NOTATION VOTE

RESPONSE SHEET

TO: Annette Vietti-Cook, Secretary

FROM: COMMISSIONER OSTENDORFF

SUBJECT: SECY-13-0061 – PROPOSED RULE: WASTE CONFIDENCE – CONTINUED STORAGE OF SPENT NUCLEAR FUEL (RIN 3150-AJ20)

Approved X Disapproved _____ Abstain _____

Not Participating _____

COMMENTS: Below ___ Attached X None ___

WMOstendorff

SIGNATURE

7/12/13

DATE

Entered on "STARS" Yes ___ No ___

Commissioner Ostendorff's Comments on SECY-13-0061, "Proposed Rule: Waste Confidence – Continued Storage of Spent Nuclear Fuel (RIN 3150-AJ20)"

When the Commission directed that the staff publish a final rule and Environmental Impact Statement (EIS) within 24 months, it did so recognizing what a tremendous undertaking that would be. To support such an expeditious timeframe, the Commission directed that "the agency's most accomplished NEPA [(National Environmental Policy Act)] practitioners" be assembled. This proposed rule and draft generic EIS (DGEIS) are testaments to the superb quality of the inter-office team both in, and supporting, the Waste Confidence Directorate. I commend all of those that worked on these documents for providing such well-written, well-justified products in such a short period of time. I therefore approve the proposed rule and DGEIS, subject only to minor edits that further clarify already outstanding documents.

I also want to commend the staff for their extraordinary efforts in communicating both internally and with the public. Waste confidence is a complex issue and I recognize the inherent challenges in effectively communicating the issues involved. There is no "right answer" in how to communicate these issues, but the staff has done everything in their power to reach out, engage, explain, and truly listen to and understand the public's concerns. I am confident that the staff's proactive engagement with stakeholders has contributed greatly to the high quality of the proposed rule and DGEIS. I remain confident that the staff will continue their commitment to effective and timely public communication.

At a high level, the fundamental question in the area of waste confidence is not when a repository will be available, but whether spent fuel can be safely stored and without significant environmental impacts until a repository becomes available. The staff's analysis once again reaffirms that spent fuel *can* be stored safely until a repository becomes available. I believe that our regulatory framework for spent fuel storage is robust and sufficiently flexible to address any necessary changes in the manner in which spent fuel is stored during extended periods. Further, the DGEIS documents the significant amount of technical work that has occurred in the last 30-40 years and reveals the environmental impacts that demonstrate the safety of the storage of spent fuel both in pools and in casks. With this vote, I reaffirm my confidence in the feasibility of safe storage of spent nuclear fuel following the licensed life for operation of a reactor.

I also reaffirm my confidence that it is feasible a repository will be developed to dispose of the nation's spent fuel. While the purpose of waste confidence is not about the timeline for development of a repository, it is one issue that I believe has received, and can continue to receive, significant attention. The NRC stands ready to conduct licensing reviews of any proposed repository. But, as the staff's analysis recognizes, and as highlighted in Commissioner Magwood's vote, it is not the NRC's role to determine when a repository will be available, nor is it the NRC's responsibility to develop a repository. Further, as the Commission has repeatedly explained, the purpose of the target date is to establish a bounding estimate for environmental analysis, not to provide a binding prediction. In the past I have supported alternative language to a specific timeframe, but, in this instance, I believe the staff has placed the appropriate caveats in the rule and the *Federal Register* Notice about the uncertainties surrounding the timeline for repository availability. More importantly, the staff has completed a DGEIS documenting the impacts if a repository is delayed or does not become available. As such, rather than predicting a date when a repository will be available, the staff's analysis provides reasonable assumptions and analyzes the uncertainties based on the complex political and social elements that will be necessary for the development of a repository. Despite these uncertainties, the feasibility of a geologic repository has been clearly demonstrated both domestically and internationally. For example, the NRC's review of the Yucca Mountain license application did not identify technical issues that would challenge the feasibility of a repository. I therefore agree with the staff's conclusion that it is feasible that a repository can be available within 60 years following the licensed life for reactor operation.

I am thus fully supportive of the staff's proposed rule language. In crafting the rule as they did, the staff followed the Commission's direction in the September 6, 2012, SRM-COMSECY-12-0016 to "build upon" the previous Waste Confidence Rule. As this issue has evolved, however, one could ask whether specific policy statements about the feasibility of safe storage of spent nuclear fuel or repository availability remain necessary in the rule now that the staff has fully analyzed these matters in a DGEIS. Similarly, Commissioner Magwood has pointed out that such statements are not legally necessary in the rule. Given these considerations, it is worth exploring whether changes to the rule should be made to replace 10 C.F.R. § 51.23(a)(2) with reference to the environmental findings of the DGEIS, similar to the language in Appendix B to Part 51. Such a change would be a departure from the Commission's historical approach of making affirmative policy statements as part of the Waste Confidence Rule. As such, stakeholder feedback is critical. Accordingly, staff should specifically solicit comments from the public about whether specific policy statements regarding the safety of continued spent fuel storage and the timeline for repository development should be made in the rule text given the expansive and detailed information in DGEIS.

Since September of last year, this Commission has asked for much from the staff and they have met, and in many ways exceeded, our expectations each time. This continues to be a high priority matter for the Commission, and I have confidence that the staff will continue on the success path they have already embarked upon and can complete a high quality rule and GEIS within the 24 month timeframe directed by the Commission.

Comment [kas1]: Revise so that C3 has a different title than the subheading C3.b.

NRC to address deficiencies related to the NRC's NEPA analysis. On September 6, 2012, the Commission instructed NRC staff to proceed with a generic EIS to analyze the environmental impacts of continued storage and address the issues raised in the Court's decision, and to update the Waste Confidence rule in accordance with the analysis in the EIS. The DGEIS and this proposed rule implement the Commission's direction.

A4. Whom Would This Action Affect?

This proposed rule would affect any nuclear power reactor applicant and licensee undergoing issuance or renewal of an operating license for a nuclear power reactor under 10 CFR parts 50 or 54, "Requirements for renewal of operating licenses for nuclear power plants;" issuance of a combined license for a nuclear power reactor under 10 CFR part 52, "Licenses, certifications, and approvals for nuclear power plants;" or amendment of a license under 10 CFR parts 50 or 52. This proposed rule would also affect the issuance of an initial, amended, or renewed license for storage of spent nuclear fuel at an ISFSI under 10 CFR part 72, "Licensing requirements for the independent storage of spent nuclear fuel, high-level radioactive waste, and reactor-related greater than Class C waste." The proposed rule could also affect participants in any proceeding addressing these licensing actions.

A5. Why Is the NRC Generically Addressing the Environmental Impacts of Continued Storage?

Since 1984, the NRC has generically addressed the environmental impacts of continued storage though a generic NEPA analysis and rule. Without a generic environmental impact analysis, site-specific consideration of the environmental impacts of continued storage would be necessary. The NRC's proposed reliance on a GEIS and rule to address environmental impacts of continued storage of spent nuclear fuel will enhance the NRC's efficiency in individual licensing reviews by addressing a set of issues that are the same or largely similar or can be reasonably predicted based on a well understood range of operating experience at each power reactor or storage site and codifying them. The generic determination in 10 CFR 51.23 would satisfy the NRC's NEPA obligations with respect to the environmental impacts of continued storage.

A6. What Types of Waste Are Addressed by Waste Confidence?

The environmental analysis in the DGEIS and in this proposed rule covers low and high burn-up spent nuclear fuel generated in light-water nuclear power reactors. It also covers mixed oxide (MOX) fuel[4], since the MOX fuel would be substantially similar to existing light-water reactor fuel and is, in fact, being considered for use in existing light-water reactors in the United States. It also covers spent nuclear fuel from small modular reactors. Small modular light-water reactors being developed will use fuel very similar in form and materials to the existing operating reactors and will not, therefore, introduce new technical challenges to the disposal of spent nuclear fuel. Waste Confidence also covers the spent nuclear fuel from one high-temperature gas-cooled reactor (HTGR) built and commercially operated: Fort Saint Vrain. The spent nuclear fuel from Peach Bottom Unit 1 is not covered because it is no longer regulated by the NRC (*see* Section 2.1.1.3 of the DGEIS).

A7. What Activities Are Not Covered by the Waste Confidence DGEIS and Proposed Rule?

Waste Confidence does not consider transportation of spent nuclear fuel during reactor operation, disposal of spent nuclear fuel, or storage of spent nuclear fuel during the licensed life for operation of the power reactor. Additionally, Waste Confidence does not address foreign spent nuclear fuel, non-power reactor spent fuel (e.g., fuel from research and test reactors),

[4] Mixed oxide fuel (often called MOX fuel) is a type of nuclear reactor fuel that contains plutonium oxide mixed with either natural or depleted uranium oxide in ceramic pellet form.

A11. What Environmental Reviews Would Be Precluded From a Site-Specific Licensing Action After the Waste Confidence Rulemaking Is Complete?

The Waste Confidence rule will satisfy the NRC's NEPA obligations with respect to continued storage for initial, renewed, and amended licenses for reactors and ISFSIs. The environmental analysis that would accompany the initial license or license renewal of individual nuclear power reactors or the initial license or license renewal of an ISFSI would consider the potential environmental impacts of storage of spent nuclear fuel during the term of the license. What would not be considered in those proceedings—due to the generic determination in 10 CFR 51.23(a)—is the potential environmental impact of continued storage of spent nuclear fuel beyond the licensed life for operation of the reactor. The NRC's regulations allow participants in the NRC's licensing proceedings to obtain a waiver of a rule if they show special circumstances why the rule should not apply to the specific proceeding (*see* 10 CFR 2.335(b)).

A12. Why Is There Not a Separate Waste Confidence Decision Document?

Historically, the Waste Confidence Decision contained five "Findings" that addressed the technical feasibility of a mined geologic repository, the degree of assurance that disposal would be available by a certain time, and the degree of assurance that spent fuel and high-level waste could be managed safely without significant environmental impacts for a certain period beyond the expiration of plants' operating licenses. Preparation of and reliance upon a GEIS is a fundamental departure from the approach used in past Waste Confidence proceedings. The DGEIS acknowledges the uncertainties inherent in the Commission's prediction of repository availability and provides an environmental analysis of reasonably foreseeable timeframes. To this end, the DGEIS considers a number of possible timeframes for repository availability, including the impacts from never having a repository. Because a GEIS, rather than an environmental assessment with "findings of no significant impact" is being issued, findings are no longer necessary.

Section C, "Decision," provides a discussion of the issues and conclusions addressed in the DGEIS that had previously appeared in the findings discussions of prior Waste Confidence decisions. To support the analysis in the DGEIS and the proposed rule, the underlying assumptions in the DGEIS address the issues assessed in the "Five Findings" as conclusions regarding the technical feasibility and availability of a repository, and conclusions regarding the technical feasibility of safely storing spent fuel in an at-reactor or away-from-reactor storage facility. The GEIS will fulfill NRC's NEPA obligations for analyzing the environmental impacts of continued storage and the related uncertainties in repository availability.

A13. How Can the NRC Complete the Environmental Impact Statement and Rulemaking in 24 Months?

The Waste Confidence proceeding is a high priority for the Commission. Following the remand by the Court of Appeals, the NRC formed a new organization, the Waste Confidence Directorate in the Office of Nuclear Material Safety and Safeguards, to develop the generic EIS and rule. In staffing the new Directorate, the NRC brought together a team consisting of many of the agency's most experienced and knowledgeable NEPA and rulemaking practitioners. The Directorate is focused on Waste Confidence. These focused NRC staff resources have enabled the NRC to conduct the hard look required by NEPA and optimize public participation in the process. The resources and expertise being devoted to the waste confidence proceeding provide confidence that the rulemaking can be completed within 24 months.

A14. What Is the Status of the Extended Storage Effort?

