WEST VALLEY DEMONSTRATION PROJECT

WASTE INCIDENTAL TO REPROCESSING (WIR) EVALUATION FOR VITRIFICATION FACILITY EXPENDED MATERIALS

Revision 1

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1.0 INTRODUCTION AND SUMMARY

This document describes the waste incidental to reprocessing (WIR) evaluation to determine whether vitrification expended materials (VEM) can be managed as either transuranic (TRU) or low-level waste (LLW). It has been prepared in accordance with WV-929, Revision 1 "Waste Incidental to Reprocessing Determination." (See Reference 1.) The WVDP VEM must undergo the WIR evaluation process because these materials could be from high-level waste (HLW) systems 63, 68, or 69, (See Attachment A in WV-929 for high-level waste system descriptions) and may consist of equipment or components with designators C, D, G, H, K, L, or V. (See Attachment B in WV-929 for equipment/component designator descriptions. Systems with those designators have been used to process, transfer, or store HLW.) In addition, the waste cannot be excluded from the WIR determination process by citation. Therefore, a WIR evaluation is necessary to determine if the VEM can be managed as other than high-level waste.

1.1 Background

The VEM is glass, slurry and airborne contaminated equipment routinely generated during continued operations and is composed of metals, ceramics, compactables, cabling and other material. Metals include pipes, tools, jumpers, bolts, and other components. Ceramics include ceramic blocks and liners. Compactables include seals, gaskets, gloves, plastic containers, plastic materials, and other similar material. Cabling includes electrical cords, thermocouple cords, and other connectors. “Other material” includes radiological probes, cameras, and glass bottles. Active management of these materials began in July 1999, with only airborne contaminated pieces being removed and placed into on-site Lag Storage as LLW. Segregated glass and slurry pieces are staged in the High Level Waste Interim Storage Facility until shielded containers are prepared. Once shielded, storage of these materials in Lag Storage as TRU waste will be possible.

1.2 Approach

For the VEM to be managed as LLW or TRU waste through the WIR evaluation process, the criteria listed in WV-929, Section 6.1.2 A or B, must be satisfied.

1.2.1 LLW Criteria

(1) Processing the VEM to remove key radionuclides to the maximum extent that is technically and economically practical will be demonstrated by comparing different processes to the baseline process of segmentation and segregation.

(2) Managing the waste to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives* (Reference 2) will be demonstrated by comparing the waste form to that of LLW disposal facilities, which by definition must meet 10 CFR Part 61 criteria.

(3) The third LLW criterion will be demonstrated by comparing estimated radionuclide concentrations of the VEM to those listed in 10 CFR 61.55.

1.2.2 TRU Criteria

(1) Processing to remove key radionuclides to the maximum extent that is technically and economically practical will be demonstrated by comparing different processes to the baseline process of segmentation and segregation.

(2) The second TRU criterion will be demonstrated by ensuring that the VEM is in a solid physical form.

(3) The third criterion will be demonstrated by comparing the waste form to the Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC), which by definition must meet the requirements of Chapter III of DOE M 435.1-1 (Reference 3).

1.3 Summary of Results

Listed below is an outline of this document and a summary of the results for each section:

Section 2.0 - provides a summary of the different processes that were reviewed and evaluates their practicality both economically and technically. Furthermore, it concludes that there are no economically practical processes available to remove key radionuclides from the VEM even though there may be technically viable processes. When all the process options are compared, the preferred choice is segmentation and segregation. It is the most cost-effective process evaluated that provides a path to disposal for the VEM.

Section 3.0 - provides an analysis of the requirements and guidance on the application of concentration limits to the residual contamination. It discusses radionuclides, their anticipated concentrations, the TRU content, and Class C limit contribution.

Section 4.0 - provides the basis by which the performance objectives set out in 10 CFR Part 61 will be met. It concludes that the anticipated waste form compares favorably with the waste acceptance criteria (WAC) of currently permitted LLW and TRU disposal facilities.

2.0 TECHNICAL AND ECONOMIC PRACTICALITY

This section describes the alternatives considered for removing the key radionuclides from VEM and for managing these radionuclides as HLW. This section also discusses the technical and economic practicality of the various alternatives as required in WV-929, Sections 7.5.1 and 7.5.2.

2.1 Technical Practicality

To classify the waste as LLW or TRU using the WIR evaluation process requires that the HLW material be processed or will be processed to the maximum extent technically practical. Two fundamental options exist for removal of key radionuclides from VEM. The first is to remove the radionuclides and recycle them back into the vitrification process ultimately resulting in additional HLW glass. This option is only feasible with an ongoing vitrification process. It is not feasible if the goal is to complete vitrification and shutdown the melter by September of 2002. It is not possible to design and implement a recycle stream in the time available. The second option is to remove radionuclides and manage the resulting waste as an unqualified nonstandard HLW form. However, there are currently no disposal options for nonstandard HLW.

The options potentially available for removal of the radionuclides and recycling them back into the vitrification process to generate qualified glass are use of a mechanical mill, chemical dissolution, high pressure wash, or use of a glass removal tool. Three methods of waste processing were evaluated even though it is possible to meet the requirements for managing all expended components as TRU or LLW through segmentation and segregation. The reports detailing the evaluations are provided in Appendices A through C and are summarized in the following sections. The first method presented is the baseline process of segmentation and segregation which is required to package the waste; the second is mechanical milling; and the third is chemical dissolution.

2.1.1 Segmentation and Segregation

Segregation involves physically separating items that are contaminated with glass and/or slurry from those that are airborne contaminated. Additionally if part of an item is contaminated, it is mechanically separated from the remaining item.

Size-reduction (segmentation) and segregation is a technically proven technique for reducing the volume of material to be managed. Equipment is readily available to perform this activity and limited training and/or skill is required.

2.1.2 High Pressure Wash

High pressure washing consists of circulating a decontamination solution through contaminated equipment internals under high pressure. The decontamination solution would then require treatment, based on the contaminants. This alternative is only useful for internally contaminated expended materials, such as jumpers and piping. The technology would not be useful for plugged equipment or externally contaminated materials. Because of the limited usefulness of this technology, it was not considered further as being practical.

2.1.3 Small Tank Dissolver

Another method for decontaminating materials is to use an aggressive chemical solution to dissolve glass and slurry or at least leach the radioactive components from the glass or slurry. Several tests were performed to assess the ability of the chemical solutions to decontaminate Inconel and stainless steel pipes and plates. These tests included placing Inconel and stainless steel plates that had glass annealed to them in solutions at different temperatures. The solutions included nitric acid, hydrofluoric acid, oxalic acid, sodium hydroxide, and water. In addition, tests were performed with slurry dried in pipes to simulate the worst case scenario of jumpers with dried slurry. These were put into solution to determine the dissolving capabilities of the different chemical solutions.

The tests showed that chemical dissolutions remove slurry and most of the glass from metal. The glass is not dissolved but is separated from the pieces as silica gel contained by the Teflon® netting that holds the sample. The tests show that chemical dissolution is a technically viable option for removing contaminants from metals.

2.1.4 Mechanical Milling (Ball Mill and Glass Removal Tool)

Mechanical milling uses grinding and impact to separate the contamination from the material. In order to test this decontamination technique, a jar mill was used to assess the grinding and impact ability of the mill to remove both glass and slurry. Tests were performed using a laboratory jar mill with a capacity of approximately 0.5 gallons at two rotational speeds. Test specimens included Inconel and stainless steel plates with glass annealed to their surface and short lengths of pipes filled with slurry that had dried. Glass chunks were also milled to determine size reduction capabilities.

Results from the jar mill test indicate that the mechanical mill can decontaminate equipment and reduce the size of glass chunks. Metal removal as well as glass and slurry removal was demonstrated and size-reduction of the glass and slurry was achieved. However, removal of the glass is very slow and the grinding action on the glass could result in very fine powders, which can introduce new material-handling problems such as caking or losses to process ventilation.

Additionally, the action of the mill on the metal surface could result in contamination being embedded in the surfaces that are being cleaned.

Optimization of the milling process could result in an aggressive action that would remove contamination and not alter the base surface severely. However, such development removes the mill from the proven category and puts it in the experimental one. Therefore, this process would not be technically practical and will not be used to disposition VEM.

2.2 Economic Practicality

In order to determine the economic practicality of the waste processing alternatives, life-cycle costs were estimated for five alternatives. The economic analysis is provided in Appendix D. The alternatives considered were:

1) Segmentation using mechanical means and segregation based on contamination
2) Small tank dissolver using cerium IV and nitric acid for decontamination
3) High-pressure washing consisting of circulating decontamination solution
4) Ball mill and tank rinse decontamination
5) Glass removal tool for mechanical removal of glass

The assumptions that were applied to all alternatives are:

- Irreversible treatment action (e.g., grouting or encapsulating glass-contaminated waste) is not an option without explicit prior regulator approval.
- There is a total of 1,141 cubic feet of waste to be treated.

The evaluation determined life cycle costs for each alternative. Life cycle costs included:

- Process Labor (operator, engineer, supervisor) costs of treating to remove contaminants, processing of any remaining nonstandard waste and decontaminating the equipment used in the decontamination process.
- Non-labor (capital, consumables, containers, facility's expenses) processing costs
- Transportation (labor and shipping) costs to interim off-site and final disposition
- Disposal costs ("life cycle costs") of interim off-site and ultimate deep geologic disposal
- Regulatory costs for safety analysis, readiness review, RCRA permit changes, as appropriate.

Because life-cycle costs are calculated to compare alternatives, common components were not included in the analysis. Thus, for purposes of comparison, the mean costs are presented in Table 1 for each alternative using segment and segregate as the baseline or zero-cost alternative.

Table 1: Present Value Life-Cycle Cost	
Alternative	**Mean Additional Cost ($k)**
Segment and Segregate	0
High-Pressure Wash	121
Small Tank Dissolver	557
Ball Mill, Tank Rinse	261
Glass Removal Tool	46

The alternatives other than the baseline alternative of segmentation and segregation require additional resources. Subsequently, the most economical process is segmentation and segregation since it is the most cost effective option while providing a path to disposal for the VEM.

2.3 Conclusions

Both segmentation and segregation and chemical dissolution are technically feasible techniques for processing the VEM. However, the chemical dissolution process would eventually encounter a situation at the end of the vitrification in which a substantial volume of equivalent material would be left that could not be recycled. Furthermore, chemical dissolution increases the life cycle cost by $557,000 while providing no added benefit.

