71-9288

# COLUMBIANA HI TECH LLC

*Nuclear Manufacturing Excellence*

August 29, 2007

Robert A. Nelson
Chief, Spent Fuel Licensing Section
Spent Fuel Project Office
United States Nuclear Regulatory Commission
Mail Stop: O-13D13
Washington, DC 20555-0001

Cc: Bill Brach, Director-SFPO

Re: License Amendment request for Certificate of Compliance USA/9288/B (U) F-96, revision 7, for the model no. CHT-OP-TU Package.

Dear Mr. Nelson,

Columbiana Hi Tech, LLC submits the attached changes to Sections 7 and 8 in support of the proposed amendment request to allow the use of a sleeve or insert within the nominal 8" oxide vessel for transport of heterogeneous material.

This submittal supplements the prior CHT submittal of July 17, 2007. Please note that the Title Page and Table of Contents pages iv, v, and vii of this supplement replace those like pages of the previous submittal of July 17, 2007.

Included are proposed revisions to Sections 7 and 8 to address operating procedures, acceptance tests and maintenance program requirements for the pellet carrier to be used for transport of heterogeneous material in the 8" oxide vessel. Attachment A provides instructions for inserting the revised pages into Revision 8 (July 2007) of the SAR. Attachment B provides a listing of the changes made with an explanation for the modification. Attachment C provides the changes and added pages.

If you have any questions concerning this request or this submittal, please feel free to contact CHT at your convenience.

Sincerely,

Donald W. Olson
President
Columbiana Hi Tech

LIMSSOI

1802 Fairfax Road • Greensboro, North Carolina 27407 Phone 336/852-5679

Enclosures:
Attachment A: Instructions for updating revision 7 to revision 8.
Attachment B: Explanation of changes to CHT-OP-TU SAR revision 7.
Attachment C: Revision 8, as supplemented August 2007 changed pages.

# ATTACHMENT A

## Instructions for Updating Revision 7 to Revision 8, as Supplemented August 2007:

**Title page and Table of Contents:**

| Remove (Revision 7): | Add (Revision 8): |
|---|---|
| Title page | Title page |
| Table of Contents page iv, v, and vii | Table of Contents pages iv, v, and vii |

**Section 1:**

| Remove ( Revision 7): | Add (Revision 8): |
|---|---|
| No Changes | |

**Section 2:**

| Remove (Revision 7): | Add (Revision 8): |
|---|---|
| No changes | |

**Section 3:**

| Remove (Revision 7): | Add (Revision 8): |
|---|---|
| No changes | |

**Section 4:**

| Remove (Revision 7): | Add ( Revision 8 ): |
|---|---|
| No changes | |

**Section 5:**

| Remove (Revision 7): | Add (Revision 8) |
|---|---|
| No changes | |

**Section 6:**

| Remove (Revision 7): | Add (Revision 8): |
|---|---|
| No Changes | |

**Section 7:**

| Remove (Revision 7): | Add (Revision 8): |
|---|---|
| 7i | 7i |
| 7-1 | 7-1 |
| 7-2 | 7-2 |
| 7-3 | 7-3 |
| 7-4 | 7-4 |
| 7-5 | 7-5 |
| 7-6 | 7-6 |
| 7-7 | 7-7 |
| 7-8 | 7-8 |
| None | Add Page 7-9 (Text) |
| 7-9 (Figure 7-1) | 7-10 (Figure 7-1) |
| 7-10 (Figure 7-2) | 7-11 (Figure 7-2) |
| 7-11 (Appendix 7.6.1 Cover Page) | 7-12 (Appendix 7.6.1 Cover Page) |

**Section 8:**

| Remove (Revision 7): | Add (Revision 8): |
|---|---|
| 8i | 8i |
| 8-2 | 8-2 |
| 8-3 | 8-3 |
| 8-4 | 8-4 |
| 8-5 | 8-5 |
| None | Add Page 8-6 (Text) |
| 8-6 (Appendix 8.3.1 Cover Page) | 8-7 (Appendix 8.3.1 Cover Page) |

ATTACHMENT B – Explanation of Changes

| Changed page | Explanation of changes made |
|---|---|
| Title page | Updated revision status from "Revision 8, June 2007" to "Revision 8, as supplemented August 2007" |
| Table of Contents page iv, v, and vii | Inserted new Section 7.1.1 for Pellet Carrier. The existing Sections 7.1.1, 7.1.2, and 7.1.3 now become Sections 7.1.2, 7.1.3, and 7.1.4. Inserted new Section 7.2.1 for Pellet Carrier. The existing Sections 7.2.1, 7.2.2, and 7.2.3 now become Sections 7.2.2, 7.2.3, and 7.2.4. Increased pages numbers of Sections 7.3, 7.4, 7.5, and 7.6 with inserted new Sections 7.1.1 and 7.2.1. Increased page numbers of Figures 7-1 and 7-2 with inserted new Sections 7.1.1 and 7.2.1 to 7-10 and 7-11 respectively. |
| 7-*i* | Revised Section 7 Table of Contents to add new Sections 7.1.1 and 7.2.1 for Pellet Carrier for Type A and Type B shipments, respectively. |
| Section 7 pages 7-1 through 7-11 | Added new Sections 7.1.1 and 7.2.1 for Pellet Carrier for Type A and Type B shipments, respectively. Caused following section to shift in page numbers. Modified old Section 7.1.3 (b) as new Section 7.1.4 (b) to further emphasize use of pellet carrier with 8" oxide vessels for Type A shipments. Modified old Section 7.2.3 (b) as new Section 7.2.4 (b) to further emphasize use of pellet carrier with 8" oxide vessels for Type B shipments. Replaced pages 7-1 through 7-11 and added 7-12. |
| 8-*i* | Revised Section 8 Table of Contents to add new Sections 8.1.3 and 8.2.3 for Pellet Carrier for Acceptance Tests and Maintenance Programs, respectively. |
| Section 8 pages 8-2 through 8-6 | Added new Sections 8.1.3 and 8.2.3 for Pellet Carrier for Acceptance Tests and Maintenance Programs, respectively. Caused following sections to shift in page numbers. Replaced pages 8-2 through 8-6 and added 8-7. |

ATTACHMENT C

Revision 8, As Supplemented August 2007
Changed Pages

# SAFETY ANALYSIS REPORT
# FOR THE
# MODEL CHT-OP-TU
# (Revision 8, as Supplemented August 2007)

Submitted by:

