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WASHINGTON, D.C. 20585

Office of Nuclear Energy

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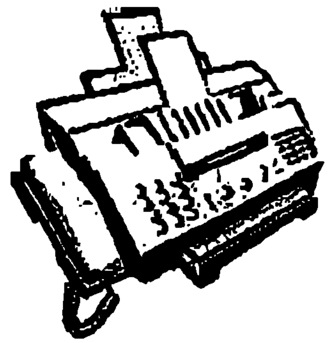

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Department of Energy

Washington, DC 20585

March 18, 2013

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Mail Stop: TWP-05-B01M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

DOCKET ID NRC-2013-0004 RESPONSES TO REQUEST FOR COMMENT ON RETRIEVABILITY, CLADDING INTEGRITY AND SAFE HANDLING OF SPENT FUEL AT AN INDEPENDENT SPENT FUEL STORAGE INSTALLATION AND DURING TRANSPORTATION

In response to the U.S. Nuclear Regulatory Commission's (NRC) request for comment in the Federal Register Notice Volume 78, Number 12 dated January 17, 2013; the U.S. Department of Energy's Office of Nuclear Energy (NE) is providing the enclosed Responses to Request for Comment on Retrievability, Cladding Integrity, and Safe Handling of Spent Fuel at an Independent Spent Fuel Storage Installation and During Transportation.

NE appreciates the NRC staff's ongoing review of the potential policy issues and requirements related to retrievability, cladding integrity, and safe handling of spent fuel as part of its evaluation of integration and compatibility between storage regulations and transportation regulations and for providing the opportunity for comment.

Please contact Syed Bokhari at (301) 903-8033 or email at Syed.bokhari@hq.doe.gov if you need further information.

Sincerely,

for

Monica C. Regalbuto
Deputy Assistant Secretary
for Fuel Cycle Technologies
Office of Nuclear Energy

cc: Peter B. Lyons, NE-1

Enclosure

U.S. Department of Energy's Office of Nuclear Energy Comments on the Nuclear Regulatory Commission's
Request for Comment for Potential Rulemaking 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

In response to the Nuclear Regulatory Commission's dated January 17, 2013 request for comments on potential rulemaking, the Department of Energy's Office of Nuclear Energy submits the following responses to the specific questions posed by the NRC in its Request for Comments on Retrievability, Cladding Integrity, and Safe Handling of Spent Fuel at an Independent Spent Fuel Storage Installation and During Transport (available in ADAMS under Accession No. ML12293A434). The specific questions raised in that document are repeated below in bold followed by the Office of Nuclear Energy's responses.

These are technical comments that do not take into account the contractual limitations under the Standard Contract. Under the provision of the Standard Contract DOE does not consider spent fuel in canisters to be an acceptable waste form absent a mutually agreed to contract modification. To ensure the ability to transfer the spent fuel to the government under the Standard Contract, the individual spent fuel assemblies must be retrievable for packaging into a DOE-supplied transportation cask.

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

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?*

<u>No</u>: An enhanced regulatory framework should include risk- informed, performance- based regulations for disposal that neither assume the licensee receiving spent fuel for disposal will choose to site and design a repository for direct disposal of high capacity canisters without repackaging, nor preclude a licensee from siting and designing a repository to do so. It is not clear that the direct disposal of high capacity canisters without repackaging will be feasible. DOE's Office of Nuclear Energy (NE) currently is evaluating the feasibility of directly disposing high capacity canisters. DOE will share information on the evaluation with the NRC and other interested parties as the work progresses. Site specific repository design considerations could have a direct bearing on whether high capacity canisters could be directly disposed or whether the spent fuel assemblies would have to be repackaged.

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?

<u>Yes</u>: An enhanced regulatory framework should consider the possibility that the repository licensee will need to be able to handle potentially degraded/damaged fuel on large production scales. An enhanced regulatory framework should assume that a repository licensee or repackaging facility licensee, not necessarily located at the repository, would be able to handle

the range of nuclear material within the limits of the licensing/technical specifications granted in its operating license. The enhanced regulatory framework should include risk-informed, performance-based criteria that the licensee should use to (1) characterize the quantities and condition of the nuclear materials it would repackage, using appropriate testing, analysis, and statistical means, and (2) design the repackaging facility to safely operate and meet applicable performance objectives. The enhanced regulatory framework should have the same applicable risk-informed, performance-based criteria regardless of whether repackaging was done as part of consolidated storage or repository development and operations, as repackaging capabilities may be necessary at either an interim storage facility or a repository.