The VEM meets the requirements for TRU or LLW when using segmentation and segregation, and there is no practical method for removing key radionuclides for solidification management as HLW; packaging for disposal is the only practical choice.

Recycling VEM back into the vitrification system is not practical since it can be disposed as it exists. Production of a recycle stream that can not be processed without continued vitrification, or generation of nonstandard high-level waste without a defined path to disposal provides no added benefit over segmentation and segregation and disposal as LLW or TRU waste.

3.0 CONCENTRATION LIMITS AND PHYSICAL FORM

3.1 10 CFR 61.55

In reviewing the packages of processed VEM, it was determined there are similarities among the waste packages. There are two different waste profiles (Appendix E), one for glass and slurry and the other for no visible contamination (airborne) and two types of containers: one a 30-gallon drum inside a 55-gallon overpack and the other a B-25 box. The maximum concentrations of key radionuclides in LLW can be calculated using the waste profiles for each container. In addition, an exposure rate can be calculated from the concentrations of radionuclides. The maximum key radionuclide concentrations for LLW classifications were estimated and are shown in Table 2. There is only one concentration provided per waste stream, since the limits are based on concentrations, the size of the container is irrelevant for the accuracy of these calculations. The calculations are provided in Appendix F.

Table 2 Maximum Concentration of Key Radionuclides in VEM for Class C Waste

Radionuclide	Concentration		Class C Limit (nCi/g)	Percentage of Limit	
	Glass/Slurry	Airborne		Glass/Slurry	Airborne
Am-241	4.9E+01	3.9E+01	100	49.3%	38.9%
Cm-245	2.4E+01	3.0E+01	100	24.2%	30.2%
Cm-244	1.0E+01	1.4E+01	100	10.4%	14.0%
Pu-238	6.1E+00	4.3E+00	100	6.1%	4.3%
Cm-246	3.0E+00	4.9E+00	100	3.0%	4.9%
Pu-239	1.7E+00	1.1E+00	100	1.7%	1.1%
Pu-241	5.4E+01	3.9E+01	3500	1.5%	1.1%
Pu-240	1.2E+00	7.7E-01	100	1.2%	0.8%
Cm-243	5.6E-01	0.0E+00	100	0.6%	0.0%
Cs-137[1]	2.6E+01	3.8E+01	4600	0.6%	0.8%
Am-243	5.5E-01	3.2E+00	100	0.5%	3.2%
Np-236	5.0E-01	0.0E+00	100	0.5%	0.0%
Sr-90[1]	2.2E+01	1.3E+01	7000	0.3%	0.2%
Pu-242	1.3E-03	6.3E-02	100	0.0%	0.1%
C-14[1]	3.9E-06	2.3E-02	8	0.0%	0.3%
Total				100.0%	100.0%

[1]Concentration units are in Ci/m^3

3.2 DOE M 435.1-1 Chapter III

The minium concentration of key radionuclides in TRU can also be calculated using the waste profiles. The results are shown in Table 3 and the calculations are presented in Appendix G.

Table 3 Minimum Concentration of Transuranics and Exposure Rates

Radionuclide	Glass and Slurry (nCi/g)		Airborne (nCi/g)	
	Drum	Box	Drum	Box
Exposure Rate (R/h)	6.0	9.9	6.6	15.0
Am-241	5.6e+01	5.6e+01	4.6e+01	4.6e+01
Am-243	6.2e-01	6.2e-01	3.8e+00	3.8e+00
Cm-242	1.2e+00	1.2e+00	9.4e-01	9.4e-01
Cm-243	6.4e-01	6.4e-01	0.0e+00	0.0e+00
Cm-245	2.8e+01	2.8e+01	3.6e+01	3.6e+01
Cm-246	3.4e+00	3.4e+00	5.8e+00	5.8e+00
Np-237	3.5e-02	3.5e-02	2.3e-02	2.3e-02
Pu-238	6.9e+00	7.0e+00	5.1e+00	5.1e+00
Pu-239	1.9e+00	1.9e+00	1.3e+00	1.3e+00
Pu-240	1.3e+00	1.3e+00	9.2e-01	9.1e-01
Pu-242	1.5e-03	1.5e-03	7.5e-02	7.4e-02
Total	1.0e+02	1.0e+02	1.0e+02	9.9e+01

The waste form has been evaluated against the waste requirements set forth in Chapter III of DOE M 435.1-1 and has been determined to be capable of meeting these requirements, including but not limited to the requirements that the waste be in a solid form and when packaged be capable of ensuring chemical and physical stability during transportation, storage and disposal, and the waste will be characterized and documented in sufficient detail to ensure safe management and compliance with the WAC as shown in Appendix H.

4.0 PERFORMANCE OBJECTIVES

4.1 Low-Level Waste

Commercial LLW disposal facilities must demonstrate reasonable assurance that exposures to humans are within the limits established in the performance objectives comparable to those in 10 CFR 61, Subpart C, to be licensed. WIR Criterion #2 requires that the final waste form be managed to meet safety requirements comparable to the Part 61, Subpart C, performance objectives. Therefore, if a packaged VEM component is able to meet the waste acceptance criteria (WAC) of a LLW disposal facility, it is able to be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61. Reference 4 documents an evaluation of the equivalence between the WAC of a DOE waste disposal site meeting DOE M 435.1-1 performance measures to a commercial (licensed) LLW disposal facility meeting 10 CFR Part 61, Subpart C performance objectives. It was concluded that the WAC of such a site is as protective as 10 CFR 61 performance objectives for non-in situ disposal. Applying this analysis, if a waste stream meets an off-site DOE waste disposal site's WAC (e.g., Nevada Test Site), it meets the WIR LLW Criterion 2.

The physical and anticipated radiological properties of VEM have been compared against LLW disposal facility WACs such as Hanford and the Nevada Test Site (NTS) and are shown in Appendix I and J, respectively. It has been concluded that VEM, once appropriately size reduced and properly packaged, will be acceptable for disposal.

4.2 TRU Waste

The glass-and slurry-contaminated portion of the waste is in a solid physical form and could be packaged to meet the TRU waste requirements set forth by the DOE in DOE M 435.1-1. A comparison of the glass-and slurry-contaminated waste to the minimum TRU requirements is presented in Table 3.

The physical and anticipated radiological properties of the waste categories have been compared against the WAC for the Waste Isolation Pilot Plant (WIPP) and is shown in Appendix H. Once properly packaged, these wastes will meet the criteria of this site, and will be acceptable for disposal as TRU Waste.

5.0 REFERENCES

1) West Valley Nuclear Services Company, WV-929 "Waste Incidental to Reprocessing Determination," June 19, 2001.

2) U.S. Nuclear Regulatory Commission. U.S. Code of Federal Regulations, 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste"

3) U.S. Department of Energy. July 1999. DOE M 435.1-1 Chapter III, "Transuranic Waste Requirements."

4) WSRC-RP-2001-00341, "Comparison of LLW Disposal Performance Objectives 10 CFR 61 and DOE 435.1," prepared by E. Wilhite, Westinghouse Savannah River Company, Savannah River Technology Center, dated March 1, 2001.

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Appendix B West Valley Nuclear Services Company, Inc. Letter WD:1999:0194 R. DiBiase to B. A. Mazurowski *Completion of High-Level Waste (HLW) Award Period 1 (October 1998 - March 1999), CPAF No. 8, 'Continued Evaluation of Vitrification Expended Material Dissolver'*

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Appendix D West Valley Nuclear Services Company, Inc. Letter WD:1998:1402 L. E. Krieger to B. A. Mazurowski *Projected Life Cycle Costs of Selected Alternatives for Decontaminating Equipment: Application of a Prototype Waste Management Deployment Model, Final Report*

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Appendix A

West Valley Nuclear Services Company, Inc.

Letter WD:1998:1257

R. DiBiase to B. A. Mazurowski

Completion of Contract Milestone V-4, Task 3, 'Processing System for Disposition of Expended Vitrification Material Equipment and Hardware'

Appendix B

West Valley Nuclear Services Company, Inc.

Letter WD:1999:0194

R. DiBiase to B. A. Mazurowski

Completion of High-Level Waste (HLW) Award Period 1 (October 1998 - March 1999), CPAF No. 8, 'Continued Evaluation of Vitrification Expended Material Dissolver'

Appendix C

West Valley Nuclear Services Company, Inc.

Letter WD:1999:0241

R. DiBiase to B. A. Mazurowski

Completion of 'Continued Evaluation of Vitrification Expended Material Dissolver,' CPAF No. 8, High-Level Waste (HLW) Award Period 1 (October 1998 - March 1999)'

Appendix D

West Valley Nuclear Services Company, Inc.

Letter WD:1998:1402

L. E. Krieger to B. A. Mazurowski

Projected Life Cycle Costs of Selected Alternatives for Decontaminating Equipment: Application of a Prototype Waste Management Deployment Model, Final Report

Appendix E

Waste Profiles for Glass/Slurry and No Visible Contamination (Airborne)

Radionuclides and Scaling Factors to Cs-137		
Radionuclide	**Glass/Slurry**	**Airborne**
Ac-227	3.8E-06	0.0E+00
Am-241	1.0E-02	5.3E-03
Am-243	1.1E-04	4.4E-04
C-14	1.5E-07	5.9E-04
Cm-242	2.2E-04	1.1E-04
Cm-243	1.2E-04	0.0E+00
Cm-244	2.1E-03	1.9E-03
Cm-245	5.0E-03	4.1E-03
Cm-246	6.1E-04	6.7E-04
Co-60	3.0E-04	1.8E-04
Cs-134	1.1E-04	0.0E+00
Cs-135	1.1E-05	0.0E+00
Cs-137	1.0E+00	1.0E+00
Eu-154	7.8E-03	2.7E-03
Fe-55	0.0E+00	1.5E-03
H-3	0.0E+00	3.0E-06
I-129	0.0E+00	0.0E+00
Nb-93m	1.9E-05	0.0E+00
Ni-59	2.2E-05	7.9E-05
Ni-63	2.3E-03	2.4E-03
Np-236	1.0E-04	0.0E+00
Np-237	6.3E-06	2.7E-06
Pa-231	9.1E-06	0.0E+00
Pd-107	9.4E-08	0.0E+00
Pu-236	8.2E-06	0.0E+00
Pu-238	1.3E-03	5.9E-04
Pu-239	3.4E-04	1.5E-04
Pu-240	2.4E-04	1.1E-04
Pu-241	1.1E-02	5.4E-03
Pu-242	2.7E-07	8.6E-06
Se-79	1.1E-09	0.0E+00
Sm-151	3.7E-03	0.0E+00
Sn-128	9.4E-07	0.0E+00
Sr-90	8.8E-01	3.5E-01
Tc-99	2.6E-05	3.4E-06
Th-232	4.7E-07	0.0E+00
U-232	4.4E-05	1.6E-04
U-233	1.1E-06	3.7E-06
U-234	4.1E-07	1.3E-06
U-235	1.2E-08	1.3E-07
U-236	3.4E-08	3.0E-07
U-238	1.1E-07	9.5E-07
Zr-93	3.8E-05	0.0E+00

Appendix F

Calculation of Maximum Concentration of Key Radionuclides in Class C LLW

This appendix describes the methodology used to calculate the maximum concentration of key radionuclides in Class C LLW. The concentration limits for Class C waste from 10 CFR 61.55 are shown in Tables 1 and 2.

