71-9212

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TP:02:04182
UFC:5822.00

November 27, 2002

Mr. D. H. Tiktinsky, Project Manager
NMSS/SFPO MS/06F18
U.S. Nuclear Regulatory Commission
One White Flint North
15555 Rockville Pike
Rockville, MD 20852-2738

Subject: REVISION TO CERTIFICATE OF COMPLIANCE FOR MODEL NUMBER RH-TRU 72-B PACKAGE, DOCKET NUMBER 71-9212

Reference 1: Letter TP:01:08008 from M. L. Caviness to D. H. Tiktinsky, dated August 29, 2001, subject: Revision 3 to Certificate of Compliance for Model Number RH-TRU 72-B Package, Docket Number 71-9212

Reference 2: Letter from D. H. Tiktinsky to M. L. Caviness, dated April 17, 2002, subject: Request for Additional Information for the Model RH-TRU 72-B Package

Reference 3: Letter TP:02:04093 from M. L. Caviness to D. H. Tiktinsky, dated June 14, 2002, subject: Revision 3 to Certificate of Compliance for Model Number RH-TRU 72-B Package, Docket Number 71-9212

Dear Mr. Tiktinsky:

Westinghouse TRU Solutions, LLC (WTS), on behalf of the U.S. Department of Energy (DOE), hereby amends the application for revision to the Certificate of Compliance for the Model RH-TRU 72-B Package, U.S. Nuclear Regulatory Commission (NRC) Docket Number 71-9212, submitted August 29, 2001 (Reference 1) and, in response to a Request for Additional Information (Reference 2), amended on June 14, 2002 (Reference 3). This submittal incorporates changes to address current fabrication issues. This amendment to the application includes the following:

ATTACHMENT A	Enclosures to Letter
ATTACHMENT B	Abstract of RH-TRU 72-B Amendment
ATTACHMENT C1	Summary of All Affected Pages in Revision 3 (November 2002) of the Safety Analysis Report (SAR) for the RH-TRU 72-B Waste Shipping Package

NMSS01

ATTACHMENT C2	Summary of Changes to Drawing No. X-106-500-SNP, Revision 3
ATTACHMENT C3	List of Revised Pages (Insert/Delete) for Revision 3 (November 2002) of the SAR for the RH-TRU 72-B Waste Shipping Package
ATTACHMENT C4	Revised Pages for Revision 3 (November 2002) of the SAR for the RH-TRU 72-B Waste Shipping Package

The following changes have been made to the application for Revision 3 (Reference 3):

- Chapters 1, 8 and Appendix 8.3.2 have been revised to eliminate the reference to completing dimensional checks in association with the fabrication lead pour.
- Appendix 1.3.2 has been revised to incorporate revisions to Drawing No. X-106-500-SNP as summarized in Attachment C2.
- Chapter 8 has been revised to include use of a pressurized envelope method as an alternative method for testing the inner vessel structure integrity.
- Appendix 8.3.2 has been revised to clarify the applicability of ASME Article NE-4220 in the lead installation procedure.

As noted in previous application submittals, an NRC/DOE agreement exists to waive applicable review fees.

If you have any questions regarding this submittal, please contact Mr. John Jackson at (505) 234-7259.

Sincerely,

M. L. Caviness, Manager
Packaging Engineering

JLJ:par

Attachments

cc: M. A. Italiano, CBFO

November 2002

ATTACHMENT A

ENCLOSURES TO LETTER

Attachment B	Abstract of RH-TRU 72-B Amendment
Attachment C1	Summary of All Affected Pages in Revision 3 (November 2002) of the Safety Analysis Report (SAR) for the RH-TRU 72-B Waste Shipping Package
Attachment C2	Summary of Changes to Drawing No. X-106-500-SNP, Revision 3
Attachment C3	List of Revised Pages (Insert/Delete) for Revision 3 (November 2002) of the SAR for the RH-TRU 72-B Waste Shipping Package
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ATTACHMENT B

ABSTRACT OF RH-TRU 72-B AMENDMENT

This amendment is proposed to address two fabrication related issues: (1) addition of a pressurized envelope method for inner vessel (IV) structure integrity testing and (2) removal of acceptance criterion for diametrical change between pre- and post-lead pour states.

Justification for Use of Pressurized Envelope Method for Testing the Inner Vessel

This amendment proposes the "Pressurized Envelope" method of helium mass spectrometer leak testing per ANSI N14.5 – 1997, Section A.5.3 of Table A.1 as a method of testing the "IV Structure Integrity" as required per Section 8.1.3.1 of the RH-TRU 72-B SAR. This will allow for an alternative testing method to be implemented during the fabrication and/or maintenance of the RH-TRU 72-B Cask.

The pressurized envelope method is currently authorized for use in testing of the Outer Cask (OC) Structure Integrity per Section 8.1.3.5 of the RH-TRU 72-B SAR. Based on operational experience to date, this method of testing large volume structures for integrity has proven to be an effective and accurate method of obtaining quantitative leakage rates of assemblies.

Implementation of the pressurized envelope method for testing the IV would allow a fabrication or maintenance leakage rate test of an IV structure to be completed without the need for a successfully leakage-rate tested OC body to be available for the testing of the IV structure. This alternative method would also allow for the IV structure test to be performed at facilities that may not have the equipment available for performing the evacuated envelope method delineated in Section 8.1.3.1 of the SAR.

Justification for Removal of Acceptance Criteria for Diametrical Change Between Pre- and Post-Lead Pour States

During fabrication of RH-TRU 72-B Casks, it was discovered that the 0.080-inch acceptance criterion for diametrical change between pre- and post-lead pour states, which is contained in Appendix 8.3.2.12 of the RH-TRU 72-B SAR, is difficult to satisfy. This criterion was established to provide verification that buckling of the OC inner shell does not occur during lead pour and cool down. It has been concluded that buckling induced displacements cannot be isolated from displacements induced by other effects when applying this criterion. Therefore, it is requested that this criterion be removed from the RH-TRU 72-B SAR and the acceptance criteria be based on the requirements of Article NE-4220 of the ASME Boiler and Pressure Vessel Code.

