ENCLOSURE 2

EVALUATION OF THE ADDITION OF FUEL ELEMENT COMBS, REMOVAL OF TIE DOWN BANDS FROM SAR FIGURES, AND DELETION OF THE 3-YEAR PERIODIC INSPECTION

Chapter 1, *General Information*, provides an overview of the packaging and its contents (HFIR unirradiated fuel elements). The changes to this chapter include the addition of a brief statement in Section 1.2.1.1, *Fuel,* indicating that optional combs may be present on the fuel element. Additionally, drawings M-11524-OH-106 and M-11524-OH-107, Figures 1.7 and 1.8 (respectively) for the Inner and Outer fuel elements, were revised to show the optional combs, including material and dimensions.

With respect to the identified nonconformances related to the tie down bands (TDB) (see Refs. 1-3), SAR Figures 1.3 through 1.5 have been updated to the latest revisions, removing the TDB from the drawing details. As discussed in Ref. 3, the TDB is not credited or evaluated in the SAR as an important-to-safety packaging component for HFIR Shipping Containers, i.e., the package does not rely on the TDB to meet the requirements of 10 CFR Part 71, Subpart E, *Package Approval Standards*.

There are no other impacts to Chapter 1. The 3-year periodic inspection is not addressed in Chapter 1.

Chapter 2, *Structural Evaluation*, incorporates key fuel element dimensions in its structural model; these dimensions are not affected by the addition of combs and are shown on the simplified drawings (Figures 1.7 and 1.8). The use of combs is not expected to adversely affect the performance of the fuel elements during normal transport or hypothetical accident conditions as the combs are welded to non-fuel-bearing portions of the fuel plates (i.e., at the top of the elements) and provide additional stiffening or rigidity to ensure the integrity of cooling channels during reactor operation. The fuel plates are attached to both the inner and outer side plates via circumferential welds, as originally designed. The text states in Section 2.1.2, *Design Criteria*, that the regulatory requirements of 10 CFR 71.73 are met so long as the fuel does not melt or fracture into numerous small pieces. The response of the fuel elements to accident conditions is calculated in Appendix C of Chapter 2. Conservative assumptions are made with regard to the fuel element construction in this analysis, i.e., that one edge of the fuel plates is clamped to the outer side plate and the other is merely supported by the inner side plate. It is stated in the side drop analysis that this condition results in the fuel plates at the top half of the element not resisting any force and thus requiring all the force to be transferred to the fuel plates along the bottom half of the element. The use of fuel element combs in this application should ensure some of the force is shared among all the fuel plates on an element during a hypothetical accident. Thus, the original analysis in Chapter 2 remains bounding and there are no changes to Chapter 2. The 3-year periodic inspection is not addressed in Chapter 2.

Chapter 3, *Thermal Evaluation*, discusses the salient features of the package and their predicted performance during normal and accident conditions. Packaging and fuel element performance

during these tests is not expected to be impacted by the optional addition of combs. Appendix B of Chapter 3 determines the minimum amount of fuel bearing material which would be exposed during a postulated fuel melting event that disregards the protection the packaging provides to the fuel. The salient features of the fuel which affect this analysis include various fuel dimensions and configuration (e.g., cladding and side plate thicknesses), materials of construction, and amount and type of nuclear material. These features are not changed due to the installation of fuel element combs. Addition of a small amount of additional aluminum will make the analysis results slightly conservative because more of the non-fueled region would have to melt before any radioactive material could be released. The 3-year periodic inspection is not addressed in Chapter 3. Consequently, there are no changes to Chapter 3.

The radioactive contents of HFIR fuel are contained in a fuel matrix composed of U_3O_8 interspersed in an aluminum filler and clad in 6061 aluminum, which together provide a containment that withstands the combined effects of the structural and thermal tests for normal and hypothetical accident conditions when transported in the HFIR unirradiated fuel element container. Chapter 4, *Containment*, credits these features as providing the primary boundary or containment. Additionally, Chapter 4 derives the A_2 value for the HFIR fuel uranium mixture for both the inner and outer elements and compares the value with the results from Appendix B of Chapter 3 to determine the fraction of melting required to release an A_2 amount of radiological material. The containment boundary (i.e., the cladding and fuel matrix) is not changed by the addition of combs to the fuel element, as the comb segments are placed in a ring on the top of the fuel plates and welded to areas of the plates approximately two inches above the fueled portion of the plates. This does not impact the containment integrity of the cladding. The 3-year periodic cask inspection is not addressed in Chapter 4. Consequently, no changes are needed in Chapter 4.

Chapter 5, *Shielding Evaluation*, states that "radiation emitted by the unshielded and unirradiated HFIR fuel assembly…is well below the levels specified in the regulations per 10 CFR 71 for shipment of radioactive materials." A change to the amount and type of radioactive material shipped in the 5797 container is not proposed. Chapter 5 will therefore not be affected by the use of fuel element combs. Periodic cask inspections are not addressed in this chapter.

Chapter 6, *Criticality Evaluation*, evaluates the cask design effectiveness in maintaining the contents subcritical during normal and accident conditions. It is stated in the analysis that the significant features of the package for criticality safety include the steel outer container wall, wood insulation, separation of the containers, and the form and composition of the fissile materials within each element. The combs serve to stabilize the fuel plates within the fueled region of the core and will not have deleterious impacts to fuel geometry during normal or accident conditions. Aluminum has a small neutron scattering cross-section; thus, the addition of a small amount of aluminum (i.e., combs) on the non-fueled region of the fuel elements will have an insignificant effect on the K_{eff} of the system during normal conditions of transport or hypothetical accident conditions. Periodic cask inspections are not addressed in this chapter. There are no changes to this section of the SAR.

Chapter 7, *Operating Procedures*, provides guidance for safely loading, unloading, and preparing an empty 5797 package for shipping. New ORNL drawing M-20978-EL-008B,

Shipping Container Tie Down Band For Unirradiated Out/In HFIR Element Details, was added for reference in the text of Chapter 7.1, *Procedures for Loading Packages*, where the TDB (referred to as a removable shoring ring) is discussed. There are no additional changes to Chapter 7.

Chapter 8, *Acceptance Tests and Maintenance Programs*, is not impacted by the use of fuel element combs. However, Section 8.2.7 has been revised to remove the 3-year periodic inspection of the containers per the design drawings. This extra-regulatory obligation was added to the SAR in response to an issue encountered in 1989 in which one or more containers were found to have been modified without prior authorization. The HFIR and ORNL work control processes have matured since that incident occurred, and no further unauthorized design changes have been identified. The containers are inspected prior to each shipment as required by Section 8.2 using an internal RRD procedure that implements the inspection guidelines of Table 8.1. The specific bases for deleting the 3-year periodic inspection are: 1) it is not required by the regulations, 2) over the past thirty years no additional unauthorized modifications have been identified, and 3) adequate controls are in place through the (now mature) ORNL and RRD work control processes to prevent future unauthorized modifications. The inspections performed prior to cask shipment verify that the salient features of the cask are available to perform as designed, ensuring the casks perform as assumed in the SAR.

Changes to Chapter 9, *Quality Assurance*, have been made in support of those made to Chapter 8, i.e., deletion of the 3-year periodic inspection. Specifically, changes were made to Section 9.3.11.2 to remove the statements regarding the three-year maintenance and repainting intervals. There are no additional changes necessary to Chapter 9 in support of adding as authorized contents fuel elements with optional combs installed.