71-9288

COLUMBIANA HI TECH LLC

Nuclear Manufacturing Excellence

February 27, 2006

Bill Brach, Director
Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
United States Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

cc. Director, Document Control Desk, SFPO (without attachments)

Re: RAI dated 12/22/05 for Revision 7 of the CHT-OP-TU, Certificate of Compliance No. 9288 / Docket Number 71-9288 and TAC Number L23884.

Dear Mr. Brach,

On August 5, 2005, Columbiana Hi Tech, LLC (CHT) requested an amendment to the Certificate of Compliance (No. 9288) for the Model No. CHT-OP-TU Transport Unit Package to include the designation "-96" in the identification number, as specified in 10 CFR 71.19(e). NRC requested additional information regarding CHT's application, and this submittal provides CHT's response to the RAI.

Attached please find one copy of the consolidated safety analysis report (SAR), revision 7 as supplemented, for the Columbiana Hi Tech (CHT) CHT-OP-TU Packaging Safety Analysis Report (SAR). The consolidated SAR includes the complete Revision 7 text, drawings and supplements, as requested by NRC.

In addition to the consolidated SAR, Attachment B is provided to itemize CHT's response to each RAI question. Attachment C is provided to summarize all of the changes to the SAR from Revision 6 to Revision 7 as supplemented.

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

Sincerely,

FOR D.W. OLSON

D.W. Olson
President – Columbiana Hi Tech, LLC
Enclosures:
Attachment A: Consolidated Safety Analysis Report for the Model No CHT-OP-TU, Revision 7
Attachment B: Itemized RAI Response
Attachment C: Explanation of Changes to the CHT-OP-TU SAR, Revision 6 to Revision 7 as Supplemented

NMSS01

Attachment A
Consolidated Safety Analysis Report for the
Model No. CHT-OP-TU Transport Unit, Revision 7 as supplemented
(1 copy)

Attachment B
Itemized RAI Response

Question 1-1: Provide a consolidated application. Ensure the consolidated application includes all the pertinent information referenced in the certificate as well as legible drawings.

Response: CHT has provided a consolidated SAR that includes all text, drawings and supplements referenced in the application.

Question 1-2: Clearly show that the package meets the current regulation requirements that became effective on October 1, 2004 (69 FR 3698).

Response: Each requirement for "-96" status is detailed in the following paragraphs with respect to the CHT-OP-TU package.

Issue 1, Changing Part 71 to the International Systems of Units (SI) Only. This proposal was not adopted in the final rule, and therefore no changes are needed in the package application or the Certificate of Compliance to conform to the new rule.

Issue 2, Radionuclide Exemption Values. The final rule adopted radionuclide activity concentration values and consignments activity limits in TS-R-1 for the exemption from regulatory requirements for the shipment or carriage of certain radioactive low-level materials. In addition, the final rule adopted an exemption from regulatory requirements for certain natural material and ores containing naturally occurring radionuclides. This rule is not applicable to the CHT-OP-TU package; thus, no changes are needed to conform to the new rule.

Issue 3, Revision of A_1 and A_2. The final rule adopted changes in the A_1 and A_2 values from TS-R-1, with the exception of two radionuclides. The CHT-OP-TU's updated containment analysis (Section 4 of the application)
incorporates the revised A_2 values, which are for radioactive material in normal form. In general, the A_2 values for radionuclides important to the containment requirements were increased. The increased A_2 values increased the maximum allowable leakage rates calculated for the oxides authorized for transport, as shown in the revised Table 4-2 of the application. The leakage rate testing requirements for the package were revised based on the calculated maximum allowable leakage rates, Table A-1, of the revised 10 CFR Part 71.

Issue 4, Uranium Hexafluoride (UF_6) Package Requirements. These changes are not applicable, since the package is not authorized for the transport of uranium hexafluoride. Therefore, no changes are needed to conform to the new rule.

Issue 5, Criticality Safety Index (CSI). The final rule adopted the CSI requirement from TS-R-1. Revision 7 of the SAR includes revisions in Sections 1 and 6 of the package application to incorporate the CSI nomenclature.

Issue 6, Type C Packages and Low Dispersible Material. This proposal was not adopted for the final rule. Thus, no changes are necessary.