As stated in Section 2.0 of the RH-TRU 72-B SAR, the RH-TRU 72-B Cask bears a strong resemblance to the NuPac 125-B Cask. Analytical techniques, successfully utilized for the licensing of the NuPac 125-B Cask, are generally repeated for the RH-TRU 72-B Cask. Additionally, parallels between the two casks are frequently taken advantage of in the RH-TRU 72-B SAR to simplify and clarify the analysis methodologies. The basis for establishing a limit on diametrical changes between pre- and post-lead pour states is presented in Section 2.6.2 of the NuPac 125-B SAR. Application of the analysis method used in the NuPac 125-B SAR to the RH-TRU 72-B Cask geometry gives a critical buckling pressure of 1,672 pounds per square inch (psi) for buckling the inner shell of the RH-TRU 72-B OC. Because the formula in the NuPac 125-B SAR does not account for initial imperfections, another calculation was made using ASME Code Case N-284, which gave a value of 1,490 psi. This Buckling Analysis is presented with this justification. Conservatively applying the smaller of these two buckling pressures to the inside of the lead annulus (i.e., the body imposing external pressure on the OC inner shell) produces a hoop stress in the lead of 14,370 psi (PR/T = 1,490(18.13)/1.88). This stress is significantly greater than the yield strength of the lead (584 psi per RH-TRU 72-B SAR, Table 2.3-1, p. 2-24). Thus, lead shrinkage on the inner shell of the RH-TRU 72-B OC cannot develop the pressure necessary to buckle the inner shell and the margin against buckling is very large. Also, axial buckling is not a concern because the circumferential weld attaching the outer shell to the OC collar is made after lead pour as discussed in Section 1.2.1.1.2, p. 1-14, of the RH-TRU 72-B SAR. Thus, the inner and outer shells of the OC are not restrained axially during lead pour. This prevents development of axial stress in either shell due to differential thermal expansion.

It should be noted that other effects are taking place during the lead pour process, which can lead to diametrical changes of the OC inner shell. These effects include relief of residual stresses associated with rolling and welding of the OC inner shell prior to lead pour. These effects can be significant as discussed in Section 2.6.2 (pp. 2-102-bd and -be) of the NuPac 125-B SAR. Since the lead annulus does not have sufficient strength to buckle the inner shell, and the inner and outer shells are not axially restrained during the lead installation process, it is concluded that the diametrical changes which have been observed during fabrication of the RH-TRU 72-B OCs are caused by effects other than buckling.

The applicable criteria for acceptance of OC inner shell diameters after lead pour, therefore, should simply be satisfaction of Article NE-4220 of the ASME Boiler and Pressure Vessel Code which is already a condition for acceptance as specified in Appendix 8.3.2.12 of the RH-TRU 72-B SAR. Article NE-4220 must be satisfied in order to validate use of Code Case N-284 and states that "The difference between maximum and minimum inside diameters at any cross section shall not exceed 1% of the nominal diameter at the cross section under consideration."

In consideration of the above, the 0.080-inch acceptance criterion currently specified in Appendix 8.3.2.12 of the RH-TRU 72-B SAR is not applicable and its replacement with requirements of Article NE-4220 of the ASME Code is proposed by this amendment.

Buckling Analysis of RH-TRU 72-B Outer Cask Inner Shell – Critical Hoop Stress for Lateral External Pressure Only

ASME Code Case N-284, Approval Date: August 25, 1980, is used in the following analysis since this version of the code case was used to perform the buckling analysis in the RH-TRU 72-B SAR. The analysis determines the hoop stress and associated lateral external pressure required to initiate buckling of the OC inner shell. As shown below, the limiting case is given by -1713.2.1 (b).

<u>Geometry and Material Input</u>
ID = 32.38 in
OD = 34.38 in
L = 121.25 in
Material = 304 SS

R = (*OD* + *ID*)/4 = (34.38 + 32.38)/4 = 16.69 in
t = (*OD* – *ID*)/2 = (34.38 – 32.38)/2 = 1.00 in
R/t = 16.69
$l_\phi = 121.25$ in
$A_\phi = 0$
$A_\theta = 0$
$M_\phi = \frac{l_\phi}{\sqrt{Rt}} = 29.68$

<u>Stress, Temperature, and Factor of Safety Input</u>
$\sigma_\phi = 0$
$\sigma_\theta = 24{,}866 psi$ ← Hoop Stress
$\sigma_{\phi\theta} = 0$
$T = 70°F$
$FS = 1.0$

Lateral External Pressure

$p = pressure$

$$= \frac{\sigma_\theta}{(R/t)}$$

$$= 24{,}866/16.68$$

$$= 1{,}490 psi$$ ← Critical Buckling Pressure

Material Properties at Temperature

$\sigma_y = 30{,}000 psi$

$E = 28.3x10^6 psi$

Capacity Reduction Factor

-1511 (b) $\alpha_{\theta L} = 0.8$

Plasticity Reduction Factor

-1610 (b) $$\frac{\sigma_\theta FS}{\sigma_y} = \frac{24{,}866(1.0)}{30{,}000} = 0.8289$$

$$\eta_\theta = 2.53 - 2.29\frac{\sigma_\theta FS}{\sigma_y}$$

$$= 2.53 - 2.29(0.8289)$$

$$= 0.6319$$

Theoretical Buckling Values

-1712.1.1 (b) $$1.65\frac{R}{t} = 27.54$$

$$M_\phi > 1.65\frac{R}{t}$$

$$C_{\theta r} = \frac{0.275}{(R/t)} + \frac{2.1}{M_\phi^4}\left(\frac{R}{t}\right)^{30}$$

$$= \frac{0.275}{16.69} + \frac{2.1}{29.68^4}(16.69)^{30}$$

$$= 0.02906$$

$$\sigma_{\theta rL} = \sigma_{reL} = C_{\theta r}\frac{E}{(R/t)}$$

$$= \frac{0.02906(28.3x10^6)}{16.69}$$

$$= 49{,}280 psi$$

$$\sigma_{heL} = \sigma_{reL}$$

Elastic Buckling Interaction Equations

-1713.1.1 $\sigma_{\phi s} = 0$

$$\sigma_{\theta s} = \frac{\sigma_\theta FS}{\alpha_{\theta L}} = \frac{24{,}866(1.0)}{0.8} = 31{,}080 psi$$

$$\sigma_{\phi\theta s} = 0$$

-1713.1.1 (a) N/A since $\sigma_{\theta s} < \sigma_{heL}$

(b) N/A since $\sigma_{\phi s} < 0.5\sigma_{\theta s}$

(c) $$\frac{\sigma_{\phi s}}{\sigma_{\phi eL}} + \left(\frac{\sigma_{\phi\theta s}}{\sigma_{\phi\theta eL}}\right)^2 \le 1.0$$

