



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
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July 25, 2000

MEMORANDUM TO: Ashok C. Thadani, Director  
Office of Nuclear Regulatory Research

FROM: William F. Kane, Director  
Office of Nuclear Material Safety  
and Safeguards

SUBJECT: USER NEED MEMORANDUM – REQUEST FOR ASSISTANCE  
REGARDING A CASK DEMONSTRATION PROGRAM FOR  
HIGH BURNUP FUEL

The Office of Nuclear Material Safety and Safeguards (NMSS) requests assistance from the Office of Nuclear Regulatory Research (RES) regarding a Cask Demonstration Program for High Burnup Fuel. This is an extension to a prior user need request concerning the dry storage and transportation of spent nuclear fuel, and it is anticipated that both of these user need requests will be a cooperative program. The purpose of the program is to establish the technical bases to allow storage of high burnup fuel (in excess of 45 GWd/MTU).

Background

In accordance with 10 CFR 72.122 (h)(1), the spent fuel cladding must be protected from degradation that leads to gross ruptures or the fuel must otherwise be confined so that degradation of the cladding will not impose operational safety problems. Further, 10 CFR 72.122(l) also requires that the storage system be designed to allow ready retrieval of the spent fuel from the storage system. In accordance with 10 CFR 72.104 and 106, the source term data (crud activity, fines, etc.) must not exceed the limits defined in these sections.

Limited information exists to show that spent fuel having burnups in excess of 45 GWd/MTU will not undergo gross degradation during the storage licensing period. Further, some information suggests increased cladding oxidation, increased hoop stresses, and changes in the fuel pellet integrity will occur with increasing burnup to about 60 GWd/MTU. These burnup-dependent effects could potentially lead to failure of the cladding and dispersal of the fuel in the storage cask. With regards to the confinement analyses, no information exists regarding the characterization of the source terms for high burnup fuel (i.e., the inventory of radionuclides in high burnup fuels that have been discharged into the spent fuel pool).

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### Areas of Needed Assistance

The Spent Fuel Project Office (SFPO) has identified and prioritized four major areas where information is needed to support our licensing review:

1. Interim and post-storage visual examinations of the fuel in the cask to assess whether gross rupture has occurred during storage and of the storage cask internals to inspect for component failure.
2. Measurements of the mechanical properties of the cladding after the storage period is completed. This data would help staff assess the impact of transportation on the structural integrity of the cladding.
3. Interim and post-storage creep strain data to assess the residual creep strain capacity during and at the end of storage. For example, if it is practical to do so, creep strain measurements could be made by mounting strain gauges on the cladding to obtain interim data.
4. Measurement, characterization, and comparison of the source terms used in licensing basis evaluations. This area complements the RES work planned at Oak Ridge National Laboratory on high burnup nuclide inventories, which was requested in our user-need memorandum dated March 27, 1998. Since that memorandum was issued, our priorities for addressing high burnup issues have increased. Further, the Reactor Systems Branch (SRXB) of the Office of Nuclear Reactor Regulation has also expressed an interest in obtaining this data to benchmark some of its computer code calculations.

The cask demonstration program should verify that the cladding of spent fuel having burnups greater than 45 GWd/MTU will remain intact for the storage license period. Zircaloy-2, Zircaloy-4, Zirlo, and/or M5 clad fuels (or other newly developed cladding materials) should be considered in evaluating the effect of storage conditions on the properties of these cladding materials. If practical, high duty fuel (e.g., fuel that experienced two 24-month cycles) should be considered as candidate fuels for the program. Additionally, selection and pre-characterization of the fuel, selection of a cask from which the fuel can be removed with relative ease, pre-storage operations (i.e., vacuum drying and transfer operations) similar to those encountered at an Independent Spent Fuel Storage Installation (ISFSI), interim mechanical property/creep measurements and visual examinations of the fuel cladding, post-demonstration test visual examinations of the cask interior, and post-demonstration test mechanical property/creep measurements of the fuel cladding should be considered for the program. Also, the demonstration program may need to consider licensing ramifications since it involves commercial spent fuel.

This information will expand NRC's technical knowledge of the storage of high burnup fuel to support ISFSI facility licensing and cask certification. Furthermore, reactor licensees may avoid the cost of canning spent fuel if a demonstration can be shown that high burnup fuel is structurally intact for long-term storage.

By 2005, Nuclear Energy Institute estimates that some of the spent fuel pools may lose full core reserve capacity if there are no casks licensed to store high burnup fuels. As a result, SFPO expects to receive a large number of amendments for storage and transport of high burnup fuel. Therefore, SFPO requests the results of the proposed cask demonstration program by 2005.

A. C. Thadani

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We also request that SFPO and SRXB be a part of the discussions and decision making that may impact the program. Once the program has been completed and a technical basis established to allow storage of high burnup fuel, we request that a technical position paper or NUREG/CR document be developed.

Dr. Kimberly Gruss (415-8586) and Christopher Brown ( 415-1988) are the NMSS points of contact.

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