CROFT

September 30, 2010

Attention: Michele Sampson
Senior Project Manager Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety and Safeguards
US Nuclear Regulatory Commission
Washington DC 20555-0001

Subject: Application for Safkeg-LS Design No. 3979A Transportation Package Approval, Response to Request for Additional Information (Docket No. 71-9337)

Reference: Letter from NRC to Croft Associates Ltd, Subject: Second Request for (Docket No. 71-9337, TAC No. L24361)

Dear Michele Sampson

This letter transmits the response to the Second Request for Additional Information (RAI) for the Croft Safkeg-LS 3979A package design, provided by the above referenced letter. The responses to the RAI are given in report CTR 2010/08 Issue A enclosed herewith.

This letter also transmits Revision 2 of the Safkeg-LS 3979A SARP (which has been revised to respond to the requests made in the RAI), revised or new supporting documents for Rev 2 of the SARP, and additional information applicable to the RAI.

The enclosed CD contains all the above referenced documents together with revised licensing drawings which are marked as Proprietary Information submitted under 10 CFR 2.390, to be withheld from public disclosure under 10 CFR 2.390 and an affidavit containing a full statement of the reasons that the proprietary information should be withheld from the public, pursuant to the requirements of 10 CFR 2.390.

If you require clarification on any aspects of our application please contact the undersigned.

Yours sincerely

Dr Robert A Vaughan
Managing Director
Croft Associates Limited

Enclosure: CD labeled SAFKEG-LS 3979A Docket No. 71-9337, TAC No. L24361 - Response to Second Request for Additional Information, September 2010

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CROFT

AFFIDAVIT PURSUANT TO 10 CFR 2.390

I, Robert A Vaughan, Managing Director of Croft Associates Limited (Croft) hereby affirm and state

1. I have been specifically delegated the function of reviewing the information sought to be withheld and am authorized to apply for its withholding on behalf of Croft.
2. Croft is providing NRC with detailed drawings as part of the Safkeg-LS 3979A SARP submission Docket No 71-9337. These detailed drawings contain proprietary commercial information.
3. The information sought to be withheld pursuant to the provisions of paragraph (a)(4) of 10 CFR 2.390 is these detailed drawings which are marked as follows in the SARP submissions "Proprietary information submitted under 10 CFR 2.390 to be withheld from public disclosure under 10 CFR 2.390".
4. These detailed drawings should be held in confidence by the NRC based on paragraph (b)(4) of 10 CFR 2.390 because:

i) This information is and has been held in confidence by Croft.

ii) This information is of a type that is customarily held in confidence by Croft and there is a rational basis for doing so because this information if released might result in the loss of an existing or potential competitive advantage as follows.

   a. The information reveals the distinguishing aspects of the design and the prevention of its use by Croft's competitors gives Croft a competitive economic advantage.

   b. The information, if used by a competitor, is likely to reduce the competitor's expenditure of resources or improve their advantage in the design, quality and manufacture of a similar product.

iii) This information is being transmitted to the NRC voluntarily and in confidence.

iv) This information is not available in public sources.

v) Public disclosure of this information is likely to cause substantial harm to the competitive position of Croft because of the reasons outlined below.

   a. Similar products are manufactured and sold by competitors of Croft.

   b. The development of this information by Croft is the result of significant expenditure of staff effort and a considerable amount of money. It is my belief that a competitor would have to undertake similar effort and expense to generate equivalent information.

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c. In order to generate such information, a competitor would also require considerable time.

d. If a competitor used this information and did not have to undertake the work required to generate this information they are likely to have lower overall costs and so are likely to have an unfair economic advantage over Croft in offering a similar product to the market.

5. Accordingly, Croft requests that the designated information be withheld from public disclosure pursuant to paragraph (a)(4) of CFR 10 2.390.

Executed on September 30, 2010

Robert A Vaughan
Managing Director
Croft Associates Limited

[Croft Affidavit Safkeg-LS RAI September 2010.docx]

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SAFKEG LS Response Matrix to the Second Response for Additional Information (RAI) from the Nuclear Regulatory Commission