$$0 + 0^2 = 0$$ OK

(d) $$\frac{\sigma_{\theta s}}{\sigma_{reL}} + \left(\frac{\sigma_{\phi\theta s}}{\sigma_{\phi\theta eL}}\right)^2 \le 1.0$$

$$\frac{31{,}080}{49{,}280} + 0^2 = 0.63$$ OK

(e) N/A since $\sigma_{\phi\theta s} = 0$

Inelastic Buckling Interaction Equations

-1713.2.1 $\sigma_{\phi p} = 0$

$$\sigma_{\theta p} = \frac{\sigma_{\theta s}}{\eta_\theta} = \frac{31{,}080}{0.6319} = 49{,}180 psi$$

$$\sigma_{\phi\theta p} = 0$$

-1713.2.1 (a) $$\left(\frac{\sigma_{\phi p}}{\sigma_{\phi eL}}\right)^2 + \left(\frac{\sigma_{\phi\theta p}}{\sigma_{\phi\theta eL}}\right)^2 \le 1$$

$$0^2 + 0^2 = 0$$ OK

(b) $$\left(\frac{\sigma_{\theta p}}{\sigma_{reL}}\right)^2 + \left(\frac{\sigma_{\phi\theta p}}{\sigma_{\phi\theta eL}}\right)^2 \le 1.0$$

$$\left(\frac{49{,}180}{49{,}280}\right)^2 + (0)^2 = 1.00$$ OK ← Limiting Case

ATTACHMENT C1

SUMMARY OF ALL AFFECTED PAGES IN REVISION 3 (NOVEMBER 2002) OF THE SAFETY ANALYSIS REPORT (SAR) FOR THE RH-TRU 72-B WASTE SHIPPING PACKAGE

The title page for the Safety Analysis Report (SAR) for the RH-TRU 72-B Waste Shipping Package has been revised to reflect the current date.

Page 1-14 has been revised to eliminate the requirement to perform dimensional checks for straightness and roundness before and after lead pour.

Appendix 1.3.2, Title Page, has been revised to reflect the current date.

Drawing No. X-106-500-SNP, Sheets 1 through 9, have been revised as described in Attachment C2.

Page 8-4 has been revised to allow the performance of the fabrication leakage rate test of the internal vessel (IV) structure by the pressurized envelope method.

Page 8-5 has been revised to add Step 8.1.3.1.12, which describes the testing of the IV structure integrity with the pressurized envelope method.

Page 8-5a has been inserted to accommodate overflow text from page 8-5.

Page 8-20 has been revised to eliminate the reference to the pre- and post-lead pour diameter and straightness measurement.

Appendix 8.3.2 has been revised to eliminate subsection 8.3.2.1 and to reword 8.3.2.12 as related to the pre- and post-lead pour diameter and straightness measurement requirements.

ATTACHMENT C2

Summary of Changes to Drawing No. X-106-500-SNP, Revision 3

Page	Explanation of Change
Sheet 1	Changed wording in Flag Note 4 to clarify purpose of reference to SAR Section 8.3.2 See Attachment B, Justification for Removal of Acceptance Criteria for Diametrical Change Between Pre- and Post-Lead Pour States for the explanation and justification for change.

ATTACHMENT C3

LIST OF REVISED PAGES (INSERT/DELETE) FOR REVISION 3 (NOVEMBER 2002) OF THE SAR FOR THE RH-TRU 72-B WASTE SHIPPING PACKAGE

SAR Section	Delete	Insert
Title Page	Title Page	Title Page
Chapter 1.0	1-14	1-14
Appendix 1.3.2	Title Page	Title Page
Appendix 1.3.2	Drawing X-106-500-SNP, Revision 3, DCN 3/2, Sheets 1 through 9	Drawing X-106-500-SNP, Revision 3, DCN 4/2, Sheets 1 through 9
Chapter 8.0	8-4, 8-5, 8-20	8-4 through 8-5a, 8-20
Appendix 8.3.2	8.3.2-1 through 8.3.2-5	8.3.2-1 through 8.3.2-4

November 2002

ATTACHMENT C4

REVISED PAGES FOR REVISION 3 (NOVEMBER 2002) OF THE SAR FOR THE RH-TRU 72-B WASTE SHIPPING PACKAGE

SAFETY ANALYSIS REPORT

FOR THE

RH-TRU 72-B WASTE SHIPPING PACKAGE

November 2002

Rev. 3

Prepared for: U.S. Department of Energy
Carlsbad Field Office
Carlsbad, New Mexico

As discussed in Appendix 8.3.2, installation of the cast lead into the outer cask is done in a carefully controlled manner. Temperatures of the inner and outer shells are continuously monitored and controlled during the lead fill and cool down processes. In addition, the weld connecting the outer shell to the bottom end plate is made after the cool-down process is complete and the entire outer cask has reached a uniform temperature. The lead pour process is described in Appendix 8.3.2, subsequent shielding integrity testing is described in Section 8.1.5, and fabrication verification testing is described in Section 8.1.3.

1.2.1.1.3 Impact Limiters

The impact limiter skins are fabricated from 300 series stainless steel. Non-stainless members include the closed-cell polyurethane foam and the ASTM A- 320, Grade L43, impact limiter attachment bolts. The polyurethane foam has a nominal density of 11.5 pounds per cubic foot. Six (6) 1-¼ - 7 UNC bolts necked down to a 1-inch diameter secure each impact limiter to the outer cask.

The outside diameter of each impact limiter is 76 inches and the length is 46 inches. The maximum weight of each impact limiter is 2,547 pounds.

1.2.1.1.4 Canister

All RH-TRU waste will be loaded directly into the waste canister or into waste containers overpacked in the canister. The RH-TRU waste canister design, which meets the specifications of Appendix 1.3.4, is illustrated in Figure 1.0-3. The canister uses a 26-inch outside diameter ¼-inch thin-wall cylinder fabricated of carbon or stainless steel as the outer shell. Including a lift pintle at the top of the canister, the overall length is 121 inches.