Issue 7, Deep Immersion Test. The final rule adopted an extension of the previous version of 10 CFR 71.61 from packages for irradiated fuel to any Type B package containing activity greater than $10^5 A_2$. The CHT-OP-TU package is not used to transport irradiated fuel. The CHT-OP-TU is rated as a Type B package; however, the maximum activity (CHT-OP-TU Level II shipment) is 182 A_2, which is much less than the activity for which the rule applies. Thus, no changes are necessary to conform to the new rule.

Issue 8, Grandfathering Previously Approved Packages. The final rule adopted a process for allowing continued use, for specific periods of time,of a previously approved packaging design without demonstrating compliance to the final rule. Since CHT has elected to submit information demonstrating compliance with the final rule, grandfathering the package is not necessary.

Issue 9, Changes to Various Definitions. The final rule adopted several revised and new definitions. These changes were adopted to provide clarity to Part 71. No change is necessary to conform to the new rule.

Issue 10, Crush Test for Fissile Material Packages. The revised 10 CFR 71.73 expanded the applicability of the crush test to fissile material packages. The crush test is required for packages with a mass not greater than 500 kilograms (1100 pounds). Since the CHT-OP-TU package has a mass greater than this, the crush test is not applicable. Therefore the requirement to perform a crush test is not applicable to the package, and no change is necessary to conform to the new rule.

Issue 11, Fissile Material Package Design for Transport by Aircraft. The final rule adopted a new section, Section 71.55(f), which addresses packaging design requirements for packages transporting fissile material by air. This requirement is not applicable to the CHT-OP-TU package.

Issue 12, Special Package Authorizations. The final rule adopted provisions for special package authorization that will apply only in limited circumstances and only to one-time shipments of large components. This provision is not applicable to the CHT-OP-TU package. Thus, no change is necessary to conform to the new rule.

Issue 13, Expansion of Part 71 Quality Assurance (QA) Requirements to Certificate Holders. The final rule expanded the scope of Part 71 QA requirements to apply to any person holding or applying for a Certificate of Compliance. QA requirements apply to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging that are important to safety. CHT's QA program satisfies the specific requirements of 10 CFR 71.101(a), (b), and (c) and the safety analysis report states that the package is designed, manufactured and maintained to the requirements of 10 CFR 71.

Issue 14, Adoption of the American Society of Mechanical Engineers (ASME) code. This proposal was not adopted in the final rule. Thus, no change is needed to conform to the new rule.

Issue 15, Change Authority for Dual-Purpose Package Certificate Holders. This proposal was not adopted for the final rule. Thus, no change is necessary to conform to the new rule.

Issue 16, Fissile Material Exemptions and General License Provisions. The final rule adopted various revisions to the fissile material exemptions and the general license provisions in Part 71 to facilitate effective and efficient regulation of the transport of small quantities of fissile material. The criticality safety of the package does not rely on limiting fissile materials to exempt or generally licensed quantities. Chapter 6 of the package application demonstrates criticality safety of the package with the authorized fissile contents. Therefore, no change is necessary to conform to the new rule.

Issue 17, Double Containment of Plutonium. The final rule removed the requirement that packages with plutonium in excess of 0.74 TBq (20 curies) have a second separate inner container. The CHT-OP-TU package is not used to transport quantaties of plutonium in excess of 0.74 TBq; thus, the rule is not applicable to CHT-OP-TU and no change is necessary.

Issue 18, Contamination Limits as Applied to Spent Fuel and High Level Waste Packages. This proposal was not adopted for the final rule. Thus, no change is needed to conform to the new rule.

Issue 19, Modification of Events Reporting Requirements. The final rule adopted modified reporting requirements. While the final rule is applicable to the package, no change is needed to either the Certificate of Compliance or the package application to conform to the new rule.

Question 1-3: Confirm that the leak rate tests for pre-shipment and periodic tests are performed to meet a reference air leakage rate of 10^{-1} ref-cc/sec in accordance with the 1997 Edition of ANSI 14.5.

Response: Section 4 has been modified to require testing to 10^{-1} ref-cc/sec for pre-shipment and periodic tests. This change does not affect Section 7, since the pre-shipment test specified is 1E-3 ref-cc/sec consistent with ANSI 14.5. Section 8 is not changed, since it refers to Section 4 for the required periodic test allowable leakage rate. However, an additional section has been added to the Appendix 8.3.1 to provide an additional test procedure for use during periodic testing. Note that the revision level of the safety analysis report remains at revision 7 and the changes have been labeled with a 7s on the revision bar to note that the changes were made with the supplement submittal.

