71-9218
71-9279

Washington
TRU Solutions LLC

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May 14, 2004

Mr. M. Rahimi, Project Manager
NMSS/SFPO, Mail Stop O13D13
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Subject: RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION ON REVISION 20 OF THE TRUPACT-II SHIPPING PACKAGE APPLICATION, DOCKET NO. 71-9218 (TAC No. L23647), AND REVISION 3 OF THE HalfPACT SHIPPING PACKAGE APPLICATION, DOCKET NO. 71-9279 (TAC No. L23645)

Reference 1: Letter from M. L. Caviness to M. Rahimi dated September 17, 2003, subject: Revision 20 of the TRUPACT-II Shipping Package Application, Docket No. 71-9218, and Revision 3 of the HalfPACT Shipping Package Application, Docket No. 71-9279

Reference 2: Letter from M. Rahimi to M. L. Caviness dated March 16, 2004, subject: Request for Additional Information on TRUPACT-II and HalfPACT Amendment Requests

Dear Mr. Rahimi:

Washington TRU Solutions LLC, on behalf of the U.S. Department of Energy (DOE), hereby submits an amendment to Revision 20 of the application for a Certificate of Compliance (CoC) for the TRUPACT-II Packaging, U.S. Nuclear Regulatory Commission (NRC) Docket No. 71-9218, and Revision 3 to the application for a CoC for the HalfPACT Packaging, NRC Docket No. 71-9279 (Reference 1). The amendment is in response to the Request for Additional Information (RAI) (Reference 2). This letter includes the following attachments:

- Attachment A lists all enclosures to this letter
- Attachment B provides detailed responses to the RAI
- Attachments C1, D1, E1, and F1 provide insert/delete instructions for the revised pages of the TRUPACT-II Safety Analysis Report, the HalfPACT Safety Analysis Report, the Contact-Handled Transuranic Waste Authorized Methods for Payload Control, and the CH-TRU Payload Appendices, respectively
- Attachments C2, D2, E2, and F2 provide the changed pages for the TRUPACT-II Safety Analysis Report, the HalfPACT Safety Analysis Report, the Contact-Handled Transuranic Waste Authorized Methods for Payload Control, and the CH-TRU Payload Appendices, respectively
- Attachment G lists the references provided with this amendment.

NMSS01

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All technical changes made to the document pages are indicated by red-lining in the margin of the documents ("|"). Where necessary to ensure consistent document formatting and pagination, multiple pages have been submitted to address a single text change.

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. B. A. Day of my staff at (505) 234-7414.

Sincerely,

T. C. Sellers for M. L. Caviness

M. L. Caviness, Manager
Packaging Engineering

:clm

Attachments

cc: M. A. Italiano, CBFO

May 2004

Attachment A

Enclosures to Letter

Attachment B	Responses to NRC Request for Additional Information on Revision 20 of the TRUPACT-II Safety Analysis Report (SAR), Revision 3 of the HalfPACT SAR, Revision 1 of the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC), and Revision 0 of the CH-TRU Payload Appendices
Attachment C1	List of Revised Pages (Insert/Delete) for Revision 20 (May 2004) of the TRUPACT-II Safety Analysis Report (SAR)
Attachment C2	Revised Pages for Revision 20 (May 2004) of the TRUPACT-II Safety Analysis Report (SAR)
Attachment D1	List of Revised Pages (Insert/Delete) for Revision 3 (May 2004) of the HalfPACT Safety Analysis Report (SAR)
Attachment D2	Revised Pages for Revision 3 (May 2004) of the HalfPACT Safety Analysis Report (SAR)
Attachment E1	List of Revised Pages (Insert/Delete) for Revision 1 (May 2004) of the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC)
Attachment E2	Revised Pages for Revision 1 (May 2004) of the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC)
Attachment F1	List of Revised Pages (Insert/Delete) for Revision 0 (May 2004) of the CH-TRU Payload Appendices
Attachment F2	Revised Pages for Revision 0 (May 2004) of the CH-TRU Payload Appendices
Attachment G	References

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Attachment B

Responses to NRC Request for Additional Information on Revision 20 of the TRUPACT-II Safety Analysis Report (SAR), Revision 3 of the HalfPACT SAR, Revision 1 of the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC), and Revision 0 of the CH-TRU Payload Appendices

Chapter 1 General Information

1-1 Clarify the status of the TRUCON documents for TRUPACT-II and HalfPACT in light of the proposal to combine the two TRAMPAC documents for the two package designs.

It is not clear if the CH-TRU Waste CONtent Codes (CH-TRUCON), Rev. 0 for HalfPACT and TRUPACT-II Content Codes (TRUCON), Rev. 13 are still valid if the proposed CH-TRAMPAC would be the single document referenced in TRUPACT-II and HalfPACT SARs. This clarification is needed per 10 CFR 71.7.

Response:
A revised CH-TRUCON, Revision 1, will replace the CH-TRUCON, Revision 0, for HalfPACT and the TRUCON, Revision 13, for TRUPACT-II. Revision 1 of the CH-TRUCON will provide a catalog of the authorized contents for both the TRUPACT-II and the HalfPACT packagings, in accordance with Section 1.5 of the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC), Revision 1.

1-2 Clarify if the change requested regarding the second paragraph in Section 5.(b)(2) of the CoC for TRUPACT-II and HalfPACT include removal of optional loadings of the Standard Waste Box (SWB) with one bin or four 55-gallon drums.

In attachment D1 and D2 of the submittal, the applicant indicates removal of Standard Waste Boxes (SWBs) with two optional payloads. However, in Section 2.9.8 of CH-TRAMPAC, the two options are stated in the beginning of the last paragraph. This clarification is needed per 10 CFR 71.7.

Response:
The change requested regarding the second paragraph in Section 5.(b)(2) of the CoC for the TRUPACT-II and the HalfPACT was not intended to remove the optional loadings of the SWB with one bin or up to four 55-gallon drums. The revision of the list of payload configurations in Section 5.(b)(2) of the CoC was proposed for simplification purposes only (i.e., to list only the outermost payload container). The specifications for the individual payload containers (Section 2.9 of the CH-TRAMPAC) define allowed overpacked configurations.

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Responses to NRC Request for Additional Information on Revision 20 of the TRUPACT-II Safety Analysis Report (SAR), Revision 3 of the HalfPACT SAR, Revision 1 of the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC), and Revision 0 of the CH-TRU Payload Appendices

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Chapter 2 Structural

2-1 Specify the type of non-destructive examination rather than leaving it as an option.

Standard pipe overpack (SPO) Drawing 163-001, Revision 5, Sheet 1, F/N 8 gives the option of performing either a volumetric (RT/UT) or surface (MT/LT) weld examination. This should not be left up to the discretion of the fabricator but specified on the applicable drawing. The staff recognizes that the affected change was to add volumetric examination as an option.

10 CFR 71.33 requires, in part, that applications must include sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package.

<u>Response</u>:
Comment incorporated. Standard pipe overpack Drawing 163-001, Revision 6, Sheet 1, F/N 8 (included in Appendix 1.3.1 of the TRUPACT-II SAR and Appendix 1.3.1 of the HalfPACT SAR) has been revised to remove all weld examination and acceptance options except for liquid penetrant and visual examination. Both liquid penetrant and visual examination and acceptance are required on the applicable welds per the ASME Boiler & Pressure Vessel Code, Section III, Division 1, Subsection NG: For Examination, Articles NG-5230 and NG-5260; For Acceptance, Articles NG-5350 and NG-5360.

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2-2 Correct the placement of "or" in non-destructive acceptance articles by placing it between NG-5330 (RT/UT) and NG-5340 (MT) in order to agree with the examination articles. Refer to standard pipe overpack Drawing 163-001, Revision 5, Sheet 1, F/N 8.

The examination articles give the option of either a RT/UT or a MT/LT/VT and the acceptance articles incorrectly give a RT/UT/MT or LT/VT option.

10 CFR 71.33 requires, in part, that applications must include sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package.

Response:
Comment incorporated. As described in the response to RAI 2-1 (above), Standard pipe overpack Drawing 163-001, Revision 6, Sheet 1, F/N 8 has been revised to remove the option for volumetric and magnetic particle examination and to bring the articles for weld examination and acceptance into agreement.

2-3 Delete F/N Note 19 which states that the welding and examination requirements of F/N's 7 & 8 aren't applicable if SA-312 pipe material is used. Refer to Standard pipe overpack Drawing 163-001, Revision 5, Sheet 1.

The pipe welding and examination requirements are applicable to the welds that attach the flange and end cap. Once the pipe is received from the pipe manufacturer, the flange and end cap must be attached via welding and then tested by the component fabricator in accordance with Code requirements.

10 CFR 71.33 requires, in part, that applications must include sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package.

Response:
Comment incorporated. Standard pipe overpack Drawing 163-001, Revision 6, Sheet 1, F/N 19 has been revised to clarify that "Flag Notes 7 and 8 do not apply to pipe body longitudinal welds if ASME SA-312 pipe material (or equivalent) is used." The ASME SA-312 requirements substitute a hydrostatic test to verify the

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structural weld integrity of pipe body longitudinal welds. F/N's 7 and 8 are always applicable to the CJP circumferential pipe body to flange and end cap welds as shown by the omission of F/N 19 in Standard pipe overpack Drawing 163-001, Revision 6, Zones B-7 and C-7, Sheets 2 and 3.

2-4 Correct and clarify the apparent inconsistency of the standard pipe overpack nominal loaded weight for the 12-inch diameter pipe stated at the top of Page 4.1-7 of the CH-TRU Payload Appendices.

One sentence of the subject paragraph states that the nominal loaded weight of the 12-inch pipe diameter component was 407 pounds and the next sentence states that it is 547 pounds. Further, if the first sentence was an editorial mistake and applies to the 6-inch pipe diameter component, explain how the 407 pounds is applicable to the 6-inch pipe diameter component contained in the Standard pipe overpack which has a maximum weight limit of only 328 pounds.

10 CFR 71.33 requires, in part, that applications must include sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package.

Response:

The standard "pipe overpack" consists of a "pipe component" (either 6 inches or 12 inches in diameter) positioned by dunnage within a 55-gallon drum. The 407-pound (lbs.) limit applies to the gross weight of a loaded 12-inch pipe component (reference Figure 4.1-2 on page 4.1-4 of CH-TRU Payload Appendix 4.1), and the 547-lbs. limit applies to the gross weight of a loaded pipe overpack containing a 12-inch pipe component (i.e., the 407-lbs. weight of the loaded 12-inch pipe component plus 140 lbs. for the 55-gallon drum and Celotex™ dunnage). The 407- and 547-lbs. weight limits are specified as part of the Standard pipe overpack specification in Tables 2.9-7 and 2.9-8 of Section 2.9.2 of the CH-TRAMPAC.

