to result in a negligible chance of a zirconium fire (i.e., 10 months for BWRs and 16 months for PWRs). Under this alternative, the licensees would still have a license condition requiring a CSP until (1) the NRC approves a license amendment to remove the CSP license condition, or (2) the NRC issues a rule that would remove the CSP license condition.

4.4.4 Affected Attributes

Industry Implementation: None

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 CS-3 the NRC would incur a one-time cost relative to the status quo for developing the rule. In Alternative CS-3, the NRC would need to review and approve the license amendment to remove the CSP license condition.

4.5 Fitness for Duty—Drug and Alcohol Testing

The Fitness for Duty (FFD) program requirements, including drug and alcohol testing requirements, are provided in 10 CFR Part 26, “Fitness for Duty Programs.” In 10 CFR 26.3, the regulation lists those licensee types and other entities that are required to comply with designated subparts of 10 CFR Part 26. Part 26, however, does not apply to a power reactor licensee that is no longer authorized to operate a nuclear power reactor because, for example, it has filed the certifications required under 10 CFR 50.82 and the NRC has docketed the certifications. Part 26 also does not apply to spent fuel storage facility licensees (i.e., when the spent fuel is no longer in the fuel pool). However, as discussed below, several elements of the

FFD program are required by existing regulations while the spent nuclear fuel is located in the spent fuel pool.

The purpose of FFD programs is to help ensure that individuals are not under the influence of any substance, or mentally or physically impaired from any cause that could adversely affect their abilities to safely and competently perform their duties. For purposes of this discussion, the major components of FFD programs include drug and alcohol testing, behavioral observation, and employee assistance programs. In addition to ensuring that individuals are not impaired in a way that adversely affects their ability to safely and competently perform their duties, the FFD program supports determinations and requirements made in other portions of NRC physical protection regulations.

In 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage," nuclear power reactors licensed under Part 50 or Part 52 are required to establish and maintain a physical protection program that will have as its objective to provide high assurance that activities involving special nuclear material are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety. The physical protection program must protect against the design basis threat of radiological sabotage (DBT) as stated in 10 CFR 73.1, which includes both external and internal threats. Consistent with 10 CFR 73.55(b)(9), nuclear power reactor licensees are required to establish an insider mitigation program (IMP) designed to mitigate the risk of insider actions that may pose a threat to the physical security of a plant. The IMP must contain, among other things, elements from the FFD program described in Part 26. However, section 73.55(b)(9)(ii)(B) does not specify which elements or requirements of the FFD program defined in Part 26 are needed to satisfy the FFD element of the IMP.

In addition, the drug and alcohol testing, behavioral observation, and employee assistance programs inform power reactor licensees' access authorization program and their determinations of an individuals' trustworthiness and reliability as required in 10 CFR 73.56, "Personnel access authorization requirements for nuclear power plants." The access authorization program must provide assurance that the individuals are trustworthy and reliable, such that they do not constitute an unreasonable risk to public health and safety or the common defense and security, including the potential to commit radiological sabotage. As required in 10 CFR 26.53, in order to grant FFD authorization to an individual, a licensee or other entity shall ensure that a portion of the requirements in Part 26 have been met for either initial authorization, authorization update, authorization reinstatement, or authorization with potentially disqualifying FFD information, as applicable. The 10 CFR 73.56(f) requires a behavioral observation program that is designed to detect behaviors or activities that may constitute an unreasonable risk to the health and safety of the public and common defense and security, including a potential threat to commit radiological sabotage.

Unlike the FFD requirements in Part 26, which are not applicable to Part 50 licensees with decommissioning power reactors, the physical protection requirements in 10 CFR 73.55, which include the IMP and the access authorization requirements in 10 CFR 73.56, are applicable to licensees after the power reactor ceases operation. Even though the spent nuclear fuel has been removed from the reactor core and the licensee has submitted the certifications under 10 CFR 50.82, licensees are still required to defend against the DBT for radiological sabotage as required by 10 CFR 73.55(b)(2) while the spent nuclear fuel is located in the spent fuel pool. Therefore, it is the NRC staff's position that the current FFD requirements for power reactors transitioning to decommissioning are not consistent nor are they clear or easily understood.

The NRC staff is considering rulemaking described below to provide clarification on these issues. The no-action alternative is also considered by the staff.

4.5.1 Alternative DA-1 (No-action alternative)

The no-action option would retain the FFD provisions of the current regulations. Licensees would continue to implement elements of 10 CFR Part 26 in their IMPs, as required by 10 CFR 73.55(b)(9) until the spent fuel is moved from the SFP to dry cask storage in an ISFSI. The NRC staff notes that based on observation of the reactor sites that recently decommissioned, licensees are implementing all of the elements of 10 CFR Part 26, with the exception of Subparts I and K, to satisfy the FFD element in their IMPs. However under this alternative, the licensees can choose which elements or subparts of 10 CFR Part 26 are implemented for their IMPs.

Independent of this rulemaking, the NRC staff is revising RG 5.77 to clarify the elements of the FFD program that should be included in the IMP. This includes stating which elements of 10 CFR Part 26 should be implemented for the IMP to provide reasonable assurance of the trustworthiness and reliability of individuals with unescorted access to protected and vital areas in order to mitigate insider threats. The revised RG 5.77 will include the following elements in an IMP: drug and alcohol testing, behavioral observation, and employee assistance aspects of the FFD program.

The staff notes that in SRM-M160623B, “Discussion of Security Issues” (ADAMS Accession No. ML16179A382), dated June 27, 2016, the Commission directed the staff to provide the draft final RG 5.77 to the Commission for review and approval. When the revised RG 5.77 is approved for publication by the Commission, the staff has the option to pursue industry commitment to the revised version. This would allow for a consistent implementation of the FFD program at decommissioning power reactors. If a licensee commits to the RG in their security plan, it becomes a condition of their license and is therefore enforceable.

4.5.2 Alternative DA-2 (Rulemaking to codify fitness for duty requirements for decommissioning power reactors)

In this alternative, the NRC staff would pursue rulemaking to amend 10 CFR Part 26 to clarify the applicability of FFD requirements for decommissioning nuclear power plants. The staff would explicitly set forth in the regulations the applicability of FFD programs to decommissioning power reactors such that appropriate portions of Part 26 subparts A through H, N, and O would be required to be implemented during decommissioning. Rulemaking would also specify which 10 CFR Part 26 requirements are necessary for inclusion in the licensee’s IMP. The FFD requirements for drug and alcohol testing would no longer be applicable once the spent nuclear fuel is moved to an ISFSI.

An FFD program during decommissioning of power reactors is necessary to ensure the fitness-for-duty and trustworthiness and reliability of individuals performing safety and security significant activities and protecting against the DBT. This alternative would resolve the regulatory inconsistencies between how Part 26 is applied to decommissioning power reactors under Parts 50 and 52, clarify which elements or subparts of 10 CFR Part 26 are necessary for a licensee to comply with the IMP requirements in 10 CFR 73.55(b)(9), state which provisions in 10 CFR Part 26 apply to decommissioning power reactors, and allow for consistent implementation and enforcement under Part 26 without having to use Part 73 as the basis for an enforcement action.

As stated above in alternative DA-1, the NRC is currently revising RG 5.77 to identify the elements of the fitness for duty program applicable to the Part 73 IMP. The changes to the revised RG 5.77 will allow for a consistent implementation of the FFD program by both the NRC and licensees and would be coupled with the rulemaking.

4.5.3 Assumptions

The NRC staff assumes that the licensee 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). Further, the burden of implementing the FFD drug and alcohol testing program will be reduced if the rulemaking alternative is pursued.

4.5.4 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.

Industry Operation: With the reduction of requirements for testing all individuals with unescorted access in the Alternative DA-2 for rulemaking, the industry's drug and alcohol testing program costs will be reduced for the length of the program.

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.

4.6 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 worker fatigue (e.g., that associated with security officers, maintenance personnel, control room operators, and emergency response personnel) 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 or hold a combined license (COL) under 10 CFR Part 52 after the Commission makes its 10 CFR 52.103(g) finding. Once the NRC dockets the Part 50 power reactor licensee's certifications under 10 CFR 50.82(a), or the Commission orders the licensee to cease operations, the Part 50 licensee is not authorized to operate and is outside the scope of 10 CFR Part 26. Therefore, Part 26, including the fatigue management provisions of Subpart I, does not directly and explicitly apply to Part 50 licensees no longer authorized to operate, which includes decommissioning reactor licensees. However, COL holders are still subject to Part 26 during the decommissioning of their facilities.

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 address fatigue concerns for security force personnel at decommissioning reactors and instead 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 nuclear power reactor that has permanently ceased operations and removed fuel from the reactor vessel, than at an operating power reactor. The number of tasks that may have significance to the protection of public health and safety or the common defense and security are likewise reduced at a decommissioning reactor. Nevertheless, considering the factors that can contribute to fatigue, a subset of personnel at a decommissioning power reactor may be subject to working conditions that can result in fatigue.

Analysis of the functions of personnel performing duties at decommissioning reactors indicates the remaining functions that are significant to the protection of public health and safety or the common defense and security are performed by certified fuel handlers (CFHs) and security personnel.

Based on the reduction of radiological risk, the staff is considering whether fatigue management provisions should apply to decommissioning facilities until spent fuel has sufficiently decayed in the SFP (i.e., 10 months for BWRs and 16 months for PWRs). If implemented, the NRC staff believes that the fatigue management requirements should be consistent with the graded approach to EP as described in Section 4.2 of this document. In an effort to establish an appropriate level of fatigue management at decommissioning sites, the NRC staff is proposing the following alternatives.

4.6.1 Alternative F-1 (No-action alternative)

For the no-action alternative, power reactor licensees under 10 CFR Part 50 that permanently shut down and defuel would continue to be outside the scope of 10 CFR Part 26, Subpart I. It is likely that 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. Licensees under 10 CFR Part 50 are not required to maintain a fatigue management program during decommissioning. However, the COL holders under 10 CFR Part 52 would be subject to Part 26 (including Subpart I) requirements during decommissioning.

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.

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

In this alternative, the NRC staff would consider voluntary implementation of industry initiatives as a means of achieving consistent measures for the management of personnel fatigue at 10

CFR Part 50 decommissioning power reactors. The voluntary initiatives would last 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). 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 30, 2015 (Ref. 48). 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. 49), declining to fully review and/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. Additionally, 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.

Based on the difference of opinion expressed on this document, the implementation of 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 a series of public meetings to discuss the analysis, align on concepts, and discuss what would be acceptable guidance to the staff.

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

In this alternative, the NRC would pursue rulemaking to codify FFD requirements for decommissioning power reactors. The NRC could amend Part 26 to be applicable to security personnel and certified fuel handlers 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 transition from level 1 to level 2, as described in Section 2.1 of this document.

4.6.4 Assumptions

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

- Part 52 licensees are already covered by NRC regulations for fatigue management during decommissioning phase and it is assumed they will submit exemptions from these fatigue management requirements.

- 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.

4.6.5 Affected Attributes

Industry Implementation: To implement Alternative F-2, industry would voluntarily complete the development of NEI 15-08 for fatigue management at decommissioning power reactors. Additionally, industry would need to re-write their fatigue management documents that are specific to each nuclear power plant based on these initiatives. These would result in a one-time cost to industry for its voluntary commitment to develop and implement these initiatives.

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 5.77, 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.

4.7 Minimum Staffing and Training Requirements for Certified Fuel Handlers

Nuclear power plant regulations do not address minimum 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. Because most licensees in decommissioning have elected to develop technical specification amendments with prescribed minimum staffing levels, lack of regulation in this area imposes a burden on both licensees and the NRC when preparing, justifying, reviewing, and evaluating staffing amendment requests, a burden that could be reduced if appropriate regulations existed. Codifying current practice at decommissioning plants would enhance the efficiency and uniformity of the process for future decommissionings.

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. The regulations define the duties of licensed operators as either the manipulation of controls or supervising the manipulation of controls that directly affect the reactor reactivity or the power level of the reactor. A decommissioning plant is

no longer “operating” and no manipulation of controls that affect reactor reactivity or power level can occur at a permanently defueled reactor. Therefore, the regulations that require specific licensed operator staffing for operating reactors are not applicable to a decommissioning plant.

Licensees have been requesting amendments to their technical specifications to eliminate the need to maintain licensed operators once their facilities have permanently ceased operations and have been permanently defueled. Furthermore, the associated licensed operator training programs have been discontinued for decommissioning plants. In place of licensed operators, decommissioning plant licensees have required the presence of a certified fuel handler (i.e., a non-licensed operator (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 certified fuel handler 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. In order to address these issues, the NRC staff is proposing the following alternatives.

4.7.1 Alternative CFH-1 (No-action alternative)

This alternative would retain the current wording of the regulations. Discontinuing the training and use of licensed operators after permanent cessation of operations and removal of fuel from the reactor vessel could be justified by interpretation of the operator staffing requirements of 10 CFR 50.54, “Conditions of Licenses,” and the training requirements of 10 CFR 50.120. 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....” This language is sufficiently broad to allow reactors that have been permanently shut down and defueled 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.

4.7.2 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 minimum staffing for a nuclear power reactor licensee that has submitted the certifications required by 10 CFR 50.82(a)(1) or 52.110(a), and provide guidance on the structure and content of a fuel handler training program that can be used to qualify a CFH that would be acceptable to the NRC staff. This alternative will not eliminate the need for licensees to submit license amendment requests in order to use non-licensed operators at a decommissioning plant.

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

The rulemaking alternative would revise the definition of "certified fuel handler" in 10 CFR 50.2 to clarify the management role of the CFH in a manner consistent with 10 CFR 50.54(y); eliminate the need for a licensee to seek the Commission's approval for fuel handler training programs suitable to qualify CFHs; add a provision that the training program address the safe conduct of decommissioning activities, safe handling and storage of spent fuel, and appropriate response to plant emergencies, in addition to requiring consistency with the existing requirements for training of non-licensed operators in 10 CFR 50.120; and specify the minimum staffing requirements in 10 CFR 50.54(m) for a nuclear power reactor licensee that has submitted the certifications required by 10 CFR 50.82(a)(1) or 52.110(a). This rulemaking alternative would reduce resources expended by both the licensee and the NRC on licensee actions involving staffing by non-licensed operators and approval of training programs to qualify CFHs, at decommissioning plants.

4.7.4 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.

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 Technical Specification Section Administrative Controls.

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.

4.8 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 decommissioning fund 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 were 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. In addition, the staff is considering changing the way in which licensees provide financial assurance for radiological decommissioning through use of a SSCE (at licensing or during operations) in lieu of the NRC minimum formula.

Presently, allowable DTF decommissioning expenses must be related to the planning for, and the cleanup and removal of, radiological structures and materials as specified in 10 CFR 50.82(a)(8)(i)(A), which states:

> Decommissioning trust funds may be used by licensees if—(A) The withdrawals are for expenses for legitimate decommissioning activities consistent with the definition of decommissioning in [10 CFR] 50.2…

In accordance with 10 CFR 50.2, "Definitions:"

> *Decommission* means to remove a nuclear facility or site safely from service and reduce residual radioactivity to a level that permits: (1) release of the property under unrestricted conditions and termination of the NRC license; or (2) release of the property under restricted conditions and termination of the NRC license.

Therefore, legitimate decommissioning DTF expenses include only those activities related to the removal of a nuclear facility, or a site, safely from service and the reduction of residual radioactivity to a level that permits license termination and release of the property for unrestricted/restricted use. The regulation does not address the commingling of funds set aside in the DTF for radiological decommissioning and funds for spent fuel management and/or site restoration.

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.

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.

4.8.1 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."

4.8.2 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 in 10 CFR 50.75 and 10 CFR 50.82 to allow the DTF to be used for radiological decommissioning, spent fuel management, and ISFSI decommissioning, so long as the licensee has delineated these expenses in the DTF and sufficient funds remain available to pay for radiological decommissioning of the facility.

- Amend the reporting requirements in 10 CFR 50.75(f)(1) and (f)(2) to be consistent with the decommissioning funding assurance reporting requirements for ISFSIs in 10 CFR 72.30(c) and to remove unnecessary reporting burdens. Licensees would report the status of decommissioning funding every 3 years instead of every 2 years.

- Amend the decommissioning regulations in 10 CFR 50.75 and 10 CFR 50.82 to allow 1 percent of the estimated total in the DTF at operation cessation to pay for miscellaneous expenses to support decommissioning. Specifically, the NRC staff would amend the regulations to allow for up to 1 percent of the estimated total of the DTF at license termination (calculated at inception of the fund, or effective date of this rule), to be used for miscellaneous expenses indirectly related to decommissioning. The withdrawal would need to satisfy the requirements of 10 CFR 50.82(a)(8)(i)(B) and (C) such that: (1) the withdrawal for such expenses would not reduce the value of the DTF

below an amount necessary to place and maintain the reactor in a safe storage condition if unforeseen conditions or expenses arise; and, (2) the withdrawals would not inhibit the ability of the licensee to complete funding of any shortfalls in the DTF needed to ultimately release the site and terminate the license.

- Amend the regulation at 10 CFR 50.75(b) to clarify that licensees shall maintain decommissioning funding assurance at all times and that licensees must correct temporary funding shortfalls within a proposed three year period. For this alternative, the regulation would be amended 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 by the licensee's site-specific decommissioning cost estimate, thereby creating a "shortfall."[4] To address a shortfall, licensees that are not under a rate setting authority (e.g., merchant plants) would be required to report the shortfall in the next decommissioning report pursuant to 10 CFR 50.75(f) and then make up the shortfall within three years from the end of that reporting period. The remaining licensees, which are under rate setting authority (e.g., utilities), would be required to report the shortfall in the next decommissioning report pursuant to 10 CFR 50.75(f). However, because utilities are permitted to utilize sinking funds as their sole method of amassing decommissioning funding, they will not be in violation unless they do not provide reasonable assurance that there will be sufficient funds for decommissioning when needed.

  The timing for funding DTF shortfalls is addressed in RG 1.159, Rev. 2, which states that shortfalls identified in biennial reports must be corrected by the time the next biennial report is due. However, earlier versions of this regulatory guide stated that "a reasonable time may be used to make up any deficit, consistent with good-faith efforts to obtain appropriate rate relief."[5] As such, licensees that report temporary funding shortfalls could, on a case-by-case basis, establish a time period approved by the NRC that extends beyond either the two year period contained in the guidance or the proposed three year period.

4.8.3 Alternative DTF-3 (Rulemaking to amend regulations to add specific site cost estimate to DTF-2)

This alternative includes all of the proposals from alternative DTF-2 and seeks to more accurately reflect the funds needed for decommissioning by amending 10 CFR 50.75(c) to require the licensee to fund the DTF to the level of either the site-specific cost estimate or the table of minimum amounts formula contained in 10 CFR 50.75(b), whichever is larger. Licensees would provide site-specific decommissioning plans, including an initial site-specific cost estimate, at fuel load (e.g., upon receipt of a Part 50 operating license or a 10 CFR 52.103(g) finding) that captures the major assumptions, major decommissioning activities, references, and any other bases used for developing this estimate. Each plan would address how the cost estimate will be adjusted for future cost escalation, the mechanism to be established for funding, and a schedule for periodic contributions and assumptions about future DTF growth (e.g., 2 percent real-rate of return). During operations, each licensee would update the site-specific cost estimate to account for cost escalation and any changes in assumptions

[4] Shortfall is defined as the difference between the amount of financial assurance provided by the licensee and the amount of financial assurance required.

[5] Regulatory guides are guidance documents that provide one way in which licensees can meet regulations and do not establish requirements.

that may result in increased decommissioning costs. The licensees would submit this updated site-specific cost estimate on 5 year intervals during the operations phase and annually thereafter during the decommissioning phase. Under this alternative, the staff recommends the following changes, in addition to the changes recommended in Alternative DTF-2:

- The table of minimum amounts in 10 CFR 50.75(b) would continue to require certification of a site-specific decommissioning cost estimate that meets, or exceeds, the NRC minimum formula amount.

- Implementation Period: The NRC staff would recommend that current licensees be provided the biennial (2 year) status report period, plus one year, to provide and assure to the site-specific decommissioning plan referenced herein.

4.8.4 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.

- For Alternatives DTF-2 and DTF-3, the NRC staff assumes that the recommended changes would minimize the need for licensees to submit exemption requests from decommissioning funding regulations.

- The NRC staff has not identified any licensee that has had a DTF shortfall that impacted its ability to conduct decommissioning activities. The cost impacts of the recommend change to make up the shortfall within three years has not been modeled at this time.

- For Alternatives DTF-2 and DTF-3, the NRC staff assumed that 1 percent of the total in the DTF at cessation of operations is available to pay for miscellaneous expenses to support decommissioning and that the withdrawals would not inhibit the licensee from ultimately releasing the site and terminating its license.

- For Alternative DTF-3, the NRC staff assumes that the site-specific decommissioning cost estimate is greater than or equal to the NRC minimum formula amount.

4.8.5 Affected Attributes

Industry Implementation: Under Alternatives DTF-2 and DTF-3, 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-3, licensees would be required to develop initial site-specific decommissioning cost estimates, which would result in a one-time cost to industry.

Industry Operation: Under Alternative DTF-2, licensees would report assurances for decommissioning against the funding in the DTF every 3 years instead every 2 years. This would result in costs averted from the lower frequency of reporting. In addition, 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 within 3 years from the end of that reporting period. Under Alternative DTF-3, licensees would commit resources to develop a site-specific cost estimate

beginning at fuel load and update the site-specific cost estimate periodically thereafter to account for cost escalation and any changes in assumptions that may result in increased decommissioning costs. This update will occur at 5-year intervals during the operating phase of a nuclear power plant site and annually thereafter during decommissioning. Each update of the site-specific cost estimate will account for cost escalation and any changes in assumptions that may result in increased decommissioning costs. These activities would result in potential operating costs to industry.

NRC Implementation: To implement Alternatives DTF-2 and DTF-3, the NRC incurs a one-time cost relative to the status quo for developing the rule. Under Alternatives DTF-2 and DTF-3, the NRC would avert the cost and resources to evaluate exemption requests to use DTF for spent fuel management. Under Alternative DTF-3, the NRC would review initial site-specific decommissioning cost estimates and may also develop guidance regarding site-specific decommissioning cost estimates, which would result in one-time costs to the NRC.

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. Under Alternative DTF-3, additional staff time would be required to evaluate the updates to the site-specific decommissioning cost estimates that are submitted at 5-year intervals during the operating phase of a nuclear power plant site and annually thereafter during the decommissioning phase. This would result in a recurring cost for the NRC.

Regulatory Efficiency: Under Alternatives DTF-2 and DTF-3, 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 Alternatives DTF-2 and DTF-3, licensees would have more flexibility concerning funding of spent fuel management than currently exists with the status quo (Alternative DTF-1). Under Alternative DTF-3, there would be a decrease in regulatory efficiency because licensees would have to each develop and update site-specific decommissioning cost estimates, instead of using the generic NRC minimum formula amount.

4.9 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 station 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 station 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.

Because of this issue, 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 are 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.

4.9.1 Alternative FP-1 (No-action alternative)

Under the no-action alternative, licensees will continue to abide by regulations in 10 CFR 140.11, "Amounts of Financial Protection for Certain Reactors," paragraph (a)(4), which require each reactor that is licensed to operate and has a rated capacity for electrical generation exceeding 100,000 kilowatts to have $450 million in primary financial protection for offsite damage and participate in the industry retrospective rating plan. Pursuant to 10 CFR 140.8, "Specific Exemptions," the Commission may grant exemptions from this regulation that it determines are authorized by law and otherwise are in the public interest. The staff provided a legal and technical basis in support of these exemptions for decommissioning power reactors in SECY 93-127, "Financial Protection Required of Licensees of Large Nuclear Power Plants during Decommissioning," (ADAMS Accession No. ML12257A628). In the Staff Requirements Memorandum for SECY-93-127 (ADAMS Accession No. ML003760936), 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 the primary level coverage to $100 million after a cooling period adequate to support air cooling of the fuel in a completely drained pool.

Similarly, under the no-action alternative, licensees will continue to abide by the requirements of 10 CFR 50.54(w) to have insurance to provide minimum coverage for each reactor site of $1.06 billion, or whatever amount of insurance is generally available from private sources, whichever is less. Pursuant to 10 CFR 50.12, "Specific Exemptions," the Commission may grant exemptions from this regulation 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. 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," dated December

17, 1996 (ADAMS Accession No. ML15062A483), 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 Staff Requirements Memorandum to SECY-96-256, dated January 28, 1997 (ADAMS Accession No. ML15062A454), the Commission supported the staff's recommendation that, among other things, would allow permanently shutdown power reactor licensees to reduce commercial onsite property damage insurance 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.

4.9.2 Alternative FP-2 (Rulemaking to amend regulations to provide a graded reduction in risk with corresponding reductions in financial protection)

This alternative recommends to amend the offsite and onsite financial protection requirements based on the reduced risk of anticipated reactor configurations over time at permanently shutdown reactors. This alternative adopts reductions in financial protection based on reductions in risk attributable to changes in spent fuel characteristics and storage modes over the period of time between permanent shutdown and termination of the license. The recommended insurance amounts would be based on the estimated cost of recovery from limiting hypothetical events for specific reactor configurations (levels) as described below.

Level 1: Permanently Ceased Operations and Permanently Defueled

Licensees would enter Level 1 after the NRC's docketing of 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." The 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. This 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. At this point, the fuel cladding would remain intact with no gap release if water in the SFP is lost. For facilities in Level 1, the requirements for offsite and onsite financial protection remain the same as an operating reactor, and as presently specified in 10 CFR 140.11(a)(4), and 10 CFR 50.54(w), respectively.

Level 2: Sufficiently Decayed Fuel

In this Level, tthe reactor is defueled and permanently shut down, and spent fuel in the SFP has decayed and cooled sufficiently that it is not susceptible to a zirconium cladding fire, or gap release caused by an incipient fuel cladding failure, in the event the SFP is unexpectedly drained. In this configuration, the spent fuel can be stored long-term in the SFP without the possibility of a zirconium fire or significant fuel cladding failure. In addition, the site may contain 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.

Pursuant to the current exemption process, the staff is considering reducing the onsite financial protection requirements from $1.06 billion to $50 million for decommissioning reactors that have reached Level 2. 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 (~450,000 gallons) containing slightly radioactive water was selected as conceivable, and ultimately set as the bounding scenario. For estimating cleanup costs, the limiting event considered costs associated with removal of soil contamination and potential contamination of the groundwater table. The onsite waste cleanup cost for this postulated event was estimated to be approximately $50 million.

The offsite radiological consequences are considered to be negligible. In economic terms, the postulated event would surpass the cleanup costs associated with a fuel handling incident and has been taken into account in determining the upper bound level of onsite insurance coverage required in Level 2. Although the Level 2 offsite consequences are considered to be negligible, an appropriate level of offsite financial protection is required because of the possibility for claims arising from asserted offsite consequences despite the expected negligible offsite consequences, and to protect the federal government from indemnity claims. 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.

Level 3: All Spent Fuel Transferred to an ISFSI

In this Level, the reactor is permanently shut down and all spent fuel has been removed to an onsite (or offsite) dry storage installation or a U.S. Department of Energy (DOE)-sponsored high-level waste repository. The remaining radioactive inventory depends on the decommissioning status and may include liquid radwaste, radioactive reactor components, and contaminated structural materials. In Level 3 when spent fuel is no longer stored in the SFP, the potential for a radiological incident is primarily in mobile sources of radioactivity. The offsite cleanup costs in this preliminary draft regulatory analysis is based on an extremely low probability radiological release from an onsite spent fuel cask. The draft regulatory basis does not consider this radiological hazard credible and instead uses as the basis an appropriate level of offsite financial protection because of the possibility for claims arising from asserted offsite consequences.

