



[7590-01-P]

NUCLEAR REGULATORY COMMISSION

10 CFR Part 72

[Docket No. PRM-72-8; NRC-2018-0017]

Requirements for the Storage of Spent Nuclear Fuel

AGENCY: Nuclear Regulatory Commission.

ACTION: Petition for rulemaking; denial.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is denying a petition for rulemaking (PRM), submitted by Raymond Lutz and Citizens Oversight, Inc. (the petitioners), dated January 2, 2018. The petitioners requested that the NRC amend its regulations regarding spent nuclear fuel storage systems to embrace the Hardened Extended-life Local Monitored Surface Storage (HELMS) approach and identified multiple revisions to accommodate such an approach. The NRC is denying the petition because the petitioners do not present information that supports the requested changes to the regulations or that provides substantial increase in the overall protection of occupational or public health and safety. The NRC's current regulations and oversight activities continue to provide for the adequate protection of public health and safety and to promote the common defense and security.

DATES: The docket for PRM-72-8 is closed on **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: Please refer to Docket ID **NRC-2018-0017** when contacting the NRC about the availability of information for this action. You may obtain publicly-available information related to this action by any of the following methods:

- **Federal Rulemaking Web Site:** Go to <https://www.regulations.gov> and search for Docket ID **NRC-2018-0017**. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical

questions, contact the individuals listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **NRC’s Agencywide Documents Access and Management System**

(ADAMS): You may obtain publicly-available documents online in the ADAMS Public Documents collection at <https://www.nrc.gov/reading-rm/adams.html>. To begin the search, select “[Begin Web-based ADAMS Search.](#)” For problems with ADAMS, please contact the NRC’s Public Document Room (PDR) reference staff at 1-800-397-4209, at 301-415-4737, or by e-mail to pdr.resource@nrc.gov. For the convenience of the reader, instructions about obtaining materials referenced in this document are provided in the “Availability of Documents” section.

- **NRC’s PDR:** You may examine and purchase copies of public documents at the NRC’s PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

FOR FURTHER INFORMATION CONTACT: Timothy McCartin, telephone: 301-415-7099, e-mail: Timothy.McCartin@nrc.gov, or Gregory R. Trussell, telephone: 301-415-6244, e-mail: Gregory.Trussell@nrc.gov. Both are staff of the Office of Nuclear Material Safety and Safeguards, the U.S. Nuclear Regulatory Commission, Washington DC 20555-0001.

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I. The Petition

Section 2.802 of title 10 of the *Code of Federal Regulations* (10 CFR), “Petition for rulemaking—requirements for filing,” provides an opportunity for any interested

person to petition the Commission to issue, amend, or rescind any regulation in 10 CFR chapter I. On January 2, 2018, the NRC received a petition from Raymond Lutz and Citizens Oversight, Inc. The NRC docketed this petition on January 22, 2018, and assigned it Docket No. PRM-72-8. The NRC published a notice of docketing and request for public comment on March 22, 2018 (83 FR 12504). The petitioners request that the NRC amend 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," to embrace the HELMS approach, for the long-term storage of spent nuclear fuel.

The petitioners recommend a hardened storage system because they state that the current storage systems are not equipped to resist malicious attacks. The petitioners further state that the current storage casks will corrode and crack and are not designed for indefinite surface storage. However, the petitioners assert that spent nuclear fuel will continue to be stored on the surface for very long time periods, potentially indefinitely, due to the lack of a deep geologic repository for permanent disposal. The NRC regulations provide that storage casks can be initially licensed for up to 40 years with possible renewals of up to 40 years, with no restriction on the number of renewals. The petitioners assert this regulatory process creates an indefinite timeframe, which they contend requires a storage system designed for an extended life. For these reasons, the petitioners recommend that all spent fuel storage systems have a design life of 1,000 years, which includes a "passive life" of 300 years. The petitioners also assert that spent nuclear fuel needs to be moved to local consolidated interim storage sites away from water resources and dense populations. Additionally, the petitioners assert that the storage casks need a more robust monitoring system, including continuous monitoring during the initial 40 years.

The HELMS approach is discussed further in Section III, “Reasons for Denial,” of this document.

II. Public Comments on the Petition

The notice of docketing of the PRM invited interested persons to submit comments. The comment period closed on June 5, 2018, and the NRC received 70 comment submissions from members of the public, interested stakeholders, and industry groups. The discussion that follows consolidates and summarizes the relevant issues. The public comments are available in their entirety at www.regulations.gov under Docket ID NRC-2018-0017. A list of the public comments and their respective ADAMS Accession numbers is included in Section IV, “Availability of Documents,” of this document.

The NRC received 58 comment submissions in support of the petition. These commenters were opposed to indefinite storage, asserted that casks are too thin, and supported double-wall canisters. Additionally, many commenters supported the petitioners’ recommendation for a 1,000-year design life. Commenters stated that interim storage facilities can be maintained for longer time periods with periodic replacement of the casks and adequate resources and attention to maintaining the storage facilities. Some commenters stated that a HELMS approach would address imminent terrorist attacks as well as unpredictable events by moving the waste to a half-dozen interim storage sites away from coastal areas or waterways.