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2-5 Specify in Section 4.1.3 of the CH-TRU Appendices the weights and configuration of the overpacks used in the side impact test. In addition, explain why 1000-pound 55-gallon drums were not a part of the test configuration.

The subject section only states a top layer of seven pipe overpacks containing 6-inch diameter components and bottom layer of seven pipe overpacks containing 12-inch diameter components without identifying weights and orientations of the overpacks within the tested inner containment vessel. This information is needed to determine if the tested arrangement bounds the licensed content for the purpose of demonstrating pipe overpack integrity.

10 CFR 71.33 requires, in part, that applications must include sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package.

Response:
Comment incorporated. Section 4.1.3 of CH-TRU Payload Appendix 4.1 has been revised to add Figure 4.1-4, Side Drop Configuration and Weights, (and renumber subsequent figures) and to clarify that a payload assembly comprised of both 6- and 12-inch Standard pipe overpacks requires like-sized pipe overpacks in each seven-pack. Figure 4.1-4 illustrates the configuration and weights of the 6- and 12-inch Standard pipe overpack side drop test. Sections 2.1.1, 6.2.1.1, and 6.2.2 of the CH-TRAMPAC have also been revised to clarify the requirement for seven-packs to be comprised of like-sized pipe overpacks.

The drop testing of the Standard pipe overpacks did not include 1,000-lbs. 55-gallon drums as part of the test configuration because they are not authorized for payload assembly with Standard pipe overpacks except when the entire payload assembly is considered to be comprised of 55-gallon drums and no credit is taken for the criticality control function of the pipe component. As delineated on page 3-2a of Section 3.1.1 of the CH-TRAMPAC and on page 6-35 of Section 6.2.4 of the CH-TRAMPAC, a payload composed of both 55-gallon drums and Standard pipe overpacks is subject to the applicable 55-gallon drum payload fissile gram equivalent (FGE) limit.

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2-6 Explain how the side drop tests discussed in Section 4.1 through Section 4.4 of the CH-TRU Payload Appendices, using a TRUPACT-II configuration performed for the SPO and S100 which are referenced in the structural HAC analysis for S200 and S300, are applicable to HalfPACT.

HalfPACT's design allows transport of half the number of drums than allowed by TRUPACT, but its maximum payload is slightly more than TRUPACT-II's payload, 7600 verses 7265, respectively. Thus, the loading above a pipe overpack in a HalfPACT for a side drop test configuration could be significantly more by as much as a factor of 2. It is not apparent from the structural testing information presented in Section 4.1 through Section 4.4 of the CH-TRU Payload Appendices, that utilize a TRUPACT-II configuration, how this would bound a HalfPACT configuration containing pipe overpacks.

10 CFR 71.33 requires, in part, that applications must include sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package.

Response:
The Standard pipe overpack side drop test, utilizing a seven-pack of 6-inch Standard pipe overpacks and a seven-pack of 12-inch Standard pipe overpacks in a TRUPACT-II inner containment vessel (ICV), is applicable to the HalfPACT for the following reasons:

a) The maximum weight limits of all pipe overpack designs were established based on the weights utilized in testing. For the pipe overpack designs not tested, analysis was used to demonstrate that the tests were bounding (see CH-TRU Payload Appendices 4.2 through 4.4).

b) The top and bottom seven-packs were decoupled from one another (in the side-drop orientation) such that the weight of only the pipe overpacks within each seven-pack provide the bearing loads.

c) The g-forces in the HalfPACT and TRUPACT-II are nearly identical as indicated by the approximately 37-inch wide flat outer containment assembly (OCA) outer shell crush deformations reported for the 30-foot side-drop

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orientations (see Table 2.10.3-3 of the HalfPACT SAR and Table 2.10.3-1 of the TRUPACT-II SAR).

The reason the HalfPACT and TRUPACT-II packages have essentially identical impact characteristics is because most of the attenuation of the drop energy is absorbed by the ends of the package (the side shells and foam contribute only a small percentage to the package's response). Since both packages weigh about the same, resulting deformations and accelerations will be about the same.

Of final note, testing of pipe overpacks occurred within an unprotected (bare) ICV that provided little attenuation of the drop energy generated by the pipe overpacks. This ultra-conservative test profile assures that any differences in drop response between the TRUPACT-II and HalfPACT are bounded by the as-tested TRUPACT-II bare ICV configuration. As such, the loading on a pipe overpack under equivalent g-loads in the TRUPACT-II or HalfPACT side drop orientation is given by the maximum weight of, and interaction between, pipe overpacks in the seven-pack in which the subject pipe overpack is assembled.

2-7 Explain in Section 4.2.3 of the CH TRU Payload Appendices why the maximum drum weight contributing to the crush depth was 547 lbs and not 1000 lbs which is the maximum weight of a 55 gallon drum.

10 CFR 71.33 requires, in part, that applications must include sufficient detail to identify the package accurately and provide a sufficient basis for evaluation of the package.

<u>Response</u>:
As discussed in Section 4.2.3 of CH-TRU Payload Appendix 4.2, the maximum weight contributing to the crush depth is 550 lbs. (not 547 lbs.), which is the maximum gross weight of the loaded S100 pipe overpack (see CH-TRAMPAC, Table 2.3-1 and Section 2.9.3). Since mixed assemblies of 55-gallon drums and S100 pipe overpacks are not authorized, the appropriately bounding weight contributing to the crush depth in the S100 pipe overpack analysis is the maximum gross weight of the S100 pipe overpack.

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Chapter 3 Thermal

3-1 Revise Section 4.2 of the CH-TRAMPAC to address the potential effect of the presence of used or partially filled aerosol cans in retrievably stored waste on package internal pressure and flammability.

Section 4.2 of the CH-TRAMPAC does not consider the potential for partially filled aerosol cans to leak or discharge inside the payload container, thereby increasing package internal pressure under normal and hypothetical accident conditions. Additionally, since the material inside the aerosol cans is unknown and may be flammable, consideration should be given to the effect on package flammability.

This information is required to ensure that package pressures do not exceed their allowable values, as stated in Chapter 3 of NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material." It is also needed to ensure that there will be no significant chemical, galvanic, or other reaction among the package contents, as required by 10 CFR 71.43(d).

Response:
Comment incorporated. Section 4.2 of the CH-TRAMPAC has been revised to add the following text in Section 4.2.1:

"Used (i.e., empty) aerosol cans are allowed as they do not impact the package internal pressure or flammability. Verification that any aerosol cans present in retrievably stored waste are empty shall be by radiography and/or process knowledge and shall be documented in site-specific compliance documents.

Any aerosol cans present in retrievably stored waste that are not empty shall be limited to one per container. In addition, to address flammability issues, containers with one partially filled aerosol can shall undergo headspace gas measurement as described in Section 5.2.5 to quantify total container flammability, including the possible contribution of any flammable contents potentially leaked or discharged from the aerosol can."

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Empty aerosol cans do not impact the package internal pressure under normal and hypothetical accident conditions or the package flammability. For retrievably stored waste, radiography and/or process knowledge are used to determine the presence of aerosol cans inside the payload container and to establish that aerosol cans are empty.

The analysis of the potential for partially filled aerosol cans to leak or discharge inside the payload container and the associated effect is presented below.

Assuming that an aerosol can is completely filled with a liquid volume of 7.82 cubic inches and a liquid-to-gas expansion ratio of 260 (within the typical range for aerosol cans), the amount of gas contribution from the aerosol can could be 7.82 x 260 = 2,033.2 cubic inches, or 33.3 liters. An aerosol can that is only partially filled would not have this level of gas expansion. The presence of other waste items and the presence of void volume in the payload container and the requirement for the payload container to be vented will ensure that any potential impacts from gas release from a partially filled aerosol can are minimal and will have no adverse impact on the payload container or the package. In addition, the pressure calculations in the TRUPACT-II SAR conservatively neglect the void volume inside the payload containers in addition to using bounding G values. Any gas release from a partially filled aerosol can is accounted for by these conservative assumptions used in the TRUPACT-II SAR pressure calculations. Therefore, the allowance for the incidental presence of partially filled aerosol cans will not impact the package internal pressure under normal and hypothetical accident conditions.

Potentially flammable contents that may be leaked or discharged from a partially filled aerosol can are quantifiable by measurement of the flammable gas concentration in the payload container headspace, which is performed as part of payload container characterization activities. Given the long storage time of several years for retrievably stored payload containers that may contain partially filled aerosol cans, any leak or discharge from an aerosol can during storage or subsequent movement during characterization would be quantified during payload container headspace gas measurement. As shown in the response to RAI 3-8 (below), typical shipping times are on the order of a few days only. The potential for a partially filled aerosol can to have not discharged during the long storage period (and, therefore, not be accounted for in the required headspace gas measurement), but to then discharge *during the short shipping period is insignificant.*

Section 4.2.1 of the CH-TRAMPAC has been revised to impose a requirement for headspace gas measurement of payload containers that include the incidental presence of an aerosol can that is not empty, as determined by radiography and/or process knowledge. The headspace of a retrievably stored payload container with a partially filled aerosol can will be measured and evaluated during characterization for compliance with the applicable flammable (gas/VOC) limits in accordance with Section 5.2.5. In addition, aerosol cans that are not empty will be limited to one per container. The addition of these requirements in the revised text of Section 4.2 of the CH-TRAMPAC addresses any potential impact on package flammability due to the presence of a partially filled aerosol can.

3-2 Revise Section 2.8 of the CH-TRAMPAC to address the potential flammability of sealed containers greater than four liters.

It is not clear that the CH-TRAMPAC adequately considers the potential or the effects of ignition of unvented containers up to five gallons, particularly in light of the fact that such containers may have been stored long enough to contain significant quantities of flammable gas. It is also not clear what, if any, margin of safety is provided by overpacking payload containers that contain such unvented containers.

This information is needed to ensure that there will be no significant chemical, galvanic, or other reaction among the package contents, as required by §71.43(d).