APPENDIX 1.3.2

General Arrangement Drawings

REVISION HISTORY			
REV	DESCRIPTION	REL	DATE
1	INITIAL RELEASE	BH	3/17/99
2	SEE DCN 1/1, 2/1 AND 3/1	B. HARGIS	1/24/01
3	SEE DCN 1/2, 2/2, 3/2 & 4/2	BH	1/25/22

NOTES, UNLESS OTHERWISE SPECIFIED

1 PRIOR TO ASSEMBLY, ALL COMPONENTS SHALL BE CLEANED OF CUTTING OILS, MARKING DYES, WELDING FLUX, SPATTER, SCALE, GRIME, AND ALL OTHER FOREIGN MATERIALS FINISHED ASSEMBLY AND ALL INTERIOR SURFACES SHALL BE CLEANED AND VISUALLY OR WIPE TEST INSPECTED IN ACCORDANCE WITH ASTM-A380.

2 REFERENCE DATA. CASK WT: 37,000 lbs.
PAYLOAD WT: 8,000 lbs.
GROSS WT: 45,000 lbs.

3 IDENTIFICATION: CASK SHALL BE IDENTIFIED IN ACCORDANCE WITH THE REQUIREMENTS OF 10 CFR 71 85 (c).

4 (3) LEAD TO BE CAST IN PLACE, PER SECTION 8 3 2 OF THE SAR LEAD SHALL MEET THE REQUIREMENTS OF QQ-L-171e GRADE A OR C OR OPTIONALLY, ASTM B29-92 PURE OR CHEMICAL COPPER LEAD.

5 ACCEPTANCE OF THE AS-INSTALLED LEAD SHIELDING SHALL BE DETERMINED BY GAMMA SCAN, AFTER COOL DOWN TO AMBIENT TEMPERATURE. ACCEPTANCE IS BASED ON AN OBSERVED ABSENCE OF ANY SIGNIFICANT VOIDS AND CONFIRMATION THAT A MINIMUM ACCEPTABLE THICKNESS EXISTS FOR THE LEAD AT ALL LOCATIONS SPECIFIC METHODS AND ACCEPTANCE CRITERIA FOR THE GAMMA SCAN ARE SET OUT IN SECTION 8.1.5 OF THE SAR.

6 THERMAL SHIELD TO BE INSTALLED AFTER ACCEPTABLE GAMMA SCAN OF LEAD IS COMPLETE.

8 THIS WELD TO BE MADE AFTER LEAD POUR AND COOL DOWN TO AMBIENT TEMPERATURE.

9 ALL WELDING PROCEDURES AND PERSONNEL SHALL BE QUALIFIED IN ACCORDANCE WITH ASME CODE, SECTION IX

10 INDICATED WELDS SHALL BE LIQUID PENETRANT INSPECTED ON ROOT PASS AND EACH WELD LAYER, IF A MULTI-PASS WELD, AND ON THE COMPLETED WELD IF A SINGLE PASS WELD IN ACCORDANCE WITH ASME B & PV CODE, SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000 AND SECTION V, ARTICLE 6.

11 INDICATED WELDS SHALL BE LIQUID PENETRANT INSPECTED ON ROOT AND FINAL PASS IN ACCORDANCE WITH ASME B & PV CODE, SECTION III, DIVISION I, SUBSECTION NF, ARTICLE NF-5000 AND SECTION V, ARTICLE 6.

12 ALL WELDS SHALL BE VISUALLY INSPECTED IN ACCORDANCE WITH AWS D1.1.

13 INDICATED WELDS SHALL BE RADIOGRAPH INSPECTED IN ACCORDANCE WITH ASME B & PV CODE, SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000, AND SECTION V, ARTICLE 2.

14 INDICATED WELDS SHALL BE ULTRASONIC TESTED PER ASME B & PV CODE, SECTION III, DIVISION I, SUBSECTION NB, ARTICLE NB-5000, AND SECTION V, ARTICLE 5.

15 TAMPER INDICATING SEAL SHALL BE INSTALLED AT ONE LOCATION CONNECTING THE UPPER IMPACT LIMITER TO THE OUTER CASK AS SHOWN. PAD EYES MAY BE INSTALLED ON UPPER AND LOWER LIMITERS FOR INTERCHANGEABILITY.

16 INDICATED ITEM(S) SHALL BE LOAD TESTED TO 150% OF THE MAXIMUM WORKING LOAD

18 DESIGN PRESSURE IS 150 psig. INNER VESSEL AND OUTER CASK CONTAINMENT BOUNDARIES SHALL BE SUBJECTED TO AN INTERNAL TEST PRESSURE EQUAL TO A MINIMUM OF 150% OF THE DESIGN PRESSURE PER 10 CFR 71 85 (b).

19 INNER VESSEL AND OUTER CASK CONTAINMENT BOUNDARIES SHALL BE HELIUM LEAK TESTED TO DEMONSTRATE A LEAKAGE RATE NOT TO EXCEED 1 X 10^{-7} STANDARD CUBIC CENTIMETERS PER SECOND IN ACCORDANCE WITH ANSI N14 5

NOTE: PRIOR TO LEAD POUR, THE INNER SHELL OF THE OUTER CASK SHALL BE HELIUM LEAKAGE TESTED.

20 INDICATED HOLES ARE PROVIDED FOR THE INSTALLATION OF AN IV HANDLING FIXTURE FOR LIFTING AND HANDLING OF IV LID, IV ASSEMBLY, AND/OR LOADED IV.

21 INDICATED HOLES ARE PROVIDED FOR THE INSTALLATION OF AN OC HANDLING FIXTURE FOR LIFTING AND HANDLING OF THE OC LID EACH LOCATION SHALL BE STENCILED OR OTHERWISE LABELED WITH THE FOLLOWING WARNING "LID LIFT ONLY".

22 PINTLE SOCKETS LOCATED AT CENTER OF IV AND OC ARE PROVIDED FOR LID HANDLING ONLY. EACH LOCATION SHALL BE STENCILED OR OTHERWISE LABELED WITH FOLLOWING WARNING: "LID LIFT ONLY".

23 TORQUE INDICATED UNLUBRICATED BOLTS (1-1/4-7UNC) TO 600-700 FT-LBS.

24 TORQUE INDICATED UNLUBRICATED BOLTS (7/8-9UNC) TO 100-200 FT-LBS.

26 OPTIONAL: HARD CHROME OR NICKEL PLATE SURFACE.

27 OUTER CASK INNER AND OUTER SHELLS, AND INNER VESSEL SHELL SHALL COMPLY WITH THE TOLERANCE REQUIREMENTS OF ASME CODE, SECTION III, DIVISION I, SUBSECTION NE, ARTICLE NE-4220.