Title	SAFKEG LS Response Matrix to the Second Responses for Additional Information (RAI) from the Nuclear Regulatory Commission	Number	CTR 2010/08
		Issue	A
		File Reference	CTR2010-08-A-v5-Response to NRC RAI 2010-07-30.docx
Compiled	S Marshall	Checked	RA Vaughan
Approved	RA Vaughan	Date	30th September 2010
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Reference Number	NRC Comment	Response
1	General Information	
1-1	Clarify the net and gross weight for the package in Section 1.2.1.1, of the application. These weights should correspond to the weight of the tested prototype, or the application should be revised to provide analytical justification that the results of the test conditions bound the weight in Section 1.2.1.1. In Section 1.2.1.1, CTR 2008/10, Rev. 1, the applicant stated that the gross weight of the package is 68 kg (150 lbs), and the net weight (without contents) is 62.1 kg (137 lbs). These weights are also reflected in Table 2-7, CTR 2008/10, Rev. 1. The gross weight of the tested prototype package was tabulated as 61.72 kg (136 lbs), and the net weight was 56.16 kg (124 lbs) in Section 2.2 of CTR 2009/21, Issue B. The comparison to the calculated mass of the package in CTR 2009/21 indicates that the tested package was 3% lighter than the design weight; however in comparison to Section 1.2.1.1, the weight difference is nearly 10% lighter, and no justification is provided to support the proposed 68 kg gross weight. This information is required to assess compliance with 10 CFR Parts 71.71 and 71.73.	The design weight of the package was set at 68 kg (150 lb) because this is the maximum mass Fed Ex will ship simply. When the prototype was manufactured, it was found to weigh 61.72 kg. As production packages could weigh more than the test package (due to minor variations within manufacturing tolerances) the maximum weight was taken as 68 kg (10% greater than the test package). The test package was dropped from a height of 10.2 m during the HAC testing in order compensate for its lower weight – the 10.2 m drop provides 13% more energy at impact than the regulatory 9m test. On reviewing the various package weights as a result of this RAI question, it was concluded that a 5% weight margin is sufficient and this has been adopted by reducing the specified (maximum) design weight to the test package weight plus 5% - which is 64.8 kg. Our experience has shown us that this will cover the expected weight variation of production packages. In order to standardised all the weights quoted in this application and supply a justification for the weight of the package with regards to the weight of the test package, the following changes have been made to the test procedure, SARP and calculation sheet CS 2010/11. The following changes have been made to the SARP and appended documents. <u>CTR 2009/21 – Test report in Section 2.2.12.2 of the SARP</u> Table 1 in section 2.2 of the test report has been amended to show the test package weights and weights with 5% margin (design weights). Paragraph 2 of section 2.2 has been updated to indicate the design weight and test package weight.

Reference Number	NRC Comment	Response
		CTR 2008/10 SARP Section 1.2.1.1 the last paragraph of this section has been altered so that the maximum weight of the package is 59 kg excluding the contents. The maximum contents weight is 5.8 kg and the gross weight of the package is 64.8 kg. Section 2.1.3 the maximum package gross weight has been reduced to 64.8 kg. Table 2-7 has been updated with reduced design weights. The title of the data columns has been changed to "Design Weight". Section 2.6.7 paragraph 6 and section 2.7.1 paragraph 3 provide justification for the design weight being 5% heavier than the tested weight. CS 2010/11 in Section 2.12.2 of the SARP Due to the decrease in the package weight, the package density calculation in CS 2010/11 has been amended. Section 2.7.2 of the SARP The recalculated package density has been entered in SARP section 2.7.2.
1-2	Revise Drawing Nos. 0C-6042, 1C-6045, and 1C-6046, and Section 2.3.1, of the application to establish the appropriate section of the Code with applicable version/date(s) for the welder and welding operator qualifications. The applicant has provided the welding requirements and acceptance criteria in notes on the drawings. However qualification of personnel performing the welding has not been	Drawings in SARP section 1.3.3 Drawing Nos. 0C-6042 note 4, 1C-6045 note 1, and 1C-6046 note 1 have been revised as follows. "All welds to be qualified in accordance with ASME section IX" has been changed to "All welding procedures and personnel shall be qualified in accordance with ASME section IX, 2007 edition, 2009 addenda".

Reference Number	NRC Comment	Response
	specified. In Section 2.3.1, the application states "All qualified welds shall be carried out by welders holding a valid qualification in accordance with the appropriate part of ASME Section VIII." The drawings and Section 2.3.1 should be revised to reflect the appropriate Code for welder and welding operator qualification. This RAI is a result of the response to RAI 1.1-2 and 1.1-2 sent on February 26, 2010. This information is required to assess compliance with 10 CFR 71.31.	Section 2.3.1 of the SARP has been revised as follows: "All qualified welds shall be carried out by welders holding a valid qualification in accordance with the appropriate part of ASME Section VIII" has been changed to "All qualified welds shall be carried out by welding personnel holding a valid qualification in accordance with the appropriate part of ASME section IX, 2007 edition, 2009 addenda". Note: The drawings have been edited as specified in this response matrix - all changes are detailed on the Modification Sheet M752 which is provided with this response matrix.
1-3	Revise Tables 1-3-6 to reflect the maximum quantity of material, by radionuclide, which can be shipped in the package and meet the hypothetical accident condition test containment requirement for release of material in a one week period. Section 4.3.4.2 notes that containment of gases is based upon the assumption that the gas material will leak from the containment system at the given leakage rate. Report CS 2009/06 calculates the size of a single leak and the maximum activity in the package which will result in a leak at the regulatory limit. This quantity is a limit which should be reflected in Table 1-3-6, since transport of a quantity greater than this limit would result in the package failing to comply with the requirements for a Type B package. (See also RAI 4-3). This information is required to assess compliance with 10 CFR 71.51(a)(2).	In Table 1-3-6 of the SARP, under "Maximum mass of radioactive material", the following changes have been made. 200g limit changed to 1g – this change has been made because the mass of gas is << 1g. this . The gas nuclide limits are given in Table 1-4-6 – the limits are those determined in calculation report CS 2009/07 Issue B. The maximum decay heat has been corrected in 1-3-6 to 10W [from 5W] – 10W has been used for the calculations for gas contents in PCS 036 (at issues A, B & C) and the results in Table 1-4-6. PCS 036 has been edited as a result of the above. The changes made are as follows. Mass limit changed from 200g to 1g. Calculation of volume of gas added (for information). A2 for Kr-79 amended to 0.02 TBq. Note that these changes have not affected the calculated package limit for gaseous contents from those listed in the SARP at Rev 1.

