Criticality:

Appendix B:

- B1.2-3 The AFS-B has plates on the outside of it. The AA433 did not. Is the overall package including the AFS-B still below the maximum weight limit?

Response: Yes, the overall package weight (including the AFS-B) is below the maximum weight. The AFS-B (and AFS-C) are designed so that the total package weight is below 14,260 pounds. Note that a fuel assembly weighs up to 1,580 pounds. A loaded AFS-B weighs up to 1,500 pounds (see Table B2.7-1) and a loaded AFS-B weighs up to 1,230 pounds (see Table C2.7-1).

Appendix C:

-C1.1-1 The number of Exxon and PNL rods are increased. However, just as did the AA433, the AFS-C states that these are the maximum that will physically fit into the AFS-C. If the dimensions didn't change from AA433 to AFS-C, then how can more rods be added, and was this analyzed? Shouldn't the weight be different?

Response: The internal dimensions did change from the AA433 to the AFS-C, which is why the total number that will fit changed slightly. The weight of the AA433 is slightly different than the weight of the AFS-C. The criticality analysis conservatively ignored the AA433, so the analysis did not change for the AFS-C. The most reactive case modeled an excess of the number of rods that will fit in the AFS-C, so the original analysis remains bounding.

-C1.2-2 Is there a distinct difference between a AFS-C and a dummy assembly, for the sake of inadvertently storing a AFS-C in place of a dummy assembly?

Response: Both the AFS-C and dummy fuel assembly are clearly labeled. Also, the dummy fuel assembly does not have a removable lid and therefore will look different than an AFS-C.

-C1.2-3 Is the combined heat load of 80 = to the heat load for the Exxon cavity (80 watts) and the PNL cavity (30 watts)?

Response: There are four limits that must all be met: (1) The total package is limited to 240 watts, (2) the AFS-C is limited to 80 watts (total of Exxon and PNL cavities), (3) the Exxon cavity is limited to 80 watts, and (4) the PNL cavity is limited to 30 watts. For example, if there are 25 watts in the PNL cavity, then the Exxon cavity would be limited to 80 – 25 = 55 watts. If the PNL cavity is empty, then 80 watts could be present in the Exxon cavity. If the Exxon cavity is empty, the PNL cavity would be limited to 30 watts.

-C6.1-2 Are the results in Table C6.1-1 still valid with an allowed increase in payload?

Response: Yes, the small increase in payload is bounded by the original analysis. In the most reactive case, more rods were modeled than could actually fit.

Structural:

1) **Section 1.0, page 1.1-1: last sentence in paragraph starting with *"Appendix A: Replacing up to three (3)….."* Please identify what "slightly damaged" means? Please defined "damaged fuel rod," and/or characterize/classify level of damage in fuel rods. This information is needed to determine compliance with 10CFR Part 71.33.**

Response: The definition of damaged fuel is contained in Appendix A (see page A1.2-1), "Damaged fuel may be bent, scratched, or dented, but under no circumstances may exhibit cladding breach." "Slightly damaged" means the same as "damaged," and is stressing that damage is not severe (i.e., no cladding breach.) A pointer to the definition of damaged fuel will be added to page 1.1-1 to clarify this definition.

2) **Throughout the main-body of the SAR, sections of Appendices were referenced generically without providing the specific Appendix, (e.g.; "Appendix 1.4.2, *Packaging General Arrangement Drawing"* and "Appendix 2.12.3, *Certification Test Results,"* etc.) which creates some level of confusion since there are three (3) Appendices in revision 6 of SAR. Please state specific appendix when referenced in the main-body of SAR. This request is an editorial correction.**

Response: All section headers, table numbers, figure numbers, and page numbers in the document are unique. For example, Appendix 1.4.2 is in the main SAR because there is no A, B, or C in the heading number. In this way, all appendices can be identified by the unique appendix number.