Columbiana Hi Tech, LLC
1802 Fairfax Road
Greensboro, NC 27407

(TABLE OF CONTENTS, CONTINUED)


6.1.1 Normal Conditions of Transport (NCT) ..... 6-2
6.1.2 Off-Normal Condition (ONC) ..... 6-3
6.1.3 Hypothetical Accident Condition (HAC) ..... 6-3
6.1.4 Discussion and Results Summary ..... 6-4
6.2 PACKAGE FUEL LOADING ..... 6-4
6.3 MODEL SPECIFICATION ..... 6-4
6.3.1 Description of Calculational Model ..... 6-4
6.4 CRITICALITY CALCULATION ..... 6-7
6.4.1 Calculation Method ..... 6-7
6.4.2 Loading Optimization ..... 6-7
6.4.3 Criticality Results ..... 6-8
6.5 CRITICAL BENCHMARK EXPERIMENTS ..... 6-8
6.5.1 Benchmark Experiments and Applicability ..... 6-8
6.5.2 Details of the Benchmark Calculations ..... 6-9
6.5.3 Benchmark Results ..... 6-9
6.6 SCALE43 INPUT DECKS - BOUNDING CASES ..... 6-9
6.6.1 Homogeneous Cases ..... 6-9
6.6.2 Heterogeneous Cases ..... 6-19
6.6.3 Tilt Sensitivity Cases ..... 6-28
6.7 REFERENCES ..... 6-35
6.8 LIST OF APPENDICES ..... 6-35
6.8.1 Equivalent Water Density Calculation for Rigid Foam Insulation ..... 6-56
6.8.2 8" Diameter Oxide Vessel Calculations with Heterogeneous Materials ..... 6-57
6.8.3 Selected Input Cases for 8" Diameter Oxide Vessel Calculations with Heterogeneous Materials ..... 6-58

SECTION SEVEN OPERATING PROCEDURES
7 OPERATING PROCEDURES ..... 7-1
7.1 LOADING PROCEDURES FOR A TYPE A SHIPMENT ..... 7-1
7.1.1 Pellet Carrier Inspection ..... 7-1
7.1.2 Oxide Vessel Inspection ..... 7-1
7.1.3 Transport Unit Inspection ..... 7-2
7.1.4 Package Loading ..... 7-2 8s
7.2 LOADING PROCEDURES FOR A TYPE B SHIPMENT ..... 7-3
7.2.1 Pellet Carrier Inspection ..... 7-3
7.2.2 Oxide Vessel Inspection ..... 7-4
7.2.3 Transport Unit Inspection ..... 7-4
7.2.4 Package Loading ..... 7-5 8s

7.3 SECURING THE PACAKAGE TO THE CONVEYANCE ..... 7-6
7.3.1 ISO Containers ..... 7-6
7.3.2 Tie Down Using Hold-down Bars ..... 7-6
7.3.3 Tie Down Using Strapping (Straps, Chain or Cable) ..... 7-7
7.3.4 Tie Down Using Other Methods ..... 7-8
7.4 UNLOADING PROCEDURES ..... 7-8
7.5 PREPARATION OF EMPTY TRANSPORT UNIT FOR TRANSPORT ..... 7-8
7.6 LIST OF APPENDICES ..... 7-9
7.6.1 Leak Testing Specifications ..... 7-12 8s
7.6.1-A Leak Test Specification CHT-LT-001 ..... 7.6.1-2
7.6.1-B Leak Test Specification CHT-LT-003 ..... 7.6.1-3

SECTION EIGHT ACCEPTANCE TESTS AND MAINTENANCE PROGRAMS
8 ACCEPTANCE TESTS AND MAINTENANCE PROGRAMS ..... 8-1
8.1 ACCEPTANCE TESTS ..... 8-1
8.1.1 Visual Inspections of the Transport Unit ..... 8-1
8.1.2 Visual Inspections of the Oxide Vessels ..... 8-1
8.1.3 Visual Inspection of the Pellet Carrier ..... 8-2
8.1.4 Leakage Tests ..... 8-2
8.1.5 Component Tests ..... 8-3 8s
8.2 MAINTENANCE PROGRAMS ..... 8-3
8.2.1 Maintenance Programs for the Transport Unit ..... 8-3
8.2.2 Maintenance Programs for the Oxide Vessel ..... 8-4
8.2.3 Maintenance Programs for the Pellet Carrier ..... 8-5
8.3 LIST OF APPENDICES ..... 8-6
8.3.1 Leak Testing Specifications ..... 8-7 8s
8.3.1-A Leak Test Specification CHT-LT-002 ..... 8.3.1-2
8.3.1-B Leak Test Specification CHT-LT-003 ..... 8.3.1-3
8.3.1-C Leak Test Specification CHT-LT-001 ..... 8.3.1-4

(LIST OF TABLES AND FIGURES, CONTINUED)

Figure 2.7- 5 Thermal Test Elevation View ..... 2-23
Figure 2.7- 6 Thermal Test Plan View ..... 2-23
Figure 2.7- 7 Performance Test Measurements ..... 2-24
Figure 2.7- 8 Oxide Vessel/Sleeve Shift ..... 2-25