Response:
Comment incorporated. Section 2.8 of the CH-TRAMPAC has been revised to replace the second paragraph of Section 2.8.1 with the following text:

"The allowance for the incidental presence of sealed containers up to five gallons is specified to address ALARA issues associated with the removal of such sealed containers from retrievably stored payload containers. While sealed containers may have been used at a site, they are not primary

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components of the waste generated. Production and maintenance activities may have generated sealed containers incidental to the primary waste generation processes.

As an example, waste information from a site data set of approximately 7,000 55-gallon drums indicates the presence of sealed container(s) greater than 4 liters (nominal) in approximately 7 percent of the waste. Of this 7 percent inventory, site radiography data suggests that the majority (60 to 70 percent) of sealed containers are only slightly larger than 4 liters in size (carboy containers). The remaining inventory of sealed containers is less than or equal to five gallons in size and consists of metal buckets with crimped lids that are taped around the circumference and plastic bottles with screw top lids. Remediation efforts to date have involved the removal and inspection of these sealed containers. The results of this remediation show that the sealed containers have been stored safely and that the contents of the sealed containers are not pressurized, indicating that the sealed containers are low gas generators and have gas communication with the atmosphere outside of the sealed container. The containers (carboy containers, metal buckets, and plastic bottles) are not designed to withstand pressure or gas accumulation.

In terms of flammable gas generation analysis, the analysis presented in Section 5.0 accounts for all of the radioactive material in the payload container, including that present in any sealed container. The methodology also assumes that all of the radioactive material is in the same inner layer.

In addition, any unlikely gas release from the sealed container will not contribute to a pressure spike in a payload container (e.g., 55-gallon drum), given the maximum size of the sealed container (5 gallons [18.9 liters]), the volume of a payload container containing a sealed container (e.g., the volume of a 55-gallon drum is 208 liters, with waste materials and a significant void volume), and the gas release properties of the payload container filter (flow rate of 35 milliliters/minute at 1 inch of water [0.656 mole/minute/ atmosphere]). Instead, the payload container will equilibrate to easily accommodate any gas release from an internal sealed container up to five gallons in size."

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The requirement to overpack the container with the sealed container provides a margin of safety by further isolating the sealed container from the packaging and reducing the sealed container as a percentage of the overpacking container volume so that there are no impacts to the packaging. Overpacking reduces the number of payload containers comprising the payload assembly (i.e., lesser number of gas generators).

3-3 Revise Section 5.2.5.4.5 to account for the shipping period when calculating the predicted innermost confinement layer flammable gas concentration in Step [I].

It is not clear that the flammable gas concentration determined by this step, which is subsequently added to the flammable VOC concentration in the innermost confinement layer for comparison to the mixture lower explosive limit (MLEL), is representative of the maximum flammable gas concentration at the end of the shipping period. Calculations for determining the maximum concentrations of flammable gas/VOCs should consider the maximum amount of time that the package could potentially be sealed.

This information is needed to ensure that the total combustible gas remains less than 5% of the free gas volume in any confined region of the package, or less than the MLEL, as stated in Section 4.5.2.3 of NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Materials."

Response:
Comment incorporated. To clarify that the predicted innermost confinement layer (ICL) flammable gas concentration is calculated at the end of the shipping period, Step [I] of Section 5.2.5.4.5 of the CH-TRAMPAC has been revised to state:

> *"If VOCs are present in the container headspace at concentrations greater than 500 ppm, as demonstrated in Step C, calculate the predicted innermost confinement layer flammable gas concentration (X_{inner}) at the end of the shipping period as:"*

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The predicted ICL flammable gas concentration is in fact calculated at the end of the shipping period through the equation provided in Step [I]. The equation provided in Step [I] is defined as follows:

$$X_{inner} = CG * R_T$$

where,

X_{inner} = The concentration of the flammable gas within the ICL at the end of the shipping period inside a TRUPACT-II or HalfPACT, dimensionless.

CG = The measured flammable gas generation rate (mole/second [sec]).

R_T = The total resistance to hydrogen release (sec/mole) (see CH-TRU Payload Appendices 2.2 and 2.3). This term includes the accumulation of gases from all payload containers during the shipping period.

This equation is identical to the equation for calculating the ICL at the end of the shipping period in Step [B] of Section 5.2.5.3.5, "Determine Compliance with Flammable (Gas/VOC) Concentration Limit." Under Step [B] of Section 5.2.5.3.5, the phrase "at the end of the shipping period" is explicitly stated, whereas in Step [I] of Section 5.2.5.4.5, the phrase was not included. However, in both steps the ICL flammable gas concentration is calculated at the end of the shipping period through the use of the total resistance term (R_T). As shown in Equation (6) of CH-TRU Payload Appendix 2.3, "Derivation of Decay Heat Limits," the total resistance (R_T) is defined as the combination of the following:

- The effective resistance to the release of flammable gas from the payload container, and
- The resistance provided by the moles of flammable gas generated by all containers during the shipping period.

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3-4 Provide Reference 3 of Section 5 of the CH-TRAMPAC: "UFGTP Long-Term Objective Implementation Methodology." Also, revise Section 5.2.5 of the CH-TRAMPAC to fully describe the UFGTP Long-Term Objective and how it is to be implemented within the CH-TRU payload control methodology.

Section 5.2.5 of the CH-TRAMPAC briefly describes a program to assign flammable gas generation rates to populations of test category waste, but does not outline the specific gas generation criteria which are considered for these populations. Also, the description does not describe what constitutes "sufficient data" in order to implement the UFGTP Long-Term Objective, or how it is determined that a number of tested containers is statistically valid to represent the entire population.

This information is needed to ensure that the total combustible gas remains less than 5% of the free gas volume in any confined region of the package, as stated in Section 4.5.2.3 of NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Materials."

Response:
Comment incorporated. A copy of Reference 3 of Section 5 of the CH-TRAMPAC is provided in Attachment G, References, and has been updated to include an example calculation. Section 5.2.5 of the CH-TRAMPAC has been revised to add Section 5.2.5.5, which fully describes and details the complete implementation of the UFGTP Long-Term Objective. The specific gas generation criteria considered for populations of test category waste and the criteria for ensuring collection of sufficient data (i.e., required subpopulation size that is statistically valid to represent the entire population) are included in the new Section 5.2.5.5 of the CH-TRAMPAC.

3-5 Revise Section 5.2.5.4.4 of the CH-TRAMPAC to describe what constitutes "sufficient data" in order to calculate the hydrogen gas generation rate for a payload container.

The applicant should state what criteria are used to determine that enough data has been collected to warrant termination of the hydrogen gas generation rate test. The response should include examples of test data and a demonstration of how hydrogen gas generation rates were determined.

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This information is needed to ensure that the total combustible gas remains less than 5% of the free gas volume in any confined region of the package, as stated in Section 4.5.2.3 of NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Materials."

<u>Response</u>:
Comment incorporated. Section 5.2.5.4.4 of the CH-TRAMPAC has been revised to add text to state what constitutes sufficient data, as follows:

> *"The term 'sufficient data' is defined as data on the parameters needed to quantify a bounding and applicable gas generation rate for the container under the test conditions prescribed in the UFGTP. In the case of containers that are tested at room temperature (Waste Types I, II, and III), sufficient data is measurement of the flammable gas concentration, temperature, and pressure. For these containers, there is no thermal equilibration of the contents with respect to the testing temperature and the gas generation rates are constant or decreasing (see Appendices 3.2 and 3.3 of the CH-TRU Payload Appendices). For containers that are tested at an elevated temperature (Waste Type IV), a thermal equilibration period exists. Measurements are taken after the equilibration period to quantify the maximum flammable gas and total gas generation rates. In this case, sufficient data is measurement of flammable gas and total gas generation rates, temperature, and pressure during a testing period that is extended until the rates are shown to remain constant or decrease, or until the testing period (time from container isolation and commencement of heating to the collection of the final gas sample) equals or exceeds the time of the allowed shipping period. In all cases, the collection of data as described herein ensures that the measured rates determined through testing are representative of the gas generation properties of the container over the allowed shipping period. The measured rates are then compared to the respective limits to demonstrate compliance with the allowable gas generation rates."*

Implementation of the UFGTP described in the CH-TRAMPAC and determination of gas generation rates from container testing are performed by the shipping sites under site-specific programs that are approved by the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO). The gas generation test program

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at each shipping site is implemented under site-specific procedures that document the program objectives and organization; applicable quality assurance (QA) program and data quality objectives; the set-up used for the testing (e.g., a belljar, which is the test chamber enclosing the container being tested); and data collection, review, reduction, and validation. A specific example for container testing using a belljar system is provided below.

Example Test Data and Determination of Hydrogen Generation Rate

A 55-gallon drum with combustible waste packaged within two inner bags and two liner bags was packaged on December 30, 1999. The drum is fitted with a filter with a diffusivity of 3.7E-6 mole/sec/mole fraction and a 0.3-inch diameter hole in the rigid liner. Flammable VOCs in the headspace have been measured as less than 500 parts per million (ppm). The drum has a decay heat of 0.182 watt and a decay heat uncertainty of 0.059 watt. The drum satisfied the 0.012 watt*year criteria in 25 days. Thus, the shipping category is 30 0109 0502. The drum decay heat limit is 0.0882 watt and allowable flammable gas generation rate (AFGGR) is 9.960E-9 mole/sec. The drum decay heat plus uncertainty of 0.241 watt exceeds the decay heat limit. Thus, the container must be evaluated under the test category.

Because the drum belongs to Waste Type III, it qualifies for testing at room temperature. The drum is loaded into the gas generation testing apparatus (i.e., the belljar, which is the test chamber enclosing the container). The initial hydrogen concentration in the belljar was measured and recorded as 69.1 ppm at a temperature of 25°C (298 K) and a pressure of 608 torr (0.80 atmosphere [atm]). After 68.35 hours of testing, the concentration of hydrogen gas within the belljar was measured and recorded as 347.0 ppm at a temperature of 25°C (298 K) and a pressure of 604 torr (0.79 atm).

Mass balance equations on hydrogen (listed below) relate the concentration of hydrogen to the hydrogen gas generation rate in the container. The calculated flammable gas generation rate (FGGR) for this drum is 3.200E-9 mole/sec. This FGGR is compared to the AFGGR. In this case, the AFGGR is 9.960E-9 mole/sec, and the drum qualifies for shipment if all other transportation requirements are satisfied.

