From: Leege, David D CIV SEA 08 NR [david.leege@navy.mil]
Sent: Thursday, September 11, 2008 10:43 AM
To: Glenny, Jessica
Cc: Cochran, Andrew P CIV SEA 08 NR; Miles, Barry K SES CIV NAVSEA 08 NR
Subject: RE: NRBK RAIs

Ms. Glenny,

As we discussed on the phone, NR will not be able to respond to the request for additional information for the review of the NRBK-41 package by September 29, 2008. We expect to issue responses by November 14, 2008. This e-mail serves as notification as requested by your letter dated August 29, 2008. Please let me know if there is anything else you need at this time.

I plan on being out of the office tomorrow, but you are welcome to call me on my cell phone at 240.320.3360.

Thank you,
David Leege
Naval Reactors
202.781.6045

-----Original Message-----
From: Jessica Glenny [mailto:Jessica.Glenny@nrc.gov]
Sent: Friday, August 29, 2008 11:01
To: Leege, David D CIV SEA 08 NR; Cochran, Andrew P CIV SEA 08 NR
Subject: NRBK RAIs

Hello Gentlemen,

This is the text of the RAIs for the NRBK-41. You'll receive the signed, official copy in the mail.
Please note that the cover letter requests your responses by September 29. If you cannot meet that date please inform us by September 15, 2008.

Enjoy the long weekend.

Jessica Glenny

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Request for Additional Information

U.S. Department of Energy

Docket No. 71-9221

Certificate of Compliance No. 9221

Model No. NRBK-41

By application dated November 5, 2007, supplemented February 22, 2008, the U.S. Department of Energy (DOE) submitted an amendment request for Certificate of Compliance No. 9221 for the Model No. NRBK-41 package. This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission staff (the staff) in connection with its review of the safety analysis report (SAR). The requested information is listed by chapter number and title in the SAR. NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," was used for this review.

Chapter 1 General Information

1-1 Provide the basis for the equation used in Section 1.2.2.6.4 for calculating the grams equivalent of U-235 to estimate the fissile content of MIN-41 and HIP-41 inner containers.

The equation listed in Section 1.2.2.6.4 is used to calculate the equivalent U-235 contents of the inner containers of the Model No. NRBK-41 package, which may contain U-233, U-235, Pu-239 and Th-232. The staff would like to get an explanation for the selection of the factors 1.4 for U-233, 1.6 for Pu-239, and 0.07 for Th-232 which are used in the equation. For clarity this information should be added to the SAR.

This information is needed to determine compliance with 10 CFR 71.31 and 71.33.

1-2 Explain the detrimental effect the degradation of the Primer N and Adhesive would have on the leak tightness, form, fit, or function of the mating plug to the male connector post-hypothetical accident fire conditions. Also, specify the temperature range specification for Primer N (ASTM D 5363).

Notes 1 and 2 on Figure 1.3-48 provide direction to apply to

Item 11, Primer N, and, Item 12, Adhesive, to the male connector leak test fitting prior to installing Item 10, mating plug, for the MIN-41 Inner Container. Notes 3 and 4 of Figure 1.3-43 provide direction to apply Item 9, Primer N, and Item 8, Adhesive, to the male connector leak test fitting prior to installing Item 7, mating plug, for the HIP-41 Inner Container. Chapter 4, Appendix 4.5.2, HIP-41 Inner Container, and Appendix 4.5.4, MIN-41 Inner Container, both state that the maximum temperature can reach in excess of 600°F. Specifications for the adhesive (Loctite 5772 Thread Sealant) states a temperature range of -65°F to 300°F.

This information is needed to determine compliance with 10 CFR 71.33 and 71.73(c)(4).

1-3 Discuss whether the remaining threads, or a segment of the remaining threads of the joint between Item 1, cap, and Item 2, male connector (Figure 1.3-51); and Item 1, plug, and Item 2, male connector, for HIP-41 (Figure 1.3-45), resist thermal contraction. Also discuss whether a stress is produced in the seal weld and if shrinkage cracks may occur. Refer to note 4 of Figure 1.3-51 (sheet 2 of 3) for the MIN-41 Internal Container and note 2 of Figure 1.3-45 for the HIP-41 Internal Container.