3) **Section A7.1, page A7-1: second paragraph: "light damaged rod" is defined as "bent, scratched, nicked, but under no circumstances shell exhibit cladding breach." How is/will the confirmation be made for no cladding breach condition for light damaged rods? This information is needed to determine compliance with 10CFR Part 71.33 and Subpart H.**

Response: On page A7-1, it is stated that the "no cladding breach condition" is confirmed by visual inspection. The fuel manufacturer utilizes trained personnel to visually inspect their fuel assemblies and individual rods.

4) **Section 2.6.5, on page 2.6-11: last sentence – shell outer diameter should read 29.62 inches per sheet 2 of 6 of Drawing 99088-20, Rev. 3. Please recalculate area (A_s) and Moment of Inertia (I_s) accordingly. This request is for recalculation/editorial correction.**

Response: This observation is correct. As a fraction, the dimension would be 29-5/8-in. This dimension was rounded up in the analyses (29.63-in) and rounded down on the drawing (29.62-in). However, because the effect on the result is negligible, it is preferable to leave the SAR unchanged.

5) **Section 2.6.5, page 2.6-12: Equation for maximum moment (M_{max}) should read $M_{max} = 5{,}869(L_e) + w(L_e)^2/2$. Please recalculate maximum moment (M_{max}), stress**

(σ) and margin of safety (MS) accordingly. This request is for recalculation/editorial correction.

Response: This is an error that will be corrected.

6) **6(a) Section B1.2.1, page B1.2-1, referring to Drawings 99008-60, sheet 1 of 2 and 2 of 2 for Item 7, which is a ¼ inch gusset-plate (item7) supporting Item 6: based on the write up in Sections B1.2.1, C1.2.1 and Section A of sheet 2 of Drawings 99008-60, 61 center to center dimension should read 15.35 inches.**

Response: It is true that 153.5/10 = 15.35-in. However, since it is desired to show this dimension with a single decimal position (i.e., 0.x), the use of two decimal positions (i.e., 0.xx) would be inappropriate. Therefore the 15.35-in. dimension is rounded down to 15.3-in. The difference (equal to 0.05-in.) does not have a significant effect on any calculation. Therefore we request that no change be made to this value.

6(b) Unless otherwise gusset-plates are not placed (welded) intermittently staggered from one side to other, column A1 of Item 7 in "List of Material" table on sheet 1 of Drawing 99008-60 should read "18."

Response: This view is acknowledged to be somewhat confusing, since gussets are typically triangular in shape; however, in this case the triangle is void area and the gusset is the piece with the two notches on the bottom side. Therefore the number of gussets is appropriate for this configuration.

6(c) The side dimensions for triangle gusset-plate (Item 7 of Drawings 99008-60 and 61, Rev. 0) were listed as "7.0X3.25." Based on ratios of known dimensions from Section B on sheet 2 of 2 of Drawings 99008-60 and 61; the item 7 should read "2.0X2.0." These requests are for editorial correction, and compliance with 10CFR Part 71.111.

Response: As noted above, the gusset spans the inner width of the box. From Section B, the width of a gusset plate is approximately 6.9-in, and the height of a gusset plate is approximately 6.9 – 3.4 - 0.5 = 3.0-in. Note also that dimensions provided on a parts lists are typically oversized and do not correspond exactly to the final machined dimensions to allow for machining tolerances.

7) **Sheet 2 of 2, Section A on Drawings 99008-60, 61, Rev. 0: Item 7 (¼ inch triangle gusset plates) is drawn as if the side is as long as width of the cavity. Please compare it to the Section B on the same page. This request is for clerical correction, and compliance with 10CFR Part 71.111.**

Response: Please see replies to comments 6b and 6c.

8) **Sections B2.7.1 and C2.7.1, Shelf Evaluation: It appears that the weight of securing devises for fuel rods (if any) were not considered (e.g., clamps, straps, bolts, nuts, washers, spacers, channels, etc.) in impact pressure calculation. Margin of safety may be adversely affected at impact acceleration level of 180g. Please provide discussions why weights of other components were not considered. Please see the next RAI, whether reduction in allowable strength should apply for welded aluminum sections for this case also. This information is needed to determine compliance with 10CFR Part 53(e), Part 71.73, Part 71.107. Reword.**

Response: The fuel rods and dunnage rods completely fill the cavity so that other securing devices are not required. Therefore, there are no other items whose weight is not considered. As for the weld, it is intentionally omitted in the center of each 15.3-in long bay so as not to reduce the strength of the aluminum there, where the stresses are greatest (farthest from the gusset supports). The weld, as such, is never depended upon for structural integrity.

