August 13, 2013

Ms. Sarah Marshall
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SUBJECT: SECOND REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF THE MODEL NO. 3977A PACKAGE

Dear Ms. Marshall:

By letter, dated September 29, 2012, as supplemented December 20, 2012, and April 23, 2013, Croft Associates Limited submitted an application for the Model No. 3977A package. To assist with our review, the U.S. Nuclear Regulatory Commission staff needs the information identified in the enclosure to this letter. Discussion of this request for additional information and a response date occurred on June 26, 2013.

We request that you provide this information by September 20, 2013. Inform us at your earliest convenience, but no later than September 13, 2013, if you are not able to provide the information by that date. If you are unable to provide a response by September 20, 2013, please propose a new submittal date with the reasons for the delay.

Please reference Docket No. 71-9338 and TAC No. L24687 in future correspondence related to this amendment request. The staff is available to discuss these questions as well as your proposed responses. If you have any questions regarding this matter, feel free to contact me at (301) 287-9225.

Sincerely,

/RA/

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

Docket No. 71-9338
TAC No. L24687

Enclosure: Request for Additional Information

Ms. Sarah Marshall
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Oxfordshire, OX14 3DB, United Kingdom

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Request for Additional Information
Docket No. 71-9338
Model No. 3977A Package

By application, dated September 29, 2012, as supplemented December 20, 2012, and April 23, 2013, Croft Associates Limited submitted an application for the Model No. 3977A package. This request for additional information (RAI) identifies information needed by staff in connection with its review of the application.

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

Drawing Review

1.1 Modify proposed Drawing No. 1C-5940 to identify the correct package.

The package under review is the Safkeg HS. However, the drawing identifies the package as Safkeg LS.

This information is necessary to satisfy the requirements in 10 CFR 71.33(a)(3) and (5).

1.2 Remove the stainless steel insert from the list of drawings on Drawing No. 1C-5940.

The inserts are part of the package and drawings have been provided for them. Also, the inserts are relied upon for shielding and other functions. Thus, for completeness, Drawing No. 1C-5940 should only identify drawings for components which will be certified.

This information is needed to confirm compliance with 10 CFR 71.33(a).

1.3 Include the grub screw in the containment vessel in certificate of compliance (CoC) Drawing Nos. 1C-5944 and 1C-5945.

The grub screws are part of the package and should appear on the drawings.

This information is needed to confirm compliance with 10 CFR 71.33(a).

General Information Review

1.4 Ensure Tables 1-4-1 through 1-4-8 show the correct limits for the package contents.

These tables are derived from analyses summarized in PCS 038 and the application. However, at least some of the tables in PCS 038 show contents limits that are less than those in Tables 1-4-1 through 1-4-8 for the same nuclides in the same contents types. The correct limits must be provided in the tables and be supported by the analyses in the application.

This information is needed to confirm compliance with 10 CFR 71.33(b) and 71.35(a).

1.5 Modify the proposed contents descriptions to list all the nuclides to be shipped in the package, including the quantity limits, and modify the analyses as necessary to demonstrate that the package meets the regulations with those nuclides.

In its first RAI response, the applicant removed proposed nuclides from Tables 1-4-1 through 1-4-8 for which the quantities were less than a Type A quantity, and the applicant proposed allowing all nuclides not listed in the tables provided they were less than an A_2 quantity. However, dose rates typically limited the quantities of the nuclides removed by the applicant. Also, type A quantities of many nuclides have significant dose rates. Consequently, staff does not find this approach is supported by the applicant's analyses. For the proposed approach, the applicant's analyses need to demonstrate that the package will meet the dose rate limits for the bounding nuclide as well as the other limits imposed on the package (e.g., heat). Alternatively, the applicant can restore the nuclides which were removed from the tables and ensure the analyses support their inclusion as contents. Since the package analyses address daughters of the proposed contents, the limits for the proposed contents will account for the daughters. Thus, daughter nuclides will not need to be specified in the CoC. Staff notes this second approach is consistent with certification of the Safkeg LS.

