March 1, 2007

Mr. Steven E. Sisley
EnergySolutions
2105 South Bascom Ave., Suite 160
Campbell, CA 95008

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - MODEL NO. MIDUS PACKAGE

Dear Mr. Sisley:

This refers to your application dated November 1, 2006, as supplemented November 17, 2006, requesting approval of the Model No. MIDUS as a Type B(U) package.

In connection with our review, we need the information identified in the enclosure to this letter. Additional information requested by this letter should be submitted in the form of revised pages. To assist us in scheduling staff review of your response, we request that you provide this information by March 21, 2007. If you are unable to provide a response by that date, our review may be delayed.

If you have any questions regarding this matter, we would be pleased to meet with you and your staff. I may be contacted at (301) 415-8513.

Sincerely,

/**RA**/

Nancy L. Osgood, Senior Project Manager
Division of Spent Fuel Storage
and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9320
TAC No. L24039

Enclosure: Request for Additional Information

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Request for Additional Information
Docket No. 71-9320
Model No. MIDUS Package

By application dated November 1, 2006, as supplemented November 17, 2006, EnergySolutions submitted an application for package approval for the Model No. MIDUS package. This request identifies additional information needed by the Nuclear Regulatory Commission staff in connection with its review of the application. The requested information is listed by chapter number in NUREG-1609, "Standard Review Plan for Transportation Packages," which was used by the staff in its review of the application. This request describes information needed by the staff for it to complete its review of the application and to determine whether the applicant has demonstrated compliance with regulatory requirements.

1.0 General Information

1-1 Depict the location of the containment boundary on drawing TYC01-1604.

Section 1.2.1.3 of the application states that drawing TYC01-1604 shows the location of the containment boundary. However, the boundary is not explicitly depicted on this drawing.

This information is necessary to satisfy the requirements of 10 CFR 71.33.

1-2 Clarify the dimensions of the cask body bottom shield.

Drawing TYC01-1602, sheet 2 of 4 indicates that the bottom diameter of the cask body bottom shield is 145.0 mm, and the widest diameter of the cask body bottom shield is 217.0 mm. However, drawing TYC01-1606, sheet 2 of 3 states that these same dimensions are 144.3 mm and 216.3 mm. It appears that this difference may be due to the presence of air gaps that are not depicted.

This information is necessary to satisfy the requirements of 10 CFR 71.7.

2.0 Structural

2-1 Clarify whether there are any welds in the cask containment boundary.

Page 2-3 of the application states “There are no welds in the cask containment system since the cask containment shell is machined from a single, solid piece of steel.” However, p. 2-5 states “The cask containment components consist of the cask containment shell, closure lid, closure bolts, and the circumferential weld between the cask outer shell and cask containment shell...” These two statements provide conflicting information regarding whether there are any welds in the cask containment boundary.

This information is necessary to verify compliance with 10 CFR 71.7.

2-2 Revise Drawing TYC01-1604, sheet 2 of 3, Detail B, to show the "3:1 taper transition" to be consistent with the Section 2.1.1.1, Cask Assembly, description.

The application states that the taper transition is included between the containment shell wall that surrounds the shield plug cavity and the top flange to minimize stress concentration at the structural discontinuity. This design feature appears to be safety related and should be included in the design drawing.

Complete and accurate information should be provided in accordance with 10 CFR 71.7(a).

2-3 On p. 2-3, Section 2.1.1.3, Overpack Assembly, clarify the statement, "The base of the overpack also includes four integral lugs that may be used for additional tie-down attachment."

The statement is unclear whether the four base lugs alone can be an option for package tie-down during transport.

The structural capability of the lugs has not been evaluated in the application under 10 CFR 71.45 (b)(2), which states, "Any other structural part of the package that could be used to tie down the package must be capable of being rendered inoperable...or must be designed with strength equivalent to that required for tie-down devices."

2-4 In Tables 2-3 and 2-4, on pp. 2-16 and 2-17, change the word "or" to "and" for the stress limit criteria for the hypothetical accident conditions.

The stress limit criteria such as those called as "Lesser of $2.4S_m$ or $0.7S_u$" should be called as "Lesser of $2.4S_m$ and $0.7S_u$" to be consistent with the ASME Code usage.

