"Structural, Thermal, and Criticality Safety Assumptions for Handling Naval Spent Nuclear Fuel in the IHF," Enclosure 1 to U#07-00413, March 12, 2007

Ref 3

Department of Energy
Washington, DC 20585

NR:RA:GFHolden U#07-00413
March 12, 2007

The Honorable Edward F. Sproat, III
Director
Office of Civilian Radioactive Waste Management
US Department of Energy
1000 Independence Ave. SW
Washington, DC 20585

Dear Mr. Sproat,

On October 4 and 5, 2006, representatives of the Naval Nuclear Propulsion Program (NNPP) met with BSC, Sandia, and DOE-RW staff in Las Vegas, NV. The meeting actions included the following:

- An NNPP action item to review the Initial Handling Facility (IHF) conceptual design and develop a list of assumptions to be used in the preclosure criticality analyses to demonstrate safe handling of naval spent nuclear fuel (SNF) in the IHF.

- A BSC, DOE, and NNPP action item to identify and resolve issues related to these assumptions, including how these assumptions will be captured in requirement documents.

This letter forwards the list of assumptions to be used in the preclosure safety analysis of naval SNF in the IHF. In addition, since there is not a complete set of event sequences for IHF operations at this time, NNPP has developed an equivalent list of assumptions for the thermal and structural analyses of the naval SNF canister. It is important to note that these assumptions only apply to event sequences when the naval SFC is in the IHF and not in the transportation configuration. NNPP is separately working with DOE staff and BSC to develop a strategy to show compliance of the transportation casks with applicable sections of 10 CFR 63 while in the Geologic Repository Operating Area.

The list of preclosure criticality, thermal, and structural assumptions is attached. The assumptions have been reviewed by DOE and BSC personnel (Low, Gardiner, Spezialetti, White, Wisenburg, and Tooker) and comments have been resolved or incorporated. Your assistance is requested to ensure that these assumptions are converted into specific IHF design requirements where appropriate to ensure the timely and accurate completion of NNPP analyses that support the License Application.

If you have questions, please direct them to Robert Gisch of my staff at 202-781-6128.

Very Truly Yours,

J. M. McKenzie
Director, Regulatory Affairs
Naval Reactors

Encl: (1) Structural, Thermal, and Criticality Safety Assumptions for Handling Naval Spent Fuel in the Initial Handling Facility (IHF)

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Structural, Thermal, and Criticality Safety Assumptions for Handling Naval Spent Fuel in the Initial Handling Facility (IHF)

The following assumptions have been derived from:

- NNPP review of the conceptual design drawings of the IHF
- Preliminary event sequences supplied to NNPP in November 2006
- Preliminary event sequences supplied to NNPP in January 2007
- Multiple discussions with BSC and DOE about the facility design
- Analysis performed to support previous surface facility designs

Preclosure Structural & Thermal

A. BSC expects to demonstrate that the following are the only off-normal conditions expected to occur in the IHF at least once during the building operational lifetime that NNPP needs to analyze:

1. A 1 in 100 year seismic event: Per the LA development schedule, BSC will develop preliminary IHF response spectra for the first and second floor by April 25, 2007. The information is scheduled to be finalized on July 2, 2007. BSC suggests that NNPP conservatively use BSC-supplied building spectra for the IHF during a 1 in 2,000 year seismic event for evaluation of naval spent fuel canister (SFC) seismic capacity.

2. Loss of Ventilation Event: BSC will design the IHF such that, once the transportation cask is open, the naval SFC external surface temperature shall not exceed 400°F during a loss of ventilation event lasting no more than 30 days.

B. BSC will design the IHF such that, once the transportation cask is open, the naval SFC external surface temperature shall be kept below 320°F for all normal operations. NNPP structural analyses for normal and pre-closure event sequences will assume that the external surface temperature of the naval SFC is 400°F.

C. NNPP will provide a single bounding source term for a breached naval SFC. The NNPP source term will bound the possible source terms from the following event sequences, which BSC expects to demonstrate have a probability of occurrence of at least 1 in 10,000 over the building operational lifetime. NNPP should be promptly informed of changes to the IHF design which result in event sequences exceeding the conditions of those listed below:

1. A flat bottom drop of the naval SFC into the open transportation cask or waste package from no more than 40 feet.

2. A drop of a canister lift adapter weighing no more than 5 tons onto the top surface of the naval SFC in an open transportation cask or waste package from no more than 10 feet. Geometry of canister lift adapter to be supplied by BSC.

3. A drop of a transportation cask containment cover or restraint onto the naval SFC inside an open transportation cask from no more than 40 feet.

4. A drop of a waste package inner vessel lid weighing no more than 2 tons onto the naval SFC inside an open waste package from no more than 40 feet.

5. A seismic event with a 1 in 10,000 chance of occurrence during the building operational lifetime while the naval SFC is in the transportation cask, waste package, or canister transfer machine. Per the LA development schedule, BSC will develop preliminary IHF response spectra for the first and second floor by April 25, 2007. The information will be finalized by July 2, 2007.