9) **Qualification of welds was not performed on the fuel rod containers under HAC conditions. Especially, qualifications of 3/8-inch partial groove weld would be a concern. The significant drawback for partial-penetration type of welds is that the opportunity to assure weld quality by non-destructive examinations (NDE) may be denied, and a cross-sectional discontinuity is created. The American Welding Society (AWS) D1.2 "Structural Welding Code – Aluminum" was referenced as the requirement for acceptance criteria for welds in notes 5 of Drawings 99008-60 and 61, Rev.0. One of the requirements in the AWS D1.2 code is the actual weld size shall be equal to or greater than the thickness of the base metal, if visual inspection were to be performed as acceptance criteria. There could be a significant difference between the strength of the heat-effected-zones (HAZ) and the strength of the unaffected sections of the welded aluminum components. Such losses in strength should be considered in designing welded aluminum structures per the ASW D1.2 code. Please provide justification for using a partial groove weld. Reduction in strength should also be considered in welded aluminum fuel rod container evaluations. This information is needed to determine compliance with 10CFR Part 55(e), Part 71.73 and Part 71.107.**

Response: None of the welds used in the AFS-B and AFS-C are structural welds. The only welds are of the gussets (part in compression) and the longitudinal 3/8-in welds, which, due to the support of the strongback, do not carry any primary loads because the AFS-B/AFS-C is securely attached in the strongback.

10) **Page 2 of 2, Section B on Drawings 99008-60, 61, Rev. 0: typical 1/8" fillet weld symbol with three (3) legs is pointing to the wrong weld locations.**

Response: Please see the responses to comments 6b and 6c.

11) **Capacity of swivel hoist ring (item 9) was listed as 2,000 lbs in Drawings 99008-60 and 61, Rev. 0. It should be noted that minimum safety factor of three (3) against yielding is required per 10CFR Part 71.45. Please provide discussion why margin of safety of three (3) was not met.**

Response: It is our understanding that 71.45(a) applies to the package itself and not to the subcomponents in the package, such as the AFS-B. However, to clarify this point; a standard 2,000 lb rated swivel hoist ring will have an inherent factor of safety of 5, as listed in the manufacturer's literature.

12) **Provide discussion/assurance that lifting and securing/closing devises (items 8, 9, 10, 11, 13 of Drawings 99008-60 and 61, Rev. 0) as designed will remain in place at times during normal conditions of transport and hypothetical accident conditions. Provide justification of torque values for bolts that will not breach the pressure**

boundary under all loading conditions as well as provide discussion of bolt torquing procedure(s).

Response 12-1: The rod box bolts are primarily locational in nature, since the box is retained in the strongback clamp arms. The bolts are retained from loosening using the aluminum washers, which are bent to hold the head. No specific bolt torquing procedure is required since the bolts only locate the lid and do not hold it in place during NCT or HAC. The pressure boundary is the actual package itself. The vent holes in the AFS box preclude the buildup of pressure.

Section 2.6.3.4 in the report refers to Table 4.2 of NUREG/CR-6007 as the source of nut factor (K), but they were listed in Table 4.1 in NUREG/CR-6007 (request for editorial correction).

Response 12-2: The SAR will be modified to note the correct table.

The values for nut factor (K) are experimentally derived constants. As a result, this experimental constant is subjected to wide variation, depending upon the specific condition under which it was measured. Even though, the lubricant type is often the dominating variable, it was advised to determine the actual nut factor on specific applications by testing. The value of 0.157 was used as the nut factor in the analytical hand calculations throughout the SAR. Please provide detailed discussion that the used nut factor is appropriate for this application. Please provide discussion on appropriateness of embedment, spacing, and edge distances of bolts used through out the assembly. This information is needed to determine compliance with 10CFR Part 55 and Part 71.107.

