RODNEY MCCULLUM
Director, Used Fuel Programs

1201 F Street, NW, Suite 1100
Washington, DC 20004
P: 202.739.8082
rxm@nei.org
nei.org

NEI
NUCLEAR ENERGY INSTITUTE

1/17/2013
78 FR 3853
(5)

RECEIVED
2013 MAR 18 PM 3:02
RULES AND DIRECTIVES BRANCH USNRC

March 18, 2013

Ms. Cindy K. Bladey
Chief, Rules, Announcements, and Directives Branch (RADB)
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Industry Response to NRC's Request for Comments on *Retrievability, Cladding Integrity and Safe Handling of Spent Fuel at an Independent Spent Fuel Storage installation and During Transportation* – Docket ID NRC-2013-0004

Project Number: 689

Dear Ms. Bladey:

On behalf of the nuclear energy industry, the Nuclear Energy Institute (NEI)[1] welcomes the U.S. Nuclear Regulatory Commission's (NRC) request for comments on the topics of retrievability, cladding integrity and the safe handling of spent fuel at an Independent Spent Fuel Storage Installation (ISFSI) (78 *Fed. Reg.* 3853). The NRC's consideration of potential changes to the regulatory framework in these areas is an important part of the comprehensive suite of improvements needed to provide a stable and predictable regulatory framework going forward as the dry cask storage industry continues to grow and evolve.

Our recommendations, summarized in the attachment, are made in the context of achieving holistic improvements in the dry storage regulatory framework. Accordingly, we have provided our thoughts on a broad scope of NRC efforts to evaluate the spent fuel storage and transportation regulatory structure, referenced in the *Federal Register* Notice (FRN). In this regard, we emphasize the importance of our recent petition for rulemaking in this area, PRM-72-7, as we believe it is foundational and necessary prior to making other potential improvements, such as those under consideration in this FRN. With respect to the primary specific improvement discussed in the FRN, we support a regulatory framework in which revised

[1] NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

performance-based and risk-informed definitions permit spent fuel retrievability to be established on a "canister basis" and do not require that it always be established on a "fuel assembly basis."

Thank you in advance for consideration of our comments. If you have any questions, please contact me.

Sincerely,

Rodney McCullum

Attachment

c: Ms. Catherine Haney, NMSS, NRC
Mr. Mark D. Lombard, NMSS/DSFST, NRC
Mr. Steve R. Ruffin, NMSS/DSFST/LB, NRC

Industry Response to the NRC's "Request for Comment on Retrievability, Cladding Integrity and Safe Handling of Spent Fuel at an Independent Spent Fuel Storage Installation and During Transportation"

1. Introduction

The industry welcomes the U.S. Nuclear Regulatory Commission's (NRC) request for comments for potential rulemaking on the topic of retrievability, cladding integrity and the safe handling of spent fuel at an Independent Spent Fuel Storage Installation (ISFSI).[1][2] The NRC's consideration of potential changes to the regulatory framework in these areas is an important part of the comprehensive suite of improvements needed to provide a stable and predictable regulatory framework going forward as the dry storage industry continues to grow and evolve. The industry commends the NRC for launching this needed re-examination of the dry storage and transportation regulatory structure for spent fuel, and we are pleased to have the opportunity to make our recommendations in response to this notice.[3] Most importantly, we urge the NRC to combine its consideration of potential improvements addressing retrievability, cladding integrity and safe handling with a rulemaking to implement the changes called for in the industry's recent petition for rulemaking [4]. We consider the changes called for in this petition to be foundational to making improvements in the dry storage and transportation regulatory framework.

A detailed explanation of the industry's recommendations for a new regulatory framework governing the role of cladding integrity for storage and transportation, including retrievability, is included in Section 2, together with a comparison of the current regulatory framework and the industry's recommended framework. This comparison concludes that the industry's recommended framework is risk-informed and performance-based, and it would result in lower costs and risks by minimizing the number of dry storage systems (DSSs)[a] potentially needed for storage and transportation of spent fuel while continuing to ensure adequate protection of public health and safety. Answers to the specific questions the NRC posed in this Notice, consistent with our recommendations, are provided in Section 3 with references to supporting details in Section 2.

The NRC's request for comments indicate that the NRC may consider potential changes in order to better harmonize 10 CFR Part 71 and 10 CFR Part 72 (transportation and storage) of spent fuel in DSSs. The industry provides a perspective on this topic in Section 4.

As mentioned above, potential changes to the regulatory framework for retrievability, clad integrity and safe handling are only part of a more broad set of improvements needed. We believe there are other regulatory improvements that must also be considered, based upon over 20 years of experience with loading DSSs and risk insights. Appendix A discusses the industry's vision of an integrated plan for improvements to DSS storage and transportation regulatory framework (see Figure A-1). Included is a discussion of prerequisite, co-requisite and synergistic improvements. Foremost among these are the

---

[a] The term "dry storage system (DSS)" used in this document is generic and includes both bolted casks and canister-based systems. Canister-based systems include a concrete overpack for storage. If they are transportable, they utilize a transportation overpack, and the term "transportation package" used in this document describes the cask/canister combined with the transportation overpack.

proposed changes identified in the industry's 2012 petition for a 10 CFR Part 72 rulemaking (PRM).[4][5] The industry's PRM requests that criteria for the Certificate of Compliance (CoC) and Technical Specifications (TS) content and format be included in the regulations to ensure that they are focused on safety, predictable and consistent. It is essential that this improvement be made at this time, since it provides the greatest advance in safety-focus and is a prerequisite for other near-term improvements that have been identified by industry and the NRC. The industry's PRM also requests that the backfit rule explicitly apply to CoCs. Application of the backfit rule will provide a framework for reasoned decision-making and ensure that changes to CoCs are safety-focused and cost-justified. The changes being contemplated by the NRC can only be effectively accomplished if they are built on a strong foundation. We believe that the proposed rule changes in the industry's PRM are necessary to assuring that this foundation exists.

2. Industry Recommended Framework for Retrievability and Cladding Integrity

The regulatory framework for retrievability, cladding integrity and safe handling is comprised of the NRC's policies, regulations, guidance and associated technical bases. The purpose of this framework is to ensure that spent fuel is stored and transported in a manner that provides adequate protection of public health and safety. It should also assure that it can achieve this purpose in a workable and risk-informed manner.

DSS designs are currently required by 10 CFR Part 72 to allow ready retrieval of spent fuel in order to facilitate further processing or disposal. Additionally, Part 72 requires that spent fuel cladding be protected against degradation and gross ruptures during storage, such that degradation does not pose operational safety problems that could hinder removal of the fuel from storage. Thus, cladding integrity plays an important role in the current regulatory framework.

Both DSSs and the spent fuel they contain are relied upon to provide the three main nuclear safety functions: (1) criticality control, (2) confinement and (3) shielding. The DSS itself provides the confinement and shielding safety functions. Spent fuel cladding serves as defense-in-depth in providing the safety functions of criticality control through geometry control and an additional level of confinement. In this role, spent fuel cladding is an engineered barrier not dependent upon what happens externally (the introduction of moderator) or the physical properties of the fuel (reactivity/burnup). These functions are well established in existing regulations and Interim Staff Guidance. The NRC has postulated, and we agree, that other options may exist for providing the safety function for which spent fuel cladding is currently relied upon.

The industry notes that the DSS safety function of preventing an inadvertent criticality from occurring can be met effectively through two additional attributes other than crediting the integrity of the cladding. First, the system's ability to confine spent fuel from the environment also serves to prevent

the intrusion of moderator, an essential condition for criticality. Second, the reactivity of spent fuel is very low in DSS configurations, due to isotopic changes associated with reactor burnup,[b] such that the risk of an inadvertent criticality is very low, even if moderator were introduced into the dry storage system. The industry believes reasonable assurance of DSS safety can be demonstrated when replacing the cladding's role in providing the criticality safety function through geometry control with moderator exclusion and burnup credit.

Cladding integrity should continue to serve a secondary role in the safety functions for criticality and confinement, but its role should be defense-in-depth-based upon a risk-informed, performance-based approach. The following discussions consider this overarching approach in responding to the NRC's questions regarding retrievability and cladding integrity.

In response to the NRC's request for input, the industry is recommending a new regulatory framework for retrievability, the role of cladding integrity, and safe handling for dry storage and transportation of spent fuel, under 10 CFR Part 72 and 10 CFR Part 71, to protect public health and safety in a manner that is more effective and efficient than the current regulatory framework. We request that the NRC implement this recommendation as described by the following key points:

- The framework for retrievability, the role of cladding integrity and safe handling should be risk-informed and performance-based, and it should maximize effectiveness and efficiency based upon the current conditions affecting spent fuel management. It should focus on the DSS to perform the safety functions, with cladding as defense-in-depth.
- Technologies exist today that can safely handle fuel with gross ruptures or other structural defects.[c] While conservative, the current NRC policy and guidance defining retrievability by "normal means" is not necessary to ensure safety and could unnecessarily increase worker dose.
- Consideration of potential DOE activities that may occur at some point in the future as part of the downstream spent fuel management activities (i.e. centralized storage, disposal or recycling) is unnecessary to provide reasonable assurance of storage and transportation safety today. Although the NRC's regulatory framework should include common-sense measures to prevent obvious operational safety issues at potential downstream facilities, more detailed concerns about the operational safety of at such facilities are best addressed in the regulations that the NRC will develop to govern these activities (such as future repository and recycle facility regulations).

---

[b] There are very limited exceptions, and these are capable of being handled on a case-by-case basis.