The extended storage effort focuses on technical and regulatory considerations for continued effective regulation of spent nuclear fuel storage and subsequent transportation over extended periods (up to 300 years). Presently, the NRC believes that the current regulatory framework used to renew current licenses can be extended to regulate the management of spent nuclear fuel and high-level radioactive waste for multiple renewal periods. The staff is examining technical areas associated with multiple renewals of fixed-term, dry storage licenses and certificates to address age-related degradation of dry cask storage systems, structures, and components. The NRC acknowledges that current licensing practices may evolve over time in response to improved understanding, operational experience, and Commission policy direction. As technical, regulatory, and policy issues are resolved, the NRC will revise guidance and staff qualification and training accordingly. In the DGEIS, the NRC has concluded that sufficient information exists to perform an analysis of continued storage impacts well into the future. Nonetheless, the NRC continues to identify and resolve potential issues associated with the storage and transportation of spent nuclear fuel storage for periods beyond an ISFSI's initial licensing and first renewal. Completion of the current effort is planned for the end of the decade. As with any rule, the NRC will evaluate any new information that is developed during this project to determine whether it's necessary to update the Waste Confidence rule.

Comment [kas2]: Insert a Q&A on why the NRC can proceed with this rulemaking while research on the extended storage of fuel is still ongoing.

A15. Did the NRC Factor in Information from the Spent Fuel Pool Study in the DGEIS?

The DGEIS does not specifically reference the draft "Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor" (hereafter referred to as the Spent Fuel Pool Study or Study). If the NRC publishes a final Study before the final GEIS is published, then a reference to the Spent Fuel Pool Study will be added to the final GEIS. Although it did not specifically reference the draft Study in the DGEIS, the staff is aware of the conclusions in the draft Study and worked closely with the authors that developed the draft Study to prepare the relevant sections of the draft GEIS. The conclusions of the draft Study support the conclusions in the GEIS and are consistent with previous studies on spent fuel pool accidents. The draft Spent Fuel Pool Study was made public for review and comment on June 24~~17~~ in advance of a July public Advisory Committee on Reactor Safeguards meeting on the draft Study. The draft Spent Fuel Pool Study is available to the public under ADAMS Accession No. MLXXXXXXX. (This information will be updated prior to publication.)

A16. Did the NRC Address Accidents in the DGEIS?

Yes, the DGEIS considered the risk and potential consequences of accidents and acts of sabotage during continued storage of spent nuclear fuel. This analysis assessed the environmental effects of man-made hazards and natural phenomena hazards, including flooding and earthquakes. As with all NEPA analyses, the DGEIS analyzed reasonably-foreseeable events, and did not consider worst-case impacts. Section 4.18 of the DGEIS discusses the environmental impacts of postulated accidents, both design-basis and severe accidents, during continued at-reactor storage and Section 5.18 discusses away-from-reactor postulated accidents. Appendix F of the DGEIS contains a more detailed analysis of spent fuel pool fires. Sections 4.19 and 5.19 of the DGEIS address impacts resulting from acts of terrorism.

A17. Does the NRC Plan to Hold Public Meetings on the Waste Confidence DGEIS and Proposed Rule?

Yes, the NRC plans to hold eight regional public meetings and two nationally Webcast meetings at NRC headquarters on the DGEIS and proposed rule. The regional meetings will be held in or near: Charlotte, North Carolina; Denver, Colorado; Toledo, Ohio; Boston (metro area), Massachusetts; New York City (metro area), New York; Minneapolis, Minnesota; San Clemente, California; and San Luis Obispo, California. These meetings will be held during the public comment period on the DGEIS and proposed rule. All meetings will be noticed on the NRC's Public Meeting Schedule Web site at http://www.nrc.gov/public-involve/public-meetings/index.cfm. Information on the public meetings will also be made available through the *Federal Register*, press releases, blog posts, and e-mails. The NRC will also post meeting notices to the Federal rulemaking Web site at https://www.regulations.gov, under Docket ID NRC-2012-0246.

Transportation Traffic Health impacts	 SMALL SMALL	 SMALL SMALL	 SMALL SMALL
Public and Occupational Health	SMALL	SMALL	SMALL
Accidents	SMALL		
Terrorism Considerations	SMALL		

Comment [kas3]: Insert Qs & As addressing the following:
- Impacts on waste confidence and/or the safe storage of fuel resulting from the potentially LARGE impact in cultural resources.
- In general, the assumptions made in the DGEIS.
- How significant changes in the assumptions would be addressed under the NRC's regulatory framework (for example, the periodicity of repackaging).
- What did the Commission assume regarding the continuation of institutional controls and why.

B6. What Are the Environmental Impacts of Away-from-Reactor Continued Storage?

The away-from-reactor environmental impacts analyzed in the DGEIS include the impacts from constructing the ISFSI. Although an away-from-reactor ISFSI would be subject to a site-specific licensing review that includes an environmental impact statement that would assess the environmental impacts due to construction, the impacts due to construction are included in the DGEIS due to the potential for that construction to occur during the timeframes analyzed in the DGEIS. For away-from-reactor storage, the unavoidable adverse environmental impacts for each resource area would be SMALL except for air quality, terrestrial ecology, aesthetics, waste management, and transportation where the impacts would be SMALL to MODERATE. Socioeconomics impacts would range from SMALL to beneficial and LARGE and historic and cultural impacts could be SMALL, MODERATE, or LARGE. The potential MODERATE impacts on air, terrestrial wildlife, and transportation are based on construction-related potential fugitive dust emissions, terrestrial wildlife direct and indirect mortalities, and temporary construction traffic impacts. The potential MODERATE impacts on aesthetics and waste management are based on noticeable changes to the viewshed from constructing a new away-from-reactor ISFSI, and the volume of nonhazardous solid waste generated by assumed ISFSI and DTS replacement activities for only the indefinite timeframe. The potential beneficial and LARGE impacts on socioeconomics would be due to local economic tax revenue increases

DGEIS and Section III.C.3, *Storage of Spent Nuclear Fuel at a Storage Facility,* of this document for additional information).

If necessary, there is no technical reason that storage of spent fuel in either spent fuel pools or dry casks cannot continue beyond 60 years after the end of the reactor's licensed life for operation. Storage of spent fuel beyond this time would continue under an approved aging management program to ensure that monitoring and maintenance are adequately performed. The DGEIS assumes that, at an appropriate time, structures, systems, and components of the ISFSIs would be replaced as part of an approved aging management program. The DGEIS assumes that these replacement activities begin during the long-term timeframe; however, based on current information, there is no expectation or requirement for replacement to occur at any specific time in the future. Continued experience with storing spent fuel will guide and inform aging management plans. At present, replacement activities (i.e., large-scale replacement of dry cask storage systems) are expected to occur no earlier than 60 years after the end of the reactor's licensed life for operation.

B9. If the NRC Is Considering Extending the Timeframe of Safe Storage, How Is That Not De Facto On Site Disposal?

Nothing in this rulemaking or the DGEIS authorizes the continued storage of spent nuclear fuel. Storage of spent nuclear fuel is authorized in site-specific licensing actions under parts 50, 52, or 72. The DGEIS and this rulemaking are intended to generically resolve the NRC's NEPA obligations with respect to the continued storage of spent nuclear fuel. Neither the DGEIS nor this rulemaking authorize the storage of spent nuclear fuel. Further, the national policy of the United States continues to be disposal of spent nuclear fuel in a geologic repository. The Blue Ribbon Commission on America's Nuclear Future reaffirmed the need and feasibility of geologic disposal in its 2012 report (the "BRC Report") (ADAMS Accession No.

(*see* also Appendix B of the DGEIS and Section III.C2., *Geologic Repository – Technical Feasibility and Availability,* of this document).

B11. What Changes Are Being Proposed for the Timing of a Geologic Repository?

The NRC is proposing a change to 10 CFR 51.23(a) that would reflect the most likely timeframe for repository availability. Proposed paragraph (a)(2) of 10 CFR 51.23 states that it is feasible to have a mined geologic repository within 60 years following the licensed life of operation for a reactor.

B12. Why ~~Did~~ Does the NRC Think it is Feasible that a Repository Can be Available in ~~Choose~~ 60 Years ~~as the Appropriate Timeframe for a Repository~~?

As discussed in the DGEIS, the NRC has analyzed three timeframes that represent various scenarios for the length of continued storage that will be needed before spent fuel is sent to a repository. The first, most likely, timeframe is the short-term timeframe, which analyzes 60 years of continued storage after the end of a reactor's licensed life for operation. As discussed in the DGEIS, the NRC has concluded this is the most likely timeframe, in part, because the DOE has expressed its intention to provide repository capacity by 2048, which is well before the 60 years after licensed life for operation for all currently operating plants, and about 10 years before the end of this timeframe for the oldest spent fuel within the scope of this analysis. Further, international and domestic experience with deep geologic repository programs supports a timeline of 25-35 years to provide repository capacity for the disposal of spent fuel. The DOE's prediction of 2048 is in line with this expectation. The NRC acknowledges, however, that the short-term timeframe, although the most likely, is not certain. Accordingly, the DGEIS also analyzed two additional timeframes. The long-term timeframe considers the environmental impacts of continued storage for a total of 160 years after the end

Comment [kas4]: Add a brief discussion addressing the uncertainty.

of a reactor's licensed life for operation. Finally, although the NRC considers it highly unlikely, the DGEIS includes an analysis of an indefinite timeframe, which assumes that a repository does not become available.

In picking a timeframe by which the Commission believes that a geologic repository is likely to become available, the Commission in no way means to imply that it believes that spent fuel will need to be stored indefinitely. Nor does it imply that a repository is only feasible at the end of the 60-year timeframe or that any particular repository site is precluded under the analysis. The Commission supports timely disposal of spent nuclear fuel and high-level radioactive waste in a geologic repository, though the DOE is currently the agency responsible for carrying out the national policy to site and build a repository. However, spent nuclear fuel will need to be stored for several decades at either reactor sites or away-from-reactor sites before ultimate disposal in a geologic repository. Having considered all available information, the Commission believes that the most likely timeframe for repository availability is 60 years beyond a reactor's licensed life for operation (*see* also the discussion in Appendix B of the DGEIS and Section III.C.2, *Geologic Repository – Technical Feasibility and Availability* of this document).

B13. How Does this Rulemaking Relate to the Licensing of Future Away-from-Reactor ISFSIs?

Future away-from-reactor ISFSI applicants must conduct a site-specific environmental analysis to support their licensing. An away-from-reactor ISFSI applicant or licensee cannot use the Waste Confidence rule and GEIS or the Part 72 Subpart K general license as the basis for constructing an away-from-reactor ISFSI. If necessary, the site-specific NEPA analysis for an away-from-reactor ISFSI could only rely on the analysis in the DGEIS and rule to a limited extent to satisfy its NEPA obligations with respect to the storage of spent nuclear fuel after the expiration of the away-from-reactor ISFSI license.

nuclear waste management company in Finland) submitted a construction license application for a final repository that will hold spent nuclear fuel from Finland's nuclear reactors. Finland expects this facility to begin receipt of spent nuclear fuel for disposal in 2020, 34 years after the start of preliminary site investigations.

Between 1993 and 2000, Sweden conducted feasibility studies in eight municipalities. One site was found technically unsuitable, and two sites were eliminated by municipal referenda. Three of the remaining five sites were selected for detailed site investigations. Municipalities adjacent to two of these sites agreed to be potential hosts and one refused. Since 2007, detailed site investigations were conducted at both Oesthammer and Oskarshamn, both of which already host nuclear power stations. On June 3, 2009, the Swedish Nuclear Fuel and Waste Management Company, SKB, selected the Forsmark Site located in the Oesthammer municipality for the Swedish spent nuclear fuel repository. The SKB submitted a license application in spring 2011. A government decision is expected in 2015. If Swedish authorities authorize construction, the repository could be available for disposal around 2025, about 30 years after feasibility studies began.