Reference Number	NRC Comment	Response
		Note - The actual nuclide limits for Tables 1-3-1 to 1-3-8 are given in the referenced related Tables 1-4-1 to 1-4-8 – no change made re this.
2	Structural	
2-1	Update the drawing to provide the critical characteristics of the O-ring compound used to demonstrate the package performance, or limit the reference for the material used for the containment vessel (CV) O-ring to Parker Compound E0740-75. Sheet 1 of licensing Drawing No. 1C-6044 lists British Standard (BS) 4518 0895-30, American Society for Testing and Materials (ASTM) D2000 and Parker Compound E0740-75. It appears that the seal used for demonstrating the package's compliance with the Hypothetical Accident Conditions was made of Parker Compound E0740-75. Although this compound meets the requirements of ASTM D2000, some elastomers which also meet ASTM D2000 may not be adequate for the application. The exact O-ring compound intended for use in the package should be listed on the licensing drawings. To reduce ambiguity, the applicant could retain the reference to Parker Compound E0740-75 and remove the ASTM and BS standards. This Request for Additional Information (RAI) is a result of the response to RAI 1.1-8 sent on February 26, 2010. This information is needed to determine compliance with 10 CFR 71.33(a)(5)(iii).	We prefer the seal specification to be independent of the supplier if possible. Hence we prefer to specify the seal using ASTM D2000. The specification of the seal material in the SARP has been edited to be: EPM to ASTM D2000 M3 BA 710 A14 B13 F17 Z1 where Z1 stands for hardness of 75±5 IRHD (or Shore A) with Critical characteristic of leaktightness performance at 200°C for 24h and 150°C for 1,000h (ref Croft procedure CP 427) Drawing No. 1C-6044 seal material descriptions have been revised as follows: 1. Parker Compound No. E0740-75 has been removed. 2. Ref items 5 & 6, IRHD has been added 3. References to BS 4518 have been clarified. 4. Note 4 has been altered to include reference to Croft Procedure CP 427 Note that BS 4518 is a dimensional standard only, it contains no material specifications. Reference numbers 0895-30, 1045-30 and 0036-24 refer to the size of the O-ring in each case (i.e. 0895-30 stands for 89.5mm inside diameter with 3.0mm diameter of cross section). BS 4518 covers tolerances etc. A copy of BS 4518 has been provided. The specification of the seal used for demonstrating the package's compliance with the NCT and HAC tests was: EPM to ASTM D2000 M3 BA 710 A14 B13 F17 Z1 where Z1 stands for hardness of 75±5 IRHD (or Shore A). Material used was James Walker compound EP18/H/75 (see James Walker MDS for EP18/H/75 and CoC

Reference Number	NRC Comment	Response
		# 960279458). This has been added to the Test Report CTR 2009/21 (ref SARP Section 2.12.2)
2-2	Clarify the application to provide verification of the maximum pressure after the hypothetical accident condition tests. Consideration should be given to the effects of degradation (charring) of the shielding insert O-ring and the potential release of volatiles. The application lists the maximum pressure for the hypothetical accident condition tests as 1000 kPa gauge in Sections 2.7.4.1, and 3.4.3. The effects of degradation of the shielding insert O-ring, and potential for release of volatiles is not addressed in either section. This RAI is a result of the response to RAI 1.2-3 sent on February 26, 2010. This information is needed to determine compliance with 71.73(c)(4).	The only cause for any pressure rise in the CV is from the increase in temperature of the air in the CV from contents heating. The following changes have been made to the SARP and appended documents. The maximum temperatures of the Shielding Inserts in the CV are 128 °C under NCT and 196 °C under HAC [see new data added to Section 3.1.3 and Tables 3-2 and 3-3 of the SARP] – these are also the maximum temperature of the O-ring of the shielded inserts. The EPM O-ring would not be affected [i.e. produce volatile gases] under these temperatures. The potential effects of degradation of the shielding insert O-ring, and potential for release of volatiles has been addressed in the SARP in Section 3.4.3 (in the para following Figure 3-11). The applicable maximum pressures under NCT and HAC are Also given in Sections 2.6.1.1 and 2.7.4.1. The contents will not emit volatiles as a restriction has been added to Tables 1-3-1, 1-3-2, 1-3-3, and 1-3-7 (which are for solid contents) under "Physical form of radioactive material" that the contents must have a melting point > 250°C and not be volatile at < 250°C. The restriction is not necessary in Table 1-3-8 as these contents are in Special Form. The maximum pressures in the CV under NCT and HAC have been provided in Calculation Sheet CS 2009/08, Issue A (ref SARP Section 2.12.2) and this has been addressed in the SARP in Sections 2.7.4.1, and 3.4.3.