Question 1-4: Justify the use of (any) carbon steel welding material with a minimum of 70 ksi. Refer to note 10 on Drawing No. OP-TU-SAR (Rev. 11, sheet 2 of 2) and note 3 on Drawing No. OP-TU-A3 (Rev. 11, sheet 1 of 1).

Response: The notes have been revised to include the grades of weld material allowed for use with the 0.15% carbon steel sheet, ER 70S-2, -3 or -6 per ASME SFA 5.18 /AWS A5.18. Additionally, the stainless steel grade "SFA A5.9" has been clarified as "ASME SFA 5.9 / AWS A5.9."

Question 1-5: Clarify the torque and lubrication requirements on the outer lid closure bolts.

Response: The drawing notes have been revised to define the surface condition requirements of the bolts used. Both lubricated and un-lubricated bolts are allowed for use, with the lower torque requirement applying to the lubricated bolts only.

Question 1-6: Referring to the applicants RAI response dated January 6, 2004, Attachment A, page 3 of 12, justify and clarify the meaning of the statement, "the A53 grade B material performs better or the same as the rolled A569 used for the test..." Provide data or arguments to support the position taken.

Response: The intent of our response, "the A53 grade B material performs better or the same as the rolled A569 used for the test..." is intended to convey that the ASTM A53 grade B material is suitable as an alternative to the A569 material, since its material properties are essentially the same as those of the ASTM A569.

ASTM A569 was withdrawn by ASTM in 2000 and was replaced by A1011. According to ASTM, A1011 CS Type B is essentially equivalent to A569. Therefore, the rest of the discussion will focus on a comparison of A1011 CS Type B (currently specified for use in the CHT-OP-TU drawings) with A53 Grade B.

The A53 material is specified for the Transport Unit Sleeve Assembly only. The function of the sleeve assembly is to provide a durable envelope to contain the rigid insulation installed in the overpack and to support the Oxide Vessels during impact. Thus, the impact properties of the steel are important, including ductility, yield strength, and the nil-ductility temperature.

Table B-1 provides a comparison of the chemical composition for the two materials.

Table B-1 Comparison of Chemical Composition

Element	Composition, %, Elemental maximum unless otherwise shown	
	ASTM A1011 CS Type B	ASTM A53 Grade B
C	0.02 – 0.15	0.30
Mn	0.60	1.20
P	0.030	0.050
S	0.035	0.045
Al	---	---
Si	---	---
Cu	0.20	0.40
Ni	0.20	0.40
Cr	0.15	0.40
Mo	0.06	0.15
V	0.008	0.08
Cb	0.008	---
Ti	0.025	---
N	---	---

From Table B-1, the carbon, manganese, phosphorus, sulfur, copper, nickel, chromium, molybdenum and vanadium content of the ASTM A53 is higher than that of the ASTM A1011. With regards to chemical composition, Biggs[a] reports that large changes in the nil-ductility temperature of mild steel are directly linked to the amount of carbon and manganese present in the steel. Both Biggs and INI[b] state that the Mn/C

[a] Biggs, W.D. *The Brittle Fracture of Steel*, Pitman Publishing, New York, 1960.
[b] INI International, *The Key to Steel*, 1265 Research Boulevard, St. Louis, MO, USA, www.key-to-steel.com.

ratio should be at least 3/1 for satisfactory notch toughness. As shown in Table B-1, the Mn/C ratio for both alloys is 4. Figures B-1 and B-2 illustrate the effect of carbon and manganese, respectively, on the nil-ductility temperature.