Figure 6-1 NCT Homogeneous: $k_{eff} + 2\sigma$ versus Mixture Density for Dry Powder 5.0 wt% Enriched Reprocessed Uranium Oxide in a n 8" diameter Oxide Vessel ..... 6-43
Figure 6-2 NCT Heterogeneous: $k_{eff} + 2\sigma$ versus Lattice Pitch for Dry Spherical Pellets 5.0 wt% Enriched Reprocessed Uranium Oxide in a 7.5" diameter Oxide Vessel ..... 6-44
Figure 6-3 Sensitivity of the Multiplication Factor to Variations in Foam Insulation Density ..... 6-45
Figure 6-4 ONC Homogeneous: Water- and Water/Poly-Moderated Homogeneous 5wt% Enriched Reprocessed Uranium Oxide Powder in an 8" Diameter Oxide Vessel ..... 6-46
Figure 6-5 ONC Heterogeneous: Water- and Water/Poly-Moderated Heterogeneous 5wt% Enriched Spherical Pellets of Reprocessed Uranium Oxide in a 7.5" Diameter Oxide Vessel ..... 6-47
Figure 6-6 Illustration of KENO Model of a single CHT-OP-TU for the Normal Condition (front corner removed) ..... 6-48
Figure 6-7 Front and Side View of SCALE Model of a single CHT-OP-TU with Tilted Oxide Vessels for Hypothetical Accident Condition Sensitivity Study ..... 6-49
Figure 6.7a Section View of SCALE Model of CHT-OP-TU for HAC (untilted Model) ..... 6-50
Figure 6-7b Sensitivity of the HAC System to Oxide Vessel Tilt, up to the Maximum Tilt Measured ..... 6-51
Figure 6-8 Arrangement of Packages Analyzed for Hypothetical Accident Conditions (Shown at the bottom plane of the Oxide Vessels) ..... 6-52
Figure 6-9 Illustration of the Relative Multiplication Factors for Graphite-moderation versus Water-moderation (7.5" vessel, $UO_2$ Powder enriched to 5wt%) ..... 6-53
Figure 6-10 $K_{eff}$ as a Function of Interspersed Moderator (water) Density ..... 6-54
Figure 6-11 Illustration of the Relative Multiplication Factors for Various Arrays sizes ..... 6-55
Figure 6.8.2-1 SCALE 4.3 and SCALE 4.4a Comparisons Results for 230 Benchmarks ..... 6.8.2-23
Figure 7-1 Minimum Tie Down Requirement Using Hold-down Bars ..... 7-10
Figure 7-2 Minimum Tie Down Requirement Using Strapping ..... 7-11

8s

## SECTION SEVEN OPERATING PROCEDURES

TABLE OF CONTENTS


**7 OPERATING PROCEDURES ..... 7-1**

*7.1 Loading Procedures for a Type A Shipment ..... 7-1*
*7.1.1 Pellet Carrier Inspection ..... 7-1*
*7.1.2 Oxide Vessel Inspection ..... 7-1*
*7.1.3 Transport Unit Inspection ..... 7-2*
*7.1.4 Package Loading ..... 7-2*
*7.2 Loading Procedures for a Type B Level I or Level II Shipment ..... 7-3*
*7.2.1 Pellet Carrier Inspection ..... 7-3*
*7.2.2 Oxide Vessel Inspection ..... 7-4*
*7.2.3 Transport Unit Inspection ..... 7-4*
*7.2.4 Package Loading ..... 7-5*
*7.3 Securing the Package to the Conveyance ..... 7-6*
*7.3.1 ISO Containers ..... 7-6*
*7.3.2 Tie Down Using Hold-down Bars ..... 7-6*
*7.3.3 Tie Down Using Strapping (Straps, Chain or Cable) ..... 7-7*
*7.3.4 Tie Down Using Other Methods ..... 7-8*
*7.4 Unloading Procedures ..... 7-8*
*7.5 Preparation of Empty Packaging for Transport ..... 7-8*
*7.6 List of Appendices ..... 7-9*
*7.6.1 Leak Testing Specifications ..... 7-12*
*7.6.1-A Leak Test Specification CHT-LT-001 ..... 7.6.1-2*
*7.6.1-B Leak Test Specification CHT-LT-003 ..... 7.6.1-3*


LIST OF TABLES AND FIGURES


Figure 7-1 Minimum Tie Down Requirement Using Hold-down Bars ..... 7-10

Figure 7-2 Minimum Tie Down Requirement Using Strapping ..... 7-11

# 7 OPERATING PROCEDURES

The Oxide Package Transport Unit (CHT-OP-TU) is loaded and unloaded and the Oxide Vessel is filled, inspected, and handled in accordance with the User's standard operating procedures. As a minimum, the User's procedures shall include the steps described in the subsequent sections. Although these steps represent the minimum required to safely operate the CHT-OP-TU, they may not include all of the DOT, NRC or other agency requirements for shipment.

## *7.1 Loading Procedures for a Type A Shipment*

### 7.1.1 Pellet Carrier Inspection

As a minimum, the User shall inspect the following items prior to loading:

a. Inspect the Pellet Carrier interior and exterior surfaces for visible flaws. The vessel should not be substantially deformed or dented (more than 1 inch in depth). If the surface is substantially deformed or dented, or if cracks or corrosion are discovered, the Pellet Carrier should not be used.

b. Place pellet packaging assemblies in the (internal) lower assembly. Add spacer plates between assemblies as needed to support each. For partial loads, add spacer blocks, empty packaging assemblies, or trays, as needed to provide support.

c. Place the (internal) upper assembly on the lower assembly and secure with clamps. The clamps are needed to secure the upper and lower assemblies together for lifting and placement into the Oxide Vessel.

d. Install lower neoprene insert in Oxide Vessel and then lower Pellet Carrier Assembly into Oxide Vessel. Size upper neoprene insert to achieve proper compression of the carrier.

e. Visually inspect the Oxide vessel lid to assure it fits properly on the Oxide Vessel with no visible gaps.

### 7.1.2 Oxide Vessel Inspection

As a minimum, the User shall inspect the following items prior to loading:

a. Inspect the Oxide Vessels interior and exterior surfaces for visible flaws. Visually inspect all accessible welds for cracks or corrosion. The welds should be free of cracks, and the vessel should not be substantially deformed or dented (more than 1 inch in depth). If the surface is substantially crushed or dented, or if cracks or corrosion are discovered, the Oxide Vessel should not be used.

b. Remove the Oxide Vessel lid and inspect for corrosion or damage to the bolt holes. Visually inspect the bolts for stripping, cracking and corrosion. If any are found to be defective, they must be replaced.

c. Visually inspect the Oxide Vessel flange sealing surface for nicks or scratches. If scratches or nicks are observed the area should be buffed to remove rough or sharp edges. After buffing, clean the sealing surfaces. Allow the area to dry thoroughly before installing the lid.

d. Visually inspect the Oxide Vessel O-rings. They should be in place, intact, and in serviceable condition. If any are found to be defective, they must be replaced.

e. Visually inspect the Oxide vessel lid to assure it fits properly on the Oxide Vessel with no visible gaps.

### 7.1.3 Transport Unit Inspection

As a minimum, the User shall inspect the following items prior to loading:

a. Inspect the Transport Unit interior and exterior surfaces, including the Outer Lid surfaces, for visible flaws. The Transport Unit should not be substantially deformed (more than 2 inches in depth).

b. The Transport Unit sleeves shall be free of debris and standing water. Confirm that the gaskets at the bottom and flange of the Transport Unit sleeves are in place.

c. Confirm that the Outer Lid gaskets and the Outer Lid flange gaskets are in place.

d. Visually inspect the Outer Lid to assure that it fits properly on the Transport Unit without gaps.