This information is needed to confirm compliance with 10 CFR 71.33(b) and 71.35(a).

1.6 Modify Section 1.2.2.1 to clarify contents limits.

The current text implies that dose rates for the proposed quantities will satisfy the limits associated with both exclusive use shipments and non-exclusive use shipments. The analyses do not support such an interpretation. Consequently, the text needs to clearly state the limits for which the package has been analyzed.

This information is needed to confirm compliance with 10 CFR 71.47.

Thermal Review

3.1 Correct the typographical error in Section No. 3.3.1 on the top of page 3-12.

The second paragraph of Section No. 3.3.1 erroneously identifies the regulation as 71.73(g). The correct regulatory citation is 71.43(g).

This information is needed to confirm compliance with 10 CFR 71.31(c).

Shielding Review

5.1 Identify the most limiting dose rate location(s) for the package, both at the package surface and at 1 meter from the package, and modify the limits of the proposed contents in Chapter 1 as necessary, based upon the following conditions:

a. the source is located at the top of the insert cavity and next to the cavity wall,
b. the insert should be placed against the CV lid,
c. the cut out in the tungsten lid is explicitly modeled, and
d. the detectors are located on the package lid and side where the DU thickness is minimized.

It is not clear, that the dose rates on the base of the package bound the dose rates on the package side, or the package lid for the configuration described in this RAI question because the AMEC report referenced by the application does not model this configuration and MicroShield cannot adequately model this geometry. The applicant should also modify the contents limits and shielding analyses as necessary based upon the results.

This information is needed to confirm compliance with 10 CFR 71.47 and 71.51.

5.2 Modify the shielding analyses to address the bremsstrahlung from all proposed contents, as well as the daughter nuclides with high emission rates of high energy beta radiation, and provide justification for any minimum energies and emission rates below which bremsstrahlung is not considered.

It is not clear that the bremsstrahlung analyses submitted by the applicant have considered all sources of this radiation of potential importance for the proposed contents and their daughter nuclides. For example, staff performed a calculation of the dose rates from actinium-227 (Ac-227) and its daughter nuclides. Using DOE/TIC-11026, *Radioactive Decay Data Tables* by David Kocher and the applicant's method for converting betas into equivalent gammas, the staff's analysis indicated that the maximum activity of Ac-227 is about one tenth the value proposed by the applicant. Staff also notes that several of the proposed contents have one or more daughters which either emit high-energy betas or have significant beta emission rates. The applicant's analyses should account for these contributions to the package dose rates and adjust the proposed contents limits as necessary. Staff recognizes that the applicant's method for converting betas into equivalent gammas may be quite conservative. The applicant may consider evaluating the minimum level of conservatism inherent in this method for this package and using that to support the analyses. In doing so, the applicant should consider a range of beta energies, as the level of conservatism may vary with energy. If there is some beta energy or emission rate below which bremsstrahlung is not considered, the applicant should state those thresholds and justify them. The applicant should also ensure it consistently applies these thresholds in its analyses for all the proposed contents and their daughters for which bremsstrahlung may be relevant.

This information is needed to confirm compliance with 10 CFR 71.47 and 71.51.

5.3 Revise Chapter 5 to remove Table 5-1 and text that discusses non-exclusive use evaluations.

The original application attempted to demonstrate compliance with the non-exclusive use dose rate limits in 10 CFR 71.47(a). Based upon staff's previous RAIs, the applicant not only modified the application to include the exclusive use limits, but also incorporated analyses to demonstrate compliance with 10 CFR 71.47(b). However, the applicant also retained the information for non-exclusive use limits. Although it is acceptable to state that the maximum quantities of allowable contents were derived, in part, to generate maximum package surface dose rates of 2mSv/hr, the application should state that, due to analytical uncertainties, package tolerances, etc., the application demonstrates compliance with the exclusive use limits. The application should retain the current descriptions of the package and vehicle configuration assumed for the analyses. It should also explicitly refer to CTR 2013/09 Issue A and its use in the analyses (i.e., analyze the effects of the different sources of uncertainty and the derivation of the factor applied to the package dose rates).