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

The effects of a canister-based retrievability policy on a future reprocessing facility would generally be similar to the effects on a repackaging facility. The reprocessing facility licensee should be able to handle the range of nuclear material within the limits of the licensing/technical specifications granted in its operating license. An enhanced regulatory framework should include risk-informed, performance-based criteria that the licensee should use to (1) characterize the quantities and condition of the nuclear materials it would reprocess, using appropriate testing, analysis, and statistical means, and (2) design the repackaging facility to safely perform the reprocessing operations to meet those applicable performance objectives. A canister-based retrievability policy could lead to the reprocessing facility operator having to deal with greater variability in the condition of spent fuel that it handles, and that variability would need to be addressed in the facility design.

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

In addition to cost, dose and timing, the decision to implement a canister-based retrieval policy should also consider spent fuel degradation, decay heat, and technology options. Also, issues associated with the transport of high burnup spent fuel need to be considered. R&D on the ability for high burnup spent fuel to withstand the rigors of the transport environment should continue. This involves development of high burnup cladding material properties (e.g., Ductile to Brittle Transition Temperature (DBTT), ductility, strength and strain characteristics), as well as determination of loading functions transmitted to the cladding during transportation operations.

Another consideration should be the fact that the dose associated with repackaging at either a centralized storage or a disposal facility may be different from the dose associated with packaging done at reactor sites. Once spent fuel is consolidated at one or more facilities, opportunities for automation, such as fully remote canister welding, make dose comparisons between operations at reactor sites and centralized storage facilities more difficult.

B. Spent Fuel Retrievability During Storage

Given the uncertainty with the material properties of high burnup spent fuel, it is unclear whether some spent fuel may degrade during storage periods longer than 20 years and subsequent transportation. The NRC would like external stakeholders to provide an assessment of (1) whether ready-retrieval of individual spent fuel assemblies during storage should be maintained, or (2) whether retrievability should be canister-based.

Given the existing dry cask storage systems (DCSSs) deployed across the country, both canister retrievability and retrievability of individual spent fuel assemblies may be necessary during storage and subsequent transportation. Canister retrievability from a DCSS is necessary for placement of the canister into a transportation overpack, removal of a canister from the overpack, and its subsequent placement into another DCSS for interim storage, processing or disposal. Retrievability of individual spent fuel assemblies from canisters or casks (welded or with bolted closure) may be necessary during storage, if the canister/cask needs to be opened for repackaging of individual spent fuel assemblies for transportation and subsequent storage, processing or disposal.

The capability to use the canister as the retrieval boundary should be pursued as an alternative to the existing assembly based retrieval boundary. Unlike cladding that is designed primarily based on operational considerations, a canister can be designed and tested specifically to ensure safety during storage and transport. Also unlike cladding, a canister can readily be inspected and, if needed, repaired and/or replaced. These considerations point strongly toward basing primary safety considerations on canister rather than cladding integrity. However, measures that preserve cladding integrity or minimize the potential to enhance its degradation for flexibility or ease of future spent fuel management operations rather than relied upon as a safety function have merit.

For example, while the definition of ready-retrieval is a policy decision, multiple sites have had to deal with damaged fuel assemblies (e.g. top nozzle failure) (ADAMS: ML081690351) and have been able to "retrieve" the fuel assembly from the spent fuel pool for placement into a damaged fuel canister. Similar processes could be used for retrieving fuel that becomes damaged during dry storage if it were to be repackaged prior to transportation. Because the integrity of the spent fuel <u>cannot be monitored</u>, there will always be uncertainty with what is happening within the canister. Therefore, focus should be placed on what is important to safety. During spent fuel storage, the primary safety objectives are to ensure doses are below prescribed regulatory limits, maintain subcriticality, and ensure confinement. The function of ready-retrieval is to facilitate additional bare fuel handling operations, but this is not a storage safety issue.

As mentioned above, canister-based retrievability should be developed as an alternative regulatory position to the existing fuel-based retrieval. The majority of modern-day canister systems are designed to meet the requirements of storage and transportation. The majority of spent fuel is stored in pools for an extended period of time and goes through multiple handling operations prior to being placed in dry storage casks. During those operations, damage to spent fuel assemblies would normally be discovered, and the damaged fuel assemblies would be placed in canisters specifically designed to store damaged fuel assemblies. The remaining (undamaged) fuel assemblies would thus normally be deemed appropriate for placement into an inert environment for storage.

Canisters are designed to maintain confinement and can be monitored for signs of failure. Subcriticality is maintained through moderator exclusion during storage, which is assured if confinement is maintained. When a canister is being made ready for transportation, the contents of the canister will be evaluated for meeting the transportation and packaging requirements of 10 C.F.R. Part 71. Hence, from a safety evaluation standpoint, the canister system should be viewed in its entirety. Prior to any shipment, external dose rates and temperatures are required to be checked per 10 C.F.R. § 71.87. Additionally, the analyzed conditions of the canister's internal geometry will need to be justified prior to transportation (1) under normal conditions of transport and (2) after hypothetical accidents. Any canister that needs to be opened for inspection and repackaged should be dealt with on a case-by-case basis, but the majority of modern-day canisters have been designed with considerable amounts of conservatism to meet the requirements of transportation when placed into a transportation overpack.

