TRANSNUCLEAR

DOCKET NO. 71-9302

REQUEST FOR SUPPLEMENTAL INFORMATION (RSI)

RELATED TO THE PROPOSED MODEL NO. NUHOMS®-MP197HB REVISION

Structural and Materials

RSI 2-1: Provide detailed descriptions of the Aging Management Program (AMP) that can effectively determine the conditions of the dry storage canisters (DSCs) and actively manage the aging of the canisters to assure that the DSCs can still perform their designed criticality safety function (i.e., preventing water from leaking into the DSC during transportation).

The package is designed to perform under the normal transportation cycle of (1) loading, package configuration, and testing; (2) actual transport performance under Normal Conditions of Transport (NCT) and Hypothetical Accident Conditions (HAC); and (3) receipt and unloading at a licensed facility. The staff's understanding is that fuel will be loaded intact and configured in a seal welded canister and then stored under a 10 CFR Part 72 license for an unknown period of time prior to actual transport. Data indicates that common types of high burnup fuel cladding may undergo ductile-brittle transition and become embrittled at different axial locations as the cladding temperature decreases (Waters NEI Forum 2012, Information presented at the recent NRC Technical Exchange in November 2011 by both Einziger (NMSS/SFST) and Machiels (EPRI)). The temperature of cladding will naturally decrease over time, however, the temperature profile for this fuel and expected state of embrittlement at time of actual transport has not been qualified. During actual transport, the performance of the cladding has not been adequately qualified under NCT stresses in a future embrittled condition.

INFORMATION INTENTIONALLY WITHHELD PER 10 CFR 2.390

Specifically, the applicant needs to consider an AMP for the various aging mechanisms such as general corrosion, stress corrosion cracking, etc. Regarding the specific details of the AMP, a description of all ten elements for all AMPs, as described in NUREG-1801 and NUREG-1927, will be helpful for the staff to evaluate the effectiveness of the AMPs. The In-Service Inspection Program, XI.M1, "ASME Section XI In-Service Inspection, Subsections IWB, IWC, and IWD" presented in NUREG-1801 may also be a good example for the AMPs to be developed for the DSCs.

This information is necessary for the staff to determine if the DSCs can perform their designed safety functions under 10 CFR 71.55.

RSI 2-2: Provide reasonable assurance that the temperature of the fuel cladding will remain above the ductile-to-brittle transition temperature (DBTT) and the cladding mechanical properties, based on the Geelhood and Beyer equations which are currently not applicable to cladding with reoriented hydrides, can be used for the structural evaluation of the fuel under NCT.

INFORMATION INTENTIONALLY WITHHELD PER 10 CFR 2.390

The yield and modulus were calculated using Geelhood and Beyer equations (U.S. Department of Energy, PNNL-17700, July 2008). This reference states that the data are not applicable to cladding that contained radial hydrides, which this fuel's cladding would have due to the drying process. Because Geelhood and Beyer are not applicable to cladding with radial hydrides, they show a continuous yield stress as the temperature is decreased. Information presented at the recent NRC Technical Exchange in November 2011 by both Einziger (NMSS/SFST) and Machiels (EPRI) indicates that, as the temperature drops below the DBTT, there is a discontinuity of the yield stress. The structural analysis by the applicant (SAR Appendix A.2.13.11) was done using the properties of the cladding at 622°F (327°C), which is well above the DBTT. It is possible that fuel stored for any substantial time may be below the DBTT; therefore, the calculations of the properties are at a temperature that may not be typical of NCT after long-term staorage. For these reasons, the staff cannot endorse the use of the yield stress and modulus used by the applicant in the evaluation of the behavior of the fuel under NCT unless the temperature at the time of transportation is above the DBTT.

In order to satisfy this RSI and use the Geelhood-Beyer report the applicant will need to:

1. Present data and analyses supporting the DBTT for the particular claddings being transported or a bounding DBTT. The analyses may consider the soluble hydrogen concentrations and precipitation in the cladding based on the heating and cooling cycles during canister loading operations.
2. Show that the minimum cladding temperature at the time of transport will be above the DBTT, as further requested in RSI 3-1.

This information is necessary to determine if the package meets the structural requirements of the fuel under NCT to meet the requirements of 10 CFR 71.43(d) and 71.55.

RSI 2-3: Provide a demonstration of compliance for the MP-197HB containment system with the regulatory requirements of 10 CFR 71.73(c)(5), 71.73(c)(6) and 71.61.

In sections A.2.7.5 through A.2.7.7 of Appendix A of the SAR, structural evaluations are performed to show compliance with the aforementioned regulations. Due to the reliance of the lid system for both containment safety and criticality safety (i.e., moderator exclusion), staff needs reasonable assurance that no water inleakage will occur under the HAC and immersion test requirements.

The foremost concern is that the structural analysis presented in the SAR for the package does not account for micro-scale effects or for the smaller parts of the containment boundary (for moderator exclusion, the water barrier), such as drain and vent ports, or the associated seals. While testing for containment leakage is standard, staff is concerned about the effects of directionality (inward versus outward) on leakage, especially in light of the required pressures (since the pressure requirements of 10 CFR 71.73(c)(6) and 71.61 are significant). A detrimental effect could occur on the containment boundary components. The seals, in particular, could potentially open paths for water in-leakage under inward pressure (which is not contemplated in standard containment leak testing).