### 7.1.4 Package Loading

a. Verify that the payload meets the requirements for a Type A quantity per the applicable Federal and/or International regulations. Verify that the payload meets the requirements specified in NRC Certificate of Compliance.

b. Load the payload into the Oxide Vessels, not to exceed 402 lb (182.3 kg) per Oxide Vessel. The payload may be pre-packaged plastic bags (per the restrictions specified in Section 1) metal or Teflon™ (PTFE) containers, or the payload may be directly loaded into the Oxide Vessels, except that heterogeneous forms (per the restriction specified in Section 1) shall use a pellet carrier when loaded in 8-inch Oxide Vessels.

c. Before placing the Oxide Vessel lid onto the Oxide Vessel flange, be sure that no residual payload is present on the flange.

d. If desired, apply O-ring lubricant to the O-ring surfaces sparingly.

e. Place the Oxide Vessel lid onto the Oxide Vessel flange. Insert a bolt in each hole provided and tighten each bolt to a torque of 75 +5 –0 ft-lbs using an alternating pattern.

f. Confirm that the Test Port Plug is installed. When a new Test Port Plug is installed, it is tightened to a torque of 60 +10 –0 in-lb.

g. Lift the closed Oxide Vessels and insert the Oxide Vessels into the Transport Unit sleeves.

h. Place the Outer Lids into the sleeves and place a bolt in each bolt hole provided. Tighten each bolt to a torque of 75 +5 –0 ft-lbs, using an alternating pattern. Install a security seal at the two locations provided on the Outer Lid. Bind the two Outer Lid handles together with a nylon tie to render them inoperable.

i. Verify that the gross weight of the loaded package does not exceed 3,757 lb (1,704.1 kg).

j. Complete a contamination and radiation survey in accordance with 10 CFR Part 71.87 (i) and (j).

k. The packaging is required to be unloaded within one year of loading.

## *7.2 Loading Procedures for a Type B Level I or Level II Shipment*

### 7.2.1 Pellet Carrier Inspection

As a minimum, the User shall inspect the following items prior to loading:

a. Inspect the Pellet Carrier interior and exterior surfaces for visible flaws. The vessel should not be substantially deformed or dented (more than 1 inch in depth). If the surface is substantially deformed or dented, or if cracks or corrosion are discovered, the Pellet Carrier should not be used.

b. Place pellet packaging assemblies in the (internal) lower assembly. Add spacer plates between assemblies as needed to support each. For partial loads, add spacer blocks, empty packaging assemblies, or trays, as needed to provide support.

c. Place the (internal) upper assembly on the lower assembly and secure with clamps. The clamps are needed to secure the upper and lower assemblies together for lifting and placement into the Oxide Vessel.

d. Install lower neoprene insert in Oxide Vessel and then lower Pellet Carrier Assembly into Oxide Vessel. Size upper neoprene insert to achieve proper compression of the carrier.

e. Visually inspect the Oxide vessel lid to assure it fits properly on the Oxide Vessel with no visible gaps.

f. The Oxide Vessel seal performance shall have been demonstrated to be capable of sustaining the minimum required leakage rate conditions for the payload (see Section 4) or to leak-tight conditions within 12 months prior to the shipment as directed by Section 8.

### 7.2.2 Oxide Vessel Inspection

As a minimum, the User shall inspect the following items prior to loading:

a. Inspect the Oxide Vessels interior and exterior surfaces for visible flaws. Visually inspect all accessible welds for cracks or corrosion. The welds should be free of cracks, and the vessel should not be substantially deformed or dented (more than 1 inch in depth). If the surface is substantially deformed or dented, or if cracks or corrosion are discovered, the Oxide Vessel should not be used.

b. Remove the Oxide Vessel lid and inspect for corrosion or damage to the bolt holes. Visually inspect the bolts for stripping, cracking and corrosion. If any are found to be defective, they must be replaced.

c. Visually inspect the Oxide Vessel flange sealing surfaces for nicks or scratches. If scratches or nicks are observed the area should be buffed to remove rough or sharp edges. After buffing, clean the sealing surfaces. Allow the area to dry thoroughly before installing the lid.

d. Visually inspect the Oxide Vessel O-rings. They should be in place, intact, and in serviceable condition. If any are found to be defective, they must be replaced.

e. Visually inspect the Oxide vessel lid to assure it fits properly on the Oxide Vessel with no visible gaps.

f. The Oxide Vessel seal performance shall have been demonstrated to be capable of sustaining the minimum required leakage rate conditions for the payload (see Section 4) or to leak-tight conditions within 12 months prior to the shipment as directed by Section 8.

### 7.2.3 Transport Unit Inspection

As a minimum, the User shall inspect the following items prior to loading:

a. Inspect the Transport Unit interior and exterior surfaces, including the Outer Lid surfaces, for visible flaws. The Transport Unit should not be substantially deformed (more than 2 inches in depth).

b. The Transport Unit sleeves shall be free of debris and standing water. Confirm that

the gaskets at the bottom and flange of the Transport Unit sleeves are in place.

c. Confirm that the Outer Lid gaskets and the Outer Lid flange gaskets are in place.

d. Visually inspect the Outer Lid to assure that it fits properly on the Transport Unit without gaps.

### 7.2.4 Package Loading

a. Verify that the payload meets the requirements specified in the NRC Certificate of Compliance.

b. Load the payload into the Oxide Vessels, not to exceed 402 lb (182.3 kg) per Oxide Vessel. If the payload decay heat is essentially zero (less than 0.068 $W/m^3$), the payload may be pre-packaged in plastic bags (per the restrictions specified in Section 1), metal or Teflon™ (PTFE) containers, or the payload may be directly loaded into the Oxide Vessels, except that heterogeneous forms (per the restriction specified in Section 1) shall use a pellet carrier when loaded in 8-inch Oxide Vessels.

c. Before placing the Oxide Vessel lid onto the Oxide Vessel flange, be sure that no residual payload is present on the flange.

d. Inspect the visible O-ring surfaces for damage. If damage is visible, replace the O-ring.

e. If desired, apply O-ring lubricant to the O-ring surfaces sparingly.

f. Place the Oxide Vessel lid onto the Oxide Vessel flange. Insert a bolt in each hole provided and tighten each bolt to a torque of 75 +5 –0 ft-lbs using an alternating pattern.

g. Perform leakage rate testing to confirm that the containment system is properly assembly for shipment and demonstrating no detected leakage when tested to a sensitivity of at least 1E-3 ref-cc/sec per ANSI N14.5-1997.

