Division of Spent Fuel Management
Interim Staff Guidance – 2, Revision 2

Issue: Fuel Retrievability in Spent Fuel Storage Applications

Introduction:

This Interim Staff Guidance (ISG) provides guidance to the staff for determining whether an application submitted under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 72 (Ref. 1), "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste" sufficiently demonstrates that the system is designed to allow ready retrieval of spent fuel. U.S. Nuclear Regulatory Commission (NRC) inspectors use the ISG and Inspection Procedures IP-60854 and IP-60855 (Ref. 2 and Ref. 3) during inspections to verify that licensees comply with 10 CFR 72.122(l). This ISG does not apply to submitted applications seeking approval under 10 CFR Part 71, "Packaging and Transportation of Radioactive Material" (Ref. 4). This guidance is not a regulation or a requirement as it addresses options to meet the regulation. Additionally, applicants may propose alternate methods to comply with the regulation which would be evaluated on a case-by-case basis. A background section is included in Appendix A.

Regulatory Basis

The regulations for safe storage of spent nuclear fuel for licensees are in 10 CFR Part 72. Retrievability is specifically mentioned in 10 CFR 72.122(l), which states that "storage systems must be designed to allow ready retrieval of spent fuel, high-level radioactive waste, and reactor-related greater than class C waste for further processing or disposal." The NRC interprets this regulation to require that a storage system be designed to allow for ready retrieval in the initial design, amendments to the design, and in license renewal, through the aging management of the design. Retrievability is applicable only during normal and off-normal conditions; it does not apply to accident conditions (Ref. 5). The retrievability requirement applies to all general licensed and specific licensed independent spent fuel storage installations (ISFSIs), including wet storage ISFSIs, however most of current licensed ISFSIs use only dry storage. 10 CFR 72.236(m) states that certificate of compliance (CoC) holders should design for retrievability; "[t]o 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."

Applicability:

The staff will apply ISG-2, Rev. 2 in reviewing ISFSI applications conducted in accordance with NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems" (Ref. 6), NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities" (Ref. 7), or NUREG-1927, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel" (Ref. 8 and 9).

This revision of ISG-2 redefines retrievability and supersedes the definition of retrievability in NUREG-1536, NUREG-1567, and NUREG-1927 and applicable storage

ISGs. The previous revision of ISG-2, Rev. 1 (Ref. 10) is superseded in its entirety by ISG-2, Rev. 2.

Technical Review Guidance

ISG-2, Rev. 2 defines ready retrieval as "the ability to safely remove, with no operational safety problems, the spent fuel from storage for further processing or disposal." In order to demonstrate the ability for ready retrieval, a licensee should demonstrate it has the ability to perform at least one of the following actions safely and with no operational safety problems:

A. remove individual or canned spent fuel assemblies from wet or dry storage,
B. remove a canister loaded with spent fuel assemblies from a storage cask/overpack,
C. remove a cask loaded with spent fuel assemblies from the storage location.

The NRC's licensing reviews and inspection oversight of the design, fabrication, construction, and operation of an ISFSI, assures the requirements of 10 CFR Part 72, including retrievability, are maintained during the initial storage period. When spent fuel is stored beyond the initial NRC-approved period of operation, 10 CFR 72.42 requires a licensee renew its storage license. Applications for renewal must contain revised technical requirements and operating conditions (fuel storage, surveillance and maintenance, and other applicable 10 CFR Part 72 requirements) that address aging mechanisms and aging effects that could affect structures, systems, and components (SSCs) relied upon for the safe storage of spent fuel. The renewal application must include (1) time-limited aging analyses (TLAAs), if applicable, that demonstrate that SSCs important to safety will continue to perform their intended function for the requested period of extended operation, and (2) aging management programs (AMPs) for management of issues associated with aging that could adversely affect SSCs important to safety.

In verifying that all applicants for an initial ISFSI license or an ISFSI license amendment meet the retrievability requirement of 10 CFR 72.122(l), the reviewer must find there is reasonable assurance the storage system design allows for ready retrieval by the use of option A, B, or C or a combination of the options. A dry storage system may demonstrate retrievability by the use of known and controlled fuel selection, limits on the loading temperature, known atmospheric environment, and transfer cask or canister temperature control (Ref. 11 and 12). The reviewer should also verify that applications for all storage systems identify the SSCs important to safety and the SSC subcomponents that are relied upon for ready retrieval. The reviewer should further verify that the Technical Specifications (TSs) included in the application provide for the maintenance of SSCs relied upon for ready retrieval. The revised definition of retrievability does not obviate the need for appropriate control of parameters during loading, vacuum drying, and transfer to the storage location (e.g., dry storage pad).