[c] Examples include experience removing fuel debris in spent fuel pools, Three Mile Island fuel removal, and handling of damaged fuel at Hanford and Idaho National Laboratory.

- Current policy to prevent or mitigate damage to fuel during the initial storage license term should continue (e.g. criteria for thermal limits and inert atmosphere and canning fuel that is already damaged) in order to provide defense-in-depth.

2.1. Background on Current Regulatory Framework

The NRC rulemaking in 1988 (53 FR 31651) added the retrievability requirement to the regulations at the same time it included requirements for a monitored retrieval storage (MRS)[d] facility in the regulations, as required by the Nuclear Waste Policy Act.[6][7][8] In order to understand the basis for the retrievability requirement, it is necessary to review the conditions at the time of the rulemaking, including the Nuclear Waste Policy Act and the Statements of Consideration (SOC) for the NRC rulemaking.

In the NWPA, the "ready-retrieval" requirement should be viewed in the context of the broader purpose of the act, which was to establish a national program for the management of spent fuel with the purpose of removing spent fuel from nuclear power reactor sites and providing for ultimate disposal. The purpose of the "ready-retrieval" requirement as it applies to an MRS is seen as a direct reflection of the national policy to ensure the fuel can be relocated to a disposal site so that the MRS does not become a de facto disposal facility. Ready-retrieval was not intended to be a safety requirement. In fact, the NWPA addresses safety in a separate sub-section, which requires that an MRS facility be designed *"to safely store...spent fuel...as long as may be necessary by maintaining such facility through appropriate means, including any required replacement of such facility."* [NWPA, Subtitle C, Section 141(b)(1)(D)]

In its 1988 rulemaking, the NRC determined that the retrievability requirement should apply to ISFSIs as well as to an MRS. The basis for this position is articulated in the proposed rule, which acknowledges that *"Section 141(b)(1)(C) of the NWPA requires the MRS be designed to provide for the ready retrieval of spent fuel and high level radioactive waste for further processing or disposal."* [7] The Commission went on to state that *"The spent fuel at an ISFSI must also be retrievable for transport to either the MRS or HLW repository whenever they become available."* These statements are consistent with the

---

[d] The proposed rulemaking to include MRS and High Level Waste (HLW) in 10 CFR Part 72 (51FR19106) clarifies that the scope of the proposed rulemaking applies to a MRS or any other facility that might be proposed by the DOE for storage of spent fuel and HLW resulting from civilian nuclear activities pending shipment to a repository or other disposal. This expressed intent is interpreted to include the proposed consolidated interim storage facility proposed by the DOE in their January 2013 "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste" report.

interpretation that the requirement was to ensure that fuel could be successfully removed from the ISFSI facility.[e]

In the 1988 rulemaking, the NRC also revised the regulations for confinement barriers and the criteria to protect cladding against gross ruptures. The requirement for the cladding's role as a confinement barrier, 10 CFR 72.122(h)(1), was established in the context of providing confinement barriers to restrict radioactive releases to the public and unnecessary exposure to radioactive material to the worker. It is further noted that 10 CFR 72.104 and 10 CFR 72.106 establish the radiological limits for ISFSIs. Prior to the 1988 rulemaking, the confinement barrier requirement was that cladding *"be protected against degradation and gross rupture."* The 1986 proposed rule added an alternative to relying on cladding as a confinement barrier, stating that spent fuel could *"be otherwise confined such that the degradation of the fuel during storage shall not pose operational safety problems with respect to its removal from storage."* The NRC's basis was that alternatives would also ensure adequate protection of public health and safety.[12] More specifically, the proposed rule stated that *"[F]or storage of spent fuel the cladding need not be maintained if additional confinement is provided. The main concern is during the handling of operations involving removal of spent fuel from its storage structure and its transfer to casks for shipment. During these operations, if the spent fuel is not properly confined, unnecessary exposure to radioactive material could occur to the worker. One way this additional exposure could be prevented is by using a canister. The canister could act as a replacement for the cladding."* [7]

Thus, it appears that the NRC's concern in regulating cladding degradation with respect to potential worker exposure was in the ability to transfer fuel into transportable packages in order to remove it from the ISFSI site. The policy and guidance decisions since publication of the rule have yielded a conservative, yet effective regulatory framework, considering the conditions at the time they were established. But this same guidance may no longer be effective or efficient due to the substantially different conditions that exist today, or those that may exist in the future.

First, early-vintage DSS designs were only licensed for storage, thus retrievability assured that fuel could be transferred to a transportation package at the power plant site. This approach was a result of both the newness of dry storage and the expectations for timely repository operations. Thus, an interpretation of retrievability as handling individual assemblies by normal means was a conservative means to ensure fuel could be removed from the ISFSI and transported by the U.S. Department of Energy (DOE) to their facility with minimal cost or operational impacts. In contrast, most dry storage systems in use at ISFSIs today are transportable, including all systems in service at ISFSI located at shutdown reactor sites. Furthermore, current and future systems are designed to be transportable, even though some do not apply for the transportation certificate at the time they apply for the storage

---

[e] The NRC staff guidance published since that time (SFST-ISG-02) states that retrievability would be demonstrated if the fuel remains undamaged during storage.[9][10] This was further reinforced through NRC policy (SECY-01-076) 12 years later, when, in 2001, the NRC defined retrievability as handling of individual or canned assemblies by normal means.[11]

certificate. Even older systems designed to be "storage only" could be capable of being certified for transportation without the need to repackage the fuel[f]. The ability to transport the DSS directly from the ISFSI eliminates the need to retrieve individual assemblies from DSSs.

Second, following the DOE's termination of work on the Yucca Mountain license application, anticipated on-site storage times have greatly increased. At the time the NRC established its policy and guidance on retrievability, storage times were expected to be shorter, given the DOE's published schedules for waste acceptance and disposal. However, with today's expectations for longer storage periods, there are questions about the performance of cladding for these extended storage periods. Given these uncertainties, there is a potential, under the current regulatory framework, that some DSSs could be expected to be reopened and repackaged to demonstrate retrievability on an individual assembly basis, even though the safety functions of sub-criticality, confinement and shielding can be demonstrated without reopening and repackaging. For example, expectations for longer periods of storage have focused attention on long-term aging management programs to demonstrate safety and compliance with regulations. If aging management programs are required to address cladding characteristics and performance, the result could be a need to reopen a lead DSS for internal inspections. Such an operation would needlessly incur increased worker doses, increased handling risks, increased resource demands on licensees, as well as increased costs. In contrast, aging management programs centered around the DSS's characteristics and performance would not rely on the DSS being reopened and would be focused on monitoring, inspection and mitigation of the external DSS materials, which are more readily accessible. An aging management program focused on the DSS is possible because the DSS is capable of performing all three of the safety functions discussed above.

The third condition, which is different, is in the expected number of DSSs that will be deployed. When the NRC established its policy and guidance, it was expected that there would be relatively few DSSs. This was due to the expectation that the DOE would soon accept and transport spent fuel from reactor sites to a repository sometime around, or not long after, the turn of the century. In contrast, the DOE's most recent strategy for managing spent fuel would likely result in numerous (at least 3,000 by 2020) DSSs *deployed at reactor sites.[13] The number of DSSs deployed has a compounding effect on the* challenges mentioned earlier with the potential need to reopen and repackage. While the overall impact of reopening or repackaging a few dozen DSSs is significant, it is dwarfed by the potential impact of reopening or repackaging thousands of DSSs.

Thus, the interpretation of retrievability as the ability to handle individual assemblies by normal means, implying that cladding integrity is necessary to ensure safety, and is no longer workable. Efforts to implement this interpretation would inevitably increase risks, operational difficulties and costs. A new

---

[f] If these DSSs were to be repackaged, this could be safely accomplished in the plant's spent fuel pool under 10 CFR 50 even if some of the cladding had failed.

framework is needed that is more risk-appropriate in assuring adequate protection of public health and safety based upon these new conditions.

2.2. Industry Recommended Framework

The regulatory framework for retrievability, the role of cladding integrity, and safe handling for dry storage and transportation should be risk-informed and performance-based. It should be based upon the current conditions affecting spent fuel management. The primary safety functions are sub-criticality, confinement and shielding. In addition, thermal and structural criteria are established to ensure these safety functions are maintained. However, retrievability and cladding integrity are not necessary to ensure these safety functions are maintained, since the DSS can provide for them independently. In fact, the DSS is typically credited for performing the safety functions, while the fuel cladding is relied upon for additional defense-in-depth.

The regulatory framework for retrievability and the role of cladding integrity should also be effective, efficient and consistent for the three major certification categories: 1) storage-only DSS, 2) transportable DSS, and 3) transportation-only package. The industry's recommended framework achieves these goals in a manner that involves minimal changes to the current regulatory framework. In particular, the following regulations, and associated regulatory policy and guidance, are addressed in the industry's recommended framework: 1) 10 CFR 72.122(h)(1) for the prevention of gross rupture or otherwise confining to prevent operational safety problems, 2) 10 CFR 72.122(l) for ready retrieval, 3) 10 CFR 72.236(m) compatibility with removal offsite, and 4) 10 CFR 71.55(d)(2) geometry of contents are not substantially altered.

2.2.1. Storage – Prevention of Gross Rupture or Otherwise Confine

Current Regulatory Framework

10 CFR Part 72.122(h)(1) – *Confinement barriers and systems. "The spent fuel cladding must be protected during storage against degradation that leads to gross ruptures or the fuel must be otherwise confined such that degradation of the fuel during storage will not pose operational safety problems with respect to its removal from storage. This may be accomplished by canning of consolidated fuel rods or unconsolidated assemblies or other means as appropriate."*

NRC-SFST-ISG-11, Revision 3 – Establishes thermal criteria to assure integrity of the cladding material.