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Mass Balance Equations

The initial flammable gas concentration in the container at the start of the testing is obtained from the mass-balance equation on flammable gas within the container as:

Equation 1

$$\frac{dn_d}{dt} = C_g - \frac{y_d}{r_{eff}}$$

where,

n_d	=	Moles of flammable gas in the container, mole
C_g	=	Flammable gas generation rate in the container, mole/sec
t	=	Time, sec
y_d	=	Mole fraction of flammable gas within innermost confinement layer of container, dimensionless
r_{eff}	=	Effective resistance of the confinement layers to the release of flammable gas, sec/mole.

From the Ideal Gas Law:

Equation 2

$$n_d = y_d n_i = \frac{y_d P V_d}{R T}$$

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where,

n_i	=	Initial moles of gas inside the drum, mole
P	=	Pressure, atm
V_d	=	Void volume within the drum, liters
R	=	Gas constant, 0.082056 atm liters/mole K
T	=	Temperature, K.

It is assumed that isothermal and isobaric conditions exist, thus, the pressure and temperature may be considered constant. Substituting the Ideal Gas Law relation (Equation 2) in the mass balance Equation (1) and rearranging terms yields:

Equation 3

$$\frac{dy_d}{dt} = \frac{C_g}{n_i} - \frac{y_d}{n_i\, r_{eff}}$$

Subject to the following initial condition of the container at the time of packaging:

Equation 4

$y_d(0) = 0$

The solution to Equation (3) at the end of the storage time, ts, with the initial condition of Equation (4) is:

Equation 5

$$y_d(ts) = C_g\, r_{eff}\, (1 - e^{-\frac{ts}{r_{eff}\, n_i}})$$

After placement of the drum inside the belljar testing apparatus, the mass balance on flammable gas inside the container is described by the following equation:

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Equation 6

$$\frac{dn_d}{dt} = C_g - \frac{y_d - y_{belljar}}{r_{eff}}$$

where,

$y_{belljar}$ = Mole fraction of flammable gas in the belljar, dimensionless.

Substitution of the Ideal Gas Law relation [Equation (2)] into Equation (6) and rearrangement of terms assuming isobaric and isothermal conditions yields:

Equation 7

$$\frac{dy_d}{dt} = \frac{C_g}{n_i} - \frac{1}{r_{eff}\ n_i}(y_d - y_{belljar})$$

Similarly, the mass balance on flammable gas within the belljar is given as:

Equation 8

$$\frac{dn_{belljar}}{dt} = \frac{y_d - y_{belljar}}{r_{eff}}$$

where,

Equation 9

$$n_{belljar} = y_{belljar} n_o = \frac{y_{belljar} P\, V_{belljar}}{R\, T}$$

where,

$n_{belljar}$	=	Moles of flammable gas inside the belljar, mole
n_o	=	Initial moles of gas inside the belljar, mole
$V_{belljar}$	=	Void volume inside belljar (internal volume of belljar – external volume of 55-gallon drum), liters

Substitution of Equation (9) into Equation (8) and rearrangement of terms yields:

Equation 10

$$\frac{dy_{belljar}}{dt} = \frac{1}{r_{eff}\ n_o}(y_d - y_{belljar})$$

Initially, at the start of the gas generation testing, the concentrations in the drum and initial measured concentration in the belljar are:

Equation 11

$$y_d(0) = y_d(ts)$$

$$y_{belljar}(0) = y_{belljar,0}$$

At the end of the elapsed testing time, tt, the concentration in the belljar is given as:

Equation 12

$$y_{belljar}(tt) = y_{belljar,tt}$$

For simplicity, the variable, y_o, is defined as:

Equation 13

$$y_o = y_{belljar,tt} - y_{belljar,0}$$

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The solution to the system of mass balance equations given by Equations (7) and (10) at the end of the elapsed testing time, tt, with the initial conditions given by Equations (11-13) for the FGGR is given by:

Equation 14

$$C_g = \frac{y_o(n_i + n_o)^2(1 + MethaneRatio)}{tt(n_i + n_o) + r_{eff}\, n_i^2\left[1 - e^{E_1}\right] + r_{eff} n_i (n_i + n_o)(e^{E_2} - e^{E_3})}$$

where,

$$E_1 = -\frac{tt\,(n_i + n_o)}{r_{eff}\; n_i\; n_o}$$

$$E_2 = -\frac{ts\; n_o + tt\,(n_i + n_o)}{r_{eff}\; n_i\; n_o}$$

$$E_3 = -\frac{ts}{r_{eff}\; n_i}$$

The *MethaneRatio* is added to conservatively account for the possible presence of methane.

For this example, the values of the variables are provided below.

Variable	Value
V_d	168.3 L
$V_{belljar}$	81.5 L
y_o	0.0002779
n_o	2.6680 moles
n_i	5.5095 moles
ts	87,833,700 sec
tt	246,060 sec
r_{eff}	4,305,300 sec/mole
E_1	-0.031795
E_2	-3.7347
E_3	-3.7029
MethaneRatio	2.5% = 0.025

Substitution of the variable values from the above table into Equation (14) yields an FGGR value for the drum of 3.200E-9 mole/sec.

3-6 Revise the CH-TRAMPAC to describe the process by which standard radiography will be used to detect the presence of prohibited items within payload containers.

Appendix 5.1 of the CH-TRU Payload Appendices specifically describes the real-time radiography (RTR) equipment and procedure for detecting prohibited items. It is unclear how an undefined general radiography procedure will accomplish the same objectives as RTR.

This information is needed to ensure that payload containers will not have prohibited items as required by the CH-TRAMPAC, and that the total combustible gas remains less than 5% of the free gas volume in any confined region of the package, as stated in Section 4.5.2.3 of NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Materials."

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Response:
Comment incorporated. Section 1.4.3 of the CH-TRAMPAC has been revised to clarify that the process by which other radiography methods may be used to detect the presence of prohibited items within payload containers must be equivalent to that for real-time radiography (RTR). The following text has been added to Section 1.4.3 after the last sentence ("Appendix 5.1 of the CH-TRU Payload Appendices describes typical real-time radiography procedures."):

> *"Other radiographic methods must meet the same performance objectives for real-time radiography (i.e., to nondestructively examine the physical form of the waste and to verify the absence of prohibited items in a payload container) and must be controlled by procedures similar to those described in Appendix 5.1 of the CH-TRU Payload Appendices for real-time radiography."*

The proposed revision to replace "real-time radiography" with the more general term of "radiography" was intended to allow the use of other radiographic methods that are equivalent to RTR with respect to CH-TRAMPAC performance objectives. While RTR is the non-destructive examination (NDE) method most commonly used in the Waste Isolation Pilot Plant (WIPP) Program, waste generator/storage sites have demonstrated that other NDE methods may offer equivalent inspection capabilities. For example, an imaging system that combines digital radiography (DR) and computed tomography (CT) may be used instead of conventional RTR to meet the same performance objectives. The performance objectives of radiography are to nondestructively examine the physical form of the waste and to verify the absence of prohibited items in a payload container (e.g., no free liquids, sealed containers, explosives, corrosives, or compressed gases, and sharp or heavy objects are suitably packaged). As stated in Section 1.4 of the CH-TRAMPAC, "Each generator or storage site shall select and implement a single method, or a combination of methods, to ensure that the payload is compliant with each requirement and is qualified for shipment. These methods shall be delineated in a programmatic or waste-specific data TRU Waste Authorized Methods for Payload Control (TRAMPAC)." If a generator or storage site elects to use a radiographic method to demonstrate compliance with a particular requirement, all activities required to achieve the radiography performance objective for that requirement shall be described in the programmatic or waste-specific data TRAMPAC. In accordance with Section 1.4 of the CH-TRAMPAC, the DOE-CBFO must approve the programmatic

TRAMPAC or waste-specific data TRAMPAC and review any implementing procedures. Implementing procedures of the site TRAMPAC include instructions specific to any radiographic method(s).

3-7 Revise Table 2.2-1 of CH-TRU Payload Appendix 2.2 to correct the apparent omission of the Waste Material Type number referenced under Total Resistance Notation.

The box next to the final total payload resistance calculation in Table 2.2-1 states: "If Waste Material Type, enter 0000." It appears that this statement should be referencing Waste Material Type II.2 in metal cans.

This information is needed to ensure that the total combustible gas remains less than 5% of the free gas volume in any confined region of the package, as stated in Section 4.5.2.3 of NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Materials."

<u>Response</u>:
Comment incorporated. Table 2.2-1 of CH-TRU Payload Appendix 2.2 has been revised to correct the omission of the Waste Material Type number. The text under the Total Resistance Notation in Table 2.2-1 has been corrected to state the following: *"If Waste Material Type II.2 (20 0000), enter 0000"*.

3-8 Revise CH-TRU Payload Appendices 3.5 and 3.6 to include sample shipping time data from various sites to support the conclusions made in these appendices.

CH-TRU Payload Appendices 3.5 and 3.6 provide justification for reducing shipping times from 60 days to 20 and 10 days, respectively. Sample shipping time data (e.g., maximum and average shipping times from various sites, duration and explanation of any delays that have occurred) would assist staff in determining the adequacy of the assumptions used to support reduced shipping times.

This information is needed to ensure that the total combustible gas remains less than 5% of the free gas volume in any confined region of the package, as stated

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in Section 4.5.2.3 of NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Materials."

Response:
Comment incorporated. To support the shipping period determination of 20 days for close-proximity shipments (i.e., within a radius of approximately 1,000 miles), CH-TRU Payload Appendix 3.5 has been revised to include sample shipping time data. The three DOE facilities nearest to the WIPP (i.e., Los Alamos National Laboratory [LANL], Rocky Flats Environmental Technology Site [RFETS], and Nevada Test Site [NTS]) are within a radius of approximately 1,000 miles of WIPP. Appendix 3.5 has been revised to add Table 3.5-2 to present the following sample data for shipments from LANL, RFETS, and NTS to WIPP:

Sample Shipping Time Data

To WIPP From	Total Number of Shipments as of 04-20-04	Average Shipping Time (hours)*	% of Time Shipments are Completed within Average Time	Shipping Time Delays	
				Duration of Maximum Delay	Explanation
LANL	71	9	98%	1 day	Delay occurred at LANL as the result of generator site issues prior to shipment departure
NTS	7	30	100%	N/A	N/A
RFETS	1,389	18	99%	2 days	Weather delay; delay occurred at RFETS prior to shipment departure and en route following departure

*Average shipping times are estimated based on average speeds of 50 miles per hour and include time associated with safety inspections, fuel and food stops, and driver breaks.