The NRC received four comment submissions from stakeholders and industry groups that did not support the petition. In general, the commenters asserted the petition is without merit, the petitioners’ suggestions are not supported by a technical basis, and costs were not considered. The commenters argued that existing regulations and oversight, including inspections, provide the necessary framework to ensure the safe storage of spent nuclear fuel. Additionally, the commenters stated that the

petitioners disregarded the NRC's experience with spent fuel storage. One commenter noted that, in NRC's 2014 final rule on the continued storage of spent nuclear fuel (79 FR 56251; September 19, 2014), the Commission emphasized that the national policy remains to dispose of spent fuel in a geologic repository and that the petitioners did not provide a basis for revisiting the Commission's policy decisions. The commenters also claimed that the petition included factual inaccuracies; however, the commenters did not provide specific information that the NRC could evaluate.

One commenter who opposed the petition noted that hardened onsite storage would further fortify the structures with mounds of concrete, steel, and gravel. This commenter believed that this would result in the permanent-storage of spent nuclear fuel at the facility.

The NRC received a comment of general concern to stop the "waste burial" at San Onofre Nuclear Generating Station. The commenter stated that money was being put before public safety but did not provide specific information for the agency to evaluate.

The NRC also received several comment submissions that were outside of the scope of this petition.

III. Reasons for Denial

A. General Discussion

The petitioners assert a mismatch now exists between the NRC regulations for the storage of spent nuclear fuel in dry casks in 10 CFR part 72 and the status for the disposal and storage of spent nuclear fuel today. The petitioners note that a geologic repository for permanent disposal of spent nuclear fuel does not exist. Additionally, the petitioners state that storage of spent nuclear fuel at nuclear plants for an indefinite

period is allowed under the NRC's regulations.¹ The petitioners request many revisions to the 10 CFR part 72 requirements and state these are needed to accommodate the indefinite surface storage of spent nuclear fuel.

Although the 10 CFR part 72 regulations were developed at a time when a geologic repository was expected to be operational in 1998, extensive work has been done since the initial development of the regulations to ensure that the continued storage of spent nuclear fuel is safe and secure. This work includes revisions to 10 CFR part 72 and the development of guidance documents. Additionally, the evaluation of operational data collected nationally and internationally demonstrates that the NRC's regulatory framework for the continued storage of spent nuclear fuel provides reasonable assurance of adequate protection of public health and safety. The Commission described the basis for the safety and security of continued storage most recently in the NRC's 2014 final rule on continued storage and accompanying NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel." In these two documents, the NRC discussed its current regulatory framework for the storage of spent nuclear fuel as a basis for the continued safe storage of spent nuclear fuel. The NRC explained that:

1. Decades of operating experience and ongoing NRC inspections demonstrate that the reactor and independent spent fuel storage installation (ISFSI) licensees continue to meet their obligation to safely store spent fuel in accordance with the requirements of 10 CFR parts 50, 52, and 72.

¹ The petitioners asserted that the NRC's 2014 final rule, "Continued Storage of Spent Nuclear Fuel," authorized indefinite storage. As part of the development of the final rule, the NRC prepared a generic environmental impact statement that analyzed the environmental impacts of continued storage and provides a regulatory basis for the rule. The final rule did not authorize the production or storage of spent fuel, nor did it amend or extend the term of any license.

2. The NRC continues to improve its understanding of long-term dry storage issues and is separately examining the regulatory framework and potential technical issues related to extended storage and subsequent transportation of spent fuel for multiple ISFSI license renewal periods extending beyond 120 years.
3. The NRC also is closely following Department of Energy and industry efforts to study the effects of storing high burn-up spent fuel in casks.
4. If the NRC were to be informed of or to identify a concern with the safe storage of spent fuel, the NRC would evaluate the issue and take whatever action or change in its regulatory program is necessary to continue providing adequate protection of public health and safety and promoting the common defense and security.

The NRC has determined that regulatory oversight will continue in a manner consistent with the NRC's regulatory actions and oversight in place today in order to provide for continued storage of spent fuel in a safe manner until the fuel can be safely disposed of in a repository.

Since the publication of the 2014 final rule, the NRC has continued to evaluate issues associated with the storage of spent nuclear fuel in dry casks and has not identified any necessary changes to the regulations based on the concerns raised by the petitioners. Furthermore, the NRC routinely evaluates the safe storage of spent nuclear fuel through operating experience and inspection findings. If the NRC identified an area needing additional oversight, the NRC would revise the regulatory requirements. After consideration of the proposals presented by the petitioners, the rationale provided in the NRC's 2014 final rule, and the evaluations discussed in this document, the NRC finds the regulatory changes requested by the petitioners are not needed to provide reasonable assurance that continued storage of spent nuclear fuel in dry cask storage systems is safe and secure.