28 MATERIAL: POLYURETHANE FOAM 11.5 LB. PER CUBIC FOOT DENSITY ±15%. INSTALLATION TECHNIQUES, ACCEPTANCE TESTS AND ACCEPTABLE DEVIATIONS IN PROPERTIES ARE SUMMARIZED IN SECTION 8.1.4 OF THE SAR.

29 THREADS PER ANSI B1.1.

31 CADMIUM PLATE.

33 (3) MATERIAL: ASTM A-276 TYPE 304 STAINLESS STEEL.

34 MATERIAL: ASTM A-240, TYPE 304 STAINLESS STEEL PLATE.

35 (3) MATERIAL: BUTYL PER RR0405-70, RAINIER RUBBER CO., SEATTLE, WA. ASTM D 2000 M3AA 710, B13, F17, Z TRACER ELEMENT.

36 O-RING SHALL BE LIGHTLY COATED WITH VACUUM GREASE PRIOR TO ASSEMBLY. SEAL SURFACES MAY ALSO, AS AN OPTION, BE COATED WITH A THIN COAT OF VACUUM SEAL GREASE.

39 AS BUILT MINIMUM THICKNESS SHALL COMPLY WITH TOLERANCES GIVEN IN ASTM-A480 AT GROUND WELD JOINTS, MINIMUM THICKNESS MAY BE REDUCED UP TO .050 INCHES.

40 INSTALL BOLT, NUT AND FLAT WASHER IN IMPACT LIMITER LIFTING LUGS PRIOR TO TRANSPORT.

41 MATERIAL: ASTM A-182, TYPE F304 STAINLESS STEEL FORGING (OPTIONAL FOR INNER VESSEL AND OUTER CASK LIDS AND END PLATES AND INNER VESSEL PAYLOAD SPACERS)

42 'CJP' INDICATES COMPLETE JOINT PENETRATION.

43 MARKING IS PER 49 CFR 172.310 (c).

44 QUALITY ASSURANCE REQUIREMENTS - 10 CFR 71, SUBPART H.

45 TORQUE PORT PLUG BOLTS TO 15-20 FT-LBS

46 DIMENSIONS ARE "BETWEEN WELDS".

47 THE TOTAL AXIAL CLEARANCE BETWEEN THE INNER VESSEL AND THE OUTER CASK CAVITY SHALL VARY FROM 1/16 TO 1 5/16.

48 PLUG WELD AND GRIND FLUSH AFTER INSTALLATION OF FOAM.

49 TOLERANCES FOR STOCK PLATE, SHEET, TUBING AND ANGLE COMPONENTS ARE TO BE PER THE APPLICABLE ASTM STANDARD FOR THE SPECIFIED MATERIAL.

50 INSERT MATERIAL SHALL MEET ASTM A434 WITH 140,000 PSI MINIMUM TENSILE STRENGTH

51 OUTER DIAMETER OF IV LID SHALL NOT EXCEED OUTER DIAMETER OF ADJACENT IV BODY FORGING.

52 (3) MODIFY 1 INCH LEG AS NECESSARY TO FIT FLAT ON BOTTOM FLANGE. ANGLE IS OPTIONAL AND IS USED AS A MANUFACTURING AID ONLY.

53 FOR EACH HEAT/LOT, PERFORM AND DOCUMENT A CHARPY TEST ON THREE (3) SPECIMENTS. TEST MUST DEMONSTRATE AT LEAST 20 FT-LB ABSORBED ENERGY AT -40°F.

54 BACKING BARS OPTIONAL.

(3) NOTES NOT USED 7, 17, 25, (30, 32,) 37 AND 38

ITEM	QTY	NEXT ASSY			
			REL	B. HARGIS	3/17/99
			APPD		
			APPD		
			APPD	K. BROWNELL	3/17/99
			ENGR	R. JOHNSON	3/17/99
			QA	B. COUNTERMAN	3/17/99
			CHECK	F. STEINER	3/17/99
			DRAWN	RI VAN LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0-2"	±1/16	±2°
2"-6"	±1/8	
6"-18"	±1/4	
18"-48"	±1/2	
> 48"	±3/4	

Prepared for
U.S. Department of Energy
by PACKAGING TECHNOLOGY INC.

(3) RH-TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING

WASTE ISOLATION PILOT PLANT WIPP

SCALE: NONE	WT N/A
REV 3	SHEET 1 OF 9
DWG SIZE D	DWG NO X-106-500-SNP
CADFILE 970155AR013.DWG	

FIGURE WITHHELD UNDER 10 CFR 2.390

			REL B. HARGIS	3/17/99
			APPD	
			APPD	
			APPD K. BROWNELL	3/17/99
			ENGR R. JOHNSON	3/17/99
			QA B. COUNTERMAN	3/17/99
			CHECK F. STEINER	3/17/99
ITEM	QTY	NEXT ASSY	DRAWN RI VAN LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0–2"	±1/16	±2°
2"–6"	±1/8	
6"–18"	±1/4	
18"–48"	±1/2	
> 48"	±3/4	

Prepared for

U.S. Department of Energy

by PACKAGING TECHNOLOGY, INC.

RH–TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING

3

WASTE ISOLATION PILOT PLANT WIPP

SCALE 3/8	WT. N/A
REV: 3	SHEET 2 OF 9
DWG SIZE D	DWG NO X–106–500–SNP
	CADFILE 970155AR023.DWG

FIGURE WITHHELD UNDER 10 CFR 2.390

			REL	B. HARDIS	3/17/99
			APPD		
			APPD		
			APPD	K. BROWNELL	3/17/99
			ENGR	R. JOHNSON	3/17/99
			QA	B. COUNTERMAN	3/17/99
			CHECK	F. STEINER	3/17/99
ITEM	QTY	NEXT ASSY	DRAWN	RI VAN LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED:

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0–2"	±1/16	±2°
2"–8"	±1/8	
8"–18"	±1/4	
18"–48"	±1/2	
> 48"	±3/4	

Prepared for

U.S. Department of Energy

by PACKAGING TECHNOLOGY, INC.

