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Evaluation of Proposed New LLW Disposal Activity

Disposal of Compacted Job Control Waste, Non-compactible, Non-incinerable Waste, And Other Wasteforms In Slit Trenches

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Revision History

Following issuance of the original document (i.e., rev. 0), it was decided to change the terminology for the calculated average concentrations derived from the inventory limit and the volumetric capacity of the unit. In the original document, the concentration values were termed "limits". This terminology proved problematic in managing the inventory limits through the deviation process. Thus, these values are now termed "concentration guidelines". Since the average concentration values presented in the UDQ serve no essential purpose, they were removed from the table. It was also decided to delete the table of materials acceptable for trench disposal (Table 2 of the original document). This table was only envisioned to be a listing of example materials. The intent of the PA, as well as the UDQ, is that any material, except for activated metal, meeting the trench WAC is acceptable.

Summary

The effect of trench disposal of low-level wasteforms that were not analyzed in the original performance assessment for the E-Area low-level waste facility, but were analyzed in the revised performance assessment is evaluated. This evaluation was conducted to provide a bridge from the current waste acceptance criteria, which are based on the original performance assessment, to those that will be developed from the revised performance assessment. The conclusion of the evaluation is that any waste **except for materials that would retain radionuclides more strongly than soil (e.g., activated metal)** that meets the radionuclide inventory limits for trench burial based on the revised performance assessment, and presented in Table 1 of this document, is suitable for trench disposal; **provided that, for cellulosic material (i.e., wood products) the current 40% restriction is retained**.

Introduction

One intent of DOE Order 435.1[1], as expressed in the performance assessment/composite analysis guidance[2], is to ensure that proposed changes in wasteforms, containers, radionuclide inventories, facility design, and operations are reviewed to ensure that the assumptions, results, and conclusions of the DOE approved performance assessment[3] (PA), and composite analysis[4] (CA), as well as any Special analyses (SA) that might have been performed, remain valid (i.e., that the proposed change is bounded by the PA and CA) and the changes are within the bounds of the Disposal Authorization Statement[5]. The goal is to provide flexibility in day-to-day operation and to require those issues with a significant impact on the PA's conclusions, and therefore the projected compliance with performance objectives/measures, to be identified and brought to the proper level of attention. It should be noted that the term performance measure is used to describe site specific adaptations of the DOE Order 435.1 Performance Objectives and requirements (e.g., performance measures such as applying drinking water standards to the groundwater impacts assessment).

The intent of this document is to provide an evaluation to determine if the proposed change to disposal practices (disposal of compacted job control waste, non-incinerable, non-compactible waste, and other wasteforms in slit trenches) is within the assumptions, parameters, and bases of the approved PA[3] and CA[4]. If it is, then this document serves as the technical basis for implementing the proposed activity. If not, then, in order to implement the proposed activity, the PA and CA would need to be updated as appropriate and DOE approval sought of the update (special analysis or revision of the PA or CA).

Description of Proposed Activity

Currently the Solid Waste Division at SRS disposes of low-level radioactive waste in trenches as well as vaults. Waste Acceptance Criteria[6] (WAC) specific to each wasteform and disposal unit limit the wasteforms and amounts (curies) of radionuclides that are allowed to be disposed in each unit. The WAC radionuclide limits are derived in part from the Radiological Performance Assessment (PA). The PA provides reasonable assurance through analysis that DOE performance objectives for LLW disposal are met. Other requirements (e.g., DOE Order 435.1, Safety Analysis Report[7]) are also incorporated into the WAC. Since the new revision of the PA has only recently been approved by DOE[8], the current WAC are reflective of Rev. 0 of the PA.

The only wasteforms currently allowed for trench disposal, because they were the only wasteforms considered in the original PA, are soil that is only suspected of being contaminated with radioactive material (i.e., suspect soil), rubble (i.e., rock, asphalt, metal, and concrete), and wood products (i.e., cellulosic material such as paper, cardboard, cloth) [9,10].

The proposed action is to also dispose of compacted job control waste (JCW), non-compactible, non-incinerable waste, and other wasteforms in trenches.