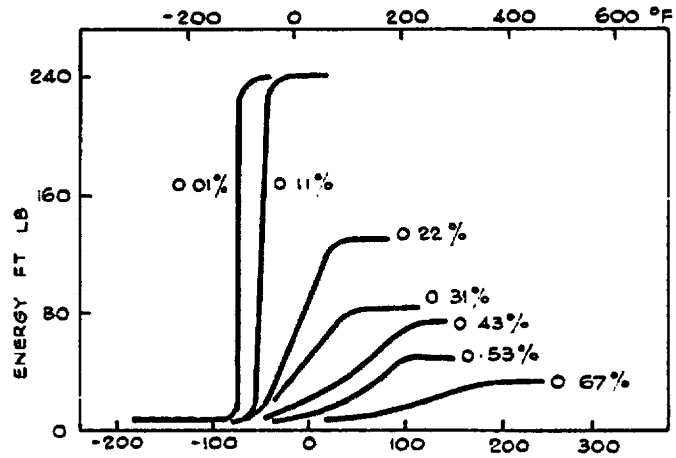

Fig. 202.—Effect of carbon on shape of transition curve of a series of steels containing 1% Mn, 0.3% Si

Figure B-1 Effect of Carbon Content on Nil-Ductility Temperature [a]

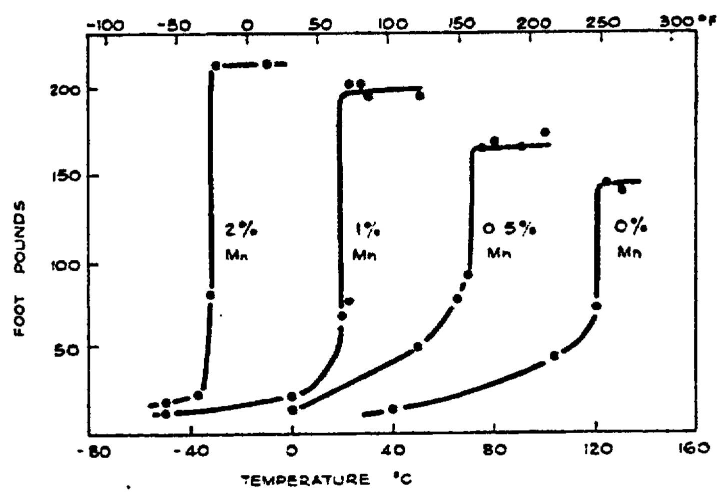

Fig. 203.—Effect of manganese on transition of Fe–Mn alloys containing 0·05 % C.

Figure B-2 Effect of Manganese Content on Nil-Ductility Temperature [a]

Going from 0.02% to 0.30 % carbon is shown in Figure B-1 to raise the transition temperature approximately 70°F. However, the addition of the manganese from 0.60 to 1.20% decreases the transition temperature by approximately 50°F. Phosphorus also has approximately the same effect in raising the transition temperature as carbon; however, the change is small from 0.03 and 0.05% and can be neglected. The effects of the remaining compositional differences is also negligible, as illustrated by Figures B-3 through B-5.

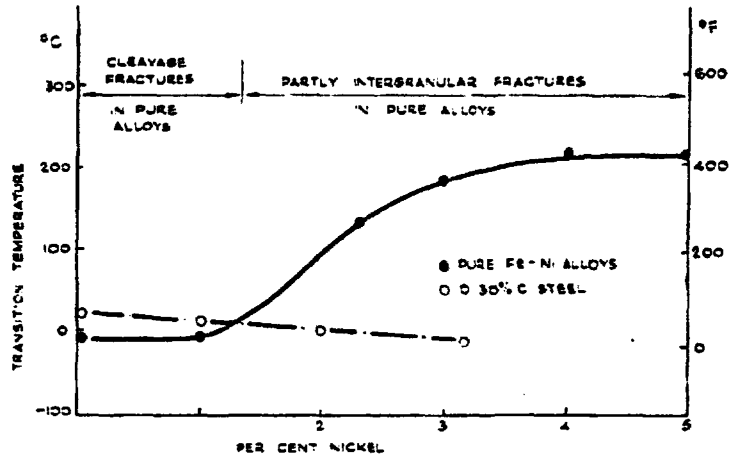

Fig 204.- Effect of nickel on average energy transition of pure Fe-Ni alloys and 0 3% C steels.[7, 22]

Figure B-3 Effect of Nickel on Nil-Ductility Temperature [a]