Based on international experience, 25-35 years is a reasonable estimate for the amount of time necessary to site, license, and open a geologic repository. The time DOE will need to develop a repository site will depend upon a variety of factors, including the passage of any required enabling legislation and budgeted funding. Broader institutional issues also bear on the time it takes to implement geologic disposal. International and domestic experience have made it clear that technical experience and confidence in geologic disposal, on their own, are not sufficient to bring about the broad social and political acceptance needed to construct a repository. Given this uncertainty, the DGEIS evaluates a range of scenarios for the timeframe of the development of a repository, including indefinite storage.

The DOE is currently the agency responsible for carrying out the national policy to site and build a repository, which includes designing, constructing, operating, and decommissioning the repository. The NRC, on the other hand, is the agency responsible for reviewing, licensing, and overseeing the construction and operation of the repository. The DOE Strategy Report states that it is the Administration's goal to have a repository sited by 2026, licensing to be complete by 2042, and the repository constructed and open for operations by 2048. The total of 35 years is consistent with international efforts and estimates of between 25 and 35 years to site, license, construct, and open a repository.

Before DOE can start the development of a new site, Congress will need to provide additional direction, beyond the current NWPA, for the long-term management and disposal of spent nuclear fuel and high-level radioactive waste. Whatever approach Congress mandates, international and domestic experience since 1990 suggests that greater attention needs to be paid to developing societal and political acceptance in concert with essential technical, safety, and security assurances. While there is no technical basis for making precise estimates of the minimum time needed to accomplish these objectives, examination of the international examples cited previously would support a range of between 25 and 35 years. ~~The Commission believes that societal and political acceptance must occur before a successful repository program can be completed, and that this is unlikely to occur until a Federal decision is made, whether for technical, environmental, political, legal, or societal reasons, that will allow the licensing and construction of a repository to proceed.~~ The BRC Report recommended using a siting process that is consent-based. In response to the BRC report, the DOE Strategy Report includes a strategy that includes the establishment of a consent-based siting process.

As discussed in this section, geologic disposal continues to be the favored disposition path both nationally and internationally. Moreover, geologic disposal has moved significantly beyond a theoretical concept as demonstrated by: 1) submission of a license application for a the Commission concludes that it is reasonable to assume the availability of ~~that~~ a mined geologic repository ~~can be available~~is feasible within 60 years beyond the licensed life for operating and planned new reactors.

C3. Storage of Spent Nuclear Fuel

Continued storage of spent nuclear fuel at-reactor or away-from-reactor sites will be necessary until a repository is available for permanent disposal. During the continued storage period, the storage of spent nuclear fuel at a storage facility is focused on safe spent nuclear fuel management. Safe spent nuclear fuel management involves a regulatory framework and the technical feasibility of safe storage. The regulatory framework applicable to both wet (spent fuel pool) and dry storage of spent nuclear fuel is discussed in Section C3.a., *Regulatory Framework*, of this document. The technical feasibility of safe storage of spent nuclear fuel in spent fuel pools is discussed in Section C3.b.i., *Technical Feasibility of Wet Storage*, and in dry cask storage in Section C3.b.ii., *Technical Feasibility of Dry Storage*, of this document (*see* also Section B.3 of Appendix B of the DGEIS).

C3.a. Regulatory Framework

A strong regulatory framework that involves regulatory oversight, continuous improvement based on research and operating experience and licensee compliance with regulatory requirements is important to the continued safe storage of spent nuclear fuel until repository capacity is available. The regulatory framework was previously addressed in Findings 3 and 5. Finding 3 analyzed whether high-level radioactive waste and spent nuclear fuel would be safely managed until repository capacity is available. Finding 5 dealt with whether safe storage capacity would be made available if necessary. The key question of these Findings is whether a regulatory framework exists to ensure the continued safe management of also contains the regulatory framework for licensing a monitored retrievable storage facility should the need arise.

A general license under subpart K of 10 CFR part 72, "General License for Storage of Spent Fuel at Power Reactor Sites," authorizes storage of spent fuel in casks previously approved by the NRC at a site already licensed to possess fuel to operate a nuclear power reactor. Under 10 CFR 72.210, "General license issued," a general license for the storage of spent nuclear fuel in an ISFSI at power reactor sites is issued to those persons authorized to possess or operate nuclear power reactors under 10 CFR parts 50 or 52. The general license is limited to spent nuclear fuel that the general licensee is authorized to possess at the site under the 10 CFR parts 50 or 52 license for the site. The general license is further limited to storage of spent nuclear fuel in casks approved and fabricated under the provisions of subpart L of 10 CFR part 72, "Approval of Spent Fuel Storage Casks;" the approved cask designs are listed in 10 CFR 72.214, "List of approved spent fuel storage casks." The NRC has approved 34 designs. The NRC conducts a technical review of each cask design before approving the design and listing it in 10 CFR 72.214. After the NRC staff documents its review of the proposed cask design in a safety evaluation report, the NRC conducts a rulemaking, which includes an ~~cask specific~~ environmental review, to add the design to the list of approved cask designs. Licensees that use casks with the approved designs must follow the terms of the Certificate of Compliance and the technical specifications for the design. Licensees must demonstrate that it is safe to store spent fuel in dry casks at their site, including analysis of earthquake intensity and tornado missiles. Licensees also review their programs (such as security and emergency planning) and make any changes to those programs needed to accommodate an ISFSI at their site.

Parts 50, 52, and 72 of 10 CFR all have provisions for license renewal. The current regulatory framework for storage of spent nuclear fuel allows for multiple license renewals the spent fuel pool is removed from the pool by the end of the short-term timeframe (*see* Section 2.2.1.1 of the DGEIS for more information on decommissioning during the short-term period).

As part of its oversight, the NRC can issue orders and new or amended regulations to address emerging issues that could affect the storage of spent nuclear fuel. For example, following the terrorist attacks of September 11, 2001, the NRC undertook an extensive reexamination of spent nuclear fuel safety and security issues. In 2002, the NRC issued orders to licensees that required power reactors in decommissioning, wet ISFSIs, and dry storage ISFSIs to enhance security and improve their capabilities to respond to, and mitigate the consequences of, a terrorist attack. These orders required additional security measures, including increased patrols, augmented security forces and capabilities, and more restrictive site access controls to reduce the likelihood of a successful terrorist attack. In 2007, the NRC issued a final rule revising the Design Basis Threat, which also increased the security requirements for power reactors and their spent fuel pools (72 FR 12705; March 19, 2007). More recently in March 2009, the NRC issued a final rule to improve security measures at nuclear power reactors, including spent fuel pools (74 FR 13926; March 27, 2009). The NRC also plans to codify enhanced security measures at ISFSIs in a future rulemaking (74 FR 66589; December 16, 2009).

Section 4.19 of the DGEIS describes the environmental impacts of potential acts of sabotage or terrorism involving the continued storage of spent nuclear fuel. The section acknowledges that as the immediate hazard posed by the high radiation levels of spent nuclear fuel diminishes over time so does the deterrent to handling by unauthorized persons. The NRC will consider this type of information in evaluating whether additional security requirements are warranted in the future.~~The BRC report noted that "over long time periods (perhaps a century or more, depending on burnup and the level of radiation that is deemed to provide adequate self-~~

~~protection), the fuel could become more susceptible to possible theft or diversion (although other safeguards would remain in place). This in turn could change the security requirements for older spent fuel. Extending storage to timeframes of more than a century could thus require increasingly demanding and expensive security protections at storage sites." Therefore, additional security requirements may be necessary in the future, should spent nuclear fuel remain in storage for a substantial period of time. If necessary, the NRC will issue orders or enhance its regulatory requirements for ISFSI security, as appropriate, to ensure adequate protection of public health and safety and the common defense and security.~~

Other examples of the NRC's oversight are the additional requirements that the NRC has imposed in response to the March 11, 2011, severe earthquake and subsequent tsunami that resulted in extensive damage to the six-unit Fukushima Dai-ichi Nuclear Power Plant in Japan. On March 12, 2012, the NRC issued multiple orders and a request for information to all of its nuclear power plant licensees. The orders addressed mitigating strategies for beyond-design basis external events and reliable spent fuel pool instrumentation. The request for information was designed to gather information to allow the NRC to reevaluate seismic and flooding hazards at operating reactor sites and to determine whether appropriate staffing and communication can be relied upon to coordinate event response during a prolonged station blackout event, as was experienced at Fukushima Dai-ichi.

Another aspect of the NRC's regulatory program for continued storage, as for reactors and other licensed facilities generally, involves generic communications. Generic communications include, but are not limited to, generic letters, bulletins, information notices, safeguards advisories, and regulatory issue summaries. Generic letters request licensee actions and information to address issues regarding emergent or routine matters of safety, security, safeguards, or environmental significance. Bulletins request licensee actions and information to address significant issues regarding matters of safety, security, safeguards, or

In addition, issuance of Materials License No. SNM-2513 for the Private Fuel Storage, LLC (PFS) facility has confirmed the feasibility of licensing an away-from-reactor ISFSI under 10 CFR part 72. ~~a~~Although there were several issues that prevented the PFS ISFSI from being built and operated, the extensive review of safety, security, and environmental issues associated with licensing the PFS facility provides additional confidence that spent nuclear fuel can be safely stored at an away from reactor ISFSI for long periods after storage at a reactor site.

The NRC will continue its regulatory control and oversight of spent nuclear fuel storage at both operating and decommissioned reactor sites for both specific and general 10 CFR part 72 licenses and 10 CFR parts 50 or 52 licenses. Decades of operating experience and ongoing NRC inspections demonstrate that these reactor and ISFSI licensees continue to meet their obligation to safely store spent fuel in accordance with the requirements of 10 CFR parts 50 and 72. If the NRC were to find noncompliance with these requirements or otherwise identify a concern with the safe storage of the spent fuel, the NRC would evaluate the issue and take action to protect the public health and safety and the environment.

As noted in the preceding paragraphs, licensees have continued to develop and successfully use onsite spent nuclear fuel storage capacity in the form of spent fuel pool and dry cask storage. Based on the preceding discussion, the Commission believes that licensees will have the necessary resources to meet obligations related to the storage of any spent nuclear fuel after reactor operations cease. The Commission concludes that the regulatory framework exists to support that spent nuclear fuel can be managed in a safe manner until sufficient repository capacity is available.

C3.b. Storage of Spent Nuclear Fuel

Order to Modify Licenses With Regard to Reliable Spent Fuel Pool Instrumentation			
Waste Confidence References – Non-NRC Documents			
NRDC v. NRC, 582 F.2d 166 (2d Cir. 1978)			
Nuclear Waste Policy Act 96 Stat. 2201 (1983) (current version at 42 U.S.C. 10132 (2006))		http://www.epw.senate.gov/nwpa82.pdf	
Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy	X		ML120970375
DOE, Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste	X		ML13011A138
Letter from J M Maddox, Eddy-Lea Energy Alliance, LLC, to C Haney, NMSS, re Notice of Intent to Submit a License Application for Consolidated Used Nuclear Fuel Storage Facility, February 26, 2013	X		ML13067A278
DOE Motion to Withdraw Application for Yucca Mountain	X		ML100621397
Request for Termination of NRC License No. SNM-2513 for Private Fuel Storage LLC	X		ML12356A063
Billone, M.C., T.A. Burtseva, and R.E. Einziger.2013 "Ductile-to-Brittle Transition Temperature for High-Burnup Cladding Alloys Exposed to Simulated Drying-Storage Conditions." Journal of Nuclear Materials 433(1–3): 431–448		http://www.sciencedirect.com/science/article/pii/S0022311512005181	
IAEA, "Scientific and Technical Basis for the Geologic Disposal of Radioactive Wastes, Technical Reports Series No. 413"		http://www-pub.iaea.org/MTCD/Publications/PDF/TRS413_web.pdf	
IAEA Technical Report Series No. 443, "Understanding and Managing Ageing of Materials in Spent Fuel Storage Facilities"		http://www-pub.iaea.org/MTCD/publications/PDF/TRS443_web.pdf	

Comment [kas5]: Provide a reference for this case since it appears that the DGEIS assumes all references are available publicly.

cost-benefit analysis of the alternatives considered in the DGEIS was prepared as part of the DGEIS (Chapter 7). If continued storage of spent nuclear fuel beyond the licensed life for operations must be assessed in site-specific licensing actions, the primary costs accrue to the NRC and to licensees and license applicants. Licensees and license applicants ultimately shoulder the majority of costs incurred to the NRC in the course of licensing actions through the NRC's license-fee program. Costs also accrue through the NRC's adjudicatory activities, which affect the NRC, licensees, license applicants, and petitioners or intervenors. The DGEIS contains an estimate that it could cost over $24 million to address continued storage in site-specific proceedings.