6. A collision of a naval SFC against the inside surface of the canister transfer machine during horizontal transit of no more than 75 ft/min.

D. NNPP will demonstrate that the following fire event sequences, which BSC expects to demonstrate have a probability of occurrence of at least 1 in 10,000 over the building operational lifetime, will not result in a breach of the naval SFC. Therefore, the source term for these fire events is zero.

1. A 30 minute, 800°C (1475°F) fire while the naval SFC is inside a sealed transportation cask in its transportation configuration.

2. A 2 minute, 1000°C (1832°F) fire outside of a bare naval SFC.

E. BSC expects to demonstrate that the following are expected to occur at a frequency of less than 1 in 10,000 (i.e., beyond Category 2) over the preclosure period. As a result, NNPP will not evaluate any of the following.

1. An IHF building collapse affecting the naval SFC or transportation cask.

2. Lightning strikes, tornados, missile impacts, high winds, and aircraft impacts affecting the naval SFC or transportation cask while in the IHF.

3. Any event sequence in the subsurface facility resulting in a waste package breach.

4. Any explosion, owing to any failure mode, which causes a breach of the naval SFC while in the IHF.

Criticality Safety Assumptions for Handling Naval Spent Fuel in the IHF: Given the current incomplete status of pre-closure event sequence development and analysis, NNPP must assume that certain event sequences (e.g., seismic events, drop of a naval SFC, drop of components on a naval SFC, etc.) could result in a breach of a naval SFC with possible rearrangement of the naval SNF contents. As a result, to reduce the probability of criticality following such events to beyond the Category 2 criterion, NNPP must assume that features will be incorporated into the IHF design to mitigate the introduction of moderator into a breached naval SFC as part of such event sequences. Without these mitigation features, it may not be possible to demonstrate that the resultant configurations remain subcritical.

A. Moderator Control: All areas that will handle bare naval SFCs or naval SFCs contained in an unsealed overpack (either waste package or transportation cask) have sufficient moderator controls in place so that the accumulation of moderator within a breached naval SFC is a beyond Category

2 event sequence. Examples of features that could be engineered into the IHF design to provide such controls are:

- Use of floor drains to prevent moderator from accumulating in the bottom of the naval SFC
- Watertight doors, barriers and seals to prevent moderator from entering the areas
- Incorporating design features to prevent lubricants or hydraulic fluids coming into contact with naval SFCs
- Fire suppression systems that can be isolated in the event of a breached naval SFC

This list is neither mandatory nor comprehensive, but is provided to identify the types of features that could be incorporated into the IHF design to meet the required moderator controls.

B. Moderators: If future development and evaluation of event sequences determines that a breach of a naval SFC and rearrangement of the naval SNF contents is a very low probability event, the moderator controls discussed in paragraph A might be relaxed. However, it may be necessary to limit the other hydrogenous materials. Consequently, controls should be incorporated so the only neutron moderator materials present in any part of the IHF where bare naval SFCs or naval SFCs contained in an unsealed overpack are handled are water or other hydrogenous materials such as hydraulic fluids (e.g., polysiloxane fluid), which are less reactive than water in criticality calculations. As an alternative, administrative controls may be used in a fashion that would result in the presence of more reactive hydrogenous materials in a breached naval SFC as being a beyond Category 2 event sequence.

C. Reflector Materials: The NNPP has demonstrated that naval SNF remains subcritical for concrete and steel alloy reflector materials by performing criticality calculations covering a broad range of steel alloy and concrete compositions and thicknesses. Therefore, there are no restrictions on the thicknesses or the compositions of the concrete or steel alloy materials used in IHF construction. For handling equipment such as the Transport and Emplacement Vehicle, the Canister Transfer Machine, and the Cask Trolley, additional materials are acceptable. They include up to 5 inches of depleted uranium and 12 inches of polyethylene-based neutron shielding in close proximity to the naval SFC. Furthermore, HLW canisters are also assumed to be permitted to be present in proximity to the naval SFC. There are no materials fabricated of lead or lead-glass and there are no shield windows of any kind in the IHF.

D. Event Sequences: All event sequences that would result in naval SNF rearranging out of the naval SFC are beyond Category 2. The only potential drop in the IHF for a bare naval SFC will be a flat bottom drop. (A naval SFC may see various orientations of drops while still in the M-290 shipping container.)

E. Naval SFC Staging: Only one naval SFC will be present at a time in each IHF handling area. There are four defined IHF handling areas in the IHF. These are the (1) Cask Preparation Area, (2) Transfer Area, (3) Waste Package Closure Area, and (4) Waste Package Loadout Area. This control ensures that neutronic interaction between naval SFCs in adjacent IHF handling areas is very small. The control also ensures that a damaged waste package or a damaged naval SFC that results from an event sequence important to criticality will not neutronically couple with another naval waste package or SFC. Naval transportation casks will be staged in the rail yard adjacent to

the IHF should this become necessary. The IHF will handle only naval SFCs and DOE high level waste (HLW) canisters.