Reference Number	NRC Comment	Response
2-3	Provide an engineering calculation to demonstrate the maximum pressure inside the containment vessel after the hypothetical accident condition tests, if contents of the package are gaseous and the gas-filled vessel is breached. Table 1-3-6 limits the maximum amount of gas to 25 bar-cc. The application does not indicate the expected maximum pressure after the hypothetical accident conditions, taking into consideration release of the gas inside the containment vessel. This RAI is a result of the response to RAI 1.2-5 sent on February 26, 2010. This information is needed to determine compliance with 10 CFR 71.43(c).	The free volume in the CV is 78 cc [see RAI 4-3 and revised text in SARP Section 2.7.4.1]. The free volume (as used in CS 2009/07) is based on the air gap between the Tungsten Insert and CV cavity of 33cc + the cavity volume of the Tungsten Insert of 55cc less an allowance of 10 cc for solid contents of the Tungsten Insert. SARP Table 1-3-6 under Product Containers has been amended to clarify the contents of the Tungsten Insert and to require a volume limit of Product containers and packing of 10cc. Therefore breaching of the product container containing the gas (of maximum amount 25 bar.cc) would increase the pressure in the CV by a maximum of 0.32 bar (given by the volume ratio 25/78). Details of the above have been added to SARP Section 2.7.4.1.
2-4	Clarify if the melting point of all solid contents (not just elemental forms) will be above the maximum temperature of the package contents. The maximum temperature of the package contents may exceed the maximum temperature of the containment boundary. The restrictions on the melting points of the solids are limited to pure elements (not compounds) and may result in the need for operating limits specified as a condition in the Certificate of Compliance. This RAI is a result of the response to RAI 1.2-1 sent on February 26, 2010. This information is needed to determine compliance with 71.73(c)(4).	No low melting point solids are required for the contents. The maximum temperatures of the Shielding Inserts in the CV are 128 °C under NCT and 196 °C under HAC [see new data added to SARP Section 3.1.3 and Tables 3-2 and 3-3 of the SARP. The radioactive contents (except for alpha emitting contents) within product containers carried in the Shielding Inserts cannot be at a higher temperature as the radiation will not all be absorbed in the contents. For alpha emitting contents, there are no low melting point elements or compounds for nuclides that emit alpha particles. A requirement has been added to SARP Tables 1-3-1, 1-3-2, 1-3-3, and 1-3-7 (which are for solid contents) under "Physical form of radioactive material" that the contents must have a melting point > 250°C. The restriction is not necessary in SARP Table 1-3-8 as these contents are in Special Form.

Reference Number	NRC Comment	Response
2-5	Provide revised analytical analyses of the package. Some of the ABAQUS outputs may have been incorrect due to erroneous input data in VECTRA report, 925-3272/R1, Rev 4. Perform a detailed review of all ABAQUS input files for their accuracy/correctness, and rerun the ABAQUS files that may have erroneous input data to determine the correct stress intensity levels at the selected locations shown in Figure 7 in the VECTRA report, 925-3272/R1, Rev 4. Staff has performed a cursory review of the ABAQUS input files for their accuracy/correctness, and identified a concern that erroneous input data may have been used to determine the stress intensity levels at the selected locations shown in Figure 7 in the VECTRA report, 925-3272/R1, Rev 4 -- e.g., LS_CV1_NCT11_HAC5.inp and LS_CV1_NCT12_HAC6.inp erroneously list a GRAV 1.1772E+06 mm/s^2 acceleration, which corresponds to a 120g acceleration. However, (1) for the normal conditions of transport (NCT) free drop case on page 2-33 in Section 2.6.7.of the application (CTR2008/10, Rev. 1) states, "A body force was applied to the model which was equivalent to an upward vertical acceleration of 120 g plus an additional factor of 50% to ensure conservatism." (2) And for the hypothetical accident conditions (HAC) free drop case on page 2-41 in Section 2.7.1 of the application (CTR2008/10, Rev. 1) states "Once the load conditions had been applied a body force of 300g was applied to the vessel which was equivalent to the deceleration of impact." Similarly, on page 8 of VECTRA report, 925-3272/R1, Rev 4 states, "Bounding values were used for the accelerations applied to the model for the impact cases. A value of 300g was used for the HAC free drop cases from 9m and a value of 180g was used for the NCT free drop cases from 1.2m."	The input files have been reviewed again and we can confirm that the correct acceleration values were used. The input files used for the analyses have been listed in section 2.6.7 (in Table 2-27) along with the acceleration values and the line in the input file where the acceleration values can be found.