Complete and accurate information should be provided in accordance with 10 CFR 71.7(a).

2-5 Correct the underscored typographical or editorial errors in the following statements:

Page 2-4. "The overpack base and lid both have 6 mm thick outer shells and 2.5 mm thick inner shells." Drawing TYC01-1603, sheet 2 of 3, indicates a 3 mm-thick inner shell.

Page 2-8. In Item 4, "Thus, condition (2) of WB-3221.9(d) is met." Condition (4) should apply.

Page 2-94. "The minimum design margin for primary stress intensities (P_m and $P_m + P_b$) due to NCT free drop loading is +0.08 for primary membrane plus..." Table 2-34 lists the minimum design margin of +0.06.

Page 2-122. "The peak transverse rigid-body acceleration due to the HAC code side drop varies from 793 g at the top end of the shield lid to 292 g at the bottom end of the cask." Table 2-43 lists the top end acceleration of 739 g.

3.0 Thermal

3-1 Provide information to justify that the physical/chemical property of the payload liquid is such that upon freezing, the Mo-99 precipitates won't form from the solution.

In order not to enhance the specific activity, the radioactive Mo-99 should not precipate from the payload solution when the temperature is cooled down to below the freezing point. Information or data are needed to confirm this behavior.

This information is needed to confirm that the package meets the package requirements of 10 CFR 71.31 and 71.47.

5.0 Shielding

5-1 Revise the shielding parameters in Tables 5-1 and 5-2 to state the nominal material thicknesses and densities, and their associated tolerances. Additionally, clarify which dimensions are given for each parameter.

No upper bound is given for any of the parameters in Tables 5-1 and 5-2. Additionally, it is unclear which dimensions are given for the radial shield and bottom shield, which are not symmetrically shaped.

This information is necessary to satisfy the requirements of 10 CFR 71.7.

5-2 State the assumptions alluded to on p. 5-9 of Section 5.3.1.1 of the application.

The application states that the inverted cases depicted in Figure 5-6 represent different assumptions about the fluid displacement by the snap ring assembly. State what those assumptions are, and how they impact the source location.

This information is necessary to verify compliance with 10 CFR 71.47.

5-3 Justify why it is conservative to model the extra fluid volume in the main payload activity, rather than to account for source fluid in the threaded hole in the shield plug.

Section 5.3.1.1 (p. 5-10) of the application states: "Scoping runs show that the source fluid in the threaded hole is very well shielded by the shield plug DU, so it is conservative to model the extra fluid volume in the main payload cavity." Justify why it is conservative to discount the source fluid that may be in the threaded hole.

This information is necessary to verify compliance with 10 CFR 71.47.

5-4 Discuss the assumptions made in the HAC shielding models compared to the final structural evaluation results from Section 2.7 of the application.

Table 5-8 shows deviations between the deformations assumed for the shielding model and the deformations estimated in the structural evaluation. Section 5.3.1.2 does not

address the underlying assumptions pertaining to these deviations. It is unclear what part(s) of the package deformed. Additionally, it is not clear how the HAC shielding model dimensions differed from those assumed for the NCT shielding models.

This information is necessary to verify compliance with 10 CFR 71.51.

5-5 State whether the hypothetical accident condition shielding models assume that the foam is present.

Section 5.3.1.2 of the application addresses the condition of the package following the drop accidents, but does not address the condition of the package after the fire. Section 3.5.4 of the application indicates that the foam will char, and predicts a recession depth of 6 cm (2.4 inches). It is unclear whether this was accounted for in the HAC shielding models.

This information is necessary to verify compliance with 10 CFR 71.51.

5-6 Specify whether Figures 5-2 through 5-8 represent normal conditions of transport or hypothetical accident conditions.

This information is necessary to verify compliance with 10 CFR 71.47 and 71.51.

5-7 Clarify which package orientation is associated with each of Figures 5-9 through 5-17.

Specify the geometry (i.e., as depicted in Figures 5-2, 5-6, 5-7, and 5-8) was assumed for each of the dose rate profiles in Figures 5-9 through 5-17. This information is necessary to verify that the most limiting orientation was considered in the shielding analysis.

This information is necessary to verify compliance with 10 CFR 71.47 and 71.51.