XII. Regulatory Flexibility Certification

In accordance with the Regulatory Flexibility Act of 1980 (5 U.S.C. 605(b)), the Commission certifies that this rule would not, if promulgated, have a significant economic impact on a substantial number of small entities. The proposed rule would modify the generic determination on the consideration of environmental impacts of continued storage of spent nuclear fuel beyond the end of the licensed life for reactor operations. This generic determination provides that no discussion of any environmental impact of spent nuclear fuel storage in reactor facility storage pools or ISFSIs for the period following the term of the reactor operating license or amendment or initial ISFSI license or amendment for which application is made is required in any environmental report, environmental impact statement, environmental assessment, or other analysis prepared in connection with certain actions. The proposed rule would affect only the licensing of nuclear power plants or ISFSIs. Entities seeking or holding NRC licenses for these facilities do not fall within the scope of the definition of "small entities"

AUTHORITY: Atomic Energy Act sec. 161, 1701 (42 U.S.C. 2201, 2297f); Energy Reorganization Act secs. 201, 202, 211 (42 U.S.C. 5841, 5842, 5851); Government Paperwork Elimination Act sec. 1704 (44 U.S.C. 3504 note). Subpart A also issued under National Environmental Policy Act secs. 102, 104, 105 (42 U.S.C. 4332, 4334, 4335); Pub. L. 95-604, Title II, 92 Stat. 3033-3041; Atomic Energy Act sec. 193 (42 U.S.C. 2243). Sections 51.20, 51.30, 51.60, 51.80. and 51.97 also issued under Nuclear Waste Policy Act secs. 135, 141, 148 (42 U.S.C. 10155, 10161, 10168). Section 51.22 also issued under Atomic Energy Act sec. 274 (42 U.S.C. 2021) and under Nuclear Waste Policy Act sec. 121 (42 U.S.C. 10141). Sections 51.43, 51.67, and 51.109 also issued under Nuclear Waste Policy Act sec. 114(f) (42 U.S.C. 10134(f)).

2. In § 51.23, the title of the section is revised and paragraphs (a) and (b) are revised to read as follows:

§ 51.23 Environmental impacts of storage of spent nuclear fuel beyond the licensed life for operation of a reactor.

(a) The Commission has developed a generic environmental impact statement (NUREG-2157) analyzing the environmental impacts of storage of spent nuclear fuel beyond the licensed life for operation of a reactor. The Commission has concluded the following:

(1) The analysis in NUREG-2157 generically addresses the environmental impacts of storage of spent nuclear fuel beyond the licensed life for operation of a reactor; and

(2) The analysis in NUREG-2157 supports the determinations that it is feasible to:

(i) safely store spent nuclear fuel following the licensed life for operation of a reactor and

(ii) ~~to~~ have a mined geologic repository within 60 years following the licensed life for operation of a reactor.

water standards) could potentially be exceeded. ~~In that circumstance, the public health impacts could be MODERATE.~~ However, it is unlikely that a leak of sufficient quantity and duration could occur without detection, or that such a leak would not be impeded by the inherent hydrologic characteristics typical at spent fuel pool locations. Therefore, based on the low probability that a long-duration leak exceeding effluent limits would go undetected and affect offsite groundwater sources to the extent that a public health limit would be exceeded, the NRC concludes that impacts during the short-term storage timeframe would be SMALL.

Tritium is a radioactive isotope of hydrogen. Water containing tritium is normally released from nuclear power plants under controlled, monitored conditions that the NRC mandates to protect public health and safety. The NRC evaluates abnormal releases of tritium-contaminated water. More information about tritium from nuclear power plants can be found at http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-radiation-fs.html.

For all other resource areas evaluated, the impacts from a spent fuel pool leak would be SMALL.

ES.16.2 Spent Fuel Pool Fires

The spent fuel pool fire environmental impacts described in Appendix F are a summary of spent fuel pool fire risk studies the NRC has completed since 1975. While most of the earlier studies were concerned with spent fuel pool fire risk during the operating life of a reactor, the most recent risk study completed in 2001 examined the risk of spent fuel pool fires during the reactor decommissioning period, which is the same storage timeframe of continued storage of spent fuel on which this draft GEIS is focused.

The NRC's determination of SMALL for the environmental impacts of a spent fuel fire is based on a **probability-weighted consequence**. This means that the risk of a spent fuel fire informed the impact determination of SMALL.

The risk of a spent fuel fire is low because even though the consequences would be high, the probability is extremely low.

The conservative estimates used to assess the impacts spent fuel pool fires in NRC's previous analyses resulted in frequency-weighted population doses and economic impacts that were much less than the values calculated for a full power reactor accident estimated in the 1996 and 2013 License Renewal GEIS for the assumptions found in previous analyses (e.g., spent fuel pool density, site population density, and time after shutdown for the event to occur). Furthermore, mitigation measures implemented by licensees as a result of NRC Orders have further lowered the risk of this class of accident. As a result, the NRC finds that the 1996 and 2013 License Renewal GEIS conclusion that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts of spent fuel pool fires are SMALL is applicable for a spent fuel pool fire during the continued storage timeframe.

1.0 Introduction

Since the inception of nuclear power, the U.S. Nuclear Regulatory Commission (NRC) (including its predecessor, the Atomic Energy Commission) has worked to find a disposal solution for spent nuclear fuel (spent fuel) generated by commercial nuclear power reactors. In the late 1970s, the NRC reexamined an underlying assumption used in licensing reactors to that time—*that a repository could be secured for the ultimate disposal of spent fuel generated by nuclear reactors, and that spent fuel could be safely stored in the interim*. This analysis was called the Waste Confidence proceeding.

Comment [kas1]: If an introduction of this nature is needed, revise so that it is clear that the NRC does not have any role in the policy decisions surrounding disposal solutions for spent nuclear fuel.

This draft *Waste Confidence Generic Environmental Impact Statement* (draft GEIS) addresses the environmental impacts of continuing to store spent fuel at a reactor site or at an away-from-reactor storage facility, after the end of a reactor's licensed life for operation until final disposition in a geologic repository ("continued storage"). This draft GEIS has been prepared to fulfill the Commission's obligations under the National Environmental Policy Act of 1969, as amended (NEPA) and NRC regulations implementing NEPA in Title 10 of the *Code of Federal Regulations* (CFR) Part 51.

1.1 History of Waste Confidence

The first Waste Confidence rulemaking began in the late 1970s in response to two significant legal proceedings. In 1977, the Commission denied a petition for rulemaking filed by the Natural Resources Defense Council (NRDC) that asked the NRC to determine whether radioactive wastes generated in nuclear power reactors can be disposed of without undue risk to public health and safety and to refrain from granting pending or future requests for reactor operating licenses until the NRC made a determination regarding disposal. The Commission stated in its denial that, as a matter of policy, it "... would not continue to license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely" (42 FR 34391). The Commission's denial of the NRDC petition was affirmed upon judicial review (*NRDC v. NRC*). Since that time, the Federal government has adopted deep geologic disposal as the national solution for spent fuel disposal (Nuclear Waste Policy Act of 1982). Recently, the U.S. Department of Energy (DOE) reaffirmed the Federal government's commitment to the ultimate disposal of spent fuel, and predicted that a repository would be available by 2048 (DOE 2013).

At about the same time the Commission denied the NRDC petition, the State of Minnesota and the New England Coalition on Nuclear Pollution challenged license amendments that permitted expansion of the capacity of spent fuel storage pools at two nuclear power plants, Vermont

Yankee and Prairie Island. In 1979, the Court of Appeals for the District of Columbia (D.C.) Circuit, in *Minnesota v. NRC*, remanded to the Commission the question of whether an offsite storage or disposal solution would be available for the spent fuel at the two facilities at the expiration of their licenses—in 2007 and 2009—and, if not, whether the spent fuel could be stored safely at those reactor sites until an offsite solution was available.

In 1979, the NRC initiated a generic rulemaking that stemmed from these challenges and the Court's remand in *Minnesota v. NRC*. The Waste Confidence rulemaking generically assessed whether the Commission could have reasonable assurance that spent fuel produced by nuclear power plants "… can be safely disposed of....when such disposal or offsite storage will be available, and....whether radioactive wastes can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available" (44 FR 61372). On August 31, 1984, the Commission published the Waste Confidence decision (49 FR 34658) and a final rule (49 FR 34688), codified at 10 CFR 51.23. In addition to addressing the NRC's assessment of the issues presented by the Court's remand, the **Decision** provided an environmental assessment (EA) and finding of no significant impact (FONSI) to support the **Rule**.

Comment [kas2]: Has not been defined yet.

Comment [kas3]: Has not been defined yet.

The analysis in 10 CFR 51.23 found that, for at least 30 years beyond the expiration of a reactor's licensed life for operation, no significant environmental impacts would result from storage of spent fuel, and expressed the Commission's reasonable assurance that a repository was likely to be available in the 2007 to 2009 timeframe. The Rule also stated that, as a result of this generic determination, the NRC need not prepare any site-specific environmental analysis in connection with continuing storage when issuing a license or amended license for a new reactor or independent spent fuel storage facility (ISFSI) (10 CFR 51.23(b)).

The first review of the Decision and the Rule occurred in 1989 and 1990. This review resulted in revisions to the Decision and the Rule to reflect revised expectations for the availability of the first repository, and to clarify that the expiration of a reactor's licensed life for operation referred to the full 40-year initial license for operation and a 30-year revised or renewed license. On September 18, 1990, the Commission published the revised Decision (55 FR 38474) and final Rule (55 FR 38472).

The Commission conducted its second review of the Decision and the Rule in 1999 and concluded that experience and developments after 1990 had confirmed the findings and made a comprehensive reevaluation of the Decision and Rule unnecessary. The Commission also stated that it would consider undertaking a comprehensive reevaluation when the pending repository development and regulatory activities had run their course or if significant and pertinent unexpected events occurred that raised substantial doubt about the continuing validity of the Waste Confidence decision (64 FR 68005).

In 2008, the Commission decided to conduct its third review of the Decision and the Rule. This review resulted in revisions to reflect revised expectations for the availability of the first repository and to encompass at least 60 years of continued storage. In December 2010, the Commission published its revised Decision (75 FR 81032) and final Rule (75 FR 81037).

In response to the 2010 rulemaking, the States of New York, New Jersey, Connecticut, and Vermont; several public interest groups; and the Prairie Island Indian Community sought review in the U.S. Court of Appeals for the D.C. Circuit challenging the Commission's NEPA analysis that supported the Rule. On June 8, 2012, the Court ruled that some aspects of the 2010 Waste Confidence rulemaking did not satisfy the NRC's NEPA obligations. The Court therefore vacated the Decision and the Rule and remanded the case to the NRC for further proceedings consistent with the Decision (*New York v. NRC*).