NRC-SFST-ISG-01, Revision 2 – Establishes criteria to determine if fuel is damaged.

Discussion of the Industry's Recommended Framework

The current policy to prevent damage to fuel during the initial storage license term should continue. This is currently accomplished through established criteria for thermal limits in NRC-SFST-ISG-11 Revision 3 and by requiring an inert atmosphere. For fuel that is damaged prior to loading, or anticipated to

become damaged during the initial license term, it would be appropriate be place it into individual fuel cans prior to loading. Although placing damaged fuel into individual fuel cans is not necessary to ensure safety or meet the requirement to otherwise confine, we believe that it is a prudent action to take for known damaged fuel. Under this part of the recommended framework, initial storage period, the safety basis is that no cladding degradation will occur or fuel with compromised cladding will be loaded into damaged fuel cans. This is identical to the current regulatory framework.

The industry recommends a regulatory framework that is risk-informed for the renewal of storage certificates and licenses, since the result of requiring individual assemblies to be demonstrated to remain undamaged during the renewal term would be to reopen and repackage to inspect and place in cans if necessary. The handling risks, worker dose considerations and costs of repackaging fuel for renewal terms would outweigh any potential benefits of placing this fuel in individual cans. It is noted that the thermal criteria and the criteria for an inert atmosphere will ensure that the majority, if not all, of the fuel cladding remains intact even for longer-term storage and multiple renewal terms.[g]

In the storage license renewal, the recommended framework would require that applicant demonstrate one of the following conditions in order to comply with 10 CFR 72.122(h)(1). First, the applicant could demonstrate that the fuel will not undergo any degradation resulting in gross rupture. Alternately, the applicant could choose to demonstrate that the DSS is transportable with any credible degradation of the fuel cladding. The third option would be to demonstrate that any credible degradation of the fuel cladding would not preclude its transfer to a transportation package, and that the licensee has the capability to perform such transfer. The industry's preference is to ensure the DSSs are transportable and to avoid repackaging.[h]

Technology currently exists to safely handle gross rupture and structural defects of fuel cladding. Therefore, the possibility of fuel degradation during storage in the renewal term does not pose a safety concern. For dual purpose transportable DSSs, the ability to transport the DSS offsite would assure compliance with the regulations. It is important to understand that compliance with the proposed regulations can be accomplished by the safe removal and transport of the DSS offsite thus precluding

---

[g] High-burnup fuel has been demonstrated to be protected against gross rupture during the initial license period, and data indicate that high-burnup fuel can continue to be protected against gross rupture beyond the initial license period. The NRC's discussion of hydride reorientation for high-burnup fuel, which could lead to cladding embrittlement under current regulatory limits for maximum cladding temperature and subsequent cooling over long periods of time. However, even if the cladding becomes embrittled, the externally applied forces necessary to cause gross rupture are not expected to occur for normal or accident storage conditions. Therefore, there is evidence to suggest that extended storage of high-burnup fuel is not of concern in the context of preventing gross rupture. Further, a demonstration program for high-burnup fuel is currently being developed to provide confirmatory data in this area. NRC involvement in order to assure that acquired data is sufficient to address staff concerns is encouraged.

[h] *It is further noted that a contemporaneous dual certification is unnecessary since the applicant would have the initial storage* term, up to 40 years, to demonstrate compliance with the regulation through one of the stated options in their renewal application. (See Section 4)

the need for ISFSIs at shutdown units to maintain costly and unnecessary wet storage facilities. For storage-only DSSs, capabilities would need to be provided, at the ISFSI location, for transfer of the fuel into a transportation package. However, if such degradation is postulated to occur in the renewal term, capabilities should be in place to assure safe handling.

Proposed Regulatory Changes

NRC-SFST-ISG-01, Revision 2 should be revised to establish criteria for storage renewal applications that: Sites with storage-only DSSs have the capability to safely handle potentially degraded fuel for the purposes of repackaging into transportation packages, or DSSs are dual purpose storage and transportation. The definition of "otherwise confined,"[i] specified in the regulations, should be clarified to credit the DSS's confinement boundary in the cases where capabilities to safely handle degraded fuel are established. Such capabilities would certainly be provided for at a potential repository or recycling facility and would be governed by the NRC regulations for such facilities.

2.2.2. Storage – Ready-Retrieval

Current Regulatory Framework

10 CFR 72.122(l) – *Retrievability. "Storage systems must be designed to allow ready retrieval of spent fuel, high-level radioactive waste, and reactor-related GTCC waste for further processing or disposal."*

SECY-01-00076 – Establishes NRC's policy on ready retrieval.

NRC-SFST-ISG-02, Revision 1 – Establishes criteria to determine if fuel is readily retrievable. *"Ready Retrieval - The ability to move a canister containing spent fuel to either a transportation package or to a location where the spent fuel can be removed. Ready retrieval also means maintaining the ability to handle individual or canned spent fuel assemblies by the use of normal means." "Normal Means - The ability to move a fuel assembly and its contents by the use of a crane and grapple used to move undamaged assemblies at the point of DSS loading. The addition of special tooling or modifications to the assembly to make the assembly suitable for lifting by crane and grapple does not preclude the assembly as being considered moveable by normal means."*

NRC-SFST-ISG-01, Revision 2 – Establishes criteria to determine if fuel is damaged.

---

[i] Historically, this has been strictly limited to individual fuel cans. However, per ISG-02, these limitations were primarily attributed to meeting the interpretation of retrievability. In the industry's recommended framework, an individual fuel can is no longer needed to meet the retrievability definition; therefore, alternative means to confinement should be permissible, such as reliance on the canister confinement.

Discussion of the Industry's Recommended Framework

A new risk-informed, performance-based interpretation of ready-retrieval should be focused on the ability to remove fuel from the ISFSI for transportation to a consolidated storage, recycling or disposal facility. This framework avoids the risks and costs of unnecessarily placing fuel into individual cans or repackaging, when not doing so can still be demonstrated to be safe and in compliance with the regulations. Although there is a nexus to safety in that retrievability assures the fuel will eventually be removed from the ISFSI, we do not believe that retrievability should be viewed as providing safety in the handling of fuel, which is more appropriately addressed in 10 CFR 72.122(h)(1) or in yet to be developed repository or recycling facility regulations. These regulations should also consider the experience under 10 CFR 50 whereby existing technologies safely handle fuel with gross ruptures or other structural defects.

For dual-purpose transportable DSSs, ready-retrieval is assured through the ability to transport the DSS offsite to a destination facility. For storage-only DSSs, ready-retrieval would need to assure the capability to repackage fuel into transportation packages at the ISFSI location. However, ready-retrieval does not need to be by "normal means" in order to ensure adequate protection of public health and safety or to ensure compliance with the regulation, since current technology can assure safety. Experience shows that measures not typically used can still be safely applied.

Proposed Regulatory Changes

Changes to 10 CFR Part 72 requirements are not necessary. The following definition of ready-retrieval is recommended and would meet the requirements of 10 CFR 72.122(l) and 10 CFR 72.236(m).

The NRC's policy in SECY-01-0076 and NRC-SFST-ISG-02, Revision 1, should revise the interpretation of ready-retrieval to be more risk-informed and performance-based. The policy and guidance should adopt the criteria/definition that ready-retrieval is the ability to remove the spent fuel from the ISFSI and to transport that fuel to a destination facility (e.g. repository, reprocessing facility or consolidated storage facility). This condition would be met if it could be demonstrated that the DSS is transportable. If the DSS is not transportable, then the condition is met if it could be demonstrated that any credible degradation of the fuel cladding would not preclude its transfer to a transportation package. The industry's preference is to ensure the DSSs are transportable and to avoid repackaging.

The above definition meets the stated requirement in 10 CFR 72.122(l) because it maintains the capability to "allow ready retrieval of spent fuel...for further processing or disposal." The above definition also meets the stated requirement in 10 CFR 72.236(m) "consideration should be given to compatibility with removal of the stored spent fuel from a reactor site, transportation, and ultimate disposition" because it ensures that fuel can be transported to a repository or other facility.

2.2.3. Storage – Compatibility with Removal Offsite

Current Regulatory Framework

10 CFR 72.236(m) – *"To the extent practicable in the design of spent fuel storage casks, consideration should be given to compatibility with removal of the stored spent fuel from a reactor site, transportation, and ultimate disposition by the Department of Energy."*

Discussion of Industry's Recommended Framework

The requirement to assure compatibility with removal offsite is intertwined with other requirements in the regulations and is sometimes a consideration in the interpretation of these requirements through NRC policy and guidance.

In the industry's recommended framework, we believe that the requirement for compatibility with removal offsite should be interpreted to provide assurance that spent fuel does not become stranded at an ISFSI. As such, the requirements should ensure that spent fuel has a viable path to be transported offsite and received by a federal destination facility, which could be a repository, recycling facility or consolidated storage facility. Parallels are identified between the requirement for ready-retrieval and this requirement. Additionally, this requirement necessitates that the framework for the retrievability and the role of cladding integrity be consistent between storage and transportation (10 CFR Part 72 and 10 CFR Part 71). Thus, while this requirement may not have any criteria that are directly applicable to the design and operation of DSSs and transportation packages, it does act through other regulations to assure the capability of removing spent fuel offsite.

Proposed Regulatory Changes

As described in Sections 2.2.1, 2.2.2, and 2.2.4.

2.2.4. Transportation – Geometry not Substantially Altered

Current Regulatory Framework

10 CFR 71.55(d)(2) – *"The geometric form of the package contents would not be substantially altered"*

NRC-SFST-ISG-11, Revision 3 – Establishes thermal criteria to assure integrity of the cladding material.