5-8 Specify, for Figures 5-9, 5-12, and 5-17, the maximum dose rate observed, and at what distance from the package it occurs. Revise Sections 5.4.4.1.4 and 5.4.4.2.3 to address the increasing dose versus distance trend.

Figures 5-9, 5-12, and 5-17 each show a trend of dose increasing with distance from the package. Section 5.4.4.1.1 indicates that the dose rates shown in Figure 5-9 eventually drop off in the radial direction, but does not state what the maximum dose rate is, or at what distance the dose rate eventually begins to drop off. Revise Sections 5.4.4.1.1, 5.4.4.1.4, and 5.4.4.2.3, along with Figures 5-9, 5-12, and 5-17, if appropriate, to explain why the dose increasing with distance trends are observed. To demonstrate the integrity of the shielding model, state and/or show the maximum dose rate, along with its location relative to the package, and demonstrate that an appropriate trend of dose decreasing with distance eventually occurs.

This information is necessary to verify compliance with 10 CFR 71.47 and 71.51.

5-9 Revise Figures 5-15 through 5-17 to show the location of the dose rate estimations relative to the package.

The horizontal axis of Figures 5-15 through 5-17 is labeled “interval” on all three figures. This label provides no information regarding the location of the dose rates relative to the package. Revise each figure to clearly indicate the dose point locations relative to the package surface.

This information is necessary to verify compliance with 10 CFR 71.51.

5-10 Revise Section 5.3.1.2 of the application to explain the role of the cleanliness seal during HAC.

Section 4.1 of the application states: “The cleanliness O-ring performs a housekeeping function, and it indirectly provides a post-accident shielding function as discussed in Sections 5.1.1.1 and 5.3.1.2.” Section 5.1.1.1 states that the presence of the cleanliness seal minimizes the potential volume for flooding under HAC, but does not quantify this volume. Section 5.3.1.2 does not address the role of the cleanliness O-ring under HAC. Revise Section 5.3.1.2 of the application to explain the role of the cleanliness seal during HAC. Specify the additional source volumes, along with their locations (i.e., annulus, disk, thimble, ring) that would be expected if the cleanliness seal did not function properly during HAC. Provide justification that the cleanliness seal will perform as expected; i.e., justify the source region volumes listed in Table 5-7 on p. 5-13 of the application will not be exceeded as a result of a hypothetical accident.

This information is necessary to verify compliance with 10 CFR 71.51.

5-11 Revise the application to include an assessment of the shielding effectiveness under hypothetical accident conditions, considering the possible brittle fracture of the depleted uranium shielding.

Based on the information on the mechanical properties of the depleted uranium (Table 2-19 of the application), the presence of an undetected flaw greater than 2.5 mm (see, e.g., SAND80-1836) may result in a brittle failure of the shield under drop test conditions at temperatures lower than 70^{O}F. The dose rates from the package could increase due to the resulting crack in the shield material. The application should be revised to include an assessment of the effects of potential brittle failure of the DU. The assessment may consider either providing assurance that there would be no brittle failure under free drop conditions or showing that any brittle failure would not result in a dose rate increase greater than the regulatory limit of 1 rem/hr at a distance of 1 meter from the package surface. To show that there would be no brittle failure, including at cold conditions, supplemental information would be needed, for example, regarding temperature-dependent materials properties (Table 2-19 of the application), demonstrating absence of flaws greater than 2.5 mm, based on material specification, nondestructive examination, or other test or determination, etc.

This information is needed to show the package meets the dose rate requirements of 10 CFR 71.51(a)(2).

7.0 Package Operations

7-1 Revise Section 7.1.1, step 16, and Section 7.1.2, step 10, to clarify that any containment system replacement O-rings are tested to demonstrate that they are leak tight.

Steps 10 and 16 specify that any damaged O-rings are replaced. However, it is not clear that the containment system O-ring seal must be leak tested to demonstrate it is leak tight after replacement. Revise steps 10 and 16 to indicate that any containment system O-ring seal must have been leak tested to leak tight within the 12 month period prior to shipment, as described in Section 8.2 of the application. Note that this does not relieve the need to perform a pre-shipment leakage test of the assembled package prior to shipment, after the contents are loaded.

This information is needed to confirm that the package meets the containment requirements of 10 CFR 71.51.

7-2 Revise Section 7.1.2 to clarify that the contents are authorized in the Certificate of Compliance.