RH–TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING

3

WASTE ISOLATION PILOT PLANT

WIPP

SCALE: 3/8		WT N/A	
REV 3		SHEET 3 OF 9	
DWG SIZE D	DWG NO X–106–500–SNP		
CADFILE 970155AR033.DWG			

FIGURE WITHHELD UNDER 10 CFR 2.390

			REL B. HARGIS	3/17/99
			APPD	
			APPD	
			APPD K. BROWNELL	3/17/99
			ENGR R. JOHNSON	3/17/99
			QA B. COUNTERMAN	3/17/99
			CHECK F. STEINER	3/17/99
ITEM	QTY	NEXT ASSY	DRAWN RI VAN LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED:

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0-2"	±1/16	±2°
2"-6"	±1/8	
6"-18"	±1/4	
18"-48"	±1/2	
> 48"	±3/4	

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RH-TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING

3

WASTE ISOLATION PILOT PLANT WIPP

SCALE: 1/4 | WT. N/A

REV 3 | SHEET 4 OF 9

DWG SIZE D | DWG NO. X-106-500-SNP

CADFILE 97015SAR043.DWG

FIGURE WITHHELD UNDER 10 CFR 2.390

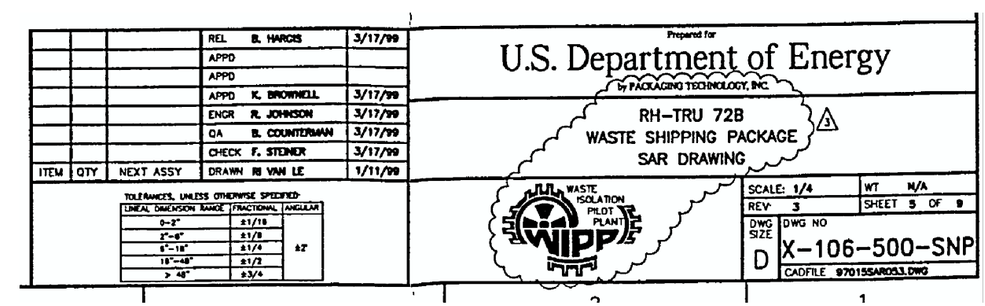

FIGURE WITHHELD UNDER 10 CFR 2.390

			REL B. HARDIS	3/17/99
			APPD	
			APPD	
			APPD K. BROWNELL	3/17/99
			ENGR R. JOHNSON	3/17/99
			QA B. COUNTERMAN	3/17/99
			CHECK F. STEINER	3/17/99
ITEM	QTY	NEXT ASSY	DRAWN RI VAN LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED:

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0–2"	±1/16	
2"–6"	±1/8	
6"–18"	±1/4	±2°
18"–48"	±1/2	
> 48"	±3/4	

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RH–TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING

3

WASTE ISOLATION PILOT PLANT

WIPP

SCALE: 1/8		WT N/A	
REV: 3		SHEET 6 OF 8	
DWG SIZE D	DWG NO X-106-500-SNP		
	CADFILE: 97015SAR063.DWG		

FIGURE WITHHELD UNDER 10 CFR 2.390

			REL	B. HARGES	3/17/99
			APPD		
			APPD		
			APPD	K. BROWNELL	3/17/99
			ENGR	R. JOHNSON	3/17/99
			QA	B. COUNTERMAN	3/17/99
			CHECK	F. STEINER	3/17/99
ITEM	QTY	NEXT ASSY	DRAWN	RI VAN LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED:

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0–2"	±1/16	±2°
2"–6"	±1/8	
6"–18"	±1/4	
18"–48"	±1/2	
> 48"	±3/4	

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RH–TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING

3

WASTE ISOLATION PILOT PLANT
WIPP

SCALE. 1/4	WT. N/A
REV. 3	SHEET 7 OF 9
DWG SIZE D	DWG NO X–106–500–SNP
CADFILE. 970155AR073.DWG	

FIGURE WITHHELD UNDER 10 CFR 2.390

			REL	B HARDIS	3/17/99
			APPD		
			APPD		
			APPD	K. BROWNELL	3/17/99
			ENGR	R. JOHNSON	3/17/99
			QA	B. COUNTERMAN	3/17/99
			CHECK	F. STEINER	3/17/99
ITEM	QTY	NEXT ASSY	DRAWN	[illegible] LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED:

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0–2"	±1/16	±2°
2"–8"	±1/8	
8"–18"	±1/4	
18"–48"	±1/2	
> 48"	±3/4	

Prepared for

U.S. Department of Energy

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RH–TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING

3

WASTE ISOLATION PILOT PLANT WIPP

SCALE: 1/2 | WT. N/A

REV: 3 | SHEET 8 OF 9

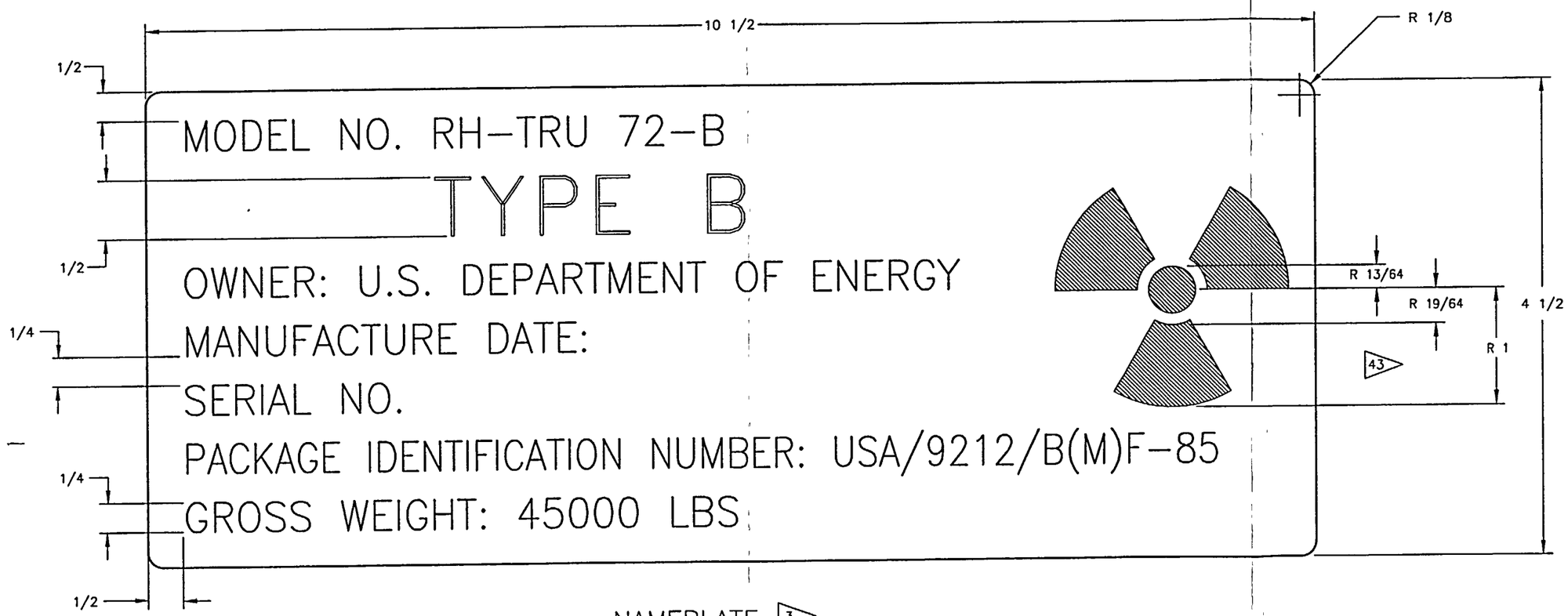
DWG SIZE D | DWG NO X–106–500–SNP

CADFILE: 970155AR083.DWG

X-106-500-SNP	9	3

REVISION HISTORY

REV	DESCRIPTION	REL	DATE
1	INITIAL RELEASE	BH	3/17/99
2	SEE DCN 1/1, 2/1 AND 3/1	B. HARGIS	1/24/01
3	SEE DCN 1/2, 2/2, 3/2 & 4/2	BH	11/25/02



NAMEPLATE 3

MATERIAL: STAINLESS STEEL (ANY GRADE)
LETTERING: ETCHED, BLACK PAINT FILLED, OR LASER ETCHED, NO PAINT FILL.

(BLOCK TOLERANCES ONLY APPLY TO OVERALL 10 1/2 INCH AND 4 1/2 INCH DIMENSIONS. ALL OTHER DIMENSIONS ARE NOMINAL.)

ITEM	QTY	NEXT ASSY			
			REL	B HARGIS	3/17/99
			APPD		
			APPD		
			APPD	K. BROWNELL	3/17/99
			ENGR	R. JOHNSON	3/17/99
			QA	B. COUNTERMAN	3/17/99
			CHECK	F. STEINER	3/17/99
			DRAWN	RI VAN LE	1/11/99

TOLERANCES, UNLESS OTHERWISE SPECIFIED:

LINEAL DIMENSION RANGE	FRACTIONAL	ANGULAR
0–2"	±1/16	±2°
2"–6"	±1/8	
6"–18"	±1/4	
18"–48"	±1/2	
> 48"	±3/4	

Prepared for
U.S. Department of Energy
by PACKAGING TECHNOLOGY, INC.

RH-TRU 72B
WASTE SHIPPING PACKAGE
SAR DRAWING 3

WASTE ISOLATION PILOT PLANT WIPP

SCALE: NONE	WT. N/A
REV 3	SHEET 9 OF 9
DWG SIZE D	DWG NO X-106-500-SNP
CADFILE 97015SAR093.DWG	

8.1.3.1 Testing the IV Structure Integrity

8.1.3.1.1 The Fabrication Leakage Rate Test of the IV structure shall be performed per Section A.5.4, Evacuated Envelope (Gas Detector), or Section A.5.3, Pressurized Envelope (Reference 8.3.1.4). Refer to Section 8.1.3.1.12.

8.1.3.1.2 The IV shall be assembled with all three main O-ring seals installed in the IV lid. Assembly is as shown on the Shipping Cask SAR Drawing in Appendix 1.3.2.

8.1.3.1.3 Install the assembled IV into a successfully leakage rate tested OC body. Refer to Section 8.1.3.5 for the OC structure leakage rate test procedure.

8.1.3.1.4 Remove the IV gas sampling port closure bolt.

8.1.3.1.5 Connect a vacuum pump to the IV gas sampling port.

8.1.3.1.6 Evacuate the IV cavity through the gas sampling port to 90% vacuum or better (10% absolute or less) of the atmospheric pressure.

8.1.3.1.7 Provide a helium atmosphere in the cavity of the IV by backfilling with helium gas to a pressure slightly greater than atmospheric pressure (+1 psi, -0 psi). Correction for tracer gas concentration shall be performed using Section B.13 of Reference 8.3.1.4.

8.1.3.1.8 Install the IV gas sampling port closure bolt.

8.1.3.1.9 Remove the OC gas sampling port closure bolt and install the OC lid.

8.1.3.1.10 Evacuate air from the OC/IV annulus through the OC gas sampling port until the vacuum is sufficient to operate the helium mass spectrometer leak detector.

8.1.3.1.11 Perform the leakage rate test to the requirements of Section 8.1.3.8. If after repeated attempts, the IV structure fails to pass the leakage rate test, isolate the leak path and, prior to repairing the leak path and repeating the IV structure leakage rate test, record the results of the test and any recommended actions for disposition in accordance with the requirements of Section 9.2.

8.1.3.1.12 <u>Testing the IV Structure Integrity - Pressurized Envelope Method</u>

8.1.3.1.12.1 The IV shall be assembled with all three main o-rings installed in the lid. Assembly is as shown on the Shipping Cask SAR drawing in Appendix 1.3.2.

8.1.3.1.12.2 Remove the IV gas sampling port closure bolt and install the helium mass spectrometer to the IV gas sampling port.

8.1.3.1.12.3 Evacuate the IV cavity through the IV gas sampling port until the vacuum is sufficient to operate the helium mass spectrometer leak detector.

8.1.3.1.12.4 Provide a helium environment at a pressure slightly above one atmosphere around the exterior of the IV, taking care to purge all other gases from any pockets or cavities adjacent to the vessel.

8.1.3.1.12.5 Determine the leakage rate of the system. Per Reference 8.3.1.4, Section A.3.6, the measured leakage rate shall conservatively be multiplied by a factor of two to account for the less than 100% concentration of the helium in the envelope surrounding the outer vessel.

8.1.3.1.12.6 Perform the leakage rate test to the requirements of Section 8.1.3.8. If after repeated attempts, the IV structure fails to pass the leakage rate test, isolate the leak path and,

prior to repairing the leak path and repeating the IV structure leakage rate test, record the results of the test and any recommended actions for disposition in accordance with the requirements of Section 9.2.

8.1.3.2 Testing the IV Lid Seal Integrity

8.1.3.2.1 The Fabrication Leakage Rate Test of the IV lid middle seal shall be performed per Section A.5.4, Evacuated Envelope (Gas Detector) (Reference 8.3.1.4).