B. The HELMS Approach

The petitioners describe a strategy for the storage of spent nuclear fuel and request changes to 10 CFR part 72 to implement a HELMS approach. Therefore, the NRC's evaluation of the petitioners' requests is structured according to this approach.

1. Hardened Storage

The petitioners assert that "hardened" storage is needed to address concerns associated with safety (e.g., unpredictable natural events such as earthquakes) and security (e.g., terrorist activity).

Safety (Natural Events)

The NRC's regulations in 10 CFR part 72 include both siting requirements (subpart E, Siting Evaluation Requirements) and design criteria (subpart F, General Design Criteria) that require an applicant to evaluate the impact of natural events on the safety of dry cask storage systems and facilities. In particular, 10 CFR 72.122 requires that natural phenomena (e.g., earthquakes, tornados, and floods) that exist or that could occur at a proposed site must be identified and assessed according to the potential to affect the safe operation of a dry cask storage system and facility. The applicant or licensee must assess the capabilities of the structures, systems, and components important to safety to withstand the effects of the severe natural phenomena and continue to perform their safety functions. For these reasons, the NRC finds its regulations in 10 CFR part 72 provide an adequate framework to evaluate the capabilities of dry cask storage systems and facilities to withstand a wide range of extreme natural events.

The petitioners also request that the NRC revise its regulations to indicate that storage is preferable "east of 104° west longitude so as to avoid the region of high-

seismic activity west of this line.” The NRC finds that this specific revision is not necessary. The assessment of natural hazards required by 10 CFR part 72 provides data on natural events, such as earthquakes, that are used in the siting of dry cask storage facilities. The NRC regulations require assessment of the hazards, which takes into consideration the specific facility design and the magnitude of the seismic risk. This assessment incorporates an understanding of how structures, systems, and components relied on for safety are affected by the hazards for a specific site and design.

The NRC is aware of the variability in the seismic risk across the United States and incorporates these data in its regulations; 10 CFR 72.102 specifically identifies 104° west longitude in the requirements for geological and seismological characteristics. Additionally, the NRC evaluated and revised the investigation of seismic hazards for a spent nuclear storage facility in the 2003 final rule, Geological and Seismological Characteristics for Siting and Design of Dry Cask Independent Spent Fuel Storage Installations and Monitored Retrievable Storage Installations (68 FR 54143; September 16, 2003). The 2003 final rule revised 10 CFR part 72 to incorporate changes to: 1) utilize the experience gained in applying the existing regulations and from recent seismic research; and 2) provide regulatory flexibility to incorporate state-of-the-art improvements in the geosciences and earthquake engineering into licensing actions. These revisions improved the evaluation of seismic hazards but did not categorically exclude regions solely on geographic location. The NRC’s regulations recognize that geographic areas west of approximately 104° west longitude are known to have potential seismic activity and provide specific requirements for the evaluation of seismicity in these areas. The NRC, however, determined that the exclusion of storage of spent nuclear fuel west of approximately 104° west longitude is unnecessary to ensure that seismic events are appropriately investigated in the safety evaluation of storage of spent nuclear fuel.

Security (Terrorist Attacks)

The petitioners recommend that hardened storage such as “an outer building of sufficient strength to resist terrorist attacks” also should be considered to provide a measure of defense-in-depth.

The NRC provides security requirements for physical protection for spent fuel storage and transportation in 10 CFR part 72, 10 CFR part 73, “Physical Protection of Plants and Materials,” and orders that provide additional security measures. For example, the NRC’s regulations at 10 CFR 73.51 include security measures to minimize the likelihood of a successful terrorist attack, including: 1) spent nuclear fuel must be stored only within a protected area so that access requires passage through or penetration of two physical barriers, and one of the barriers is required to offer substantial penetration resistance; 2) the perimeter of the protected area must be subject to continual surveillance and be protected by an active intrusion alarm system; and 3) the primary alarm station must be located within a protected area and have bullet-resisting walls, doors, ceiling, and floor.

Additionally, the NRC initiated several actions designed to provide high assurance that a terrorist attack would not lead to a significant radiological event at an ISFSI. These include: 1) continual evaluation of the threat environment by the NRC, in coordination with the intelligence and law enforcement communities, which provides, in part, the basis for the protective measures currently required; 2) protective measures in place to reduce the likelihood of an attack that could lead to a significant release of radiation; 3) the robust design of storage casks, which provides substantial resistance to penetration; and 4) NRC security assessments of the potential consequences of terrorist attacks against ISFSIs. Over the past 20 years, no known or suspected attempts have taken place to: 1) sabotage or to steal radioactive material from storage casks at

ISFSIs; or 2) directly attack an ISFSI. Nevertheless, the NRC is continually evaluating the threat environment to determine whether any specific threat to ISFSIs exists.