Step 1 instructs the shipper to confirm that the payload meets the contents specification in Section 1.2.2. Revise step 1 to clarify that the contents must be authorized for transport by the Certificate of Compliance.

The requirements of 10 CFR 71.87 state that the shipment must be made in conformance with the license, which invokes the terms and conditions of the Certificate of Compliance.

7-3 Revise Section 7.4.2 to include additional information regarding the pre-shipment leakage testing of the package:

(a) Section 7.4.2 should be expanded to provide information about how the minimum test sensitivity is assured. For example, a methodology for determining the minimum test duration and an acceptable pressure change (including instrument sensitivity as indicated in Section 7.4.1) should be provided. Although the application states the method to be used for the leak test (i.e., pressure rise test) there are not sufficient details to assure that the test method will achieve the specified test sensitivity (1×10^{-3} ref/cc-sec).

(b) Revise the test description to indicate that the test is a go-no-go test, and to clarify that an indication of leakage (at the specified test sensitivity) means that the package may not be shipped. Although the pre-shipment leak test sensitivity need not be greater than 1×10^{-3} ref-cc/sec, any leakage greater than 1×10^{-7} ref/cm3-sec is not acceptable (consistent with the evaluation in Section 4 of the application).

7-4 Revise Section 7.3, step 19, to include appropriate radiation surveys to confirm that the package is empty and meets the radiation limits specified in DOT regulations for empty packagings.

Step 19 specifies surface contamination measurements, but does not specify radiation measurements.

See 49 CFR 71.421(a)(2), as referenced in 49 CFR 71.428, for radiation limits specific to empty packagings.

7-5 The following editorial comments are noted.

(a) Review and revise as necessary to ensure that Section 7 uses consistent terms for the package components. For example, Section 7.3, step 1 uses the term "shield plate" where it may be referring to the shield lid.

(b) Review and revise as necessary Section 7.2.2, step 8, to clarify what components are surveyed for radiation and contamination. Note that step 3 indicates that the shield lid is not transferred into the hot cell, however, step 7, includes the shield lid. In addition, the section on Special Controls or Precautions specifically refers to step 8.

8.0 Acceptance Tests and Maintenance Program

8-1 Revise Section 8.1.1 to clarify that each packaging must meet the drawings referenced in the certificate of compliance.

This section references the drawings in Section 1.3.2, however, it should be clarified that, per 10 CFR 71.85 and 71.87, the package must meet the drawings referenced in the Certificate of Compliance.

8-2 Revise Section 8.1.6 to include an appropriate shielding test, or include justification for why a shielding test is not needed.

The shielding function is one of the primary safety features of the package. It is an established practice that each packaging should be tested prior to first use to demonstrate that the shielding is adequate, and does not contain unacceptable voids or porosity. Note that NUREG/CR-3854, "Fabrication Criteria for Shipping Containers," may contain useful information.

This information needs to be provided to show that the package design has adequate shielding to meet the requirements of 10 CFR 71.47.

8-3 Revise Section 8.1.7 to include an appropriate thermal test, or provide justification for why such a test is not needed.

The application states that the thermal test is not applicable. However, the packaging incorporates specific design features (i.e., the thermal spider) to assure adequate heat transfer from the package. A thermal test would demonstrate that the thermal spider functions as designed.

This information is needed to demonstrate that the package will not exceed the internal temperatures and pressures for which it was analyzed, including the maximum normal operating pressure as defined in 10 CFR 71.4.

8-4 Revise Section 8.2.3.4 to address metal removal that reduces the thickness of a containment component.

The second bullet under Section 8.2.3.4 instructs the Certificate Holder/Designer to evaluate and approve replacement and repair tasks addressing metal removal that reduces the thickness of a structural, shielding, or thermal component below its licensed dimension. This bullet should be revised to also include containment components.

This revision is necessary to satisfy the requirements of 10 CFR 71.43(f) and 71.51(a)(1).

8-5 Review and revise as necessary Section 8.2.3.4, first bullet, to clarify that packagings that do not meet the drawings referenced in the Certificate of Compliance are not authorized for transport of radioactive material.

For use under the general license in 10 CFR 71.17, the packagings must be fabricated in accordance with the design approved by the Commission.