Background

Initially, the disposal concept for the E-Area LLW facility was that all waste would be disposed in concrete vaults. As Rev. 0 of the PA was being finalized, an appendix (Appendix I) was added to consider the disposal of soil from excavations in contaminated areas, but in which no radioactivity can be detected, (i.e., suspect soil) in slit trenches. After Rev. 0 of the PA was issued, a study was conducted to broaden the category of waste acceptable for trench disposal to include rubble (i.e., rock, asphalt, metal, and concrete)[9]. Subsequently, the effect of disposal of wood products (i.e., cellulosic material) in trenches was analyzed and radionuclide limits were revised accordingly[10]. In the revised E-Area PA[3], only very general characteristics of the waste were incorporated into the slit trench analysis; thus, any waste that meets the radionuclide inventory limits for trench burial based on the revised PA[3] and the Solid Waste Management Safety Analysis Report[7] is suitable for trench disposal, except for materials that would retain radionuclides more strongly than soil (e.g., activated metal).

A previous analysis[10] showed that wood products (i.e., cellulosic material) degrade in the environment to form organic material that can enhance the mobility of some radionuclides in the subsurface environment. The analysis developed radionuclide limits applicable to wood products (Table 1 of reference 10). These limits have been incorporated into the current WAC[6]. The analysis also recommended that wood product waste comprise no more than 40 percent by weight of the wastes disposed in the active disposal area; this restriction is implemented procedurally.

The enhanced mobility of certain radionuclides due to the presence of wood products was incorporated into the PA revision[3]. However, at this time, it is not clear whether the 40% restriction on the amount of cellulosic material that may be disposed is still required. Additional research[11, 12] shows no decrease in the K_d values selected from the earlier study compared with results of tests with much larger quantities of wood products. However, full interpretation and consideration of the applicability of these results to the PA has not yet been completed. Thus, at this time, the 40% restriction on wood products must be applied to trench disposal of waste containing material that would degrade similarly to wood products (i.e., cellulosic material such as paper and cardboard).

The aspect of the trenches that is significant to this evaluation is:

- The wasteforms considered. The wasteform analyzed influences the rate of release of radionuclides from the trench to the subsurface environment and may also influence intrusion into the waste.

Options for disposal of compacted JCW, non-compactible, non-incinerable Waste and other LLW

Options for disposal of compacted JCW, non-compactible, non-incinerable waste, and other LLW wasteforms that are bounded by the current PA analyses are discussed below. The options consider different disposal units for the wasteforms being considered.

1. The option analyzed in the original PA (i.e., disposal of low-activity waste such as compacted job control waste and non-compactible, non-incinerable waste in the low-activity waste vaults) is clearly within the bounds of the PA.

2. The option being evaluated here, namely the disposal of compacted job control waste, non-compactible, non-incinerable waste, and other forms of LLW in slit trenches, is within the bounds of the approved PA revision[3] **if** the radionuclide limits for the slit trenches derived from the revised PA[3], and presented in Table 1 of this document, are applied to this waste **and** the waste contains no material that would retain radionuclides more strongly than soil (e.g., activated metal) **and** the compacted JCW does not exceed 40% by weight of the waste disposed in the active part of the trench, unless it can be shown that the JCW does not contain cellulosic material.

Supporting Analysis

There are three basic pathways considered in the PA, the groundwater pathway, the air pathway, and the intruder pathway. The proposed activity involves a change in the wasteforms to be disposed in trenches. In order to conclude that the activity is bounded by the PA, it must be shown that the disposal of the new wasteforms would not result in a greater impact than that calculated in the PA.

For the groundwater pathway, the wasteform can affect the analysis in two ways. The wasteform can retain the radionuclides longer than assumed in the PA or release them more readily. The wasteform can alter the chemistry of the radionuclides to either enhance or diminish their mobility after they have been released from the waste. In the PA[3], the wasteform was assumed to have the same properties as soil with the exception of wood products which will degrade into organic matter that could enhance the migration of radionuclides from the disposed waste. The radionuclide distribution factors, K_d, which would be impacted by the presence of organic matter derived from wood products[10], were adjusted accordingly in the PA[3].

