

March 28, 2012

Mr. Mark S. Whittaker  
EnergySolutions  
140 Stoneridge Drive  
Columbia, SC 29210

SUBJECT: SECOND REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF  
THE MODEL NO. 8-120B PACKAGE

Dear Mr. Whittaker:

By letter dated June 30, 2011, EnergySolutions (ES) submitted an application to the U.S. Nuclear Regulatory Commission for approval of the Model No. 8-120B package. The June 30, 2011, application replaced in its entirety the January 28, 2011, initial amendment request, and incorporated responses to the Request for Supplemental Information letter dated March 22, 2011. By letter dated November 30, 2011, ES provided responses to the first request for additional information dated September 30, 2011. ES also provided a consolidated revision of the application.

In connection with the staff's review of the application, we need the information identified in the enclosure to this letter. We request that you provide this information by May 15, 2012. If you are unable to meet this deadline, you must notify us in writing no later than May 7, 2012, of your submittal date and the reasons for the delay. The staff will then assess the impact of the new submittal date and notify you of a revised schedule.

Please reference Docket No. 71-9168 and TAC No. L24549 in future correspondence related to this request. The staff is available to meet with you to discuss your proposed responses. If you have any questions regarding this matter, I may be contacted at (301) 492-3408.

Sincerely,

**/RA/**

Pierre Saverot, Project Manager  
Licensing Branch  
Division of Spent Fuel Storage and Transportation  
Office of Nuclear Material Safety  
and Safeguards

Docket No. 71-9168  
TAC No. L24549

Enclosure: Second Request for Additional Information

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<b>NAME:</b>	PSaverot		MCall		BTripathi		MGordon		DPstrak		MRahimi	
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Request for Additional Information  
for the  
Model No. 8-120B Package  
Docket No. 71-9168

By letter dated June 30, 2011, EnergySolutions (ES) submitted an application for approval of the Model No. 8-120B package. The June 30, 2011, application replaced in its entirety the January 28, 2011, initial amendment request, and incorporated responses to the Request for Supplemental Information letter dated March 22, 2011. By letter dated November 30, 2011, ES provided responses to the first request for additional information (RAI) dated September 30, 2011. ES also provided Revision No. 1 of its consolidated application.

This second RAI identifies information needed by the staff in connection with its review of the application. The requested information is listed by chapter number and title in the applicant's Safety Analysis Report. The staff reviewed the application using the guidance in NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Material."

Each individual RAI section describes information needed by the staff to complete its review of the application and to determine whether the applicant has demonstrated compliance with the regulatory requirements.

## **Chapter 1 – General Information**

### **Licensing Drawings and Bill of Materials**

- 1-1 Clarify and limit what corrective actions will be taken if the lead shielding has a 10 percent or greater loss of material.

The corrective remedies mentioned in note 6 on sheet 1 of Licensing Drawing C-110-E-007, Rev. 16, are not specified. In previously approved applications, limited quantities of lead metal (the amount was specified on the licensing drawings) were permitted to be attached to the gamma shield to mitigate casting defects. The re-melting of lead while still in the annulus (presumably through a high-temperature heat source such as a blowtorch) could affect the properties of the steel shell and may not be acceptable.

This information is required to demonstrate compliance with 10 CFR Part 71.33(a)(5) and 71.47(a).

## **Chapter 2 – Structural Evaluation**

- 2-1 Justify the lead slump amount of 0.15 inches, and the punctured lead thinning of less than 0.5 inches resulting from the Hypothetical Accident Conditions (HAC) tests.

The staff could not verify these numbers from calculations presented in ST-627 Rev. 1, nor from calculations in ST-679 Rev. 0. These values were further used in the modeling

of the shielding of the package. Provide details of how these numbers were derived, and indicate where these numbers can be found in each of the two calculations mentioned above.

The information is required to demonstrate compliance with 10 CFR 71.71 and 71.73.

## Chapter 5 – Shielding Evaluation

- 5-1 Modify the first paragraph of Section 1.2.2.2 of the application to remove the contradiction regarding neutron producing materials in the contents.

