DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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December 14, 1998

The Honorable Ernest J. Moniz
Under Secretary of Energy
1000 Independence Avenue SW
Washington, DC 20585-1000

Dear Dr. Moniz:

The Defense Nuclear Facilities Safety Board (Board) and its staff have reviewed Department of Energy (DOE) standard DOE-SAFT-0067, *Criteria for Packaging and Storing Uranium-233-Bearing Materials*, dated October 2, 1998. The Board's staff has also conducted a thorough review of the technical basis document, *Assessment of U-233 Storage Safety Issues at Department of Energy Facilities*.

The Board notes that several improvements in the standard have been made since the earlier draft was issued on April 30, 1998, and our comments on that draft dated June 10, 1998, were provided. However, based on the staff's review, the Board believes a number of issues still need to be addressed.

DOE and the 97-1 Technical Team recognize that they need to gather additional data to verify (1) technical bases for the uranium container pressurization mechanisms based on adsorbed water, (2) stabilization temperature, and (3) assumed integrity of ceramic fuel pellets (including storage within plastic). In addition to the need for data on these subjects, other issues noted in the enclosure to this letter need to be addressed.

The comments provided in the enclosure are intended to address storage of U-233 over a 50 year period. As such, the comments are aimed at achieving the following objectives: (1) strengthening the technical basis for the standard; (2) ensuring that containers do not contain significant quantities of plastics and volatile materials; (3) ensuring that required attributes of materials, packaging, and facilities credited as barriers are adequately specified; and (4) clarifying several requirements. If DOE intends to store U-233 only for an interim period, DOE may propose other ways (e.g., use of periodic inspection and surveillance data, vitrification) to achieve safe storage of U-233.

The Board believes that characterization and inspection data, particularly of the uranium presently stored at Oak Ridge National Laboratory (ORNL), are needed to assess adequately the safety of this material. The Board encourages ORNL to complete the development of final plans for the characterization and inspection of U-233 stored in Building 3019 and to finalize procurement of the equipment needed to conduct inspections safely. Likewise, the Board understands that characterization of the ceramic fuel materials at Idaho National Engineering and Environmental Laboratory (INEEL) is planned. The results of these efforts ought to be incorporated into the site assessment reports for ORNL and INEEL.

The Board urges DOE to revise the proposed standard expeditiously, while continuing its program for inspection and characterization of the material currently in storage without delay. Pursuant to 42 U.S.C. § 2286b(d), the Board requests that DOE prepare a report by January 15, 1999, regarding DOE's plans for addressing the issues identified in the enclosure to this letter.

If you have any questions on this matter, please do not hesitate to contact me.

Sincerely,

John T. Conway
Chairman

c: Mark B. Whitaker, Jr.

Enclosure

Enclosure

Comments on the Final DOE Standard SAFT-0067
***Criteria for Packaging and Storing Uranium-233-Bearing Materials*, October 2, 1998**

A. Unless adequate justification for less stringency can be provided, the following revisions should be incorporated:

1. The wording which specifies the use of outer containers for oxide monoliths ought to be changed from "may consist" to "shall consist" in Section 4.2 and from "is provided" to "shall be provided" in Section 4.2.5.

2. The wording of Section 4.2.1.e ought to be changed from "Should have" to "Shall have." In addition, the term "handling accidents" needs to be defined, e.g., 6-foot drop on a hard unyielding surface, 30-foot drop down a vertical tube onto a hard unyielding surface, etc.

3. The inner container ought to be designed to provide reasonable assurance that the outer surface will remain contamination free over the life of the package. The caveat, "at the time of repackaging" ought to be removed. Appendix A can clarify that outer containers should not be opened in the future solely for the purpose of measuring this. However, if a package is opened in the future, the inner container must be examined and meet this criteria.

4. Repackaged containers ought to be designed to remain leak-tight, as defined by ANSI N14.5-1997, over the design life. Outer containers should be measured to this criteria during surveillance. Surveillance of the inner container seal should follow the same guidelines as outlined for inspecting contamination on the container exterior.

5. The standard needs to specify functional requirements that a material form or facility must meet if it is to replace a container as a barrier in the packaging system.