Because the level of radiological risk has decreased from Level 2 to Level 3, by transferring the spent fuel to an onsite (or offsite) dry storage installation or a DOE-sponsored high-level repository, the NRC staff is considering reducing the required level of offsite financial protection to $50 million. This level of financial protection is considered sufficient because of the possibility for claims arising from asserted offsite consequences based on the remaining site radiological contamination that exceeds the unrestricted release levels or to compensate for an extremely low probability radiological release from a spent fuel storage cask (Ref. 46). For the financial protection requirements in Level 3, where there is no fuel in the SFP and risk is dependent on radioactive inventory at the reactor station site, the onsite coverage would remain at $50 million. The $50 million amount is the estimated amount needed to recover from a postulated rupture of a large and slightly contaminated liquid storage tank.

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

Level 4 characteristics are similar to Level 3, except that the reactor site has no significant amount of mobile sources of radioactivity and the spent fuel has been transferred offsite to a long-term storage repository. The basis for the transition from Level 3 to Level 4 begins at the point at which reactor station site has less than 1,000 gallons of liquid radwaste stored onsite and continues until the licensee has cleaned the site to unrestricted release levels, a confirmatory survey is performed, and the NRC license is terminated.

Under these circumstances, the offsite requirement would be reduced to $25 million, because of the possibility for claims arising from asserted offsite consequences. This would minimize the possibility that federal government indemnification would be required. As noted above, under the PAA, offsite liability insurance coverage is required for licenses issued under Section 103 of the AEA, which under the NRC's regulations include 10 CFR Part 50 licenses (and by extension, 10 CFR Parts 52 and 54 licenses). Thus, while offsite insurance coverage for such licensees can be reduced, offsite financial insurance protection must be maintained until the NRC license is terminated.

The onsite coverage could be further reduced or eliminated to account for negligible onsite consequences. The staff is considering reducing the onsite financial protection requirements in Level 4, when there is no fuel in the SFP and no significant source of mobile radioactive material, to either $25 million or zero. The $25 million amount is based on the possibility of having to clean up onsite contamination from an accidental rupture of a less than 1,000 gallon contaminated liquid storage tank during shutdown activities. Elimination of onsite insurance coverage would be warranted when a licensee has completed all decommissioning activities other than a confirmatory survey for license termination.

4.9.3 Level Summary

Alternative FP-2 may preclude licensees from filing an exemption from offsite and onsite financial protection. Table 9 provides a summary of offsite and onsite insurance requirements at each level.

Table 9 Financial Protection Requirements and Indemnity Agreement Alternatives Costs and Benefits Summary

Level	Description	Financial Protection Requirement (constant dollars)	
		Offsite	Onsite
Level 1	Permanently Ceased Operations and Permanently Defueled	$450 million; participation in the industry retrospective rating plan	$1.06 billion
Level 2	Transition after the spent fuel has cooled sufficiently so that the fuel cannot heat up to clad ignition temperature within 10 hours under adiabatic conditions.	$100 million	$50 million
Level 3	All Spent Fuel	$50 million	$50 million

Level	Description	Financial Protection Requirement (constant dollars)	
		Offsite	Onsite
	transferred to an ISFSI or offsite. Total liquid radwaste stored onsite is greater than or equal to 1,000 gallons.		
Level 4	Total liquid radwaste stored onsite is less than 1,000 gallons.	$25 million	$25 million or eliminated

4.9.4 Assumptions

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

- For Alternative FP-1, all nuclear power plant sites will submit exemption requests for onsite and offsite damage protection should the rulemaking not go forward.
- For Alternatives FP-1 and FP-2, 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 damage protection.
- For Alternatives FP-1 or FP-2 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 Alternative FP-2, 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.

4.9.5 Affected Attributes

Industry Implementation: Under Alternative FP-2, 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.

NRC Implementation: To implement Alternative FP-2, the NRC incurs a one-time cost relative to the status quo for developing the rule. Under Alternative FP-2, 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.

4.10 Application of Backfitting Protection

The language of 10 CFR 50.109 and the issue finality provisions in 10 CFR Part 52 (hereinafter collectively referred to as the "Backfit Rule") clearly apply 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.

How the Backfit Rule applies to decommissioning plants is not as clear. In SECY-98-253, "Applicability of Plant-Specific Backfit Requirements to Plants Undergoing Decommissioning" (ADAMS Legacy No. 9806110221), 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 the paper 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 for power operation and "conceptually inappropriate in evaluating the impacts of a backfit on a decommissioning plant."

- The Statements of Considerations (SOC) for the 1970, 1985, and 1988 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 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 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 draft regulatory basis. Currently, the Backfit Rule guidance in Management Directive 8.4, "Management of Facility-Specific Backfitting Information Collection," (Ref. 27) discusses the applicability of backfitting 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.

4.10.1 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.

4.10.2 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," issued July 1990. This NUREG describes the types of backfits, how backfitting determinations are made and justified, how generic and facility-specific backfits are imposed, and the appeal process. This NUREG was issued before significant changes in the Commission's regulations concerning issue finality and the application of backfitting provisions to nonreactor licensees, such as spent fuel storage installations and fuel cycle facilities.

Pursuant to SECY-14-0002, "Plan for Updating the U.S. Nuclear Regulatory Commission's (NRC's) Cost-Benefit Guidance" (Ref. 28), the NRC staff is updating its methodologies and tools to perform cost-benefit analysis in support of regulatory, backfit, and environmental analyses. These updates could include updates to NUREG-1409 or other guidance documents related to backfit analyses. In June 2016, the NRC's Executive Director for Operations tasked the staff to

assess the adequacy and currency of the NRC's existing backfitting requirements, guidance, criteria, and procedures, including NUREG-1409 (Ref. 51).

4.10.3 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 Ch. I for decommissioning regulations, create a new subpart within 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 facility," in 10 CFR 50.109(a)(1). 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.

4.10.4 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.

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.

4.11 Aging Management

An initial operating license is issued for up to 40 years of plant operation. 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," allows for a license renewal of up to 20 years. Current regulations do not limit the number of 20-year renewal terms that may be issued. Two letters of intent have been sent to the NRC, stating that the licensees for Peach Bottom and Surry will submit applications for subsequent license renewal in mid-2018 and early 2019, respectively. Therefore, the NRC staff considers it prudent to consider the scenario where a reactor, and its SFP, are in commercial operation for 80 years. The requirement in 10 CFR 50.82, "Termination of license," allows the licensee up to 60 years to decommission the site, with a provision for extensions. While no licensee has yet approached the full 60 years allowed for decommissioning, the NRC staff considers it prudent to consider the scenario where a licensee does use the full 60 years, following 80 years of reactor operation. Therefore, the NRC staff is basing this evaluation on the potential for a SFP being in operation 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. 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 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 recommended by the NRC staff to address this issue.

4.11.1 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.

4.11.2 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.

4.11.3 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.

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.

Industry Implementation: Under Alternative AMP-2, licensees would incur ongoing costs to inspect passive and long-lived SCs supporting the SFP operation.

5 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 (Alternative 1). 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.

5.1 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 4 (Ref. 30). 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 four attributes on a quantitative basis: industry implementation, industry operation, NRC implementation, and NRC operation. 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 and process exemptions and amendments for decommissioning before 2016 are sunk costs and are not considered in this preliminary draft regulatory analysis.

5.1.1 Regulatory Baseline

This preliminary draft 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 baselines used in this analysis, the staff assumes full licensee compliance with existing NRC regulations.

5.1.2 Discount Rates

In accordance with guidance from the Office of Management and Budget (OMB) Circular No. A-4, "Regulatory Analysis" (Ref. 31), and NUREG/BR-0058, Revision 4 (Ref. 30), 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.[6] A 3-percent discount rate approximates the real

[6] The rates presented in Appendix C to OMB Circular No. A-94 (Ref. 41) 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.

rate of return on long-term government debt, which serves as a proxy for the real rate of return on savings to reflect reliance on a social rate of time preference discounting concept. A 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[7] concept to reflect the time value of resources directed to meet regulatory requirements.

5.1.3 Cost/Benefit Inflators

To evaluate the costs and benefits consistently, the analysis inputs are inflated into 2016 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 2016 dollars is as follows:

$$\frac{\text{CPIU}_{2016}}{\text{CPIU}_{\text{Value Year}}} * \text{Value}_{\text{Value Year}} = \text{Value}_{2016}$$

Values of CPI-U used in this cost-benefit analysis are summarized in Table 10.

Table 10 Consumer Price Index—All Urban Consumers, U.S. City Average

Base Year	CPI-U Annual Average[a]	Forecast Percent Change from Previous Year[b]
1992	140.300	
1993	144.500	
1996	156.900	
1998	163.000	
2007	207.342	
2008	215.303	
2009	214.537	
2010	218.056	
2011	224.939	
2012	229.594	
2013	232.957	
2014	236.736	
2015	237.017	
2016	240.098	1.30%
2017	245.620	2.30%
2018	251.515	2.40%
2019	257.552	2.40%

[a] United States Bureau of Labor Statistics, "CPI Detailed Report," June 2016. 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. 32).

[b] United States Congressional Budget Office, "The Budget and Economic Outlook: 2016 to 2026." Table 2-1, "CBO's Economic Projections for Calendar Years 2016 to 2026," January 2016,

[7] 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.

https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51129-2016_Outlook_Summary.pdf (Ref. 33).

5.1.4 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. 34), and general cost-benefit methodology. The NRC labor rate for fiscal year 2016 is $128 per hour.[8]

The estimated mean industry labor rate is $130 per hour. The NRC staff derived these labor rates according to data provided by BLS. The NRC staff used the 2015 occupational employment and wages data, which provided labor categories and the mean hourly wage rate by job type and used the inflator discussed in Section 5.1.3 to inflate these labor rate data to 2016 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 proposed 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 preliminary draft 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 6.10.

5.1.5 Affected Entities

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

- Operating reactor sites: The NRC staff models 62 U.S. light-water nuclear power reactors sites in this analysis.[9] 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 Clinton Power Station

[8] 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).

[9] Based on information obtained from NUREG-1350, Volume 28, "Information Digest: 2016–2017," Appendix G, "U.S. Commercial Nuclear Power Reactor Operating Licenses—Expiration by Year, 2013–2049," issued August 2016 (Ref. 42).

in June 2017 and Quad Cities Nuclear Power Station in June 2018, Oyster Creek Nuclear Generating Stations and Pilgrim Nuclear Power Station plan to shut down in 2019, and 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.

- 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 2019 and 2020, respectively and Virgil C. Summer Nuclear Station, Units 2 and 3, assumed to begin operations in 2019 and 2020, respectively.[10]

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.

5.1.6 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)).

5.1.7 Base Year

The rulemaking is expected to be complete in 2019. The date of the first draft of the regulatory basis is in 2016, so the monetized benefits and costs in this analysis are expressed in year 2016 dollars. Ongoing and annual costs of operation related to the alternatives are assumed to begin in year 2019 unless otherwise stated and are then discounted back into year 2016 dollars.

5.1.8 Time Period of Analysis

To define the period of analysis covered by this preliminary draft regulatory analysis (i.e., the period over which costs and benefits would be incurred), the NRC derived an average remaining license term for operating licensees and COL licensees. These average remaining license terms were calculated based on data from NUREG-1350, vol.28, *NRC Information*

[10] Fermi Unit 3, Levy County Units 1 and 2, and South Texas Project, Units 3 and 4 are not included in this analysis because as of 11/1/2016, 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.

Digest (Ref. 42). The average license terms consist of an operating period and is then followed by a 60 year period for SAFSTOR and ENTOMB decommissioning and a 12.5 year period for DECON decommissioning.

To estimate the average remaining license term for operating reactors, the NRC assumed each operating site applies for and receives one, 20-year license renewal beyond its original 40-year license term. For the 65 sites in the analysis, the NRC estimated that the average remaining operating license term is 24 years, as of the effective date of the final rule. At the end of this 24-year period, the NRC assumes that these sites would enter the decommissioning phase, and would in turn incur decommissioning site costs.

There are two new reactor sites included in the analysis (i.e., Summer Units 2 and 3 and Vogtle Units 3 and 4). The NRC assumes that both sites will apply for and receive one 20-year license renewal in addition to the original 40-year license. Based on these assumptions, the new reactor sites would incur costs associated with the final rule from 2017 through 2080.

5.1.9 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. Working group members were also consulted to obtain expert opinion on the levels of effort (labor hours) to complete modeled activities. In addition, the NRC staff used historical cost data to estimate the future cost of some requirements (e.g., drug and alcohol testing) via 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 categories 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 were chosen at random 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. With 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 6.10 of this analysis provides a description of the Monte Carlo simulation methods and a presentation of the results.

6 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[11] 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 conducting regulatory analyses has value in that it helps decision makers think in depth about specific alternatives and their associated results.

6.1 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 costs one time because they would no longer need to apply for exemptions and license amendments. However, adding clarity and making improvements to the current NRC regulations for decommissioning power reactors will also result in additional one-time costs to licensees. Discussion of both the averted costs and costs of each area of decommissioning is presented in the next two sections.

6.1.1 Averted Industry Implementation Costs

Submission 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 EP-2 for the EP decommissioning area, licensees would not need to apply for exemptions from EP requirements. This would result in a one-time benefit (i.e., averted cost) to industry.

- Under Alternative EP-3 for the EP decommissioning area, licensees would not need to apply for exemptions from EP requirements. Additionally, licensees would not need to submit license amendment requests in order to process and submit a revised emergency plan that describes their commitments and plan features to meet the requirements of one of the decommissioning levels (i.e., PSEP, PDEP, or IOEP). These would result in one-time benefits to industry.

[11] 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.

- Under Alternatives EP-2 and 3, a licensee would not need to obtain a specific 10 CFR Part 72 license or make changes to its EP program when all of its spent fuel has been transferred to an ISFSI. This would result in a one-time benefit to industry.

- 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.

- 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 staffing and training requirements for 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 benefit to industry.

- Under Alternatives DTF-2 and DTF-3 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 benefit to industry.

- Under Alternatives FP-2 for offsite and onsite financial protection requirements and indemnity agreements, licensees would not need to apply for exemptions from offsite and onsite financial protection requirements.

Table 11 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 shown, they all have the same averted implementation costs. Note that the licensees that have already entered decommissioning (i.e., Crystal River, Vermont Yankee, San Onofre, and Kewaunee), and those that have submitted an intent to decommission before 2019 (i.e., Fort Calhoun) will not get the benefit from the avoidance of the exemption and amendment process. This is because these licensees will likely have already submitted exemption or amendment requests to the NRC for processing before the final rulemaking takes effect in 2020.

Table 11 Averted Industry Implementation Costs

Areas of Decommissioning	Alternatives	Industry Implementation Costs Averted (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	$ 10,474,000	$ 2,386,000	$ 5,222,000
Emergency Preparedness	EP-3	$ 18,125,000	$ 4,129,000	$ 9,037,000
Physical Security	PS-2	$ 3,079,000	$ 702,000	$ 1,535,000
Minimum Staffing and Training Requirements CFH	CFH-3	$ 604,000	$ 137,000	$ 301,000
Decommissioning Trust Fund	DTF-2	$ 1,911,000	$ 435,000	$ 953,000
Decommissioning Trust Fund	DTF-3	$ 1,911,000	$ 435,000	$ 953,000
Offsite & Onsite Financial Protection	FP-2	$ 1,365,000	$ 311,000	$ 681,000

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars.
*** NPV = net present value.

6.1.2 New Industry Implementation Costs

Although licensees would avert costs for some of the areas of decommissioning described in Section 6.1.1, these recommended rulemaking actions would also result in an additional one-time cost to the licensees for the remaining decommissioning areas:

- Alternative DA-2 for the FFD—drug and alcohol testing during decommissioning will result in an additional one-time cost to industry because it will have to modify the drug and alcohol testing procedures in order to comply with the new regulation.

- Alternative DTF-3 for the DTF will result in an additional one-time cost to licensees, because they will be required to provide an initial site-specific cost estimate to be reviewed by the NRC.

- Alternative B-2 for the backfitting protection will result in an additional one-time cost to licensees, because they will contribute to the review of the update of NUREG-1409.

- Alternative AMP-2 for the aging management area of decommissioning will result in an additional one-time cost from licensees having to contribute to the review of the regulatory guidance documents for aging management.

- Alternative CFH-2 for the certified fuel handler area of decommissioning will result in a one-time cost to industry for completion of the development of the voluntary industry initiatives for staffing and training at permanently shutdown and defueled reactors and clarification of related definitions.

Table 12 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.

Table 12 Additional Industry Implementation Costs

Areas of Decommissioning	Alternatives	Additional Industry Implementation Costs (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Minimum Staffing and Training Requirements CFH	CFH-2	$ (36,000)	$ (33,000)	$ (35,000)
Decommissioning Trust Fund	DTF-3	$ (19,756,000)	$ (17,251,000)	$ (18,875,000)
Backfit Protection	B-2	$ (51,000)	$ (46,000)	$ (49,000)
Aging Management	AMP-2	$ (36,000)	$ (33,000)	$ (35,000)

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars.

6.2 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 costs and costs that result on a recurring basis, annually or otherwise, are termed the operational cost. Discussion of the operational cost for each area of decommissioning is presented in the next two sections.

6.2.1 Averted Industry Recurring Costs

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

- Under Alternatives EP-2 and EP-3 for emergency preparedness, licensees would avoid paying FEMA fees after Level 2.

- Under Alternative DA-2 for drug and alcohol testing, the industry's drug and alcohol testing program cost will be reduced for the length of the program due to the reduction of requirements for testing all individuals with unescorted access.

Table 13 presents the mean total recurring averted costs for the emergency preparedness and drug and alcohol testing areas of decommissioning. Note that only 62 nuclear power plant sites are accounted for in this attribute, because four sites (i.e., Crystal River, Kewaunee, San Onofre, and Vermont Yankee) have already entered decommissioning. A pro-rated averted cost is assigned to sites that have submitted (i.e., Fort Calhoun) or plan to submit (i.e., Oyster Creek and Pilgrim) an intent to decommission (by year 2020).

Table 13 Averted Industry Operational Costs

Areas of Decommissioning	Alternatives	Industry Operations Costs Averted (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	$ 22,355,000	$ 7,188,000	$ 12,698,000
Emergency Preparedness	EP-3	$ 22,355,000	$ 7,188,000	$ 12,698,000
Fitness for Duty, Drugs & Alchohol	DA-2	$ 2,041,000	$ 431,000	$ 959,000

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars

6.2.2 Industry Recurring Annual Costs

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

- Under Alternative CS-2 for cyber security, information technology (IT) labor hours will be needed to implement cyber security protection until all of the spent fuel has been transferred to an ISFSI. When compared to the regulatory baseline, this results in cyber security protection costs.

- Under Alternative CS-3 for cyber security, IT labor hours will be needed to implement cyber security protection until the spent fuel in the pool has cooled enough to result in a negligible chance of a zirconium fire. 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 costs to continue the fatigue management 10 months for BWRs and 16 months for PWRs.

- Under Alternative DTF-2 for the DTF, licensees would expend resources to process decommissioning funding assurance reports.

- Under Alternative DTF-3 for the DTF, licensees would update the initial site-specific cost estimate every 5 years to account for cost escalation and any changes in assumptions that may result in changed decommissioning costs. Once in the decommissioning phase, this site-specific cost estimate would be updated and submitted to the NRC annually.

Table 14 presents the industry operational costs for these recommended decommissioning requirements.

Table 14 Additional Industry Operation Costs

Areas of Decommissioning	Alternatives	Additional Industry Operations Costs (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Fitness for Duty, Fatigue	F-2	$ (3,612,000)	$ (912,000)	$ (1,891,000)
Fitness for Duty, Fatigue	F-3	$ (3,612,000)	$ (912,000)	$ (1,891,000)
Decommissioning Trust Fund	DTF-2	$ 183,000	$ 71,000	$ 119,000
Decommissioning Trust Fund	DTF-3	$ (1,988,000)	$ (291,000)	$ (725,000)
Cyber Security	CS-2	$ (350,589,632)	$ (74,126,701)	$ (164,803,343)
Cyber Security	CS-3	$ (53,240,000)	$ (11,161,000)	$ (25,625,000)

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars
*** All nuclear power plant sites are expected to be impacted by the DTF changes.
**** Sites that decommission between 2016 and 2019 may incur operational costs for the aging management and FFD changes depending on when the rule goes into effect.

6.3 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 this rule.

6.3.1 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 time to process these submittals would be avoided, and the NRC would avert these costs. This would result in a one-time benefit to the NRC for each exemption and amendment request. Exemption or 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 15 displays the NRC averted implementation costs for processing exemption and amendment requests.

Table 15 Averted NRC Implementation Costs

Areas of Decommissioning	Alternatives	NRC Averted Implementation Costs (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	$ 5,212,000	$ 1,187,000	$ 2,598,000
Emergency Preparedness	EP-3	$ 9,019,000	$ 2,055,000	$ 4,497,000
Physical Security	PS-2	$ 1,932,000	$ 440,000	$ 963,000
Minimum Staffing and Training Requirements CFH	CFH-3	$ 1,201,000	$ 274,000	$ 599,000
Decommissioning Trust Fund	DTF-2	$ 951,000	$ 217,000	$ 474,000
Decommissioning Trust Fund	DTF-3	$ 951,000	$ 217,000	$ 474,000
Offsite & Onsite Financial Protection	FP-2	$ 626,000	$ 143,000	$ 312,000

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars.

6.3.2 New 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, developing and issuing the proposed rule and draft guidance, and developing and issuing the final rule and guidance. These one-time costs begin in 2016 with the regulatory basis and are assumed to end in 2020 with the development and issuance of the final rule. The preliminary draft regulatory analysis does not include estimates to perform ongoing decommissioning licensing activities. Table 16 shows the estimated cost for developing and issuing the final rule and associated RGs for each area of decommissioning in 2016 dollars.

Table 16 NRC Additional Implementation Costs

Areas of Decommissioning	Alternatives	NRC Additional Implementation Costs (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	$ (843,000)	$ (764,000)	$ (807,000)
Emergency Preparedness	EP-3	$ (843,000)	$ (764,000)	$ (807,000)
Physical Security	PS-2	$ (843,000)	$ (764,000)	$ (807,000)
Cyber Security	CS-2 & 3	$ (711,000)	$ (644,000)	$ (680,000)
Fitness for Duty, Drugs and Alcohol	DA-2	$ (712,000)	$ (646,000)	$ (682,000)
Fitness for Duty, Fatigue	F-3	$ (712,000)	$ (646,000)	$ (682,000)
Minimum Staffing and Training Requirements CFH	CFH-3	$ (712,000)	$ (646,000)	$ (682,000)
Decommissioning Trust Fund	DTF-2	$ (742,000)	$ (672,000)	$ (710,000)
Decommissioning Trust Fund	DTF-3	$ (742,000)	$ (672,000)	$ (710,000)
Offsite & Onsite Financial Protection	FP-2	$ (712,000)	$ (646,000)	$ (682,000)
Backfit Protection	B-2	$ (316,000)	$ (286,000)	$ (302,000)
Backfit Protection	B-3	$ (712,000)	$ (646,000)	$ (682,000)
Aging Management	AMP-2	$ (222,000)	$ (201,000)	$ (212,000)

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars

6.4 NRC Operation

This attribute accounts for the projected economic effect caused by routine and recurring activities in the proposed alternatives by the NRC. The staff estimates that by improving the regulations governing decommissioning power reactors, there would be no cost averted on an annual basis. Rather, costs would be incurred annually due to the expense of NRC resources to provide oversight. Only two areas of decommissioning are affected where the NRC would provide more oversight into decommissioning power reactors. These areas are FFD and DTF.

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 resources and incur costs in order to provide oversight for the fatigue portion of the 10 CFR Part 26 regulations in the decommissioning phase.

Under Alternative DTF-3, the NRC would expend resources to review all licensee site-specific cost estimates periodically (every 5 years for licensees in operating phase and annually for licensees in decommissioning phase).

Table 17 Additional NRC Operational Costs

Areas of Decommissioning	Alternatives	NRC Operation Costs (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Fitness for Duty, Fatigue	F-3	$ (49,000)	$ (12,000)	$ (25,000)
Decommisstion Trust Fund	DTF-2	$ 182,000	$ 71,000	$ 119,000
Decommisstion Trust Fund	DTF-3	$ (1,978,000)	$ (290,000)	$ (722,000)

* There may be discrepancies in calculations due to rounding.

6.5 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, Minimum Staffing and Training Requirements for Certified Fuel Handler, Decommissioning Trust Fund, Offsite and Onsite Financial Protection Requirements and Indemnity Agreements and Application of Backfitting Protection. 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 exemption and amendment requests to the NRC and by the NRC to review these exemption and amendment 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.

6.6 Public Health (Accident & Routine) and Safeguards and Security Considerations

As stated in the draft regulatory basis document (Ref. 1), the need for a power reactor decommissioning rulemaking is not based on safety or security concerns. A power reactor decommissioning rule is expected to have no impact on public health and safety.

6.7 Other Government

Some areas of decommissioning (e.g., emergency preparedness) considered in this analysis may impact state, local, or tribal governments and have been modeled based on the available information. The NRC staff will consider public comments and input received on this analysis during the development of the final regulatory basis, including new information regarding the potential impacts on state, local, and tribal governments.

6.8 Environmental Considerations

Currently, no environmental impacts are expected. However as stated in the draft regulatory basis document (Ref. 1), an environmental assessment will be prepared if the rulemaking for decommissioning reactors could result in an environmental impact. An evaluation of these impacts will be incorporated into this analysis at that time. The NRC staff will also consider public comments and input received on environmental considerations during the development of the final regulatory basis.

6.9 Disaggregation

The NRC completed a screening review in accordance with guidance in Section 4.3.2, "Criteria for the Treatment of Individual Requirements," of the Regulatory Analysis Guidelines (Ref. 30), for the areas of decommissioning containing an alternative that includes rulemaking:

- Emergency Preparedness
- Physical Security
- Cyber Security
- FFD – Fatigue Management
- Staffing and Training Requirements for Certified Fuel Handlers
- Decommissioning Trust Fund
- Offsite and Onsite Financial Protection Requirements
- Application of Backfitting Protection

In the screening review, the analysis evaluated the recommended requirements of each area of decommissioning and found that each requirement considered separately would satisfy the objectives of decommissioning.

6.10 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.[12]

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)[13] distributions and the discreet values for the integer distributions. For these distributions, the

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[12] Information about this software is available online at www.palisade.com.

[13] 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.

NRC staff used collected input to set the minimum and maximum values of the PERT distributions and the values of the integer 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 are presented for Alternative 2 of each area of decommissioning, unless otherwise indicated.