In response to the previous RAI 5-1, the applicant added a statement to the first paragraph in Section 1.2.2.2 to preclude neutron-producing materials. The statement, however, introduces a contradiction to the sentence preceding it allowing fissile materials up to the fissile exemption limits to be present in the package. Fissile materials produce neutrons. Thus, the paragraph should be modified to remove the contradiction. One possible option is to rephrase the last sentence of the paragraph to read as: "Materials producing neutrons through  $\alpha, n$  or  $\gamma, n$  reactions and materials, other than fissile materials as allowed in the preceding sentence, producing neutrons through spontaneous fission are not authorized." The modification should ensure that the neutron source of the contents remains insignificant; otherwise, the shielding evaluation should be modified to account for neutron sources.

This information is required to demonstrate compliance with 10 CFR 71.33(b), 71.35(a), 71.47, and 71.51.

- 5-2 Provide the information requested in the previous RAI 5-4.

In the previous RAI 5-4, staff requested additional information regarding shipment data to be used to support the applicant's shielding evaluation. As has been indicated in a previous review (see the SER for the recent Model No.10-160B package review) and as evidenced by the RAIs associated with this current application, staff continues to have concerns regarding the shielding evaluation and contents specification method proposed by the applicant for this package. Dose rate measurement data from previous shipments with the Model No. 8-120B package can provide significant support in demonstrating the adequacy and/or conservative nature of the proposed evaluation and contents specification method. The use of the data may alleviate the need for further significant scrutiny of the method. However, the staff finds that to be sufficient for this purpose the data needs to include the information requested in the previous RAI 5-4. The RAI does not request a statistically significant sampling; rather, it requests a sampling that can be reasonably construed to represent the contents to be shipped in the Model No. 8-120B package with respect to the contents characteristics described in that RAI. The adequacy of the radiation surveys in identifying the locations of and the values of the maximum dose rates for the package should also be justified.

This information is required to demonstrate compliance with 10 CFR 71.35(a), 71.47, and 71.51.

- 5-3 Modify the method for determining the allowable gamma source and the procedures in Attachment 1 to Chapter 7 of the application so that the 5 percent reduction is performed

as part of the procedures performed by the package user to determine the allowable contents.

Staff finds that reducing the allowable source strengths, as discussed by the applicant in its response to the previous RAI 5-6, is an appropriate way to account for uncertainties and non-conservatisms in various areas of the range of applicability for the method to determine the allowable package contents. However, staff finds that the application of the 5 percent reduction is more effective when incorporated as part of the procedures performed by the package user considering the scale of values in Figure A-1 of Attachment 1 and the level of precision that the figure allows. A 5 percent reduction in the curves themselves is nearly indistinguishable and will not lead to any real difference in the allowable source strength of the contents that would be determined by the entity that uses the figure.

This information is required to demonstrate compliance with 10 CFR 71.47, 71.51, and 71.87(a) and (f).

- 5-4 Provide further justification for the need to address bremsstrahlung only for total beta source activities exceeding  $2 \times 10^{12}$  betas/second.

In response to the previous RAI 5-8, the applicant provided a method to address bremsstrahlung from beta-emitting contents. As part of that method, the applicant proposed to only require consideration when the source strength exceeds  $2 \times 10^{12}$  betas/second. While the applicant provided a basis for deriving this value, it is not clear that a lesser source strength need not be considered. For example, for a point source with betas with a maximum energy of 3.5 MeV, this source strength (assuming the average beta energy is one third the maximum) would result in a fraction of about 0.106 for a ratio of the equivalent gammas to the allowable gamma strength. Since the HAC case is limiting for point sources, this translates to 106 millirem per hour (mrem/hr) at 1 meter (or about 10 percent of the dose rate limit). Staff finds that this could potentially result in a package that exceeds the allowable limits and that, therefore, a lower threshold is warranted. Staff recognizes that the applicant compared dose rates between the equivalent gamma source and the beta source, both calculated using MCNP. The results indicate significant conservatism in the method. However, these calculations appear to be for normal conditions of transport (NCT) only. The currently proposed threshold beta source strength may be found acceptable if the applicant can show a similar level of conservatism for a point source under HAC, including for a maximum beta energy at the maximum gamma energy allowed in the package.

This information is required to demonstrate compliance with 10 CFR 71.47, 71.51, and 71.87.

- 5-5 Clarify the following statements:
- a. Shoring is used to prevent axial movement of contents as well as radial movement.
  - b. Shoring is only credited in NCT for maintaining position and not for providing shielding.

This information is important to understanding the applicant's evaluation method for the

allowable contents and its relation to how the package is operated.

This information is required to demonstrate compliance with 10 CFR 71.47, 71.51 and 71.87.