8.1.3.2.2 The IV shall be assembled with all three main O-ring seals installed in the IV lid. Assembly is as shown on the Shipping Cask SAR Drawing in Appendix 1.3.2.

8.1.3.2.3 Attach a vacuum pump and a source of helium gas, in parallel, to the backfill port. Fittings will include a specially-designed tool which will maintain a leak-tight interface between the backfill/test port and the helium supply/vacuum pump, while allowing manipulation of the backfill/test port closure bolt. This tool will be referred to as a "test port tool." Install valves on each of the lines to allow independent isolation of the vacuum pump and the source of helium gas to the backfill port. Close the valve to the source of helium gas and open the valve to the vacuum pump. Figure 8.1.3.2-1 provides a schematic of this configuration.

lid, inside the cask, at a distance equal to the inside radius of the cask. A dose reading is then recorded. The lead sheet thickness in the test lid holder is then adjusted to establish the nominal less 10% lead thickness configuration. Again, the source is placed below the test lid at a distance equal to the inside radius of the cask and a dose reading is recorded. Additional dose readings are taken in 1/8-inch lead thickness increments between and beyond the two base readings until four to eight dose readings are obtained. The resultant data is then plotted on a chart for dose values versus lead thickness. The value for nominal less 10% lead thickness is utilized as the maximum acceptable dose value for the inspected cask.

Indications of non-conformance with the above stated standards shall be recorded on a Non Conformance Report (NCR), or equivalent, for Project Team disposition prior to repair and final acceptance in accordance with the requirements of Section 9.2.

8.1.6 Thermal Acceptance Tests

Material properties established in Section 3.2, Summary of Thermal Properties of Materials, are consistently conservative for the analyses performed. As such, with the exception of the polyurethane foam (addressed in Section 8.1.4, above), acceptance tests for material thermal properties are not performed.

8.1.7 Lead Installation Tests

Testing during the lead installation process involves meeting the requirements of ASME Boiler and Pressure Vessel Code Division 1, Section III, Subsection NE, Article NE-4220 (Reference 8.3.1.2) and close monitoring of the cask temperatures during the preheat, lead pour, and cool-down processes. A more detailed description of the lead installation and testing is presented in Appendix 8.3.2.

APPENDIX 8.3.2

Lead Installation Procedure

8.3.2 Lead Installation Procedure

The following delineates the procedure for installation of poured lead into the RH-TRU 72-B outer cask. The procedure presents pre-pour, lead pour, gamma scan inspection of the lead shielding, and post-pour requirements. Note: The outer cask thermal shield is attached after lead pour and cool down.

8.3.2.1 (THIS SUBSECTION REMOVED)

8.3.2.2 Interior cavities and surfaces of the OC shells which are to be in contact with the lead shielding shall be swabbed with solvent, wiped down, sandblasted, or otherwise cleansed of loose mill scale, weld slag, and all carbonaceous materials prior to lead pour.

8.3.2.3 All OC inner and outer surfaces shall be supported or braced, as necessary, to prevent distortion during the lead-pouring and cool-down operations.

8.3.2.4 The lead-pouring operation is performed with the cask inverted (i.e., the OC base plate is up, lid end is down).

Fill pipes shall be provided through the outer shell of the outer cask, adjacent to the lid-end forging, sized as required to allow for rapid and even lead fill.

Standpipes shall be provided through the OC outer shell, adjacent to the base plate, sized as required to allow for easy access of lead during the cooling operation.

Vent risers shall be provided through the cask base plate to allow for escape of air and impurities.

8.3.2.5 The outer cask shall be instrumented with thermocouple wires at eight (8) locations on the inside and outside to monitor temperature

differentials between the two shells. A total of sixteen (16) thermocouples shall be required. Internal and/or external bracing may be temporarily removed to facilitate thermocouple installation.

The thermocouples shall be mounted opposite each other on the inside and outside shells to assure proper temperature differential measurements. The thermocouple sets shall be mounted at equal intervals over the full length of the outer cask. The sets shall also be located around the cask circumference so that all areas of the outer cask are instrumented.

In addition, a calibrated strip recorder with the thermocouples capable of measuring temperatures to 1,000 °F and plotting time/temperature data every 60 seconds shall be utilized.

Adequate precautions must be taken to assure that the thermocouples are protected from impact or flame impingement during the preheat, lead pour, and cool-down phases.

8.3.2.6 All outer cask components (i.e., outer shell, inner shell, top end forging and bottom end closure) shall be uniformly preheated to a temperature of 600 °F to 700 °F over the entire surface prior to lead pouring. Preheating shall be done in a suitable enclosure to assure uniform preheating. During preheat, the maximum temperature change for any thermocouple shall not exceed 100 °F in any thirty (30) minute period.

8.3.2.7 The temperature of the lead at the time of lead pour shall range from 750 °F to 850 °F.

8.3.2.8 The rate of lead flow shall be controlled to fill the outer cask as rapidly and evenly as possible. The lead shall enter the cavity in such a way as to minimize impingement on the outer cask shells.

8.3.2.9 Heat sources shall be controlled during the cool-down period so that the outer cask is cooled to insure that only one solidifying front exists in the lead.

During cool-down, the maximum temperature change for any thermocouple shall not exceed 100 °F in any thirty (30) minute period, and the maximum difference in temperatures between any pair of thermocouples mounted directly opposite each other (one on the OD and the corresponding one on the ID) shall not exceed 300 °F at any instant in time.

8.3.2.10 Molten lead at a minimum temperature of 750 °F shall be added to the standpipes, as necessary, at a rate consistent with normal shrinkage.

8.3.2.11 After all the thermocouples indicate a temperature less than 100 °F, the thermocouples and any internal and/or external bracing shall be removed and the outer cask gamma scanned in accordance with the tests delineated in Section 8.1.5.

8.3.2.12 Upon a successful gamma scan inspection cask measurements taken after lead pour must meet the requirements specified on the Shipping Cask SAR Drawing in Appendix 1.3.2. (Note: Specifically the tolerance requirements of ASME Boiler and Pressure Vessel Code, Division 1, Section III, Subsection NE, Article NE-4220, as defined in flag note 27 of the SAR Drawing, shall be met.)

8.3.2.13 Remove all fill pipes, vent pipes, and standpipes, clean the holes thoroughly of all lead, and install plugs of identical material as the base material.