6.10.1 Emergency Preparedness

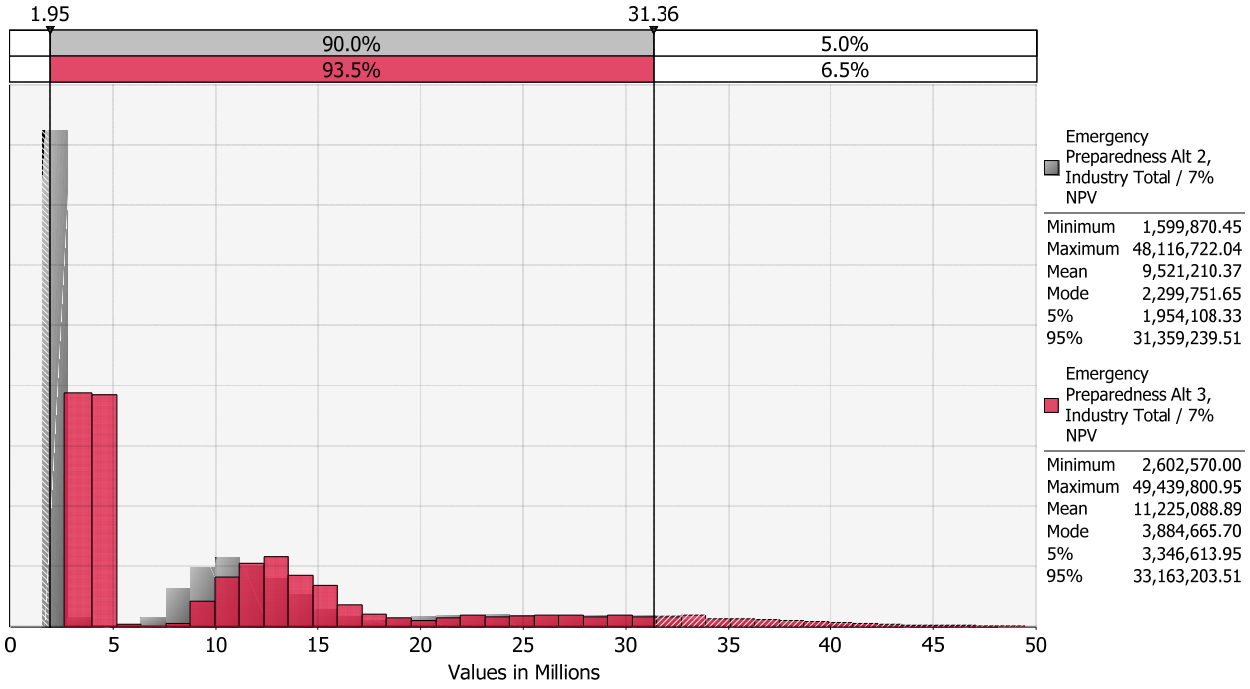

Figure 1 Variation of Industry Cost due to the Uncertainty in the Emergency Preparedness Cost Drivers (Alternatives EP-2 and EP-3)

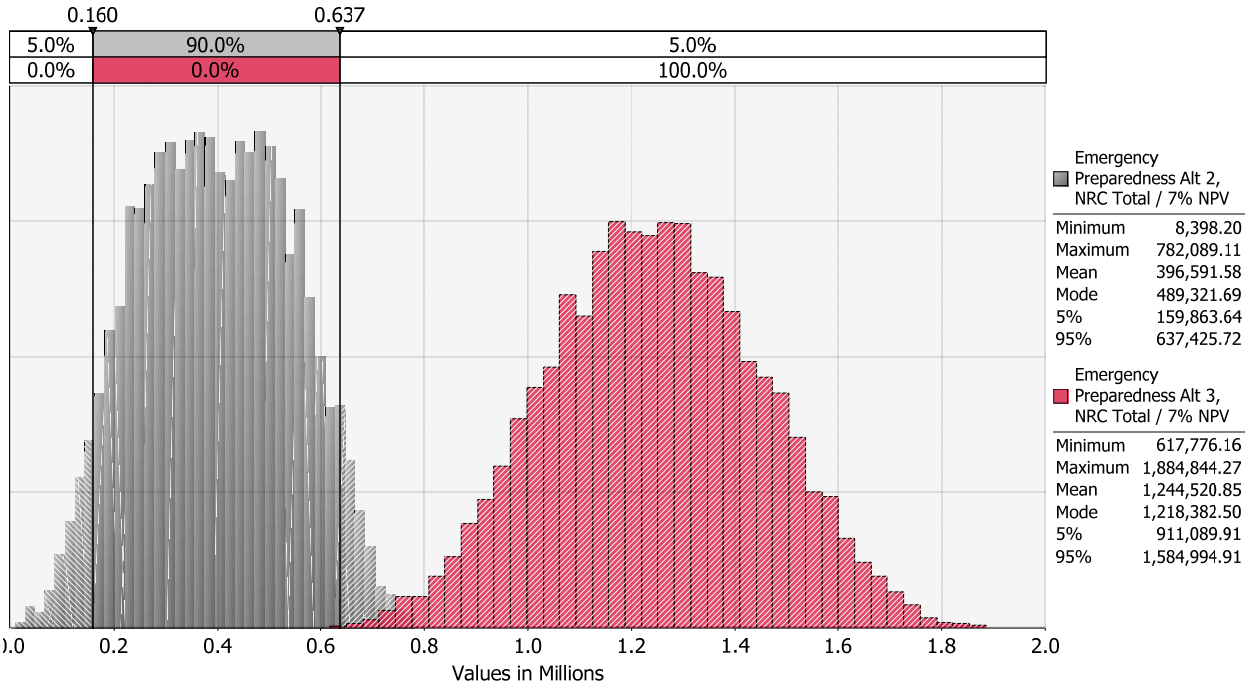

Figure 2 Variation of NRC Cost due to the Uncertainty in the Emergency Preparedness Cost Drivers (Alternatives EP-2 and 3)

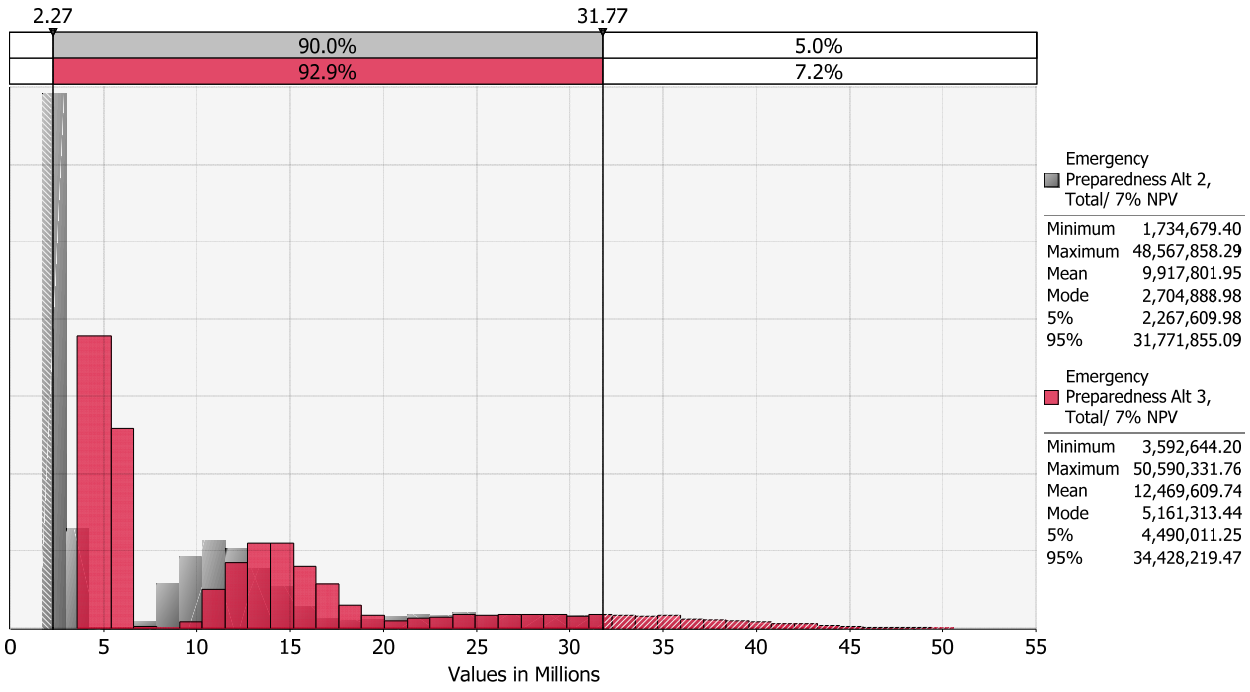

Figure 3 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Emergency Preparedness Cost Drivers (Alternatives EP-2 and 3)

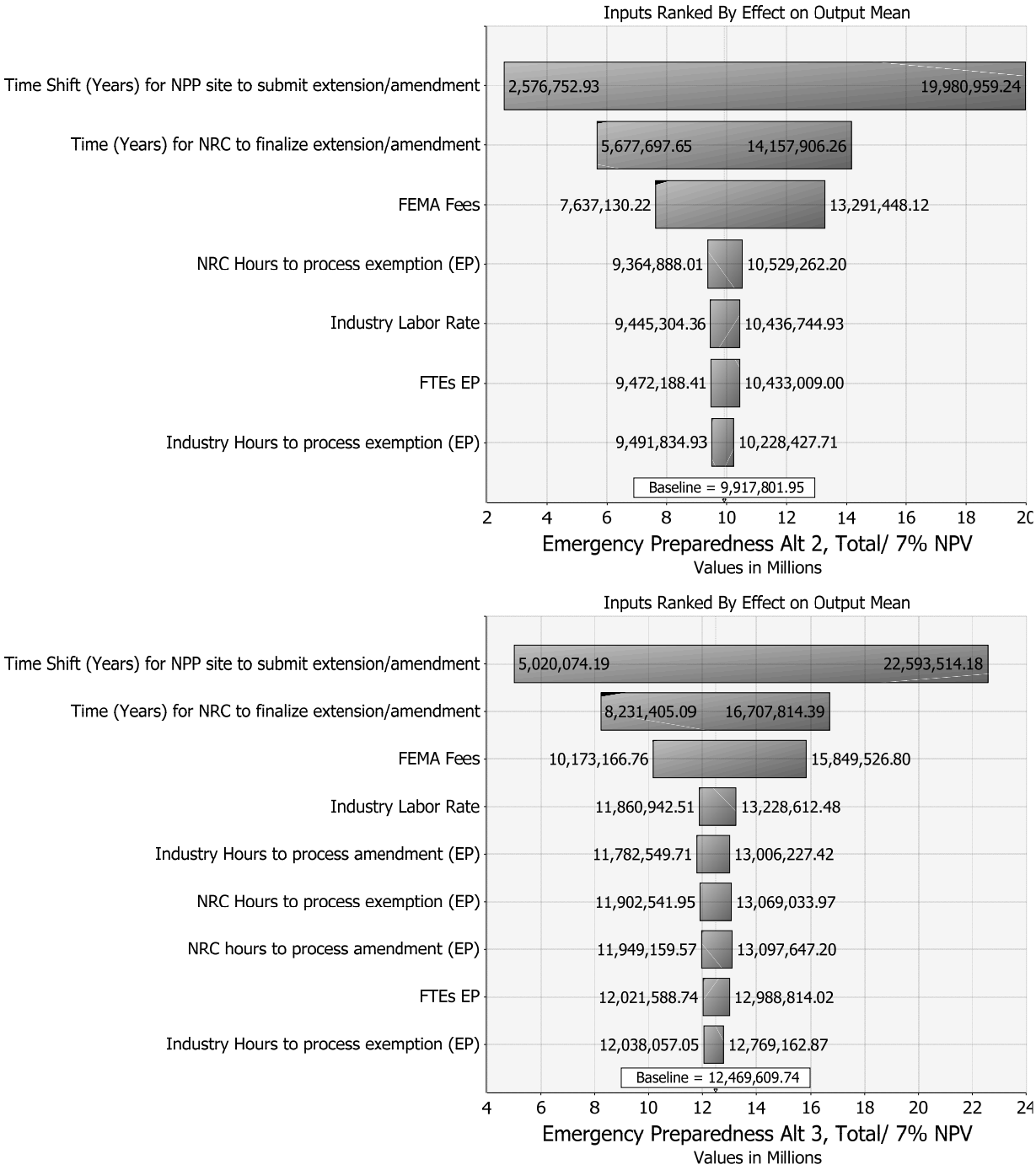

Figure 4 Tornado Chart Showing the Variation of Total Cost due to each Emergency Preparedness Cost Driver (Alternatives EP-2 and 3)

As shown in Figure 1 through Figure 4, the recommended regulatory changes to the emergency preparedness area of decommissioning for EP-2 would result in averted costs to both the nuclear power industry and the NRC over the decommissioning period in the range of $1.73 million to $48.6 million (7 percent NPV). For EP-3 these recommended changes would result in averted costs to both the nuclear power industry and the NRC over the decommissioning period in the range of $3.59 million to $50.6 million (7 percent NPV).

For both alternatives, 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.

6.10.2 Physical Security

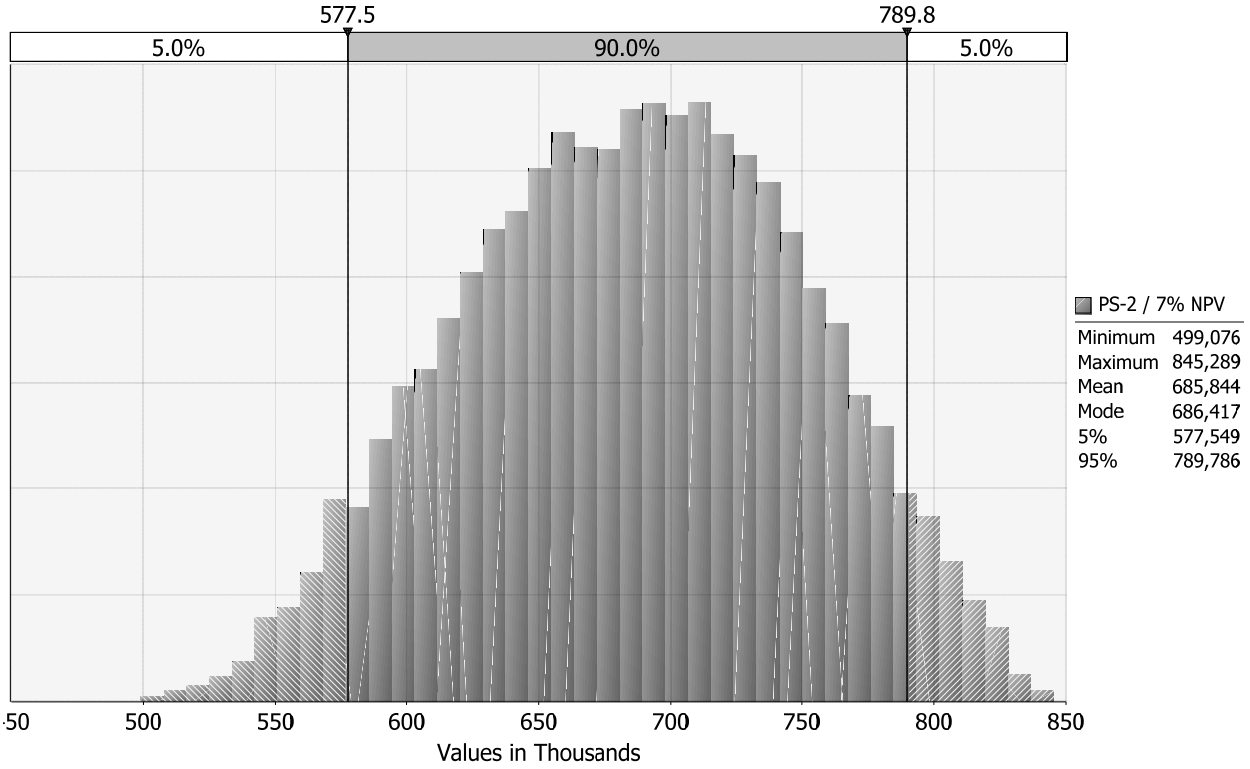

Figure 5 Variation of Industry Cost due to the Uncertainty in the Physical Security Cost Drivers (Alternative PS-2)

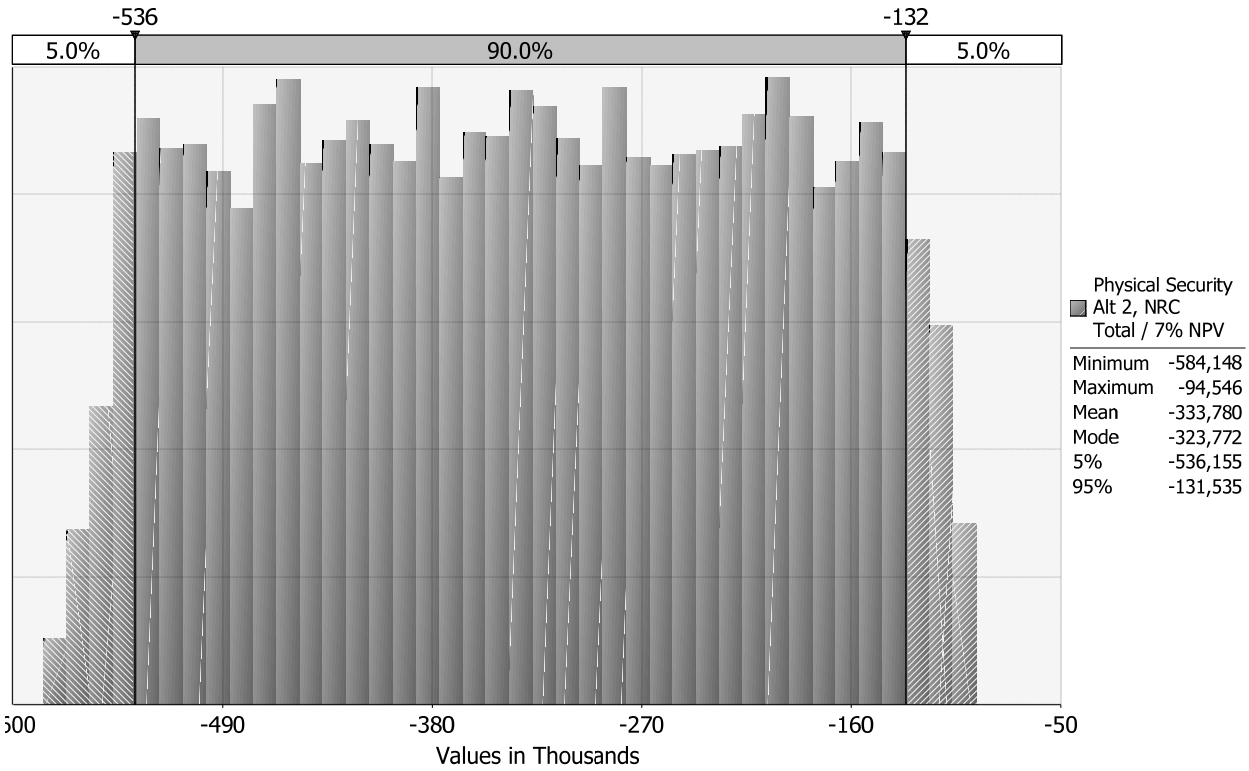

Figure 6 Variation of NRC Cost due to the Uncertainty in the Physical Security Cost Drivers (Alternative PS-2)

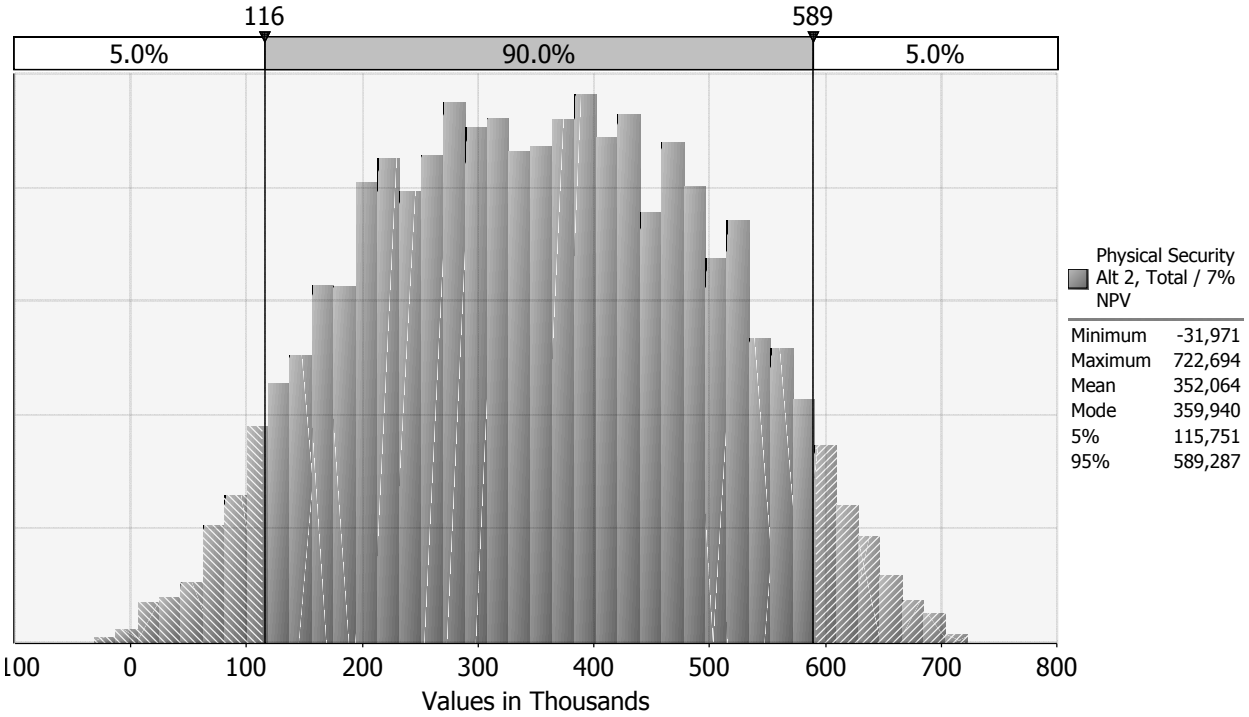

Figure 7 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Physical Security Cost Drivers (Alternative PS-2)

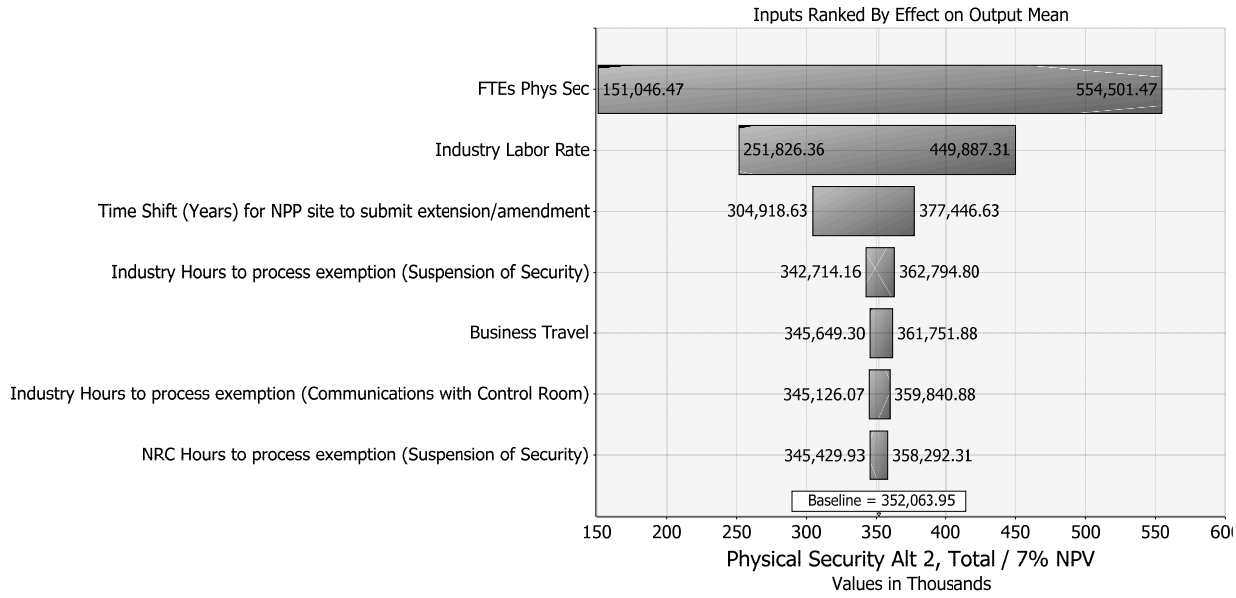

Figure 8 Tornado Chart Showing the Variation of Total Cost due to each Physical Security Cost Driver (Alternative PS-2)

As shown in Figure 5 through Figure 8, the recommended regulatory changes to the physical security area of decommissioning will result in additional or averted costs to both the nuclear power industry and the NRC over the decommissioning period in the range of ($32,000) to $723,000 (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.