   1. Each Oxide Vessel is leakage tested using the test port provided on the lid of the Oxide Vessel (see Appendix 1.3.1, Drawing OPTU-V-AB1 Sheet 1 Section A-A).

   2. All tests are performed by trained and qualified personnel in accordance with written procedures and the results are documented with the shipping papers, as required by ANSI N14.5-1997, Section 8.5.

   3. The sensitivity of the detector used shall be $1.0 \times 10^{-3}$ ref-cc/sec or better as required by ANSI N14.5-1997, Section 8.6. The test used shall be demonstrated as having a minimum sensitivity of $1.0 \times 10^{-3}$ ref-cc/sec prior to use.

   4. Appendix 7.6.1 provides detailed specifications for performing leakage tests consistent with the requirements of ANSI N14.5-1997 and this SAR. These

specifications are provided for reference only, as they are specific to the equipment and instrumentation in use. The User should utilize the provided specifications as guidelines for development of in-house procedures based upon the required leakage test sensitivity and the equipment and instrumentation to be used.

h. Following leakage testing, visually inspect the Test Port Plug for stripping, cracking and corrosion. The O-ring should in place, intact and in serviceable condition. If the Test Port Plug is found to be defective, the Test Port Plug must be replaced. Install the Test Port Plug and tighten it to a torque of 60 +10 –0 in-lb.

i. Lift the closed Oxide Vessels and insert the Oxide Vessels into the Transport Unit sleeves.

j. Place the Outer Lid into the sleeve and place a bolt in each bolt hole provided. Tighten each bolt to a torque of 75 +5 –0 ft-lbs, using an alternating pattern. Install a security seal at the two locations provided on the Outer Lid. Bind the two Outer Lid handles together with a nylon tie to render them inoperable.

k. Verify that the gross weight of the loaded package does not exceed 3,757 lb (1,704.1 kg).

l. Complete a contamination and radiation survey in accordance with 10 CFR Part 71.87 (i) and (j).

m. The packaging is required to be unloaded within one year of loading.

## *7.3 Securing the Package to the Conveyance*

The shackles provided at the upper frame of the CHT-OP-TU are used for lifting only and are not used for tie down of the package. Following placement of the CHT-OP-TU on the conveyance, the shackles shall be secured to the angle frame with nylon tie to prevent the shackle from being used as tie down.

### 7.3.1 ISO Containers

CHT-OP-TU packages may be close-packed in an ISO Container without the use of the tie downs on the CHT-OP-TU feet. Wooden shoring should be used as necessary between and around the packages to assure they do not shift during transport.

### 7.3.2 Tie Down Using Hold-down Bars

The CHT-OP-TU can be secured for transport using transverse Hold-down bars through the slots provided in the packaging feet. Eight feet are available for use; six are used for tie-down. Each face of the CHT-OP-TU foot is slotted for insertion of a hold-down bar with a 2" wide by 2" high hole (on-center).

Two Hold-down bars are used per package, one at each end of the package, perpendicular to the direction of vehicle travel as shown in Figure 7-1. The 1-¾" x 1-¾" x 50" steel used shall have a yield strength of at least 40,000 psi, and the performance of the Hold-down bar is evaluated in Section 2.

The hold-down bar is secured to the conveyance at four locations per bar, as shown in Figure 7-1: on either side of the package, and at the midpoint location between each engaged foot. The hardware used to secure the Hold-down bar must restrain the bar from vertical movement, but the bar should not be clamped or welded to the hardware. Each set of hardware securing the bar to the conveyance must be capable of supporting a load of 15,000 lb. This hardware and its interface with the conveyance shall be evaluated by the User for the conditions and criteria specified in Section 2.

a. Inspect the Hold-down bars for cracks, corrosion and wear. If these conditions are found, the Hold-down bars should not be used. Inspect the hardware used to secure the Hold-down bar to the conveyance for cracks, corrosion and wear. If these conditions are found, the hardware should not be used.

b. Insert the Hold-down bars through the securing hardware and CHT-OP-TU feet as shown in Figure 7-1.

c. Secure the ends of the Hold-down bars.

### 7.3.3 Tie Down Using Strapping (Straps, Chain or Cable)

The CHT-OP-TU can be secured for transport using steel strapping through the slots provided in the packaging feet. Eight feet are available for use; six are used for tie-down. Each face of the CHT-OP-TU foot is slotted for insertion of the strapping with a 2" wide by 2" high hole (on-center).

A minimum of two straps are used per package, one at each end of the package, perpendicular to the direction of vehicle travel as shown in Figure 7-2. Each strap used shall have a minimum working load limit of 21,630 $lb_f$. If necessary, multiple straps may be used in parallel to achieve the required load capability. For example, if the cable being used has a working load limit of 6,000 lb, four cables must be secured through the same three legs of the package to achieve the minimum required load capacity. The performance of the strapping is evaluated in Section 2.

The fastenings used to secure the straps to the conveyance must be capable of supporting at least 21,630 $lb_f$ without yielding. This hardware and its interface with the conveyance shall be evaluated by the User for the conditions and criteria specified in Section 2.

a. Inspect the strapping for cracks, corrosion and wear. If these conditions are found, the strapping should not be used. Inspect the hardware used to secure the strapping to the conveyance for cracks, corrosion and wear. If these conditions are found, the hardware should not be used.

b. Insert the strapping through the CHT-OP-TU feet as shown in Figure 7-2.

c. Secure the ends of the strapping.

### 7.3.4 Tie Down Using Other Methods

The feet of the CHT-OP-TU have been evaluated for tie down using the methods described in Section 7.3.1, 7.3.2, and 7.3.3. Other methods must be evaluated for conformance with the applicable regulations and the results documented by the User.

## *7.4 Unloading Procedures*

a. Verify that the tamper-indicating seals are intact prior to removing the Outer Lid.

b. Loosen the Outer Lid bolts and remove the Outer Lid.

c. Remove the Oxide Vessels from the Transport Unit sleeves.

d. Unload the payload from the Oxide Vessels.