Note 4 of Figure 1.3-51 states to remove excess threads above the joint between Item 1, cap, and Item 2, male connector, followed by deposition of a 0.06-inch fillet weld for MIN-41; and note 2 of Figure 1.3-45, Item 1, plug, and Item 2, male connector, for HIP-41. However, this seal weld will be deposited on part of the existing thread flat of Item 2, flush with the top of the leak test penetration. A notch in the base metal at this thread flat may cause a weld undercut at the root of the weld. This notch could become a stress-sensitive location in the weld, located in the heat-affected zone where the mechanical properties have been altered. When cooling, fillet welds need the ability to shrink due to the thermal contraction. With threaded connections seal welded, the threads will resist the thermal contraction and produce a stress across the fillet weld resulting in shrinkage cracks. In addition, if thread sealer is used or if cutting oil residue is present both may act as a source of hydrogen during welding and increase the propensity for cracking.

This information is needed to determine compliance with 10 CFR 71.43(f).

1-4 Discuss the basis for allowing localized loss of heat affected zone properties as acceptable for the seal weld stated in note 6 of Figure 1.3-51 (sheet 2 of 3) for the MIN-41 Inner Container and note 6 of Figure 1.3-45 for the HIP-41 Inner Container.

When changes from the base metals' exposure to heat are combined with the reduction in cross-section of any notched area, the mechanical strength is greatly reduced. This may be critical in applications that involve impact, low temperature or fatigue conditions.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

1-5 Discuss what corrective actions or methods will be employed to the seal weld procedure/process should the metallographic evaluations and nondestructive evaluations fail the acceptance criteria of note 9 of Figure 1.3-51 (sheet 2 of 3) for the MIN-41 Inner Container and note 5 of Figure 1.3-45 for the HIP-41 Inner Container.

Qualification and requalification of welding procedures can become time consuming and costly should the destructive and nondestructive evaluations fail the acceptance criteria requirements of note 9 for the MIN-41 and note 5 for the HIP-41 Inner Containers.

This information is needed to determine compliance with 10 CFR 71.71.35 (a).

1-6 Discuss how the seal weld process was determined to be the most effective and efficient method of sealing Item 1, the plug, to Item 2, the male connector for the HIP-41 Inner Container of Figure 1.3-45 and Item 1, the cap, to Item 2, the male connector, for the MIN-41 Inner Container of Figure 1.3-51 (sheet 3 of 3).

Various non-welding metal and non-metal sealing processes exist which may prove to be as or more effective and efficient at providing the desired results for the end use of both inner containers. These various processes may preclude all or portions of the requirements on Figure 1.3-45 for the HIP-41 Inner Container and Figure 1.3-51 (sheet 2 & 3 of 3) for the MIN-41 Inner Container in addition to meeting normal and accident conditions.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

1-7 Correct the weld symbols for the following figures: 1.3-7, 1.3-8, 1.3-10, 1.3-11, 1.3-13, 1.3-16, 1.3-19, 1.3-21, 1.3-26, 1.3-27, 1.3-58, 1.3-60, 2.5-3, 2.5-4, 2.5-8.

Various symbols on the above referenced figures do not meet the requirements of American National Standards Institute/American Welding Society (ANSI/AWS) A2.4, Standard Symbols for Welding, Brazing and Nondestructive Examination.

This information is needed to determine compliance with 10 CFR 71.31.

Chapter 2 Structural

2-1 Identify the code or standard used to develop the stress based acceptance criteria when evaluating the components important to safety as well as the containment boundary of the inner containers for the Model No. NRBK-41 package.

This information is needed to determine compliance with 10 CFR 71.71, and 71.73.

2-2 Provide Reference 2-22, "Stresses from Radial Loads and Eternal Moments in Cylindrical Pressure Vessels," in Appendix 2.10.4.

The equations presented on page 2.5-8 for evaluating the cask shell (cap

casting) do not have an
appropriate reference provided so that the methodology can be evaluated.

This information is needed to determine compliance with 10 CFR 71.31.

2-3 Provide Reference 2-41, "Structural Design Basis (SDB-63)," in Appendix 2.10.4.