Response 12-3: As mentioned above (response 12-1), the rod box bolts only serve to locate the box lid. The whole rod box is securely located by the clamp arms of the strongback, which hold the box in place by clamping it, thus retaining the box lid. Therefore the nut factor does not play a major role with respect to the rod box bolts. All of the other bolts used in the package, except those associated with the Fuel Control Structure (FCS), were thoroughly tested during the certification test program which is described in detail in Main Appendix 2.12.3. Since the bolts or lubricants have not been changed since the test was performed, it is our view that it is not necessary to re-evaluate the performance of the bolts.

13) **In Section 2.2.2 and in Sections A2.2, B2.2, C2.2 in Appendices A, B, C the applicant stated that *"materials of the transportation cask will not have significant chemical and galvanic reactions, and are not significantly affected by radiation, which was concluded from the previous use of similar materials without any incident."* In Section 8.2, the applicant states that *"the requirements of periodic maintenance program that includes pressure of MPPF, and leakage rate testing of penetrations and seals to ensure continued performance."* The applicant will visually inspect fabricated components of MPPF to ensure justification for continued operation. Slow developing material degradation mechanisms due to structural and/or metallurgical defects under normal service loading conditions are difficult to identify visually at initial stages. Immediately after that initial stage, growth/ propagation stages can develop in exponential levels. Regulations in 10CFR Part 71, Subpart H require that Type B packaging be designed, constructed and maintained under a certified quality assurance program – *"e.g.; Section 8.0 Quality Assurance of NUREG/CR-6007 states that "bolts should undergo acceptance testing prior to use that the tests***

should include both destructive and non-destructive testing," Section 8.0 of NUREG-1609 states about the requirements of periodic tests and replacements of components, and Section 2 of NUREG-1609-Supplement 1states that there can be significantly greater chemical and radiation effects in MOX-RAM packages than in LEU-RAM packages." **Please provide discussions to ensure the structural integrity for load bearing critical components of the packaging system will be in compliance with the regulatory requirements during its service life with a quality assurance/ maintenance program, which does not include periodic NDE techniques.**

Response: Regarding the effects of radiation, the field from a fresh fuel MOX package is extremely weak when compared to spent fuel packagings, and no structural degradation is evident in those packages. As for periodic testing, we note that the containment boundary is pressure tested, followed by helium leakage rate testing, every five years. Helium leakage rate testing is performed on the containment seal at replacement. The bolts are visually inspected before each use. Bolts have been analyzed for fatigue in Section 2.1.2.2.2.1 and have a generous margin against fatigue failure. There are consequently numerous inspections of structural parts in the maintenance program.

14) **On Figures B2.7-1 and C2.7-1 "Gusset Plates" arrow is pointing to the cavity of the rod container. The arrow should point at the gusset plate. This request is for clerical correction.**

Response: Correct as drawn, please see response to comments 6b and 6c.

15) **Sections B8.2 and C8.2 state that "scheduled maintenance program is not required, and visual inspections are performed on fuel rod containers that, if required, repair and replacement shall be performed prior to use." Please provide discussions on how a discretionary maintenance application can ensure structural integrity of fuel rod containers. If a fuel rod container were to be declared damaged - is there a proper process of checking the integrity of unloaded fuel rods? This information is needed to determine for compliance with 10CFR Part 71.101.**

Response: If a fuel rod container were damaged, it would not be loaded with fuel rods. If a fuel rod container is undamaged at loading, it is not likely it would be damaged during shipment. Therefore, it is not clear from the question what scenario is being postulated. Further, the maintenance program is not discretionary. The SAR clearly states that "damaged components shall be repaired or replaced prior to use." Please clarify this point during the teleconference.

We were hoping that we would be able to retrieve your SINDA/FLUINT input files. Our intention is to not review them as part of the amendment approval, but rather to have them for file.

Response: The output files (as PDF files) were provided with the Revision 0 submittal. These CDs should be at the back of the original binder. If not, we can send a copy.