## *7.5 Preparation of Empty Packaging for Transport*

Preparation of an empty CHT-OP-TU for shipment:

a. If any residual payload remains in the Oxide Vessels, confirm that the shipment meets the regulatory definition of "empty."

b. The Transport Unit sleeves shall be free of debris and standing water. Confirm that the gaskets at the bottom and flange of the Transport Unit sleeves are in place.

c. Confirm that the Outer Lid gaskets and the Outer Lid flange gaskets are in place.

d. Examine the Oxide Vessel flange to be sure that no residual payload or other debris is present on the flange. Place the Oxide Vessel Lid on the Oxide Vessel flange. Insert a bolt in each hole provided and tighten each bolt to a torque of 75 +5 –0 ft-lbs using an alternating pattern. Repeat until all Oxide Vessel lids are installed.

e. Lift the closed Oxide Vessel and insert it into the Transport Unit sleeve.

f. Place an Outer Lid into the sleeve and place a bolt in each bolt hole provided. Tighten each bolt to a torque of 75 +5 –0 ft-lbs, using an alternating pattern. Install a security seal at the two locations provided on the Outer Lid.

g. Repeat steps 7.5e and 7.5f until all of the Oxide Vessels are secured into the Transport Unit.

h. Complete contamination survey in accordance with 10 CFR 71.87 (i) and (j).

i. Label the Transport Unit "Empty."

## 7.6 *List of Appendices*

### 7.6.1 Leak Testing Specifications

7.6.1-A Leak Test Specification CHT-LT-001
7.6.1-B Leak Test Specification CHT-LT-003