5-6 Justify the following statements, modifying the evaluation as necessary:

- a. The evaluation method adequately accounts for the variation in distribution of radioactivity within the source volume for distributed sources for NCT and HAC.
- b. The distribution of radioactivity within the source volume won't change due to HAC.

In response to the previous RAI 5-5, the applicant indicated it had changed one of the criteria for a distributed source to be the source that must meet the definition of "essentially uniformly distributed." It is not clear from the application how the evaluation accounts for the distribution of radioactivity within the source volume that is allowed by this definition under NCT and HAC. The evaluation appears to rely on a uniformly distributed source, whereas the distribution can vary by a factor of three. Also, the applicant indicated that the distribution of radioactivity within the source volume would not be affected by HAC. The basis for this statement is not clear. It is not clear that the definition of "essentially uniformly distributed" applies to a package that has experienced HAC. Thus, the applicant should justify the statement. The evaluation should be modified, as needed, to address these concerns. Staff calculations indicate there may be concerns for meeting dose rate limits when accounting for variations in the source distribution.

This information is required to demonstrate compliance with 10 CFR 71.47 and 71.51.

5-7 Justify the applicability of the current evaluation to distributed sources that don't fill the whole package cavity, and modify the evaluation as necessary.

In response to the previous RAI 5-10, the applicant discussed smaller distributed sources with increased densities versus the sources filling the entire package cavity. The staff's concern is more with smaller volume sources that have the same (or lower) density and the same source strength as the sources that fill the package cavity. It appears from the procedures described in Attachment 1 to Chapter 7 that these kinds of sources are acceptable. Thus, these kinds of sources should be evaluated for NCT and HAC dose rate compliance. Staff calculations indicate that there may be concerns for meeting dose rate limits for these sources, at least for NCT. Concerns regarding radioactivity distribution within the source described in RAI 5-6 above should also be addressed for these sources too.

This information is required to demonstrate compliance with 10 CFR 71.47 and 71.51.

5-8 Provide the following:

- a. Verification that the calculations that form the basis of the shielding and allowable contents determination method are correct and yield dose rates that meet the regulatory limits. The proposed contents limits should be adjusted as necessary.

- b. Justification of the configuration of the model related to the lead slump in the HAC models.
- c. The maximum dimension of the gap between the package top flange and the primary lid, modifying the licensing drawing to include this dimension.
- d. Verification that the HAC models account for lead thinning due to the puncture test.

Staff has performed some confirmatory calculations (using the applicant's source configurations) to verify that the allowable contents determined by the applicant's method will meet the regulatory dose limits. These calculations indicate higher dose rates with dose rate limits being exceeded for some of the contents limits, e.g., point sources. Also, the shielding HAC model should account for the full amount of lead slump predicted in the structural evaluation (see RAI 2-1 of this letter).

Additionally, the shielding evaluation and models appear to rely on the gap between the primary lid and the top flange being a maximum value; this aspect affects the configuration of the lid steel versus the lead and lead slump. The licensing drawing shows the dimension of the gap as a minimum. Thus, it appears the drawing should be modified to show the gap dimension as a maximum value.

Staff looked at the sample inputs provided by the applicant for HAC dose rate calculations. Staff was unable to identify that any of the HAC sample inputs include thinner lead resulting from the puncture test, whereas at least the models used to support Appendix 5 of Reference 5.7.2 were supposed to include this effect. HAC modules shall include lead thinning.

This information is required to demonstrate compliance with 10 CFR 71.47 and 71.51.

## **Chapter 7 – Package Operations**

- 7-1 Modify step 2 of Attachment 1 to Chapter 7 of the application to clarify how a source is determined to be a point source or a distributed source.

In response to the previous RAI 7-5, some clarification was provided regarding this procedure. However, the description is still not adequately clear. One possible option is to modify the third sentence of step 2 of Attachment 1 to read as follows: "Content that does not meet both of these criteria for a distributed source shall be considered a point source." The procedure needs to clearly indicate that contents must meet both criteria (the definition of "essentially uniformly distributed" and the minimum volume) to be classified as a distributed source for the purpose of determining the allowable source strength.

This information is required to demonstrate compliance with 10 CFR 71.47 and 71.87.