NRC-SFST-ISG-01, Revision 2 – Establishes criteria to determine if fuel is damaged.

Discussion of the Industry's Recommended Framework

A regulatory framework that is consistent between storage and transportation is necessary in order to ensure the viability of dual purpose transportable DSS certification. The industry's recommended

framework for retrievability and the role of cladding integrity is risk-informed and performance-based, not only in storage but also in transportation. Our recommendations would assure that transportation packages continue to ensure the safety functions of sub-criticality, containment and shielding during normal conditions of transport and hypothetical accident conditions.

The purpose for geometric form not to be substantially altered should be interpreted in the context of maintaining sub-criticality, which is reasonable given the location of the requirement alongside the requirements for sub-criticality. In this interpretation, preventing substantial alteration of the geometric form is important when it is considered in the larger context of non-spent fuel transportation, which includes gases and liquids. In those applications, the geometric form may be the only means to assure sub-criticality. However, in the context of spent fuel, limitations on the geometric form are not the only means to control criticality. Spent fuel is less reactive than new fuel due to depletion of fissile isotopes and buildup of fission products. Consideration of these in criticality analyses (called burnup credit) provides substantial sub-criticality control.

In addition, and perhaps more importantly, transportation packages can be designed to preclude moderator intrusion under all normal and accident conditions of transport as further means to control sub-criticality. The industry believes reasonable assurance of transportation package safety can be demonstrated by replacing the cladding's role in providing the criticality safety function through geometry control with moderator exclusion. The role of moderator exclusion is further discussed in Appendix A.

The current framework interprets "substantially altered" to include even minor changes to the fuel and is not consistent with a risk-informed, performed-based view of criticality safety. If cladding degradation did occur, it is likely to be limited in both the extent of the failure and the number of failed pins and, hence, would not constitute a significant safety concern. Even in the highly unlikely situation in which fuel escapes from the cladding, the fuel can be removed safely when it arrives at the destination facility. As long as analyses can demonstrate that the transportation package will maintain the safety functions of sub-criticality, containment and shielding, then the contents would not be "substantially altered."

Proposed Regulatory Changes

Changes to 10 CFR 71.55(d)(2) may not be necessary if a revised interpretation through NRC policy and/or guidance for "substantially altered geometric form" is sufficient to implement a recommended risk-informed, performance-based framework. The interpretation could rely upon recent NRC actions to improve reliance on burnup credit in ISG-8, Revision 3, and consideration of realistic configurations addressed in ISG-19. If a rulemaking for 10 CFR 71.55(d)(2) is pursued, then potential revisions to 10 CFR 71.55(b), 71.55(d)(3) and 71.55(e)(2) could also implement conforming improvements to the regulatory framework.

The NRC should establish a risk-informed, performance-based policy providing an interpretation of "substantially altered geometric form" that is applicable to spent fuel transportation packages.

"Substantially altered geometric form" for spent fuel transportation packages should mean a change to the overall configuration of the fuel or internal components such that the ability for the package to perform the safety functions of sub-criticality, containment and shielding can no longer be demonstrated. Cracking of fuel cladding that does not result in fuel pellets relocating outside of the fuel rod is not considered substantially altered. If fuel is postulated to become relocated, and can be demonstrated to remain subcritical in safety analyses, then the geometric form is also not substantially altered.

Even if the NRC maintains its current definition of retrievability and interpretations for clad integrity for spent fuel DSSs, a requirement for retrievability of individual assemblies by normal means in transportation is not necessary to ensure safety. In fact, a retrievability requirement for transportation would result in significant impacts in the form of increased costs and overall risks and would have an exceedingly small safety benefit to worker dose. For consolidated storage, resolving the challenges in implementing storage requirements subsequent to transportation would be manageable engineering tasks and would not benefit from a retrievability requirement for transportation. Finally, the introduction of retrievability requirements for transportation could impose an unintended backfit to acceptance criteria for design-basis accidents defined in the regulations for transportation packages.

2.3. Acceptance of Spent Fuel by a Future Disposal or Recycling Facility

We believe that it is improper for the NRC to speculate on the activities of the national program for spent fuel management and potential future DOE facilities. In fact, we believe that such speculation is inconsistent with the NRC's Principles of Good Regulation, and in fact is unnecessary to ensure safety through the regulatory framework for dry storage and transportation of spent fuel. Technologies exist today for safe handling of spent fuel that is not retrievable by normal means. If disposal, recycling and even consolidated storage activities require such handling of damaged fuel, then the associated facility will be required, and will be able, to do so safely.[j] Therefore, handling of grossly ruptured or structurally degraded fuel that is not in an individual can would be an operational issue that could be safely addressed in accordance with appropriate regulations by engineered processes, equipment and tools. Since the NRC's focus is on safety, we believe the NRC should not establish requirements to improve ease of operations (as would be the case if an individual assembly retrievability requirement were to be included in storage and transportation regulations).

We do not agree with the assumption that all spent fuel will need to be repackaged from DSSs/transportation packages into disposal packages. If the transportable DSSs are directly placed into a repository, then no such repackaging would be necessary. It should be noted that NEI submitted a number of contentions in the Yucca Mountain licensing proceeding [14] to seeking to compel the DOE to directly dispose of DSSs in the repository based on an EPRI analysis showing that this was scientifically

[j] Requirements for safe handling would be included in the regulations for the particular facility (e.g. repository or recycling).

and technically achievable. Finally, the Standard Contract between utilities and the DOE establishes that the DOE must accept all fuel, no matter the condition. Since current technology exists to safely handle grossly ruptured or structurally degraded fuel, disposal and recycling activities should not be considered when establishing the regulatory framework for storage and transportation. Although 10 CFR Part 72.236(m) describes that compatibility with ultimate disposition by the DOE be considered, it should not be interpreted to maximize the ease of operations for the disposal or recycling facility when the safety of these operations will be more appropriately addressed in the regulations for these facilities.

There would not be any negative impacts on a potential recycling or disposal facility due to a change in the regulatory framework. Handling of grossly ruptured or structurally degraded fuel at these facilities can be performed safely. If desired, a recycling facility could select fuel capable of being handled by normal means, since it is likely that the majority of fuel would meet this criterion under the industry-recommended framework. Furthermore, most of the spent fuel would not be destined for recycling, since the amount of spent fuel generated thus far and forecasted greatly exceeds the amount of spent fuel that could be recycled, even in the most aggressive scenarios.

2.4. Comparison of Current and Industry Recommended Frameworks

The regulatory framework for retrievability and the role of clad integrity must meet the purpose of assuring adequate protection of public health and safety. This goal is accomplished in the current framework, and would continue to be accomplished in the industry's recommended framework, through the focus of ensuring the ability of the DSS/transportation package to perform the safety functions of sub-criticality, confinement/containment and shielding. In comparing options for the regulatory framework, the one that is risk-informed and performance-based, and maximizes regulatory efficiency and effectiveness, would be the prime candidate for implementation. Accordingly, comparison of the attributes of various options should include consideration of the associated costs and benefits.

In studies performed by EPRI and the NRC, the risks of dry storage ranged from very low to extremely low with latent cancer fatality (LCF) risk calculated to be between 2.0×10^{-12} and 1.7×10^{-13} per year.[15][16] Similarly, the risks of spent fuel transportation are very low, as determined by an updated NRC study "collective dose risks are vanishingly small."[17] These risks, when considered in the context of the NRC's safety goals, and compared to the 2×10^{-6} LCF/yr public and 1×10^{-5} LCF/yr worker thresholds of negligible risk, indicate that there is substantial opportunity to improve regulatory efficiency by modifying requirements based upon risk insights.[18]

Costs and risks in the current regulatory framework would result from the potential need to repackage fuel to demonstrate retrievability of individual assemblies and/or maintain cladding integrity for extended storage periods or transportation. Repackaging DSSs is estimated to increase worker doses

and handling risks by a factor of three due to a combination of factors.[k] The first is that repackaging would multiply the number of loading, unloading and handling activities for the same number of assemblies. The second is that placing fuel in individual cans would require a lower capacity DSS in order to handle the larger lateral profile and account for thermal factors. In the extreme case, it is estimated that placing all of the fuel into individual cans would result in an increase of 25-75% of total DSSs needed for the same number of fuel assemblies. This total increase in number of DSSs would also increase the risks and costs for transportation of the spent fuel. Finally, both repackaging and individual assembly canisters would increase the low-level waste disposal environmental impacts and associated with storage and transportation. Even if the costs are estimated conservatively based solely on the need for an additional 50% of DSSs, the additional costs resulting from repackaging due to the current regulatory framework could reach $1.5B by 2020 and increase by $80M per year thereafter.[l]

In contrast, the industry-recommended framework would result in comparatively less cost and risk. The industry's recommended framework shifts the decision to repackage potentially degraded fuel to the destination facility, which can be constructed to better handle such fuel and would be licensed to provide for safe handling.[m] However, if there is a potential that some fuel may experience gross rupture or structural defects prior to arriving at the destination facility, then the unloading of these assemblies may result in slightly higher costs and risks. It is estimated that the increase in costs and risks may be 25-50% higher than unloading assemblies by normal means. However, not all assemblies will need to be unloaded by non-normal means, and while the exact percentage is impossible to determine at this time, data indicate that it would be exceedingly small. Furthermore, a 25% increase in handling costs and risks of potentially damaged fuel at a destination facility under the industry-recommended framework is less than a 50% increase in costs and risks resulting from an increased number DSSs necessary under the current regulatory framework. Thus the cumulative effect on cost and dose of the industry's recommended framework is expected to be less than under the current framework.