When an applicant for an initial ISFSI license or an applicant for an amendment to an ISFSI license relies on Option A to demonstrate ready retrieval, the reviewer should confirm that the applicant demonstrated the fuel assemblies will not exhibit gross degradation, and will be removable. Additional review will be needed in the case where there is an assembly with gross degradation or an assembly contains rods with breaches greater than a pinhole leak or a hairline crack (i.e., gross ruptures that could lead to release of fuel particulates per ISG-1, Rev. 2 [Ref. 12]). The reviewer should confirm

that the applicant demonstrates the fuel assembly can be placed inside a secondary container, as described in ISG-1 as a “can for damaged fuel.” The secondary container must confine the fuel particulate to a known volume and be capable of removal without posing operational safety problems.

If an applicant for an initial dry storage ISFSI license or an applicant for an ISFSI license amendment relies upon Option A to demonstrate ready retrieval, it is likely the storage cask/canister will, at some point, need to be moved from the storage location to a location where the spent fuel assemblies can be removed from the cask/canister. When the reviewer anticipates that the cask/canister will have to be moved, the reviewer should confirm the applicant relying upon Option A to demonstrate ready retrieval, also demonstrates ready retrieval under Option B or Option C. This is consistent with the previous guidance on fuel retrievability.

When an applicant for an initial ISFSI license or for an ISFSI license amendment demonstrates ready retrieval with Option B or Option C, the continued ready retrieval of the storage system should be addressed in its TS. However, in addition to the TS, an applicant may also propose to implement a program to identify, monitor, and mitigate possible degradation that could impact the intended function of the dry storage system’s SSCs and subcomponents of the dry storage system, that are relied upon to comply with the retrievability requirements.

The NRC reviewer of an application for renewal of an ISFSI license should verify the 10 CFR 72.122(l) retrievability requirement is met, by ensuring that the approved design bases for the item being relied upon in the option(s) chosen (e.g., fuel assembly, cask, or canister) to demonstrate ready retrieval, including any programs implemented, has not been altered. Additionally, the reviewer should verify that the AMPs and TLAAs provide reasonable assurance that the approved design bases will be maintained during the period of extended operation. This will include reviewing operating experience, including inspections and analyses performed during the initial storage period for ensuring SSCs relied upon for ready retrieval were maintained. The reviewer should refer to Draft NUREG-1927, Rev. 1 (Ref. 8) for additional guidance.

CoC holders and applicants for a CoC are not required by regulation to demonstrate retrievability under 10 CFR 72.122(l); however, 10 CFR 72.236(m), which applies to CoC holders, states that retrievability should be considered to the extent practicable in the design to consider removal of the spent fuel from storage, transportation, and ultimate disposition. When a CoC applicant for an initial certificate, amendment, or revision chooses to incorporate retrievability aspects, the reviewer should confirm the retrievability aspects are technically justified and verify that Part 72 requirements affected by retrievability are evaluated and met. This may include the NRC reviewer confirming that the design for the dry storage system includes an evaluation for potential degradation mechanisms for both the storage cask/canister and the spent fuel to assure that the design of the system has considered removal of the spent fuel from storage during the storage term. Note that the general licensee must comply with the retrievability requirement in 10 CFR 72.122(l), and should demonstrate that canister/casks meet the amendment loading requirements.

Recommendation:

This ISG recommends the following definition to be used by staff when evaluating Part 72 applications:

> Ready retrieval: The ability to safely remove, with no operational safety problems, the spent fuel from storage for further processing or disposal.
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> Acceptable means for removing the spent fuel from storage include the ability to perform at least one of the following actions safely and with no operational safety problems:
>
> A. remove individual or canned spent fuel assemblies from wet or dry storage,
> B. remove a canister loaded with spent fuel assemblies from a storage cask/overpack,
> C. remove a cask loaded with spent fuel assemblies from the storage location.

The staff recommends the definitions for ready retrieval be incorporated into NUREG-1536, NUREG-1567, and NUREG-1927. These definitions do not necessitate any actions for currently approved storage systems.

Approved: **[DRAFT]** _____

Mark Lombard, Director **Date**
Division of Spent Fuel Management

Appendix A

This Appendix is provided to give insight on the history and evolution of the regulatory requirement of fuel retrievability.

Section 141(b)(1)(C) of the Nuclear Waste Policy Act (NWPA) of 1982, as amended (Ref. 13), requires that each monitored retrievable storage (MRS) facility be designed "…to provide for the ready retrieval of such spent fuel and waste for further processing or disposal." The Nuclear Regulatory Commission (NRC) codified this portion of the NWPA in its 1988 final rulemaking "Licensing Requirements for the Independent Spent Fuel Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (Ref. 14), which added MRSs to the scope of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 72 and required retrievability for all independent spent fuel storage installations (ISFSIs), 10 CFR 72.122(l).

For general and specific licensees, the regulation regarding retrievability is 10 CFR 72.122(l), which requires that "storage systems must be designed to allow ready retrieval of spent fuel, high-level radioactive waste, and reactor-related greater than class C waste for further processing or disposal." It is supported by 10 CFR 72.122 (h)(1), which requires that, for 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." 10 CFR 72.236(m) directs that certificate of compliance (CoC) holders and applicants consider retrievably in cask design. The regulation states that, "[t]o 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."