N/A = Not applicable.

To support the shipping period determination of 10 days for shipments designated as controlled shipments, CH-TRU Payload Appendix 3.6 has been revised to include sample shipping time data for shipments from the DOE sites that have shipped to WIPP to date. This data includes data from the shipments to WIPP that travel the greatest distance (i.e., 1,847-mile shipments from the

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Hanford Site to WIPP). Appendix 3.6 has been revised to add Table 3.6-3 to present the following sample data for shipments to WIPP:

Sample Shipping Time Data

To WIPP From	Total Number of Shipments as of 04-20-04	Average Shipping Time (hours)*	% of Time Shipments are Completed within Average Time	Shipping Time Delays: Duration of Maximum Delay	Shipping Time Delays: Explanation
ANL	11	43	100%	N/A	N/A
Hanford	76	43	98%	2 days	Weather delay; delay occurred at Hanford Site prior to shipment departure
INEEL	603	32	98%	5 days	Weather delay; delay occurred en route; shipment was returned to INEEL and delayed prior to second departure
LANL	71	9	98%	1 day	Delay occurred at LANL as the result of generator site issues prior to shipment departure
NTS	7	30	100%	N/A	N/A
RFETS	1,389	18	99%	2 days	Weather delay; delay occurred at RFETS prior to shipment departure and en route following departure
SRS	346	36	99%	3.7 days	Weather delay; delay occurred at SRS prior to shipment departure

*Average shipping times are estimated based on average speeds of 50 miles per hour and include time associated with safety inspections, fuel and food stops, and driver breaks.

N/A = Not applicable.

In addition to the site- and route-specific delays summarized above, additional delays have occurred during shipments to WIPP as follows:

- Delays due to national emergencies – On September 11, 2001, all shipments were held at sites prior to departure, or if en route were diverted to RFETS, and delayed for two weeks. On March 20, 2003, at the start of the U.S.

invasion of Iraq, all shipments were stopped where they were, at sites or en route, and delayed for approximately five days.

- Delays due to vehicle accident – To date, two vehicle accidents have occurred during shipments to WIPP resulting in delays of six hours (Wyoming) and approximately three hours (New Mexico).

Delays due to national emergencies notwithstanding, the longest shipping time delay from a site to WIPP is five days, well below the ten days proposed for the controlled shipment. In addition, it should be noted that any loaded package that is delayed at a site prior to departure beyond 24 hours must be vented (and the closure process repeated) as specified by CH-TRU Payload Appendix 3.6. As such, any delays occurring at a site prior to departure will be limited to 24 hours for 10-day controlled shipments.

Chapter 4 Containment

No questions or clarifications are needed.

<u>Response</u>
None needed.

Chapter 5 Shielding

5-1 Revise Section 3.2.1 of the CH-TRAMPAC to define the criteria used to determine that supplemental shielding used in order to meet surface dose rate limits of Table 3.2-1 will be fixed in location under normal conditions of transport, and that reconfiguration under hypothetical accident conditions will not cause package one-meter dose rates in excess of 1 rem/hr.

Supplemental shielding used to meet 10 CFR Part 71 radiation dose rate limits should be described in sufficient detail to determine its adequacy under normal and hypothetical accident conditions of transport. At a minimum, the applicant should describe the types of supplemental shielding expected to be used to meet

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payload container surface dose rates, and the specific criteria used to determine the condition of the shielding under normal and hypothetical accident conditions.

This information is needed to determine that the package will meet the external radiation standards for all packages required by §71.47, and those required for Type B packages under §71.51(a).

Response:
Comment incorporated. Section 3.2.2 of the CH-TRAMPAC has been revised to delineate the methods of compliance and verification required to demonstrate that internal shielding, used to meet the payload container surface dose rate requirement, will under normal conditions of transport (NCT) and hypothetical accident conditions (HAC) ensure that the requirements of 10 CFR 71.47 and 10 CFR 71.51(a) are met. The purpose of utilizing supplemental internal payload container shielding is to eliminate the need to repackage waste that has been historically stored in structurally robust shielded payload container configurations for the purposes of on-site shipping and handling or ALARA. Demonstration of the robustness of the shield, along with its ability to ensure that the package dose rate requirements are satisfied, shall be documented and submitted to the CH-TRU Payload Engineer for evaluation on a case-by-case basis. The following text has been added to Section 3.2.2 of the CH-TRAMPAC:

"If supplemental shielding is used to meet the surface dose rate limits, the following methods must be used to demonstrate compliance:

a) The structural response of the internal shield, to the extent utilized to provide distance and material attenuation of the source term, shall be verified through analysis and/or test with respect to the conditions of 10 CFR 71.71(c)(7) and 10 CFR 71.73(c)(1).

b) The configuration of the shield in both the normal conditions of transport and hypothetical accident conditions scenarios, as determined in (a) above, shall be evaluated through analysis and/or test to establish the maximum neutron and/or gamma source term allowed to ensure that the package dose rate requirements of 10 CFR 71.47 and 10 CFR 71.51(a) are met.

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c) The analyses and/or tests conducted to satisfy the requirements of (a) and (b) above shall be performed under a 10 CFR 71 Subpart H equivalent QA program. The internal shield shall have been constructed under a shipping or generator site QA program and the resulting fabrication documentation shall be reviewed for compliance with the shield configuration evaluated in (a) above under a 10 CFR 71 Subpart H equivalent QA program.

Compliance with the above requirements shall be documented in each applicable case for submittal to the CH-TRU Payload Engineer, who will direct the review and evaluation of the request. Written approval is required before internal shielding may be used to meet the radiation dose rate requirement."

Chapter 6 Criticality

6-1 Clarify in Chapter 6 of the TRUPACT-II and HalfPACT SARs how it is determined whether or not fissile material is mechanically or chemically bound to special reflector material in the CH-TRU waste.

Section 6.2.1 of the SARs states that "... if the special reflector, excluding beryllium, is chemically or mechanically bound to the fissile material, Case A limits apply even in the presence of greater than 1 % by weight quantities of the special reflector." It is unclear what is meant by "chemically or mechanically bound," or how it would be determined that fissile material present in CH-TRU waste is in such a condition.

This information is required to ensure that the applicant has identified the most reactive credible configuration consistent with the chemical and physical form of the material to be shipped, as required by 10 CFR 71.55(b).

<u>Response</u>:
Comment incorporated. Sections 6.0, 6.2.1, 6.2.3, and 6.2.4 of the TRUPACT-II and HalfPACT SARs have been revised to add the definitions for mechanically and chemically bound and/or to clarify that the special reflector materials evaluation provided in Section 6.4.3.3 applies to all TRU waste such that the limits summarized in Section 6.4.3.5 are appropriate. A summary of the limits

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has also been added to Section 3.1.1 of the CH-TRAMPAC. Additionally, Section 6.4.3.3 of the TRUPACT-II and HalfPACT SARs have been revised to clarify the form of magnesium oxide present in TRU waste.

Chemically bound means that the special reflector materials are chemically reacted with the fissile material such that the reflector materials and the fissile materials are chemically interacted and are stable. Mechanically bound means the fissile material is mechanically bound to the reflector such that the reflector material will not disengage from the fissile material because it is topographically imbedded, topographically interlocked, or surface contaminated. A summary discussion of the six special reflectors of interest is provided in Section 6.4.3.3 of the TRUPACT-II and HalfPACT SARs.

The shipping sites are required to identify the waste material type in each payload container. Identification is made by one or more of the following methods: process knowledge, radiography, or visual examination. Each container is also evaluated for compliance with CH-TRAMPAC requirements – such as material form, quantity of fissile material, decay heat, etc.

Plutonium has always been a valuable commodity due to national defense and national security and has been carefully guarded and tabulated since the beginning of the manufacturing cycle in the 1940s [Settle, Katz]. Therefore, if the plutonium were easily separated from the material matrix, then recovery would have occurred prior to the material being declared waste. The methods used to produce and recover plutonium are well known and become part of the transuranic waste process knowledge.

The method used to determine the most reactive credible configuration for special reflectors was to evaluate the list of possible reflector materials such as Be, BeO, carbon, D_2O, MgO, depleted U, Pb, Ni, Inconel, SS304, Zr, Bi, Cu, Fe, V, Cr, SiO_2, concrete, Mo, Co, Mn, Nb, gypsum, Sn, CH_2, etc. From this list, only six reflectors were determined to be of interest for the criticality model [Neeley]. Another study was conducted for each of the six special reflectors of interest (Be, BeO, carbon, D_2O, MgO, depleted U) to determine their presence in TRU waste by running a query of the TRU Waste Baseline Inventory Database (TWBID) [Taggart]. All CH-TRU waste streams destined for WIPP disposal contain waste stream specific information provided by the waste generators; this information is

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collected in the TWBID. Every TRU waste stream listed in the database was individually reviewed for the presence and form of the six special reflectors of interest as described in Section 6.4.3.3 of the TRUPACT-II and HalfPACT SARs. These waste streams were also crosschecked against the waste types listed in the CH-TRAMPAC, Table 5.1-1, CH-TRU Waste Material Types and G Values, to assure CH-TRAMPAC compliance. The result of the investigation is, "Based on the physical form of the six special reflector materials of interest identified in the TWBID...it is not credible that waste special reflector materials could organize into a form that would increase reactivity" [Taggart].

The mechanisms that could cause the special reflectors of interest to become unbound during normal conditions of transport or hypothetical accident conditions (flooding and fire) were investigated. Extensive plutonium studies were conducted for the WIPP waste in a brine solution in various acid conditions. Plutonium solids have a very low solubility in water [Katz]. Under an equilibrium condition with plutonium solids (i.e. plutonium salts), the solubility was found to be less than 0.1 ppm under a neutral pH condition [Hoffman]. The maximum temperature inside the TRUPACT-II and HalfPACT during normal conditions of transport and/or the hypothetical accident fire is significantly less than required to melt either the plutonium or special reflector materials. There is no other identified mechanism that would occur during normal conditions of transport or hypothetical accident conditions that could cause the reflecting material to become unbound from the plutonium: The solubility is too low and the potential maximum temperature is insufficient.

The special reflectors of interest that occur in transuranic waste are discussed below.