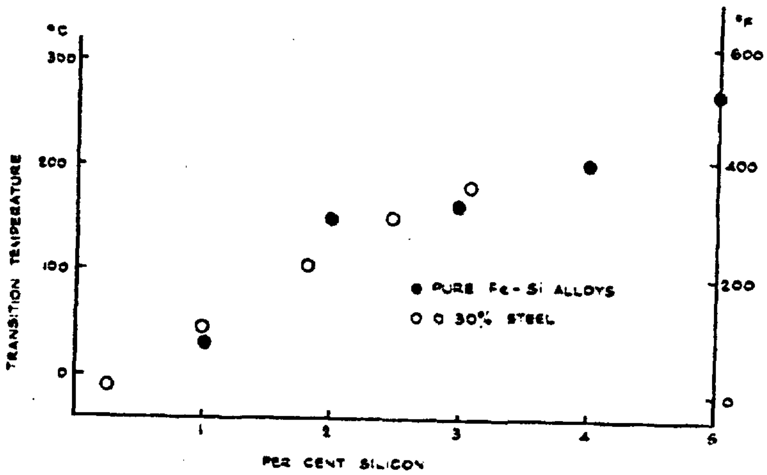

Fig. 205 —Effect of silicon on the average energy transition of pure Fe-Si alloys and 0 3% C steel.[7, 22]

Figure B-4 Effect of Silicon on Nil-Ductility Temperature [a]

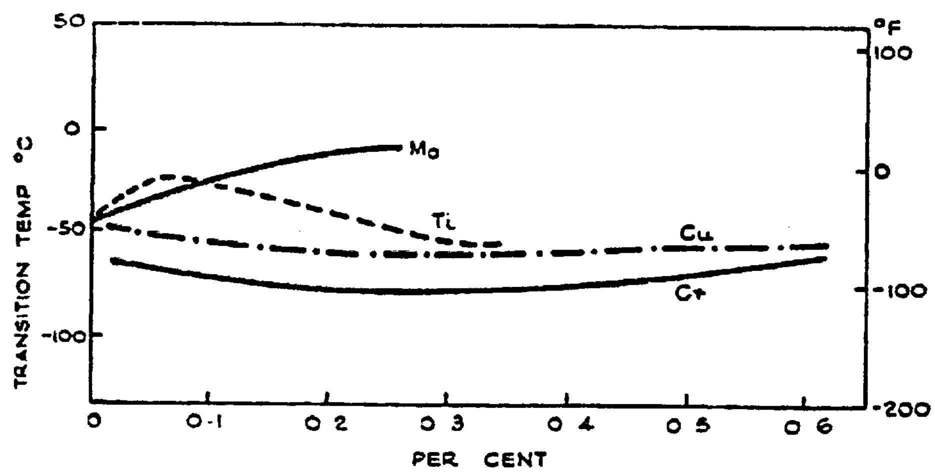

Fig. 206.—Effect of miscellaneous alloying elements on 15 ft lb transition of a 0·3% C steel.[7]

Figure B-5 Effect of Miscellaneous Alloying Elements on Nil-Ductility Temperature [a]

Based on this qualitative comparison of the effects on the particular elements on the nil-ductility temperature, it appears that the net effect is that the two materials have approximately equivalent nil-ductility temperatures, within 20°F of each other and occurring somewhere above 20°F. The HAC test series of the container was completed at a package temperature of -20°F; thus, both of these alloys would have been below the nil-ductility temperature. Therefore, the package has been demonstrated to perform adequately under brittle fracture conditions.

Further, the previous submittal provided information from the ASME Code regarding the allowable service temperature of the ASTM A53 Grade B material, demonstrating that this material has a lower service temperature allowable than the A1011. This information supports the conclusion reached in the previous submittal that the performance of the two materials with respect nil-ductility behavior is equivalent.

Table B-2 provides a comparison of the mechanical requirements for the two materials.

Table B-2 Tensile Requirements

	Tensile Strength, min. psi	Yield Strength, min. psi	Elongation in 2 in.
ASTM A1011 CS Type B	----	30,000 to 50,000 non-mandatory	≥25 non-mandatory
ASTM A53 Grade B	48,000	30,000	≈36

It is notable that the mechanical requirements for the A1011 are non-mandatory. The A53 has the same minimum yield strength as the A1011; however, the elongation of the A53 is much higher (about 44%), indicating a more ductile material. During impacts, a higher-ductility material can absorb a much larger quantity of energy before fracture. Thus, the A53 grade B material should perform as well as the A1011 with respect to energy absorption during impact.

Based on these comparisons, the ASTM A53 Grade B material provides equivalent performance to the ASTM A1011 CS Type B, and thus also provides equivalent performance to the ASTM A569 material used in the original performance test series.