The NRC conducted security assessments for ISFSIs using several storage cask designs that are representative of current NRC certified designs. The results of these security assessments contain sensitive unclassified information and therefore are not publicly available. Plausible threat scenarios considered in the generic security assessments for ISFSIs included a large aircraft impact similar in magnitude to the attacks of September 11, 2001, and ground assaults using expanded adversary characteristics consistent with the design basis threat for radiological sabotage for nuclear power plants. Based on these assessments, the NRC concluded there is no need for further security measures at ISFSIs beyond those currently required by regulation and imposed by orders issued after September 11, 2001. The post-9/11 orders are not publicly available because they contain safeguards information. Furthermore, the NRC is not aware of any threat analyses that support requirements for additional hardening of spent fuel casks.

2. Extended Life

To plan for indefinite storage, the petitioners request that the regulations be revised to require that dry cask storage systems be designed for a “design life” of 1,000 years, which includes a “passive life” of 300 years with a goal that during this period the storage system “will remain safe, contained, and shielded” without maintenance or other intervention. The petitioners describe a dual-wall container as one approach for extended dry cask storage.

The petitioners recommend that several sections in 10 CFR part 72 be changed to implement the 1,000-year design life. The petitioners suggest that a dual-wall container be required based, in part, on the petitioners’ position that the single-wall

canisters currently used in many storage system designs will inevitably be compromised due to cracking. However, the petitioners emphasize that the HELMS proposal does not rely on the adoption of this specific proposal, if the extended-life criterion is satisfied (Petition Attachment page 6).

Under the current regulations, dry cask storage systems are designed as passive systems, which rely on natural air circulation for cooling, and are inherently robust, massive, and highly resistant to damage. The NRC regulations at 10 CFR 72.128 and 72.236 specify requirements for ensuring dry cask storage facilities and systems are safe and will remain safe under normal, off-normal, and accident conditions.

The license terms for spent fuel storage systems must not exceed 40 years, as specified at 10 CFR 72.42 for a storage installation and at 10 CFR 72.238 for an initial certificate for spent fuel storage casks. However, a license or certificate may be renewed for a period not to exceed 40 years and multiple renewals may be requested. The NRC has determined that a 40-year licensing period, in conjunction with the slow degradation rates of spent fuel storage systems, provides reasonable assurance that significant storage, handling, and transportation issues do not arise during a single license period. Additionally, if information collected during a license period identifies emerging issues and concerns, there would be sufficient time to develop regulatory solutions and incorporate them into future licensing periods. The NRC requires that the collection of appropriate information and the implementation of aging management activities are part of license renewals. These include: 1) time-limited aging analyses that demonstrate that the structures, systems, and components important to safety continue to perform their intended functions; and 2) aging management programs for specific issues known to be associated with aging, which could adversely affect structures, systems, and components important to safety.

The NRC determined its regulatory framework provides reasonable assurance for the continued safe and secure storage of spent fuel. Since the publication of NRC's 2014 final rule on the continued storage of spent nuclear fuel (79 FR 56251; September 19, 2014) the NRC has issued guidance that defines acceptable approaches to manage aging during extended storage through inspections, monitoring activities, and preventive actions. Two of the NRC's guidance documents addressing aging management are: 1) NUREG-1927, Revision 1, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel"; and 2) NUREG-2214, "Managing Aging Processes in Storage (MAPS) Report." The Standard Review Plan, NUREG-1927, Revision 1, provides guidance for the staff's review of general information, scoping evaluation information, and aging management information in a renewal application. Specifically, the Standard Review Plan addresses the review of time-limited aging analyses and aging management programs to address issues associated with aging, including aging management programs for welded stainless steel canisters, reinforced concrete structures, and high burnup fuel. The MAPS report, NUREG-2214, provides a generic evaluation of aging mechanisms, which have the potential to undermine the ability of dry cask storage systems' structures, systems, and components to fulfill their important-to-safety functions. The MAPS report also updates the NRC's aging management program guidance and discusses additional aging management programs that were not described in NUREG-1927. For example, the MAPS report discusses a program for managing the aging of bolted cask storage systems, which is an alternative to welded canister-based designs.

The NRC also developed a temporary instruction, NRC Temporary Instruction 2690/011, "Review of Aging Management Programs at Independent Spent Fuel Storage Installations." The temporary instruction serves as an information-gathering activity and

the resulting data will be used to develop a new NRC inspection procedure to evaluate licensees' performance of these aging management activities.

The nuclear industry has recently contributed operational information, data, and proposals to address extended storage. This includes a system to collect and disseminate operating experience, for use by aging management programs at storage sites. The industry has also published guidance on developing aging management activities in license renewal applications. This guidance is entitled "Format, Content and Implementation Guidance for Dry Cask Storage Operations-Based Aging Management" (NEI 14-03) and is being reviewed by the NRC for endorsement. The NEI 14-03 provides a broad framework for integrating feedback from dry cask storage operating experience, research, monitoring and inspections into the management of aging-related degradation for structures, systems, and components at ISFSIs. Additionally, the Institute of Nuclear Power Operations (INPO) implemented the Independent Spent Fuel Storage Installation Aging Management INPO Database that collects, aggregates, and shares aging-related operating information to inform the aging management programs of ISFSI licensees and certificate of compliance holders.