6.10.3 Cyber Security

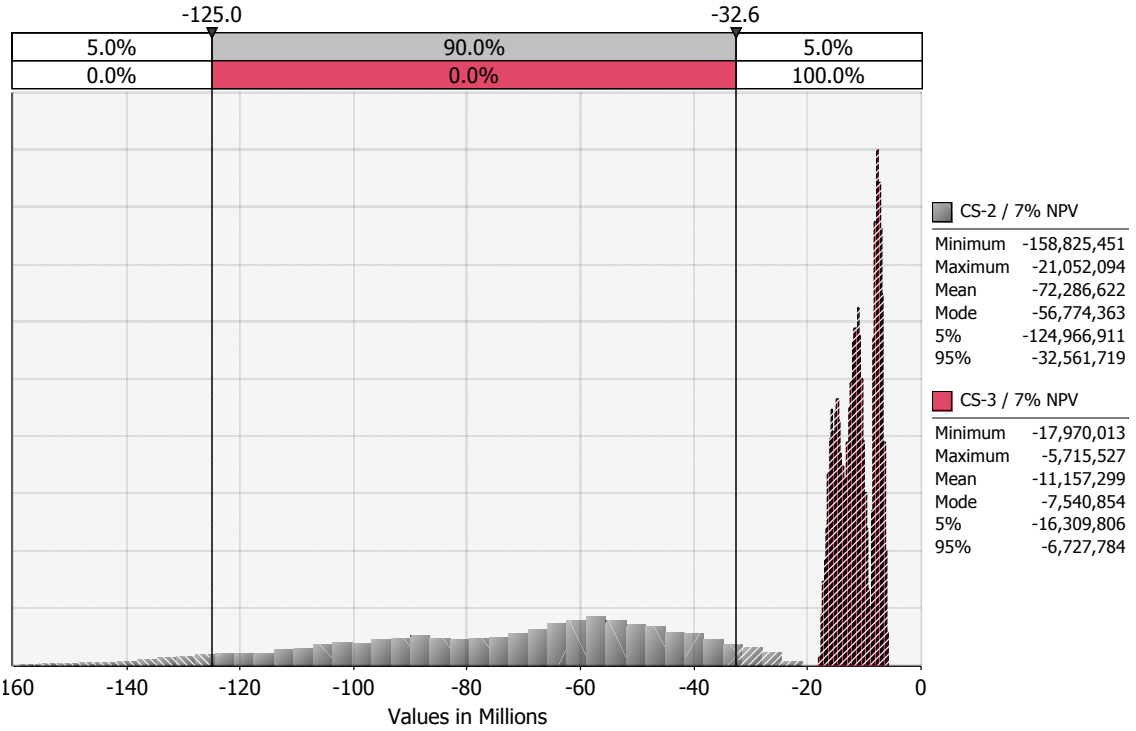

Figure 9 Variation of Industry Cost due to the Uncertainty in the Cyber Security Cost Drivers (Alternatives CS-2 & 3)

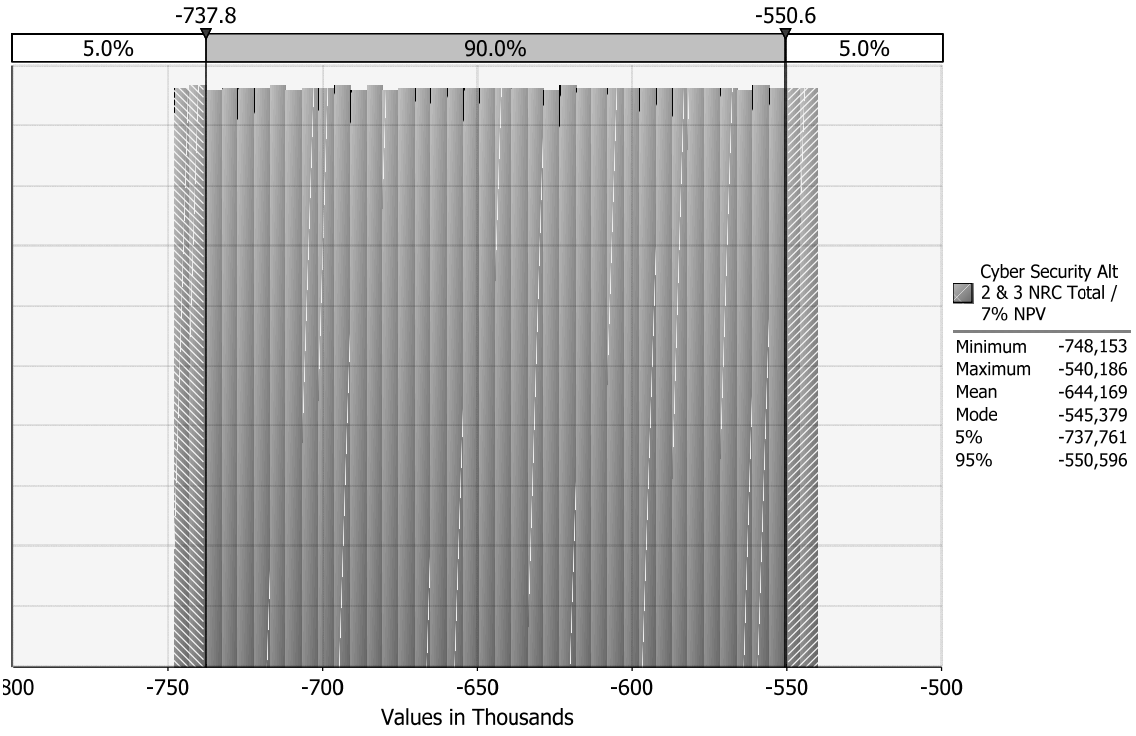

Figure 10 Variation of NRC Cost due to the Uncertainty in the Cyber Security Cost Drivers (Alternatives CS-2 & 3 have the same NRC cost and distribution)

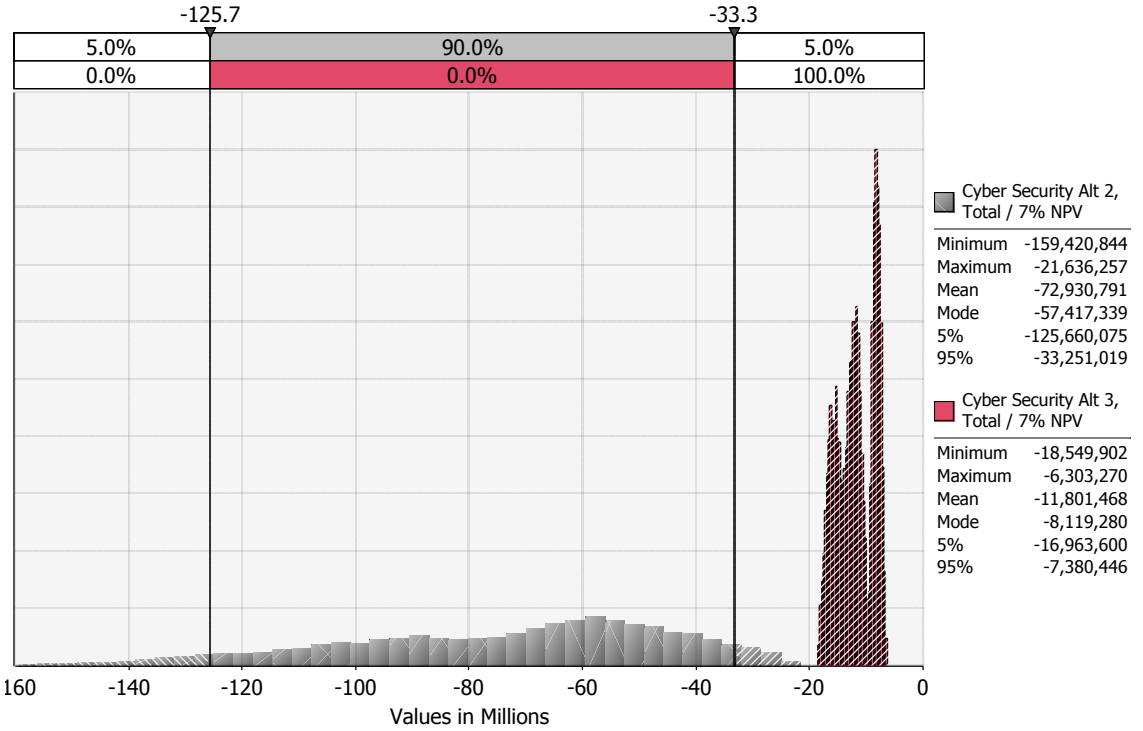

Figure 11 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Cyber Security Cost Drivers (Alternatives CS-2 & 3)

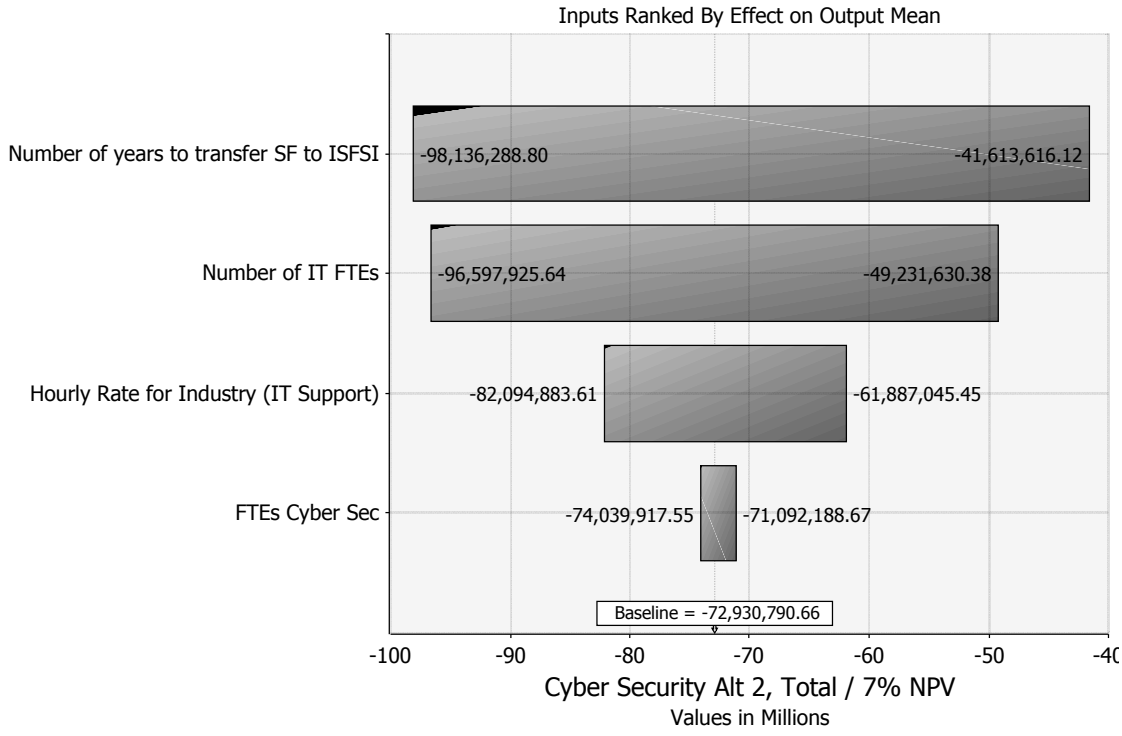

Figure 12 Tornado Chart Showing the Variation of Total Cost due to each Cyber Security Cost Driver (Alternative CS-2)

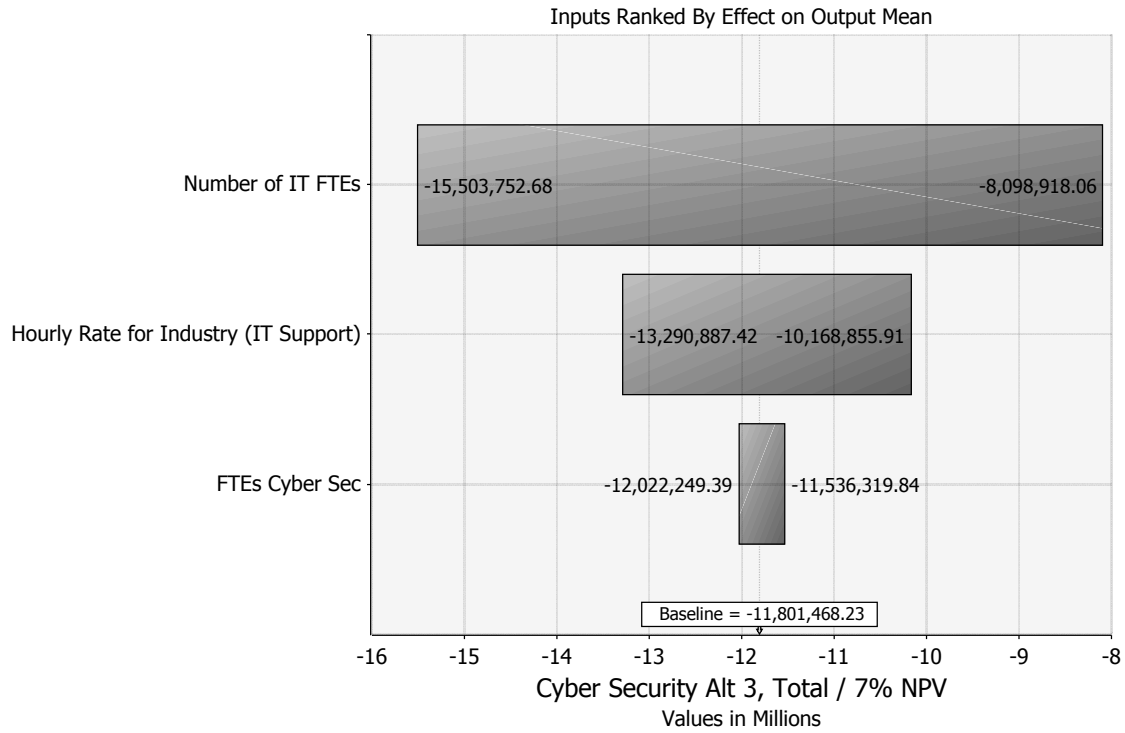

Figure 13 Tornado Chart Showing the Variation of Total Cost due to each Cyber Security Cost Driver (Alternative CS-3)

As shown in Figure 9 through Figure 13, the recommended regulatory changes to the cyber security area of decommissioning (Alternative CS-2) will result in costs to both the nuclear power industry and the NRC over the decommissioning period in the range of ($159 million) to ($21.6 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 number 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 both the nuclear power industry and the NRC over the decommissioning period in the range of ($18.5 million) to ($6.30 million) at 7 percent NPV. The cost drivers that have the greatest influence on total cost are the number of IT staff personnel responsible for cyber security and their hourly rates.

6.10.4 Fitness for Duty—Drug and Alcohol Testing

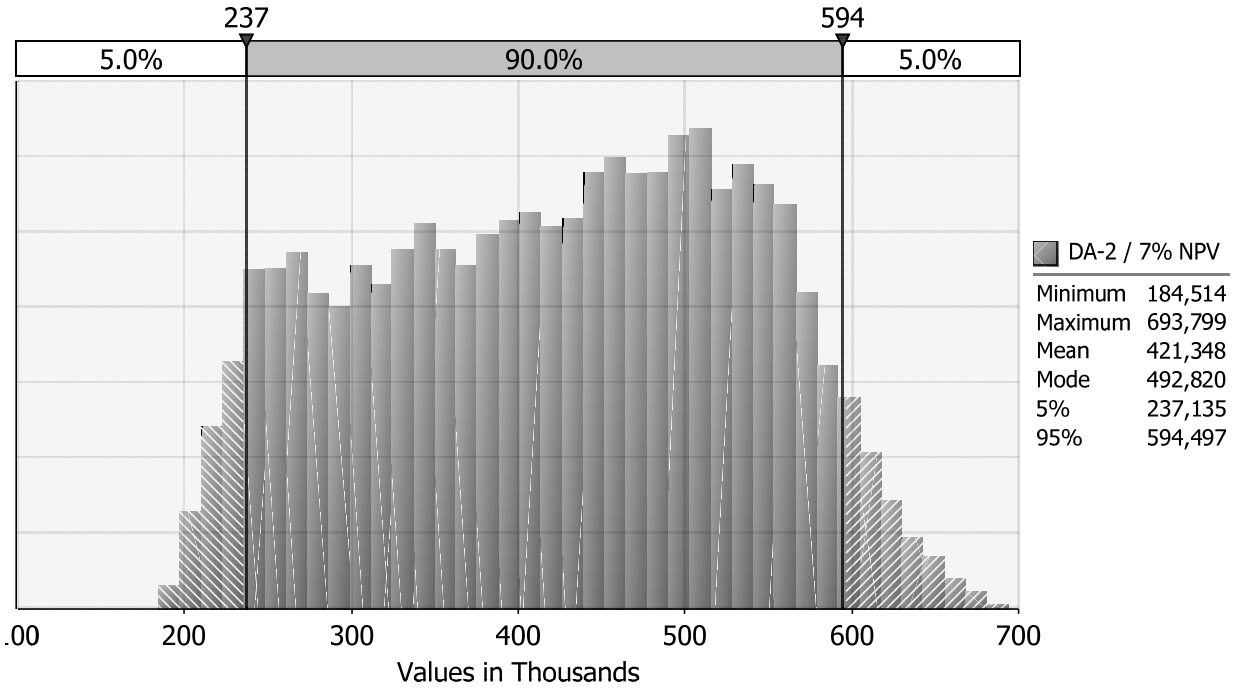

Figure 14 Variation of Industry Cost due to the Uncertainty in the Drug and Alcohol Testing Cost Drivers (Alternatives DA-2)

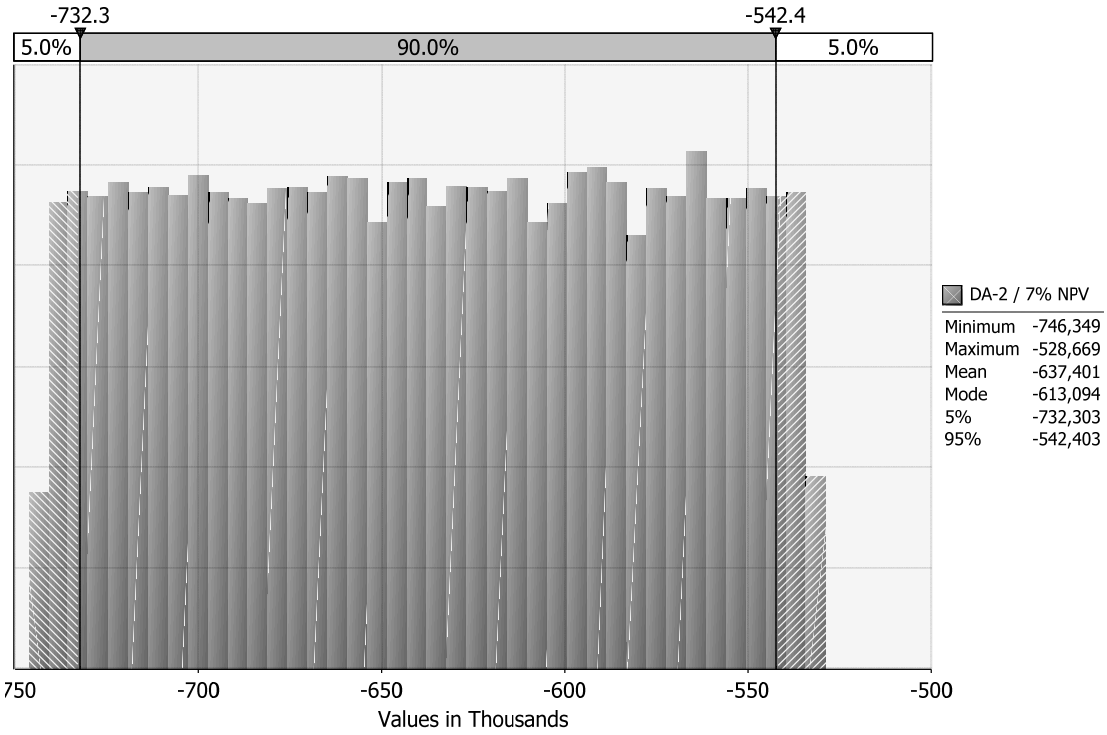

Figure 15 Variation of NRC Cost due to the Uncertainty in the Drug and Alcohol Testing Cost Drivers (Alternatives DA-2)

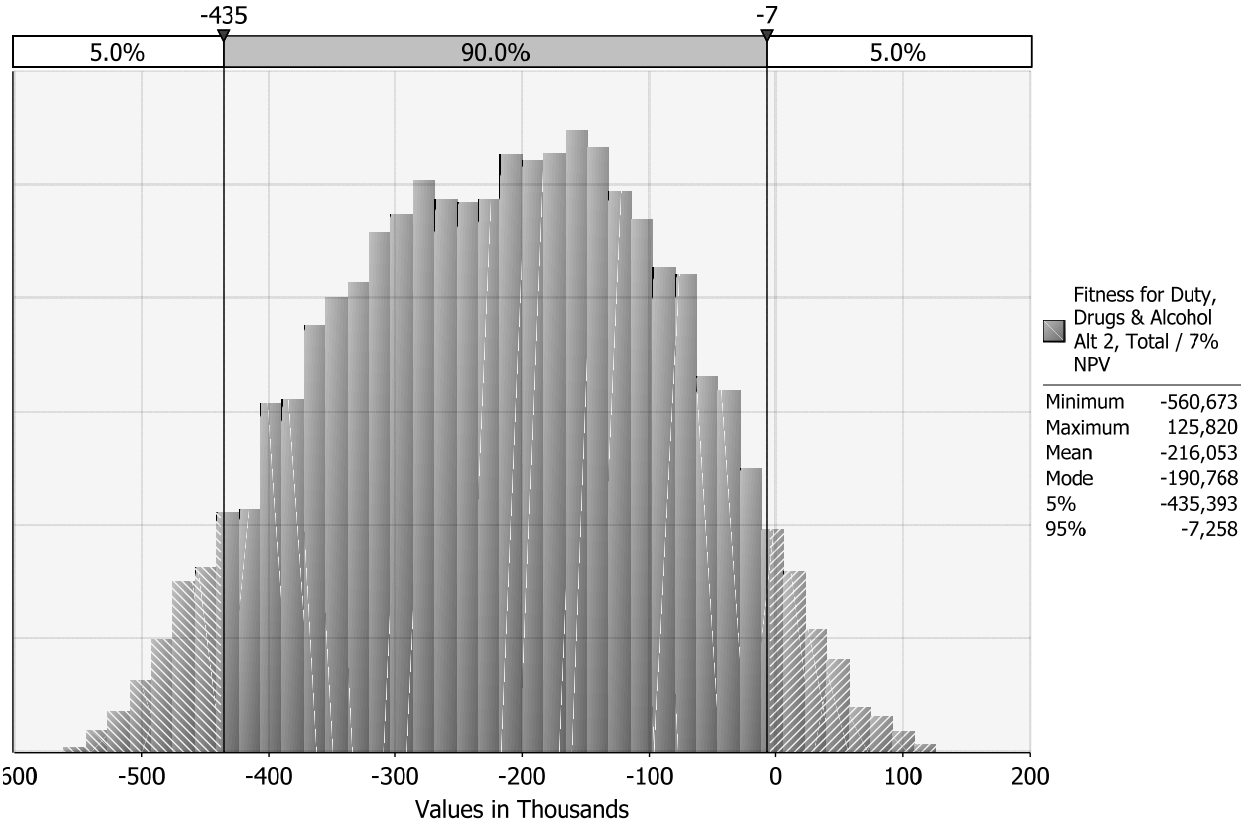

Figure 16 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Drug and Alcohol Testing Cost Drivers (Alternatives DA-2)

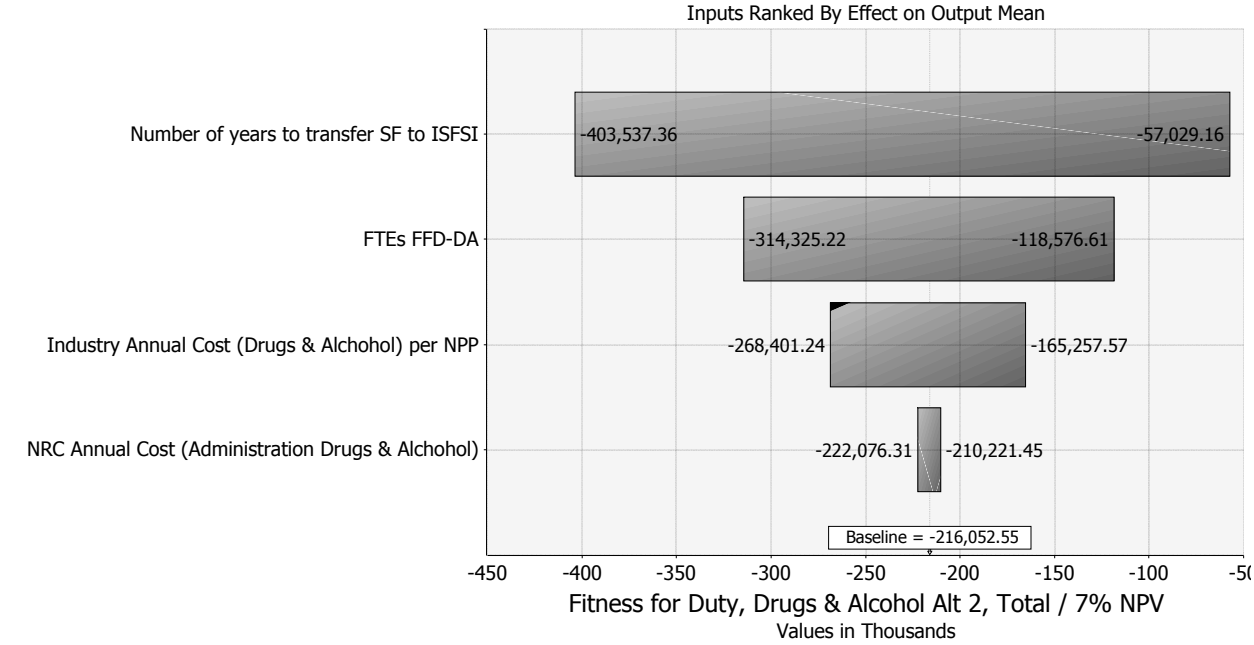

Figure 17 Tornado Chart Showing the Variation of Total Cost due to each Drug and Alcohol Testing Cost Driver (Alternative DA-2)

As shown in Figure 14 through Figure 17, the recommended regulatory changes to the FFD-drug and alcohol testing area of decommissioning (Alternative DA-2) will result in costs to both the nuclear power industry and the NRC over the decommissioning period in the range of ($561,000) to $126,000 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 number of FTEs to implement this rulemaking.