Question 1-7: Justify the conclusion in Section 1.2.3.1(e) and 7.2.3(b) that hydrogen generated from a payload with less than 0.068W/m^3 generates less hydrogen then required to form a flammable mixture. Why is this value different from the value used in RAI response dated January 6, 2004, Attachment A, page 5 of 12, which uses 0.011 W/m^3?

Response: The rate of gas generation as a product of ionizing radiation is directly related to the type of radiation (alpha, beta, gamma and/or neutron), the energy emitted from the radioactive decay, and the fraction of emitted energy absorbed by the material being irradiated (the plastic).

The maximum $G(H_2)$ value for polyethylene is 4.0 molecules H_2/100 eV [c] and is the highest listed for polymers at room temperature. However, the predominant radiation type for the isotopes allowed for shipment is alpha radiation having an energy of approximately 4.5 MeV [d]. The payload is

[c] *NUREG/CR-6673, Hydrogen Generation in TRU Waste Transportation Packages*, May 2000, Table 3.1.
[d] NUREG/CR-1413, *A Radionuclide Decay Data Base – Index and Summary Tables*, ORNL Union Carbide.

placed in the plastic container within the Oxide Vessel; therefore, only the outer surface of the payload is near the plastic material. Also, because the range of an alpha particle in UO_2 powder is less than 0.002 cm [e], only the decay energy of the outermost layer contributes to radiolysis of the material.

The decay heat limit for the payload is given as 0.068W/m^3, based on the A_2 value of ^{234}U and assuming homogenous heat generation throughout the payload. This value is different from the value used in the previous submittal because it is based on the A_2 value for ^{234}U which was changed when the regulations were last modified.

Assuming a layer of 0.002 cm at the exterior surface of the UO_2 payload contributes to radiolysis of the plastic material, the decay heat available is approximately:

$$(0.068\ W/m^3)[(20.828\ cm)^2 - (20.824\ cm)^2]\pi\,(102.87\ cm)/4$$
$$= 9.153\text{E-}07 \text{ W per Oxide Vessel or } \underline{3.66\text{E-}06 \text{ W per package}}$$

Thus, the hydrogen generated in the package is:

$$(3.66\text{E-}06\ W)(4.0\ molecules\ H_2/100\ eV)(6.242E18\ eV/sec)/6.023E23\ molecules/mole)$$
$$= 1.52\text{E-}12 \text{ moles } H_2/\text{sec}$$
$$= \underline{1.18\text{E-}03 \text{ L } H_2/\text{year},}$$

based on 24.6 L H_2 per mole. The amount of energy that could be released by one year's accumulation of hydrogen is about 0.013 BTU.[f] Thus, the volume of H_2 gas generated per year is so small that even should an ignition occur, any resulting detonation would have a negligible impact on the Oxide Vessel. Note that Section 7 requires the package to be unloaded within 1 year.

Question 1-8: Justify the durability of the O-rings specified on Drawing No. OP TU-V-AB1, Rev. 7 sheet 1 of 2. Compare service radiation expected in this service with lifetime acceptable limits for the material.

Response: The Parker O-Ring Handbook[g] states that an elastomer's resistance to compression set can become severely affected at a dose of 1 x 10^7 rads, with over 85% set occurring in all elastomers tested at a dose of 1 x 10^8 rads. The handbook also reports that at 1 x 10^6 rads and below, only minor effects were observed for all elastomers tested. Section 5 of the CHT-OP-TU SAR reports a maximum expected dose rate of 141 mR/hr at the surface of a filled Oxide Vessel, which equates to a maximum absorbed dose of 1,236 rad per year. The time to reach a dose of 1 x 10^6

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[e] Estimated per *Reference Material for CH-TRAMPAC, Rev. 0,* August 1998, pp.5.3-17.
[f] Based on a heat of combustion of 62,000 BTU/lb.
[g] *The Parker O-Ring Handbook,* Parker Hannifin Corporation, Cleveland, OH, 1999, pp. 3-14.

rads is much greater than the design lifetime of the package (20 years); therefore, the O-rings should remain durable with respect to the expected radiation exposure over the entire lifetime of the package.