In addition to the activities mentioned above that generically address extended storage, the NRC has undertaken research and guidance development on more focused aging issues. Two focus areas are high-burnup fuel and stress corrosion cracking of spent fuel storage canisters.

The NRC recognizes that the cladding for high-burnup spent nuclear fuel may be subject to aging mechanisms (e.g., hydride reorientation and creep) due to its service history (e.g., time, temperature, pressure) that could affect performance during handling, storage, and transportation of spent fuel. Since the publication of the NRC's 2014 final rule on continued storage, the NRC continues to research the effects of extended storage of high-burnup spent nuclear fuel, as part of the NRC's effort to evaluate and

update its regulations. In 2018, the NRC published for comment NUREG-2224, “Dry Storage and Transportation of High Burnup Spent Nuclear Fuel.” The NUREG-2224 report presents an engineering assessment of a wide range of recent studies and activities evaluating the mechanical performance of high-burnup spent nuclear fuel cladding. The studies evaluated in NUREG-2224 examined specific aspects of storage and transportation of high-burnup spent nuclear fuel, including:

- A study on fatigue strength provides data to allow for more accurate assessments of the structural behavior of high-burnup spent nuclear fuel under normal conditions of transportation and hypothetical accident conditions, as well as dry storage system drop and tip-over events (NUREG/CR-7198, Revision 1);
- A study on how the characteristics of high-burnup spent nuclear fuel could affect the mechanisms by which spent nuclear fuel can breach the cladding and the amount of spent nuclear fuel that can be released from the failed fuel rods (NUREG/CR-7203); and
- Investigations of the fatigue and bending strength performance of high-burnup spent nuclear fuel cladding in as-irradiated and hydride-reoriented conditions (Wang et al).

Stress corrosion cracking of spent fuel storage canisters is another aspect of extended storage that has received significant NRC and stakeholder attention. The nuclear community has undertaken research and guidance development to understand this aging mechanism and to develop inspection approaches, including the creation of new rules for canister inspections in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. The nuclear industry, Federal government, the Department of Energy national laboratories, and suppliers of spent fuel dry storage systems participate in the Extended Storage Collaboration Program (ESCP), which

investigates aging effects and mitigation options for the extended storage and transportation of spent nuclear fuel. In 2015, the ESCP published, “Susceptibility Assessment Criteria for Chloride-Induced Stress Corrosion Cracking of Welded Stainless Steel Canisters for Dry Cask Storage Systems.” This document summarizes the major factors that affect the susceptibility of stainless steel dry storage canisters to atmospheric chloride-induced stress corrosion cracking and identifies which dry cask storage systems will most likely need inspections and enhanced monitoring programs to detect the potential for initiation and propagation of chloride-induced stress corrosion cracking. In 2017, the ESCP also published, “Aging Management Guidance to Address Potential Chloride-Induced Stress Corrosion Cracking of Welded Stainless Steel Canisters.” This document provides guidance and recommendations for the development of an aging management program to address the potential for chloride-induced stress corrosion cracking of austenitic stainless steel canisters, with an emphasis on evaluating and incorporating user-generated information and operational experience, as they become available.

Significant work continues both nationally and internationally to enhance the understanding of the degradation of dry cask storage systems—including stress corrosion cracking of spent fuel storage containers—as well as the inspection and collection of operating experience. These efforts are consistent with the NRC’s regulatory approach to enhance understanding of potential degradation mechanisms associated with dry cask storage systems. This enhanced understanding assists the NRC with identifying potential concerns with the safe storage of the spent fuel, with evaluating any such issues identified, and taking necessary actions, up to and including issuing orders or revising its regulations.

Although the petitioners request a long-lived waste package design with the goal of no maintenance or other interventions for the initial 300 years, the petitioners request that the NRC retain its current license term of up to 40 years for a certificate of compliance or license in 10 CFR part 72. The petitioners express the opinion that dry cask storage should be enhanced, but do not provide information to support the claim that the NRC's regulatory approach for dry cask storage is not safe and secure.

The NRC's current practice of renewing a certificate of compliance or a license for no more than 40 years allows for new technical and scientific information and operational data to be considered by the NRC when it decides whether to approve the renewal of a license or certificate of compliance. The NRC's licensing requirements in 10 CFR part 72 provide for a robust storage system design. However, the 40-year term does not mean a dry storage cask is no longer safe at the end of the licensing period. The NRC has determined that to renew a spent fuel storage cask design, the certificate holder or licensee must assess the need for maintenance and/or monitoring in the future. In NUREG-2157, the NRC evaluated environmental impacts by assuming "the replacement of dry casks after 100 years of service life; however, actual replacement times will depend on actual degradation observed during ongoing regulatory oversight for maintaining safety during continued storage. Scientific studies and operational experience to date do not preclude a dry cask service life longer than 100 years" (NUREG-2157; page B-18). The NRC continues to evaluate aging management programs and to monitor dry cask storage in order to update its service-life assumptions and to identify and address circumstances that could require repackaging of spent fuel earlier than anticipated.