This information is needed to confirm compliance with 10 CFR 71.35(a) and 71.47.

5.4 Modify Table 5-2 to include comparisons of the dose rates at 2 meters from the vehicle edge to the regulatory limit. Also, confirm the package surface dose rates in Table 5-2 are correct and correct the regulatory reference in Table 5-3.

The package surface dose rates reported in Table 5-2 appear to be inconsistent with those given in CTR 2013/09 Issue A, and Table 5-2 does not include the two meter dose rate. Additionally, the correct regulation for the hypothetical action conditions (HAC) table (Table 5-3) is 71.51(a).

This information is needed to confirm compliance with 10 CFR 71.35(a) and 71.47.

5.5 Modify the application to clearly state the ICRP 51 dose conversion factors used in the application and to provide a correct comparison of the ICRP 51 factors used versus the factors in ANSI/ANS-6.1.1, 1977.

The application merely indicates that ICRP 51 factors were used. However, there are different sets of factors, based on orientation of the model in relation to the radiation source. The application should state which orientation, and thus which set of factors, was used (e.g., anterior posterior). Figure 6 of CTR 2013/09, Issue A, compares the ANSI/ANS-6.1.1, 1977 factors to those used from ICRP 51. Based on its evaluation of the factors, the staff finds the curve representing the ICRP 51 factors is incorrect at energies below 0.1 MeV. Contrary to the information provided by the applicant in response to the first RAI letter, the factors do not increase with decreasing energy. Staff has determined that they are constant for a small energy range before decreasing with decreasing energy. The analyses should be updated to reflect this and the application modified to reflect any impacts on either shielding analyses or contents limits.

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

5.6 Address the following with regard to the closure of the inserts as described in Section No. 7.1.2, step 6:

a. demonstrate that all contents, including solid powders, will be confined to the insert cavity under all regulatory test conditions including the normal conditions of transport (NCT) vibration test; and
b. either show that the current operating instructions result in a consistent closure of the insert, or include a leak test appropriate for all proposed contents as part of the closure operations and justify the acceptability of that test.

Although the applicant provided HAC drop test reports in response to a previous RAI regarding confinement of the proposed contents in the inserts, the reports did not provide clear evidence that the method of closure was as described in Section No. 7.1.2 of the application or that the forces on the insert in the HAC tests bound those that an insert in an actual package will experience for the same HAC tests. Since a distance of approximately 4 mm lies between the top of the insert lid and the bottom of the CV lid, staff believes it is possible for vibration to loosen the lid during transport allowing the contents, whether liquid or powder, to escape from the insert cavity. Additionally, it is not clear that the current operating instructions will result in consistent closure of the insert since "hand-tight" closure differs with individual strength. Thus, in some cases, it may be easier for the insert lid to loosen and allow the contents to escape the insert. The package operations must ensure consistent closure of the insert since the shielding analyses for both NCT and HAC conditions depend upon the contents being confined to the insert cavity. Alternatively, the shielding analyses should be modified to address contents leaking from the insert. Additionally, it is not clear that the leak test currently specified for liquid contents provides sufficient proof of confinement of the contents. It also seems that a leak test should be specified for all insert contents.

This information is needed to confirm compliance with 10 CFR 71.47, 71.51, and 71.87.

Operations Review

7.1 Modify Chapter 7 to address the following:

a. remove discussion of operations specific to the steel insert and its liner;
b. change 'conformity' to 'compliance' in Section No. 7.1.1, step 1;
c. change references to drawings in Section No. 1.3.3 to reference the CoC drawings;
d. add a reference to Section No. 7.1.1, step 11 to Section 7.1.3, step 2, or justify its omission;
e. add a step in Section No. 7.1.2 to verify the insert body and lid serial numbers match each other;
f. ensure all operating instructions impacted by the grub screw are modified appropriately;
g. modify Section No. 7.3, step 6, to refer to 49 CFR 173.428(a) for contamination limits for empty packages; and
h. ensure the requirements of Section No. 7.1.1, step 13, and Section No. 8.2.3.2, step 3, are consistent.