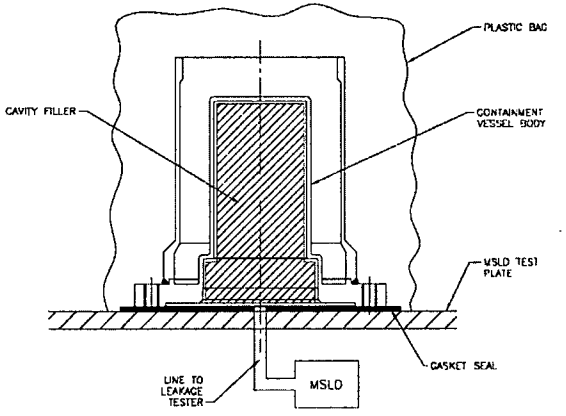
Reference Number	NRC Comment	Response
	This information is required to assess compliance with 10 CFR Parts 71.71 and 71.73.	
2-6	Check tabulated displacement values of CV in CTR 2009/21, Issue B, Table 8, "Acceleration data for drop test" for correctness and provide a description of how the displacement values were determined. Displacements of CV at the end of acceleration pulse in millimeters (mm) are tabulated in Table 8, "Acceleration data from drop tests" in CTR 2009/21. Those displacement values may have been erroneously listed, if they were to be compared with the dimensional differences tabulated in Table 9, "Dimensions taken before NTC and HAC tests." There is no discussion of the displacement values in the text for Section 5, in conjunction with the discussion of the peak acceleration data. This information is required to assess compliance with 10 CFR Part 71.71 and 71.73.	Displacement data has been removed from CTR 2009/21. This data had been included unnecessarily in the original report, but it is not used in the evaluation of the package performance and has therefore been removed as superfluous.
2-7	Provide analyses/evaluation to ensure the containment boundary is maintained due to reduction in closure screw preload of CV at cold conditions. The effect of reduction in closure screw preload of CV for the integrity of the containment boundary need to be performed due to the difference in the thermal expansion coefficient of Type 304L stainless steel vessel lid and SA-A320/A320M, Grade L43 alloy steel closure screw at cold temperature levels. This information is required to assess compliance with 10 CFR Part 71.71(c)(2).	The analyses takes into account the difference in thermal expansion coefficients of the lid and bolts. The force required to maintain compression of the O-rings is 9906 N (source: Croft). The total bolt force (for all 8 bolts) at the end of each analysis was: NCT1: 84.7 kN NCT2: 52.4 kN NCT3: 84.7 kN NCT4: 54.6 kN NCT5: 84.7 kN NCT6: 54.5 kN NCT7: 84.9 kN NCT8: 55.1 kN NCT9: 84.9 kN NCT10: 55.2 kN NCT11: 85.1 kN

Reference Number	NRC Comment	Response
		NCT12: 55.3 kN HAC1: 95.1 kN HAC2: 55.5 kN HAC3: 95.2 kN HAC4: 54.9 kN HAC5: 95.3 kN HAC6: 55.6 kN Therefore there is sufficient force in all cases to maintain compression in the O-rings and maintain the containment boundary.
2-8	Review the following calculation for the CV screw force based on the torque value, and provide reason(s) for the discrepancy between the calculation provided in the response for RAI 2-9. Using the following common industry approach, the staff was not able to confirm CV screw tension force similar to the one presented in the response for RAI 2-9. Torque: (given) T = 10 Nm = 7.376 ft-# Nut factor: for Alloy or Mild Steel (assumed) -- experimentally derived constant K = 0.2 Nominal diameter of the closure screw: (given - item 4, from Drawing No. 1C-6044, Rev. A) D = 10 mm = 0.394 inch, Formula for bolt force: Taken from the following Referenced Documents: - NUREG/CR-6007 "Stress Analysis of Closure Bolts for Shipping Casks," - EPRI, NP-5067 "Good Bolting Practices" F = T / (K*D) = [(7.376 ft-#)*(12 in/ft)] / [(0.2)*(0.394 in)] = 1,123	The bolt force calculation is based on that given in *Machinery's Handbook 28th Edition.* A copy of the calculation is given in "bolt tension 3.pdf", along with the relevant section of *Machinery's Handbook* "28012_08a.pdf". In our calculation, the equation used for calculating the flank angle is different to that given in *Machinery's Handbook,* as the equation in that book was not dimensionally correct. Assuming a friction coefficient of 0.11 (steel-on-steel with molybdenum sulphide grease) gives a bolt tension of 8.12 kN, as used in the analysis. The friction coefficient can vary by ±20%. This gives lower and upper bound values for the bolt tension of 6.99 kN and 9.68 kN respectively. In NUREG/CR-6007, the mean value of K for bolts lubricated with moly grease is 0.137. This gives a bolt tension of 7.30 kN. Using the upper and lower bound values of K (0.16 and 0.10), gives bolt tensions of 6.25 kN and 10.0 kN. These values are similar to those calculated using the method in *Machinery's Handbook.* The lower bound value of 6.25 kN is 23% less than the value used in the analysis. If all the forces reported in 2-7 were reduced by 23%, there would still be sufficient force to maintain O-ring compression. The upper bound value of 10 kN is 23% more than the value used in the analysis. In this case the margin for bearing stress would reduce from 0.32 to 0.07. However, this is still acceptable.