For the air pathway, the wasteform can either enhance or retard the release of volatile radionuclides to the subsurface environment. In the PA, the air pathway analysis for trench disposal was very conservative. All of the tritium and ^{14}C was assumed to be available for atmospheric transport at the time of disposal. For radon (produced from decay of ^{234}U), vapor phase diffusion from a 2.7 m thick waste zone with the properties of soil and a 1 m thick soil cover was assumed. These assumptions bound all wasteforms.

For the intruder pathway, the wasteform can affect the analysis in two ways. If the proposed wasteform releases radionuclides more readily than those analyzed in the PA, the residual radionuclide concentrations in the wasteform at the time that intrusion is hypothesized would be less and the calculated dose would be less. Similarly, if the proposed wasteform retains radionuclides more strongly than those analyzed in the PA, the residual concentrations in the wasteform at the time that intrusion is hypothesized would be greater and the calculated dose would be greater. The analyses in the approved PA[3] considered a generic wasteform with the properties of soil with the exception of wood products which will degrade into organic matter that could enhance the migration of radionuclides from the disposed waste. The PA analyses bound all waste types except those that would retain radionuclides more strongly than soil (e.g., activated metal). If the proposed wasteform is more durable (remains recognizable as waste for a longer time) it may preclude intrusion either by impeding the intrusion event (e.g., digging or drilling) or by "warning" the intruder that he is not performing his activity in the natural environment. The analyses in the approved PA[3] considered a generic wasteform (i.e., one that does not impede intruder activity and is not recognizable as waste) that bounds all wasteforms except those that retain radionuclides more strongly than soil.

Compacted JCW is composed of a variety of materials such as paper, cardboard, plastic, and wood. A previous analysis[10] showed that wood products (i.e., cellulosic material) degrade in the environment to form organic material that can enhance the mobility of some radionuclides in the subsurface environment. The analysis developed radionuclide limits applicable to wood products (Table 1 of reference 10). These limits have been incorporated into the current WAC[6]. The analysis also recommended that wood product waste comprise no more than 40 percent by weight of the wastes disposed in the active disposal area.

The enhanced mobility of certain radionuclides due to the presence of wood products was incorporated into the PA revision[3]. However, at this time, it is not clear whether the 40% restriction on the amount of cellulosic material that may be disposed is still required. Additional research[11, 12] shows no decrease in the K_d values selected from the earlier study compared with results of tests with much larger quantities of wood products. However, full interpretation and consideration of the applicability of these results to the PA has not yet been completed. Thus, at this time, the 40% restriction on wood products must be applied to trench disposal of waste containing material that would degrade similarly to wood products (i.e., cellulosic material such as paper and cardboard).

Non-compactible, non-incinerable waste is comprised of material that can neither be compacted nor incinerated. The bulk of this material is some form of metal or wood. Prior analysis[9] has shown that metal, as well as other materials, should be included in the category of rubble and should be acceptable for disposal in the slit trenches. The current slit trench WAC includes metal as an acceptable wasteform. As stated above, wood is an acceptable material for trench disposal. In the revised PA[3], all forms of waste, except those that retain radionuclides more strongly than soil, are represented in the analysis of the slit trenches. Thus, disposal of non-compactible, non-incinerable waste is bounded by the PA.

Therefore, the proposed activity (i.e., disposal of compacted JCW, non-compactible, non-incinerable waste, and other wasteforms in trenches) is bounded by the PA[3]. Waste Acceptance Criteria have not yet been developed and implemented from the revised PA[3]. Table 1 provides radionuclide inventory limits for slit trench disposal, derived from the revised PA[3] for slit trench disposal.

Evaluation

1. Does the proposed activity involve a change to the Performance Assessment or exceed PA performance measures/conclusions?

   No. Per the analysis above, the proposed activity does not involve a change to the Performance Assessment or exceed PA performance measures/conclusions.

2. Does the proposed activity involve a:

   a. change to the basic disposal concept as described in the PA?

      No. Trench disposal was analyzed in the PA. The proposed activity is merely a change in the wasteforms allowed for trench disposal in the current WAC, which is based on the original PA.

   b. change to the analyses or radionuclide limits as described in the PA?

      No. The analyses and radionuclide limits developed in the PA and the WAC derived from them do not change.

   c. change in the disposal authorization that leads to a significant change in projected dose?