7-2 Modify the following:

- a. Section 7.0 of the application to indicate that the maximum permissible activity for beta emitting contents is the lesser of 3,000  $A_2$  and the maximum activity determined per Attachment 1 for packages containing a cumulative beta source strength that exceeds the minimum value justified in the applicant's shielding evaluation.
- b. The heading of Attachment 1 to indicate the procedure is also used for determining beta activity limits.
- c. Step 3 of Attachment 1 to Chapter 7 to clarify that the minimum beta source strength for which the procedure applies is a package's total beta source strength.
- d. Step 3 of Attachment 1 to Chapter 7 to describe the factor that replaces the  $9.1E-03$  factor for converting the beta source to an equivalent gamma source for contents with significant quantities of materials with atomic number (i.e.,  $Z$ ) greater than 26.

The applicant developed a method for determining the maximum beta source strength for the package in response to the previous RAI 5-8. The applicant also modified the procedures in Attachment 1 to Chapter 7 to include procedures for the package user to determine the allowable beta emitting contents for their particular shipment. However, the description in Section 7.0 (and the heading to Attachment 1) needs to indicate to the user that this procedure needs to be performed for beta-emitting contents. It currently does not; thus, the user may not recognize this condition of package use and improperly load the package.

The procedures in Attachment 1 and the description in Section 7.0 should clearly indicate that the minimum beta strength for which the method applies is the total beta strength for the package (i.e., it is not per-nuclide beta strength); thus, the procedures must be used for packages for which the total beta strength for the nuclides present in the package exceeds the minimum strength described in the procedures. Reference 5.7.2 indicates that the factor of  $9.1E-03$  is acceptable for contents materials with  $Z$  up to 26 and that for contents of a higher  $Z$ , the factor should be replaced by  $3.5 \times Z \times E-04$ . The procedures should include instructions regarding the appropriate factor for use with the contents.

This information is required to demonstrate compliance with 10 CFR 71.87(a) and (f).

- 7-3 Modify paragraph 7.1.19.3 of the application to read as follows: "That the provisions of 10 CFR 71.87 are met, including that the external radiation dose rates are less than or equal to 200 mrem/hr at the surface and less than or equal to 10 mrem/hr at 2 meters in accordance with 10 CFR 71.47 *by performing radiation surveys. These surveys should be sufficient to ensure that any non-uniformity in the distribution of radioactivity does not cause the surface or the 2 meter limit to be exceeded.*" (Italics added to note suggested changes to the text.)

As indicated in the previous RAI 7-2, the currently proposed language is not clear.

This information is required to demonstrate compliance with 10 CFR 71.47 and 71.87(j).

7-4 Make the following corrections:

- a. The regulatory reference in paragraph 7.3.2 should be changed to 49 CFR 173.428(d); there is no 10 CFR 173.428(e).
- b. The new step 5 in Attachment 1 to Chapter 7 should refer to the new step 4 (and not the new step 3).
- c. The precision and accuracy of the gamma strength limits in the examples in Attachment A-1 should be consistent with the precision and accuracy allowed by Figures A-1 and A-2 from which the limit values are to be derived by the package user.
- d. Several of the values for source limits and density correction factors (DCF), in appropriate examples, appear to be inconsistent with Figures A-1 and A-2 and inconsistent with the procedures outlined in Attachment 1 for energies outside the range shown in the figures.
- e. Some contents activities in the examples also appear to be incorrect or not used in the full process of determining acceptability of the contents.

These questions still remain from the previous RAI 7-3 and as a result of changes made to respond to other RAI questions. Any changes to respond to RAI questions should be reviewed altogether to ensure the resulting operations descriptions are accurate and correct.

Regarding item c, Figure A-2 allows for a precision of 0.05 for the DCF and 0.5 for payload density, while the precision of the limits from Figure A-1 is limited due to the logarithmic scale. For item d, staff noticed that some limit values (and DCF values in applicable examples) don't match the values derived from the attachments figures. For example, the values for energies below 0.5 MeV don't match the limit for 0.5 MeV (as they should per the Attachment 1 procedures). All the limits in the examples should be verified versus the figures since many appear to be incorrect.

Also, some DCF values appear to be high for some energy levels due to rounding up or due to that energy being between the energies shown in Figure A-2; the conservative approach would be to round down or use the lower DCF from the plotted energies. The procedures should be clarified to address these aspects too. For item e, staff noticed that the activity for energy group 4 in example 2 appeared to be lower than it is and energy group 8 in example 4 is missing the converted beta (to gamma) source from Y-90. The applicant should ensure the examples are correct since a package user may rely on them to guide its determination of acceptance of the contents in a given shipment.