Table 1 Class C Limits for Long Lived Radionuclides	
Radionuclide	**Concentration (Ci/m^3)**
C-14	8
C-14 in activated metal	80
Ni-59 in activated metal	220
Nb-94 in activated metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	[1]100
Pu-241	[1]3,500
Cm-242	[1]20,000
[1]Units are nanocuries per gram.	

Table 2 Class C Limits for Short Lived Radionuclides	
Radionuclide	**Concentration (Ci/m^3)**
Ni-63	700
Ni-63 in activated metal	7000
Sr-90	7000
Cs-137	4600

As shown in Tables 1 and 2, the concentrations for radionuclides are needed in units of volume and mass. The volume can be calculated from the size of the container, but the mass requires the density of the VEM as well as the volume of the container. Upon reviewing radioactive waste documentation, it was found that the composition of all the waste containers was assumed to be metal oxide. In these calculations, iron oxide with a density of 5.24 g/cm^3 was used as the source material. As is the practice by WVNS, two containers were evaluated a thirty-gallon drum placed in a 55-gallon overpack and a B-25 box. The volume and mass of the waste in each container type are calculated below;

Calculating Volume

30-gallon drum

$$V = 30gal \times 0.0038\frac{m^3}{gal}$$

$$V = 0.12m^3$$

B-25 Box
A B-25 box is 90 ft^3

$$V = 90\,ft^3 \times 0.028\frac{m^3}{ft^3}$$

$$V = 2.55m^3$$

Calculating Mass

$$M = V \times \rho$$

30-gallon drum

$$M_D = 0.12m^3 \times 5.24\frac{g}{cm^3} \times \left(100\frac{cm}{m}\right)^3$$

$$M_D = 6.1E + 05g$$

B-25 Box

$$M_D = 2.55m^3 \times 5.24\frac{g}{cm^3} \times \left(100\frac{cm}{m}\right)^3$$

$$M_D = 1.3E + 07g$$

The radionuclides in glass/slurry and airborne VEM and their ratios are provided in Table 3. The scaling factor is to ^{137}Cs.

Table 3 Radionuclides and Scaling Factors		
Radionuclide	**Glass/Slurry**	**Airborne**
Ac-227	3.8E-06	0.0E+00
Am-241	1.0E-02	5.3E-03
Am-243	1.1E-04	4.4E-04
C-14	1.5E-07	5.9E-04
Cm-242	2.2E-04	1.1E-04
Cm-243	1.2E-04	0.0E+00
Cm-244	2.1E-03	1.9E-03
Cm-245	5.0E-03	4.1E-03
Cm-246	6.1E-04	6.7E-04
Co-60	3.0E-04	1.8E-04
Cs-134	1.1E-04	0.0E+00
Cs-135	1.1E-05	0.0E+00
Cs-137	1.0E+00	1.0E+00
Eu-154	7.8E-03	2.7E-03
Fe-55	0.0E+00	1.5E-03
H-3	0.0E+00	3.0E-06
I-129	0.0E+00	0.0E+00
Nb-93m	1.9E-05	0.0E+00
Ni-59	2.2E-05	7.9E-05
Ni-63	2.3E-03	2.4E-03
Np-236	1.0E-04	0.0E+00
Np-237	6.3E-06	2.7E-06
Pa-231	9.1E-06	0.0E+00
Pd-107	9.4E-08	0.0E+00
Pu-236	8.2E-06	0.0E+00
Pu-238	1.3E-03	5.9E-04
Pu-239	3.4E-04	1.5E-04
Pu-240	2.4E-04	1.1E-04
Pu-241	1.1E-02	5.4E-03
Pu-242	2.7E-07	8.6E-06
Se-79	1.1E-09	0.0E+00
Sm-151	3.7E-03	0.0E+00
Sn-128	9.4E-07	0.0E+00
Sr-90	8.8E-01	3.5E-01
Tc-99	2.6E-05	3.4E-06
Th-232	4.7E-07	0.0E+00
U-232	4.4E-05	1.6E-04
U-233	1.1E-06	3.7E-06
U-234	4.1E-07	1.3E-06
U-235	1.2E-08	1.3E-07
U-236	3.4E-08	3.0E-07
U-238	1.1E-07	9.5E-07
Zr-93	3.8E-05	0.0E+00

The concentrations can be determined using the scaling factors for the radionuclides and the mass and/or the volume of the waste. Calculating the maximum concentrations is an iterative process. An initial estimate of the ^{137}Cs activity is made and the scaling factors are applied to the remaining radionuclides. The concentrations of key radionuclides are computed in the required units and divided by the limits. The fractions are then summed. This process is repeated until the sum of the fractions is equal to 1. The example provided gives the desired results.

For Glass/Slurry

Calculating Activity of Each Radionuclide

^{137}Cs activity estimate 3 Ci

The scaling factors provided in Table 3 are multiplied by 3 to obtain the activity of the individual radionuclides. The activity of each radionuclide and its scaling factor are shown in Table 4.

Table 4 Radionuclide Activity Calculations			
Radionuclide	**^{137}Cs activity (Ci)**	**Glass/Slurry Scaling Factor**	**Activity (Ci)**
Ac-227	3	3.8E-06	1.1e-05
Am-241	3	1.0E-02	3.0e-02
Am-243	3	1.1E-04	3.3e-04
C-14	3	1.5E-07	4.5e-07
Cm-242	3	2.2E-04	6.6e-04
Cm-243	3	1.2E-04	3.6e-04
Cm-244	3	2.1E-03	6.3e-03
Cm-245	3	5.0E-03	1.5e-02
Cm-246	3	6.1E-04	1.8e-03
Co-60	3	3.0E-04	9.0e-04
Cs-134	3	1.1E-04	3.3e-04
Cs-135	3	1.1E-05	3.3e-05
Cs-137	3	1.0E+00	3.0e+00
Eu-154	3	7.8E-03	2.3e-02
Fe-55	3	0.0E+00	0.0e+00
H-3	3	0.0E+00	0.0e+00
I-129	3	0.0E+00	0.0e+00
Nb-93m	3	1.9E-05	5.7e-05
Ni-59	3	2.2E-05	6.6e-05
Ni-63	3	2.3E-03	6.9e-03
Np-236	3	1.0E-04	3.0e-04
Np-237	3	6.3E-06	1.9e-05
Pa-231	3	9.1E-06	2.7e-05
Pd-107	3	9.4E-08	2.8e-07
Pu-236	3	8.2E-06	2.5e-05
Pu-238	3	1.3E-03	3.9e-03
Pu-239	3	3.4E-04	1.0e-03
Pu-240	3	2.4E-04	7.2e-04
Pu-241	3	1.1E-02	3.3e-02
Pu-242	3	2.7E-07	8.1e-07
Se-79	3	1.1E-09	3.3e-09
Sm-151	3	3.7E-03	1.1e-02
Sn-128	3	9.4E-07	2.8e-06
Sr-90	3	8.8E-01	2.6e+00
Tc-99	3	2.6E-05	7.8e-05
Th-232	3	4.7E-07	1.4e-06
U-232	3	4.4E-05	1.3e-04
U-233	3	1.1E-06	3.3e-06
U-234	3	4.1E-07	1.2e-06
U-235	3	1.2E-08	3.6e-08
U-236	3	3.4E-08	1.0e-07
U-238	3	1.1E-07	3.3e-07
Zr-93	3	3.8E-05	1.1e-04

Calculating the Concentration for Each Radionuclide

The activity calculated for each radionuclide is divided by either the mass or volume of the waste depending on the units given with the Class C limit. The activity, volume or mass, and concentration are shown for each radionuclide in Table 5. In addition, the Class C limit is provided and the ratio of the concentration to the limit. The sum of the ratio is 1. Table 5 presents the maximum concentrations allowable in a 30-gallon drum of Glass/Slurry contaminated waste while still meeting 10 CFR 61.55 limits for Class C waste.