Reference Number	NRC Comment	Response
	$\#_{force}$ = 509 kg_{force} = 4,995 N The difference in CV screw forces are: ~5.0 N vs. 8.12 N Note that for higher K values, the difference in screw force would be even larger. Furthermore, the calculated CV screw force from the torque value is directly related to previous RAI (see RAI 2-8). This information is required to assess compliance with 10 CFR 71.71 and 71.73.	
3	Thermal	
3-1	Clarify Section 3.2.2 of the application to identify the type of O-ring material used for low-temperature testing. Provide a specific reference to the section of the supporting documentation or analysis to verify that the containment vessel remained leak-tight at -40°C. Section 3.2.2 should be revised to provide a specific reference within report CTR 2009/21, Issue A, for the low-temperature testing of the containment vessel. Additionally, the description of the O-ring material should be revised to reflect the O-ring material must be as described on Drawing No. 1C-6044. This question is a result of the response to RAI 1.1-8 sent on February 26, 2010. The staff wants to confirm that Parker Compound E0740-75 was used to demonstrate a leak-tight configuration at -40°C. This information is needed to determine compliance with 10 CFR 71.71(c)(2).	The details for the material of the O-ring used in the test package (James Walker MDS for EP18/H/75) has been included in the test report CTR 2009/21 (in Section 2-12-2 of the SARP) in section 2 and the data sheet and Certificate of Conformity (James Walker CoC # 960279458) have been referenced (these sheets have been attached for information to this RAI response). Section 3.2.2 of the SARP has been updated so that the O-ring material reflects that in drawing number 1C-6044. The ASTM D2000 standard B13 requires the O-ring to be tested for 3 minutes at -40°C therefore this provides proof the O-rings will perform satisfactorily at low temperatures. The wording in SARP section 3.2.2 now references the ASTM D2000 standard and has been clarified to highlight that the package was cooled to -40°C for the HAC tests with the package leak tested on completion of all the tests. Specific references have been provided in SARP section 3.2.2. The following text has been added to SARP Section 3.2.2 in the penultimate para – this is self explanatory.

Reference Number	NRC Comment	Response
		"The critical characteristic test specified in CP 427 (in SARP section 8.3.2) provides assurance that the material supplied for use in packages, provides the required degree of sealing at 200°C for 24h and 150°C for 1,000h."
3-2	Revise the application to provide the maximum temperature of the package contents and the O-ring of the shielded inserts under HAC. The maximum temperature of the containment vessel is stated in the application, but it is not clear if the temperature of the package contents and the O-ring on the shielded inserts exceed the maximum temperature of the containment vessel. Also, the effect of temperature on contents was not evaluated since some content like cesium have a relatively low melting and boiling point. This RAI is related to the response to RAI 1.2-1 sent on February 26, 2010. This information is needed to determine compliance with 71.73(c)(4).	The maximum temperatures of the Shielding Inserts in the CV are 128 °C under NCT and 196 °C under HAC [see new data added to Section 3.1.3 and Tables 3-2 and 3-3 of the SARP – these are also the the maximum temperature of the O-ring of the shielded inserts. The radioactive contents (except for alpha emitting contents) within product containers carried in the Shielding Inserts cannot be at a higher temperature as the radiation will not all be absorbed in the contents. For alpha emitting contents, there are no low melting point elements or compounds for nuclides that emit alpha particles. A requirement has been added to SARP Tables 1-3-1, 1-3-2, 1-3-3, and 1-3-7 (which are for solid contents) under "Physical form of radioactive material" that the contents must have a melting point > 250°C and not be volatile at < 250°C. The restriction is not necessary in SARP Table 1-3-8 as these contents are in Special Form. The O-ring in the Shielding Inserts is EPM with service temperature of 150°C and would therefore not be damaged under the maximum NCT temperature of 128 °C. The EPM is rated for 200 °C and therefore would therefore not be damaged under the maximum HAC temperature of 196 °C. Note however that the O-ring seal of the Shielding Insert is not assumed to provide sealing under HAC.
3-3	Remove the temperature limit of 204°C from Table 3-3 for the containment vessel lid seal and replace it with the batch test temperature of 200°C from Chapter 8. Also, Note 1 associated with this seal temperature limit should reference the batch testing requirements for this seal.	SARP Table 3-3 has been updated to reference a temperature limit of 200°C for the containment vessel lid seal. Note 1 of this table now includes a reference to section 8.1.5.2.

