NUCLEAR ENERGY INSTITUTE

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Mr. E. William Brach
Director
Spent Fuel Project Office
Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Dear Mr. Brach:

On October 4, 1999, the NRC Spent Fuel Project Office (SFPO) provided a review of the Nuclear Energy Institute (NEI) document "Fuel Classification Protocol for Dry Fuel Storage." The protocol was written in support of ISG-1, "Damaged Fuel," to provide guidance for determining whether spent fuel is damaged or undamaged.

On January 20, 2000, NEI forwarded the "Fuel Classification Protocol for Dry Fuel Storage." Subsequently we have modified that submittal and provide the enclosed revised protocol to the NRC for endorsement.

Please contact me at (202) 739-8109 or by e-mail (lxh@nei.org) or, contact Alan Nelson at (202) 739-8110 or by e-mail (apn@nei.org), if a meeting is in order or if we can be of further assistance to you or your staff on these matters.

Sincerely,

Lynnette Hendricks

Lynnette Hendricks

Enclosure

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NMSS 2.4

Fuel Classification Protocol for Dry Fuel Storage and Transportation

Objective: **To specify an acceptable method that provides reasonable assurance in the classification of spent fuel assemblies as undamaged or damaged.**

Background

Classification of spent fuel assemblies as undamaged or damaged is an important element of utilities' planning for dry fuel storage and eventual transportation away from their reactor sites. Many utilities are now, or soon will be, planning to store spent fuel assemblies in dry fuel storage (DFS) systems that are licensed by the U.S. Nuclear Regulatory Commission (NRC). Spent fuel assemblies to be stored in these systems must meet certain requirements specified in the applicable specific license or Certificate of Compliance (general license). These licenses permit a certain amount of normal minor "damage" which does not present any safety issues during storage. Minor damage is anticipated in a small percentage of fuel assemblies during operation in the reactor core or during handling in the spent fuel pool. Spent fuel assemblies with damage no greater than the amount permitted by the license are classified as "undamaged", while those with damage exceeding that amount are classified as "damaged". The DFS system license either prohibits storage of fuel assemblies classified as damaged, or permits their storage subject to additional measures specified in the license. The threshold stipulated in the license above which a spent fuel assembly is to be considered damaged has varied somewhat among the licenses previously issued by the NRC and those currently under review by the NRC. Moreover, the licenses have typically not specified a method to obtain reasonable assurance that spent fuel assemblies are properly classified.

Since both the NRC and DOE are concerned with the issue of fuel classification, this protocol specifies an acceptable method to provide reasonable assurance that spent fuel assemblies are properly classified as undamaged or damaged consistent with the NRC interim staff guidance (ISG-1) and the existing DOE Contracts regarding failed fuel.

Discussion

Utilities may use either of two types of DFS systems. The first type is a "storage-only" system, which is licensed only for storage of the spent fuel.

(Subsequent transportation offsite would require the spent fuel to be repackaged into a transportation cask, also licensed by the NRC.) The other type is a "transportable" system, which is licensed for both storage and transportation. Generally, both types of DFS systems incorporate design requirements that make classification of spent fuel as undamaged or damaged necessary. These requirements are generally related to the ability of the fuel assembly to maintain fuel configuration as well as the structural integrity of the assembly for handling. More stringent design requirements are imposed on the transportable DFS systems because of the more severe conditions that must be addressed during transportation. Recently, the NRC staff has issued interim guidance (ISG-1) for storage and transportation that requires "canning" of damaged fuel that the NRC staff has defined as having "known or suspected cladding" defects greater than a hairline crack or a pinhole leak."

This protocol specifies an acceptable method to provide reasonable assurance that spent fuel assemblies are properly classified as undamaged or damaged consistent with the NRC interim staff guidance (ISG-1) and the existing DOE Contracts. Some latitude is provided to classify observed defects as undamaged for storage and transportation with appropriate engineering justification. The classification method of this protocol may need to be more restrictive in some cases than what is needed to meet the licensing requirements of certain previously licensed, storage only DFS systems. For those cases, the licensing requirements of a specific DFS system shall be met.