<u>MAGNESIUM OXIDE (MgO)</u>
All the magnesium oxide waste found in the TWBID search was a waste generated from the calcium reduction of plutonium tetrafluoride. Plutonium tetrafluoride and calcium were placed into magnesium oxide crucibles with sodium peroxide and sand. This mixture was heated to about 800°C in a furnace. The process was very effective and almost all the plutonium concentrated in the bottom of the MgO crucible. The plutonium button was retrieved by breaking open the crucible and the remaining materials were segregated for recycle and disposal [Murray]. The sand, slag, and crucible

residues (SS&C) were reprocessed [Moy, Murray]. Since the plutonium is mechanically bound and is interlocked in the surface layers of the crucible pieces, the SS&C was pulverized and dissolved in acid under vigorous process conditions. Other wastes, such as floor sweepings from the above process, required incineration prior to acid dissolution [Murray]. Liquid acid is prohibited in TRU waste, therefore there is no mechanism present to separate MgO.

CARBON
Carbon was found in the TWBID search as graphite, ash, and small amounts of organic liquid waste [Taggart], but there is no mechanism that would cause the graphite to separate or reconfigure.

Graphite: Graphite molds were used to cast plutonium and plutonium alloy. Due to graphite having a very porous surface, the graphite molds were frequently removed by destroying the cast. The classified shapes of the graphite molds were also sanitized by crushing and reducing them to less than a half-inch in size [Anderson, Pritchard]. The plutonium imbedded in the molds was either recycled or disposed depending on the economic discard limit (approximately 0.15% by weight). The reprocessing methods were similar to the magnesium oxide with acid wash and incineration.

Ash: Ash was also found in the CH-TRU waste streams. Due to complex mechanical bonding, the ash has proven to be more difficult to extract plutonium from than other reflector materials. The easiest way to extract carbon was to reburn the ash waste at 600°C for a period of 4 hours [Blum]; however, other mechanically bonded impurities such as silicon on the burnt ash will still be tightly bound and mechanically inseparable.

Organic liquid: Since the CH-TRAMPAC dictates that any liquids greater than 1% by volume are prohibited; all the liquid waste must be solidified. Solidification (i.e. cementation, vitrification, etc.) assures plutonium and potential reflectors are mechanically bound and also chemically bound for some solidification options.

Graphite powder additive: In some cases, additional graphite particulate may have been added to reduce the attractiveness of the material from the safeguards & security point of view; however, the original plutonium waste was found to be mechanically or chemically bounded with substantial amounts of

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other oxides (e.g., silicates, heavy metal oxides, etc.) prior to adding the graphite material [WSPF#RLRFETS.001].

DEPLETED URANIUM
There are three types of depleted uranium-contaminated waste found in the TWBID search: (1) debris waste containing metal scrap, uranium standards (calibration sources), and weapons components, (2) solidified sludge, and (3) solutions.

Debris waste: Plutonium contaminated uranium scrap and surplus uranium materials are difficult to decontaminate, attesting to the plutonium and uranium being mechanically bound. Techniques such as electrochemical decontamination are often employed that dissolve layers of the surface material in order to remove the plutonium [Lloyd].

Solidified Sludge: Solidified sludge (i.e., cementation, vitrification, etc.) containing uranium and plutonium bind these metals/oxides mechanically and chemically, thus rendering them inseparable.

Uranium and plutonium solutions: Since the CH-TRAMPAC dictates that any liquids greater than 1% by volume are prohibited; all the liquid waste must be solidified. Solidification (i.e., cementation, vitrification, etc.) assures plutonium and reflector are mechanically bound and also possibly chemically bound for some solidification options.

BERYLLIUM / BERYLLIUM OXIDE (Be/BeO)
As discussed in the TRUPACT-II and HalfPACT SAR Sections 6.4.3.3, Be/BeO may be present in quantities greater than 1% by weight. Containers, except for pipe overpacks, with greater than 1% by weight Be/BeO reflectors will be shipped under the Case B limits at less than or equal to 100 FGE per TRUPACT-II or HalfPACT. Pipe overpacks, which only contain Be in greater than 1% by weight quantities that is chemically and/or mechanically bound, will be shipped under the Case E limits at 200 FGE per pipe overpack and 2,800 FGE per TRUPACT-II or 1,400 FGE per HalfPACT, respectively.

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DEUTERIUM (D_2O)
D_2O is not expected in any of the CH-TRU waste streams. Even if it was expected, it is a liquid and any liquid greater than 1% by volume is prohibited; therefore, all the deuterium oxide waste must be solidified. Solidification (i.e., cementation, vitrification, etc) assures that the plutonium and deuterium reflector materials are mechanically bound.

CONCLUSION
Our research shows that the special reflector materials of interest (other than Be/BeO) in CH-TRU waste are either: (a) not present in quantities greater than 1% by weight, i.e., trace amounts or (b) chemically or mechanically bound to the plutonium, i.e., inseparable mixture. During normal conditions of transport the reflector materials, if present, will remain bound to the plutonium. During hypothetical accident conditions there is no identified mechanism that would cause the special reflector materials of interest to become unbound from the plutonium. If the plutonium could somehow disengage from the rest of the waste matrix and congregate into a most reactive sphere (i.e., improbable reorganization) – the special reflector materials of interest will remain as a non-fissile impurity within the sphere. They will not credibly reconfigure into a reflective shell around the sphere.

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WIPP Waste Stream Profile Form #RLRFETS.001, M4T00-TRU-03-487, February 2004, Rocky Flats Environmental Technology Site, Golden, Colorado.

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6-2 In Chapter 6 of the TRUPACT-II and HalfPACT SARs discuss the methods to be used to demonstrate the thicknesses and packing fractions of special reflectors in CH-TRU waste for comparison to the parameters given in Table 6.2-1.

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It is not clear if or how the applicant intends to show that particular CH-TRU waste payloads contain special reflector materials meeting the parameters listed in Table 6.2-1. It is also not clear whether or not the special reflector material thicknesses or packing fractions can reconfigure under hypothetical accident conditions into a more reactive geometry.

This information is required to ensure that the applicant has identified the most reactive credible configuration consistent with the chemical and physical form of the material to be shipped, as required by 10 CFR 71.55(b).

Response:
Table 6.2-1 presents the results of KENO-V.a calculations that were performed to evaluate the sensitivity of the equivalent thickness of special reflector materials at various packing fractions and is presented for completeness only. This application does not request approval of limits based on Table 6.2-1. There is no requirement for the sites to demonstrate the thickness of special reflector materials at various packing fractions for comparison to the parameters given in Table 6.2-1 because the special reflector materials of interest in CH-TRU waste are, as stated in the conclusion to the response to RAI 6-1, either: (a) not present in quantities greater than 1% by weight or (b) chemically or mechanically bound to the fissile material. Additionally, even if the fissile material could somehow disengage from the rest of the waste matrix and congregate in a most reactive sphere – the special reflector materials of interest will remain as a non-fissile impurity within the sphere. They will not credibly reconfigure into a reflective shell around the sphere.

6-3 **Clarify in Chapter 6 of the TRUPACT-II and HalfPACT SARs how it will be assured that axial spacing provided for criticality control under Case D will remain in place during hypothetical accident conditions. Also, discuss the potential for fissile material reconfiguration between overpacking drums under Case D during hypothetical accident conditions.**

It is not clear that the geometry conditions relied on for criticality control under the Case D criticality analysis will be present after the hypothetical accident conditions testing described in 10 CFR 71.73.

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This information is required to ensure that the applicant has identified the most reactive credible configuration consistent with the chemical and physical form of the material to be shipped, as required by 10 CFR 71.55(b).

Response:
Comment incorporated. Sections 6.2.4, 6.3.1.4, and 6.4.3.4 of the TRUPACT-II and HalfPACT SARs have been revised to clarify that the separation between pucks in two axially adjacent overpack drums is maintained at greater than or equal to 0.50 inch through the use of a compacted puck drum spacer. Appendix 1.3.1 of the TRUPACT-II and HalfPACT SARs has been revised to add Drawing 163-006 that provides the requirements for the 55-, 85-, and 100-gallon compacted puck drum spacers. Section 3.1.1 of the CH-TRAMPAC has been revised to require the use of puck drum spacers, as applicable to the compaction controls utilized in the machine compaction operation. The puck drum spacers ensure that the minimum separation is maintained under NCT and HAC conditions as verified and documented in the Packaging Technology, Inc., test report, TR-017, Rev. 0, March 2004, *Test Report for Compacted Drums*, which is provided in Attachment G, References.

The potential reconfiguration of fissile material between or outside of the overpack drums would result in a configuration that is bounded by either the Case A or Case D criticality analyses with 325 FGE limits. If all of the fissile material is bound inside of two compacted pucks at the most reactive ratio of 200/125 FGE, such that all the fissile material is moderated by water and polyethylene at a packing fraction greater than 70%, then the Case D analysis is bounding. If all of the fissile material were to reconfigure outside of the compacted pucks, then the fissile material would be moderated by water only such that the Case A analysis is bounding. As demonstrated through the compacted puck drum testing, the compacted pucks remained intact after the HAC drops such that it is not credible for highly moderated fissile material to be released from one compacted puck and reconfigure inside of another. Therefore, the Case D analysis is appropriately bounding for machine compacted waste in the form of puck drums.

For machine-compacted waste not meeting the requirements of Case D, Sections 6.4.3.4 and 6.4.3.5 of the TRUPACT-II and HalfPACT SARs and Section 3.1.1 of the CH-TRAMPAC have been revised to address the shipment

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of machine-compacted waste under the limits defined for Case C (250 FGE per TRUPACT-II or HalfPACT).

6-4 Revise Chapter 3 of the CH-TRAMPAC to address uncertainty associated with the determination of ^{240}Pu in the CH-TRU waste.

The determination of ^{239}Pu fissile gram equivalents (FGE) in Chapter 3 of the CH-TRAMPAC conservatively includes two times the measurement error in the total. The determination of ^{240}Pu in the CH-TRU waste should also include a method to account for measurement uncertainty.

This information is needed to ensure that the applicant has identified the specific contents of the package according to 10 CFR 71.33(b).

<u>Response</u>:
Comment incorporated. Section 3.1.1 of the CH-TRAMPAC has been revised to require that two times the error (i.e., two standard deviations) be subtracted from the 240-Pu content for purposes of determining the appropriate FGE limit in Table 3.1-1.

6-5 Revise the polyethylene packing fraction used in Chapter 6 of the TRUPACT-II and HalfPACT SARs to account for the potential presence of blocks or other material forms which may result in a higher polyethylene packing fraction than thin sheeting. Alternatively, revise the CH-TRAMPAC to ensure that such forms of polyethylene or other high hydrogen density materials are excluded from the TRUPACT-II and HalfPACT payloads in excess of the packing density assumed.