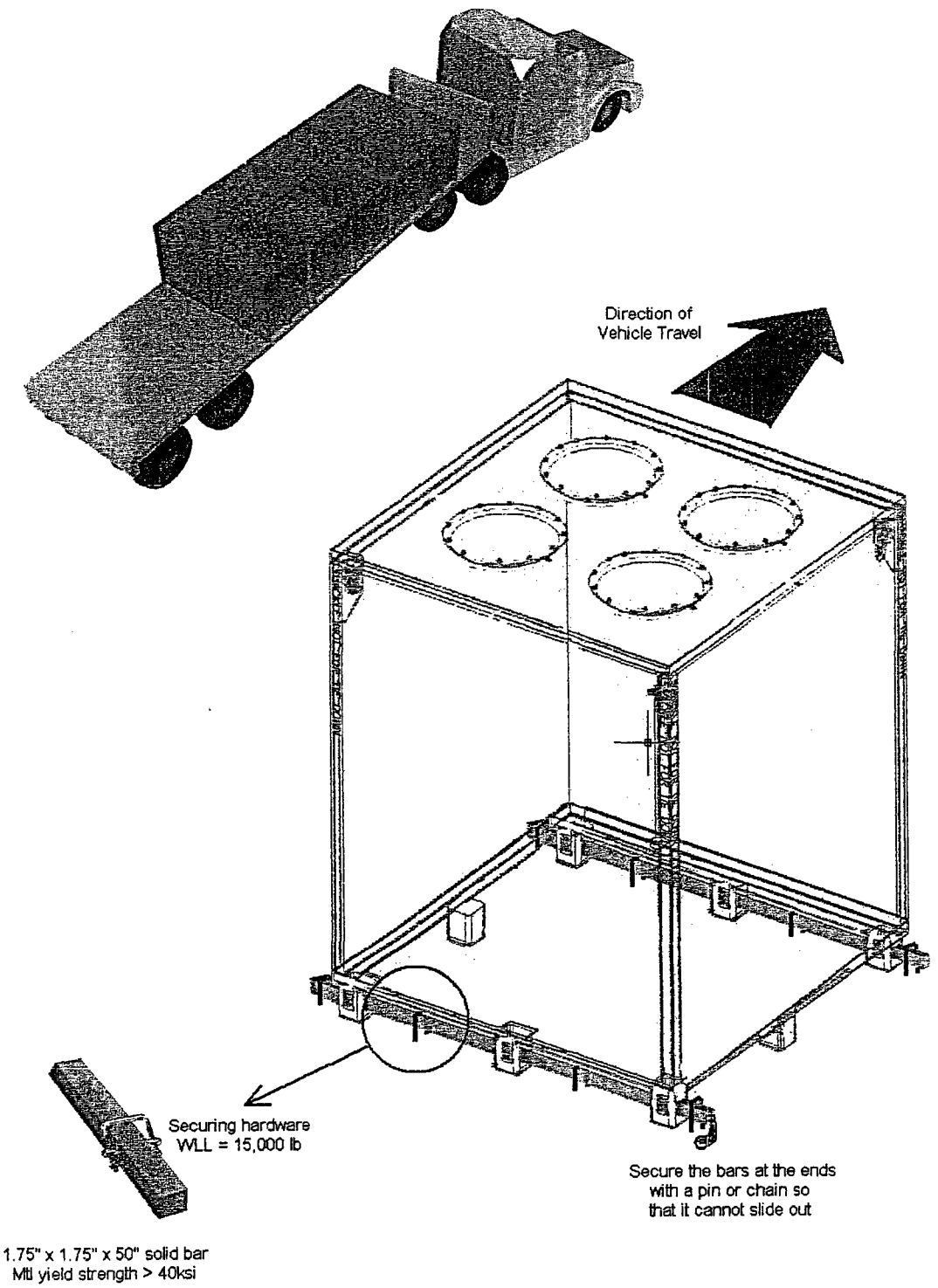


**Figure 7-1 Minimum Tie Down Requirement Using Hold-down Bars**

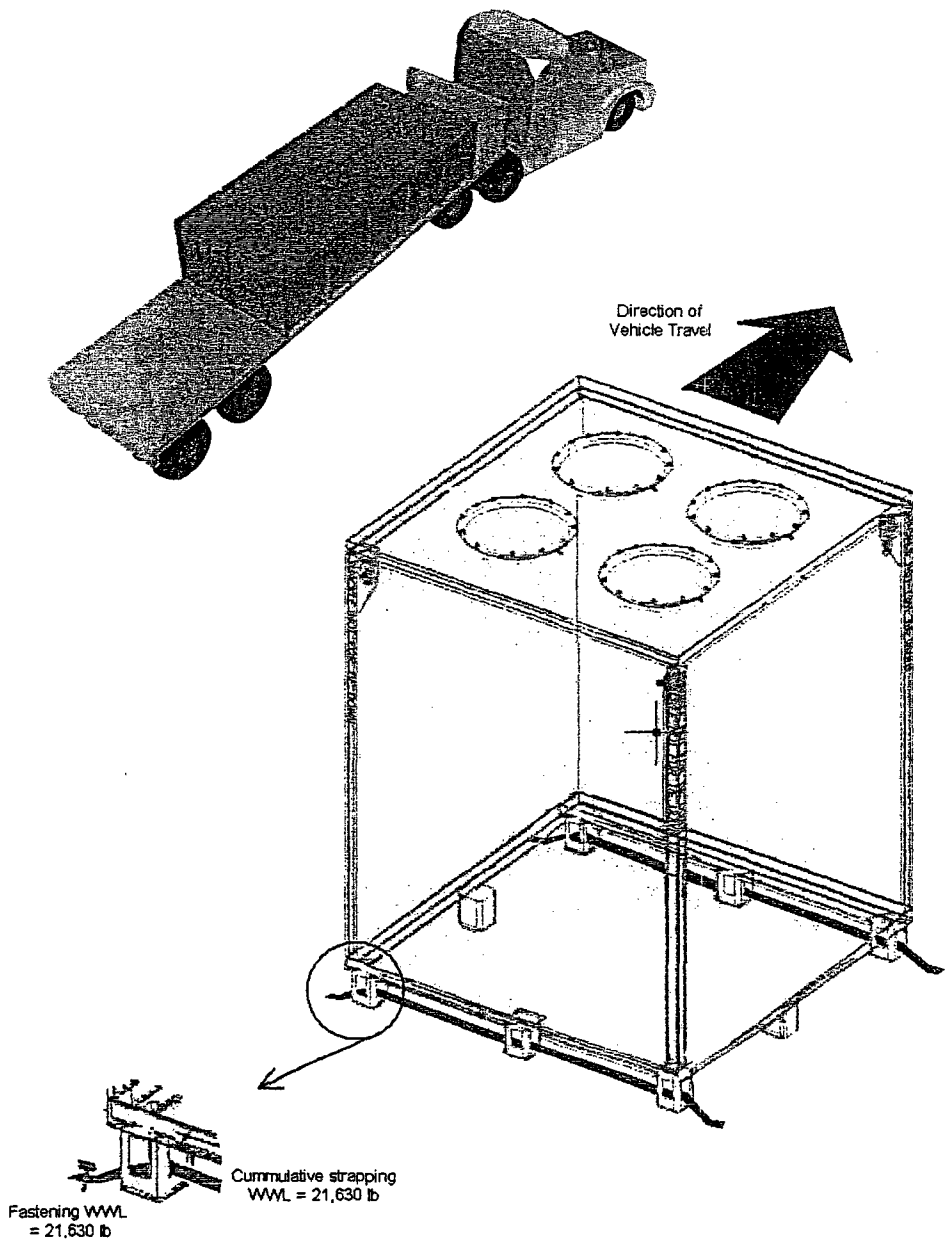


**Figure 7-2 Minimum Tie Down Requirement Using Strapping**

# Appendix 7.6.1

## Leak Testing Specifications
## (3 pages)

TABLE OF CONTENTS

**8 ACCEPTANCE AND MAINTENANCE PROGRAMS ..... 8-1**
8.1 ACCEPTANCE TESTS ..... 8-1
*8.1.1 Visual Inspections of the Transport Unit ..... 8-1*
*8.1.2 Visual Inspections of the Oxide Vessels ..... 8-1*
*8.1.3 Visual Inspections of the Pellet Carrier ..... 8-2*
*8.1.4 Leakage Tests For Type B Level I and Level II Oxide Vessels ..... 8-2*
*8.1.5 Component Tests ..... 8-3*
8.2 MAINTENANCE PROGRAMS ..... 8-3
*8.2.1 Maintenance Programs for the Transport Unit ..... 8-3*
*8.2.2 Maintenance Programs for the Oxide Vessel ..... 8-4*
*8.2.3 Maintenance Programs for the Pellet Carrier ..... 8-5*
8.3 LIST OF APPENDICES ..... 8-6
*8.3.1 Leak Testing Specifications ..... 8-7*
*8.3.1-A Leak Test Specification CHT-LT-002 ..... 8.3.1-2*
*8.3.1-B Leak Test Specification CHT-LT-003 ..... 8.3.1-3*
*8.3.1-C Leak Test Specification CHT-LT-001 ..... 8.3.1-4*

- Closure bolts, including grade and condition.
- Required permanent marking.

### 8.1.3 Visual Inspections of the Pellet Carrier

a. The as-built dimensions of the following components shall be within the tolerances prescribed by the fabrication drawings

- Upper and lower assembly wall thicknesses and length.
- Metal volume of carrier.
- Final assembled weight.

b. Installation of the following components shall be verified and documented

- Required markings.

### 8.1.4 Leakage Tests For Type B Level I and Level II Oxide Vessels

PLEASE NOTE: When the Oxide Vessel is engraved for Type A usage only, there is no leakage test requirement.

a. Prior to first use, leakage rate testing of the Oxide Vessel seals shall be performed per the requirements of Section 4 of this SARP demonstrating a leakage rate less than $1.0 \times 10^{-5}$ ref-cc/sec using the guidelines provided in ANSI N14.5-1997.

b. Each Oxide Vessel is leakage tested using the test port provided on the lid of the Oxide Vessel (see Appendix 1.3.1, Drawing OPTU-V-AB1 Sheet 1 Section A-A).

c. All tests are performed by trained and qualified personnel in accordance with written procedures and the results are documented with the fabrication record. As required by ANSI N14.5-1997, Section 8.5.

d. The sensitivity of the detector used shall be $5.0 \times 10^{-6}$ ref-cc/sec or better as required by ANSI N14.5-1997, Section 8.6.

e. The test used shall be demonstrated as having a minimum sensitivity of $5.0 \times 10^{-6}$ ref-cc/sec prior to use.

f. Appendix 8.3.1 provides detailed specifications for performing leakage tests consistent with the requirements of ANSI N14.5-1997 and this SAR. These specifications are provided for reference only, as they are specific to the equipment and instrumentation in use. The User should utilize the provided specifications as guidelines for development of in-house procedures based upon the required leakage test sensitivity and the equipment and instrumentation to be used.

g. Each Oxide Vessel shall be hydrostatically tested (excluding the lid and seals) to 52 psig for ten (10) minutes with no leaks detected.