Table 5 Activity, Concentration, Limit and Ratio for Radionuclides in Glass/Slurry						
Radionuclide	**Activity**	**Mass/Volume**	**Concentration**	**Limits**	**Units**	**Ratio**
Ac-227	1.1e-05	1.2e-01	9.8e-05	No Limit	Ci/m^3	
Am-241	3.0e-02	6.1e+05	4.9e+01	100	nCi/g	4.9e-01
Am-243	3.3e-04	6.1e+05	5.5e-01	100	nCi/g	5.5e-03
C-14	4.6e-07	1.2e-01	3.9e-06	8	Ci/m^3	4.9e-07
Cm-242	6.4e-04	6.1e+05	1.1e+00	20000	nCi/g	5.3e-05
Cm-243	3.4e-04	6.1e+05	5.6e-01	100	nCi/g	5.6e-03
Cm-244	6.3e-03	6.1e+05	1.0e+01	100	nCi/g	1.0e-01
Cm-245	1.5e-02	6.1e+05	2.4e+01	100	nCi/g	2.4e-01
Cm-246	1.8e-03	6.1e+05	3.0e+00	100	nCi/g	3.0e-02
Co-60	9.0e-04	1.2e-01	7.7e-03	No Limit	Ci/m^3	
Cs-134	3.1e-04	1.2e-01	2.7e-03	No Limit	Ci/m^3	
Cs-135	3.3e-05	1.2e-01	2.8e-04	No Limit	Ci/m^3	
Cs-137	3.0e+00	1.2e-01	2.6e+01	4600	Ci/m^3	5.6e-03
Eu-154	2.3e-02	1.2e-01	2.0e-01	No Limit	Ci/m^3	
Fe-55	0.0e+00	1.2e-01	0.0e+00	No Limit	Ci/m^3	
H-3	0.0e+00	1.2e-01	0.0e+00	No Limit	Ci/m^3	
I-129	0.0e+00	1.2e-01	0.0e+00	0.08	Ci/m^3	0.0e+00
Nb-93m	5.6e-05	1.2e-01	4.8e-04	No Limit	Ci/m^3	
Ni-59	6.5e-05	1.2e-01	5.6e-04	No Limit	Ci/m^3	
Ni-63	6.9e-03	1.2e-01	5.9e-02	700	Ci/m^3	8.5e-05
Np-236	3.1e-04	6.1e+05	5.0e-01	100	nCi/g	5.0e-03
Np-237	1.9e-05	6.1e+05	3.1e-02	100	nCi/g	3.1e-04
Pa-231	2.7e-05	6.1e+05	4.4e-02	100	nCi/g	4.4e-04
Pd-107	2.8e-07	1.2e-01	2.4e-06	No Limit	Ci/m^3	
Pu-236	2.4e-05	6.1e+05	4.0e-02	100	nCi/g	4.0e-04
Pu-238	3.7e-03	6.1e+05	6.1e+00	100	nCi/g	6.1e-02
Pu-239	1.0e-03	6.1e+05	1.7e+00	100	nCi/g	1.7e-02
Pu-240	7.2e-04	6.1e+05	1.2e+00	100	nCi/g	1.2e-02
Pu-241	3.3e-02	6.1e+05	5.4e+01	3500	nCi/g	1.5e-02
Pu-242	7.9e-07	6.1e+05	1.3e-03	100	nCi/g	1.3e-05
Se-79	3.4e-09	1.2e-01	2.9e-08	No Limit	Ci/m^3	
Sm-151	1.1e-02	1.2e-01	9.4e-02	No Limit	Ci/m^3	
Sn-128	2.8e-06	1.2e-01	2.4e-05	No Limit	Ci/m^3	
Sr-90	2.6e+00	1.2e-01	2.2e+01	7000	Ci/m^3	3.2e-03
Tc-99	7.8e-05	1.2e-01	6.7e-04	3	Ci/m^3	2.2e-04
Th-232	1.4e-06	6.1e+05	2.3e-03	No Limit	nCi/g	
U-232	1.3e-04	6.1e+05	2.1e-01	No Limit	nCi/g	
U-233	3.3e-06	6.1e+05	5.5e-03	No Limit	nCi/g	
U-234	1.2e-06	6.1e+05	2.0e-03	No Limit	nCi/g	
U-235	3.5e-08	6.1e+05	5.8e-05	No Limit	nCi/g	
U-236	1.0e-07	6.1e+05	1.7e-04	No Limit	nCi/g	
U-238	3.2e-07	6.1e+05	5.2e-04	No Limit	nCi/g	
Zr-93	1.1e-04	1.2e-01	9.6e-04	No Limit	Ci/m^3	
Sum of the Ratios						1.0e+00

Key Radionuclides

Table 6 presents the key radionuclides and their maximum concentrations for glass/slurry contaminated waste in a 30-gallon drum. Key radionuclides are those with concentrations greater than or equal to 0.1% of the Class C limit.

Table 6 Maximum Concentration of Key Radionuclides in VEM for Class C Waste			
Radionuclide	**Concentration Glass/Slurry**	**Class C Limit (nCi/g)**	**Percentage of Limit Glass/Slurry**
Am-241	4.9E+01	100	49.3%
Cm-245	2.4E+01	100	24.2%
Cm-244	1.0E+01	100	10.4%
Pu-238	6.1E+00	100	6.1%
Cm-246	3.0E+00	100	3.0%
Pu-239	1.7E+00	100	1.7%
Pu-241	5.4E+01	3500	1.5%
Pu-240	1.2E+00	100	1.2%
Cm-243	5.6E-01	100	0.6%
Cs-137[1]	2.6E+01	4600	0.6%
Am-243	5.5E-01	100	0.5%
Np-236	5.0E-01	100	0.5%
Sr-90[1]	2.2E+01	7000	0.3%
Total			99.9%
[1]Concentration units are in Ci/m^3			

Key Radionuclides for both Waste Profiles

The calculations were repeated for Slurry/Glass contaminated VEM in a B-25 Box and for Airborne contaminated VEM in both the 30-gallon drum and a B-25 Box. The results are given in Table 7. Only one value is given for Glass/Slurry and Airborne contaminated VEM. Since the limits are based on concentrations and the results are concentrations, the size of the container is immaterial for the accuracy available for these calculations.

Table 7 Maximum Concentration of Key Radionuclides in VEM for Class C Waste					
Radionuclide	**Concentration**		**Class C Limit**	**Percentage of Limit**	
	Glass/Slurry	**Airborne**	**(nCi/g)**	**Glass/Slurry**	**Airborne**
Am-241	4.9E+01	3.9E+01	100	49.3%	38.9%
Cm-245	2.4E+01	3.0E+01	100	24.2%	30.2%
Cm-244	1.0E+01	1.4E+01	100	10.4%	14.0%
Pu-238	6.1E+00	4.3E+00	100	6.1%	4.3%
Cm-246	3.0E+00	4.9E+00	100	3.0%	4.9%
Pu-239	1.7E+00	1.1E+00	100	1.7%	1.1%
Pu-241	5.4E+01	3.9E+01	3500	1.5%	1.1%
Pu-240	1.2E+00	7.7E-01	100	1.2%	0.8%
Cm-243	5.6E-01	0.0E+00	100	0.6%	0.0%
Cs-137[1]	2.6E+01	3.8E+01	4600	0.6%	0.8%
Am-243	5.5E-01	3.2E+00	100	0.5%	3.2%
Np-236	5.0E-01	0.0E+00	100	0.5%	0.0%
Sr-90[1]	2.2E+01	1.3E+01	7000	0.3%	0.2%
Pu-236	4.0E-02	0.0E+00	100	0.0%	0.0%
Pu-242	1.3E-03	6.3E-02	100	0.0%	0.1%
C-14[1]	3.9E-06	2.3E-02	8	0.0%	0.3%
Total				99.9%	99.9%
[1]Concentration units are in Ci/m^3					

Appendix G

Calculation of Minimum Concentration of Key Radionuclides in TRU

This appendix describes the methodology that was used to calculate the minimum concentration of key radionuclides in TRU. By definition, TRU is any waste containing 100 nCi/g of alpha emitting transuranics with half-life greater than 20 years.

The concentrations for transuranics are required in units of mass. The mass of the container can be determined by multiplying the density of the waste by the volume of the container. Upon reviewing radioactive waste documentation, it was found that the composition of all the waste containers was assumed to be metal oxide. In these calculations, iron oxide with a density of 5.24 g/cm^3 was used as the source material, and two containers were evaluated a thirty-gallon drum inside a 55-gallon overpack and a B-25 box. The volume and mass of the waste of each container type are calculated below;

Calculating Mass

Volume

30-gallon drum

$$V = 30 gal \times 0.0038 \frac{m^3}{gal}$$

$$V = 0.12 m^3$$

B-25 Box

A B-25 box is 90 ft^3

$$V = 90 ft^3 \times 0.028 \frac{m^3}{ft^3}$$

$$V = 2.55 m^3$$

Mass

$$M = V \times \rho$$

30-gallon drum

$$M_D = 0.12 m^3 \times 5.24 \frac{g}{cm^3} \times \left(100 \frac{cm}{m}\right)^3$$

$$M_D = 6.1E+05 g$$

B-25 Box

$$M_D = 2.55 m^3 \times 5.24 \frac{g}{cm^3} \times \left(100 \frac{cm}{m}\right)^3$$

$$M_D = 1.3E+07 g$$

The radionuclides in glass/slurry and airborne VEM and their ratios are provided in Table 1. The scaling factor is to ^{137}Cs.

Table 1 Radionuclides and Scaling Factors		
Radionuclide	**Glass/Slurry**	**Airborne**
Ac-227	3.8E-06	0.0E+00
Am-241	1.0E-02	5.3E-03
Am-243	1.1E-04	4.4E-04
C-14	1.5E-07	5.9E-04
Cm-242	2.2E-04	1.1E-04
Cm-243	1.2E-04	0.0E+00
Cm-244	2.1E-03	1.9E-03
Cm-245	5.0E-03	4.1E-03
Cm-246	6.1E-04	6.7E-04
Co-60	3.0E-04	1.8E-04
Cs-134	1.1E-04	0.0E+00
Cs-135	1.1E-05	0.0E+00
Cs-137	1.0E+00	1.0E+00
Eu-154	7.8E-03	2.7E-03
Fe-55	0.0E+00	1.5E-03
H-3	0.0E+00	3.0E-06
I-129	0.0E+00	0.0E+00
Nb-93m	1.9E-05	0.0E+00
Ni-59	2.2E-05	7.9E-05
Ni-63	2.3E-03	2.4E-03
Np-236	1.0E-04	0.0E+00
Np-237	6.3E-06	2.7E-06
Pa-231	9.1E-06	0.0E+00
Pd-107	9.4E-08	0.0E+00
Pu-236	8.2E-06	0.0E+00
Pu-238	1.3E-03	5.9E-04
Pu-239	3.4E-04	1.5E-04
Pu-240	2.4E-04	1.1E-04
Pu-241	1.1E-02	5.4E-03
Pu-242	2.7E-07	8.6E-06
Se-79	1.1E-09	0.0E+00
Sm-151	3.7E-03	0.0E+00
Sn-128	9.4E-07	0.0E+00
Sr-90	8.8E-01	3.5E-01
Tc-99	2.6E-05	3.4E-06
Th-232	4.7E-07	0.0E+00
U-232	4.4E-05	1.6E-04
U-233	1.1E-06	3.7E-06
U-234	4.1E-07	1.3E-06
U-235	1.2E-08	1.3E-07
U-236	3.4E-08	3.0E-07
U-238	1.1E-07	9.5E-07
Zr-93	3.8E-05	0.0E+00

The concentrations can be determined using the mass of the waste and the scaling factors. Calculating the minimum concentrations in TRU waste is an iterative process. An initial estimate of the ^{137}Cs activity is made and the scaling factors are applied to the transuranics. The concentrations are then summed. This process is repeated until the sum of the concentration of transuranics equals 100. An example is provided. For this example, the results give the desired solution.

Example

For Glass/Slurry

^{137}Cs activity estimate 3.4 Ci

Calculating Concentration of Each Transuranic

The scaling factors provided in Table 1 are multiplied by 3.4 to obtain the activity of the transuranics. The activity and concentration of each transuranic in the waste streams are shown in Table 2. The percent of the limit of 100 nCi/g for each transuranic is also listed in Table 2.