Screening Criteria for Fuel Classification

The following screening methodology depicted in figure 1 is an acceptable approach for classifying spent fuel as undamaged or damaged.

1. If fuel has no observable damage and no indication of operating leakage from reliable core history records then it may be classified as undamaged.

2. If operating records indicate the potential for damage, then previous operational fuel inspections (e.g., sipping, UT) and operating records may be used to classify fuel. If these inspections and records indicate no damage or the damage appears to be not greater than pinhole leaks or hairline cracks, then the fuel may be classified as undamaged.

   Fuel that is suspect based on Criteria 2 shall receive a detailed visual inspection as described in II. to assist in determining if it shall be classified as damaged or undamaged.

3. If the detailed visual inspection indicates no observable cladding damage and/or defects in excess of pin hole leaks and hair line cracks, and no internal fuel debris, the fuel assembly may be classified as undamaged. A channeled BWR fuel assembly that is suspect (i.e., core history records review, operating records review or external visual inspection of channel indicate possible damage) can either be classified as damaged, or it can be internally inspected to determine the condition by de-channeling or by other appropriate means such as a boroscope inspection.

4. If the inspection of the assembly indicates significant cladding defects, an engineering evaluation shall be performed to determine if there is reasonable assurance that the damaged area will still retain pellets and fuel particulates. The evaluation shall consider normal impact events for transportation and off normal events for storage. If such evaluation is positive, then it shall be documented and retained as part of the record for each fuel assembly. The assembly may then be classified as undamaged.

   Assemblies that can not meet Criteria 1 through 4 shall be classified as damaged fuel and packaged in accordance with NRC requirements.

5. In addition to Criteria 1 through 4, which address cladding integrity, any assembly that fails to meet the fuel bundle handling capability requirement of III. shall be classified as damaged fuel.

All fuel will receive an external visual examination for observable damage prior to loading it into a DFS. This examination need not include any special procedures or equipment other than the normal observations made during fuel handling and transfer.

The following protocols provide a listing of activities to attain reasonable assurance that damaged fuel has been appropriately classified.

I. Records

Historical records may be used to determine whether or not fuel assemblies are damaged. Records that provide a reasonable basis for this determination include:

- Operating History - Reactor core operating records indicating fuel integrity of fuel assemblies removed from a particular cycle.

- Operational Fuel Inspection Data - Sipping, ultrasonic testing, eddy current testing and profilometry, visual, or other technique that indicates fuel assembly cladding and structural integrity.

II. Visual Inspection

The following methodology is an acceptable approach to visually inspect spent fuel for evidence of structural integrity or damage to cladding which may require special handling for dry storage and transportation. This section provides guidance for personnel qualification, process, inspection methodology, and recommended records for visual inspections.

A. Personnel Qualifications

- Fuel inspectors should pass a visual acuity test in accordance with SNT TC-IA of the America Society of Non-destructive Testing.
- Fuel inspectors should be trained on the site-specific fuel inspection procedures.

B. Process

- Visual inspection should be performed with a camera inspection technique adequate to identify pinhole defects and cracks.
- A supplemental visual inspection of the internal condition of a suspect fuel assembly (i.e. with backlighting) for gross damage and loose fuel debris should be conducted when visual inspection is performed.
- Visual inspection should be videotaped.

C. Inspection Methodology

- The entire length of the assembly should be inspected on all four sides.
- Lighting should be adequate to detect reportable defects.

D. Records

- Fuel assembly identification should be documented.
- Structural cladding defects to be reported should include:
  - cracks
  - identifiable cladding breaches (i.e. holes)

- loose internal fuel debris
- broken or out of position fuel rods

III. Fuel Bundle Handling Capability

Relevant past history or current experience that indicates a fuel assembly can be grappled, handled, and moved in a normal manner is sufficient to demonstrate handling capability. Failures to meet this requirement shall be documented and the fuel assembly treated as damaged.

IV. Documentation

Documentation that may be used to determine the fuel assembly integrity relative to a damaged fuel classification may include one or more of the following:

- Reactor core operating records
- Operational fuel inspection data
- Visual inspection records
- Fuel assembly handling capability failures

FUEL CLASSIFICATION PROCESS

Figure 1