Although a detailed risk assessment could be performed to quantify the costs and risks for both the current and industry-recommended frameworks, such an assessment may not be necessary. This is because variations in risks for these frameworks, while they do have comparative differences in risks, do not change the overall conclusions that for both the risks are orders of magnitude below the NRC's acceptable-risk thresholds, and in fact are extremely low. The qualitative assessment provided here

---

[k] Estimates provided here are based upon design and operations experience and are considered generally accurate. A more detailed study could provide more accurate and slightly different estimates.

[l] Total of 3,000 DSSs expected to be loaded by 2020, at a rate of 160 DSSs per year thereafter. Costs of DSSs conservatively estimated at $1M each. [Based upon proprietary information]

[m] Unloading risks and worker doses at a national program's destination facility are estimated to be similar to the loading risks and worker doses at the originating ISFSI. Unloading a DSS results in an average of 400 person-mrem (approximate) based upon industry experience.[19]

demonstrates that the industry's recommendations would result in relatively lower risk and costs than the current framework. Therefore, a qualitative assessment to compare the frameworks may be sufficient to provide a cost-benefit justification for implementing the industry's recommended framework. The conclusion is that the industry's recommended framework would result in significantly less costs and a reduction in risks and worker dose by a factor of three, as compared to the current framework. However, if a detailed assessment is performed, inputs of risks and costs associated with the regulatory framework could be obtained from a recent EPRI study.[19]

To help illustrate the impacts of the current and industry's recommended frameworks, two scenarios are described in the table below.

<table>
<tr><td colspan="2">Scenario #1

Spent fuel has been stored for an extended period of time, and it cannot be fully demonstrated to meet retrievability of assemblies by normal means or clad integrity requirements for the renewed storage term or subsequent transportation (i.e. classified "Damaged" per ISG-1, Rev 2).</td></tr>
<tr><td>Current Framework

While the NRC identified that the required action would be for the licensee to bear the potential cost for repackaging the fuel, the risks associated with this course of action have not been analyzed. Since the fuel presumably would not meet the assembly-based retrievability or clad integrity requirements of 10 CFR 72, it would need to be placed into individual fuel cans prior to being repackaged into a transport package. This would require additional loading, handling and unloading, and additional DSSs/transportation packages.</td><td>Industry-Recommended Framework

In this scenario, the fuel can remain in storage and be transported safely (i.e. meet the criticality, confinement/containment, and shielding requirements). Although there may be minor increases to worker dose at the destination facility, these would be far less than the certain risks associated with repackaging the fuel under the current framework in a facility not specifically designed for this purpose.</td></tr>
<tr><td colspan="2">Scenario #2

High-burnup fuel cannot be fully demonstrated to meet assembly-based retrievability or clad integrity requirements for the initial storage term or transportation due to a lack of conclusive data (i.e. unable to classify but believed to be "Undamaged" per ISG-1, Rev 2).</td></tr>
<tr><td>Current Framework

In this scenario, high-burnup fuel would need to be placed into individual fuel cans prior to transportation as described in Scenario #1. Fuel</td><td>Industry-Recommended Framework

In this case, the requirement would be that the fuel can be stored for the initial storage term (i.e., perform the criticality, confinement and shielding</td></tr>
</table>

loaded into dual-purpose transportable DSSs would be required to be repackaged in order to place fuel into individual cans. This would require additional loading, handling and unloading, and additional DSSs.	safety functions). It is noted that in this case, available data suggest that the fuel is "undamaged," but it is insufficient to demonstrate full assurance. Although there may be minor increases to worker dose at the destination facility, these would be far less than the certain risks associated with repackaging the fuel at a reactor facility that is not specifically designed for this purpose under the current framework.

3. Responses to NRC's Questions

Direct responses to the NRC's questions are provided in this section. It is noted that a review of the industry's recommended framework for retrievability and the role of clad integrity, as described in Section 2, is necessary to fully understand our responses to the NRC's questions. Where applicable, the answer will reference additional details described in industry's recommended framework.

3.1. Acceptance of Spent Fuel by a Future Disposal or Reprocessing Facility

Responses to the NRC's specific questions are as follows:

Question 1: Should an enhanced regulatory framework assume the licensee receiving spent fuel for disposal will be able to site and design a repository for direct disposal of these high capacity canisters without repackaging?

Answer 1: Direct disposal is certainly credible and it is the industry's objective to assure that any future repository have this capability. However, it would not be workable for the regulatory framework for dry storage and transportation of spent fuel to speculate on the activities of the national program for disposal of spent fuel. Technologies exist today for safe handling and disposal of spent fuel, even if the spent fuel is not retrievable by normal means. Methods that are not "normal" can and have been carried out safely. If the disposal activities require such handling it will be done safely and in accordance with the applicable regulations. (See Section 2.3)

Question 2: Should an enhanced regulatory framework assume the repository licensee will be able to handle and repackage potentially degraded/damaged fuel on large production scales?

Answer 2: Yes. Technologies exist today for safe handling and disposal of spent fuel, even if the spent fuel is not retrievable by normal means. The Yucca Mountain Safety Analysis Report (SAR) describes that this capability would have existed. If the disposal activities require handling of fuel by non-normal means, then they will be required (for example by new recycle or repository regulations) and will be able to do so safely. Therefore, the repository licensee

will be able to safely handle and repackage potentially degraded/damaged fuel on large production scales. This is not a safety issue; it is an operational matter that can be addressed by engineered processes, equipment and tools. Since the NRC's focus is on safety, we believe the NRC should not establish requirements to improve ease of operations. (See Section 2.3)

Question 3: What effects, if any, would a canister-based retrievability policy have on a future reprocessing facility?

Answer 3: None. (See Section 2.3)

Question 4: What other factors, such as cost, dose or time, should be considered?

Answer 4: The primary factor for consideration is the adequate protection of public health and safety. Where a framework is not necessary for adequate protection of public health and safety, its associated costs should be evaluated and justified. (See Section 2.4)

3.2. Spent Fuel Retrievability During Storage

Responses to the NRC's specific questions are as follows:

Question: (1) Whether ready-retrieval of individual spent fuel assemblies during storage should be maintained, or (2) whether retrievability should be canister-based.

Answer: A new risked-informed, performance-based NRC policy and guidance on 10 CFR 72.122(l) for retrievability is needed. The industry's preference is to assure that DSSs are transportable in order to avoid repackaging, and thus our recommended framework is most similar to the NRC's described "Canister-Based Retrievability." However, we do not recommend defining retrievability as either "Fuel Assembly-Based" or "Canister-Based," as it is unnecessary and could be problematic. Instead, retrievability should be defined as the ability to remove spent fuel from the ISFSI and to transport that fuel to a repository, reprocessing facility or consolidated storage facility. This performance-based definition assurance compliance with the regulations and allows flexibility in meeting the requirement. (See Section 2.2)

3.3. Cladding Integrity

Responses to the NRC's specific questions are as follows:

Question 1: Should the spent fuel cladding continue to be protected from degradation that leads to gross rupture, or otherwise confine the spent fuel, during storage such that it will not pose operational safety problems with respect to its removal from storage? In particular, provide any explanatory information discussing the additional cost, dose, and effort required to repackage potentially damaged fuel over canned spent fuel, if the prohibition against gross

deformation to the cladding were removed and the spent fuel required repackaging (whether by DOE or storage licensees).

Answer 1: The regulation, 10 CFR 72.122(h)(1), that specifies this requirement should remain; however, the interpretation of this requirement should be modified to be more risk-informed and performance-based and to clarify the use of the provision to "otherwise confine." (See Section 2.2 the for industry's recommended framework and Section 2.4 for consideration of the effects of repackaging)

Question 2: Should each high-burnup spent fuel assembly be canned to ensure individual fuel assembly retrievability? Additionally, should spent fuel assemblies classified as damaged prior to loading continue to be individually canned prior to placement in a storage cask? In particular, the NRC is interested in gathering input on the additional cost, dose and effort required to place individual fuel assemblies in a damaged fuel can during storage cask loading. Comparison of the upfront cost, dose and effort to can all high-burnup fuel assemblies against the cost, dose and effort to repackage potentially damaged fuel at a repository or prior to transport to a repository, may factor into the NRC's retrievability policy decision-making process.

Answer 2: No, each high-burnup spent fuel assembly should not be canned to ensure individual fuel assembly retrievability. To do so would be to presume, without basis, degradation mechanisms that have not been observed to occur.[n] Yes, assemblies classified as "damaged" prior to being placed into dry storage should continue to be placed into individual cans prior to placement in the DSS. (See Section 2.2 for the industry's recommended framework and Section 2.4 for consideration of the effects of repackaging).

3.4. Transportation Retrievability

Responses to the NRC's specific questions are as follows:

Question 1: The NRC would like external stakeholders to comment on (a) whether retrievability should be extended to transportation packages after normal conditions of transportation (similar to the storage requirements), or (b) is it acceptable for high-burnup spent fuel to degrade such that damaged fuel may have to be handled when the package is opened? Extending retrievability to transportation may be important if the U.S. were to move to consolidated interim storage and if the NRC were to maintain its current definition of assembly-based retrievability during storage.

---

[n] The industry, led by EPRI, is undertaking an R&D project to collect confirmatory data on the high-burnup fuel performance for storage and transportation. The industry's plans will soon be formally communicated to the NRC via letter from NEI.