ATTACHMENT C – Explanation of Changes

Changed page	Revision level	Explanation of changes made
Title Page	7	This page was modified to reflect the current company name, SAR revision level, and date.
v	7s	This page of the main table of contents was updated.
1-1	7	This page was modified to reflect the current company name, SAR revision level, and date. The term "transport index" was revised to "criticality safety index" consistent with current regulations.
1-3	7	The heat generation threshold for the package was recalculated based on the current regulations revised A2 values.
Appendix 1.3.1 Drawing OP-TU-SAR Rev. 10	7	Added views of optional weep hole configurations (option A and option B) on the Transport Unit upper angles, item ab. Also added locations of the weep holes on the Top view and External Elevation. Water accumulation has been observed on the existing packages and the weep holes have been added to the design to eliminate it. On the bill of materials, all specifications requiring 1011 CS Type B have been modified to add "or equivalent." The original steel specification for the package was A569, which ASTM subsequently replaced with A1011. Both of these are standard 0.15 maximum percent carbon steel specifications with non-mandatory strength and elongation ranges. However, the ASTM A1011 sheet is not commonly stocked by vendors and is therefore difficult and expensive to obtain. Several other grades of steel are equivalent in strength and elongation and CHT requests that any 0.15% (max) carbon steel sheet having an equivalent strength and ductility range be allowed for use. Since the nil ductility temperature of the A569 and A1011 grades are well above 0°F and the package was tested at low temperature, variations in nil ductility temperatures of equivalent sheet steels should not impact the performance of the package. The specification for Item bb, the outer lid hex bolts, has been modified to allow equivalent grades of bolts to be used, or any bolt having the required minimum tensile strength and Rockwell C hardness (stainless version only). Note 7 has been modified to allow a lower outer lid bolt closure torque of 55 ft-lb. The original bolt torque of 75 ft-lb was specified based on bolts that were un-lubricated and new. In practice, lubricated bolts are used and the bolts remain serviceable through many shipments. Due to polishing of the threads during use and the addition of lubrication, a lower torque is required to attain the appropriate bolt preload. Note 12 has been added to ensure the weep holes do not become blocked by weld material during later fabrication steps.

Changed page	Revision level	Explanation of changes made
Appendix 1.3.1 Drawing OP-TU-SAR Rev. 11	7s	Note 10 has been revised to provide specific grades of weld material allowed for use with the carbon steel sheet used. Additionally, the note has been revised to clarify the grades of weld material allowed for use with the stainless sheet. Note 7 has been modified to reflect the requirements for both lubricated and un-lubricated bolts.
Appendix 1.3.1 Drawing OP-TU-SAR Rev. 12	7s	Note 10 was corrected to show proper SFA designation of weld wire.
Appendix 1.3.1 Drawing OP-TU-A2 Rev. 10	7	The specification for items gd and ge have been modified to remove the words "closed cell" to correct the description. The gaskets used are solid. The specification for item gd has been modified to allow a slightly higher durometer.
Appendix 1.3.1 Drawing OP-TU-A2 Rev. 11	7s	Note 6 has been revised to provide specific grades of weld material allowed for use with the carbon steel sheet used. Additionally, the note has been revised to clarify the grades of weld material allowed for use with the stainless sheet.
Appendix 1.3.1 Drawing OP-TU-A2 Rev. 12	7s	Note 6 was corrected to show proper SFA designation of weld wire.
Appendix 1.3.1 Drawing OP-TU-A3 Rev. 11	7s	Note 3 has been revised to provide specific grades of weld material allowed for use with the carbon steel sheet used. Additionally, the note has been revised to clarify the grades of weld material allowed for use with the stainless sheet.
Appendix 1.3.1 Drawing OP-TU-A3 Rev. 12	7s	Note 3 was corrected to show proper SFA designation of weld wire.
Appendix 1.3.1 Drawing OP-TU-A4 Rev. 10	7	The specification for items gb and gc have been modified to remove the words "closed cell" to correct the description. The gaskets used are solid.
Appendix 1.3.1 Drawing OP-TU-A4 REV. 11	7s	Note 5 has been revised to provide specific grades of weld material allowed for use with the carbon steel sheet used. Additionally, the note has been revised to clarify the grades of weld material allowed for use with the stainless sheet.
Appendix 1.3.1 Drawing OP-TU-A4 REV. 12	7s	Note 5 was corrected to show proper SFA designation of weld wire.