Table 2 Activity, Concentration and Percentage of Total for Transuranics

Transuranic	Activity (Ci)	Concentration (nCi/g)	Percentage of Limit
Am-241	3.4E-02	5.6E+01	56.2%
Am-243	3.8E-04	6.2E-01	0.6%
Cm-242	7.3E-04	1.2E+00	1.2%
Cm-243	3.9E-04	6.4E-01	0.6%
Cm-245	1.7E-02	2.8E+01	27.7%
Cm-246	2.1E-03	3.4E+00	3.4%
Np-237	2.1E-05	3.5E-02	0.0%
Pu-238	4.2E-03	7.0E+00	7.0%
Pu-239	1.2E-03	1.9E+00	1.9%
Pu-240	8.2E-04	1.3E+00	1.3%
Pu-242	9.0E-07	1.5E-03	0.0%
Total		1.0E+02	100%

Key Transuranics

The concentration of the key transuranics, those that comprise more than 0.1%of the 100 nCi/g, limit for both container types for glass/slurry and airborne profiles of VEM is given in Table 3.

Table 3 Key Radionuclides their Concentration and Percentage of Total Transuranics

Transuranics	Glass/Slurry		Airborne	
	Concentration (nCi/g)	Percentage	Concentration (nCi/g)	Percentage
Am-241	5.6E+01	56.2%	4.6E+01	46.2%
Am-243	6.2E-01	0.6%	3.8E+00	3.8%
Cm-242	1.2E+00	1.2%	9.4E-01	0.9%
Cm-243	6.4E-01	0.6%	0.0E+00	0.0%
Cm-245	2.8E+01	27.7%	3.6E+01	35.8%
Cm-246	3.4E+00	3.4%	5.8E+00	5.8%
Np-237	3.5E-02	0.0%	2.3E-02	0.0%
Pu-238	7.0E+00	7.0%	5.1E+00	5.1%
Pu-239	1.9E+00	1.9%	1.3E+00	1.3%
Pu-240	1.3E+00	1.3%	9.2E-01	0.9%
Pu-242	1.5E-03	0.0%	7.4E-02	0.1%
Total	1.0E+02	100.0%	1.0E+02	100.0%

Appendix H

Comparison of VEM TRU Waste to WIPP Waste Acceptance Criteria

WIPP Waste Acceptance Criteria Requirement	WVNS Response
Payload containers must be steel Department of Transportation (DOT) Type A or equivalent 55-gallon drums, SWBS, or TDOP in good condition.	WVNS will only use approved containers to ship VEM TRU waste to WIPP
Removable surface contamination on contact handled transuranic (CH-TRU)waste payload containers, payload assemblies, and packagings shall-be less than 20 dpm/100 cm^2 alpha and 200 dpm/100 cm^2 beta-gamma. The fixing of surface contamination to meet these criteria is not allowed.	Removable surface contamination on all VEM waste packages will be verified to meet these requirements by radiological surveys. Packages will be decontaminated as necessary to meet these requirements.
CH-TRU waste containers shall be labeled with a bar code label consisting of the site identification and a unique container identification number. CH-TRU waste containers shall also be marked with the "shipping category." The container identification number and the shipping category may be on the same label(s).	All VEM waste containers will be bar coded with the required information.
Empty drums used as dunnage to complete a seven-pack of waste drums in a shipment to WIPP shall be labeled "EMPTY" or "DUNNAGE" and have container marking, as appropriate.	WVNS will label empty drums used as dunnage accordingly.
If a seven-pack of empty drums or an standard waste box (SWB) is shipped as dunnage to fill a Transuranic Package Transporter- Model II (TRUPACT-II), label the drums/SWB "EMPTY" or "DUNNAGE," but do not label them with container identification numbers.	WVNS will label empty drums used as dunnage accordingly.
To maximize the shipping efficiency of the TRUPACT-II, the use of dunnage drums should be minimized. In the event the use of dunnage drums cannot be avoided, the preferred practice for maximizing the efficiency of waste handling and the utilization of disposal room capacity is to ship them in multiples of seven (i.e., seven-packs).	WVNS will limit the use of empty drums as dunnage.

WIPP Waste Acceptance Criteria Requirement	WVNS Response
Each payload container shall have one or more filter vents that meet the specifications of the TRUPACT-II Safety Analysis Report (SAR). All filter vent models must be approved by the Carlsbad Field Office (CBFO) prior to their use on payload containers. A listing of CBFO approved filter vent models is available from the CBFO Web Page (http://www.wipp.carlsbad.nm.us/transport.htm). The model number of each filter vent or combination of filter vents installed on a payload container shall be reported in the WIPP Waste Information System (WWIS).	WVNS will use filter vents as required.
The radionuclide composition which comprises 95 percent or more of the activity must be reported in the WWIS for each waste container.	The composition of the VEM will be reported.
The Pu fissile gram equivalent (FGE) of the radionuclides in each waste container shall be reported to WIPP using the WWIS. Payload containers must meet both the TRUPACT-II and the WIPP repository requirements for criticality.	The Pu-FGE will be reported for each VEM container.
The total ^{239}Pu FGE for a TRUPACT-II payload shall be calculated and recorded in the Payload Assembly Transportation Certification Document (PATCD).	The total ^{239}Pu FGE for a TRUPACT-II payload shall be calculated and recorded in the PATCD as required.
The TRU alpha activity concentration in the waste must be greater than 100 nCi/g with half-lives greater than 20 years. The tare weight of the waste containers (including the rigid liner and any added shielding) shall be subtracted before performing the calculation to obtain TRU alpha activity concentration.	All VEM shipped to WIPP will meet the definition of TRU waste.
Plutonium-239 equivalent curies (PE-CI) quantities shall be calculated for each container. Limits are 55-gallon drum $\leq$ 200 ^{239}Pu FGE Limit SWB $\leq$ 325 ^{239}Pu FGE Limit TDOP $\leq$ 325 ^{239}Pu FGE Limit	WVNS will calculate PE-CI quantities for each VEM container.

WIPP Waste Acceptance Criteria Requirement	WVNS Response
The external radiation dose rates of individual payload containers and the loaded TRUPACT-II shall be ≤ 200 mrem/h at the surface and ≤ 10 mrem/h at 2 m. Neutron contributions to the total payload container dose rate shall be reported separately in the WWIS.	All VEM containers shipped to WIPP will meet these requirements.
The aggregate volume of residual liquid in a payload container shall be less than 1 percent (volume) of the payload container. Internal containers shall contain less than 1 inch or 2.5 cm of liquid in the bottom of the containers.	There will be no residual liquid in the VEM containers.
Payload containers shall be verified to be free of sealed containers greater than 4 L.	There are no sealed containers in VEM
Pyrophoric radioactive materials shall be present only in small residual amounts (<l percent by weight) in payload containers. CH-TRU waste streams that are expected to contain any metallic radionuclides are to be treated (oxidized) to eliminate as much of the potential pyrophorics as possible before being placed in containers for shipment to WIPP. A validated process (i.e., one that has been proven by test or analysis) that converts pyrophoric compounds to a nonpyrophoric form may be used to meet this criterion.	VEM contains no pyrophoric material.
Each individual waste payload container must come from a waste stream documented using an approved Waste Stream Profile Form (WSPF). These forms identify the proper hazardous waste codes as well as the absence of corrosive, reactive, and ignitable characteristics. After CBFO approval of the WSPF, RCRA hazardous waste codes for each contact handled (CH) mixed waste container must be reported to WIPP using the WWIS.	WVNS will document the VEM waste streams using the WSPF.
Only wastes that have been shown to meet the approved TRUPACT-II chemical lists in the Safety Analysis Report for the TRUPACT-II Shipping Package (SARP) are acceptable at WIPP.	VEM meets the approved TRUPACT-II chemical list.
CH-TRU waste shall contain no explosives, corrosives, or compressed gases. If corrosives, pressurized containers, or explosive materials are found to be present, they must be physically removed, neutralized, or treated to render them inert such that a violent reaction is not possible.	VEM contains no explosives, corrosives, or compressed gases.

WIPP Waste Acceptance Criteria Requirement	WVNS Response
All waste containers shall be headspace gas sampled and analyzed in accordance with an approved site-specific quality assurance project plan (QAPjP), as defined in the waste analysis plan (WAP).	WVNS will sample and analyze headspace gas for all VEM TRU containers.
Wastes determined by either acceptable knowledge or sampling and analysis to have a polychlorinated biphenyl (PCB) concentration greater than or equal to 50 ppm are prohibited.	VEM does not contain PCBs.
Payload containers shall be assigned an approved shipping category.	WVNS will assign approved shipping categories to VEM TRU waste.
Decay heat for each payload container plus the measurement error shall be less than or equal to the limits of the assigned shipping category. The value of the decay heat shall be recorded on the Payload Container Transportation Certification Document (PCTCD).	WVNS will verify that all containers meet the limits for decay heat for the shipping category.
Test category containers shall be tested to determine if the limits on hydrogen gas generation and flammable organics in the headspace are met. Data from the testing shall be recorded on the PCTCD for test category waste.	VEM will not generate hydrogen gas or flammable organics.
For content codes that identify potentially flammable volatile organic compounds (VOCs) as part of the waste, approved waste generation procedures shall be used to ensure that the total concentration is $\leq$500 ppm in the headspace of each payload container. If an upper limit cannot be established for the amount of potentially flammable VOCs in a content code or if the theoretical limit of 500 ppm is exceeded, a gas sampling program shall be implemented. For content codes that do not contain any flammable VOCS, there are no sampling requirements.	VEM does not contain flammable VOCs.
Sites shall prepare a (Waste Stream Profile Form) WSPF for each waste stream. Characterization and certification information for each payload container shall be submitted to the WWIS and approved by the Data Administrator. Any waste container from a waste stream that has not been preceded by an appropriate certified WSPF is not acceptable at WIPP.	WVNS will prepare a WSPF for the VEM TRU waste stream.

WIPP Waste Acceptance Criteria Requirement	WVNS Response
Sites shall prepare a bill of lading and a uniform hazardous waste manifest (UHWM) for CH-TRU waste shipments. The Land Disposal Restriction (LDR) notification for CH-TRU mixed waste shipments shall state that the waste is not prohibited from land disposal. For shipment in TRUPACT-II, a PATCD and PCTCD shall be prepared for containers and assemblies. For each waste container, the radionuclide composition constituting at least 95 percent of the activity shall be reported to WIPP using the WWIS. The radionuclides listed on the manifest must match those listed in the WWIS.	WVNS will prepare a bill of lading with the required information for all VEM TRU containers shipped to WIPP.