The Court concluded that the Waste Confidence rulemaking proceeding is a major Federal action necessitating either an environmental impact statement (EIS) or an EA that results in a FONSI. The Court identified three deficiencies in the NRC's environmental analysis:

1. Related to the Commission's conclusion that permanent disposal will be available "when necessary," the Court held that the Commission needed to evaluate the environmental effects of failing to secure permanent disposal, given the uncertainty about whether a repository would be built.
2. Related to 60 years of continued storage, the Court concluded that the Commission had not adequately examined the risk of spent fuel pool leaks in a forward-looking fashion.
3. Also related to continued storage, the Court concluded that the Commission had not adequately examined the consequences of potential spent fuel pool fires.

In response to the Court's decision, the Commission stated in Commission Order CLI–12–16 that it would not issue reactor or ISFSI licenses dependent upon the Waste Confidence rule until the Court's remand is appropriately addressed (NRC 2012a). This decision is not an indication that the Commission lacks confidence in the availability of an ultimate disposal solution, but rather reflects the Commission's need to develop an analysis that assesses the environmental impacts of continued storage in a manner addressing the Court's remand.[1] The Commission stated, however, that this determination extends only to issuance of the reactor or ISFSI license, and that all licensing reviews and proceedings should continue to move

[1] "Waste confidence undergirds certain agency licensing decisions, in particular new reactor licensing and reactor license renewal. Because of the recent court ruling striking down our current waste confidence provisions, we are now considering all available options for resolving the waste confidence issue, which could include generic or site-specific NRC actions, or some combination of both. We have not yet determined a course of action. But, in recognition of our duties under the law, we will not issue licenses dependent upon the Waste Confidence Decision or the Temporary Storage Rule until the court's remand is appropriately addressed." (NRC 2012a) at 4 *citations omitted*.

The first timeframe—*short-term storage*—lasts for 60 years and begins after the end of the licensed life for a nuclear power plant. The NRC evaluated the environmental impacts resulting from the following activities that occur during the short-term storage timeframe:

- continued storage of spent fuel in spent fuel pools (at-reactor only) and ISFSIs
- routine maintenance of at-reactor spent fuel pools and ISFSIs (e.g., maintenance of concrete pads)
- construction and operation of an away-from-reactor ISFSI (including routine maintenance)
- handling and transfer of spent fuel from spent fuel pools to ISFSIs

The next timeframe—*long-term storage*—is 100 years and begins immediately after the short-term storage timeframe. The NRC evaluated the environmental impacts resulting from the following activities that occur during long-term storage:

- continued storage of spent fuel in ISFSIs, including routine maintenance
- one-time replacement of ISFSIs and spent fuel canisters and casks
- construction and operation of a DTS (including replacement)

For the long-term storage timeframe, the NRC assumes that all spent fuel has already been moved from the spent fuel pool to dry cask storage by the end of the short-term storage timeframe. The spent fuel pool would be decommissioned within 60 years of permanent cessation of operation, as required by 10 CFR 50.82.

The third timeframe—*indefinite storage*—assumes that a geologic repository does not become available. In this timeframe, at-reactor and away-from-reactor ISFSIs would continue to store spent fuel in dry casks ~~storage would continue to be stored onsite in spent fuel pools until the end of the short-term storage timeframe and in at-reactor and away-from-reactor ISFSIs~~ indefinitely. For the evaluation of environmental impacts if no repository becomes available, the following activities are considered:

- continued storage of spent fuel in ISFSIs, including routine maintenance
- replacement of ISFSIs and spent fuel canisters and casks every 100 years
- construction and operation of an away-from-reactor ISFSI (including replacement every 100 years)
- construction and operation of a DTS (including replacement every 100 years)

These activities are the same as those that would occur for long-term storage, but without a repository, they would occur repeatedly.

1.8.3 Analysis Assumptions

To evaluate the potential environmental impacts of continued storage, this draft GEIS makes several assumptions.

- Although the NRC recognizes that the precise time spent fuel is stored in pools and dry cask storage systems will vary from one reactor to another, this draft GEIS makes a number of reasonable assumptions regarding the length of time the fuel can be stored in a spent fuel pool and in a dry cask before the fuel needs to be moved or the facility needs to be replaced. With respect to spent fuel pool storage, the NRC assumes that all spent fuel is removed from the spent fuel pool and placed in dry cask storage in an ISFSI no later than 60 years after the end of the reactor's licensed life for operation. With respect to dry cask storage, the NRC assumes that the licensee uses a DTS during long-term and indefinite storage timeframes to move the spent fuel to a new dry cask every 100 years. Similarly, the NRC assumes that the DTS and the ISFSI pad are replaced every 100 years. For an ISFSI that reaches 100 years of age near the end of the short-term storage timeframe, the NRC assumes that the replacement would occur during the long-term storage timeframe.
- Based on its knowledge of and experience with the structure and operation of the various facilities that will provide continued storage, including the normal life of those facilities, the NRC believes that spent fuel pool storage could last for about 60 years beyond the licensed life for operation of the reactor where it is stored, and that each ISFSI will last about 100 years, for a total of 160 years or less of likely continued storage if a repository becomes available.
- **Institutional controls will continue.** This assumption avoids unreasonable speculation regarding what might happen in the future regarding Federal actions to provide for the safe storage of spent fuel. Although government agencies and regulatory safety approaches can be expected to change over long periods of time into the future, the history of radiation protection has generally been towards ensuring increased safety as knowledge of radiation and effectiveness of safety measures has improved. For the purpose of the analyses in this draft GEIS, the NRC assumes that regulatory control of radiation safety will remain at the same level of regulatory control as currently exists today.

Comment [kas4]: Provide additional information to this bullet about how other federal agencies address institutional controls.

- The DOE analyzed a no-action alternative in their Final EIS for Yucca Mountain (DOE 2008) that considered the loss of institutional controls. In particular, the DOE considered a specific scenario in which spent fuel and high-level radioactive waste would remain in dry storage at commercial and DOE sites and would be under institutional controls for approximately 100 years, and beyond that time, it was assumed there would be no institutional controls. The NRC provided comments to the DOE related to their assumption about the loss of institutional controls (NRC 2000). The NRC stated that it did not consider the loss of institutional controls a reasonable assumption because the Federal government would continue to control licensed material under its authority for as long as necessary to protect the public health and safety.

- A DTS will be built at each ISFSI location during long-term storage timeframe to facilitate spent fuel transfer and handling.
- The NRC assumes a 100-year replacement cycle for spent fuel canisters and casks. This assumption is consistent with assumptions made in the Yucca Mountain Final EIS (DOE 2008).
- The 100-year replacement cycle also assumes replacement of the ISFSI facility and DTS.
- Based on currently available information, the 100-year replacement cycle provides a reasonably conservative assumption for a storage facility that would require replacement at a future point in time. However, this assumption does not mean that dry cask storage systems and facilities *need* to be replaced every 100 years to maintain safe storage.
- The NRC assumes that the land used for the ISFSI pads and DTS would be reclaimed after the facilities are demolished and, therefore, could be used again in the next 100-year replacement cycle. The NRC believes this assumption is reasonable because the characteristics of the previously disturbed land is already known and is suitable for ISFSI and DTS design and construction.
- The NRC assumes that aging management, including routine maintenance activities and programs occurs between replacements. These "routine" or planned maintenance activities are distinct from the "replacement" of facilities and equipment.
- The spent fuel is moved from the spent fuel pool to dry cask storage within the short-term storage timeframe.
- The NRC assumes that for nuclear power plants that operate for the term specified in its license, decommissioning will occur~~s~~ within 60 years after the licensed life for operations in accordance with 10 CFR 50.82 or 52.110. Under these regulations, a plant that terminates its license early is required to complete decommissioning within 60 years after the permanent cessation of operation. The NRC also assumes that, by the end of the short-term storage timeframe, a licensee will either terminate its Part 50 or 52 license and receive a specific Part 72 ISFSI license (see 10 CFR Part 72, Subpart C) or receive Commission approval under 10 CFR 50.82(a)(3) or 52.110(c) to continue decommissioning under its Part 50 or 52 license. In either case, the NRC assumes that the NRC will conduct an appropriate site-specific NEPA analysis for either issuance of a Part 72 ISFSI license or approval to continue decommissioning in accordance with 10 CFR 50.82(a)(3) or 52.110(c). Further, NRC assumes that replacing an ISFSI and licensing a DTS are licensing actions that would be subject to separate site-specific NEPA reviews. The ISFSI and DTS would be decommissioned separately.

- Replacement of the entire ISFSI would occur over the course of each 100-year interval, starting at the beginning of the long-term storage timeframe.
- Construction, operation, and replacement of the DTS are assumed to occur within the long-term storage timeframe. If the DTS is built at the beginning of the long-term storage timeframe, it could be near the end of its useful life by the end of that storage timeframe. To be conservative, the NRC included the impacts of replacing the DTS one time during the long-term storage timeframe.
- Because an away-from-reactor ISFSI could store fuel from several different reactors, the earliest an away-from-reactor ISFSI would enter the short-term timeframe is when the first of these reactors reaches the end of its licensed life for operation.
- The amount of spent fuel generated is based on the assumption that the nuclear power plant operates for 80 years (40-year initial term plus two 20-year renewed terms).[2]
- A typical spent fuel pool of 700 metric tons of uranium (MTU) storage capacity reaches its licensed capacity limit about 30 years into the licensed life for operation of a reactor. At that point, some of the spent fuel would need to be removed from the spent fuel pool and transferred to a dry cask storage system at either an at-reactor or away-from-reactor ISFSI.
- The environmental impacts of constructing a "spent fuel pool island," which allows the spent fuel pool to be isolated from other reactor plant systems to facilitate decommissioning, are considered within the analysis of cumulative effects in Chapter 6. Because a new spent fuel pool cooling system would be smaller in size and have fewer associated impacts than existing spent fuel pool cooling systems, the environmental impacts of operating the new spent fuel pool cooling system in support of continued storage in the spent fuel pool, would be bound by the impacts of operating the existing cooling system described in Chapter 4.
- It is assumed that an ISFSI of sufficient size to hold all spent fuel generated will be constructed during licensed life for operation ~~will be constructed~~.
- Sufficient low-level waste (LLW) disposal capacity will be made available when needed. Historically, the demand for LLW disposal capacity has been met by private industry. NRC expects that this trend will continue in the future. For example, in response to demand for LLW disposal capacity, Waste Control Specialists, LLC, opened a LLW disposal facility in Andrews County, Texas on April 27, 2012.

[2] The Commission has not determined as a matter of policy that a second renewal is a possibility. This draft GEIS included two renewals as a conservative assumption in evaluating potential environmental impacts.

storage and transportation are generally referred to as dual-purpose casks and dual-purpose canisters. Some vendors refer to their dual-purpose casks or canisters as "multipurpose" canisters, which implies that it would be suitable for storage, transportation, and disposal. However, in the absence of a repository program, there are no specifications for disposal canisters and, therefore, no dual-purpose casks or canisters have been certified as multipurpose (DOE 2012a).

There are 69 ISFSIs licensed to operate in 34 states. As of the beginning of 2012, ISFSIs were storing spent fuel in over 1,700 loaded dry casks. Of the currently licensed ISFSIs, 54 are operating under general licenses and 15 have specific licenses (NRC 2013b). Figure 2-2 shows the locations of U.S. ISFSIs. Information on ISFSIs is presented in Appendix G of this draft GEIS.

NRC authorizes construction and operation of ISFSIs by general and specific licenses. A general license is created by regulation and confers the right upon the general licensee to proceed with the licensed activity without further review or approval by the NRC. A specific license, by contrast, requires an application to perform the licensed activity and NRC review and approval by granting the license.