Changed page	Revision level	Explanation of changes made
Appendix 1.3.1 Drawing OPTU-V-AB1 Rev. 7	7	The specification for Item blt, the Oxide Vessel bolts, has been modified to allow equivalent grades of bolts to be used, or any bolt having the required minimum tensile strength, yield strength and elongation. At the User's request, tamper-indicating bolt designs have been added for use with the Oxide Vessel. Views of Options A and B of the tamper-indicating bolt design have been added to the drawing. In use, two of the tamper-indicating bolts are used in place of the standard bolt. Option A uses a small hole through one corner of the hex head of the bolt and is an off-the-shelf item commonly used for this purpose. Option B is fabricated using a bolt that is a quarter-inch longer than the current Oxide Vessel bolt. The lower threads are machined off, creating a flat surface with a hole that protrudes slightly at the lower surface of the Oxide Vessel flange when assembled. Neither design impacts the strength of the bolt or the closed joint.
Appendix 1.3.1 Drawing OPTU-V-AB1 Rev. 7	7s	Note 7 has been modified to reflect the requirements for both lubricated and un-lubricated bolts.
Appendix 1.3.1 Drawing OPTU-V-AB1 Rev. 8	7s	Note 10 on sheet 1 of drawing was corrected to show proper SFA designation of weld wire. Sheet 2 of drawing was revised to include the revision block.
2-1	7	This page was modified to reflect the current company name.
2-2	7	This page was revised to allow AWS D1.1 welder qualifications as an alternative to ANSI/ASME B&PV welder qualifications. Additionally, the requirement for ASNT-TC-1A inspection qualifications was clarified from "all inspections" to "all weld inspections."
2-14	7	An entry for the crush drop was added.
2-19	7	The correct regulatory paragraph was added.
3-1	7	This page was modified to reflect the current company name. The heat generation rate threshold was modified consistent with the new rate calculated in Section 1 using the current regulations revised A2 values.
4-3	7	The calculations were revised using the current regulations revised A2 values.
4-4	7	The calculations were revised using the current regulations revised A2 values. Additionally, the requirement for a leakage test sensitivity of 1E-05 ref-cc/sec for maintenance tests was eliminated. The sensitivity required for these maintenance tests was revised in Section 8 from 1E-05 ref-cc/sec to one-half the allowable maximum leakage rate for the material being shipped, consistent with ANSI N14.5-1997.
4-4	7s	The containment criterion has been revised to reflect the maximum allowable by ANSI N14.5-1997 of 1E-01 ref-cc/sec.
4-5	7	The calculations were revised using the current regulations revised A2 values.
4-6	7	The calculations were revised using the current regulations revised A2 values. Additionally, the requirement for a leakage test sensitivity of 1E-05 ref-cc/sec for maintenance tests was eliminated. The sensitivity required for these maintenance tests was revised in Section 8 from 1E-05 ref-cc/sec to one-half the allowable maximum leakage rate for the material being shipped, consistent with ANSI N14.5-1997.

Changed page	Revision level	Explanation of changes made
4-6	7s	The containment criterion has been revised to reflect the maximum allowable by ANSI N14.5-1997 of 1E-01 ref-cc/sec. Additionally, the text in the first paragraph has been revised to clarify the location within the SAR of the respective leak test requirements: pre-shipment in Section 7, fabrication and periodic in Section 8.
4-8	7	The calculations were revised using the current regulations revised A2 values.
4-10	7	The calculations were revised using the current regulations revised A2 values.
6-1	7	The term "transport index" was revised to "criticality safety index" consistent with current regulations.
7-4	7	The heat generation rate threshold was modified consistent with the new rate calculated in Section 1 using the current regulations revised A2 values.
8-*i*	7s	The table of contents has been updated.
8-3	7	This page was revised to allow AWS D1.1 welder qualifications as an alternative to ANSI/ASME B&PV welder qualifications.
8-5	7	The sensitivity required for these maintenance tests was revised from 1E-05 ref-cc/sec to one-half the allowable maximum leakage rate for the material being shipped, consistent with ANSI N14.5-1997.
8-5	7s	Added "8.3.1-C Leak Test Specification CHT-LT-001" to list of appendices.
8.3.1-1	7s	The appendix introduction has been modified to reflect the addition of a third leak test specification.
8.3.1-4 and attached 9 pages	7s	A third leak test specification has been added as a suitable leak test specification for periodic testing.