Page 2.5-3 of the SAR presents a calculation evaluating trunnion plate, which applies a
methodology from the above reference. The staff is unable to determine if this methodology is
correct without the relevant material excerpted from the reference. This is especially critical as
the factor of safety against yielding is only 1.058.

This information is needed to determine compliance with 10 CFR 71.45.

2-4 Provide a justification for the simplified energy approach used for determining the
penetration depth of a steel puncture bar dropped from a height of 1 meter thus impacting the
outer curved surface of the Model No. NRBK-41 package.

An analysis is presented on page 2.6-62 which calculates the depth of penetration of an
impacting bar. The source of this analytical approach is unclear and staff cannot evaluate
whether this approach is valid.

This information is needed to determine compliance with 10 CFR 71.71(c)(10).

2-5 Provide Reference 2-44, "Structural Analysis of Shipping Casks: Effects of Jacket
Physical Properties and Curvature on Puncture Resistance," in Appendix 2.10.4.

An empirical formula for puncture due to the impact of the package onto a 6-inch diameter steel
pipe from a height of 1 foot was presented, but it was unclear without

the reference material
whether this formula is applicable.

This information is needed to determine compliance with 10 CFR 71.73(c)(3).

2-6 Justify the crushing assumption of thin-walled components.

Maximum decelerations for flat bottom drop are calculated assuming crushing of the skid
assembly using the CRUSHTAB program. The analysis is performed using the combined areas
of the webs of the skid assembly I-beams. Webs are thin-walled members subject to buckling,
which the CRUSHTAB manual specifies it cannot handle. The staff requests by way of
calculation a demonstration that this method produces conservative results.

This information is needed to determine compliance with 10 CFR 71.71(c)(7) and 71.73(c)(1).

2-7 Explain element properties of analyses used in the PATRAN analysis for pressure
conditions in HIP-41.

The stress distribution contours shown in Figure 2.10.5.4 appear to be smoothed, but element
degree and integration method is not specified so quality of numerical results cannot be
assessed. note that results exceeding yield in axial tension (56,000 psi vs. 40,000 psi) and shear
(26,000 psi vs. 20,000 psi) were localized to a 1/8" region (see Figure 2.10.5.4-5).

This information is needed to determine compliance with 10 CFR 71.73 (c)(4).

2-8 Justify the element size used in high-stress locations for PATRAN analysis for pressure
conditions in HIP-41.

A high stress-concentration area warrants further refinement of mesh and a convergence analysis.

This information is needed to determine compliance with 10 CFR 71.73(c)(4).

2-9 Demonstrate by way of calculation or other means that this package is not affected by vibration.

Section 2.6.5 of the application does not discuss the ANSI N14.23 peak vibration standards applicable to light packages tied down to a trailer bed. The vibration load is not expected to cause structural damage to the package; however, a more rigorous (i.e., quantitative) treatment of vibration loads is requested despite the justification presented in the SAR. The applicant should demonstrate that the construction of the cask and operating experience is sufficient to preclude such vibration damage to the package.

This information is needed to determine compliance with 10 CFR 71.71(c)(5).

2-10 Provide an evaluation showing that fatigue due to transport or other mechanism is not a credible safety concern for this package.

Fatigue due to transport or other mechanism was not addressed in the SAR.

This information is needed to determine compliance with 10 CFR 71.71(c)(5).

2-11 Make the following editorial clarifications:

a) Replace the word "paragraph" with "10 CFR 71.45," in Section 2.5.1.

Page 2.5-1, Section 2.5.1, the second sentence states in part "[...] any lifting device under excessive load would not impair the ability of the package to meet other requirements of the paragraph."

b) Clarify the reference to "container plug," on page 2.6-6.

Page 2.6-6 contains references to "container plug," when the calculations are actually made considering the container cap standpipe.

c) Correct axis orientations in Figures 2.5-2 and 2.5-6.

Figures 2.5-2 and 2.5-6, which illustrate a free body diagram and lengths and angles, respectively, have conflicting orientations for the x and y axes.

This information is needed to determine compliance with 10 CFR 71.31.

Chapter 3 Thermal

3-1 Revise the application and verify that lead melting does not occur during a HAC.