As these concepts apply to ISFSIs, every nuclear power reactor licensee holds a general license, by virtue of 10 CFR Part 72, Subpart K, which authorizes storage of spent fuel in casks whose design has been approved by the NRC. Licensees must evaluate the safety of using the approved casks at the ISFSI for site-specific conditions, including man-made and natural hazards, and must conform to all requirements under Subpart K for use of the approved design. In addition, licensees must review their programs for operating the reactor (e.g., physical security, radiation protection, or emergency planning) to determine if those programs are affected by use of the casks and, if so, to seek approval from the NRC for any necessary changes to those programs.

Further, a reactor licensee can seek a specific license to construct and operate an ISFSI, which requires NRC's review of the safety, environmental, and physical security aspects of the proposed facility and the licensee's financial qualifications. If the NRC concludes the proposed ISFSI meets licensing criteria, the NRC grants the specific license. This license contains various conditions (e.g., leak testing and monitoring) and specifies the quantity and type of material the licensee is authorized to store at the site. A specific license runs for a term of 40 years and may be renewed in accordance with all applicable requirements ~~without limit for an additional 40 years~~ (NRC 2012a).

NRC (U.S. Nuclear Regulatory Commission). 2004a. *General Electric Company Morris Operation Technical Specifications for Safety.* License SNM–2500, Morris, Illinois. Accession No. ML043630567.

NRC (U.S. Nuclear Regulatory Commission). 2004b. *Environmental Impact Statement for the Proposed Idaho Spent Fuel Facility at the Idaho National Engineering and Environmental Laboratory in Butte County, Idaho.* NUREG–1773, Washington, D.C. Accession No. *ML040490135.*

NRC (U.S. Nuclear Regulatory Commission). 2011a. *Recommendations for Enhancing Reactor Safety in the 21^{st} Century: The Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident.* SECY–11–0093, Washington, D.C. Accession No. ML111861807.

NRC (U.S. Nuclear Regulatory Commission). 2011b. *Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance.* NUREG–1927, Washington, D.C. Accession No. ML111020115.

NRC (U.S. Nuclear Regulatory Commission). 2012a. *Information Digest, 2012–2~~1~~013.* NUREG–1350, Volume 24, Washington, D.C. Accession No. ML12241A166.

NRC (U.S. Nuclear Regulatory Commission). 2012b. *A Summary of Aging Effects and Their Management in Reactor Spent Fuel Pools, Refueling Cavities, Tori, and Safety-Related Concrete Structures.* NUREG/CR–7111, Washington, D.C. Accession No. ML12047A184.

NRC (U.S. Nuclear Regulatory Commission). 2013a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG–1437, Revision 1, Washington, D.C. Accession No. ML13107A023.

NRC (U.S. Nuclear Regulatory Commission). 2013b. *List of Power Reactor Units.* Washington, D.C. Available at http://www.nrc.gov/reactors/operating/list-power-reactor-units.html.

PFS (Private Fuel Storage LLC). 2012. Letter from R. Palmberg to NRC dated December 20, 2012, regarding "Termination of NRC License No. SNM–2513 for Private Fuel Storage LLC." La Crosse, Wisconsin. Accession No. ML12356A063.

S. Cohen & Associates, Inc. 1998. *Effectiveness of Fuel Rod Cladding as an Engineered Barrier in the Yucca Mountain Repository.* McLean, VA. Accession No. ML033500112.

The EPA generally designates a nonattainment area based upon air quality monitoring data or modeling studies that show the area violates, or contributes to violations of the national standard. The area also is referred to as an air quality control region, which the EPA designates for air quality management purposes and which typically consists of one or more counties. The EPA designates the area as attainment/ unclassifiable if the area meets the standard or expects to meet the standard despite a lack of monitoring data or modeling studies. After the air quality in a nonattainment area improves so that it no longer violates or contributes to violations of the standard and the State or Tribe adopts an EPA-approved plan to maintain the standard, EPA can re-designate the area as attainment. These areas are known as maintenance areas. In the License Renewal GEIS (NRC 2013a), the NRC identified operating plants located within or adjacent to counties with designated nonattainment areas. EPA periodically reviews ambient pollution concentrations throughout the country and reclassifies the attainment status of areas. Attainment designation status for areas is presented in 40 CFR Part 81.

Three EPA Air Quality Designations

- ***Nona~~A~~ttainment***: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.
- ***~~Nona~~Attainment***: Any area (other than an area identified in clause (i)) that meets the national primary or secondary ambient air quality standard for the pollutant.
- ***Unclassifiable***: Any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

Each State develops an implementation plan that includes a strategy for attaining or maintaining the NAAQS, modeling that demonstrates attainment or maintenance, and various rules, regulations, and programs that provide the necessary air pollutant emissions reductions. On tribal lands, Federally recognized Indian tribes can develop their own tribal implementation plan, similar to State implementation plans. If the State or Tribe fails to submit a required plan, EPA can promulgate a plan known as a Federal implementation plan. In accordance with Section 176(c) of the Clean Air Act and the General Conformity Regulations (40 CFR Part 51 and Part 93), the NRC must analyze its licensing actions to ensure that its Federal action conforms to any applicable implementation plan. Conformity determinations are required when a department, agency, or instrumentality of the Federal government engages in, supports in any way or provides financial assistance for, licenses or permits, or approves any activity to ensure that the activity conforms to an applicable implementation plan. Currently, the General Conformity Regulations (40 CFR Part 51 and Part 93) apply to all Federal actions that are taken in nonattainment or maintenance areas.

The NRC will evaluate and document the need for a conformity determination for the activities within its authority that require an NRC license. These evaluations are completed as part of environmental impacts include, but are not limited to air quality, land use, and water and ecological resources. Consequently, environmental justice, as well as other socioeconomic issues, are normally considered in site-specific environmental reviews (69 FR 52040).

In the present case, however, the NRC has determined that it can provide an assessment of the environmental justice impacts during continued storage compared to environmental justice impacts of storage during reactor operations. As previously stated in Chapters 2 and 3, this draft GEIS and the Waste Confidence rule are not licensing actions and do not authorize the continued storage of spent fuel. The environmental analysis in this draft GEIS fulfills a small part of the NRC's NEPA obligation with respect to the licensing or relicensing of a nuclear reactor or spent fuel storage facility. Further, the site-specific NEPA analysis that is required prior to an NRC licensing action will include a discussion of the impacts on minority and low-income populations, and will appropriately focus on the NRC decision directly related to specific licensing actions. As with all other resource areas, this site-specific analysis will allow the NRC to make an impact determination with respect to environmental justice for each NRC licensing action. A generic determination of the human health and environmental effects impacts during continued storage is possible because the NRC understands how the environmental impacts change when a nuclear power plant site transitions from reactor operations to continued storage. Based on this knowledge, the NRC can provide an assessment of the potential human health and environmental effects during continued storage. As discussed in the following sections, the NRC has determined that the human health and environmental effects from continued storage would be small compared to the impacts that are normally experienced during reactor operations.

4.3.1 Short-Term Storage

As previously explained in Section 4.2.1 (socioeconomics—short term), the socioeconomic effects of reactor operations have become well established because regional socioeconomic conditions will have adjusted to the presence of the nuclear power plant (NRC 2013a). After the cessation of reactor operations, a small number of workers (15–85) would continue to maintain and monitor spent fuel pools. These workers would also transfer spent fuel from spent fuel pools to at-reactor ISFSIs. Once all of the spent fuel is transferred from the spent fuel pools to dry cask storage, spent fuel pool storage operations worker positions would be eliminated. For at-reactor ISFSIs, a small number of workers (30–35) would be needed to maintain and monitor the at-reactor ISFSI. Consequently, ~~employment opportunities for~~socioeconomic impacts due to continued storage would ~~remain unaffected~~be unchanged in comparison to the period of reactor operations for minority and low-income populations.

Generally, the continued maintenance and radiological monitoring associated with spent fuel storage, either in spent fuel pools or at-reactor ISFSIs, during the short-term timeframe ensures that any human health and environmental effects would remain within regulatory limits for the general population. Based on a review of recent REMP reports, human health impacts would not be expected in special pathway receptor populations living near a nuclear power plant site as a result of subsistence consumption of water, local food, fish, and wildlife during the short-term timeframe. A modified REMP would remain in effect after the nuclear power plant ceases operations through the short-term timeframe. Monitoring would ensure that radiological doses would remain within regulatory limits and minority and low-income populations would experience no new human health and environmental effects during the short timeframe beyond what had already been experienced during reactor operations.

As previously discussed for the other resource areas in Chapter 4, the overall contributory human health and environmental effects from continued short-term spent fuel storage would be limited in scope and SMALL for all populations. ~~Upon detection, licensees would take corrective action to contain the leak and treat the affected groundwater.~~ Therefore, minority and low-income populations are not expected to experience disproportionately high and adverse human health and environmental effects from the continued short-term storage of spent fuel. In addition, as indicated in the NRC policy statement, the potential for environmental justice impacts would also be considered during the environmental reviews for specific licensing actions associated with each particular storage facility (69 FR 52040).

4.3.2 Long-Term Storage

In addition to monitoring and maintenance, long-term storage includes the construction and operation of a DTS and replacement of the at-reactor ISFSI and DTS. Construction and operation of a DTS would constitute a federal action under NEPA and site-specific analysis would include an analysis of the potential effects on minority and low-income populations. NRC environmental justice analyses are generally limited to evaluating the human health and environmental effects of the proposed licensing action and the potential for minority and low-income populations to be disproportionately affected. As stated in the NRC policy statement, environmental justice assessments would be performed as necessary in the underlying licensing action for each particular facility (69 FR 52040). DTS license reviews would not rely on the analysis in this draft GEIS, because the site-specific NEPA analysis would consider the site-specific impacts on minority and low-income populations.

Potential impacts on minority and low income populations from the construction, operation, and replacement of the DTS and at-reactor ISFSI would mostly consist of environmental and socioeconomic effects during construction (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short term and primarily limited to onsite activities. Minority and low income populations residing along site access roads could be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction and the relatively low numbers of workers (60–80 short-term construction workers), these effects are likely to be minimal and limited in duration. Increased demand for rental housing during construction could cause rental costs to rise temporarily, disproportionately affecting low-income populations living near the site who rely on inexpensive

4.8 Groundwater Quality and Use

This section describes the potential environmental impacts on groundwater water quality and consumptive use caused by continued storage of spent fuel in spent fuel pools and at-reactor ISFSIs.

4.8.1 Short-Term Storage

During short-term storage, most groundwater consumptive use and quality impacts that had been caused by reactor operations would cease. Groundwater dewatering may occur during short-term storage because groundwater may be pumped for potable water, sanitary uses, and maintenance of spent fuel pools. However, surface-water resources may be used for these activities.

The NRC determined in the License Renewal GEIS that consumptive use of groundwater during reactor operation would be SMALL because groundwater supplies are commonly not used or are used as a backup water source. During normal reactor operations, at most reactors, the withdrawal rate from production aquifers is kept below 378 L/min (100 gpm) to avoid groundwater-use conflicts (NRC 2013a). When reactor operations cease, the use of groundwater is greatly reduced, especially at sites where reactor operations use groundwater as a backup water source (e.g., H.B. Robinson Steam electric plant [NRC 2005b]). The potential use of groundwater is greatly reduced when reactor operation ceases, because cooling-water system demands are substantially lower after the facility is shut down and spent fuel is removed from the reactor vessel (NRC 2002b).

4.8.1.1 Spent Fuel Pools

Because consumptive water-use impacts on groundwater resources during short-term storage of spent fuel in spent fuel pools would be significantly less than during normal reactor operation, the resultant impacts on groundwater at offsite wells would be nondetectable or so minor that they would not destabilize groundwater resources. As a result, the NRC has made a generic conclusion that the consumptive water-use impacts on groundwater resources during short-term storage of spent fuel in spent fuel pools would be minor or minimal.