Additionally, the NRC has previously recognized that "in the interest of decreasing radiation exposures, storage casks should be designed to be compatible with transportation and Department of Energy [DOE] design criteria to the extent practicable… to the extent that cask designers can avoid return of the spent fuel from dry cask storage to reactor basins for transfer to a transport cask before moving it off site for disposal" (Ref. 15).

The NRC staff's previous position on retrievability, as stated in interim staff guidance (ISG) - 2, Rev. 1 (Ref. 10), defined ready retrieval as "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."

The guidance for retrievability in ISG-2, Rev. 1 was developed when an operating repository was expected to be operating in the near future. As of 2015, the duration of the storage of spent fuel storage at an ISFSI or MRS remains uncertain. Therefore, the staff re-assessed the regulatory necessity and practical impact of maintaining and confirming the ability to handle an individual fuel assembly from the canister or cask by normal means as part of the guidance on retrievability.

The NRC's licensing reviews and inspection oversight of the design, fabrication, construction, and operation of an ISFSI, assures that the safety and retrievability requirements of 10 CFR Part 72 are maintained during the initial storage period. When spent fuel storage will continue beyond the initial NRC-approved period of operation, the NRC's storage regulations that 10 CFR 72.240 require that renewal applications contain revised technical requirements and operating conditions (fuel storage, surveillance and maintenance, and other Part 72 requirements) that address aging mechanisms and aging effects that could affect structures, systems, and components (SSCs) relied upon for the safe storage of spent fuel. The renewal application must include (1) time-limited aging analyses (TLAAs), if applicable, that demonstrate that SSCs important to safety will continue to perform their intended function for the requested period of extended operation, and (2) aging management programs (AMPs) for management of issues associated with aging that could adversely affect SSCs important to safety.

Under the guidance of ISG-2, Rev. 1, if a licensee's ability to demonstrate ready retrieval relies on the handling of each individual fuel assembly from a canister or cask by normal means, then periodic monitoring or inspections may be required to verify the condition of the fuel and the internal components of the storage system. Because of the difficulties in accessing the spent fuel and the interior components of some storage systems, opening the storage system may be necessary to conduct inspection, monitoring, and remediation. Opening a storage system is labor intensive, but more importantly, it exposes workers to additional dose, and particularly for welded canisters, may require breaching and reestablishing the confinement boundary with no additional safety benefit. Additionally, it is not current practice to open the storage system to verify fuel condition.

Consistent with the staff's ongoing review of the regulatory framework for spent fuel storage and transportation (see COMSECY-10-0007, Ref. 16), the staff began exploring alternatives to the guidance on the application of ready retrieval. The staff's review has centered on redefining the ability of the fuel assemblies to be removed from a canister or cask by normal means, but maintaining the ability of the canister or cask to be removed from the storage location. By redefining guidance on the ability to remove the individual spent fuel assemblies or canned assemblies by normal means and providing alternatives, the spent fuel would still be retrieved safely and be readied for transportation consistent with the law and regulations. In addition this approach assures that the confinement of spent fuel in dry storage is maintained without the potential negative impacts that could may accompany opening the storage system.

In an effort to engage stakeholders in this discussion and solicit stakeholder views, the staff held two public meetings on July 27, 2011 and August 16, 2012 (Ref. 17 and 18). Additionally, in January 2013, NRC issued a *Federal Register* notice (Ref. 19) requesting public comment on several topics, including retrievability. The NRC received 18 sets of comments on the *Federal Register* notice (Ref. 20). Staff work in this area was delayed until recently due to work on the storage renewal regulatory framework and high burnup fuel related activities. For this reason, the staff held an additional public meeting on July 29, 2015, to provide an update on the staff's work on retrievability (Ref. 21).

In addition to conducting the public dialogue, the staff considered the methods used in other countries for the dry storage of spent nuclear fuel and reviewed international guidance for spent fuel storage. The staff participated in several multilateral working groups related to extended spent fuel storage. The staff reviewed the International Atomic Energy Agency's (IAEA) Specific Safety Guide No. SSG-15, "Storage of Spent

Nuclear Fuel" (Ref. 22). This IAEA guide is consistent with the NRC's current position that spent fuel should be retrievable under normal and off-normal design conditions. The revision of ISG-2, Rev. 2 does not change this view. The IAEA's guidance states retrievability is also applicable during accident conditions, which differs from the NRC's position (Ref. 5).

This updated guidance, ISG-2, Rev. 2, presents a practical approach for implementation of fuel retrievability that will continue to protect public health and safety while reducing the negative impacts associated with the approach established in ISG-2, Rev.1.

References:

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4. 10 CFR Part 71. *Code of Federal Regulations*, Title 10, Energy, Part 71, "Packaging and Transportation of Radioactive Material." Washington, DC.

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