The Washington TRU Solutions, LLC Document Number WP 08-PT.09, "Test Plan to determine the TRU Waste Polyethylene Packing Fraction," simulates CH-TRU waste as polyethylene sheeting. The packing fraction from this simulation is asserted to be 14% which appears to be low in spite of a manual compaction. On the other hand, on Page 10 of SAIC-1322-001 report a packing fraction of 70% is indicated to be reasonable. Therefore, a packing fraction which includes the presence of higher density forms of polyethylene or other high hydrogen density materials should be used.

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This information is needed to ensure that the applicant has identified the specific contents of the package according to 10 CFR 71.33(b).

<u>Response</u>:
The use of a 25% polyethylene packing fraction which is homogenously mixed with fissile material and water is a conservative and appropriately bounding moderator for non-machine compacted CH-TRU waste because of the following:

a) Polyethylene and other hydrocarbon based materials that are present in CH-TRU waste are in the form of plastic bags or other plastic forms such as bottles, gloves, and hoses, which have characteristic shapes and dimensions that result in low packing fractions that are bounded by the 14% value determined in WP 08-PT.09. The use of a 25% polyethylene packing fraction as the minimum packing fraction modeled provides significant conservatism to the 14% value determined in the test.

b) Polyethylene and other hydrocarbon-based materials are not present in tightly-packed small particulate forms in sufficient quantity or purity to credibly act as moderators with a packing fraction that approaches either the maximum theoretical packing fraction of 70% (based on highly ordered systems) or the maximum achievable packing fraction of 50% (based on randomly ordered particles).

c) Blocks or chunks of moderating materials would result in a heterogeneous fissile mixture that is less reactive than a 25/75 poly/water moderator that is homogenously mixed with fissile material.

The presence of larger blocks of polyethylene was evaluated and the results incorporated as Section 2.5 of SAIC-1322-001 Rev. 1, which is provided in Attachment G, References. At a 25% overall packing fraction of polyethylene in the fissile sphere, reactivity is reduced as the polyethylene is divided into discrete spheres. The number of polyethylene spheres modeled ranged from 1 to 12,167 while the keff + 2σ value ranged from 80% to 99.5% of the homogeneous value at the respective ends of the range. A polyethylene packing fraction of 52.2%, equal to the theoretical packing fraction of a cubic array and approximately equal to the maximum achievable packing fraction for a random array of particles, was modeled using discrete spheres. (Tests with uranium and other powders have

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shown that even when a can of powder is shaken or vibrated, the maximum density achieved is approximately 50% of the theoretical value; this density is often referred to as the tap density.) Due to the reduction in reactivity caused by the heterogeneity, a system with polyethylene particles greater than 2.2 cm in diameter will be less reactive than a homogeneous system at 25% polyethylene packing fraction as modeled in Case A.

Chapter 6.0 of the TRUPACT-II and HalfPACT SARs has been updated to reference the updated version of SAIC-1322-001.

6-6 **Revise Section 3.3 of the pipe overpack criticality analysis to clarify the moderation condition assumed for the Case F pipe overpack payload geometry.**

PacTec Document Number ED-076, "Pipe Overpack Criticality Analysis for the TRUPACT-II Package," states that the pipe components under Case F are modeled with "... a range of 40% polyethylene/60% water mixture (to identify optimal moderation)." It is unclear from this statement whether the applicant evaluated a range of polyethylene to water mixtures, or used the 40% polyethylene/60% water mixture as bounding. If the 40% polyethylene/60% water mixture is considered bounding for this analysis, the applicant should state why this ratio is more appropriate than the 25% polyethylene/ 75% water mixture used elsewhere in the analysis.

This information is required to ensure that the applicant has identified the most reactive credible configuration consistent with the chemical and physical form of the material to be shipped, as required by 10 CFR 71.55(b).

Response:
Comment incorporated. The appropriately bounding packing fraction for polyethylene in CH-TRU waste is established by WP 08-PT.09 as 14%. Various polyethylene packing fraction values, all greater than 14%, were conservatively utilized for convenience in the TRUPACT-II and HalfPACT criticality analyses for non-machine compacted waste. The ED-076 report, which is provided in Attachment G, References, was revised to clarify that the poly/water ratio in the Case F analyses was fixed at 40/60, where the H/Pu ratio was varied to determine optimum moderation. Because CH-TRU waste in pipe overpacks is

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non-machine compacted, the use of a 40% polyethylene packing fraction is appropriately conservative.

Sections 6.0, 6.2.5, and 6.2.6 of the TRUPACT-II and HalfPACT SARs have been revised to clarify that Cases E and F apply to non-machine-compacted waste only. Additionally, Section 6.4.3.5 has been revised to clarify that Case F is provided for completeness only and no limits based on Case F are requested (see response to RAI 6-1). CH-TRU Payload Appendices 4.2, 4.3, and 4.4 have been submitted in their entirety to reference the updated version of ED-076.

6-7 **Revise the pipe overpack analysis to show that the applicant has identified the highest reactivity for the S200-A models under Case E.**

Tables 27 and 28 of the PacTec Document Number ED-076, "Pipe Overpack Criticality Analysis for the TRUPACT-II Package," for the S200-A wet and dry models under Case E, do not appear to have identified the highest reactivity for either model. The highest reactivity shown for these cases is at an H/Pu ratio of 1000, which is the highest H/Pu considered. Evaluations at higher H/Pu ratios may yield a higher k_{eff}.

This information is required to ensure that the applicant has identified the most reactive credible configuration consistent with the chemical and physical form of the material to be shipped, as required by 10 CFR 71.55(b).

<u>Response</u>:
Comment incorporated. The reactivity peaked at an H/Pu ratio of 1000 because there was not room in the pipe component to add additional water. To determine the H/Pu ratio at which reactivity is maximized, additional cases were run and documented in a revision to ED-076, which is provided in Attachment G, References, in which beryllium and/or plutonium is removed to allow volume for additional water. For an H/Pu ratio of 1100, the beryllium content is reduced to 578 g. For an H/Pu ratio of 1200, the beryllium is removed completely and the plutonium is reduced to 191 FGE. For an H/Pu ratio of 1300, the plutonium is further reduced to 176.6 FGE. The most reactive condition, k_s = 0.9115, occurred at an H/Pu = 1100 and is below the USL of 0.9377.

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6-8 Provide description of the reference case in Figure 2.2-1 of the SAIC-1322-001 report.

The SAIC-1322-001 report neither provides a description of the reference case, for which the results are depicted in Figure 2.2-1, nor does it provide the bases for selecting the specific parameter values for the reference case. This information is required per 10 CFR 71.55(b).

Response:
Comment incorporated. The SAIC-1322-001 report, which is provided in Attachment G, References, has been revised to incorporate a description of the reference case in Section 2.3, which is also cross-referenced in Section 3.2 of the report. Additionally, discussion and figures were added in Sections 2.3 and 2.4 for the KENO-V.a moderator study model and in Section 3.2 for the reflector study model.

6-9 Provide the basis for not considering other materials such as paraffins, polypropylene/polybutadiene based rubbers, and silicone greases/waxes which are more reactive than polyethylene.

Page 37 of the SAIC-1322-001 report asserts that the presence of materials such as those mentioned in the above is not credible. However, these materials are allowed under Type III.1 waste category. This information is required per 10 CFR 71.55(b).

Response:
Comment incorporated. SAIC-1322-001, which is provided in Attachment G, References, has been revised to state that all of the materials questioned, with the exception of the silicone grease/wax, are more reactive than the reference case (25% polyethylene packing fraction), but less reactive than polyethylene (100% packing fraction). As discussed in the Executive Summary and Section 2.6 of SAIC-1322-001, Rev. 1, the specific applications for the more reactive silicone based hydrocarbon modeled were investigated to show that moderation of the fissile sphere by a pure form of this material is not credible. The remaining materials are, therefore, conservatively evaluated through the modeling of polyethylene at the bounding packing fraction for these materials (i.e., a packing fraction greater than 14%).

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6-10 Provide a description of the model in Page 12 of PacTec Document ED-076 which is consistent with Figure 3-2.

For example, the text indicates the ICV and OCV shell thickness on the top and bottom is 1.27 cm. However, Figure 3-2 indicates that this thickness is for the sides. There are a number of other inconsistencies. This information is needed per 10 CFR 71.7.

__Response__:
Comment incorporated. PacTec Document ED-076, which is provided in Attachment G, References, has been revised. The KENO-V.a schematic of the TRUPACT-II has been revised and renumbered as Figure 3-1 to correctly illustrate the ICV+OCV top and bottom thickness as 1.27 cm and the ICV+OCV side thickness as 1.11 cm.

6-11 Clarify how 0.299 Kg of beryllium constitutes 1% of 200 g Pu.

On Page 14 of PacTec Document ED-076, 0.299 Kg of beryllium is assumed to be uniformly distributed with 200 g of plutonium. 0.299 Kg of beryllium is about 150% of plutonium. This information is needed per 10 CFR 71.7.

__Response__:
The Be evaluated was 1% of the weight of the waste contents, not 1% of the Pu content in the waste. Therefore, the maximum weight of the waste contents for a 6-inch pipe overpack is 66 lbs. (see CH-TRAMPAC Table 2.9-7) such that the Be weight is (0.01)(66 lbs.) = 0.66 lbs. = 0.299 kilogram (Kg).

6-12 Explain the volume fraction of 0.023 used for the water saturated polyethylene mixture that fills the space between the shells as stated in PacTec ED-076 Revision 2: Pipe Overpack Criticality Analysis for the TRUPACT-II Package.

This information is required to ensure that the applicant has identified the most reactive credible configuration consistent with the chemical and physical form of the material to be shipped as required by 10 CFR 71.55(b).

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Response:
The density of foam filling the space between the outer containment vessel (OCV) and OCA outer shell is nominally 8.25 pounds per cubic foot (pcf) (0.132 grams/cubic centimeter [g/cc]). The density of foam utilized in the S200 pipe overpack to position the lead shield inside of the pipe component is nominally 15 pcf (0.240 g/cc). A single lower nominal density foam (0.021 g/cc) was originally assumed in the models. The 0.023 volume fraction used in the models arises from modeling the polyurethane as polyethylene. A polyethylene density of 0.92 g/cc is the default for SCALE. Thus, modeling 0.021 g/cc polyurethane foam as polyethylene results in a volume fraction of 0.021 / 0.92 = 0.023.