Answer 1: No, retrievability should not be extended to transportation packages after normal conditions of transportation. Since the purpose of retrievability is to ensure that fuel can be transported from an ISFSI, the fact that the regulation is transportation inherently meets this purpose. (See Section 2.2) Furthermore, transportation retrievability is not necessary to assure adequate protection of public health and safety, nor is it necessary even if the NRC requires assembly-based retrievability during storage. The question implies that there is an expectation that high-burnup spent fuel may degrade and damaged fuel will need to be repackaged after transportation. This has not been shown to be true, and in fact there is data that suggests high-burnup fuel would not degrade during transportation.[o] However, even if some high-burnup fuel would become damaged during transportation, this would be an acceptable risk if the transportation package could perform the safety functions and repackaging is avoided.

Question 2: If it is acceptable for the fuel to degrade, should the package application for a certificate of compliance provide a description of the design and operations of any facilities and methods necessary to handle the damaged fuel (at the facility that will open the package)?

Answer 2: It is not appropriate for the transportation certificate to describe the design and operations of facilities that might receive the package. This would result in duplication of regulations resulting in reduced regulatory clarity and stability, and the potential for conflicting requirements in transportation, recycling and disposal requirements. A transportation certificate should be limited to describing its own design and operation in the context of protecting public health and safety. Including facility design and operating requirements in the package CoC (where they can only speculate to the overall design and operations of that facility) would result in imposing requirements on facility design before it occurs or conflicts that would need to be reconciled between the two licensing actions. Any discussion in the transportation certificate should be limited to the expected condition of the fuel and procedures for opening and unloading the transportation package.

3.5. Additional Comments

In addition to the comments responding to areas solicited by the NRC, we provide the following comments on other details in the NRC's document.

3.5.1. Definition of High-burnup Fuel

On page four of the NRC's request for comments, the NRC states in the first sentence of the second paragraph, "...fuel with peak rod average burnup greater than 45,000 MWd/MTU is considered high-

[o] NEI's forthcoming letter on storage and transportation of high-burnup fuel will include a synthesis of existing data that supports the conclusion that this fuel will continue to maintain cladding integrity during long-term storage and transportation.

burnup fuel..." This definition of high-burnup fuel is inconsistent with the long-standing definition used for years in ISFSI licenses and DSS/transportation package CoCs. The definition should be "Fuel with average burnups generally exceeding 45,000 MWd/MTU." This is the widely accepted definition of high-burnup fuel, and is the definition provided by the NRC in the most recent ISG-11, Revision 3.

3.5.2. Definition of Damaged Fuel

The definition of damaged fuel is specific to the DSS/transportation package certificates since these definitions depend upon the DSS/transportation package's design and are inputs for the analyses that demonstrate safety and regulatory compliance. This is an appropriate approach, even though they are not always consistent with the definition in the NRC's guidance, since tailored definitions of damaged fuel for each DSS/transportation package certificate results in the most effective and efficient protection of public health and safety.

The industry-recommended framework, which revises the definition of retrievability to be performance-based, will avoid the risks of reopening and repackaging DSSs due to issues related to the current definition of damaged fuel in the NRC guidance. Some fuel may potentially be classified as damaged due to the NRC guidance definition being based upon ready-retrieval of assemblies by normal means, but would not be classified as damaged based upon their ability to perform safety functions. Permitting the definition of damaged fuel to be focused on performance of safety functions, and not ready-retrieval, will ensure that assemblies are not defined as damaged when they are not, in fact, known to be damaged.

4. Harmonization of Storage and Transportation Regulations

Harmonization of the storage (10 CFR Part 72) and transportation (10 CFR Part 71) regulations for spent fuel has the potential to streamline the process for dual certification of DSSs, i.e., both storage and transportation. The potential benefits associated should be pursued, but care should be taken to address the significant challenges in harmonizing these two regulations for spent fuel. These challenges include: 1) current differences in technical approaches for these two regulations, 2) lack of a change control process in transportation (equivalent to 10 CFR 72.48), and 3) differences in the licensing terms of the two regulations. In addition, the fundamental scope of the two regulations is dramatically different. These differences must be resolved prior to pursuing harmonization of the regulations, which is depicted in Figure 1. Thus, a rulemaking to pursue such improvements would benefit from additional discussions with stakeholders prior to being initiated.

Although the NRC did not state any potential changes beyond those for retrievability and the role of cladding integrity, we have identified three potential changes. These include a change control process for spent fuel transportation, consistent storage and transportation, and streamlined dual certification. Other questions should be explored in the discussions leading up to an NRC decision on whether to initiate a rulemaking on harmonization of 10 CFR Part 71 and 10 CFR Part 72, including whether these two regulations should be combined and how would this affect non-spent fuel transportation; if 10 CFR

Part 71 should establish a new sub-part dedicated solely to spent fuel transportation; or if a new part of the regulations needs to be established in order to address a new category of simultaneous-dual certification for storage and transportation of spent fuel.

Nonetheless, we believe that improvements to the regulatory framework for retrievability, clad integrity and safe handling is one piece of the integration of the regulations, that this piece can proceed based upon current understanding, and that it does not depend upon resolution of the broader considerations regarding integration of the regulations. Additionally, we provide the following considerations as the broader topic of integration is evaluated.

4.1. Change Control Process for Transportation

A change control process for transportation, 10 CFR Part 71, should be pursued for spent fuel packages. It is noted that several other regulated activities by the NRC include a regulation for a change control process. The most widely known is for reactor operation in 10 CFR 50.59, and for ISFSIs and DSSs in 10 CFR 72.48. These change control processes are essential to an efficient and effective regulatory framework. They permit licensees and CoC holders to evaluate proposed activities in order to determine whether these activities require prior NRC review and approval. This reduces the need for NRC resources to review and approve proposed activities of little or no safety significance and ensures that changes beyond a certain regulatory threshold are reviewed by the NRC.

We believe that a change control process similar to 10 CFR 72.48 is currently needed in the existing regulatory framework of 10 CFR Part 71 for dual purpose transportable DSSs. In the current regulatory framework, if a DSS is dual certified for storage and transportation, and the CoC holder makes a change pursuant to 10 CFR 72.48 in the storage licensing basis, this change could require prior NRC review and approval for transportation under 10 CFR Part 71. This results in significant regulatory inefficiencies for dual-certified DSSs. It is noted that while the NRC has provided guidance in ISG-20 for changes to transportation packages without prior NRC approval, the changes permitted through this guidance are very limited and much more restrictive than what equivalent change control processes provide for in other parts of the regulation (10 CFR 50.59 and 10 CFR 72.48). While we appreciate the flexibility of ISG-20, it is insufficient to achieve regulatory clarity and stability, and lack of a change control process in 10 CFR Part 71 for spent fuel packages is a barrier to harmonizing 10 CFR Part 71 and 10 CFR Part 72.

4.2. Consistency of Certification Term

The certification term for spent fuel transportation packages should be revised and made consistent with the certification term for DSSs. Currently, a spent fuel transportation system CoC (the transportable DSS, or the transportable DSS and transportation package) term is five years, requiring renewal every five years. In contrast, the DSS certification term is up to 40 years with subsequent 40-year renewals. While a five-year license term may be appropriate for some of the packages regulated under 10 CFR Part 71 (packages to transport non-spent nuclear fuel radioactive materials), it is not necessary for DSSs that are also certified for spent fuel transportation. The differences in certification terms between storage

and transportation result in regulatory inefficiencies and are a barrier to harmonizing 10 CFR Part 71 and 10 CFR Part 72. A certification term of up to 40 years for the transportable DSS would improve regulatory efficiencies, making it easier to maintain dual certification of DSSs. If necessary, the transportation package could retain a five-year certification and renewal term, since these packages could be used several times during their certification term.

4.3. Requirement for DSSs to be Transportable

An option to streamline dual certification of storage and transportation could provide substantial benefits; however, a requirement for all DSSs to also be transportable, or even to couple all storage certifications/licenses with transportation certifications,[p] is not necessary to ensure safety and could be problematic. While such a requirement may provide operational efficiencies by ensuring that there is no potential need for repackaging prior to transportation, the additional transfer of fuel from a DSS to a transportation package can be, and has been repeatedly demonstrated to be, performed safely.

In general, the industry prefers to utilize transportable DSSs. In fact, most DSS technologies available in the market today are designed to also be transportable. However, due to the current regulatory framework for transportation certification (including the lack of change control process for transportation and differences in certification terms), not all of these DSS designs have been submitted for transportation certification. Further, potentially protracted NRC review times for certification under one regulation would unnecessarily delay certification under the other regulation if the certifications were combined. This is problematic because many times there are licensees that depend upon a timely storage certification in order to load spent fuel and ensure unfettered spent fuel management operations.

While the industry supports the options to receive dual certification at the same time, there is no safety benefit to requiring it for all applications. It is also premature to consider requirements for simultaneous dual certification as part of an effort to harmonize 10 CFR Part 71 and 10 CFR Part 72, and consideration of this should be postponed until the pre-requisite improvements of a change process and consistent certification terms are implemented. If simultaneous-dual certification is proposed in a future rulemaking, risk-informed principles should be incorporated such that the additional efforts necessary to pursue such an option, is offset by reduction in efforts to demonstrate regulatory compliance in other areas.

---

[p] This includes both simultaneous certification (storage and transportation certifications approved concurrently) and contemporaneous certification (storage and transportation applications submitted together and certified around the same time in order that the storage certification has reasonable expectations that the transportation certification could be approved).

5. References

[1] "Retrievability, Cladding Integrity and Safe Handling of Spent Fuel at an Independent Spent Fuel Storage Installation and During Transportation," *Federal Register* 78FR3853, January 17, 2013.