Section 3.4.2.2.3 of the NRBK-41 SAR states that "[i]n the hypothetical fire accident transient, the heat input from the fire causes lead melting in the NRBK-41 cask." The current thermal and shielding analysis apparently credits molten lead or partial lead melting during HAC. It is not clear if any interaction effects between molten lead and the package would result in unanalyzed package configurations, or shielding thicknesses that provide less attenuation than presently assumed (see RAI 5-1).

The thermal design may be re-analyzed to ensure the transient peak temperatures of package components as a function of time after the fire and the maximum temperatures from the post-fire, steady-state condition do not exceed their maximum allowable values, and that lead shielding does not reach the melting temperature.

This information is needed to determine compliance with 10

CFR 71.73.

3-2 Provide complete details of TRUMP and ABAQUS computer models, or any new models, that have been used for thermal evaluation for NCT and HAC, respectively.

The details of the models should include input and output files, and all assumptions used in the models and analyses such as boundary and initial conditions. This will assist the staff in verifying the adequacy of the thermal evaluation.

This information is needed to determine compliance with 10 CFR 71.41, 71.71, and 71.73.

3-3 Provide a description of how the maximum allowable decay heat load of 240 Btu/hr was determined.

Section 3.1.1, page 3.1-3, fourth paragraph of the SAR states: "Results of the thermal analysis show that a cargo decay heat load of 240 Btu/hr produces a maximum NRBK-41 surface temperature of 122°F, under 10 CFR Part 71 prescribed, 100°F ambient and no solar load condition." The SAR does not provide descriptions of any calculations, or an explicit model for this determination. This description should include an example calculation along with all assumptions made for the analysis, such as boundary conditions. The analysis model that was used to determine surface temperature of the package should also be provided.

This information is needed in to determine compliance with 10 CFR 71.43 (g).

3-4 Identify the fill gas assumed to be present within the inner container(s) (MIN-41 or HIP-41) during the hypothetical fire accident conditions.

Section 3.3 of the SAR states: "The evaluations presented in this chapter conservatively consider air in lieu of helium." Although this assumption is conservative for NCT, it may not be conservative for fire accident conditions due to the higher thermal conductivity of helium.

This information is needed to determine compliance with 10 CFR 71.73(c).

3-5 Provide complete details of the Model No. NRBK-41 package pressure venting device

that allows venting only steam from the lead cavity.

Appendix 3.5.1 lists few details of the pressure venting device which claims to safely vent steam from the lead cavity while retaining the molted lead in the cavity. This appendix further describes briefly the tests and experiments in designing and testing the venting device. A complete description which includes design specifications, tests and experiments, which satisfy the three main functions listed on page 3.5.1-3 of Appendix 3.5.1, should be provided in the SAR.

This information is needed to determine compliance with 10 CFR 71.35(a).

Chapter 4 Containment

4-1 Submit References 4-3 and 4-4, on page 4.5.3-1, both of which address the release fraction of radioactive material postulated to escape from the secondary containment during NCT.

Section 4.5.1.2 mentions References 4-3 and 4-4 as to where the guidance for determining the fraction of releasable material and supporting test data can be found, respectively. A short summary of these references' conclusions is presented on page 4.5.1-3.

This information is needed to determine compliance with 10 CFR 71.31(b).

4-2 Explain how the testing to determine the release fraction of crud in Reference 4-4 from the secondary containment compensates for the conditions associated with NCT (e.g., temperature, vibration, reduced external pressure, internal pressure, etc.) as required by 10 CFR 71.71. Also, justify not using a more typical release fraction of 0.15.

The application utilizes a release fraction for the crud of 8.626E-6 based on testing performed in Reference 4-4, but no explanation of the test conditions is made other than internal pressure. Also, the standard release fraction for crud is 0.15, which is documented in NUREG-1609.

This information is needed to determine compliance with 10 CFR 71.51(a)

(1).

4-3 Evaluate and justify the effect of all crud from the cask inner surface and the inner containers outer surface being available for release if the secondary containment boundary is breached during HAC as stated in the first paragraph of Section 4.5.1.2.