Continued short-term storage of spent fuel in spent fuel pools could result in radiological impacts on groundwater quality. As discussed in Appendix E, in the very unlikely event that a leak from a spent fuel pool goes undetected and the resulting groundwater plume reaches the offsite environment, it is possible that the leak could be of sufficient magnitude and duration to contaminate a groundwater source above a regulatory limit (i.e., a maximum contaminant level [MCL] for one or more radionuclides). ~~As a result, the NRC acknowledges that the radiological impacts on groundwater quality resulting from a spent fuel pool leak during short-term timeframe could potentially be SMALL to MODERATE.~~

But, ~~t~~The impacts of a spent fuel pool leak on offsite groundwater depend on many factors, including the volume and rate of water released from the spent fuel pool, the radionuclide content and concentration and water chemistry of the spent fuel pool water, the direction of groundwater flow, the distance to an offsite groundwater receptor, the velocity or transport rates of radionuclides through the subsurface, and radioactive decay rates. Further, a~~A~~s discussed in Appendix E, ~~however,~~ spent fuel pool design (e.g., stainless-steel liners and leakage-collection systems) and operational controls (e.g., monitoring and surveillance of spent fuel pool water levels) make it unlikely that a leak will remain undetected long enough to exceed any regulatory requirement (e.g., the NRC dose limit or EPA-mandated Maximum Contaminant Level) in the offsite environment. Although a small number of spent fuel pool leaks have caused radioactive liquid releases to the environment, based on the available data, none of these releases have affected the health of the public (NRC 2006a). In addition, onsite groundwater monitoring required to comply with 10 CFR 20.1501 provides added protection with respect to identifying a spent fuel pool leak and, if necessary, isolating and remediating contaminated groundwater onsite. A recent revision to the NRC's regulations that explicitly requires monitoring of subsurface areas will further ensure that leaks are detected. Besides these measures, the hydrologic characteristics associated with typical nuclear power plant settings (see Section E.2.1.3)—such as their location near large waterbodies (due to cooling requirements), shallow water table flow direction toward these waterbodies, flat hydraulic gradients in the shallow water tables, large distance to local groundwater users, and the likelihood that local groundwater usage is in deeper confined aquifers—will act to impede the offsite migration of future spent fuel pool leakage. Finally, current and future spent fuel pool sites are required to have routine environmental monitoring programs in place that should take samples at offsite groundwater sources (e.g., potable or irrigation) in areas where the hydraulic gradient or recharge properties are suitable for contamination (NRC 1991c,d). Further, any detection of onsite contamination would likely result in additional monitoring, including additional sampling of any nearby private wells, as part of an expanded environmental monitoring program. With these measures and characteristics in place, it is unlikely that offsite migration of spent fuel pool leaks will occur or go undetected. Based on these factors, the NRC concludes that the radiological impacts on groundwater quality resulting from a spent fuel pool leak during the short-term timeframe would be SMALL.

The NRC is aware that unintentional releases of nonradiological hazardous substances have infrequently occurred after reactors shut down. Except for a few substances (e.g., diesel fuel), these hazardous spills are often localized, quickly detected, and relatively easy to remediate (NRC 2002b). During the short-term storage timeframe, the licensee will decommission the site, which will result in the ultimate cleanup of the portions of the reactor facility that are not needed for continued short-term storage in a spent fuel pool. In addition, permit requirements (e.g., NPDES permit) and the requirements for compliance with the Resource Conservation and Recovery Act (RCRA) and the Safe Drinking Water Act would minimize potential risks for licensed facilities are also required to operate using an as low as reasonably achievable program to ensure radiation doses are maintained as low as is reasonably achievable.

Based on the reasons provided above, the NRC concludes that the impacts on public and occupational health during long-term storage would be SMALL.

4.17.3 Indefinite Storage

The public and occupational health impacts of continuing to store spent fuel without a repository would be similar to those described for long-term storage. The activities and associated human health impacts would remain the same. The main difference is that these activities would occur repeatedly.

The no repository scenario was analyzed in detail in the Yucca Mountain final EIS (FEIS) (DOE 2002) as the no-action alternative. The Yucca Mountain FEIS analyses looked at the short- and long-term impacts of continued storage of spent fuel and high-level radioactive waste at 72 commercial and 5 U.S. Department of Energy (DOE) sites for 10,000 years. The Yucca Mountain FEIS, in the analysis of the no-action alternative, assumes all commercial spent nuclear fuel would eventually be stored in dry configurations in ISFSIs at the existing locations. Detailed analyses were provided to demonstrate the expectation that maintenance, repairs, repackaging, operation, and construction at the storage facilities would be conducted in accordance with the requirements of the Occupational Safety and Health Administration and 10 CFR Parts 20 and 72, as discussed in the sections above. In addition, administrative controls and design features would minimize worker nonradioactive and radioactive exposures. The Yucca Mountain FEIS analyses and the discussion provided in Section 4.17.2 support the conclusion that public and occupational radiological health impacts could be maintained within the public and occupational dose limits of 10 CFR Parts 72 and 20. Therefore, the NRC concludes that the impacts on public and occupational health due to the indefinite storage of spent fuel in at-reactor ISFSIs would be SMALL.

4.18 Environmental Impacts of Postulated Accidents

This section describes the environmental impacts of postulated accidents involving the continued storage of spent fuel.

During continued storage, numerous features combine to reduce the risk associated with accidents involving spent fuel storage in spent fuel pools and ISFSIs. Safety features in the **design, construction, and operation of nuclear power plants and ISFSIs, which are the first line of defense, are intended to prevent the release of radioactive materials. Additional measures** are designed to mitigate the consequences of failures in the first line of defense. These include the NRC's reactor site criteria in 10 CFR Part 100, "Reactor Site Criteria," that require the site to

Comment [kas1]: Spacing

Unquantified costs and benefits of the alternatives (Chapter 7, Table 7-6) pertain to schedule uncertainties, the ability to litigate site-specific issues, and site-specific continued storage analyses. First, all alternatives other than the proposed action create schedule uncertainties that result from site-specific litigation of generic continued storage issues. While costs that result from these uncertainties may be large, they are difficult to quantify—they vary significantly because they are case- and fact-dependent. Second, perceptions vary among stakeholders regarding whether unquantified benefits are costs or benefits. The ability to litigate site-specific issues without a waiver petition pursuant to 10 CFR 2.335 carries both costs and benefits. In addition, there is a benefit from NRC's reviewing continued storage in site-specific licensing actions.

8.7 Recommendation

The NRC recommendation is to select the proposed action—revising 10 CFR 51.23—as the preferred alternative ~~of adopting a rule that assumes the short-term storage alternative is the most likely scenario for handling spent fuel after reactor operations~~. The NRC recommendation is based on (1) the NRC's independent impact assessments of continued storage summarized in the draft GEIS, which would result in substantially the same impact conclusions for any of the evaluated alternatives; (2) the NRC's consideration of public scoping comments in the development of the draft GEIS; and (3) the NRC's analysis of the cost-benefit balance of the proposed action and alternatives. In making its preliminary recommendation, the NRC determined that none of the alternatives assessed were obviously superior to the proposed action.

8.8 References

10 CFR Part 2. *Code of Federal Regulations*, Title 10, *Energy*, Part 2, "Agency Rules of Practice and Procedure." Washington, D.C.

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Washington, D.C.

59 FR 7629. February 16, 1994. "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." *Federal Register*, U.S. Environmental Protection Agency, Washington, D.C.

National Environmental Policy Act (NEPA) of 1969, as amended. USC 4321-4347.

Table 9-1. List of Preparers—NRC

Name	NRC Office	Experience	Function or Expertise
David Brown	NMSS	B.S., Physics, Muhlenberg College, 1990 M.S., Environmental Health Physics, Clemson University, 1993 Years of Relevant Experience: 20	Air quality, climate change, surface water, groundwater, transportation, public and occupational health, accidents and safeguards
Ralph Cady	RES	B.S., Geology, University of Connecticut, 1974 M.A., Geology, University of Connecticut, 1976 Ph.D., Hydrology, University of Arizona, 1989 Years of Relevant Experience: 24	Spent fuel pool leaks
Jennifer Davis	NMSS	B.A, Historic Preservation and Classical Civilization (Archaeology); Mary Washington College, 1996. 2 years of fieldwork; 11 years of experience in NEPA compliance, project management, historic and cultural resource impact analysis and regulatory compliance	Historic and cultural resources, socioeconomics, environmental justice, land use, noise
Donald Helton	RES	B.S., Nuclear Engineering, North Carolina State University, 1999 M.S., Nuclear Engineering, Texas A&M University, 2002 Years of Relevant Experience: 10	Spent fuel pool fires
Merri Horn	NMSS	B.S., Physics, Eastern Illinois University, 1980 M.S., Environmental Systems Engineering, Clemson University, 1987 Years of Relevant Experience: 29	Waste Confidence rule and decision
Andrew Kugler	NRO	B.S., Mechanical Engineering, Cooper Union, 1978 M.S., Technical Management, Johns Hopkins, 1998 Years of Relevant Experience: 34	Away-from-reactor impacts
Emily Larson	NRR	**B.A., Anthropology (major, emphasis archaeology) and History (minor); M.A., Archaeology**; 1 year of fieldwork; 1.5 years of experience in NEPA compliance; historic and cultural resource impact analysis and regulatory compliance	Historic and cultural resources
Sarah Lopas	NMSS	B.A., Molecular Biology, Lehigh University, 2001 MPA, Environmental Science and Policy, Columbia University, 2006 Years of Relevant Experience: 11	Executive summary, outreach
Timothy McCartin	NMSS	B.S., Physics, Xavier University, 1973 M.S., Physics, Wayne State University, 1976 Over 30 years' experience evaluating safety and regulatory compliance of geological disposal facilities	Public and occupational health, accidents and safeguards, Waste Confidence rule and decision

Comment [kas1]: To maintain consistency, there should be a university listed here.

Table 9-1. List of Preparers—NRC (cont'd)

Name	NRC Office	Experience	Function or Expertise
Paul Michalak	NMSS	B.S., Education, Temple University, 1978 M.S., Hydrology, New Mexico Institute of Mining and Technology, 1989 Years of Relevant Experience: 25	Spent fuel pool leaks
Michelle Moser	NRR	B.S., Environmental Sciences, Brown University, 2002 M.S., Biological Sciences, Stanford University, 2005 10 years of experience in ecological research and aquatic ecology, 7 years of experience in cumulative impact assessment and NEPA compliance	Aquatic ecology, cumulative impacts
Jessie Muir	NMSS	B.S., Biosystems Engineering, Clemson University, 2000 M.S., Environmental Engineering and Science, Clemson University, 2002 4 years in environmental compliance and solid waste management, 6 years in NEPA compliance and project management	Solid waste management
Tom Nicholson	RES	B.S., Geological Sciences, Pennsylvania State University, 1972 M.S., Geology, Stanford University, 1976 Professional Geologist, Indiana Certified Professional Hydrogeologist, AIH Years of Relevant Experience: 38	Senior technical advisor for radionuclide transport in the environment
Jeffrey Rikhoff	NRR	M.R.P., Regional Planning, M.S., Economic Development and Appropriate Technology; 25 years of experience in NEPA compliance, socioeconomics and environmental justice impact analysis, cultural resource impacts, and comprehensive land-use and development planning	Socioeconomics, environmental justice
Andrew Stuyvenberg	NMSS	B.S., Biochemistry/Molecular Biology and Political Science, Marquette University, 2002 M.E.M., Environmental Economics and Policy, Duke University, 2005 J.D., Georgetown University Law Center, In Progress Years of Relevant Experience: 8	NEPA alternatives, NEPA process, cost-benefit analysis
Michael Wentzel	NMSS	B.S., Microbiology, University of Texas, 1997 Years of Relevant Experience: 15	Ecological resources, aesthetics, spent fuel pool leaks and fires

NRO = Office of New Reactor.
NRR = Office of Nuclear Reactor Regulation.
NSIR = Office of Nuclear Security and Incident Response.
RES = Office of Nuclear Regulatory Research.