This information is required to demonstrate compliance with 10 CFR 71.81.

7-5 Justify using the DCF in Figure A-2 for a payload density of 0.5 g/cc for payloads that

have densities less than 0.5 g/cc.

Figure A-2 of the application does not include densities below 0.5 g/cc. However, the curve indicates the DCF value would drop significantly if it were extended to lower payload densities. Thus, it would be non-conservative to use the DCF at a density of 0.5 g/cc for payloads with lower densities. If payloads with lower densities are not shipped, then the procedures could be modified to limit allowable payloads to those with densities of 0.5 g/cc and above.

This information is required to demonstrate compliance with 10 CFR 71.47 and 71.87.

- 7-6 Clarify the procedures for using the DCF for gamma energies not specifically plotted in Figure A-2 to indicate that the DCF for a specific gamma energy (or energy group) will be the smallest DCF of the nearest gamma energies (above and below) to the specific gamma energy (or energy group) being evaluated.

In response to the previous RAI 7-6, the applicant modified step 6 of Attachment A-1 to address this question. Specifically, the step now includes the direction that the "Applicable DCF is the smallest value at a particular density from the range of energy curves." However, the meaning of this statement is not clear. Further, it is not clear that the examples in the attachment are consistent with this statement.

The procedure should be modified to indicate that for a gamma energy (or energy group) that does not match those energies plotted in Figure A-2, the appropriate DCF is the lower of the DCF for the plotted gamma energy that is just above and the DCF for the plotted gamma energy that is just below the gamma energy (energy group) for which the DCF is being determined. The examples should also be modified to be consistent with this approach.

This information is required to demonstrate compliance with 10 CFR 71.47 and 71.87.

## **Chapter 8 – Acceptance Tests and Maintenance Program**

- 8-1 Provide a description of the acceptance leakage tests for packages fabricated after April 1, 1999, but before January 1, 2011.

In response to the previous RAI 8-5, the applicant modified its acceptance testing to address all package configurations to be used under the certificate of compliance. However, it appears that there are some packages for which an acceptance leakage test is not specified. Section 8.2 is for packages fabricated after April 1, 1999. However, the leakage tests in Section 8.2.4 are only for packages fabricated after January 1, 2011. Thus, the applicant needs to provide a description of the leakage tests that apply to packages fabricated between these two dates. If Section 8.2.4 is to apply to all packages fabricated after April 1, 1999, then the January 1, 2011, date should be deleted from the text in that section.

This information is required to demonstrate compliance with 10 CFR 71.85 and to ensure that the package performance will meet the requirements of 10 CFR Part 71, Subpart E.

- 8-2 Modify the shielding acceptance tests to include more of the details regarding the acceptance test and criterion determination described in the response to the previous

RAI 8-7 and to clarify how the acceptance criterion will be applied.

The response to the previous RAI 8-7 indicated the test will be performed with a gamma source positioned in the cask and that the acceptance criterion will be determined by calculation of the expected dose rates on the cask exterior. This information is an important aspect of the acceptance tests and should be included in the test description in the application. Additionally, the description of how the criterion is applied is not clear. It should indicate that packages for which any dose rate measurement indicates the lead is less than the minimum specified in the drawing in the current certificate of compliance shall not be acceptable and shall be remedied and retested.

This information is required to demonstrate compliance with 10 CFR 71.85(a).

- 8-3 Include a visual inspection of accessible surfaces of the packaging for significant defects, e.g., large dents, prior to loading and provide a statement indicating that significant damage to the packaging will preclude shipment until the cask repairs are made to bring the packaging into conformance with the licensing drawings.

The presence of large dents or defects to the packaging could influence the safety performance of the packaging during HAC. The current language in the application mandates only that EnergySolutions will be contacted if damage to the package is observed.

This information is required to demonstrate compliance with 10 CFR 71.33(a)(5) and 71.71(c)(4).

- 8-4 Justify that the foam density is consistent in the impact limiters or justify that the thermal and mechanical properties of the foam in the impact limiters will be bounded by significant deviations in foam density.

A recent, initial inspection finding discovered that Last-A-Foam used in a Part 71 transportation package had a density and crush strength more than 50% greater than what was required in the package's application. Yet, foam poured into shapes dissimilar to transportation package's impact limiters for acceptance testing met the density requirements listed in the application.

This information is required to demonstrate compliance with 10 CFR 71.33(a)(5), 71.71(c)(1), and 71.71(c)(4).