If the repackaging of spent nuclear fuel becomes necessary, the regulations in 10 CFR 72.236(h) require that spent fuel storage systems be compatible with wet or dry spent fuel loading and unloading facilities. If a storage canister needs to be opened, the

licensee must keep radioactive material confined, maintain the fuel in an arrangement that does not cause a nuclear chain reaction, and shield the workers and the public from radiation. The industry has decades of operating experience with wet transfer of new fuel and spent fuel, which involves spent fuel handling equipment and procedures that are similar to those used in a dry transfer system. The NRC concluded the safe transfer of spent fuel will occur regardless of whether a site maintains a spent fuel pool (see Section 4.17.2 of NUREG-2157). Transfer operations at existing facilities routinely maintain public and occupational doses that are well within existing limits.

The NRC also notes the following design and operational characteristics of spent fuel storage systems continue to support safe storage of spent fuel:

- Dry cask storage systems are designed as passive systems that rely on natural air circulation for cooling and they are inherently robust, massive, and highly resistant to damage.
- Dry cask storage facilities and systems are designed to remain safe under normal, off-normal, and accident conditions.
- The degradation rates of spent fuel storage systems are sufficiently slow that significant storage, handling, and transportation issues are not expected to develop during a single 40-year license period.
- If information collected during a license period indicates any emerging issues and concerns, there would be sufficient time to develop technical and regulatory solutions and incorporate them into future licensing periods.

In summary, the NRC's regulatory approach uses the operational experience and scientific information collected and assessed during licensed operation to ensure the safe storage of spent nuclear fuel. The petitioners' proposal to specify a 1000-year lifetime for a storage system is unnecessary, arbitrary, and offers no commensurate

benefit to public health and safety when compared with the NRC's current approach. The NRC's current regulatory framework requires a re-evaluation be conducted at least every 40 years to determine the continued safety of a dry cask storage system and to assess the need for maintenance and/or monitoring in the future. The technical arguments provided by the petitioners do not raise concerns that are not addressed by the NRC in both regulations and NUREG-2157. The NRC finds the recommended 1,000-year design life for a storage canister is not necessary to maintain the continued safe storage of spent nuclear fuel, consistent with the NRC regulations.

The NRC concludes that its current regulations at 10 CFR part 72 provide adequate protection of the public health and safety without the need for an extended design life as proposed by the petitioners.

3. Local Siting

The petitioners assert that spent fuel should be consolidated at a limited number of local sites, which according to the petitioners means locating a consolidated storage site "near the source of the waste." The petitioners request the NRC's regulations be revised to restrict the siting of consolidated storage installations to: 1) at least 5 miles from any ocean, bay, river, lake, or other important water resource; 2) at least 300 feet above sea level if it is within 30 miles of any ocean; 3) at least 15 miles away from the boundary of any city, town, or other population and at least 5 miles from residential properties; 4) at least 5 miles from any major road, railroad, waterway, or industrial area; and 5) preferably east of 104° west longitude to avoid a region of high seismic activity.

The NRC's regulations in 10 CFR part 72 require that dry cask storage systems be compatible with the local geographical and environmental characteristics where the storage facility is located. In particular, the structures, systems, and components important to safety must be designed to: 1) be compatible with site characteristics and

environmental conditions associated with normal operations, maintenance, and testing; 2) withstand the effects of natural phenomena such as earthquakes, tornadoes, and floods; and 3) consider the most severe natural phenomena reported for the site and surrounding area, with appropriate margins to take into account the limitations of the data and the period of time in which the data have accumulated. Additionally, an applicant must demonstrate that individual dose limits will be met for normal operations (10 CFR 72.104) and accident conditions (10 CFR 72.106). These public dose limits take into consideration local characteristics, such as the location of nearby residents and transportation routes that traverse the controlled area of the facility.

The NRC concludes its regulatory requirements for the safe storage of dry spent fuel at a specific location provide reasonable assurance of adequate protection of public health and safety. A license application for spent fuel storage evaluates the relevant hazards, conditions, and characteristics for a specific site in a safety evaluation report. The NRC finds the specific siting criteria suggested by the petitioners are unnecessary.

Chloride-induced stress corrosion cracking provides an example of how site-specific concerns are evaluated by the NRC. The petitioners cite this cracking phenomenon as being an unavoidable degradation of stainless steel canisters exposed to outside air. The petitioners request dual-wall containers, or another approach, be adopted to prevent a radiation release to the public and environment during extended storage. Areas near salt water bodies with chloride-containing salts at elevated levels may have increased potential for chloride-induced stress corrosion cracking of canisters. The NRC conducted testing to determine the conditions under which welded stainless steel canisters may be susceptible to stress corrosion cracking, including that caused by chlorides. The test results were published in two publicly-available reports:

1) NUREG/CR-7030, "Atmospheric Stress Corrosion Cracking Susceptibility of Welded and Unwelded 304, 304L, and 316L Austenitic Stainless Steels Commonly Used for Dry

Cask Storage Containers Exposed to Marine Environments” (October 2010); and
2) NUREG/CR-7170, “Assessment of Stress Corrosion Cracking Susceptibility for
Austenitic Stainless Steels Exposed to Atmospheric Chloride and Non-Chloride Salts”
(February 2014).