Comment [kas2]: To maintain consistency, there should be a university listed here.

requirement (e.g., the NRC dose limit or EPA-mandated Maximum Contaminant Level) in the offsite environment. In addition, onsite groundwater monitoring required to comply with 10 CFR 20.1501 provides added protection with respect to identifying a spent fuel pool leak and, if necessary, isolating and remediating contaminated groundwater onsite. Besides these measures, the hydrologic characteristics associated with typical nuclear power plant settings (see Section E.2.1.3)—such as their location near large waterbodies (due to cooling requirements), shallow water table flow direction toward these waterbodies, flat hydraulic gradients in the shallow water tables, large distance to local groundwater users, and the likelihood that local groundwater usage is in deeper confined aquifers—would act to impede the offsite migration of future spent fuel pool leakage. Finally, current and future spent fuel pool sites are required to have routine environmental monitoring programs in place that should take samples at offsite groundwater sources (e.g., potable or irrigation) in areas where the hydraulic gradient or recharge properties are suitable for contamination (NRC 1991a,b). Further, any detection of onsite contamination would likely result in additional monitoring, including additional sampling of any nearby private wells, as part of an expanded environmental monitoring program. With these measures and characteristics in place, it is improbable that offsite migration of spent fuel pool leaks will occur or go undetected.

In the very unlikely event that a leak goes undetected and the resulting groundwater plume reaches the offsite environment, it is possible that the leak could be of a sufficient enough magnitude and duration that contamination of a groundwater source above a regulatory limit (i.e., a Maximum Contaminant Level for one or more radionuclide) could occur. ~~As a result, the NRC acknowledges that the radiological impacts to groundwater quality resulting from a spent fuel pool leak during the short-term timeframe would be SMALL to MODERATE.~~ But, because of the relatively small size of the maximum assumed leak rate, the impacts to groundwater would be highly localized and would not be expected to impact regional groundwater resources. If contamination from a spent fuel pool leak were to exceed a Maximum Contaminant Level for one or more radionuclides at a groundwater source that currently supplies water to public water supplies or that has the potential to supply a public water supply (including private wells), the EPA could take emergency action under the Safe Drinking Water Act (EPA 1991). Emergency actions include, but are not limited to, providing alternative water supplies, public notification of potentially affected users, and remediation of the contamination (EPA 1991).

The impacts of a spent fuel pool leak on offsite groundwater depend on many factors, including the volume and rate of water released from the spent fuel pool, the radionuclide content and concentration and water chemistry of the spent fuel pool water, the direction of groundwater flow, the distance to an offsite groundwater receptor, the velocity or transport rates of radionuclides through the subsurface, and radioactive decay rates. However, as discussed previously, it is unlikely that a leak of sufficient quantity and duration could occur without detection, or that such a leak would not be impeded by the hydrologic characteristics typical at spent fuel pool locations. Therefore, based on the low probability of a leak with sufficient environment from nuclear power plants (NRC 2006b). The NRC Groundwater Task Force (NRC 2010c) reviewed data on releases to groundwater that occurred subsequent to the publication of the Lessons Learned Task Force report. A more recent study identified other nuclear power facilities that have experienced spent fuel pool leakage, including Crystal River Unit 3, Davis-Besse Unit 1, Diablo Canyon Units 1 and 2, Duane Arnold, Hope Creek, and Kewaunee (Copinger et al. 2012). For those facilities, with the exception of Kewaunee, the leakage was contained within the spent fuel pool leakage-collection system.

Table E-5 lists the maximum tritium contamination detected onsite and at offsite locations from the spent fuel pool leakage events. The table shows that contamination had not migrated offsite at the time the data were collected.

Table E-5. Dose from Inadvertent Releases of Radioactive Liquids from Nuclear Power Plant Spent Fuel Pools

Comment [kas1]: Put these results into context as far as regulatory limits and health risks. Also, clarify whether any of these events result in contamination of drinking water.

Site	Maximum Tritium Contamination (pCi/L) Detected Within the Site Boundary	Maximum Water Contamination (pCi/L) at Offsite Locations	Receptor and Pathways	Yearly Dose (mrem)
Hatch	(a)	None detected at offsite water sources; long-term monitoring in place	Negligible	Negligible
Indian Point	200,000 for tritium (100 for nickel-63 50 for strontium-90)	Approximation made in dose calculations	MEI(b)	0.0021
Salem	15,000,000(c)	None detected	NA	NA
Seabrook	750,000	Groundwater plume has not migrated offsite	Negligible	Negligible
Watts Bar	30,000	Groundwater plume has not migrated offsite	Negligible	Negligible

Source: NRC 2013

(a) Approximately 124,000 gallons of liquid containing 0.2 Ci of tritium and 0.373 Ci of mixed fission products were released to a swamp which is located in the owner-controlled area.

(b) MEI = Maximally exposed individual: A hypothetical individual who, because of proximity, activities, or living habits, could potentially receive the maximum possible dose of radiation or of a hazardous chemical from a given event or process.

(c) Maximum tritium level in sample of groundwater near the seismic gap; extensive groundwater remediation program in place.

NA = Not applicable because water contamination was not detected at offsite locations.

<u>NRC Groundwater Task Forces</u>

In 2006, the NRC chartered an in-house Lessons Learned Task Force to conduct a systematic lessons-learned review of unplanned, unmonitored releases of radioactive liquids into the environment from nuclear plants, which included inadvertent releases from spent fuel pools as that assessed various accident sequences including spent fuel pool failure due to wind-driven missiles, aircraft crashes, heavy-load drop, seal failure, inadvertent draining, loss-of-cooling, and seismic events (NRC 1989).

The NRC has also assessed the probability that these various events could occur. For example, in its earliest study, the NRC determined that the probability of the drainage of the spent fuel pool was much less than a loss-of-cooling event for the reactor because accidental drainage of the spent fuel pool requires multiple simultaneous failures (NRC 1975). Further, in 1989 the NRC quantified the probabilities of various accident initiating events and assessed the health and economic consequences of a spent fuel pool accident (NRC 1989).

Finally, as discussed in more detail below, the NRC confirmed that the overall risks associated with these types of accidents remain low because the spent fuel pool loss-of-cooling event probability is low (NRC 2001). As discussed in more detail below, since the NRC completed this study in 2001, the NRC has continued to implement regulations and orders that further reduce the likelihood of a spent fuel pool fire. These additional reductions in the likelihood of a spent fuel pool fire mean that the risks are lower now than those NRC reported in its 2001 study. Further, no new information has emerged that would cause the NRC to question the results of this study.

F.2.1 Consequences of a Spent Fuel Pool Fire

The release of radionuclides into the environment resulting from a spent fuel pool fire can lead to severe consequences, both in terms of direct human health impacts (e.g., early fatalities or latent cancer fatalities) and economic damages arising from the actions taken to avoid human exposures (e.g., evacuation and relocation costs, costs for cleanup of contaminated land, and the loss of economic value associated with land that cannot be used following a severe accident). These consequences do not consider the probability that an accident will occur. Possible initiating events and the probability that these events could occur are discussed in Section F.2.2. The following discussion and Table F-1~~Table F-1~~ examine the consequences of a spent fuel pool fire.

In NUREG–1738 and Table F-1, source terms for high ruthenium (Ru) and low Ru are expressed as ranges. **For example, the total collective dose for the high Ru source term ranges from 1.34 × 10^5 to 2.37 × 10^5 person-Sv.** The ranges in Table F-1~~Table F-1~~ are mean values of consequences of a spent fuel pool fire in which the NRC assumed a late evacuation of 95 percent of the population inside the 16-km (10-mi) emergency planning zone around Surry Power Station (Surry). The late evacuation assumption means that evacuation is started, but not completed before the release begins. The low value corresponds to a fire that occurs 10 years after shutdown, at which time radioactive decay has reduced the amount of radioactive material that could be released. The high value corresponds to a fire that occurs within 30 days after shutdown.

Comment [kas1]: Explain what a person-Sv is and put that into a health context.

Table F-1. Spent Fuel Pool Accident Probability and Consequences[a]

Comment [kas2]: In plain English, explain the frequencies.

		Individual Risk per Event					
	Accident Frequency (per year)	Early Fatality (1 mi)[b]	Latent Fatality (10 mi)[b]	Total person-Sv per Event	Collective Early Fatality per Event (10 mi)[b]	Latent Fatality[c] (0–500 mi)	Total Onsite and Offsite Economic (million $ per event)
NUREG–1738 (high Ru)	5.8×10^{-7}(d) to 2.4×10^{-6}(e)	4.68×10^{-3} to 4.43×10^{-2}	6.39×10^{-2} to 8.49×10^{-2}	1.34×10^{5} to 2.37×10^{5} (50 mi)[b]	<1 (0.360) to 191	-	-
NUREG–1738 (low Ru)	5.8×10^{-7}(d) to 2.4×10^{-6}(e)	1.63×10^{-3} to 1.27×10^{-2}	1.29×10^{-2} to 1.88×10^{-2}	4.72×10^{4} to 5.58×10^{4} (50 mi)[b]	<1 to 2	20,000–27,000	-
NUREG–1353	2.0×10^{-6}	-	-	2.6×10^{5} (50 mi)[f]	-		55,700[g,h]
NUREG/ BR–0184	-	-	-	2.6×10^{5} (50 mi)[i]	-		57,800[g,j]

(a) All values are approximate.
(b) Consequence values were obtained from NUREG–1738 (NRC 2001, Tables 2 and 3 of Appendix 4B). [Note: Similar values appear in NUREG–1738 (NRC 2001, Tables 3.7-1 and 3.7-2), but were incorrectly reporting values from Appendix 4B.]
(c) Consequence values were obtained from NUREG–1738 (NRC 2001, Appendix 4).and reflect a range of results from the seven cases evaluated.
(d) Electric Power Research Institute data from NUREG–1738 (NRC 2001).
(e) Lawrence Livermore National Laboratory data in NUREG–1738 (NRC 2001).
(f) Case 2 values were obtained from NUREG–1353 (NRC 1989, Table 4.8.3). Case 2 assumed the entire spent fuel pool inventory was released.
(g) Values adjusted to 2010 dollars using the Consumer Price Index Inflation Calculator.
(h) Values were obtained from NUREG–1353 (30,200 Million $ in 1988 dollars; excludes replacement power costs) (NRC 1989, Tables 5.1.1 and 5.1.2).
(i) Values were obtained from NUREG/BR–0184 (NRC 1997, Table C.101).
(j) Values were obtained from NUREG/BR–0184 (26,400 Million $ in 1983 dollars; excludes replacement power costs) (NRC 1997, Table C.95 and C.101).

As discussed below, the assumptions described above are conservative assumptions of the consequences of the spent fuel pool fire. These conservative assumptions further reduce the likelihood that the actual consequences would be as high as indicated in Table F-1~~Table F-1~~. For example, the low Ru results from the 2001 study more realistically represent the anticipated consequences of even a high-volatility Ru spent fuel pool fire sequence. The 95 percent evacuation estimate is less than the NRC's best estimate of actual evacuation of 99.5 percent, of the populace from the 16-km (10-mi) emergency planning zone, which was used by the NRC in its "2012 NRC State-of-the-Art Reactor Consequence Analyses Report for Surry" (NRC 1990, 2012). However, in NUREG–1738 the NRC used a value of 95 percent in sensitivity studies to address concerns that the fraction of the public that does not evacuate could be higher. "Late evacuation" is a reasonable assumption for decay times of less than about 2 years, for which the time-to-release could be less than 10 hours. However, the time-to-release (following the initiating event) will be