6.10.5 Fitness for Duty—Fatigue

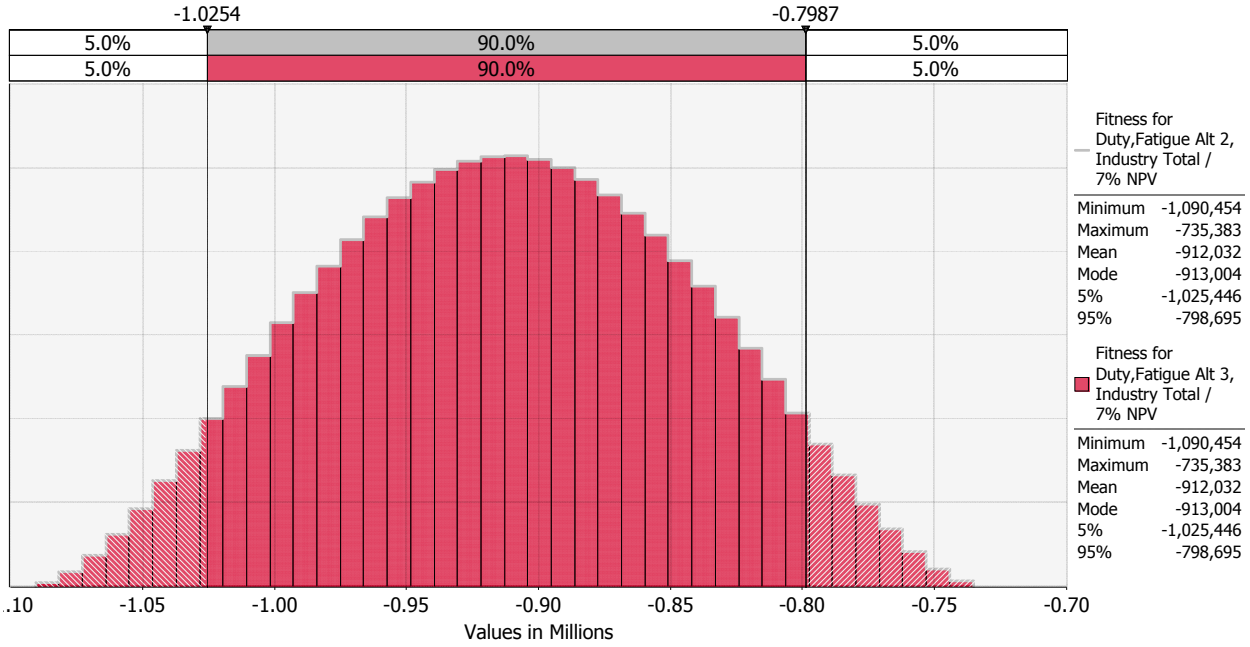

Figure 18 Variation of the Industry Cost due to the uncertainty in the Fatigue Cost Drivers (Alternatives F-2 and 3)

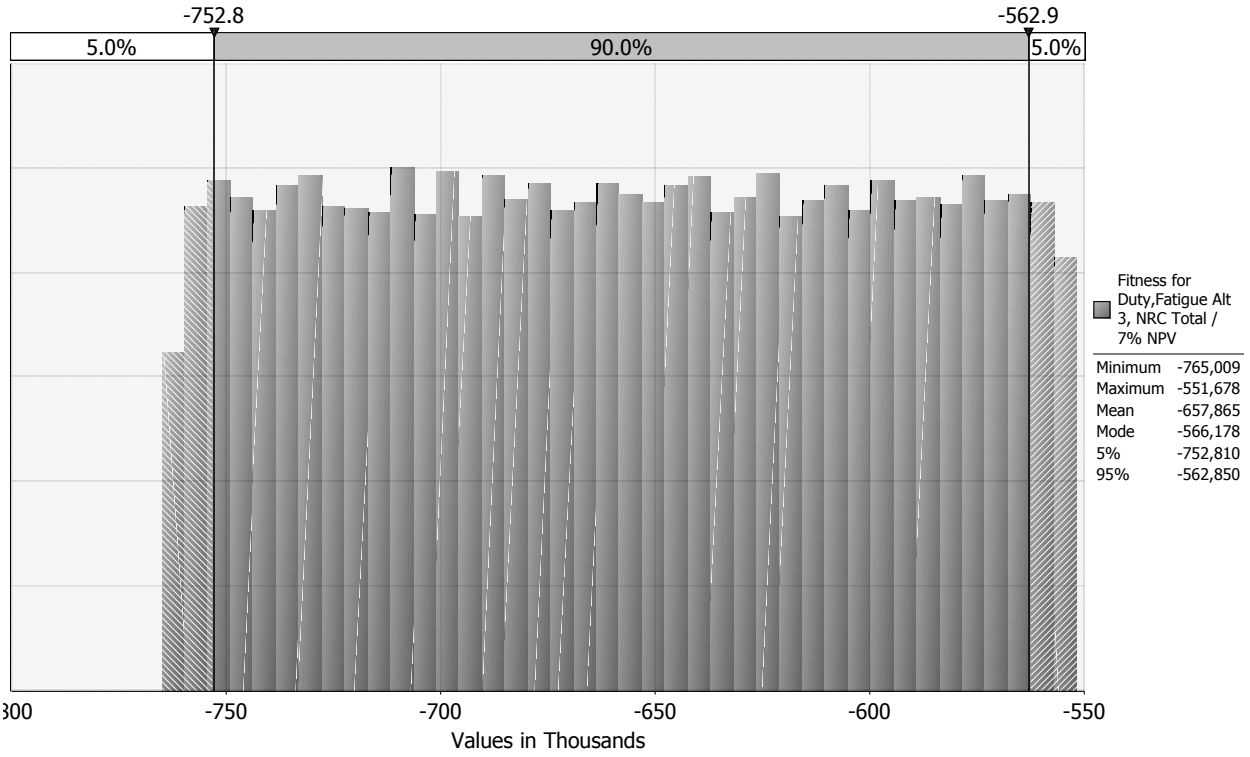

Figure 19 Variation of the NRC Cost due to the uncertainty in the Fatigue Cost Drivers (Alternatives F-3)

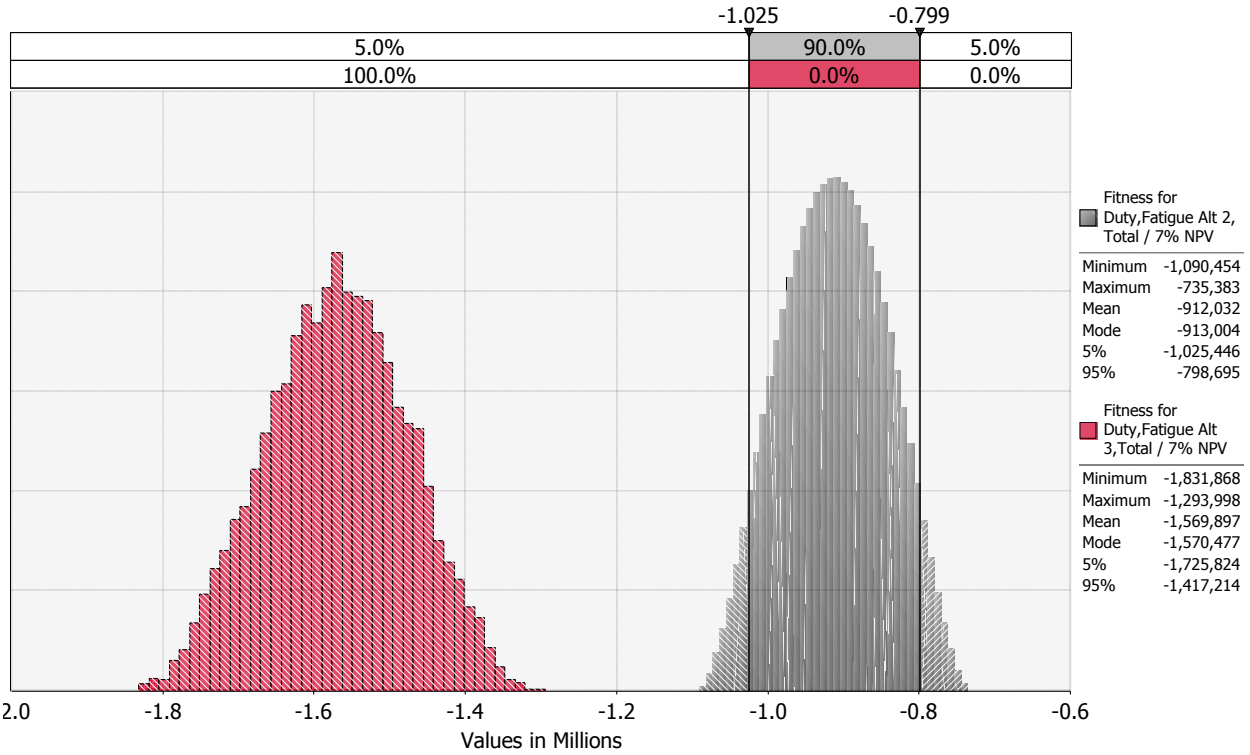

Figure 20 Variation of the Total Cost (Industry and NRC) due to the uncertainty in the Fatigue Cost Drivers (Alternatives F-2 and 3)

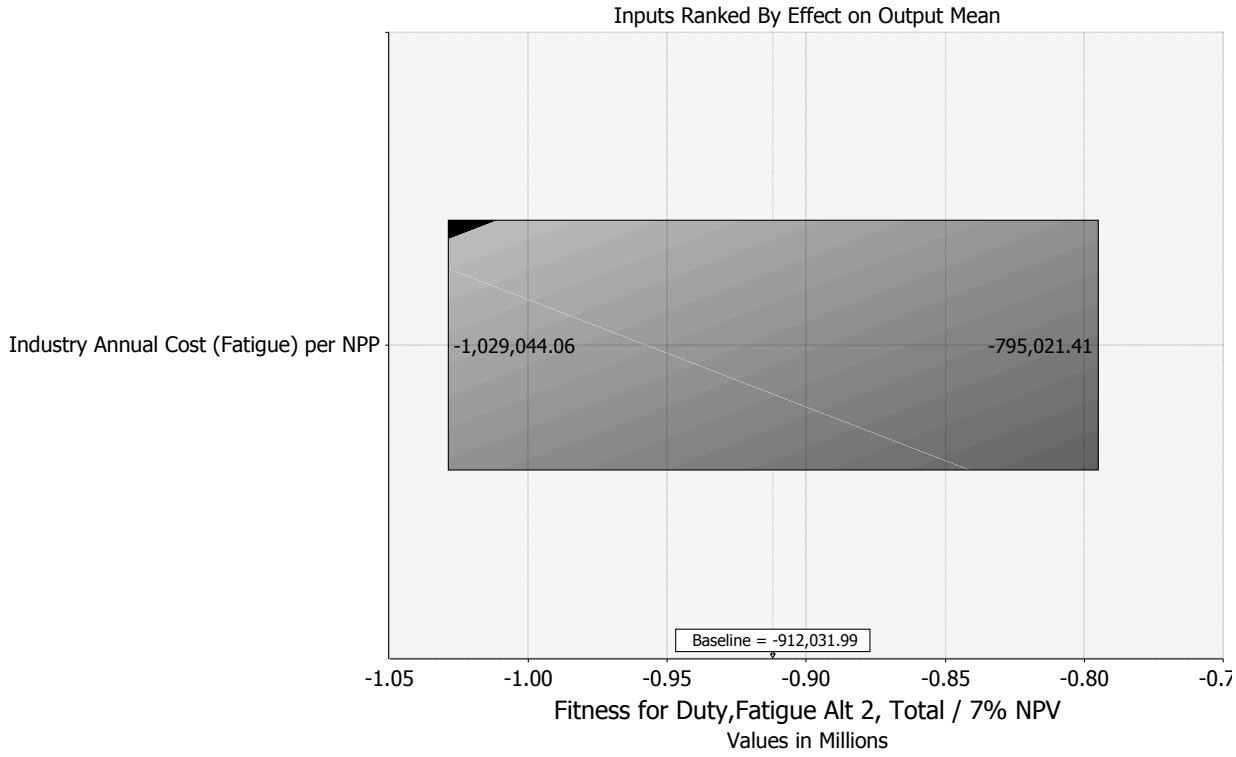

Figure 21 Tornado Chart Showing the Variation of Total Cost due to each Fatigue Cost Driver (Alternative F-2)

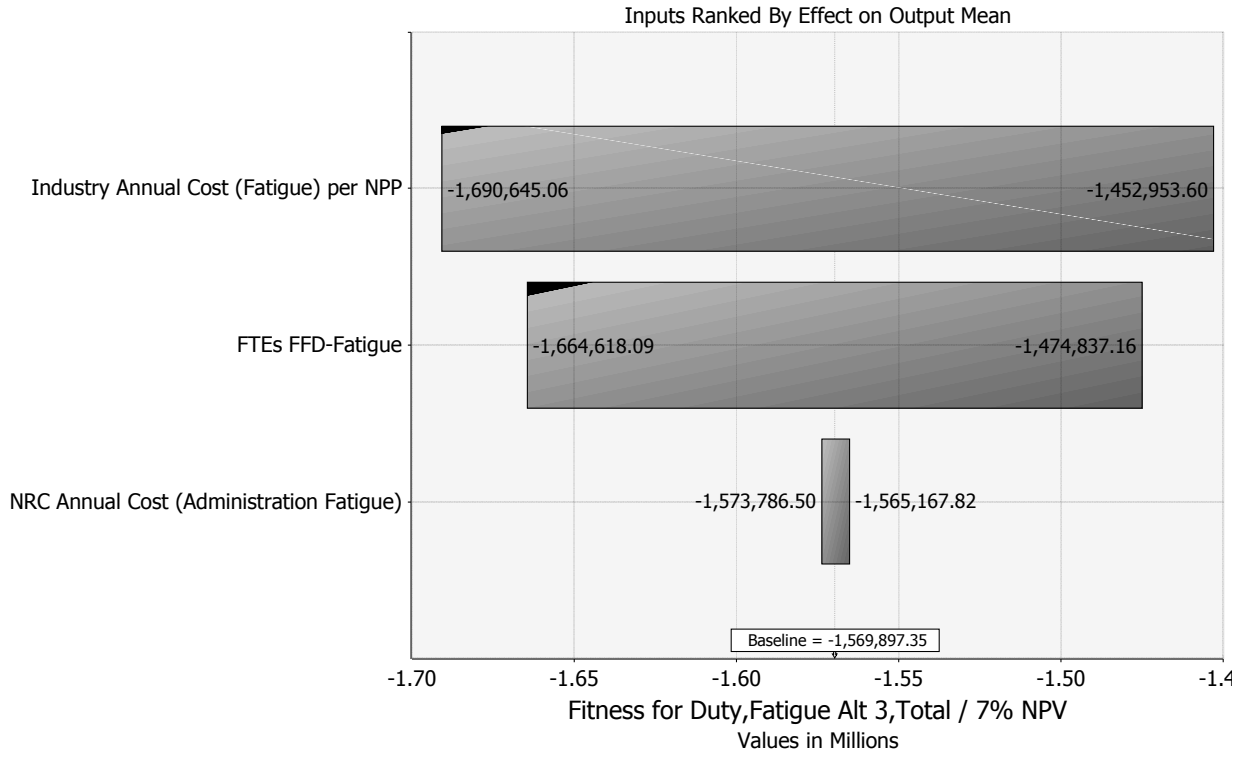

Figure 22 Tornado Chart Showing the Variation of Total Cost due to each Fatigue Cost Driver (Alternative F-3)

As shown in Figure 18 through Figure 22, the recommended regulatory changes to the FFD–fatigue area of decommissioning (Alternative F-2) will result in costs to both the nuclear power industry and the NRC over the decommissioning period of approximately ($1.09 million) to ($735,000) using a 7 percent NPV. The cost driver that has the greatest influence on total cost is industry resources to implement and manage FFD fatigue programs at their NPP sites during decommissioning.

The recommended regulatory changes to the FFD—fatigue area of decommissioning (Alternative F-3) will result in costs to both the nuclear power industry and the NRC over the decommissioning period of approximately ($1.83 million) to ($1.29 million) using a 7 percent NPV. The cost driver that has the greatest influence on total cost is industry resources to implement and manage FFD fatigue programs at their NPP sites during decommissioning and the cost to complete rulemaking.

6.10.6 Minimum Staffing and Training Requirements for Certified Fuel Handlers

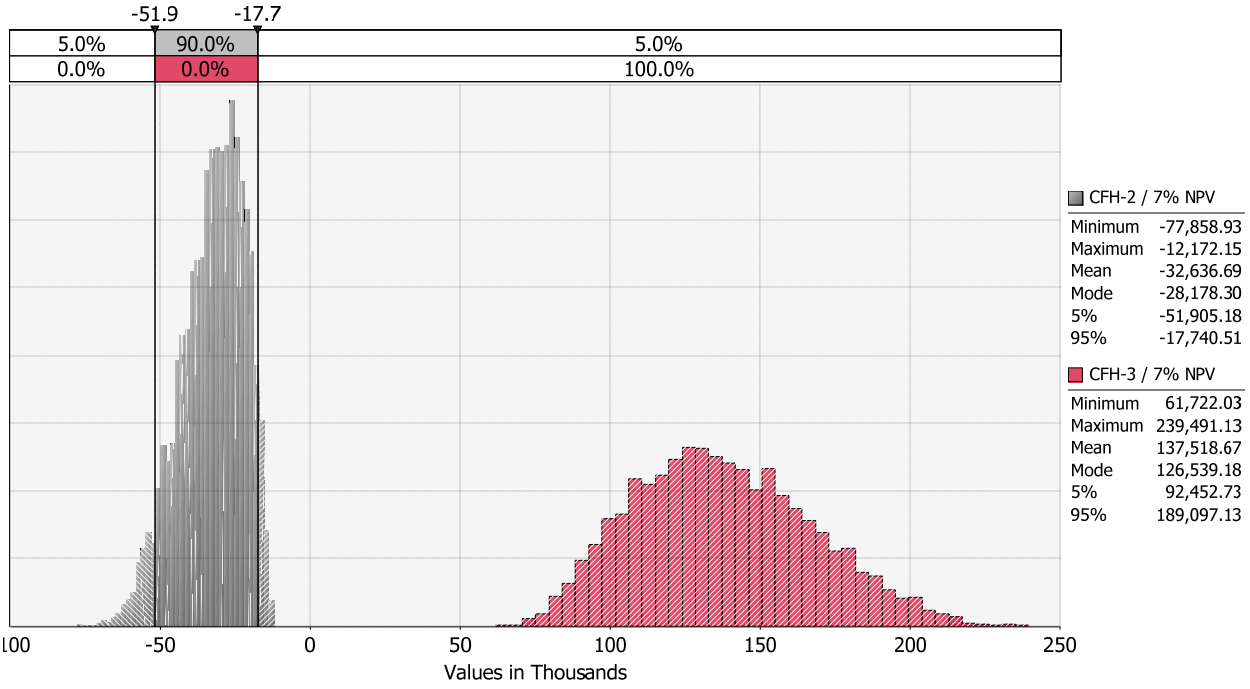

Figure 23 Variation of Industry Cost due to the Uncertainty in the Certified Fuel Handler Cost Drivers (Alternatives CFH-2 and 3)

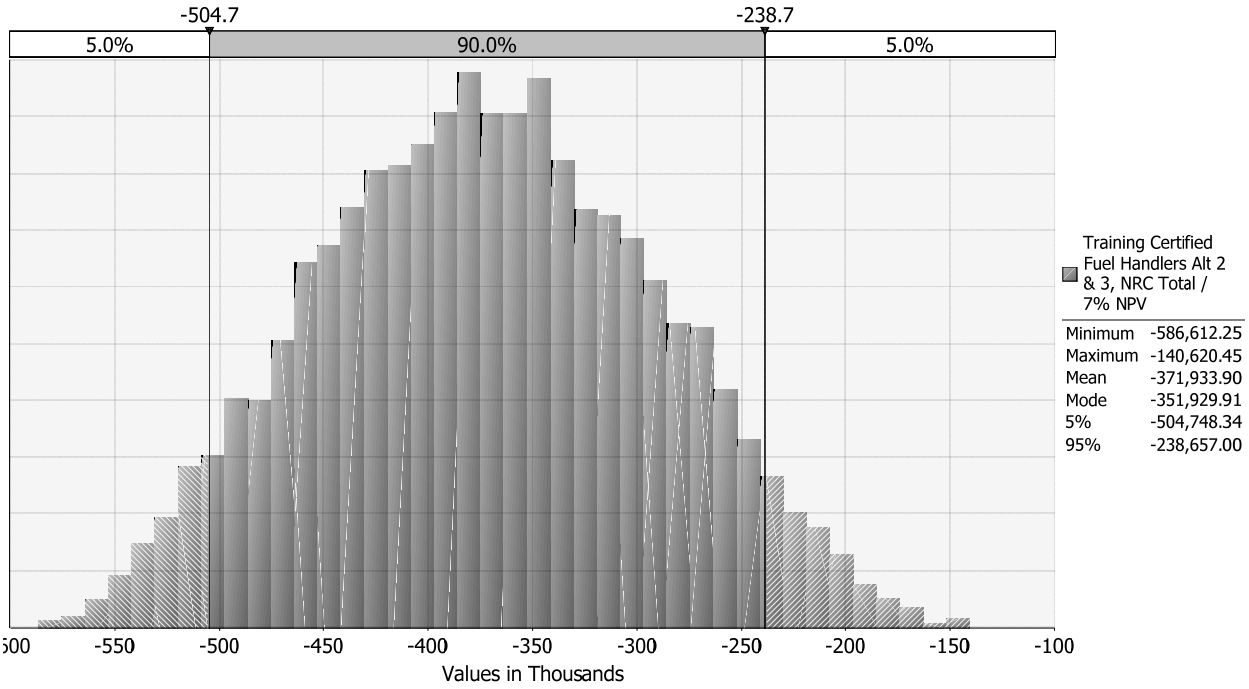

Figure 24 Variation of NRC Cost due to the Uncertainty in the Certified Fuel Handler Cost Drivers (Alternatives CFH-2 and 3)

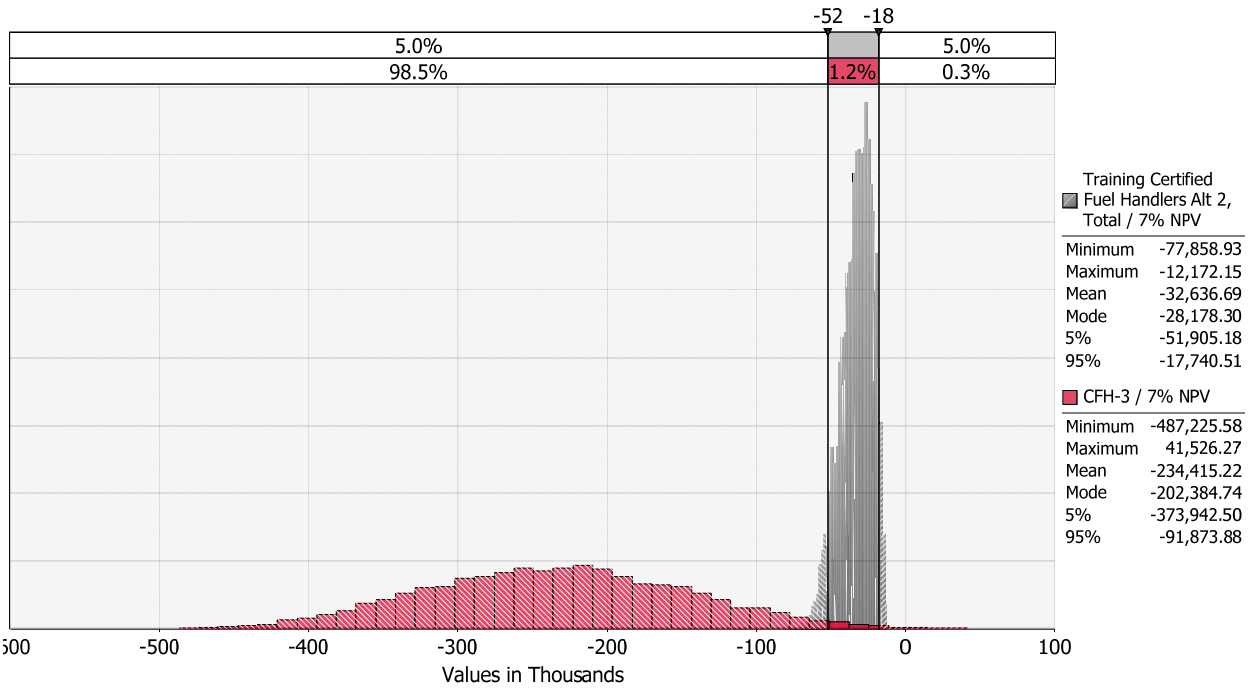

Figure 25 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Certified Fuel Handler Cost Drivers (Alternatives CFH-2 and 3)

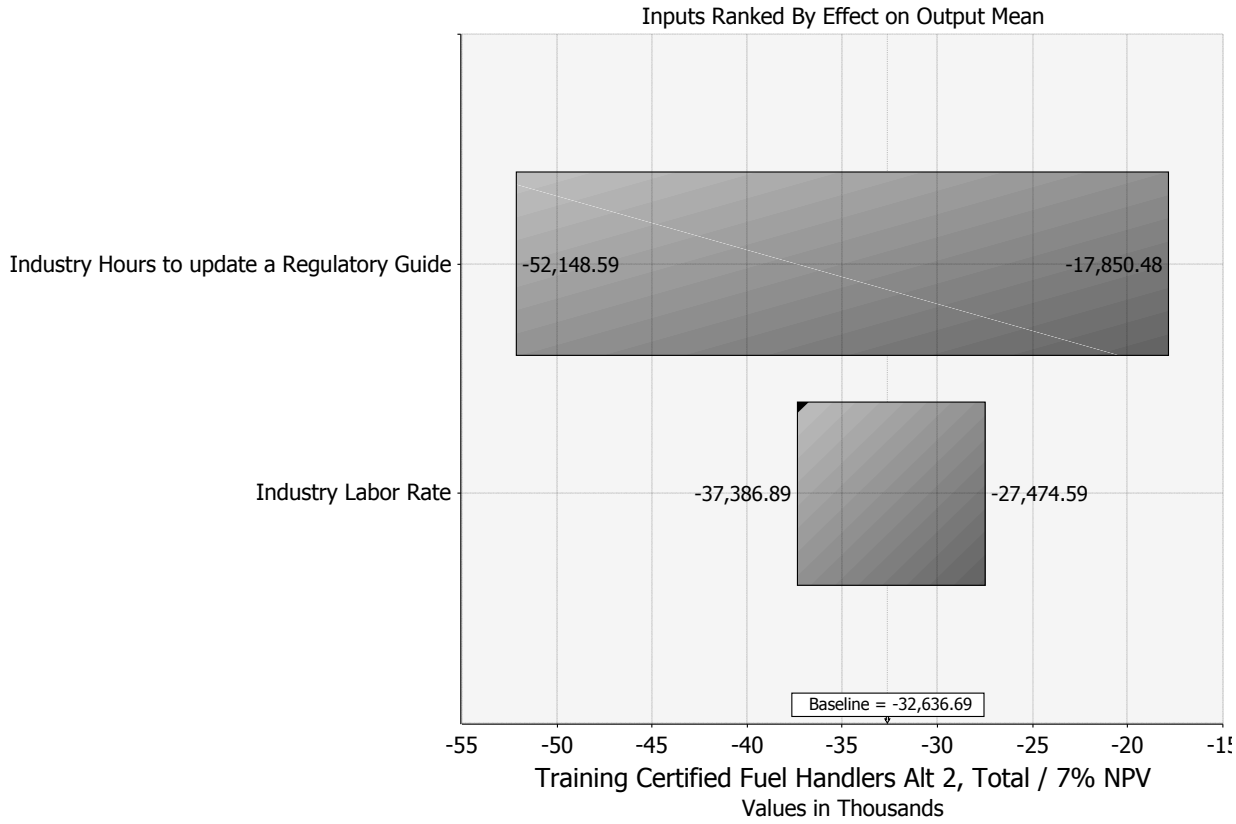

Figure 26 Tornado Chart Showing the variation of Total Cost due to each Certified Fuel Handlers Cost Driver (Alternative CFH-2)

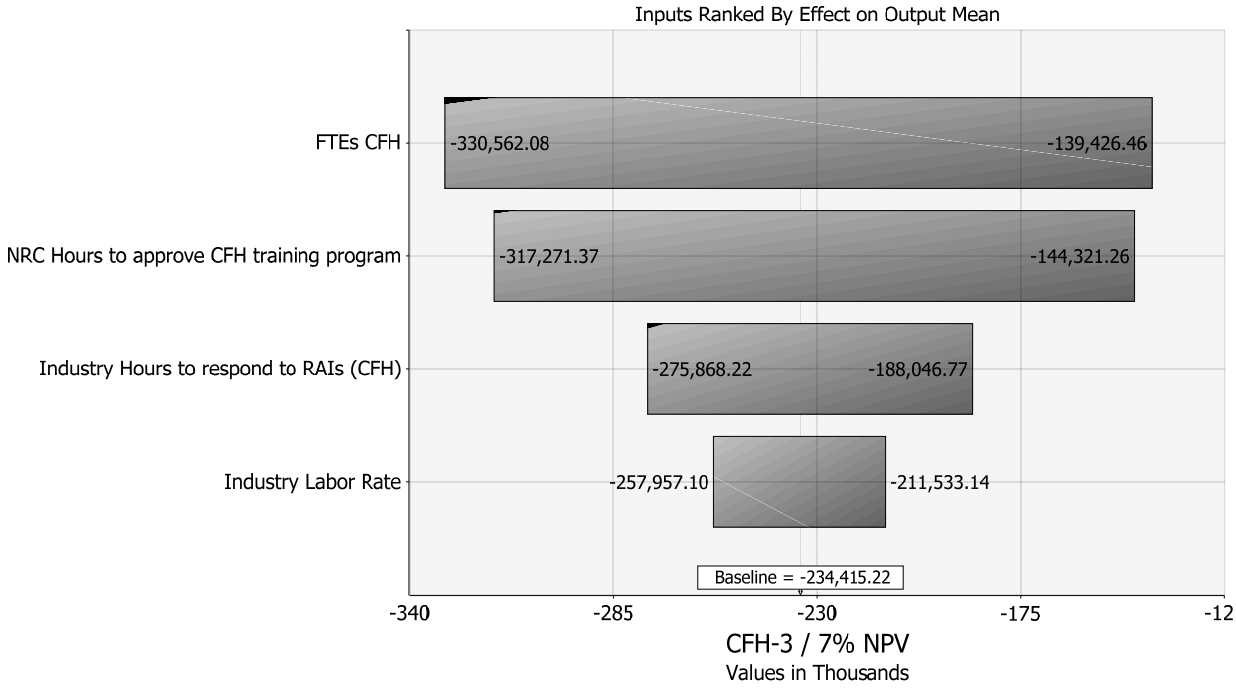

Figure 27 Tornado Chart Showing the variation of Total Cost due to each Certified Fuel Handlers Cost Driver (Alternative CFH-3)

As shown in Figure 23 through Figure 27, the recommended 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 both the nuclear power industry and the NRC over the decommissioning period in the range of ($77,900) to ($12,200) using a 7 percent NPV. The cost driver that has the greatest influence on total cost is the number of hours for industry to update the regulatory guide initiatives.