Appendix I

Comparison of VEM LLW to Hanford Waste Acceptance Criteria

Hanford Waste Acceptance Criteria Requirement	WVNS Response
For all waste, a detailed record must be kept of the contents, volume, and weight, as well as any added fillers, sorbents, stabilization agents, or solidification agents.	WVNS will document the contents of all waste containers.
For containerized waste, the container type, weight, internal and external volume, any shielding provided, and the date packaged must be recorded. In the case of labpacks, the record should include the exact number, type, and volume of inner containers.	WVNS will document required information
The waste generator must determine the physical and chemical characteristics of the waste with sufficient accuracy and detail to properly designate and manage the waste in accordance with the unit-specific acceptance criteria and all applicable regulations (i.e., acceptable knowledge)	WVNS knows the physical and chemical characteristics of the VEM.
For waste that is a hazardous waste as defined in 40 CFR 261, waste characterization must be sufficient to establish whether the waste is a restricted waste under the LDR provisions of 40 CFR 268 and, if so, to determine the applicable treatment standard(s) for that waste. Testing of a representative sample at a Hanford Site laboratory or another independent laboratory is required if a generator certifies that a waste stream meets a concentration-based treatment standard of 40 CFR 268.	VEM is not hazardous waste.
Hazardous debris that is managed in accordance with the alternative treatment standards for hazardous debris (40 CFR 268.45) does not require sampling and analysis for adequate physical/chemical characterization.	VEM is not hazardous waste.
The major radionuclides in the waste and the concentration of each major radionuclide must be established with sufficient sensitivity and accuracy to properly classify and manage the waste in accordance with the radiological limits.	The concentrations of the major radionuclides in VEM are determined using scaling factors.
Generators shall segregate uncontaminated waste from radioactive waste to minimize waste volume and the cost of waste treatment and disposal.	WVNS segregates radioactive waste from non-radioactive waste.
Generators shall attempt to obtain radiological release of dangerous waste and TSCA PCB waste generated from radioactive material areas in accordance with their site/facility radiological release criteria.	VEM material is neither TSCA or PCB.

Hanford Waste Acceptance Criteria Requirement	WVNS Response
All waste shall be segregated by the Waste Specification Records (WSRDs) to facilitate proper treatment, storage, and/or disposal. The WSRDs identify major waste streams, grouped in a manner that defines currently available storage and disposal methods and, for waste requiring treatment, the anticipated treatment and/or disposal methods. When it is not technically feasible or it is cost prohibitive to segregate a given waste stream by WSRD, the generator must document the basis for not segregating the waste and acceptance is contingent on either (1) the WMP acceptance organization identifying a treatment/disposal pathway or (2) approval by DOE-RL to receive the waste stream for storage.	WVNS will segregate its waste streams according to VEM categories of waste.
WSRDs will include certain waste stream specific requirements to facilitate, treatment, storage, and/or disposal. These criteria must be met in addition to the requirements identified in this document. The current set of WSRDs along with instructions for selecting the appropriate WSRD can be obtained from the Hanford Site Solid Waste Acceptance Program Internet web site (http://www.hanford.gov/wastemgt/wac/index.htm).	WVNS will meet the requirements of the WSRDs.
Every effort shall be made to avoid the generation of waste for which no treatment/disposal path has been identified.	WVNS will avoid generating waste that has no path for disposal.
The generator must retain all record copy material used for waste characterization and designation in accordance with federal and state requirements and DOE Orders. These records include process knowledge, sampling information, analytical data, inventory records, and related information. The generator must transfer copies of certain records as requested by the WMP acceptance organization through the waste acceptance process described on the Hanford Site Solid Waste Acceptance Program Internet web page (http://www.hanford.gov/wastemgt/wac/index.htm).	WVNS will retain all required documentation and transmit it as requested.
Radioactive waste to which access has been limited for national security reasons and cannot be declassified shall be managed in accordance with the requirements of DOE 5632.IC, Protection and Control Safeguards and Securities Interest, and DOE 474. 1, Control and Accountability of Nuclear Materials.	VEM waste is not classified waste.

Hanford Waste Acceptance Criteria Requirement	WVNS Response
The generator shall notify the WMP acceptance organization of any classified waste during the acceptance process. Classified waste is managed on a case-by-case basis.	VEM is not classified waste
A DOE/NRC 741 form must be completed for waste that contains accountable nuclear material (DOE Order 474. 1)	VEM is not classified waste.
A portion of the waste containers sent to Hanford Site TSD units must be verified by physical inspection, nondestructive examination, and/or chemical screening as stated in waste analysis plans for the TSD units (e.g., HNF-I 886). For most waste types, this verification can be performed at one of the Hanford Site TSD units. Certain types and configurations of waste, however, cannot be verified easily and could require verification at the generator's location before or during packaging. In these cases, generators must notify the Hanford Site acceptance organization and make verification arrangements before packaging the waste. This requirement applies to the following types of waste: • Shielded waste • Remote-handled waste • Waste packaged in containers larger than 2.74 meters long by 1.6 meters wide by 1.7 meter high (nominally 9 feet long by 5.25 feet wide by 5.5 feet high) • Waste containers weighing more than 3,180 kilograms (7,000 pounds) • Mixed waste treated by macroencapsulation or microencapsulation • Highly compacted (supercompacted) waste • Other waste that is to be treated or packaged in a form that cannot be inspected easily subsequent to treatment or packaging.	WVNS will notify the Hanford Site of any waste that meets these requirements.

Hanford Waste Acceptance Criteria Requirement	WVNS Response
All free liquids must be sorbed or stabilized, or otherwise removed from the waste. except as specifically allowed as follows. • Containerized free liquids are allowed in the following situations, but cannot exceed 1 % of the volume of the waste: • Free liquids in a very small container, such as an ampule • Small articles that contain free liquids required for the article to function • For liquid-containing waste where condensate could form an inner plastic packaging (e.g., bags) subsequent to packaging, the condensate shall be eliminated to the maximum extent practical by placing sorbents within the inner plastic packaging. In any case, the amount of liquid cannot exceed 1% of the volume of the waste or 0.5% of waste processed to a stable form. • Residual liquids in large debris items shall be sorbed or removed. In cases where it is not practical to remove suspected liquids and it is impossible to sample to determine if liquids are present, the liquids shall be removed to the maximum extent possible by draining suspected liquids at low points and placing an adequate amount of sorbent around each item. In any case, the amount of liquid cannot exceed 1% of the volume of the waste.	VEM waste containers do not contain free liquids.
Waste that is initially subject to regulation under RCRA can be disposed with a determination that the waste is no longer dangerous waste and the waste meets the applicable treatment standards of 40 CFR 268 and WAC 173-303-140. These waste types include the following. • Hazardous debris that is exempted from regulation under 40 CFR 261.3(f). • Waste that originally was designated only with characteristic waste numbers D001 through D043 that is no longer hazardous, and that meets all of the applicable treatment standards of 40 CFR 268. • A copy of the applicable notification to the EPA Regional Administrator, as specified in 40 CFR 268.7, and data supporting this notification must be provided to the WMP acceptance organization. • Waste initially designated as state-only waste under WAC 173-303 can be disposed in the LLBG with a determination that the waste has been properly treated and redesignated as nondangerous waste following treatment.	VEM does not meet the regulation of a RCRA waste.

Hanford Waste Acceptance Criteria Requirement	WVNS Response
Organic liquids and chelating compounds exceeding 1% of the waste by weight must be solidified or stabilized to a form that immobilizes the organic and chelating compounds.	VEM does not contain organic liquids or chelating compounds in excess of 1% of the waste.
Asbestos containing waste material shall be packaged in accordance with 40 CFR 61.150. Wetting with water is allowed as long as it does not exceed applicable free liquid requirements.	VEM does not contain asbestos.
If heat generation from radiological decay in the waste package exceeds 3.5 watts per cubic meter (0.1 watt per cubic foot), the package must be evaluated to ensure that the heat does not affect the integrity of the container or surrounding containers. This evaluation must be provided to and approved by the WMP acceptance organization.	VEM does not exceed this heat generation due to radiological decay.
Gas generation from radiolytic or biological decomposition of containerized waste must be controlled to prevent pressurization exceeding 1.5 atmospheres (152 kilopascals absolute pressure), and combustible gas (e.g., hydrogen, methane) concentrations exceeding the lower explosive limit during handling before disposal.	VEM does not generate gas.
Packaging of animal carcasses: Radioactive animal carcasses must be packaged as follows. The waste must be packaged in an inner and outer metal package, where the outer package has a capacity at least 40 percent greater than that of the inner package. The outer package must be a metal container that meets applicable transportation requirements for shipment to the LLBG. The inner package shall be lined with a minimum 4 ml plastic liner. The animal carcass(es) in the inner package must be surrounded with slaked lime. The plastic liner and inner package must be sealed. A minimum of 7.6 centimeters (3 inches) of mineral sorbent must be placed in the bottom of the outer package, the inner package placed into the outer package, and the void space filled between the two packages with additional mineral sorbent. The outer package must be sealed.	VEM does not contain animal carcasses.

Hanford Waste Acceptance Criteria Requirement	WVNS Response
Removable contamination on accessible surfaces of waste packages shall not exceed the limits of the Project Hanford Radiological Control Manual Table 2-2. For returnable overpacks, this criteria also applies to the outside of the inner package.	VEM containers will be surveyed and decontaminated, as required to meet this requirement.
Contact-handled waste shall not exceed 1 millisievert per hour (100 millirem per hour) at 30 centimeters (1 foot) from the waste package.	VEM containers will meet this requirement.
Remote-handled waste shall meet the applicable dose rate restrictions of DOT or an approved packaging safety analysis. Remote-handled waste shall be configured for unloading such that personnel exposures are maintained as low as reasonably achievable (ALARA), and in no case shall the personnel exposure rate exceed 100 millirem per hour.	All remote handled waste will be meet this requirement
Outer packages that meet one of the following criteria will provide adequate containment for disposal. • Packages that meet the applicable DOT requirements of 49 CFR. • Packages that have been evaluated through an approved packaging safety analysis.	WVNS will only use outer packages that meet these requirements.
All outer packages shall be nonflammable or constructed of fire-retardant materials. All exterior surfaces of wooden packages shall be treated with a fire-retardant material leaving a maximum flame-spread index of 25 when tested to ASTM Standard Test Method for Surface Burning Characteristics of Building Materials (ASTM E-84-96). Cardboard containers are not acceptable for disposal. Packages and sacrificial rigging shall not contain regulated materials, such as lead.	WVNS will only use outer packages that meet these requirements.
Outer containers shall be in good condition, with no visible cracks, holes, bulges, substantial corrosion, or other damage that could compromise integrity.	WVNS will only use outer packages that meet these requirements.
Large heavy items must be secured in containers by bracing, blocking, or other means to prevent damage to the container during handling and transportation. When shielding is used to reduce the surface dose rate of a waste container, the shielding and waste must be secured to prevent shifting during handling and transportation.	WVNS will meet these requirements when packaging VEM.