The NUREG/CR-7030 report documents the NRC’s evaluation of the stress corrosion cracking susceptibility of welded and unwelded austenitic stainless steels that are commonly used in dry storage systems in humid, chloride-rich environments. The test results reported in NUREG/CR-7030 indicate that chloride-induced stress corrosion cracking is highly dependent on the concentration of deposited sea salt, residual stress, cask temperature, and the relative humidity of the surrounding environment. The report recommends methods for determining salt deposition rates on the stainless steel canisters currently used in dry storage systems. The NRC assessed stress corrosion cracking susceptibility for austenitic stainless steels exposed to atmospheric chloride and non-chloride salts to determine the conditions under which dry storage canisters may be susceptible to stress corrosion cracking. These findings were presented in NUREG/CR-7170. Additional testing recommended in NUREG/CR-7170 is currently being undertaken at national laboratories and universities under the ESCP. The NRC will use the results of these additional studies to evaluate the adequacy of siting requirements. However, to date, the NRC has not identified information indicating the current siting requirements are inadequate.

The NRC concludes that its regulatory requirements for the safe storage of dry spent fuel at a specific location provide reasonable assurance of adequate protection of public health and safety. A licensee applying for approval of a spent fuel storage facility must evaluate the relevant hazards, conditions, and characteristics for a specific site in a safety analysis report. A licensee must demonstrate that the facility will meet the safety limits for the release of radioactive materials in effluents and dose limits accounting for

site characteristics, such as seismic hazards, the local population, tsunamis, and floods. Therefore, the NRC concludes it is not necessary to incorporate the petitioners' proposed additional siting requirements into NRC's regulations.

4. Monitoring

The petitioners request that continuous monitoring be required during the initial licensing period of up to 40 years, to determine when corrective action would be needed. The petitioners suggest that periodic monitoring would be required after this initial period.

The NRC's regulations provide robust inspection and monitoring procedures for identifying conditions that could undermine safety. Additionally, the NRC's regulatory guidance assists licensees in meeting the requirements. The regulations at 10 CFR 72.44(c)(1)-(3) require that a licensee provide the surveillance requirements for inspecting and monitoring stored waste and for maintaining the integrity of required systems and components of an ISFSI in its technical specifications. The regulations at 10 CFR 72.122(h)(4) require that licensees be capable of monitoring spent fuel to identify concerns and take corrective actions as necessary to maintain safe storage conditions.

The NRC is evaluating licensees' aging management programs against NRC Temporary Instruction 2690/011, "Review of Aging Management Programs at Independent Spent Fuel Storage Installations," as part of its oversight of renewed licenses and certificates of compliance. The NRC uses the inspection process to determine whether licensees have adequate processes or procedures planned or in place to implement approved aging management programs consistent with the requirements of 10 CFR part 72, and as provided in renewed ISFSI licenses and renewed certificates of compliance for casks. The temporary instruction includes a

comprehensive evaluation of aging management programs, including the licensees' inspection and monitoring methods and techniques, and the frequency, sample size, data collection, and timing of licensee inspections.

Furthermore, NUREG-2157 summarizes technical information supporting low degradation rates of spent fuel in dry cask storage systems and concludes that dry cask storage systems will provide adequate protection for periods well beyond a 40-year license period. The NRC stated that scientific "studies and operational experience to date do not preclude a dry cask service life longer than 100 years" (see NUREG-2157, page B-18). Additionally, dry cask storage systems rely on passive structures, systems, and components to maintain safety and have no active or moving parts during storage. The 40-year license period is sufficiently short and the degradation of storage system materials is sufficiently slow that significant storage, handling, and transportation issues are not expected to arise during a single license period, and if information collected during a license period identifies emerging issues and concerns, there would be sufficient time to develop regulatory solutions and incorporate them into future licensing periods (NUREG-2157, Appendix B). Therefore, the NRC does not require continuous monitoring.

The NRC's regulations in 10 CFR part 72 provide the licensee flexibility in designing the monitoring program appropriate to its facility; however, the NRC inspects the monitoring and aging management programs to verify compliance with the regulations. Specifically, the NRC verifies through inspection that the functions of the structures, systems, and components important to safety are maintained throughout the period of extended operation. The NRC is not aware of technical information supporting the need for continuous monitoring of ISFSI systems, and the petitioners did not provide any such support.

5. Surface Storage

The petitioners assert that the NRC and the public should embrace surface storage of spent nuclear fuel and should plan to store it safely, passively, and indefinitely on the surface because that is how waste is currently stored. This assertion does not involve a proposed change to the existing regulations.