It appears that the Model No. NRBK-41 could be breached during HAC, but no justification is provided for the acceptability of the resulting release of a source term greater than one A2 as defined in Table 4.5.1.1, "Radioactive Material within a Cask Cavity Due to Water Pit Exposure" is presented.

This information is needed to determine compliance with 10 CFR 71.51(a)(2).

4-4 Describe how the primary containment (inner container) is purged with helium when only one connection is used. Also, state the pressure of helium to be achieved. Describe, with the aid of a drawing, the "special designed adapter" which facilitates this operation and allows the leak test plug to be installed while maintaining a pressurized helium environment with the canister.

The operation procedures, Section 7.1.2, step 9, and Section 7.1.3, step 6, state that a "specially designed adapter" is installed over the cap standpipe to purge and pressurize the primary containment with helium, and then allows installation of the leak test plug. However, it is not apparent from the drawings submitted what the configuration of this adapter is. It is not clear whether this "special designed adapter" is a part of the containment boundary or is a temporary fixture to aid in the installation of the leak test plug. Also, it is not clear how these operations can be accomplished.

This information is needed to determine compliance with 10 CFR 71.31(b).

4-5 Explain the description provided in Chapter 4, paragraph 4.1.1.1.1, MIN-41 Inner Container and paragraph 4.1.1.1.2, HIP-41 Inner Container as it states "...metal-to-metal contact between a welded on leak test fitting and mating plug..."

notes 1 and 2 of Figure 1.3-48 provide direction to apply Item 11, Primer N, and Item 12, Adhesive, to the male connector leak test fitting prior to installing Item 10, mating plug, for the MIN-41 Inner Container. Also, notes 3 and 4 of Figure 1.3-43 provide direction to apply Item 9, Primer N, and Item 8, Adhesive, to the male connector leak test fitting prior to installing Item 7, mating plug, for the HIP-41 Inner Container. The staff is uncertain how the above described contact is considered metal-to-metal with the use of Primer N and Adhesive applied to the male connector threads prior to installing the mating plug.

This information is needed to determine compliance with 10 CFR 71.33.

4-6 Make the following editorial clarifications:

a) Revise the reference to Figure 4-1 in Section 4.1.1.1.1, to read Figure 4.1-1.

b) Correct the page number, 4.3-5, in Section 4.4, to 4.4-1.

c) Revise Table 4.5.1-1, for NRBK-41-12. The column labeled, "Fi, Isotope as a Fraction of Total Activity," totals 0.9793, but it should total unity.

This information is needed to determine compliance with 10 CFR 71.31.

Chapter 5 Shielding

5-1 Verify that the volume of lead after the fire accident, as determined by the thermal analysis discussed in Section 3.4, assures adequate shielding to meet the dose limits of 10 CFR 71.51.

Section 5.3.1.1.2 of the application states that the volume of lead lost during a hypothetical fire

accident is conservatively incorporated into the shield model at the appropriate locations.
However, staff recommends in Section 3.5.5.3 of NUREG-1609 that lead does not reach
melting temperature. It is not clear if the nature of the lead melt, actual volume melted, physical
interaction, and potential orientation of the package shielding can be predicted well enough to
take significant credit in the accident shielding analyses. The application may clarify, in part,
whether the predicted end-configuration has been benchmarked with any physical testing of this
design, or any similar lead shielding systems, for a 10 CFR Part 71 fire test. (see RAI 3-1).

This information is needed to determine compliance with 10 CFR 71.33 and 71.55.

Chapter 8 Acceptance Tests and Maintenance Program

8-1 Explain the reason for no thermal acceptance tests to demonstrate the heat transfer
capability of the Model No. NRBK-41 package after fabrication and during the service life of the
package as described in Section 8 of the application. Clarify if thermal tests are performed as
part of the maintenance program.

The thermal tests may be needed to confirm that heat transfer performance is consistent with
the thermal analyses given uncertainties in calculations, fabrication, or aging of the package
during its service life. The staff would like to verify that the maintenance program remains
adequate to assure packaging effectiveness for this "-96" approval request. If thermal tests are
performed, the application should indicate the frequency, method of testing, and the equipments
used in the tests.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

E-mail Properties

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