Acceptance Review for MP197 – Materials

- **<u>Request for Supplemental Information</u> (RSI):**

RSI – 1: May be Acceptable If: The applicant must address the deficiencies in the data base stated below, or treat all fuel with any cladding penetrations as damaged fuel and place in a damaged fuel can.

Criteria: Acceptance Evaluation of Addendum 10 f, g, h Dealing with Cladding Behavior. The applicant has provided insufficient justification that the conclusions drawn from the provided data is applicable to the conditions or contents of transportation

The three addendums deal with the behavior of the cladding. Addendum 10g "Fuel Integrity Project, Bend tests on as-irradiated fuel series 11, and 12" gave details of the sample characteristics, test apparatus to do 3 point bend tests, testing parameters and conditions, and results of the testing in the form of stress, displacement curves, and photos of the samples. Samples were fueled ~50 GWd/MTU Zircaloy-4, and -2 clad fuel rod segments. Tests were conducted at constant temperatures of 25C and 500C, and constant pressure.

The value of these tests appears small as there are no hydrogen levels stated, no decreasing stress to simulate potential hydride reorientation, and no pre-, or post- test metallography to indicate the hydride structure. Testing was only on Zircaloy cladding.

Addendum 10h provided many unidentified tables, and load deflection curves for the tests. There were also many plots of graphic deflection with no indication of how the curves were generated. The computer simulations are not an issue for the materials review.

Addendum 10f presented the analysis of the data in the other two addendums in an attempt to develop fracture toughness of high burnup cladding. Results at 50 GWd/MTU from the current tests were compared to fracture toughness measurements at lower burnups obtained from the literature. A linear extrapolation, based on the strain energy density concept that the staff does not except, was made to higher burnups. Major questions are: 1) the validity of a linear extrapolation , 2) data comparisons with no knowledge of the hydrogen levels of the current tests, and 3) applicability of results with no simulated drying affects/

This data is presented as proprietary but touches on a generic issue of high burnup fracture toughness. In order to approve this data for support of the fuel behavior, extensive review will be required of the addendums, references made in the addendums that the applicant would have to supply. Due to the far ranging implications of these addendums, and the conclusions drawn from the addendums, this issue would have been better treated in a topical report.

Use of this data for rods that are already breached (any size) breach) when loaded requires answers to points 1, and 2 above. All three points must be resolved before the data can be applied to rods that may breach after the cask is dried.

The staff does not consider this an acceptable approach as presented. In past applications the information supplied to justify the fracture toughness has been rejected. In TN-68 the applicant was told that the staff does not accept the methodology and they should remove it

from the application since it was not necessary. In TN Amendment 10, the margin between the calculated fracture toughness, and the measured fracture toughness was so great that the applicability of the data was not questioned further. See also RSI-1: Structural.

This information is required by the staff to verify the compliance with 10 CFR 71.71 and 10 CFR Part 71.73 regulations.

- **Observations:**

1) The applicant should revise to address the following: 1) the current definitions must be made consistent with the requirements of part 71 and the analysis must be provided. 2) The definition can be left as is, if the applicant shows that any assembly that is retrievable will remain in a configuration that is subcritical.

(Chapter 1.A all subsections, Definition of damaged fuel.)

The applicant has not revised the definition of damaged fuel, especially the assembly, to make it relevant to transportation. Almost all definitions of damaged fuel, submitted by the applicant, contain a statement that "The extent of the damage is to be limited such that a fuel assembly needs to be handled by normal means" or "…is able to be handled by normal means and retrievability is assured following normal and off-normal event". While logically desirable, there is no part 71 requirements for the retrievability of the spent fuel from the cask. This is a part 72 requirement. Part 71.55(d) does require that under normal conditions of transport, 1) the contents would remain subcritical, and 2) the geometric form of the package contents (i.e. the fuel and assembly) would not be substantially altered. Also Part 71.55(e)(1) requires that the fissile material must be assumed to be in its most reactive credible configuration consistent with the damaged condition of the package and the chemical and physical form of the contents. In other words the definition for transportation should not say that the assembly will remain retrievable but that for an assembly to be considered undamaged it must not contain flaws that will allow it to entertain a critical configuration.

The staff does not consider this an acceptable approach as presented. Without acceptable definitions of damaged fuel, the staff is unable to determine the physical condition of the assemblies and their subsequent behavior under accident conditions and inspectors will be unable to determine whether the proper fuel was placed in damaged fuel can.

2) The applicant should revise the SAR and reference in the CoC, to add a plan to ensure that for any DSC that has spent an extended time in storage, that the contents and DSC itself meet all the conditions in the CoC. This plan should include inspections to obtain data, or analysis to support that the: 1) the mechanical and thermal properties of the components of the DSCs related to safety, and 2) contents, have not degraded during the storage period.

No evidence was presented to indicate that the thermal and mechanical properties of the DSCs, or contents have not degraded during storage and are still applicable to the transportation evaluation. All the mechanical and thermal properties of the materials of construction of the DSC used in this part 71 request are for pristine materials. Many of the DSCs were constructed and loaded many years ago, and have been on the storage pad for a considerable number of years.

The staff does not consider this an acceptable approach as presented. The materials properties used for the evaluation of the safety systems and contents of the DSCs that have already been in storage service must be representative of the conditions at the time of transport, not at the time of the loading of the DSC.

3) The applicant should provide analysis that the acceptance and qualification plans for the neutron absorber in the DSCs are consistent with the current criteria designated in Standardized NUHOMS Amendment 10.

The guidance on the qualification and acceptance of the neutron absorber material has been evolving. The current staff guidance has been adopted in TN Amendment 10. Older qualification and acceptance criteria may not be as rigorous as the currently accepted guidance used for transport. See SAR Section A.8.1.7 where additional guidance on qualification and acceptance for the neutron absorber from storage to transportation is necessary.

- **Acceptance Review Results:**

The package may be acceptable – if the applicant provides information as described above in a timely manner to the staff, prior to any detailed review can begin.