C. Summary

The NRC maintains that a strong regulatory framework including both regulatory oversight and licensee compliance is important to the continued safe storage of spent fuel. The NRC's regulatory framework for spent fuel storage is supported by well-developed regulatory guidance; voluntary domestic and international consensus standards; research and analytical studies; and processes for implementing licensing reviews, inspection programs, and enforcement oversight (NUREG-2157, page B-33). The technical information and operational experience collected and evaluated both internationally and nationally on dry cask storage continues to support the adequacy of 10 CFR part 72 to provide reasonable assurance of adequate protection of public health and safety and to promote the common defense and security.

IV. Availability of Documents

The documents identified in the following table are available to interested persons through one or more of the following methods, as indicated.

DOCUMENT	DATE	ADAMS ACCESSION NO. OR FEDERAL REGISTER CITATION OR WEB SITE
Petition for Rulemaking (PRM-72-8)	January 2, 2018	ML18022B207
Requirements for the Indefinite Storage of Spent Nuclear Fuel, Petition for Rulemaking; Notice of Docketing and Request for Comment	March 22, 2018	83 FR 12504

Public Commenters List	May 9, 2019	ML19137A265
Continued Storage of Spent Nuclear Fuel; Final Rule	September 19, 2014	79 FR 56238
NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel"	September 2014	ML14196A105 (Vol. 1) ML14196A107 (Vol. 2) Also ML14198A440 (Package)
Geological and Seismological Characteristics for Siting and Design of Dry Cask Independent Spent Fuel Storage Installations and Monitored Retrievable Storage Installations; Final Rule	September 16, 2003	68 FR 54143
NUREG-1927, Revision 1, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel"	June 2016	ML16179A148
NUREG-2214, "Managing Aging Processes in Storage (MAPS) Report"	October 2017	ML19214A111
NRC Temporary Instruction 2690/011, "Review of Aging Management Programs at Independent Spent Fuel Storage Installations"	January 2018	ML17167A268
Nuclear Energy Institute NEI 14-03, Revision 2, "Format, Content and Implementation Guidance for Dry Cask Storage Operations-Based Aging Management"	December 2016	ML16356A210
NUREG-2224, "Dry Storage and Transportation of High Burnup Spent Nuclear Fuel" (Draft for Comment)	July 2018	ML18214A132
NUREG/CR-7198, Revision 1, "Mechanical Fatigue Testing of High-Burnup Fuel for Transportation Applications"	October 2017	ML17292B057
NUREG/CR-7203, "A Quantitative Impact Assessment of Hypothetical Spent Fuel Reconfiguration in Spent Fuel Storage Casks and Transportation Packages"	September 2015	ML15266A413

Oak Ridge National Laboratory; Wang, J.-A., H. Wang, H. Jiang, Y. Yan, B. B. Bevard, J. M. Scaglione; “FY 2016 Status Report: Documentation of All CIRFT Data including Hydride Reorientation Tests”	September 2016	ORNL/SR-2016/424 Available at: https://www.energy.gov/sites/prod/files/2017/02/f34/10Documentation%20DataCollectCIRFT%20TestsRodEndsHydrideReorTest.pdf
Electric Power Research Institute, “Susceptibility Assessment Criteria for Chloride-Induced Stress Corrosion Cracking (CISCC) of Welded Stainless Steel Canisters for Dry Cask Storage Systems”	September 2015	EPRI-3002005371 The EPRI report is publicly available at the www.epri.com Web site.
Electric Power Research Institute, “Aging Management Guidance to Address Potential Chloride-Induced Stress Corrosion Cracking of Welded Stainless Steel Canisters”	March 2017	EPRI-3002008193 The EPRI report is publicly available at the www.epri.com Web site.
NUREG/CR-7030, “Atmospheric Stress Corrosion Cracking Susceptibility of Welded and Unwelded 304, 304L, and 316L Austenitic Stainless Steels Commonly Used for Dry Cask Storage Containers Exposed to Marine Environments”	October 2010	ML103120081
NUREG/CR-7170, “Assessment of Stress Corrosion Cracking Susceptibility for Austenitic Stainless Steels Exposed to Atmospheric Chloride and Non-Chloride Salts”	February 2014	ML14051A417
NUREG-1949, “Safety Evaluation Report Related to Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada,” Volume 2: Repository Safety Before Permanent Closure	January 2015	ML15022A146

V. Conclusion

The NRC determined that the petitioners do not present information that supports the requested changes to the regulations or provides substantial increase in the overall protection of occupational or public health and safety. The NRC’s current regulations

continue to provide for the adequate protection of public health and safety and to promote the common defense and security.

For the reasons cited in Section III of this document, the NRC is denying PRM-72-8.

Dated at Rockville, Maryland, this 16th day of January, 2020.

For the Nuclear Regulatory Commission.

Annette L. Vietti-Cook,
Secretary of the Commission.

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