Reference Number	NRC Comment	Response
	This information is needed to determine compliance with 10 CFR 71.73(c)(4).	
4	Containment	
4-1	Revise Section 4.1 of the application to correct the statement that there are no welds that are a part of the containment boundary or to provide a detailed explanation of why lid welds are not considered to be part of the containment boundary. Section 4.1 of CTR 2008/10, Rev. 1 states, "There are **no welds**, valves, or pressure relief devices present in the containment boundary and the package does not rely on any filter or mechanical cooling system to meet the containment requirements. Detail A of Drawing No. 1C-6044, Issue B and Detail B of Drawing No. 1C-6045 illustrate a bevel weld on the containment vessel lid, which is directly on the containment boundary indicated in Figure 4-1 of CTR 2008/10, Rev. 1. This information is required by the staff to assess compliance with 10 CFR 71.51.	The presence of the weld has been included within SARP section 4.1 (new 2nd para) along with an explanation describing that the weld does not affect the containment properties and simply holds the shielding plug in place.
4-2	Revise Section 8.1.4 of the application to ensure that the entire containment boundary is leak tested per ANSI N14.5 - 1997, "American National Standard for Radioactive Materials – Leakage Tests on Packages for Shipment". ANSI 14.5-1997, Table 1, "Containment boundary test requirements" requires that "Entire containment boundary including welds, seals, closures valves, ..." are required to be evaluated during the fabrication leak testing. The leak test requirement is intended to include leak testing of the base material. Per CTR 2008/10, Rev. 1, the applicant has committed to using the evacuated envelope method to perform the acceptance	The leakage testing of the lid and the cavity wall (including the base) are described in SARP sections 8.1.5.3 and 8.1.5.4. Cross references to these tests have been included in SARP section 8.1.4. A diagram is included below to demonstrate how the cavity wall will be tested.

Reference Number	NRC Comment	Response
	(fabrication) leakage test. Upon further review of CP 390, TR 09/03/17, and TR 09/03/30 the staff is unsure of how the current leak test, as required in Step 8.1.4, of Section 8 of the application, will provide leak testing of the entire containment boundary, including the base material. As described, the mass spectrometer leakage detector (MSLD) is only placed in the closure vicinity to indicate a containment seal (item 5 of Drawing No. 1C-6044 Issue B) leak. This information is required by the staff to assess compliance with 10 CFR 71.51.	
4-3	Clarify Section 4.3.4.2, and the calculations provided in CS 2009/07, Issue A, for the maximum activity for each radionuclide intended to be shipped as a gas. The text in Section 4.3.4.2 notes krypton-85 as the radionuclide to be shipped as a gas, however Table 1-4-6 and report CS 2009/07, both identify the material as krypton-79. The specific radionuclide is important because the regulations in 10 CFR 71.51 allow the release of 10 times the A_2 value for krypton-85 in a one week period. This 10 times limit does not apply to krypton-79. Additionally, the A_2 value used in report CS 2009/07 for krypton-79, 2.00E+12 becquerels, is not the current A2 value for this radionuclide in the U.S. regulations, 10 CFR Part 71 and 49 CFR Part 173. The U.S. regulations do not have a specific value assigned for krypton-85, therefore, the default value from 10 CFR Part 71, Table A-3, "General Values for A_1 and A_2" should be used to calculate the maximum quantity of material that can be released from the package. The U.S. has not adopted the 2003	Reference to Kr-85 has been deleted from SARP Section 4.3.4.2 as this is not listed in the contents listed in SARP Table 1-4-6. The calculation report CS 2009/07 (in SARP section 4.5.2) has been revised using the following. A2 for Kr-79 = 2 x 10^{-2}TBq – from 10 CFR Part 71 Table A-3 for beta or gamma emitting radionuclides See also response to RAI 2-3.

Reference Number	NRC Comment	Response
	or newer editions of TS-R-1, "Regulations for the Safe Transport of Radioactive Material" which contain a higher A_2 value for krypton-79. This higher value cannot be used for transport until it has been incorporated into the U.S. regulations. The applicant may petition both the Commission and the Associate Administrator for Hazardous Materials Safety, in the Department of Transportation's Pipeline and Hazardous Materials Safety Administration for authorization to use an A_1 or A_2 value other than as listed in the regulations. The volume used to calculate the quantity of xenon-133 released in a one week period appears to exceed the bounding free volume. If the bounding free volume were used to calculate the density, the amount released would exceed one A_2 per week. This information is required by the staff to assess compliance with 10 CFR 71.51.	
8	Acceptance Tests and Maintenance Program	
8-1	Correct Table 8-1, "Package Maintenance Summary" of the Safety Analysis Report. The fasteners on the outer keg and containment vessel are visually inspected prior to loading, as described in Section 7.1.1(8) and 7.1.1(13). This RAI is a result of the response to RAI 7-3 sent on February 26, 2010. This information is needed to determine compliance with 10 CFR 71.37(a).	Table 8-1 corrected as required
8-2	Revise section 8.1.5.2 to describe the "test rig" used to test the O-ring responsible for containment and provide the acceptance criteria for the batch testing to show that the containment vessel will maintain a leak-tight configuration after the containment vessel has been heated to 200°C for 24-hours, as specified on Drawing No. 1C-6044, sheet 1.	CP 427 (in SARP section 8.3.2) describes the test used to carry out the 200°C testing of the O-ring; this procedure has been attached to section 8.3.2 of the SARP and is referenced in the text in Section 8.1.5.2.