C. Cladding Integrity

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?

Yes: There are multiple approaches that can be employed to protect spent fuel cladding from degradation and thus gross rupture. For example, sufficient cooling, adequate drying, helium refill, canister welding and monitoring should protect spent fuel cladding from degradation that leads to gross rupture during storage, and therefore should not pose operational safety problems with respect to its removal from storage. One should distinguish between cladding degradation and gross rupture. The ductility of irradiated cladding is expected to decrease with increased cooling time due to the reduction in cladding temperature. However, gross rupture of such cladding would only occur if internal plenum gas pressures were high, as may be associated with external loads imposed by off-normal events (e.g., drops) during handling. The internal gas pressure decreases with cooling time during storage, and off-normal loads would normally not be high enough to challenge cladding integrity for low burnup fuel.

The better the condition in which the fuel remains, the easier future handling of the fuel will be. Hence, current protection practices (drying, backfilling with helium, etc.) should be continued because they could prevent unwanted degradation. Eliminating current protection practices could make fuel handling activities more complicated and costly and lead to increased exposures to personnel. Safety requirements should focus on the entire system approach used, with various options available, not just the fuel cladding or fuel assembly performance alone.

The current protective measures used, such as drying restrictions and the use of helium fill gas, should be maintained. If fuel is to be removed from storage casks and repackaged, then the facility performing these operations will need to be able to handle damaged fuel assemblies properly. Operational safety aspects will need to be designed and engineered into the facility and its operations, as part of the facility license.

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, 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 NRC's retrievability policy decision making process.

<u>No:</u> Each high burnup spent fuel assembly should not be required to be individually canned to ensure individual fuel assembly retrievability.

Damaged fuel should be stored in cans designed to contain damaged fuel using current storage and transport regulations. As noted above, the dose associated with repackaging at either a centralized storage or a disposal facility should not be assumed to be equivalent to the dose associated with packaging done at reactor sites. Also as noted above, if the spent fuel packaging is centralized, opportunities for automation such as fully remote canister welding make dose comparisons to today's packaging techniques moot.

It is good practice to put individual damaged spent fuel assemblies into canisters before placing them in a storage cask. However, the current definition used for damaged fuel (≥1 mm through-wall crack) may need to be modified to specify a minimum crack width as well as a crack length, if possible loss of fuel particles through the crack is an issue. Fuel rods with pin-hole leaks and/or hairline cracks are currently considered as undamaged fuel.

D. Transportation Retrievability

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.

(a): A retrievability requirement should not be extended to transportation packages. The regulation at 10 C.F.R. § 71.55(d)(2) requires that, under "normal conditions of transport" i.e., under the tests specified in 10 C.F.R. § 71.71, "the geometric form of the package contents would not be substantially altered...." This requirement indicates that the fuel assembly should be in a condition that generally would allow for retrieval and repackaging if necessary. Such retrieval and repackaging would need to be done at a facility that is designed to accommodate such retrieval and packaging, while maintaining ALARA principles. Therefore, imposing the additional retrievability requirement for transportation packages under normal conditions of transportation would not be likely to improve safety.

(b) Yes: High burnup spent fuel may degrade such that damaged fuel must be handled when a package is opened after transportation. Therefore, appropriate steps should be implemented to keep the occurrence and level of damage to the fuel assemblies during transport to acceptable levels. During normal conditions of transport of high-burnup spent fuel, fatigue is a potential degradation mechanism if the cladding were already embrittled significantly by radial hydrides and with incipient cracks in the cladding surface. Research to learn more about high burnup fuel cladding material properties is ongoing. The results of the research will be used to inform effective management of high burnup spent fuel during transportation and subsequent handling.

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)?

No: While it would be beneficial if the applicant for a certificate of compliance were to provide a description of the design and operation of equipment and methods necessary to handle the damaged fuel in the background documentation supporting an application for a certificate of compliance, it is not necessary to include this material directly *in* the application for the certificate of compliance document, for the reasons discussed below. Such documentation should demonstrate that handling damaged fuel would be feasible. However, the capability to actually handle the damaged fuel properly would have to be demonstrated in the design and licensing documentation *of the facility that will open the package*, not by the applicant for the transportation package certificate of compliance. The licensee of the facility that will open the package should be given the flexibility to design facilities and equipment that handle a wide variety of transportation packages containing damaged fuel, and should not be committed to the designs and equipment that might be specified by each certificate of compliance holder. The facility licensee can set waste acceptance criteria and identify what types of information must be part of the shipping manifest with each cask, which it can synchronize with its facilities and equipment design to make its handling of packages containing damaged fuel feasible and compliant with safety requirements.