[2] "Request for Comment Retrievability, Cladding Integrity and Safe Handling of Spent Fuel at an Independent Spent Fuel Storage Installation and During Transportation," US NRC, ADAMS Accession No. ML12293A434, January 17, 2013.

[3] "Staff Requirements - COMSECY-10-0007 - Project Plan for Regulatory Program Review to Support Extended Storage and Transportation of Spent Nuclear Fuel," US Nuclear Regulatory Commission, December 6, 2010.

[4] "Petition to 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'", Letter from A. Petriengelo, NEI to A. Vietti-Cook, US NRC, October 3, 2012.

[5] "Spent Fuel Cask Certificate of Compliance Format and Content", *Federal Register* 78FR8050, Docket No. PRM #72-7, February 5, 2013.

[6] *Federal Register* 53FR31651; August 19, 1988.

[7] Proposed rulemaking leading to 1988 rulemaking; 51 FR 19106, May 27, 1986.

[8] Section 141(b)(1)(C) of the Nuclear Waste Policy Act (NWPA).

[9] ISG-2, Rev. 0 "Fuel Retrievability" (ADAMS Accession No. ML092800367).

[10] ISG-2, Rev. 1, 2010 (ADAMS Accession No. ML100550861).

[11] SECY-01-0076, ADAMS Accession No. ML011020520).

[12] "Environmental Assessment for 10 CFR Part 72 'Licensing Requirements for the Independent Storage of Spent Fuel and High-Level Radioactive Waste'," US NRC NUREG-1092, August 1984.

[13] "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," US DOE, January 2013.

[14] "The Nuclear Energy Institute's Petition to Intervene in the Matter of U.S. Dept. of Energy (High Level Waste Repository)," Docket No. 63-001, December 19, 2008.

[15] "Probabilistic Risk Assessment (PRA) of Bolted Storage Casks," EPRI Technical Report 1009691, December 2004.

[16] "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant," US NRC NUREG-1864, March 2007.

[17] "Spent Fuel Transportation Risk Assessment," US NRC draft NUREG-2125, May 2012.

[18] "Risk-Informed Decision-making for Nuclear Material and Waste Applications," US NRC, Revision 1, February 2008.

[19] "Impacts Associated with Transfer of Spent Nuclear Fuel from Spent Fuel Storage Pools to Dry Storage After Five Years of Cooling, Revision 1," EPRI Report # 1025206, August 2012.

Appendix A

The Industry's Integrated Plan for Regulatory Framework Improvements for Spent Fuel Storage and Transportation

The industry's integrated plan for regulatory improvements for spent fuel storage and transportation (10 CFR Part 72 and 10 CFR Part 71) are based upon over 20 years of successfully and safely implementing the regulations; acknowledgement of the need for a holistic approach to regulatory improvements, as well as the need to better risk inform the regulatory framework;[a] and recognition of on-going regulatory framework improvements.[b] After extensive evaluation, we determined that there was a subset of potential changes that: 1) are essential to achieve needed improvements to regulatory efficiency and effectiveness, 2) can only be achieved by amending the regulations, and 3) are not currently being pursued or considered by the NRC. The changes proposed in Section 3 were determined to be foundational to improving regulatory efficiency and effectiveness, and are therefore included in this petition for rulemaking. The following discussion provides some background on the major driving forces for regulatory framework improvements proposed in this petition.

1. Lessons Learned

The existing 10 CFR Part 72 regulations governing the storage of spent nuclear fuel (SNF)at ISFSIs were originally established based upon a combination of the philosophies used to develop regulations governing the licensing of special nuclear material, 10 CFR Part 70, and transportation of radioactive materials, 10 CFR Part 71. Amendments to 10 CFR Part 72 have been made since the time of the original rule that have also incorporated the experience acquired through the regulation of nuclear reactors in 10 CFR Part 50. The regulatory framework for dry storage of spent fuel evolved in this manner because widespread and long-term use of dry storage simply was not anticipated, given the original expectation that spent fuel would be loaded directly into a transportation package for shipment to a repository or reprocessing facility and that storage space in spent fuel pools would be adequate up to that point.

While the current requirements ensure that dry storage can be accomplished safely over long periods of time, much has been learned over the course of the safe loading and storage of 1,700 DSSs in the past 25 years. This experience indicates that there is a need for a more risk-informed, performance-based

---

[a] NRC Tasking Memorandum from G. Jaczko to B. Borchardt, "Evaluating Options Proposed for a More Holistic Risk-Informed, Performance-Based Regulatory Approach," June 14, 2011.

[b] SRM-COMSECY-10-0007.

approach to the regulatory framework that takes into account the current maturity of the technology in order to improve efficiency and effectiveness.

While improving the efficiency of nuclear safety regulations may seem counterintuitive during a period in which additional NRC requirements are being promulgated in response to the Fukushima Dai-ichi accident, in reality, one of the lessons learned from this event is that processes for removing SNF from reactor sites must become more efficient. This situation makes a compelling point about the need to assure that spent fuel can be efficiently moved through a progression of steps that provide assurance of long-term safety —i.e., from pools, to DSSs, to centralized storage or recycling facilities, and ultimately to a repository. The current 10 CFR Parts 71 and 72 regulatory framework does not optimize this progression because it is not appropriately risk-informed. Improving these regulations based on risk insights and performance-based principles is not just a good idea; it is required to improve the level of protection of the public's health and safety.

2. Risk-Informing the Regulatory Framework

In April 2012, the NRC Risk Management Task Force, headed by NRC Commissioner George Apostolakis, issued NUREG-2150, "A Proposed Risk Management Regulatory Framework," encouraging the adoption of a more risk-informed approach to regulating dry storage of SNF. Section 4.7 of this report acknowledges the need to expedite rule changes and updates to regulatory guidance for SNF storage based on risk considerations. (Section 4.8 makes a similar recommendation for SNF transportation.) The recommended Option B states:

> This option would emphasize specific rule and guidance changes to the existing SNF storage regulatory approach to implement the Risk Management Regulatory Framework contained in the proposed Commission Policy Statement developed to adopt this framework. It would also apply the proposed risk management regulatory framework to the Commission-directed review of the paradigm of spent fuel storage. This would include substantive outreach to interim SNF storage stakeholders. It might involve forming a working group to determine where risk management might offer the greatest opportunities. These opportunities might include staff training on risk concepts, defense-in-depth (DID) and practical applications of risk methods (including development of qualified risk assessment staff), development of guidance and tools to support risk-informing regulatory activities, and guidance and rule changes that may result from activities related to extended storage and transportation.

There is already a strong basis to undertake an effort to improve spent fuel storage regulations based on risk insights. In 2006, two dry storage probabilistic risk assessments (PRAs) were published, one by the Electric Power Research Institute and one by the NRC staff. The results of these studies were presented at the August 28, 2006 meeting of the NRC's Advisory Committee on Nuclear Waste (ACNW). Both reached the same conclusion: The risks of dry storage ranged from very low to extremely low with latent cancer fatality (LCF) risk calculated to be between 2.0×10^{-12} and 1.7×10^{-13} per year. These risks, when

considered in the context of the NRC's safety goals, and compared to the 2 x 10^{-6} LCF/yr public and 1x 10^{-5} LCF/yr worker thresholds of negligible risk[c], indicate that there is substantial opportunity to improve regulatory efficiency by modifying requirements based upon risk insights. This conclusion should be recognized in regulatory improvement efforts.

In the case of dry storage of SNF (under 10 CFR Part 72), the NRC's regulatory framework appears to be graded in an inverse manner from what the risk insights would suggest. The safety systems for DSSs are much less complex, have lower probabilities of failure, and much less significant accident consequences than operating reactors. Nevertheless, implementation of the current regulatory framework by the NRC has resulted in an unnecessarily low threshold for regulatory intervention. In particular, the relatively high level of detailed information subject to NRC review and approval in Part 72 licenses and CoCs is not consistent with that for operating reactors when viewed from a risk perspective. The NRC's recent recommendation to implement a proposed risk management regulatory framework through selected guidance and rule changes provides an excellent opportunity to accrue significant benefits in dry storage and transportation regulation. We fully support this recommendation and within this response identify several regulations that we believe should be addressed in accordance with these recommendations, including how these regulations and supporting guidance should be updated.

3. Holistic Perspective

A holistic approach to improving the 10 CFR Part 71 and 72 regulatory framework for SNF would need to encompass not only the regulations themselves, but also the guidance documents that help both the NRC and the industry implement the regulations, along with the supporting technical bases for the regulations and guidance documents. Implementation of regulations, including the technical approach, should be consistent when similar regulations are established in multiple areas (for example 10 CFR 50.59 and 10 CFR 72.48). A holistic approach would ensure that methods acceptable under one area (e.g. Part 50), would also be acceptable under another area (e.g. Part 72).