Reference Number	NRC Comment	Response
	The sealing surface of the "test rig" should have the exact dimensions (within the specified dimensional tolerances) and configuration, and be made of the same materials, as the containment vessel. The leak test sensitivity and acceptance rate should be specified for the test. This information is not adequately described for the acceptance test in Section 8.1.5.2. This RAI is a result of the response to RAI 3-8 sent on February 26, 2010. This information is needed to determine compliance with 10 CFR 71.43(f).	
E	Editorial	
E-1	Revise the application to remove the truncated formatting comment boxes from the right-hand margin. Chapters 2, Structural Evaluation, and 3, Thermal Evaluation, submitted on March 31, 2010, have formatting "track changes" boxes in the right hand margin. These were cut off in the conversion to .pdf format, resulting in text that runs off the page. While these do not affect the review, staff would prefer to have these chapters resubmitted so it does not appear that there is missing information in the application.	Formatting boxes have been removed from the right hand margin of SARP sections 2 and 3.
E-2	Revise Figure 3-1 to provide the missing text from the "Materials" color key (legend). As submitted on March 31, 2010, in Figure 3-1, the color identifiers are truncated on the "Materials" legend.	Conversion of the SARP word document to adobe has been correctly completed to ensure the legend is still present.
E-3	Provide the descriptive name for the first use of the acronym NCR in Chapter 7 of the application. In Section 7.1.1, step 7, it is noted that mismatched components should be removed from service and action taken in accordance with the users NCR system. For clarity, staff would prefer to have NCR spelled out in this first usage. The acronym may	Description for the acronym NCR has been added on the first use in SARP section 7.1.1, step 7.

Reference Number	NRC Comment	Response
	continue to be used throughout the remainder of the chapter.	
E-4	Revise the introductory material in Section 7, to require package users to file a report in accordance with 10 CFR 71.95, for any instance in which there is a significant reduction in the effectiveness of the package, where any defect with safety significance is identified after the first use of the packaging, or any instance in which the conditions of approval in the Certificate of Compliance were not observed in making a shipment. In addition to notifying the Certificate holder when a condition of the Certificate is not met, package users are required to provide a written report to the Commission in accordance with 10 CFR 71.95. Staff notes that the licensee should obtain the Certificate holder's input, but that it is the licensee who is required to submit the report. This regulatory requirement is not clearly identified in the Package Operations chapter of the application.	The introductory material in SARP section 7 (new 3rd para) has been updated to clarify the reporting requirements of 10 CFR 71.95.

Changes made to the SARP at Rev 2 not related to an RAI.		
Item	**Issue and change made**	**Comments**
1	Changes made due to a design change for stainless steel insert LS-50x103-SS Design No 3986 Table 1-1 - masses in last line of table amended. Figure 1-5c - drawing and exploded view amended. Table 1-3-3, 1-3-5, 1-3-7 & 1-3-8 - Maximum weight of contents of the CV amended to 2.5 due to change in design of the stainless steel insert Section 0, Document Reference drawing 2C-6175 – Issue status changed to B.	The only change is for the external body of the insert from "waisted" to a plain cylinder and O-ring change from NBR to EPM [to be the same as the CV O-ring material]. This change is of no safety significance as the steel insert is much lighter than the tungsten inserts. This change is of no safety significance. This change is of no safety significance as the steel insert is much lighter than the tungsten inserts. This is for the design change noted above.
2	The text in the 2nd and 3rd paras in Section 1.2.2.3 Contents Types has been amended to clarify the references to the tables that detail the General Requirements and Activity Limits for each Contents Type.	

Project Title	Stress analysis of Safkeg Flasks
Project Number	925-327
Calculation Title	Bolt pre-load
Calculation Ref	C1
Issue	2

Calc by	GD Jones	Date	18/08/10
Checked by		Date	
Appd by		Date	

Units

BOLT TENSION
Introduction

This calculation determines the tension in a bolt for a given torque tightening.

Bolt Tensile Load

Bolt nominal diameter $d := 10 \cdot mm$

Thread pitch $P := 1.5 \cdot mm$

Friction Coefficient between screw threads $\mu_s := 0.11$

Friction coefficient between bearing surfaces $\mu_w := 0.11$

(From Machinery's p1432, Table 1, value for steel bolts with molybdenum sulphide grease. Assume same value for both friction coefficients)

Nut spot face diameter $S_d := 8 \cdot mm$

Applied torque $T := 10 \cdot N \cdot m$

Effective spot face diameter $D_w := \frac{d + S_d}{2}$

Flank angle $\alpha := \operatorname{atan}\left(\frac{P}{2 \cdot d}\right)$

Pitch diameter of thread $d_2 := d - 0.65 \cdot P$

Torque coefficient (eq. 13 on p1436) $K := \frac{1}{2 \cdot d} \cdot \left(\frac{P}{\pi} + \mu_s \cdot d_2 \cdot \sec(\alpha) + \mu_w \cdot D_w \right)$

Bolt tension $W := \frac{T}{K \cdot d}$ $W = 8.120 \cdot kN$

Reference

1. "*Machinery's Handbook 28th Edition*", Industrial Press Inc. 2008.