The recommended 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 both the nuclear power industry and the NRC over the decommissioning period in the range of ($487,000) to $41,500 using a 7 percent NPV. The cost drivers that have the greatest influence on total cost for this area of decommissioning are the cost to complete rulemaking for CFH and the number of hours for industry to prepare, submit, and obtain Commission's approval for a CFH training program.

6.10.7 Decommissioning Trust Fund

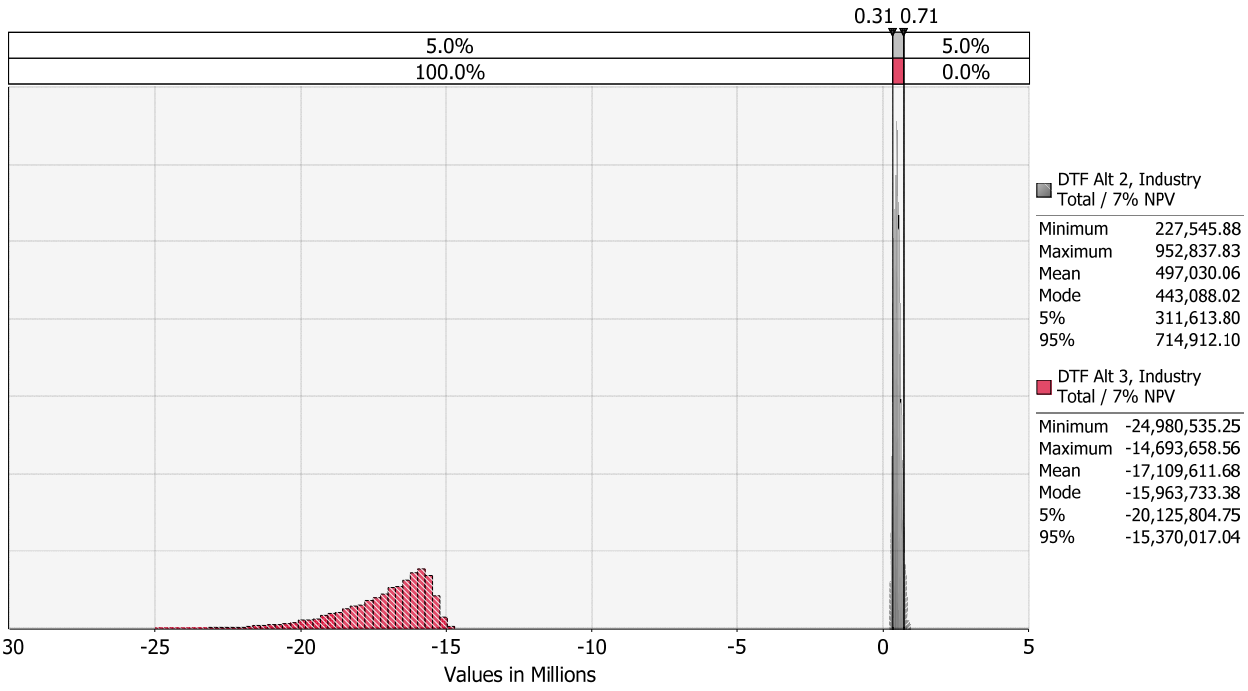

Figure 28 Variation of Industry Cost due to the Uncertainty in the Decommissioning Trust Fund Cost Drivers (Alternatives DTF-2 and 3)

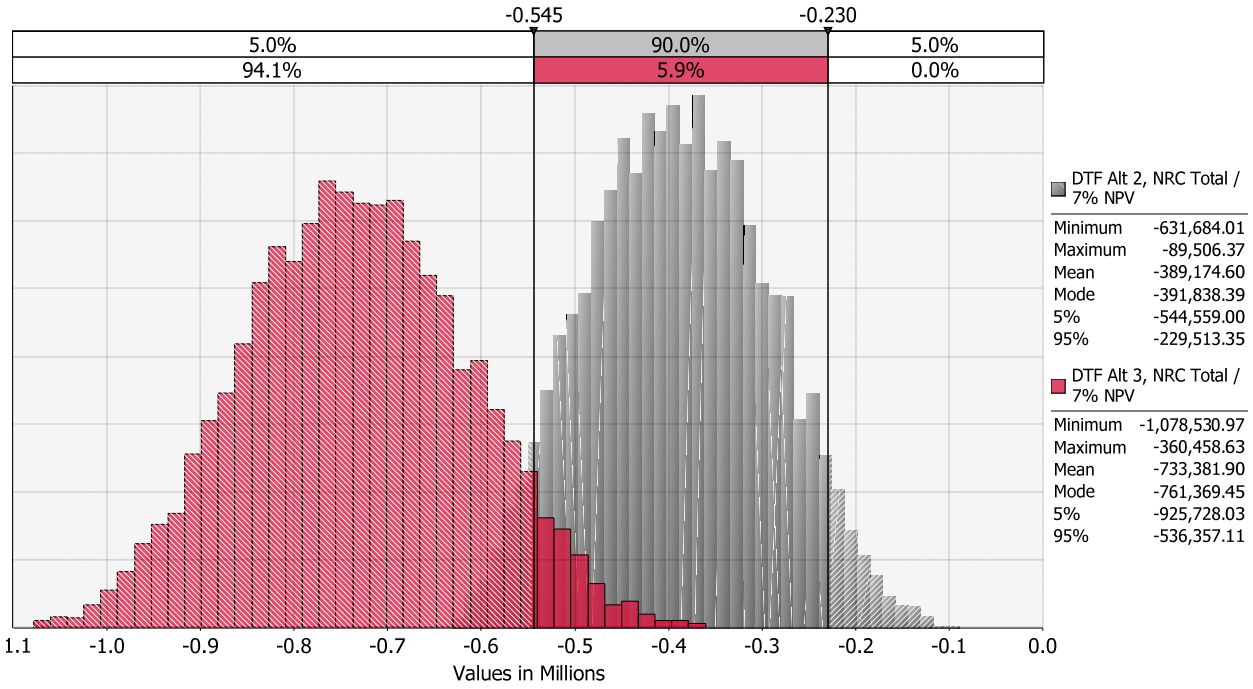

Figure 29 Variation of NRC Cost due to the Uncertainty in the Decommissioning Trust Fund Cost Drivers (Alternatives DTF-2 and 3)

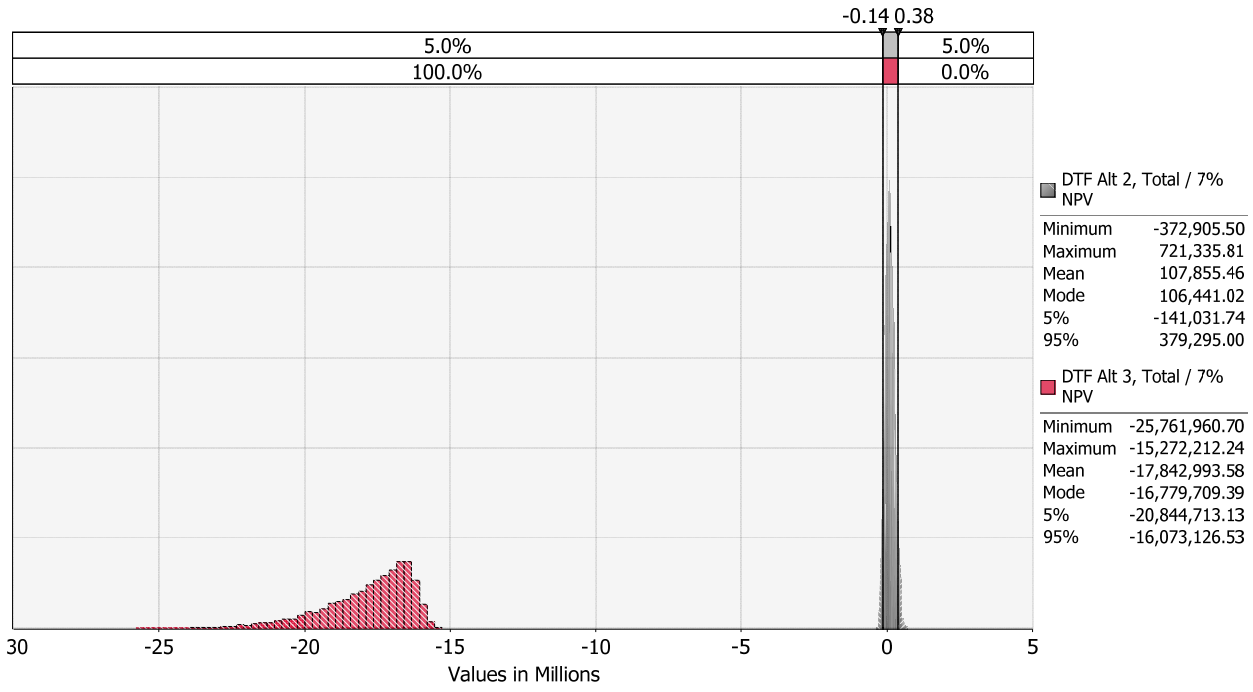

Figure 30 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Decommissioning Trust Fund Cost Drivers (Alternatives DTF-2 and 3)

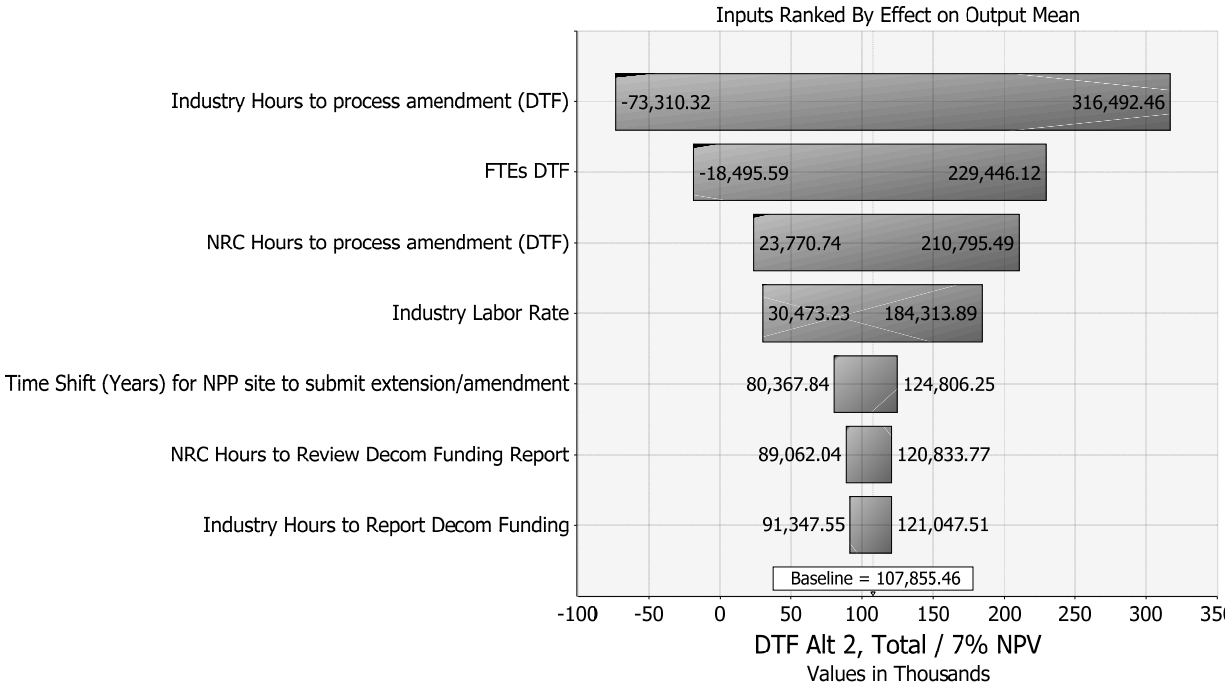

Figure 31 Tornado Chart Showing the Variation of Total Cost due to each Decommissioning Trust Fund Cost Driver (Alternatives DTF-2)

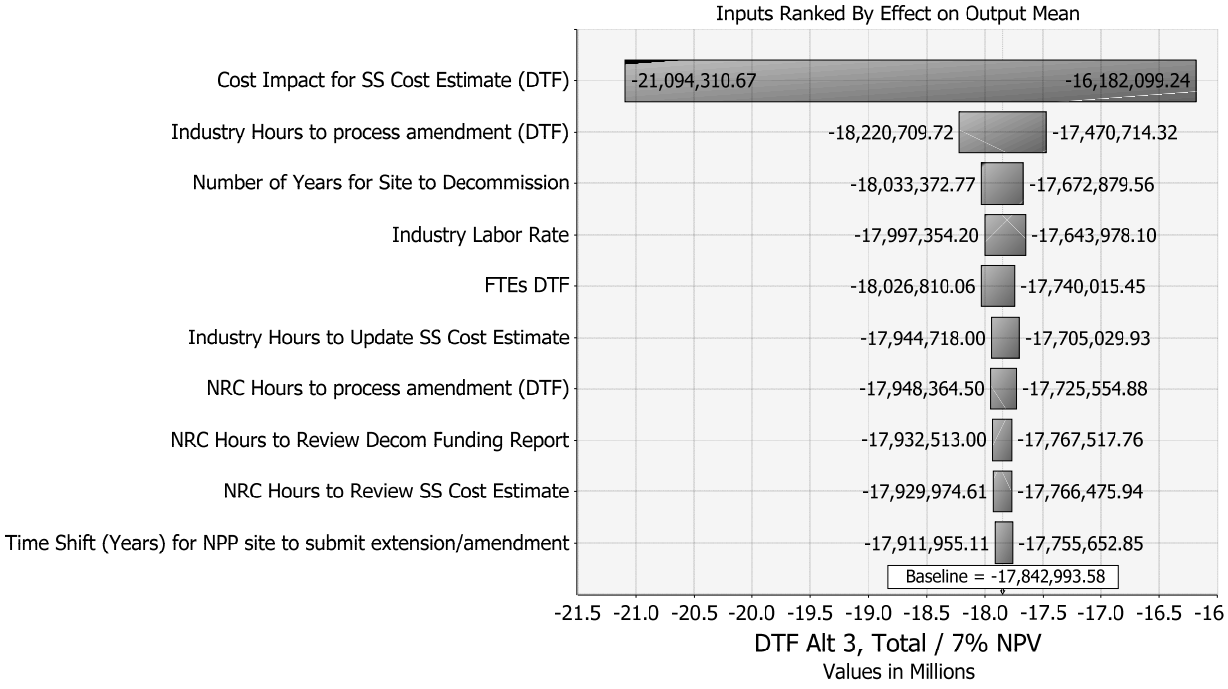

Figure 32 Tornado Chart Showing the Variation of Total Cost due to each Decommissioning Trust Fund Cost Driver (Alternatives DTF-3)

As shown in Figure 28 through Figure 32, the recommended regulatory changes to the DTF area of decommissioning (Alternative DTF-2) will result in additional or averted costs to both the nuclear power industry and the NRC over the decommissioning period in the range of

($373,000) to $721,000 using a 7 percent NPV. The cost driver that has the greatest influence is the number of hours for industry to process an amendment.

The recommended regulatory changes to the DTF area of decommissioning (Alternative DTF-3) will result in costs to both the nuclear power industry and the NRC over the decommissioning period in the range of ($25.8 million) to ($15.3 million) using a 7 percent NPV. The cost driver that has the greatest influence is the additional cost for the nuclear power industry to complete the site-specific cost estimates.

6.10.8 Offsite and Onsite Financial Protection Requirements and Indemnity Agreements

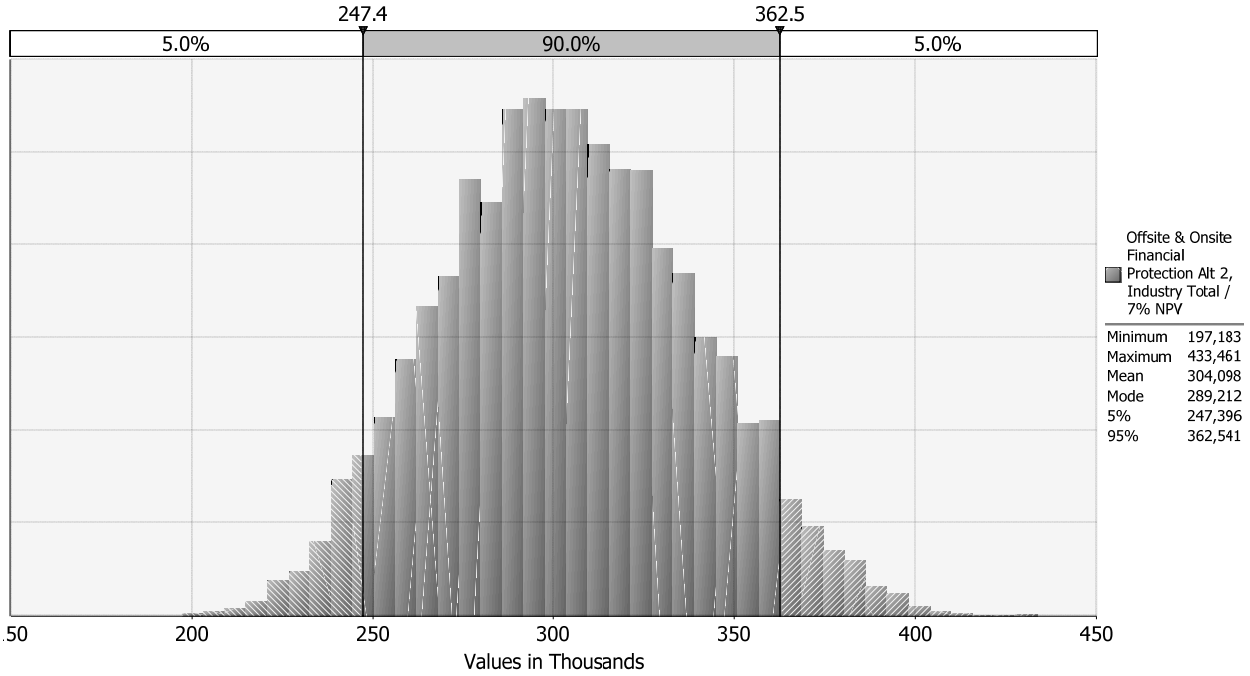

Figure 33 Variation of Industry Cost due to the Uncertainty in the Financial Protection Cost Drivers (Alternative FP-2)

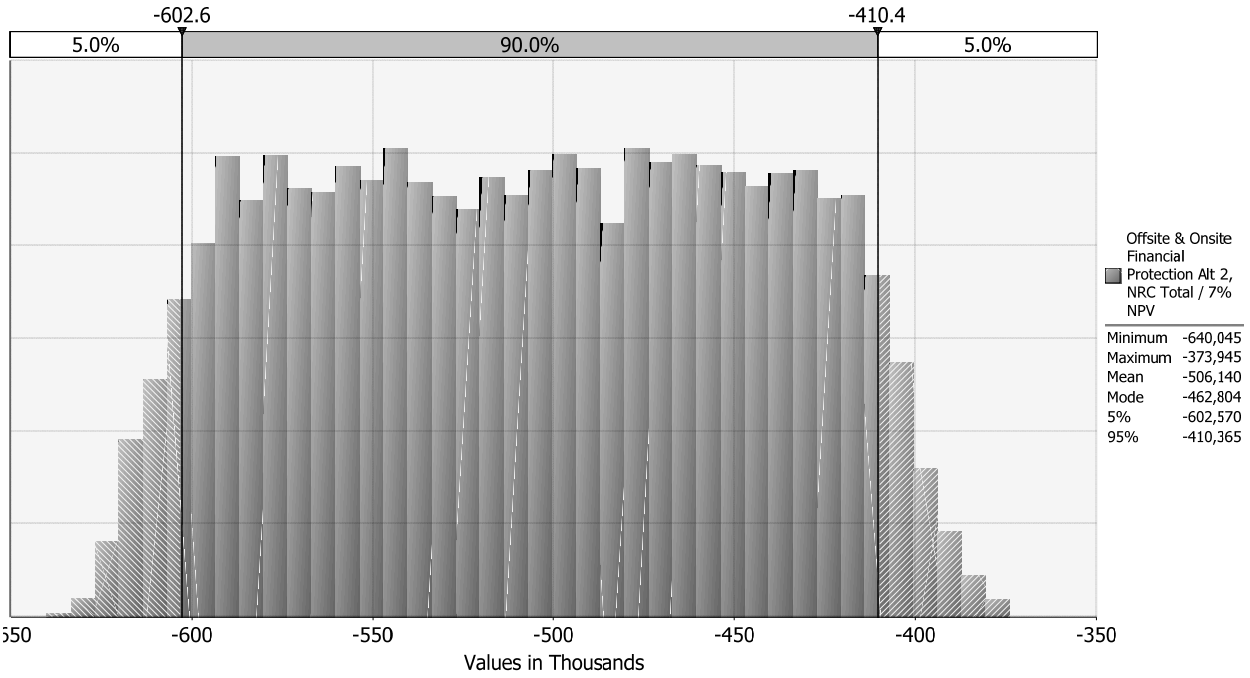

Figure 34 Variation of NRC Cost due to the Uncertainty in the Financial Protection Cost Drivers (Alternative FP-2)

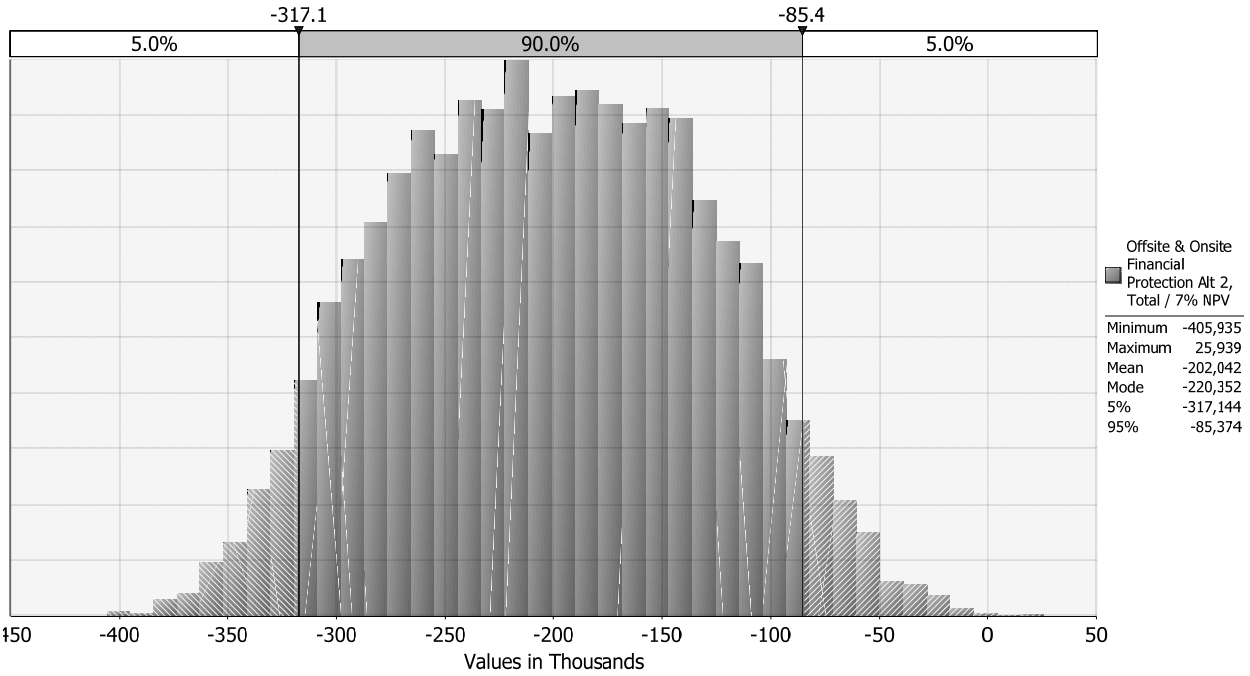

Figure 35 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Financial Protection Cost Drivers (Alternative FP-2)

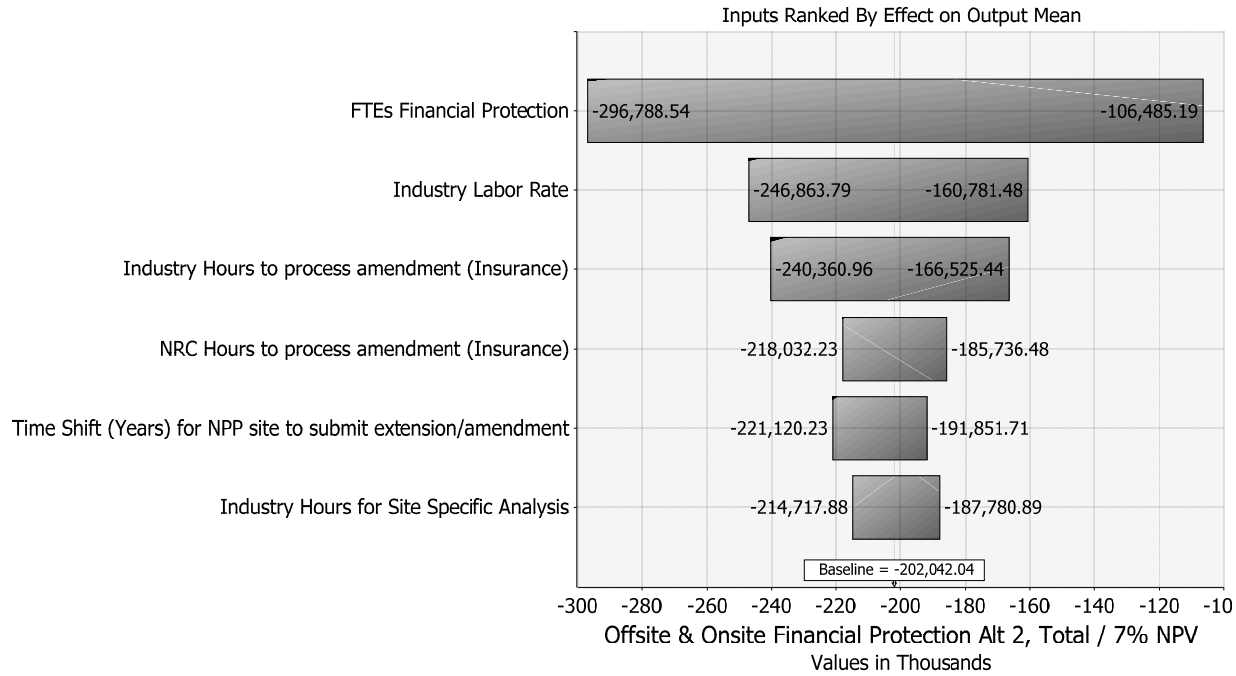

Figure 36 Tornado Chart Showing the Variation of Total Cost due to each Financial Protection Cost Driver (Alternative FP-2)

As shown in Figure 33 through Figure 36, the recommended regulatory changes to the offsite and onsite financial protection area of decommissioning (Alternative FP-2) will result in additional or averted costs to both the nuclear power industry and the NRC over the decommissioning period in the range of ($406,000) to $26,000 using a 7 percent NPV. The cost drivers that have the greatest influence on total cost are the number of NRC FTEs to implement rulemaking and the nuclear power industry labor rate for hours that are averted to complete the exemption process for reduction in financial protection.