For item a above, since the stainless steel insert is not being approved as part of the package, references to the stainless steel insert and the PTFE insert should be removed from Section No. 7.1.2, step 2, and Section No. 7.3, step 2. Also, since potentially significant neutron sources are only transported in the steel insert, references to neutron radiation can be removed in Section No. 7.1.3, step 9, and Section No. 7.3, Step 7. Item c, which was not addressed in the response to the previous RAI letter, is important since

Section No. 1.3.3 lists drawings for components that will not be approved. For item d above, it appears that Section No. 7.1.3, step 2 should reference Section No. 7.1.1, step 11, in addition to steps 9 and 10. For item f above, staff believes Section No. 7.1.1, step 5; Section No. 7.2.2, step 3; and the paragraph just preceding Section No. 7.3, step 1, should be modified to remove and install the grub screw at the appropriate times or justify that these actions are not needed. In addition, the applicant should ensure other steps in Chapter 7 are not affected by the addition of this screw. For item h above, the acceptance criteria in Section No. 7.1.1, step 13, are not all supported by the applicant's analyses. They should be modified to be consistent with the acceptance criteria presented in Section No. 8.2.3.2, step 3, for acceptable damage to the package.

This information is needed to confirm compliance with 10 CFR 71.47 and 71.87.

7.2 Revise operating instructions as necessary to ensure any changes resulting from the analyses associated with question 5.6 of this enclosure are incorporated.

The current operating instructions for insert closure direct operators to install the insert caps until they are "hand tight." The information generated by question 5.6 may make the existing instructions inadequate.

This information is needed to confirm compliance with 10 CFR 71.87.

Maintenance Review

8.1 Modify the application as follows:

a. remove discussion of acceptance tests and maintenance specific to the steel insert and its liner;
b. Section No. 8.2.3.2, step 1, needs to clarify the discussion of matching serial numbers as was done for similar steps in Chapter 7 and other places in Chapter 8 (e.g., see Section No. 8.2.3.3, step 1).

For item a above, these descriptions include Section No. 8.2.3.5, step 5. For item b above, these clarifications were requested in staff's previous RAIs, which discussed specific places that needed clarification. The applicant should ensure that the clarification is done in all relevant locations in the application, particularly in Chapters 7 and 8.

This information is needed to confirm compliance with 10 CFR 71.85 and to assure the maintenance program is adequate to assure package performance meets the requirements in 10 CFR Part 71, Subparts E and F, during its service life.

8.2 Modify the shielding acceptance test in Section No. 8.1.6 to provide a test and acceptance criterion that are based on and supported by the package description and analyses in the application.

The current test uses a criterion of 20% dose rate increase as a threshold between acceptable and unacceptable shielding. This criterion is not clear and does not appear to be supported by the analyses. The applicant needs to provide an acceptance test with an acceptance criterion that is clearly tied to the package design and supported by the analyses described in the application.

The following is an example of acceptance test language which was previously approved by staff: A gamma scan shall be performed over the surface of the DU lid and body shielding. The measured dose rates are compared to the dose rates calculated for the DU lid and body shielding with the minimum dimensions and the minimum density, as well as the chemical composition, specified in the CoC drawings. The calculations and the measurements (the scan) shall use the same source, the same source quantity, and the same geometry and configuration (of the source, shielding and detector). The DU lid and body shielding are acceptable if the measured dose rates do not exceed the calculated dose rates.

This information is needed to confirm compliance with 10 CFR 71.47, 71.51, and 71.87(j).

8.3 Correct the typographical error in Section Nos. 2.6.1.2 and 8.1.6 as well as Table 2-8.

Both the first paragraph of Section No. 2.6.1.2 and 8.1.6, as well as Table 2-8, refer to lead shielding. The SAFKEG-HS shielding material is not lead but depleted uranium.

This information is needed to confirm compliance with 10 CFR 71.33(a)(5).