### 8.1.5 Component Tests

Prior to acceptance for use, each Oxide Vessel and Transport Unit shall be subjected to the following tests using the acceptance criteria of ASME NF-5360, 5342, and 5352:

a. The full length of all Oxide Vessel external welds shall be inspected using Visual or Liquid Penetrant methods per Drawing Number OPTU-V-AB1 (Appendix 1.3.1). No surface indications are permitted, no undercut is allowed.

b. The full length of the Lifting Shackle welds on the Transport Unit shall be inspected using Visual, Liquid Penetrant and/or Magnetic Particle methods. No surface indications are permitted, no undersize welds are allowed and no undercut is allowed.

c. The full length of the welds between the Transport Unit bottom plate and the Transport Unit feet shall be inspected using Visual, Liquid Penetrant and/or Magnetic Particle methods. No undersize welds are allowed and no undercut is allowed.

## *8.2 Maintenance Programs*

The user shall establish written procedures for the annual maintenance and inspection of each CHT-OP-TU requiring the following as a minimum. All welding repairs shall be performed by welders qualified in accordance with Section IX of the ANSI/ASME Boiler and Pressure Vessel Code or AWS D1.1 and to the requirements of the NRC Certificate of Compliance.

### 8.2.1 Maintenance Programs for the Transport Unit

a. Remove each Outer Lid and set aside for inspection.

b. Remove each Oxide Vessel from the Transport Unit and set aside for inspection per Section 8.2.2.

c. Visually inspect the Transport Unit sleeves for radioactive contamination and debris. If radioactive contamination is present, decontaminate. Remove any solid debris. If standing water is present, it must be removed.

d. Visually inspect the Transport Unit exterior for visible flaws. Visually inspect all accessible welds for cracks or corrosion. The exterior welds should be free of cracks, and the exterior surface should not be torn or substantially crushed (more than 2 inches of crush depth). If the exterior surface is torn or substantially crushed or cracks are discovered, the unit should be repaired and re-certified for use. The User may remove light surface corrosion by polishing as required. If the corrosion is not easily removed, or if pitting or scaling is observed, the unit should be repaired and re-certified for use.

e. Visually inspect the Outer Lid for corrosion or damage to the bolt holes. Visually inspect the Outer Lid bolts for stripping, cracking and corrosion. If any are found to be defective, replace them with an equivalent bolt.

f. Visually inspect the lifting shackles to assure they are sound and free from weld cracks, damage and deterioration.

g. Visually inspect the welds between the Transport Unit bottom plate and the Transport Unit feet to assure they are free from cracks, damage or deterioration.

h. Visually inspect the Transport Unit feet to assure that they are not damaged.

i. Check that the gaskets and support pads are present and in serviceable condition. If the gaskets show signs of brittle cracking, or any tears are present in the material, or permanent set has occurred, replace the gasket or pad.

j. Assure that security seal holes are functional and capable of maintaining their integrity when seals are used.

### 8.2.2 Maintenance Programs for the Oxide Vessel

a. Remove the Oxide Vessel Lid.

b. Visually inspect the Oxide Vessel outer surfaces for visible flaws. Visually inspect all accessible welds for cracks or corrosion. The welds should be free of defects. If the exterior surface is substantially dented (more than 1") or cracks are discovered, the vessel shall be repaired by the Owner and re-certified for use. Note that all repairs shall be consistent with the engineering drawings (Appendix 1.3.1) and shall include the required weld inspections. The User may remove light surface corrosion by polishing as required. Oxide Vessels having corrosion that results in a reduction in the wall thickness of more than 10% of the original

specification shall be discarded.

c. Visually inspect the Oxide Vessel flange for corrosion or damage to the bolt holes. Check the flange sealing surface finish and polish as necessary to restore the required 32rms (minimum) finish.

d. Visually inspect the Oxide Vessel bolts for stripping, cracking and corrosion. If any are found to be defective, replace them with an equivalent bolt. Visually inspect the Test Port Plug for stripping, cracking and corrosion. The Test Port Plug O-ring should in place, intact and in serviceable condition. If the Test Port Plug is found to be defective, the Test Port Plug must be replaced.

e. Visually inspect the Oxide Vessel lid for corrosion or damage to the bolt holes. Check the lid sealing surface finish and polish as necessary to restore the required 32rms finish.

f. Check that the hoist ring is sound and free from cracks, damage and deterioration.

g. For Type B Oxide Vessels, the Oxide Vessel shall be leakage tested annually demonstrating a leakage rate less than the maximum allowable leakage rate specified for the material being shipped. The method used to test the seals shall have a sensitivity of at least one-half of the maximum allowable leakage rate.

1. The Oxide Vessel shall be assembled for testing as described in Section 7.2.3d, e and f. Note that if O-ring lubricant is not normally used for shipments, it should not be used for these maintenance tests.
2. Appendix 8.3.1 provides detailed specifications for performing leakage tests consistent with the requirements of ANSI N14.5-1997 and this SAR. These specifications are provided for reference only, as they are specific to the equipment and instrumentation in use. The User should utilize the provided specifications as guidelines for development of in-house procedures based upon the required leakage test sensitivity and the equipment and instrumentation to be used.
3. If the leak test results are unacceptable, remove the lid and inspect the sealing surface and O-rings. Clean the sealing surface and replace the O-ring as required. Install the lid, tightening all studs/bolts the proper torque of 75 ft-lb [+5 –0] using an alternating pattern. Re-test as per above.

### 8.2.3 Maintenance Programs for the Pellet Carrier

a. Remove the Pellet Carrier from the Oxide Vessel.

b. Visually inspect the Pellet Carrier surfaces for visible flaws. If the exterior surface is substantially dented (more than 1") or cracks are discovered, the carrier shall be repaired

by the Owner and re-certified for use. Note that all repairs shall be consistent with the engineering drawings (Appendix 1.3.1).

## *8.3 List of Appendices*

### 8.3.1 Leak Testing Specifications

8.3.1-A Leak Test Specification CHT-LT-002
8.3.1-B Leak Test Specification CHT-LT-003
8.3.1-C Leak Test Specification CHT-LT-001

# Appendix 8.3.1

## Leak Testing Specifications
## (3 pages)