6.10.9 Application of Backfitting Protection

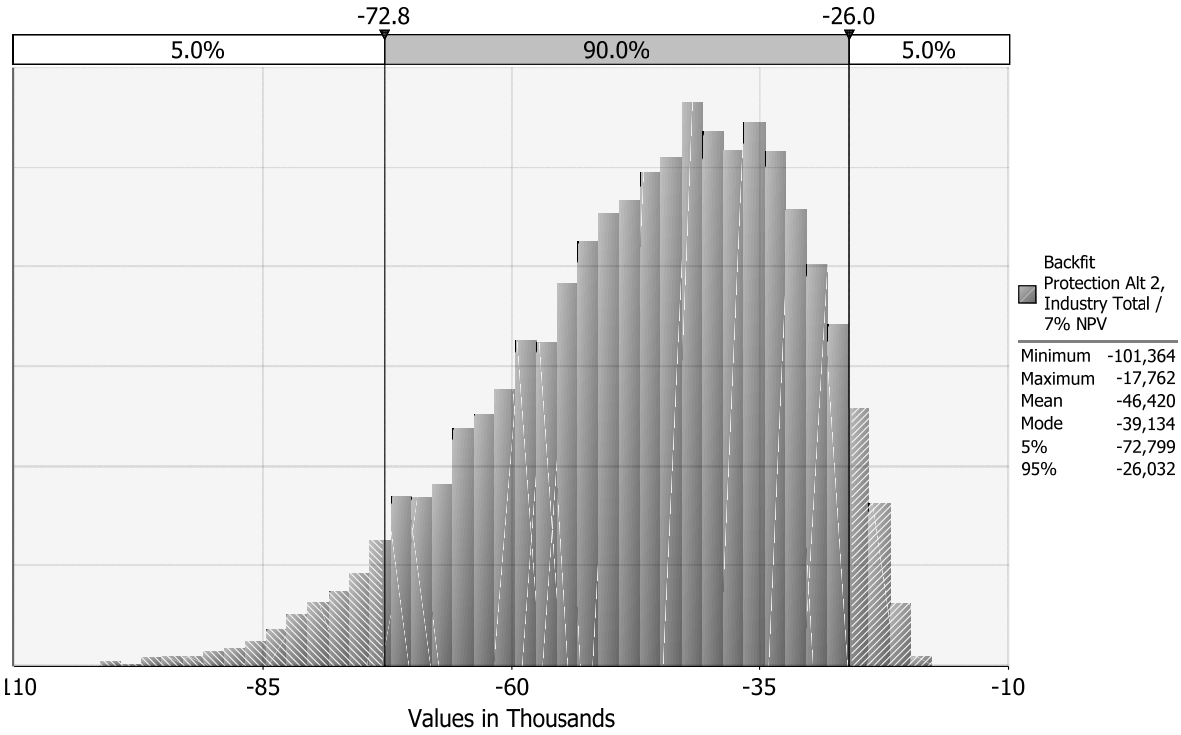

Figure 37 Variation of Industry Cost due to the Uncertainty in the Backfitting Cost Drivers (Alternative B-2)

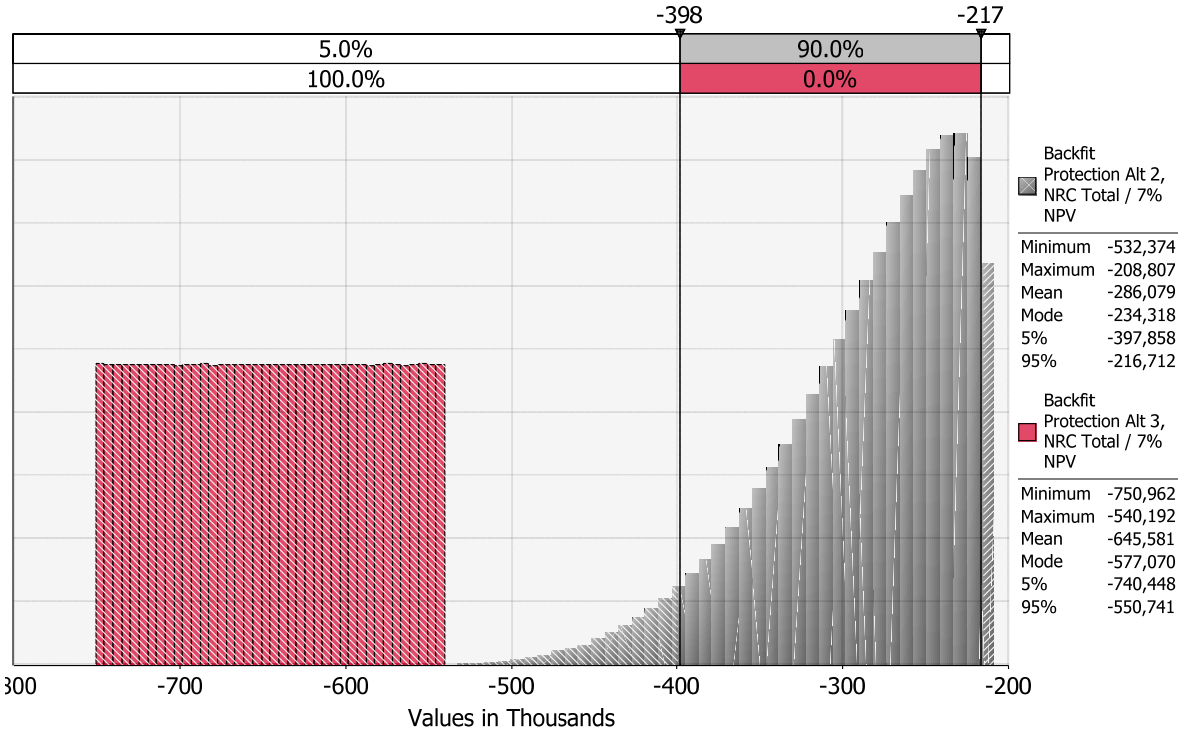

Figure 38 Variation of NRC Cost due to the Uncertainty in the Backfitting Cost Drivers (Alternatives B-2 and 3)

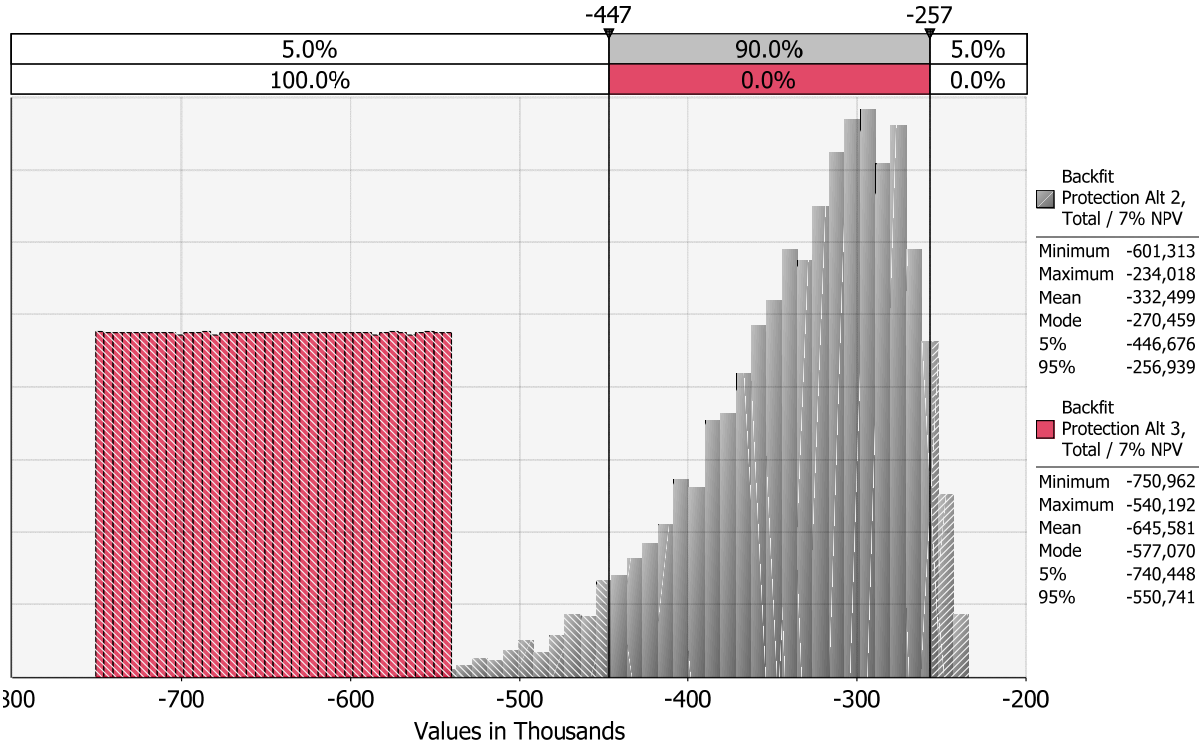

Figure 39 Variation of Total Cost due to the Uncertainty in the Backfitting Cost Drivers (Alternatives B-2 and 3)

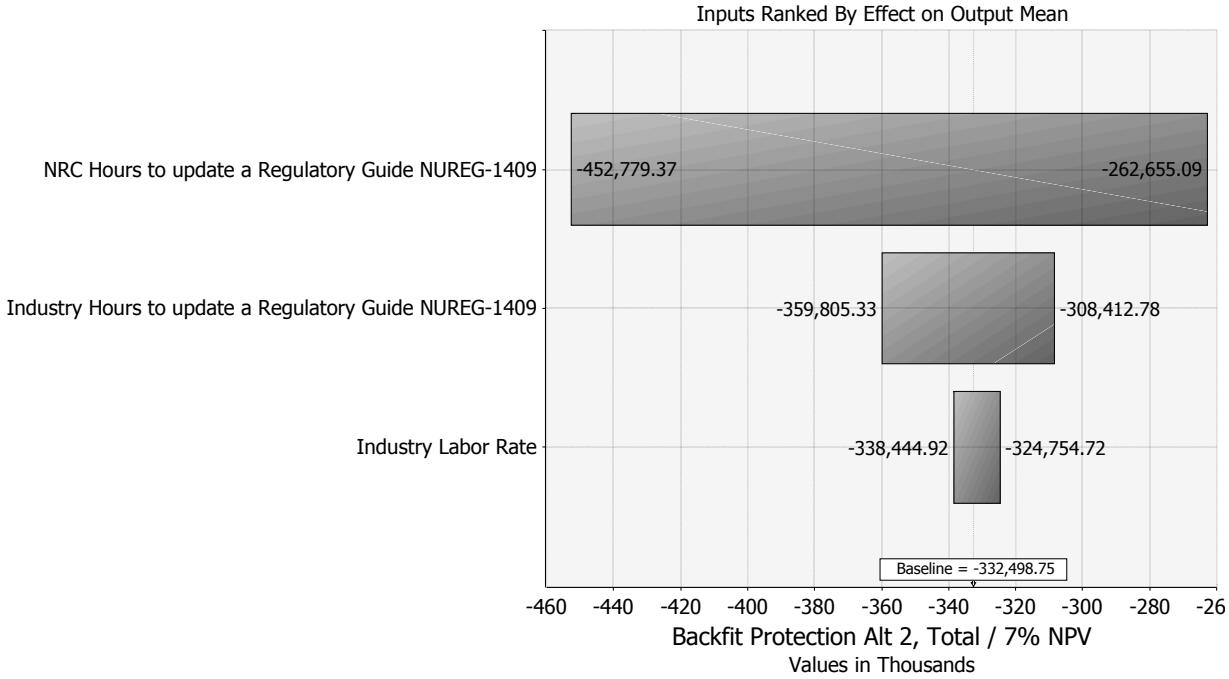

Figure 40 Tornado Chart Showing the Variation of Total Cost due to each Backfitting Cost Driver (Alternative B-2)

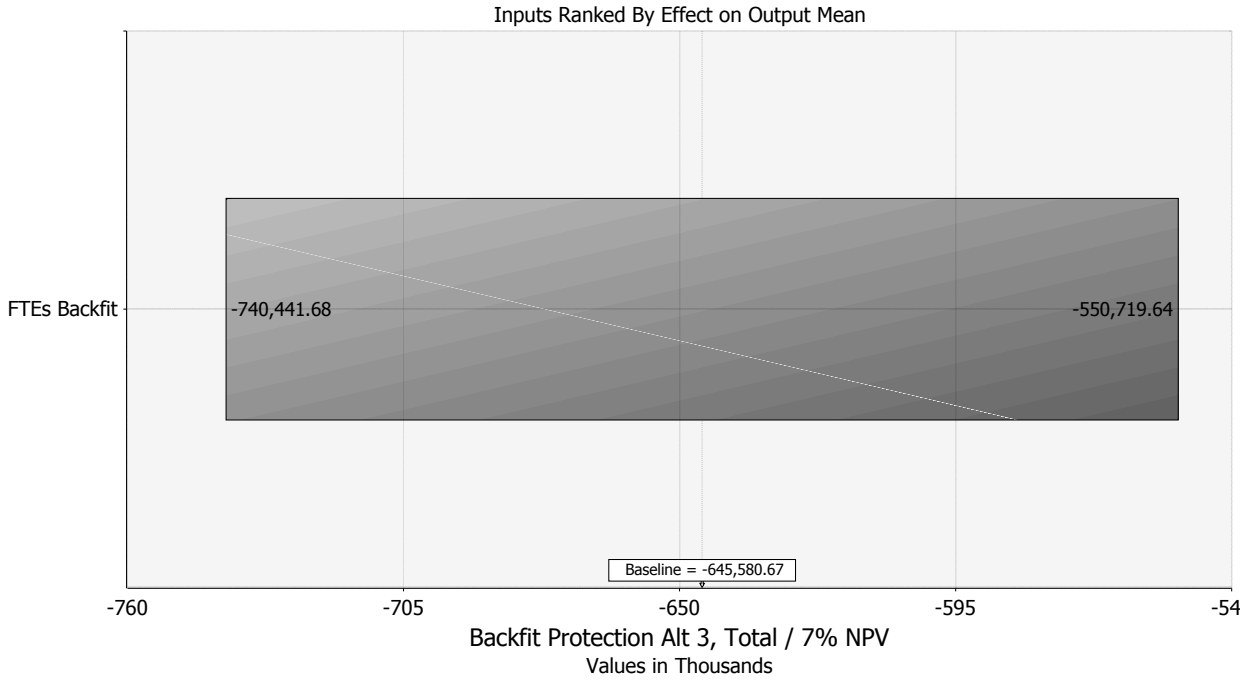

Figure 41 Tornado Chart Showing the Variation of Total Cost due to each Backfitting Cost Driver (Alternative B-3)

As shown in Figure 37 through Figure 41, the recommended regulatory changes to the backfitting protection area of decommissioning (Alternative B-2) will result in costs to both the nuclear power industry and the NRC over the decommissioning period in the range of ($601,000) to ($234,000) 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 and nuclear power industry to update NUREG-1409.

In addition, the recommended regulatory changes to the backfitting protection area of decommissioning (Alternative B-3) will result in costs to the NRC over the rulemaking period that is in the range of ($751,000) to ($540,000) using a 7 percent NPV. Only one cost driver exists for this alternative and it is the number of full-time equivalent staff required to implement the rulemaking for this area of decommissioning.

6.10.10 Aging Management

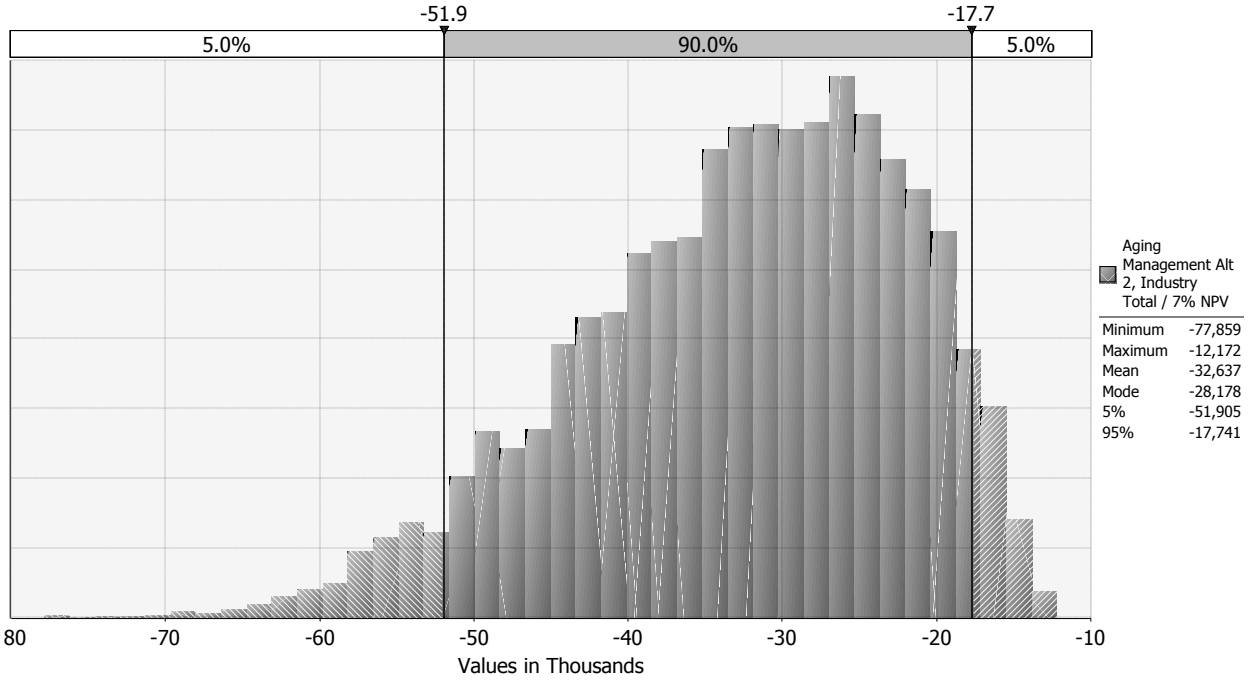

Figure 42 Variation of Industry Cost due to the Uncertainty in the Aging Management Program Cost Drivers (Alternatives AMP-2)

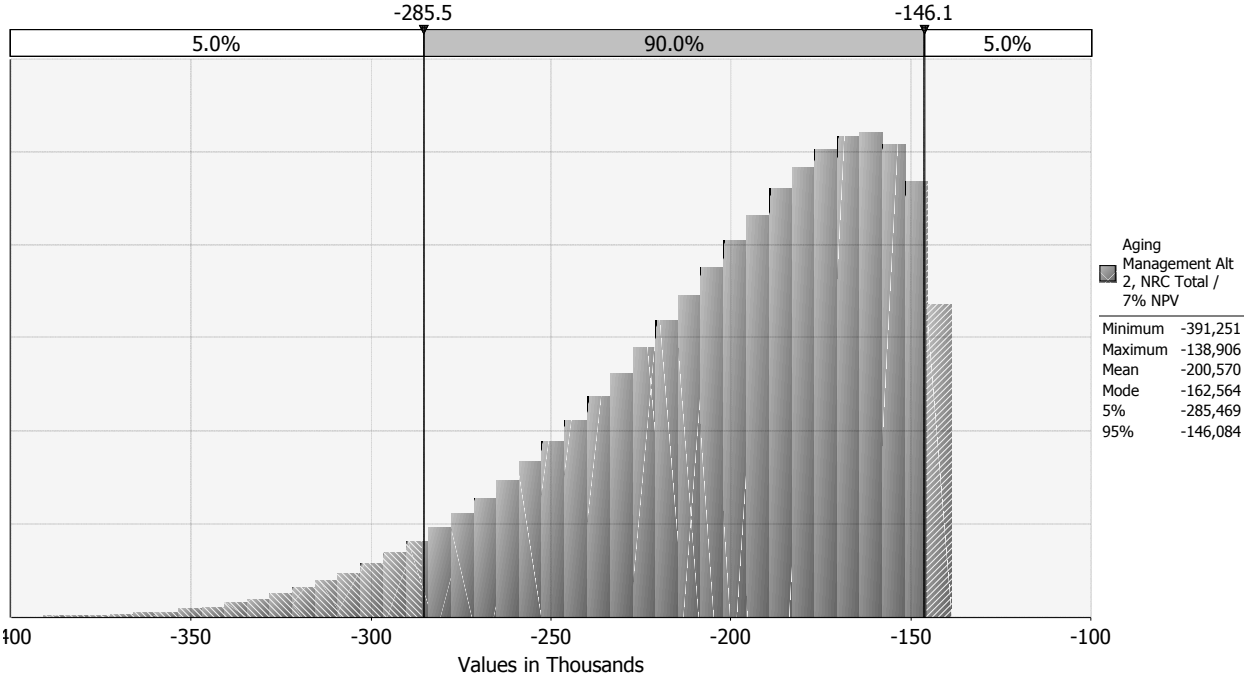

Figure 43 Variation of NRC Cost due to the Uncertainty in the Aging Management Program Cost Drivers (Alternatives AMP-2)

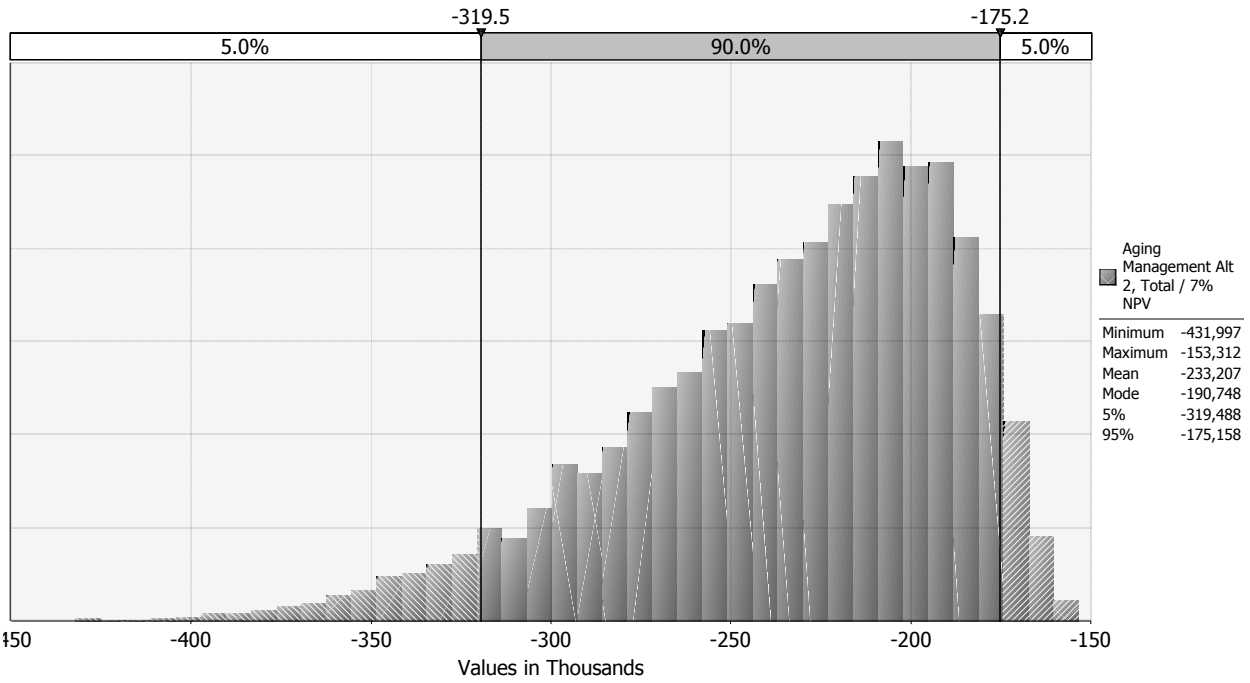

Figure 44 Variation of Total Cost (Industry and NRC) due to the Uncertainty in the Aging Management Program Cost Drivers (Alternatives AMP-2)

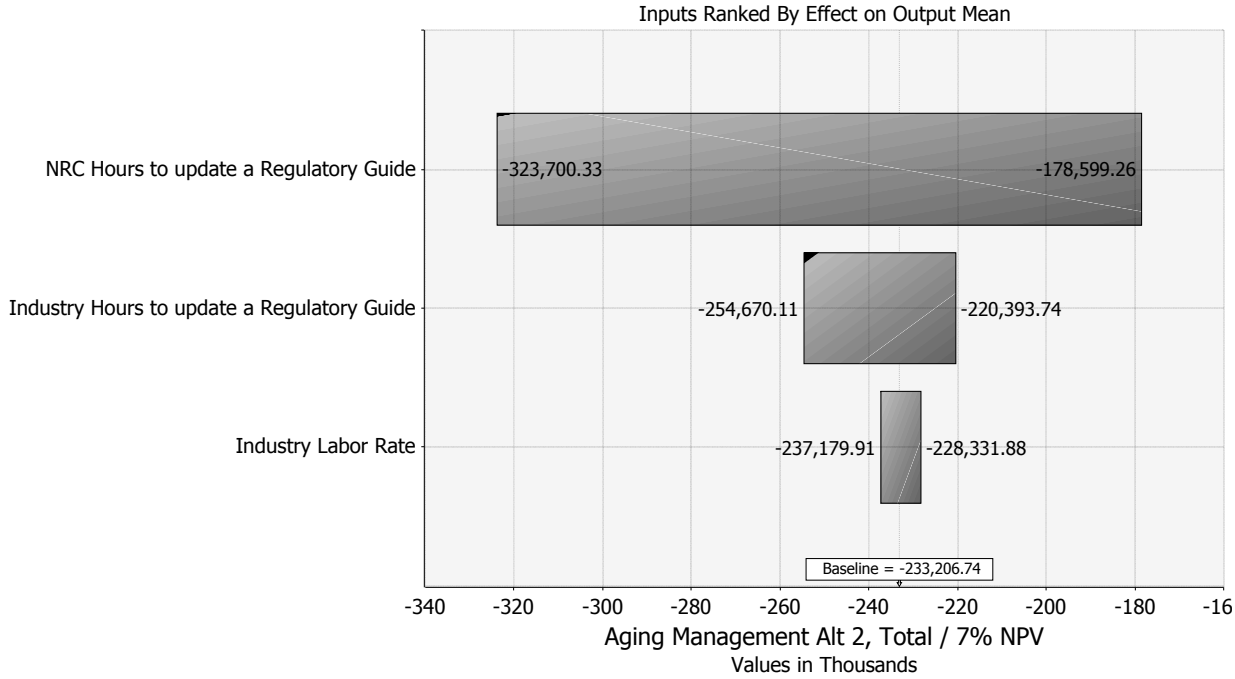

Figure 45 Tornado Chart Showing the Variation of Total Cost due to each Aging Management Program Cost Driver (Alternative AMP-2)

As shown in Figure 42 through Figure 45, the recommended regulatory changes to the aging management area of decommissioning (Alternative AMP-2) will result in costs to both the nuclear power industry and the NRC over the decommissioning period in the range of ($432,000) to ($153,000) using a 7 percent NPV. The cost drivers that have the greatest

influence on total cost are the number of NRC and Industry hours to update the AMP regulatory guide.