6. Clarify the requirement for maintaining a facility barrier to read as "storage facility barrier shall be maintained through normal operations, anticipated operational occurrences, and all facility design basis accidents."

7. Section 4.2.1 ought to include a requirement to prohibit plastics inside the storage containers unless examination shows that it is acceptable.

8. There needs to be a moisture limit for the backfill gas such as the "100 ppm or less" criterion used in the Y-12 storage criteria for highly enriched uranium. This would minimize the amount of moisture available to pressurize the container.

9. The standard ought to include a requirement to measure or otherwise ensure the mass of moisture and other volatiles inside the containers is bounded by the mass assumed in the design calculations for container pressurization.

10. The wording in Section 4.4 ought to be changed from "should identify:" to "shall identify:"

B. In addition to the above concerns, technical bases for many of the requirements identified in the standard are not fully supported by technical data. While it is understood that continuing research, characterization, and experimentation may substantiate some of the assumptions, conservative values should be used until this research provides better data. The revised values can then be incorporated.

1 Moisture content: moisture content could lead to over pressurization of a container, potentially contaminating the storage vault or personnel in the event of container failure during handling. Alternatively, a defensible basis is needed to establish that container over pressurization is not credible.

a. 4.1.1 — No basis is provided for why baking metallic pieces at 650°C for 6 hours is sufficient to fully convert the metal to stabilized oxide. The reference provided deals with production of oxide from ammonium diuranate in a hydrogen atmosphere, not in air, as specified in the standard.

b. 4.1.2 — The basis for processing parameters to limit adsorbed moisture in oxides deals with the production of UO_2. The reference provided addresses production of oxide from ammonium diuranate in a hydrogen atmosphere, not in air, as specified in the standard. In addition, the applicability of this reference for the adsorption of water by UO_3 or U_3O_8 has not been established.

c. 4.1.2 — Although the standard assumes the thermal stabilization process will convert residual salts to oxide, no basis is provided for this assumption, and this subject is not addressed by the reference. The residual salts pose a container corrosion concern if moisture is present.

d. 4.1.3 — The basis for lack of adsorbed moisture in monoliths after exposure to air before sealing, followed by subsequent extended storage, is not fully supported by technical data.

e. 4.3.2.b — There is no basis for assuming that a measured pressure will be the maximum anticipated internal pressure. Radiolytic pressure generation is a slow process, and a single measurement may not represent the maximum pressure that can be expected.

f. 4.3.2.b — The view that radiolysis of water will produce a steady state pressure of only 1 to 2 atmospheres is based on the extrapolation of data from experiments on pools of water or saturated vapor. The applicability of these conclusions to adsorbed water on particulate material with a small vapor phase and a large gas phase (air or nitrogen) is not fully supported by technical data. In contrast, the Y-12 storage criteria limit moisture to an amount that would result in a container pressure no larger than 1 atmosphere, assuming all water transforms to hydrogen and oxygen gas.

2 Material form integrity: The material form can provide a barrier to the spread of contamination, replacing one of the containers. As a barrier, the material must perform an important safety function. Failure to do so eliminates one layer of defense in depth. Further characterization of existing material forms is needed to address this issue.

   a. 4.1.3 — The basis for continued integrity of the monolithic forms after extended storage is not fully supported by technical data.

   b. 4.1.4 — The basis for structural integrity of the ceramic fuel pellets after extended storage is not fully supported by technical data.

   c. 4.2.5 — The basis for assuming that the ceramic fuel pellets and oxide monoliths will resist radon emission is not fully supported by technical data. This is particularly important because radon release is a mechanism for dispersion of the highly radioactive daughter product thallium-208.

3 Package integrity: The existing unsealed packages at Idaho National Environmental and Engineering Laboratory (INEEL) are identified in the standard as being satisfactory to provide containment for ceramic fuel pellets. While the majority of the INEEL inventory is clad, there are some containers in which containment is provided by organic seals. Furthermore, in some containers unclad fuel pellets are stored in plastic bags.

   a. 4.2.6 — The suitability of painted shipping containers as a barrier for extended storage is not fully supported by technical data.

   b. 4.2.6 — The stability of organic seals and plastic packaging during extended storage is not fully supported by technical data.