Hanford Waste Acceptance Criteria Requirement	WVNS Response
All packages must be configured for safe unloading by forklift or crane. Alternate means of unloading could be allowed with approval from the TSD unit manager or designee. Packages that must be unloaded by crane shall be equipped with a lifting system designed to safely lift the fully loaded package. All slings and lifting devices shall meet the requirements of the Hanford Site Rigging Manual. For packages that leave special unloading requirements, information must be provided to the WMP acceptance organization concerning the methods for unloading before the shipment is scheduled. Sacrificial rigging shall be provided for remote-handled waste packages. Rigging shall not contain regulated materials, such as lead.	WVNS will meet these requirements.
All waste shall be in a form that minimizes settling and subsidence to the maximum extent feasible. The following forms will be considered to meet these criteria: • Containerized waste that fills at least 90 percent of the internal volume of the container. To calculate the volume of void spaces in the waste, only voids exceeding 5.1 centimeters (2 inches) in all dimensions need be considered. • Containerized soil and soil-like solids, sorbed liquids, and waste compacted to a minimum of 20 pounds per square inch that fills at least 80 percent of the volume of the container • Non-containerized waste that will not subside in the disposal environment (e.g., rocks, dirt, building rubble, activated metal) • Packaging in a HIC or placement in a Hanford-provided HIC or monolith in the LLBG. If the applicable WSRD for the waste specifies that stabilization is required, this requirement will be met • Stabilization in concrete or other stabilization agents.	WVNS will meet these requirements when packaging VEM for disposal.
Waste containers shall be labeled.	WVNS will label all waste containers

Appendix J

Comparison of VEM LLW to NTS Waste Acceptance Criteria

NTS Waste Acceptance Criteria Requirement	WVNS Response
Generators must ensure waste is handled, stored, and shipped in accordance with applicable DOE, DOT, Environmental Protection Agency (EPA), state, and local regulations and requirements.	WVNS will meet all applicable DOE, DOT, EPA, state and local requirements while handling, storing and shipping VEM.
The concentration of alpha-emitting transuranic nuclides with half-lives greater than 20 years must not exceed 100 nCi/g. The net weight of the waste (excluding the weight of the container and shielding) must be used to calculate the specific activity of the waste in each container. The following isotopes shall be considered when making the transuranic waste determination: ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{244}Pu, ^{241}Am, ^{242}Am, ^{243}Am, ^{243}Cm, ^{245}Cm, ^{246} Cm, ^{247}Cm, ^{248}Cm, ^{250}Cm, ^{247}Bk ^{249}Cf ^{251}Cf.	All VEM waste packages sent to NTS will meet this requirement.
Radionuclide concentration must be reported.	Concentrations of radionuclides in the VEM will be reported, as required.
Commercial waste designated as Greater-than-Class C (GTCC, as defined in Title 10 CFR 61.55), and DOE waste that, if commercially generated, would meet the GTCC definition, may be evaluated for disposal on a case-by-case basis depending on site-specific waste classification limits. This review may involve considering nonroutine disposal options (e.g., controlling depth of disposal, considering other waste forms and package integrity, limiting the other types of wastes disposed nearby) or the development of a specific radiological performance assessment.	WVNS will request special evaluation, if required.
LLW offered for disposal must not exhibit characteristics of, or be listed as, hazardous waste as identified in Title 40 CFR, state of Nevada regulations, or state-of-generation hazardous waste regulations. State of Nevada regulations require that waste regulated as hazardous in the state of generation must be regulated as hazardous when brought into the state of Nevada.	VEM is not hazardous material.
The use of lead shielding in containers of LLW is an acceptable practice provided the shielding is necessary for radiation protection and not radioactively contaminated when introduced.	Lead shielding will only be used for radiation protection.

NTS Waste Acceptance Criteria Requirement	WVNS Response
Liquid waste and waste containing free liquids must be converted into a form that contains as little freestanding and noncorrosive liquid as is reasonably achievable. Liquid waste and waste containing free liquids should be processed to a solid form or packaged in sufficient sorbent for twice the volume of the liquid. The free liquid must not exceed 1 percent of the volume of the waste when the waste is in a disposal container; or 0.5 percent of the volume of the waste processed to a solidified form. Provisions for additional sorbent should be made when significant temperature and atmospheric differences exist between the generating site and the disposal site.	VEM waste packages will not contain liquid.
Waste must be evaluated to determine its potential to release liquid during handling, storage, and transportation.	VEM does not have the potential to release liquids during handling, storage and transportation.
Fine particulate wastes shall be immobilized so that the waste package contains no more than 1 weight percent of less-than- 10-micrometer-diameter particles, or 15 weight percent of less-than-200-micrometer-diameter particles. Waste that is known to be in a fine particulate form or in a form that could mechanically or chemically be transformed to a particulate during handling and interim storage must be immobilized.	VEM does not contain more than 1 weight percent of less than 10 micrometer diameter particles or 15 weight percent of less than 200 micrometer diameter particles.
LLW gases must be packaged at a pressure that does not exceed 1.5 atmospheres at 20 ˚C. Compressed gases as defined by Title 49 CFR shall not be accepted. Examples of compliance methods include puncturing aerosol cans and removing the valve mechanism from expended gas cylinders.	VEM does not contain gases
Where practical, waste must be treated to reduce volume and provide a more stable waste form. Wastes must not react with other wastes or the packaging during storage, shipping, handling, and disposal.	VEM will be treated to reduce volume and provide a more stable waste form.

NTS Waste Acceptance Criteria Requirement	WVNS Response
Chemical stability and compatibility must be demonstrated to ensure that no reactions occur and significant quantities of harmful gases, vapors, or liquids are not generated (specifically when different waste forms are combined in a single waste container).	WVNS will demonstrate stability and compatibility of the VEM.
LLW containing pathogens, infectious wastes, or other etiologic agents as defined in Title 49 CFR shall not be accepted.	VEM does not contain pathogens, infectious waste or other etiologic agents.
LLW packages containing chelating or complexing agents in amounts greater than 1 percent of the waste shall not be accepted unless stabilized or solidified.	VEM does not contain complexing agents
PCB contaminated LLW shall not be accepted for disposal unless the PCB concentration meets municipal solid waste disposal levels of≤ 50 ppm. Refer to Title 40 CFR, state of Nevada, and state-of-generation regulations for PCB disposal requirements.	VEM does not contain PCBs
Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.	VEM is not capable of detonation.
Waste must not be pyrophoric. Pyrophoric materials contained in the waste shall be treated, prepared, and packaged to be nonflammable. Pyrophoric materials that are blended in a hardened concrete matrix are considered to be treated to be nonflammable.	VEM is not pyrophoric.
Sources containing transuranic nuclides must be individually evaluated against the transuranic criteria, considering only the mass of the source and any component integral to the source.	VEM does not contain sources.

NTS Waste Acceptance Criteria Requirement	WVNS Response
Sealed sources that have an activity of less than 3.7 MBq (100 mCi) can be a component of waste streams such as contaminated trash. The total volume of the waste can be used for waste classification and for determination of the radionuclide concentration. Characterization of non-transuranic sources (i.e., less than 3.7 MBq (100 mCi)) on an individual source basis is not required, provided the characterization method used is adequate to ensure compliance with the radionuclide reporting criteria.	VEM does not contain sources.
Sealed sources that have an activity of 3.7 MBq (100 mCi) or greater shall be segregated from other waste and profiled as a separate waste stream. These sealed sources shall be characterized on an individual basis using the volume or mass of the source to determine the radionuclide concentration Sealed sources may be co-packaged with other waste streams provided Section 3.0 Waste Acceptance Criteria are met.	VEM does not contain sources.
Asbestiform Low-Level Waste (ALLW) is defined as any LLW containing friable asbestos material; Category I nonfriable asbestos-containing material (ACM) that has become friable; Category 1 nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading; or Category H nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder. ALLW must be packaged, marked, and labeled in accordance with the requirements of Title 40 CFR, State of Nevada Solid Waste Disposal Site Permit (SW1300001, current revision), state-of-generation, and the NTS Management Plan for the Disposal of Low-Level Waste with Regulated Asbestos Waste, current revision. Packages containing ALLW must meet the applicable shipping requirements for the radioactive contents of the package." ALLW must be wetted with a water and surfactant mixture and packaged in a plastic bag which is not less than 6 mil in thickness, a combination of plastic bags which equal at least 6 mil in thickness, or a container which is lined with plastic.	VEM does not contain asbestos material.

NTS Waste Acceptance Criteria Requirement	WVNS Response
If free liquid is present, sorbent must be added to ensure compliance with the free-liquids criteria. Sharp edges and comers in the package must be padded or protected to prevent damage to the plastic bag during handling, shipping, and disposal.	VEM does not contain free liquids
Each container used to dispose ALLW must bear a label that contains one of the following statements. (1) CAUTION CONTAINS ASBESTOS FIBERS AVOID OPENING OR BREAKING CONTAINER BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH (2) CAUTION CONTAINS ASBESTOS FIBERS AVOID CREATING DUST MAY CAUSE SERIOUS BODILY HARM (3) DANGER CONTAINS ASBESTOS FIBERS AVOID CREATING DUST CANCER AND LUNG DISEASE HAZARD	VEM does not contain ALLW.
ALLW must be segregated into a separate waste stream. Because of state notification requirements and disposal cell capacity, ALLW must be packaged separately from other waste streams. Call DOE/NV WNM at (702) 295-3181 for assistance and a copy of the current NTS Management Plan for the Disposal of Low-Level Waste with Regulated Asbestos Waste, which includes specific requirements for pre-shipment notifications.	VEM does not contain ALLW.