6.11 Summary

This preliminary draft regulatory analysis identifies and integrates costs and benefits that will emerge from implementing the areas of decommissioning that contain a rulemaking alternative.

6.11.1 Quantified Net Benefit

Table 18 and Table 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	Industry Total Costs (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	$ 10,474,000	$ 2,386,000	$ 5,222,000
Emergency Preparedness	EP-3	$ 18,125,000	$ 4,129,000	$ 9,037,000
Physical Security	PS-2	$ 3,079,000	$ 702,000	$ 1,535,000
Cyber Security	CS-2	$ (350,590,000)	$ (74,127,000)	$ (164,803,000)
Cyber Security	CS-3	$ (53,240,000)	$ (11,161,000)	$ (25,625,000)
Fitness for Duty, Drugs and Alcohol	DA-2	$ 2,041,000	$ 431,000	$ 959,000
Fitness for Duty, Fatigue	F-2	$ (3,612,000)	$ (912,000)	$ (1,891,000)
Fitness for Duty, Fatigue	F-3	$ (3,612,000)	$ (912,000)	$ (1,891,000)
Minimum Staffing and Training Requirements CFH	CFH-2	$ (36,000)	$ (33,000)	$ (35,000)
Minimum Staffing and Training Requirements CFH	CFH-3	$ 604,000	$ 137,000	$ 301,000
Decommissioning Trust Fund	DTF-2	$ 2,094,000	$ 507,000	$ 1,072,000
Decommissioning Trust Fund	DTF-3	$ (19,833,000)	$ (17,107,000)	$ (18,648,000)
Offsite & Onsite Financial Protection	FP-2	$ 1,365,000	$ 311,000	$ 681,000
Backfit Protection	B-2	$ (51,000)	$ (46,000)	$ (49,000)
Aging Management	AMP-2	$ (36,000)	$ (33,000)	$ (35,000)

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars.

Table 19 Total Net Benefits and Costs for NRC

Areas of Decommissioning	Alternatives	NRC Total Costs (2016 dollars)		
		Undiscounted	7% NPV	3% NPV
Emergency Preparedness	EP-2	$ 4,368,000	$ 423,000	$ 1,791,000
Emergency Preparedness	EP-3	$ 8,175,000	$ 1,290,000	$ 3,689,000
Physical Security	PS-2	$ 1,089,000	$ (324,000)	$ 156,000
Cyber Security	CS-2 & 3	$ (711,000)	$ (644,000)	$ (680,000)
Fitness for Duty, Drugs & Alcohol	DA-2	$ (673,000)	$ (637,000)	$ (663,000)
Fitness for Duty, Fatigue	F-3	$ (761,000)	$ (658,000)	$ (707,000)
Minimum Staffing and Training Requirements CFH	CFH-3	$ 489,000	$ (372,000)	$ (83,000)
Decommissioning Trust Fund	DTF-2	$ 391,000	$ (384,000)	$ (117,000)
Decommissioning Trust Fund	DTF-3	$ (1,769,000)	$ (745,000)	$ (958,000)
Offsite & Onsite Financial Protection	FP-2	$ (86,000)	$ (503,000)	$ (370,000)
Backfit Protection	B-2	$ (316,000)	$ (286,000)	$ (302,000)
Backfit Protection	B-3	$ (712,000)	$ (646,000)	$ (682,000)
Aging Management	AMP-2	$ (222,000)	$ (201,000)	$ (212,000)

* There may be discrepancies in calculations due to rounding.
** All values are in 2016 dollars.

6.11.2 Qualitative Costs and Benefits

In addition to regulatory efficiency addressed in Section 6.5, the alternatives provide additional costs and benefits as described below. These costs and benefits have not yet been quantified into monetary values:

No-Action Alternatives (Status Quo) Costs and Benefits:

The no-action alternative (status quo) for each decommissioning topic area would keep the current decommissioning regulations in effect. Decommissioning transition licensing actions that are justified based on the reduced risks posed by the permanent cessation of operation and permanent removal of fuel from the reactor would continue to be handled on a case-by-case basis by NRC review and approval of exemption and license amendment requests. The no-action alternative may not result in a predictable regulatory environment because variability in exemption requests might result in differing requirements at different decommissioning reactor facilities. This no-action alternative also results in significant burdens on licensees to submit and the NRC to review these licensing actions as quantified within this document.

Emergency Preparedness Costs and Benefits:

To implement Alternative EP-2 and Alternative EP-3, 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 50requirements 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.

Under Alternatives EP-2 and 3, a licensee would not need to obtain a specific 10 CFR Part 72 license or make changes to its EP program when all of its spent fuel has been transferred to ISFSI. Additionally the NRC would avert staff time to process the license request or review changes to the EP program. These would result in one-time benefits to industry and the NRC.

Fitness for Duty Drug and Alcohol Testing Costs and Benefits:

Alternative DA-2: Helps promote uniformity and standardization in the application of drug and alcohol testing programs at decommissioning power reactors. Licensees may expend less resources than the status quo to comply with the new regulations for drug and alcohol testing during decommissioning.

Fitness for Duty Fatigue Costs and Benefits:

Alternative F-2: Promotes more uniform approach to FFD fatigue programs among decommissioning power reactors. Licensees would not be required to implement fatigue management programs by regulation and this may lead to inconsistent implementation of fatigue management programs among Part 50 decommissioning power reactors. Industry would incur a one-time cost to adapt the industry initiatives to each individual nuclear site such that these initiatives would be specific to these particular sites.

Alternative F-3: Licensees would be required to implement fatigue management programs by regulation, and this will lead to consistent implementation of fatigue management programs among Part 50 decommissioning power reactors.

Staffing and Training Requirements for Certified Fuel Handlers Benefits:

Alternative CFH-3: This alternative would result in cost averted due to the elimination of the need for a licensee to seek the NRC's approval for fuel handler training programs.

Decommissioning Trust Fund Costs and Benefits:

Alternative DTF-2: Would reduce the need for future decommissioning funding assurance exemption requests given that clear regulatory requirements would be in place to govern the use of the DTF. 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.

Alternative DTF-3: Would minimize 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 (with current licensees and licensees in decommissioning also reexamining their costs in compliance with the recommended changes). May lead to a major rulemaking, since licensees would be required to make up for any short fall in the DTF. This may require the makeup of $100 million or more in decommissioning funding on an annual basis, which could have significant impact on facilities' cash flow until the DTF is satisfied with the site-specific cost estimate.

Under Alternatives DTF-2 and DTF-3, 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 3 years from the end of the reporting period

identifying the shortfall. The addition of a time period 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 transition from a generic minimum regulatory required amount to a site-specific decommissioning cost estimate proposed in Alternative DTF-3 could result in the identification of a shortfall. The 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.

The relaxation of DTF reporting from every two years to every three years would result in a quantified averted cost and regulatory efficiency in that licensees could report decommissioning funding assurance for the site (i.e., reactor unit and onsite ISFSI under 10 CFR 72.30) in a single report. However, under these alternatives, NRC would lose some regulatory efficiency in its ability to track licensees' financial assurance for decommissioning, to monitor their funds, and lose some timeliness to obtain actions from licensees to correct financial assurance shortfalls in a timely manner.

By specifying a timeframe for funding shortfalls, Alternatives DTF-2 and DTF-3 would enhance the safety provided by NRC's reactor decommissioning requirements, by helping to ensure that the reactor decommissioning is adequately financed and that delays or shortfalls do not occur in the funding of decommissioning that could create challenges to public health or safety or result in the potential for significant underfunding of decommissioning obligations.

By encouraging the submittal of site-specific cost estimates early in the operating phase, the NRC staff would ensure that sufficient funding would be available for plant decommissioning and would avoid potential underfunding scenarios near cessation of plant operation if the site-specific cost estimate is substantially greater than the generic regulatory minimum. The site-specific cost estimate would clarify the amount of funds available for radiological and non-radiological decommissioning expenses, including spent fuel management and Part 72 specific-licensed ISFSI decommissioning.

Offsite and Onsite Financial Protection Requirements and Indemnity Agreements Costs and Benefits:

Alternative FP-2: Allows flexibility for licensees to reduce insurance requirements without the need to file exemptions. This flexibility would be consistent with the graded approach to EP. The reduction in insurance requirements can save each licensee $2,100 (in base year 1992 dollars) per year and per $1M of coverage for offsite insurance and between $1.5 million and $4.2 million (in base year 1993 dollars) for onsite insurance (Ref. 50).

Application of Backfitting Protection Benefits:

Alternative B-2: Provides clarity to the backfit rule for licensees in the decommissioning phase.

Alternative B-3: Same as Alternative B-2, but instill in regulation. This would ensure that all licensees in decommissioning are governed by the same backfit rule that is applicable to decommissioning.

Aging Management Benefits:

Alternative AMP-2: Provides guidance that outlines how the licensees will manage the effects of aging for decommissioning plants. This reduces uncertainty on how licensees can meet the provisions in 10 CFR 50.51 and 50.65(a)(1).

6.12 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 affect the risk posture 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) and 52.98(a).

7 DECISION RATIONALES FOR AREAS OF DECOMMISSIONING

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

7.1 Decision Rationales 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 draft regulatory basis and the qualitative discussion of costs and benefits for these recommendations.

7.1.1 Level of PSDAR Review and Approval by the NRC

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 preliminary conclusion is that the direct and indirect costs to amend the regulations for this area and to implement the changes described in Alternatives DAR-3 and DAR-4 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 DAR-2 – Guidance Development/Enhancement, only Alternative DAR-2 provides administrative changes and guidance revisions that would 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. The NRC staff also recommends to include guidance that encourages licensees to provide an additional discussion of what considerations and site-specific issues would be addressed in the LTP when it is submitted because that document contains a greater level of detail than the PSDAR regarding remediation activities, final site disposition, and overall decommissioning completion.

As a result, Alternative DAR-2 would provide the public access to more detailed information in the PSDARs for those licensees choosing to implement the enhanced guidance than that provided by Alternative DAR-1, without reducing the flexibility provided by the use of a PSDAR instead of a DP for decommissioning plants, or imposing unnecessary burdens on licensees and NRC staff through the rulemaking process. Furthermore, most of the costs to implement Alternative DAR-2 are for the NRC to update RG 1.185 and NUREG-0586 (GEIS).

7.1.2 Appropriateness of Maintaining the Three Existing Options for Decommissioning

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 preliminary 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 pursing immediate DECON of at least certain systems and components at the facility.

As a result, Alternative O-2 would provide public 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 and RG 1.185.

7.1.3 The 60-year Timeframe Associated with Decommissioning

Based on the assessment performed in this analysis and the consideration of the 1996 rulemaking, 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 preliminary 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, the considerations for selecting that option, 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 public 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.

7.1.4 The Role of State and Local Governments and Non-Governmental Stakeholders

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 requirements for the implementation of community advisory boards, the staff's preliminary 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.

7.1.5 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's preliminary conclusion is that the direct and indirect costs to amend the regulations for this area and to implement the changes described in Alternatives SFM-2 and SFM-3 may result in a quantitative showing that the benefits exceed the costs and that the alternative with the greatest net benefit cannot be determined at this time. A qualitative analysis of each of the alternatives is provided below.

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 in the decommissioning process, as well as expanding overall regulatory transparency and openness. If these assumptions are valid, Alternative SFM-2 may result in a positive net cost-benefit result.
However, Alternative SFM-2 would do nothing to 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 promulgate rule language that is already present in other sections of 10 CFR Chapter I and simply 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 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. If these assumptions are valid, Alternative SFM-3 may result in a positive net cost-benefit result. 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.

7.1.6 Clarifying the Environmental Requirements

Based on the preliminary assessment of the costs and benefits for clarifying the decommissioning environmental requirements, the NRC staff believes that Alternative ENV-2 has merit in providing an effective way to resolve the existing issues and should be evaluated further in finalizing the regulatory basis. This alternative will allow for greater public participation and public engagement as well as clarify the current area of confusion in the environmental requirements. Furthermore, most of the costs to implement Alternative E-2 are for the NRC to amend 10 CFR 51.53 and 10 CFR 51.95 to clarify that the discussions in the environmental requirements regarding the need for a license amendment before decommissioning activities commence apply only to non-power reactors, in accordance with the 1996 changes to the decommissioning regulations.

7.2 Decision Rationale for Decommissioning Areas

In the draft regulatory basis (Ref. 1), the NRC staff did not recommend an alternative to pursue for the following areas of decommissioning – Cyber Security, Fitness for Duty (FFD) – Drug and Alcohol Testing, Fitness for Duty (FFD) – Fatigue, Minimum Staffing and Training Requirements for Certified Fuel Handlers, and Aging Management. In these areas of decommissioning, it is the staff's intent to determine the alternatives based on public comments received on the draft regulatory basis document. The NRC staff's recommended alternative for each of these areas of decommissioning, along with a full assessment of the rulemaking alternatives, will be documented in the final regulatory basis. The NRC staff, however, did recommend a rulemaking alternative for the following areas of decommissioning - Emergency Preparedness, Physical Security, Decommissioning Trust Fund, Application of Backfitting Protection, and Offsite and Onsite Financial Protection Requirements and Indemnity Agreements.

For all areas of decommissioning, a quantitative cost benefit analysis was completed and will inform the staff for determining which alternative to pursue in the proposed stage of rulemaking. The following subsections present the decision rationales of the draft regulatory basis for each area of decommissioning along with a quantitative and qualitative analysis of the alternatives. Note that alternatives that are discussed are other than the no-action (status quo) alternatives because the no-action alternatives are a baseline against which to compare the cost of the other alternatives (i.e., the cost of these alternatives are relative to the no-action alternatives and represent the change in cost compared to the status quo).

The preliminary draft regulatory analysis finds that there is a 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:

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- Regulatory burden on nuclear power plant licensees is reduced by eliminating the need to submit requests for exemptions for reductions in onsite and offsite damage 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 draft 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 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.

7.2.1 Cost Benefit Analysis Summary

Table 20 provides the quantified and non-quantified costs and benefits for each alternative in each area of decommissioning.

Table 20 Summary of Totals

Areas of Decommissioning	Alternatives	Total Costs (2016 dollars)		Nonmonetary Benefits
		7% NPV	3% NPV	**Regulatory Efficiency:** 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. **Safety and Common Defense**: 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.
Emergency Preparedness	EP-2	$ 2,809,000	$ 7,014,000	
Emergency Preparedness	EP-3	$ 5,420,000	$ 12,727,000	
Physical Security	PS-2	$ 378,000	$ 1,692,000	
Cyber Security	CS-2	$ (74,771,000)	$ (165,484,000)	
Cyber Security	CS-3	$ (11,805,000)	$ (26,305,000)	
Fitness for Duty, Drugs & Alcohol	DA-2	$ (206,000)	$ 296,000	
Fitness for Duty, Fatigue	F-2	$ (912,000)	$ (1,891,000)	
Fitness for Duty, Fatigue	F-3	$ (1,570,000)	$ (2,598,000)	
Minimum Staffing and Training Requirements CFH	CFH-2	$ (31,000)	$ (34,000)	
Minimum Staffing and Training Requirements CFH	CFH-3	$ (234,000)	$ 218,000	
Decommissioning Trust Fund	DTF-2	$ 122,000	$ 955,000	
Decommissioning Trust Fund	DTF-3	$ (17,852,000)	$ (19,605,000)	
Offsite & Onsite Financial Protection	FP-2	$ (192,000)	$ 311,000	
Backfit Protection	B-2	$ (333,000)	$ (351,000)	
Backfit Protection	B-3	$ (646,000)	$ (682,000)	
Aging Management	AMP-2	$ (233,000)	$ (247,000)	

7.2.2 Emergency Preparedness

The NRC staff is recommending either rulemaking Alternatives EP-2 or EP-3 over the no-action alternative (status quo), because these rulemaking alternatives 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, Alternatives EP-2 and EP-3 would provide a graded approach to reduce emergency preparedness requirements at decommissioning sites. Finally, the cost beneficial analysis as detailed in Table 20 show that both of these alternatives are cost beneficial. The final recommendation, however, will be informed by public comments received on the draft regulatory basis document and the preliminary draft regulatory analysis. The NRC staff's final recommendation, along with a full assessment of the rulemaking alternatives described above, will be documented in the final regulatory basis.

7.2.3 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.

7.2.4 Cyber Security

No alternative has yet been recommended by the NRC staff. The cost benefit analysis however shows that both rulemaking Alternatives CFH-2 and CFH-3 result in costs to both industry and the NRC as detailed in Table 20. No benefit has yet been identified by the staff to pursue either of these rulemaking alternatives as it is the intent of the staff to seek public comments in order to identify the benefits. The NRC staff's recommendation, along with a full assessment of the rulemaking alternatives described above, will be documented in the final regulatory basis.

7.2.5 Fitness for Duty—Drug and Alcohol Testing

No alternative has yet been recommended by the NRC staff. The cost benefit analysis however shows that rulemaking Alternative DA-2 results in costs to both industry and the NRC as detailed in Table 20. 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. The NRC staff's recommendation, along with a full assessment of the rulemaking alternative, will be documented in the final regulatory basis.

7.2.6 Fitness for Duty—Fatigue

No alternative has yet been recommended by the NRC staff. The cost benefit analysis however shows that both Alternatives F-2 and F-3 results in costs to both industry and the NRC as detailed in Table 20. The benefit derived from pursuing Alternative F-2 is the potential to clarify the NRC's guidance for managing fatigue at 10 CFR Part 50 decommissioning plants and provides a mechanism in which the staff and industry representatives could align on these measures. The benefit derived from pursuing Alternative F-3 is the codification of FFD-Fatigue requirements for decommissioning plants and the potential reduction in requirements for Part 52 licensees. This would require a licensee in decommissioning to have a FFD program in place to manage fatigue. The NRC staff's recommendation, along with a full assessment of the rulemaking alternative, will be documented in the final regulatory basis.

7.2.7 Minimum Staffing and Training Requirements for Certified Fuel Handlers

No alternative has yet been recommended by the NRC staff. The cost-benefit analysis, however, 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 20. 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. The NRC staff's recommendation, along with a full assessment of the rulemaking alternative, will be documented in the final regulatory basis.

7.2.8 Decommissioning Trust Fund

Alternatives DTF-2 or DTF-3 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 be in place to assure adequate funding for decommissioning earlier in a facility's lifecycle.
- 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.
- 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.

As detailed in Table 20, Alternative DTF-2 presents a benefit at 7 percent NPV and at 3 percent NPV. Alternative DTF-3 is, however, not cost-beneficial at either NPVs because of the cost licensees would incur to update the site-specific cost estimate on a periodic basis. The final recommendation will be informed by public comments received on the draft regulatory basis document. The NRC staff's final recommendation, along with a full assessment of the rulemaking alternatives described above, will be documented in the final regulatory basis.

7.2.9 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 accidents is reduced at a decommissioning reactor when compared to that at an operating reactor. 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 power plant licensees is reduced by eliminating the need to submit exemptions for reduction to onsite and offsite damage protection. This will also reduce the need for the NRC to review these exemption submittals. As detailed in Table 20, 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 NRC staff's final recommendation, along with a full assessment of the rulemaking alternatives described above, will be documented in the final regulatory basis.

7.2.10 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 results in costs to both industry and the NRC as detailed in Table 20. The benefit derived from pursuing Alternative B-2 is uncertain at this time. 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. Here the scope of activities and approvals that would continue from the operations phase into a decommissioning phase would be determined. The NRC staff's final recommendation, along with a full assessment of the rulemaking alternatives described above, will be documented in the final regulatory basis.

7.2.11 Aging Management

No alternative has yet been recommended by the NRC staff. The cost benefit analysis shows that Alternative AMP-2 results in costs to both industry and the NRC as detailed in Table 20. 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. The decision on which alternative the NRC staff recommends will be informed by public comments received on the draft regulatory basis document. The NRC staff's recommendation, along with a full assessment of the rulemaking alternatives described above, will be documented in the final regulatory basis.

8 GUIDANCE AND NUREG DOCUMENTS

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"
- 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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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 (2015 dollars)	Hourly 10th Percentile Wage (2015 dollars)	Hourly 90th Percentile Wage (2015 dollars)	Source
Executive	Top Executives (111000)	$74.04	$50.42	$88.85	http://www.bls.gov/oes/current/oes111011.htm
	Chief Executives (111011)	$99.35	$69.44	$119.22	http://www.bls.gov/oes/current/oes_nat.htm#11-0000
	Average	***$86.70***	***$59.93***	***$104.03***	
Managers	First-Line Supervisors of Production and Operating Workers (511011)	$46.40	$34.76	$58.02	http://www.bls.gov/oes/current/oes511011.htm
	First-Line Supervisors of Mechanics Installers and Repairers (491011)	$45.74	$36.65	$56.43	http://www.bls.gov/oes/current/oes491011.htm
	Industrial Production Managers (113051)	$61.78	$47.31	$71.73	http://www.bls.gov/oes/current/oes113051.htm
	General and Operations Managers (111021)	$71.28	$50.13	$84.07	http://www.bls.gov/oes/current/oes111021.htm
	Average	***$56.30***	***$42.21***	***$67.56***	
Technical Staff	Nuclear Engineers (172161)	$49.54	$41.02	$57.99	http://www.bls.gov/oes/current/oes172161.htm
	Nuclear Technicians (194051)	$39.84	$33.12	$45.99	http://www.bls.gov/oes/current/oes194051.htm
	Nuclear Power Reactor Operators (518011)	$43.26	$37.57	$48.83	http://www.bls.gov/oes/current/oes518011.htm
	Industrial Machinery Mechanics (499041)	$33.28	$26.29	$40.64	http://www.bls.gov/oes/current/oes499041.htm
	Average	***$41.48***	***$34.50***	***$48.36***	
Admin Staff	Office and Administrative Support Occupations (430000)	$27.57	$19.35	$35.28	http://www.bls.gov/oes/current/naics4_221100.htm#43-0000
	First-Line Supervisors of Office and Administrative Support Workers (431011)	$42.21	$31.18	$53.10	http://www.bls.gov/oes/current/oes431011.htm
	Office Clerks General (439061)	$22.81	$16.12	$28.50	http://www.bls.gov/oes/current/oes439061.htm
	Average	***$30.86***	***$22.22***	***$38.96***	
Licensing Staff	Paralegals and Legal Assistants (232011)	$30.95	$26.55	$35.61	http://www.bls.gov/oes/current/oes232011.htm
	Lawyers (231011)	$73.33	$48.82	$88.00	http://www.bls.gov/oes/current/oes231011.htm
	Average	***$52.14***	***$37.69***	***$61.80***	

Position Title	Occupation (SOC Code)	Hourly Mean Wage (2015 dollars)	Hourly 10th Percentile Wage (2015 dollars)	Hourly 90th Percentile Wage (2015 dollars)	Source
Total	***Average***	***$53.50***	***$39.31***	***$64.14***	
	Burdened labor rate	***$128.39***	***$94.34***	***$153.95***	
	Burdened labor rate (2016 Dollars)	***$130.06***	***$95.57***	***$155.95***	

(1) The U.S. Department of Labor, Bureau of Labor Statistics (BLS) wage is equal to or greater than $90.00 per hour or $187,199 per year without specifying a value. For this analysis, the NRC staff estimated that the 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. 35).

(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. 36).

APPENDIX B: UNCERTAINTY ANALYSIS VARIABLES

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
2016 Hourly Rate for industry	$128.63	PERT	$95.57	$130.06	$155.95
2016 Hourly Rate for industry (IT Support)	$90.77	PERT	$67.44	$91.78	$110.05
2016 NRC Labor Rate	$128.00	PERT	$126.00	$128.00	$131.00
Number of years to Implement rulemaking	4	NONE			
NRC rulemaking contract support	$(1,560,000)	NONE			
NRC Cost (rulemaking)	$(8,975,808)	NONE			
NRC Cost (rulemaking) per year	$(2,243,952)	NONE			
Total number of NRC hours (Working Group FTEs + OGC + Rulemaking Branch) per year	14484	RISK UNIFORM	11644		17324
Number of NRC hours for EP	1647	RISK UNIFORM	1164		2130
Number of NRC hours for Phys Sec	1647	RISK UNIFORM	1164		2130
Number of NRC hours for Cyber Sec	1389	RISK UNIFORM	1164		1613
Number of NRC hours for FFD – Drug & Alcohol Testing	1392	RISK UNIFORM	1164		1619
Number of NRC hours for FFD - Fatigue	1392	RISK UNIFORM	1164		1619
Number of NRC hours for CFH	1392	RISK UNIFORM	1164		1619
Number of NRC hours for DTF	1448	RISK UNIFORM	1164		1732
Number of NRC hours for Insurance	1392	RISK UNIFORM	1164		1619
Number of NRC hours for Backfit	1392	RISK UNIFORM	1164		1619
Number of NRC hours for Aging Management	1392	RISK UNIFORM	1164		1619
Number of nuclear power plant (NPP) sites that will enter the decommissioning transition phase after the rulemaking becomes effective	57	NONE			
Number of years from T_0, to transfer all SF to dry cask storage in ISFSI	10	INTEGER UNIFORM	5	10	15

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
Number of years from T_0, when all SF is transferred to DOE (beyond ISFSI)	26	INTEGER UNIFORM	21	26	31
Number of years from T_0 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	21	38
IT staff personnel required to implement Cyber Security protection	3	INTEGER UNIFORM	2	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
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 (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

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
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 industry to update a Regulatory Guide	280.7	PERT	120	238	612
Number of hours for NRC to update a Regulatory Guide	1733.3	PERT	1200	1400	3600
Number of hours for industry to develop fatigue initiatives	1733.3	PERT	1200	1400	3600
Hours industry to process amendment (CFH)	82.5	PERT	27.0	80.0	148.0
Hours NRC to process amendment (CFH)	41.5	PERT	14.0	40.0	75.0
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 review NUREG-1409	398.3	PERT	180	340	850
Number of hours for NRC to update NUREG-1409	2466.7	PERT	1800	2000	5000
Number of hours for NRC review of Aging Management Program	3.8	PERT	3.0	3.8	4.5

Parameter	Mean value	Distribution Type	Low	Most Likely (Base)	High
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
FEMA fees averted	$1,036,815	PERT	$514,200	$947,025	$1,918,592
Average cost of business travel per week:	$950.00	PERT	$600	$950	$1,300
Industry Annual Cost (Manage Drug & Alcohol Testing) per NPP	$(329,671)	PERT	$(395,605)	$(329,671)	$(263,736)
Industry Annual Cost (Manage Fatigue) per operating NPP	$(475,314)	PERT	$(570,377)	$(475,314)	$(380,251)
NRC Annual Cost (Administration Drug & Alcohol Testing) per NPP	$(6,402)	PERT	$(5,122)	$(6,402)	$(7,683)
NRC Annual Cost (Administration Fatigue) per operating NPP	$(6,402)	PERT	$(5,122)	$(6,402)	$(7,683)
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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