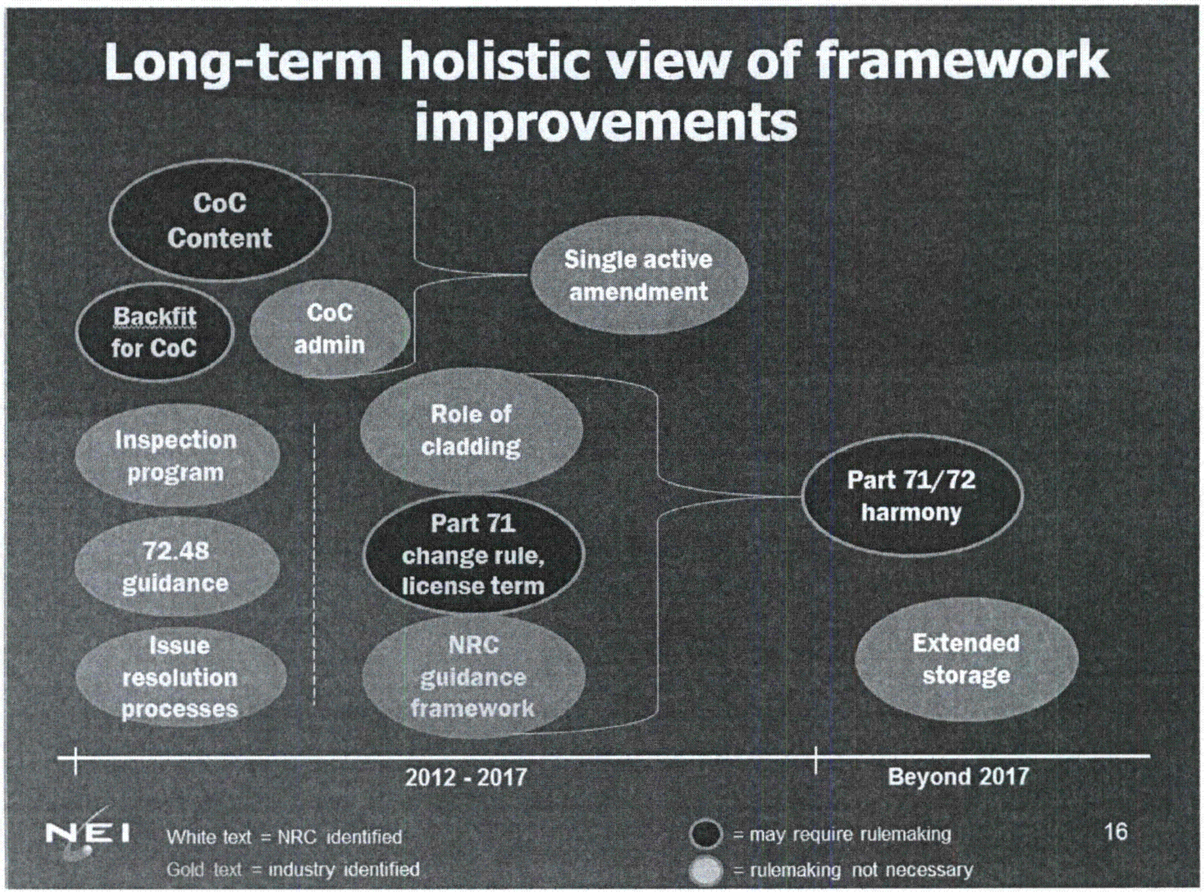
Both the industry and the NRC have identified several potential changes to the regulatory framework for spent fuel storage and transportation (10 CFR Part 72, and 10 CFR Part 71) that could result in overall improvements in the regulation of these activities. The industry has evaluated these potential improvements and has concluded that some are dependent upon prior implementation of other improvements, others are dependent upon concurrent implementation of other improvements, and some improvements have synergistic effects with other improvements. Figure A-1 provides an integrated view of some of the most significant improvements. The figure identifies which

---

[c] NRC's framework for "Risk-Informed Decision-making for Nuclear Material and Waste Applications," Revision 1.

improvements may require a rulemaking and some interdependencies. Details of these improvements are also explained.[d]

Figure A-1: Holistic View of Framework Improvements



(1) **The industry's 2012 Petition for Rulemaking (PRM-72-7)** – The industry conveyed the fundamental importance of improving the content and format, including criteria, for ISFSI CoCs and TSs. These improvements must be made through rulemaking in order to achieve the necessary regulatory durability and stability, and are necessary before some other improvements in the storage and transportation regulatory framework can be made. In addition, the industry's PRM identifies that the backfit provision of 10 CFR 72.62 must be extended to CoCs and CoC holders in order to full achieve regulatory stability and

[d] The improvements related to "Retrievability, Role of Clad Integrity and Harmonization of 10 CFR Part 72 and 10 CFR Part 71" are not described here, since they are the subject of the main body of this document.

consistency. Other minor changes to the rules were identified that should be made if a Part 72 rulemaking proceeds

(2) **Streamline DSS Certification Process** – This improvement relates to the rulemaking process currently required for the initial CoC and subsequent amendments to the CoC. The industry believes improvements to the certification process are needed and recognizes that the NRC also has on-going efforts to identify improvements in this area. We initially investigated the potential for eliminating the rulemaking process for CoC amendments but noted a prior PRM in 2000 that made a similar request and was denied. After reviewing the history of this prior attempt and experience since, we determined that elimination of the requirement to issue rulemaking for CoC amendments may not be advisable. We believe some improvements to the certification amendment process (e.g., rulemaking concurrent with staff safety evaluations and ability to make corrections to CoCs without rulemaking), could be performed without rulemaking and should be pursued in the near term. Other improvements to the certification amendment process (e.g., a single active amendment) should only be made after pre-requisite improvements are made (the near-term certification improvements and the industry's PRM).

(3) **General License Process and Interface between Parts 50 and 72** – This improvement relates to improved clarity on the implementation of the general license and activities at the interface of Part 50 and Part 72 requirements (e.g., site hazards analyses and DSS loading, handling, and unloading activities performed in a Part 50 licensed facility). Based on lessons learned from operating experience and NRC inspections, the industry believes that guidance in this area, perhaps developed by industry and reviewed by the NRC, will be beneficial, and is interested in further discussion of this topic with the NRC.

(4) **Implementation of 10 CFR 72.48** – This improvement relates to the industry-developed, NRC-endorsed guidance governing implementation of the 10 CFR 72.48 rule, currently NEI 96-07, Appendix B, endorsed in Regulatory Guide 3.72. The industry submitted a comprehensive update to the NEI guidance for implementing the 10 CFR 72.48 regulatory requirements for NRC endorsement in September 2012.[e] Endorsement of this updated guidance will improve program implementation by CoC holders and licensees and clarify the use of the rule for NRC inspections.

(5) **Moderator Exclusion** – This improvement relates to the capability of a transportation package design to prevent the intrusion of moderator into the fuel cavity. The Commission directed the NRC staff to further investigate the use of burnup credit prior to reconsidering a rulemaking for moderator exclusion.[f] Recently issued Revision 3 to ISG-8, *Burnup Credit in the*

---

[e] NEI Letter from M. Nichol to NRC E. Benner "Submittal of NEI 12-04, *Guidelines for 10 CFR 72.48 Implementation,* Revision 0, dated August 2012," September 10, 2012.

[f] SRM-SECY-07-0185, "Moderator Exclusion in Transportation Packages."

Criticality Safety Analyses of PWR Spent Fuel in Transport and Storage Casks, has expanded the acceptable manner for applying burnup credit in package criticality analyses. Furthermore, there has been experience in implementing ISG-19, *Moderator Exclusion Under Hypothetical Accident Conditions and Demonstrating Subcriticality of Spent Fuel Under the Requirements of 10 CFR 71.55(e).* To further build on these improvements, and as these activities may satisfy the prerequisites communicated by the Commission, we are interested in discussing with the NRC the potential to re-initiate a rulemaking for moderator exclusion.

(6) **Inspection Program** – The NRC has an on-going effort to make improvements to the 10 CFR Part 72 inspection program, and industry has provided input at public meetings and through formal correspondence.[8] We look forward to further progress in the NRC's efforts and the opportunity to provide additional input as appropriate. We recognize that rule changes that place more information under licensee control, as those proposed herein, and a highly effective inspection program that gives the NRC confidence in the ability of licensees and CoC holders to effectively carry out this responsibility, are two improvement elements that go hand in hand.

(7) **Interim Staff Guidance** - In order to provide a stable and predictable regulatory environment, much care and attention needs to be placed on the process of establishing and maintaining the relevant NRC guidance, e.g., Regulatory Guides (RGs), and Standard Review Plans (SRPs). In the current implementation of spent fuel storage and transportation regulations, many regulations are interpreted through Interim Staff Guidance (ISG) (some in existence for over ten years), and the ISGs are expected to be used by applicants, licensees and CoC holders. However, an ISG is intended to be a temporary measure to modify NRC staff review guidance, and hence lacks the durability and stability of a RG, which is intended to be used by the industry. There are also several SRPs that are applicable to dual-purpose transportable DSSs (DSSs that are certified for storage and transportation)—e.g., NUREG-1536, NUREG-1567, NUREG-1617, and NUREG-1927—for which there is a significant amount of overlapping guidance (often consistent but not in all cases), and which all in some way reference one or more common ISG(s).

Some of these SRPS have had the ISGs incorporated and some have not, further creating confusion. Ease of creation and multiple SRPs addressing the same review topics may be reasons the NRC desires to place ISGs as a centerpiece of the regulatory framework, and the reason the ISGs have proliferated and remain active indefinitely. Unfortunately, this regulatory structure of managing generic technical issues, establishing Industry guidance for applicants and interpreting regulations through ISGs, multiple overlapping SRPs and the

[8] NRC Letter from A. Mohseni, *et al.* to NEI D. Weaver, *et al.*, "Licensing, Inspection and Enforcement Programs Review for Storage and Transportation – Working Group Report," December 14, 2011.

relatively few RGs presents a challenge to ensuring straightforward application of the regulatory framework and results in a decrease in regulatory clarity, efficiency and effectiveness.

Retiring existing ISGs and significantly limiting their future use through improvements to processes for configuration control, updating of SRPs, and use of RGs and other more appropriate regulatory tools, is an essential activity in a holistic approach. We look forward to working with the NRC, and further communicating the industry's thoughts, on achieving a more straightforward regulatory framework by implementing improvements to the organization of the network of guidance documents.