NTS Waste Acceptance Criteria Requirement	WVNS Response
Animal carcasses containing, or contained in, radioactive materials shall be packaged with the biological material layered with lime and placed in a metal container meeting applicable requirements. If the resultant waste matrix is capable of gas generation, the container shall be vented with a carbon composite High-Efficiency Particulate Air (HEPA) filtration device. DOE/NV may require analysis of the waste decomposition gases. Animal carcasses preserved with formaldehyde shall not be accepted for disposal.	VEM does not contain animal carcasses.
For this section, beryllium is defined as elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may be released as an airborne particulate. Beryllium-containing waste, and beryllium-contaminated equipment must be packaged in sealed, impermeable bags (minimum 6 mil), containers, or enclosures to prevent the release of beryllium dust during handling and transportation. The bags, containers, and enclosures must be labeled with the following information. "DANGER, CONTAMINATED WITH BERYLLIUM DO NOT REMOVE DUST BY BLOWING OR SHAKING CANCER AND LUNG DISEASE HAZARD"	VEM does not contain of beryllium.
Waste packages must meet applicable DOE Orders, Title 10 CFR, Title 40 CFR, and Title 49 CFR requirements such as: design, nuclear safety, radiation levels, activity limits, nuclear heating, and multiple hazards. Waste packages must be capable of withstanding the stresses associated with the loading, handling, stacking, and shipping of the package.	All VEM waste packages will meet applicable DOE Orders, Title 10 CFR, Title 40 CFR, and Title 49 CFR requirements.
External contamination levels for waste packages and transport vehicles must meet the release limits specified in Title 10 CFR Part 835, appendix D.	All VEM waste containers and transport vehicles will meet the Title 10 CFR Part 835, appendix D release limits.

NTS Waste Acceptance Criteria Requirement	WVNS Response
The quantity of fissionable (fissile) material in a waste package shall be limited so that an infinite array of such packages will remain subcritical. This quantity shall be determined on the basis of a specific Criticality Safety Evaluation (CSE). A CSE shall be performed for the following wastes: • Waste packages having greater than 15 g of ^{235}U and the ^{235}U enrichment is equal to or greater than 0.90 percent by weight (Wt%). Any level of enriched uranium present in the waste must be identified and reported on the waste profile in Section E. • Waste packages containing fissionable nuclides, other than enriched uranium nuclides will be assessed on a case-by-case basis. Fissionable nuclides are listed in DOE Order 420. 1, "Facility Safety," Table 4.3 - 1.	WVNS will perform CSEs as required on VEM packages.
The package closure must be sturdy enough that it will not be breached under normal handling conditions.	VEM package closure will meet this requirement.
The disposal package (packaging and contents) must be capable of supporting a uniformly distributed load of 16,477 kg/m^3 (3,375 lbs/ft^2). This is required to support other waste packages and earth cover without crushing during stacking and covering operations. Actual physical testing or design engineering calculations may be used to demonstrate this requirement. This section does not apply to bulk waste, waste packaged in steel drums, or cargo containers.	VEM disposal packages will meet this requirement.
Handling procedures and ALARA documentation must be referenced on the WP for wastes requiring remote handling. The disposal site may request this documentation. Packages exceeding 2 mSv/hr (200 mR/hr) dose rate on contact are usually considered for remote handling.	WVNS will provide all handling procedures and ALARA documentation as required.

NTS Waste Acceptance Criteria Requirement	WVNS Response
Waste packages must be provided with cleats, offsets, rings, handles, permanently attached or removable skids, other auxiliary lifting devices to allow handling by means of forklifts, cranes, or similar handling equipment. Removable skids are preferred to assist in meeting NTS Performance Assessment objectives for reducing disposal cell subsidence. Lifting rings and other auxiliary lifting devices on the package are permissible, provided they are recessed, offset, or hinged in a manner that does not inhibit stacking the packages. The lifting devices must be designed with a 5:1 safety factor based on the ultimate strength of the material. All rigging devices that are not permanently attached to the waste package must have a current load test based on 125 percent of the safe working load. Permanently attached rigging devices shall have traceable certifications. They must not show any signs of corrosion, kinking, birdcaging, or other deterioration.	VEM disposal packages will meet this requirement.
Boxes measuring 1.2- x 1.2- x 2 1 -m (4- x 4- x 7-ft) or 1.2- x 0.6- x 2 1 -m (4- x 2- x 7-ft) (width x height x length, plus or minus ½ inch) or 208-liter (55-gallon) drums should be used. These sizes allow optimum stacking efficiency in disposal cells.	VEM disposal packages will meet this requirement.
Bulk waste generally exists in a form not suited to the conventional packaging requirements. Bulk LLW must meet the requirements of Title 49 CFR. Large items of bulk waste, such as machinery, may be considered for disposal unpackaged. For the transfer of unpackaged bulk material having external contamination, the contamination must be fixed, covered, or contained sufficiently for safe transfer.	VEMP is segregating and segmenting its bulk waste for packaging and disposal.
Bulk waste shipping containers may be returned to the generator after decontamination. Decontamination and return of bulk waste shipping containers may incur additional operational costs for the generator.	VEMP is segregating and segmenting its bulk waste for packaging and disposal.
In addition to the weight limits for specific packaging designs, packages shall not exceed 4,082 kg (9,000 lbs) per box and 544 kg (1,200 lbs) per drum. This weight limit does not apply to bulk waste.	VEM disposal packages will meet this requirement.

NTS Waste Acceptance Criteria Requirement	WVNS Response
Waste packages must be loaded to ensure that the interior volume is as efficiently and compactly loaded as practical to minimize void space. More than one waste stream may be packaged in a disposal container. High-density loading will allow efficient RWMS space utilization and provide a more stable waste form that will reduce subsidence and enhance the long-term performance of the disposal site.	VEM disposal packages will meet this requirement.
Methods must be employed to ensure that the integrity of the in-process waste package is not compromised (i.e., prohibited items are not introduced into the waste package).	WVNS will ensure the integrity of the VEM waste packages.
Once the waste package certification activities have been completed and the packages have been sealed, the packages must be stored in a secure, protected area to prevent deterioration and unauthorized intrusion. Tamper indicating devices, clips, or banding can be used to indicate that the package has not been opened.	WVNS will store VEM waste packages in a secure, protected area to prevent deterioration and unauthorized intrusion.
Each waste package must be marked and labeled.	WVNS will mark and label all VEM packages as required.
The shipment and package numbers must be bar coded.	WVNS will mark and label all VEM packages as required.
MW offered for disposal must meet the applicable requirements of the NTSWAC, Title 40 CFR, state of Nevada, state-of-generation, package criteria and disposal site permit requirements for identification, treatment, and disposal.	VEM offered for disposal will meet applicable requirements.
After a generator secures written approval from the DOE/NV AMEM to send waste to an NTS RWMS, the generator should contact BN to arrange for transfer of the waste and accompanying records. BN will coordinate unclassified waste shipment transfers at NTS. "Classified waste," unclassified accountable, or special nuclear material shipments will be coordinated by DOE/NV Safeguards and Security Division.	WVNS will notify NTS in accordance with their procedures.

NTS Waste Acceptance Criteria Requirement	WVNS Response
To expedite waste receipt and handling at NTS, waste generators shall, at a minimum comply with the following: • Prior to departure of a waste shipment to the NTS, the generator shall attach security seals to the shipping trailer's door latches or to each package if not enclosed in a trailer. • When the shipment leaves the generator site, the generator shall enter the following pre-notification information on the BN HAZTRAK database. If the generator is unable to enter information on the BN HAZTRAK, pre-notification should be made by fax to BN (702) 295-6852. For "classified waste", unclassified accountable, or special nuclear material shipments, generators should also contact DOE/NV Safeguards and Security Division (702) 295-0082. For all shipments, the following information must be provided: 1) Date and time shipment departed generator site 2) Estimated date and time of arrival (ETA) at NTS 3) Shipment number, shipper's name, shipper' s contact number 4) Carrier, driver's name (must be legible), driver's license number and state 5) Trailer number, seal number(s), DOT 'Proper Shipping Name(s)" 6) Number of packages, package type (boxes, drums, cargo containers, burrito wraps, etc.), and gross weight 7) Waste stream number and description of waste	WVNS will comply with these requirements.
Consign unclassified waste shipments to: Bechtel Nevada For U.S. Department of Energy Waste Management Nevada Test Site - Zone 2 Mercury, NV 89023	WVNS will consign waste shipments to this location.

NTS Waste Acceptance Criteria Requirement	WVNS Response
Consign "classified waste," unclassified accountable, or special nuclear material classified waste shipments to: U.S. Department of Energy Attn: Security Specialist DOE/NV Safeguards and Security Division For Bechtel Nevada Waste Management Nevada Test Site - Zone 2 Mercury, NV 89023	WVNS VEM waste packages do not meet these classifications.
Because unclassified and classified shipments are consigned differently, they should be shipped separately (i.e., on different trailers and have different shipment numbers and separate shipping papers). Under small-volume conditions, combined shipments can be arranged. Contact BN and DOE/NV Safeguards and Security Division for guidance.	WVNS VEM is unclassified.
If the shipment's ETA should change, the generator shall enter the changes on the BN HAZTRAK database at the earliest opportunity and provide the new ETA. Generators unable to update information on the BN HAZTRAK shall notify BN by phone. For "classified waste", unclassified accountable, or special nuclear material shipments, generators should contact DOE/NV Safeguards and Security Division.	WVNS will enter changes on the BN HAZTRAK database as required.
For materials regulated by DOT, complete shipping papers with shipper's certification, as required by Title 49 CFR, must accompany each shipment.	Completed shipping papers will accompany each shipment, as required.
A "Uniform Hazardous Waste Manifest" or equivalent state-of-generation manifest, accompanied by the appropriate documentation, shall be used when shipping MW. For on-site shipments of MW, an on-site Waste Manifest may be used.	VEMP shipments will comply with this requirement..
The original completed and signed Package Storage and Disposal Request (PSDR) or the original of an equivalent, shall accompany each shipment.	An original PSDR will accompany each shipment.

NTS Waste Acceptance Criteria Requirement	WVNS Response
An electronic version of the PSDR shall be transferred to BN prior to shipment arrival (E-mail address: wmdata@nv.doe.gov). Shipments will not be accepted if a PSDR is not on file.	An electronic version of the PSDR will transferred to BN prior to shipment arrival.
An appropriate Waste Certification Statement shall be signed by an authorized Waste Classification Officer (WCO) or Alternate WCO.	A Waste Certification Statement will be signed by a WCO or Alternate WCO.