This information is necessary to determine compliance with the regulatory requirements of 10 CFR 71.73(c)(5), 71.73(c)(6) and 71.61.

Thermal

RSI 3-1: Perform a thermal analysis to show that during NCT, the minimum spent fuel cladding temperature remains above the ductile-to-brittle transition temperature. The analysis should be performed considering the worst ambient conditions (e.g., cold weather) that will result in the minimum temperatures. Also, modeling and discretization errors of the analysis should be determined to obtain the uncertainty of the predicted temperatures.

This information is needed to determine compliance with 10 CFR Part 71 (71.71 and 71.73).

RSI 3-2: Perform the thermal analysis for the reconfigured fuel case by properly characterizing the reconfigured fuel with effective thermal properties that correspond to the assumed reconfigured geometry (with reconfigured fuel assemblies shifted entirely either towards the bottom or towards the top of the DSC).

INFORMATION INTENTIONALLY WITHHELD PER 10 CFR 2.390

This information is needed to determine compliance with 10 CFR 71.71.

Shielding

RSI 5-1: Provide the calculations and results for the package surface dose rates under NCT.

In accordance with 10 CFR 71.47(b)(1), under NCT, the surface dose rate must not exceed 10 mSv/hr (1000 mrem/hr) at any point of the external surface of the package for exclusive use. The SAR, however, does not provide information on the package surface dose rate. Staff requests the applicant to provide supplementary information on the package surface dose rate calculations and results to demonstrate that the package meets the requirements of 10 CFR 71.47(b)(1).

This information is needed in order for the staff to perform a detailed review of the package to determine compliance with 10 CFR 71.47.

RSI 5-2: Provide benchmark calculations for the assembly depletion analysis code TRITON for high burnup fuel.

The SAR indicates that benchmark calculations have been performed for the source term calculation code, TRITON, for high burnup fuel. However, the SAR does not provide specific information on how these benchmark calculations were performed. Staff requests the applicant to provide more detailed information on code benchmark calculations for isotopes that are important to shielding. In particular, the applicant is requested to provide information on the number of radiochemical assay samples used for each isotope, justification for using these samples, input and output files of the code benchmark calculation models, the method used to determine the correction to the isotopic concentrations and the associated uncertainties, and identification of trends with respect to burnup, cooling time, and key fuel design and depletion parameters.

This information is needed in order for the staff to perform a detailed review of the package to determine compliance with 10 CFR 71.47 and 71.51.

RSI 5-3: Provide test results that demonstrate that, after all of the tests as prescribed in 10 CFR 71.73, the package neutron shield will be able to retain a uniform layer of 25% of the original thickness and the layer remains attached to the aluminum tube walls that are facing the fuel basket.

The shielding analysis takes credit for 25% of the neutron shield material for the package under HAC; however, there is no clear information to support the justification for the credit. For the low burnup fuel contents, as approved in the current CoC, a penalty of one extra year of cooling time was applied to compensate for the uncertainty of the credit. Staff made the approval for the low burnup fuel contents based on engineering judgment. However, the same judgment may not be applicable to high burnup fuel because the neutron source from high burnup fuel has substantially higher contribution to the package dose rate. For this reason, it is necessary for the applicant to demonstrate that the neutron shield remains attached to the package body under the tests specified by 10 CFR 71.73. Specifically, 10 CFR 71.73 requires that the puncture, and free drop tests shall be so designed that these tests will result in maximum damage to the package. Section A.2.7 of the SAR does not provide sufficient information on the tests performed and the subsequent performance of the neutron shield after the tests. Staff requests the applicant to provide information on the tests performed and the testing results to demonstrate that these tests comply with 10 CFR 71.73, and that the test results indicate at least 25% of the neutron shield remains in a uniform layer attached to the aluminum tube walls facing the fuel basket. The descriptions and results of the tests need to address all aspects of 10 CFR 71.73 requirements, particularly those that require that all of the tests were so designed that maximum damage is applied to the package.

This information is needed in order for the staff to perform a detailed review of the package to determine compliance with 10 CFR 71.51.

RSI 7-1: Provide means and procedures that can be used to effectively determine the conditions of the high burnup fuel in the package prior to unloading and the procedures and facilities that are required to unload the reconfigured fuel, if necessary.

INFORMATION INTENTIONALLY WITHHELD PER 10 CFR 2.390

The applicant should provide in Chapter 7, “Package Operations,” procedures and detailed descriptions of the required tools for handling reconfigured fuel in the unloading process.

The applicant should supplement the unloading procedures in the SAR, Table A.7-5 with additional details for the package user and recipient facility to check the conditions of the fuel in the package prior to unloading to assess if the fuel remained intact. The staff requests that the applicant revise the operating procedures of the package to assure detailed loading and unloading procedures are in place to: (1) determine if the fuel has stayed substantially intact and (2) handle the reconfigured fuel if necessary. The applicant should describe procedures and handling equipment for unloading potentially reconfigured high burnup fuel in various potential damaged states (e.g., partial broken rods, significant separation of rods, or reconfigured debris within the individual cells of the package.

The applicant should also propose a CoC condition for notifying package users and the NRC if unexpected cladding damage is detected at future recipient facilities.

This information is needed in order for the staff to proceed to a detailed review of the package to determine compliance with 10 CFR 71.55(b) and 71.89.