Since the limiting analysis cases use a void in the region between the OCV and OCA outer shells, the use of a lower density foam in this region is conservative. When more reflection results in a higher reactivity (such as the single unit cases), the modeled polyurethane foam in the OCV/OCA space was assumed to be saturated with water. This assumption is conservative because the polyurethane foams utilized in the packaging and S200 pipe overpack designs are closed-cell and absorb water only as a function of exposed surface area (~0.015 lbs/ft^2). Therefore, the representation of the foam in the space between the OCV and OCA Outer Shell bounds the true HAC physical condition.

In response to RAI 6-7 (above), additional S200 cases were run to search for the maximum reactivity. As documented in the revision to ED-076, which is provided in Attachment G, References, in these additional cases, the S200 foam density was changed to 15 pcf (0.2403 g/cc) and modeled as polyethylene with a volume fraction of 0.2612 in the region surrounding the lead shield inside of the pipe component. For consistency, the original S200 cases were rerun with 15 pcf foam in this region.

6-13 Provide sample KENO input files for the calculations (Tables 12 through 32) presented in PacTec ED-076 Revision 2: Pipe Overpack Criticality Analysis for the TRUPACT-II Package. Include NCT and HAC cases.

This information is required per 10 CFR 71.7(a).

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(Continued)

Response:
Comment incorporated. PacTec Document ED-076, which is provided in Attachment G, References, has been revised to include sample KENO input files for the calculations.

Chapter 7 Operating Procedures

7-1 Describe the impact of eliminating the three polyethylene filters which is mentioned in Section 7.1.2.4.1 of the current SAR.

It is not clear where exactly in the package these polyethylene filters have been used and what the impact would be when they are eliminated. This clarification is needed per 10 CFR 71.7.

Response:
Three 1/8-inch diameter radial penetrations, with optional polyethylene filters for the TRUPACT-II and without filters for the HalfPACT, are provided near the top of the lower ICV seal flange, above the innermost (containment) O-ring seal (see Detail AU on TRUPACT-II General Arrangement Drawing 2077-500SNP, Sheet 7, in Appendix 1.3.1 of the TRUPACT-II SAR). This feature was added to the TRUPACT-II at the same time as the sponge rubber ICV debris shield, which is located inside the upper ICV seal flange, following TRUPACT-II Engineering Development Testing. The intent of the debris shield was to prevent fine dust and debris from fouling the containment O-ring seal. The intent of the 1/8-inch diameter penetrations was to ensure that helium would reach the region between the debris shield and the containment O-ring during leakage rate testing. At that point in time, filters were needed so that fine dust could not bypass the debris shield. Following testing of CTU-1 and CTU-2, and prior to testing CTU-3, a wiper O-ring seal was added for additional containment seal protection. A corresponding port was also added in the ICV vent port to allow a helium gas purge of the small space between the wiper O-ring seal and the containment O-ring seal (see Section J-J on General Arrangement Drawing 2077-500SNP, Sheet 4, in Appendix 1.3.1 of the TRUPACT-II SAR). With the addition of the wiper O-ring seal and helium purge port, the three radial penetrations serve only to allow communication of helium gas to both sides of the foam rubber debris shield during leakage rate testing. Being isolated from the payload cavity by the

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wiper O-ring seal, the three penetrations are protected from any payload cavity debris. Because of this protection, the polyethylene filters are no longer necessary thereby eliminating the corresponding need for visual inspection of the optional polyethylene filters prior to each use of the TRUPACT-II.

7-2 **Clarify if removing O-ring seals from the packages for the purpose of airing out the helium gas is part of the normal operation, and if it should be listed as part of operating procedures.**

Due to the permeation of helium through the O-ring seals, the TRUPACT-II packages were failing the leak test which necessitated replacement of O-ring seals more frequently. However, the NRC staff was notified that an additional step that consists of removing O-rings and airing the helium gas out of the O-ring seals has been added to the operation and it appears to be working. If this has become a part of normal operation, the operating procedure needs to reflect this additional step. This clarification is needed per 10 CFR 71.7.

Response:
Current site procedures specify removing, cleaning, and visually inspecting the O-ring seals prior to re-use within the packaging. However, site procedures do not define a formal "airing out" process to reduce or eliminate residual helium that may be entrapped within the rubber matrix. Regardless of the condition of the O-ring seals with respect to possible helium entrainment, they must still be shown to pass a 1×10^{-7} ref·cc/s, air, leakage rate test (or optional 1×10^{-3} ref·cc/s, air, pre-shipment rate-of-rise leakage rate test). Therefore, adding an "airing out" step is unnecessary.

7-3 **Explain why checking for surface contamination is not included in the unloading procedure.**

Generally, as part of the unloading procedure, swipe samples are taken from the package surface to determine any possible increase in surface contamination during transit. This clarification is needed per 10 CFR 71.7.

Response:
Neither 49 CFR §173.443, or 10 CFR §71.87 or §71.89 require surface contamination checks following shipment and prior to the package unloading

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process. In addition, as referenced in the new draft to RegGuide 7.9 (DG-7003), 10 CFR §20.1906 does require both surface contamination and radiation level checks of a package system within three (3) hours of receipt for greater than Type A quantities of radioactive material. However, although a valid regulation, 10 CFR §20.1906 is a facility requirement, not a transportation requirement, and is addressed in non-transportation related facility procedures.

Chapter 8 Acceptance Tests and Maintenance Program

8-1 Justify elimination of testing the OCA and ICV lids lifting sockets which is currently listed as part of Acceptance Tests in the TRUPACT-II SAR.

It is not clear why the current HalfPACT SAR does not include testing of the OCA and ICV lid lifting sockets. Therefore, the justification to eliminate it from the TRUPACT-II SAR in order to be consistent with the HalfPACT SAR is not valid. This clarification is needed per 10 CFR 71.7.

<u>Response</u>:
Comment incorporated. At the time of the original HalfPACT SAR submittal, the 10 CFR §71.45(a) regulatory requirements were interpreted to apply to lift points that were designed to lift the entire package (i.e., forklift pockets) and not individual packaging components (i.e., OCA and ICV lid lifting sockets). However, OCA and ICV lid lifting socket load tests have been performed on all TRUPACT-II and HalfPACT production units under the requirements originally specified in the TRUPACT-II SAR, Section 8.1.2.1.

In accordance with the guidance provided in Reg Guide DG-7003, Sections 8.1.2.1 of the TRUPACT-II and HalfPACT SARs have been revised to incorporate OCA and ICV lid lifting socket load tests.

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Chapter 9 Quality Assurance Program

9-1 Explain the QA program that is used to specify QA requirements equivalent to the NRC QA requirements for the activities related to design, fabrication, assembly, testing, procurement, use, maintenance, and repair.

The CoC holder is the U.S. Department of Energy while the SAR is prepared and submitted by Washington TRU Solutions, LLC, with Packaging Technology's name on the drawings. It is not clear which quality activities are performed by each entity to satisfy the QA requirements.

Response:
The DOE–CBFO Quality Assurance Program Document, (QAPD), (DOE/CBFO-94-1012, Revision 5, May 2003) establishes QA program requirements for all quality-affecting programs, projects, and activities sponsored by the DOE-CBFO. The QAPD is a compilation of QA program source documents from various agencies that regulate the WIPP. One of the program source documents is 10 CFR Part 71. The QAPD states in part, *"Program participants shall develop and follow plans and procedures that effectively implement the requirements described in this QAPD along with those requirements contained within the...TRUPACT-II Certificate of Compliance, including TRUPACT-II Authorized Methods for Payload Control (TRAMPAC), as applicable."* Therefore, QA programs for design, fabrication, assembly, testing, procurement, use, maintenance, and repair of Type B packaging that meet the QAPD satisfy the requirements of 10 CFR Part 71, Subpart H.

Compliance with the QAPD is a condition of the contract between the DOE and Washington TRU Solutions LLC (WTS) for the management and operation of WIPP. Also included in the scope of the contract is preparation and submittal of applications to the U.S. Nuclear Regulatory Commission (on behalf of the DOE) for Type B packagings used for the shipment of transuranic waste to WIPP; e.g., TRUPACT-II, HalfPACT, and RH-TRU 72-B. WTS maintains the WIPP Quality Assurance Program Plan for Type "B" Packaging (WP 08-PT.03) that identifies the applicable QA requirements for the, use, maintenance, and repair of Type B packagings. WP 08-PT.03 also states the QA requirements and procedures implemented by WTS. WP 08-PT.03 is written to comply with 10 CFR Part 71 Subpart H, and follows guidance found in U.S. Nuclear Regulatory Commission

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Regulatory Guide 7.10, Establishing Quality Assurance Programs for Packaging Used in the Transport of Radioactive Material, Annex 2.

Procurement of TRUPACT-II and HalfPACT is done by DOE-CBFO under the QAPD. Use of TRUPACT-II and HalfPACT is by WTS and DOE generator sites under programs that also meet the requirements of the QAPD. WTS enters into subcontracts for design, fabrication, assembly, testing, maintenance, and repair of Type B packagings with vendors that maintain U.S. Nuclear Regulatory Commission approved 10 CFR 71 Subpart H QA programs. Packaging Technology's name appears on the drawings because they were subcontracted to WTS for packaging design control including preparation of drawings.

Attachment C1

List of Revised Pages (Insert/Delete) for
Revision 20 (May 2004) of the TRUPACT-II Safety Analysis Report (SAR)

SECTION	DELETE	INSERT
Covers and Spine	Covers and Spine	Covers and Spine
Table of Contents	i through xviii	i through xviii
Chapter 1.0	1.3.1-1, 1.3.1-2, Dwg. 163-001, sheets 1-3 (Rev. 5), —	1.3.1-1, 1.3.1-2, Dwg. 163-001, sheets 1-3 (Rev. 6), Dwg. 163-006, sheet 1 (Rev. 0)
Chapter 6.0	6.1-1 through 6.1-6, 6.2-1 through 6.2-6, 6.3-1 through 6.3-6, 6.4-1 through 6.4-10	6.1-1 through 6.1-6, 6.2-1 through 6.2-6, 6.3-1 through 6.3-6, 6.4-1 through 6.4-10
Chapter 8.0	8.1-1 through 8.1-18	8.1-1 through 8.1-20