      No. The proposed activity will not result in a significant change in projected dose.

   d. change in the results in the approved PA that is greater than 10%?

      No. The proposed activity will not cause the results in the PA to change more than 10%.

   e. change of greater than 10% in the dose calculated in the approved PA?

      No. The proposed activity will not change the dose calculated in the PA by more than 10%.

   f. Does the proposed activity modify the analysis or conclusions provided in the Composite Analysis?

      No. The proposed activity modifies neither the analysis nor the conclusions provided in the Composite Analysis.

   g. change to the Disposal Authorization Statement?

      No. The proposed activity does not necessitate a change to the Disposal Authorization Statement.

Conclusion

The proposed activity (i.e., disposal of compacted JCW, non-compactible, non-incinerable waste, and other wasteforms in trenches) is bounded by the PA^3; provided the waste contains no material that would retain radionuclides more strongly than soil (e.g., activated metal) and cellulosic material is limited to 40% by weight of the waste disposed in the active trench area. Because WAC have not yet been developed and implemented from the revised PA^3, Table 1 provides radionuclide inventory limits for slit trench disposal, derived from the revised PA^3.

References

1. *Radioactive Waste Management*, Order 435.1, U. S. Department of Energy, July 9, 1999.

2. *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*, U.S. Department of Energy, November 10, 1999.

3. *Radiological Performance Assessment for the E-Area Vaults Disposal Facility*. WSRC-RP-94-218, Rev. 1. Savannah River Laboratory, Westinghouse Savannah River Company, Aiken, SC., January 31, 2000.

4. *Westinghouse Savannah River Company Composite Analysis E-Area Vaults and Saltstone Disposal Facilities,* WSRC-RP-97-311, Rev. 0, September 1997.

5. *Disposal Authorization Statement for the Department of Energy Savannah River Site E-Area Vaults and Saltstone Disposal Facilities,* 9/28/99

6. WSRC 1S Savannah River Site Waste Acceptance Criteria Manual, Procedure WAC 3.17 Low Level Radioactive Waste Acceptance Criteria, Rev. 2, June 10, 1999.

7. *Safety Analysis Report Savannah River Site Solid Waste Management Facility* (U), WSRC-SA-22, Rev.2, September 1999.

8. Memorandum, W.L. Noll to P.I. Hudson, *Approval of the Radiological Performance Assessment (PA) for the E-Area Low-Level Waste Facility, Revision 1 (WSRC-RP-94-218)*, 2/29/2000.

9. *PA Based Functional Definition of Suspect Soil*, SRT-WED-96-0152, J.R. Cook, January 26, 1996.

10. *Re: Additional Information for E-Area Vault Performance Assessment, Appendix I "Suspect Soil Performance Analysis" – Results of Modeling the Effects of Organic Matter on the Mobility of Radionuclides as it Relates to the Disposal of Wood Products in E-Area Slit Trenches*, SRTC-WED-96-0195, J.L. Meyers and S.M. Serkiz, April 24, 1996.

11. *Phase I Nuclide Partition Laboratory Study Influence of Cellulose Degradation Products on the Transport of Nuclides from SRS Shallow Land Burial Facilities* (U), WSRC-TR-98-00460, Rev. 0, S.M. Serkiz, et al, December 20, 1998.

12. *Phase II Nuclide Partition Laboratory Study Influence of Cellulose Degradation Products on the Transport of Nuclides from SRS Shallow Land Burial Facilities* (U), WSRC-TR-99-00298, Rev. 0, S.M. Serkiz, et al, August 29, 1999.

Table 1 Slit Trench Radionuclide Inventory Limits

Radionuclide [a]	Inventory limit [b] Ci/5 trenches
H-3	6.3E+00
C-14	2.7E+00
Ni-59	3.7E+02
Co-60	7.3E+08
Ni-63	2.8E+05
Se-79	1.1E+02
Rb-87	3.1E-01
Sr-90 +d	5.7E+02
Zr-93 +d	2.8E+01
Tc-99	5.5E-01
Pd-107	4.1E+01
Cd-113m	2.4E+04
Sn-121m	1.2E+06
Sn-126 +d	5.6E+01
I-129	5.2E-04
Cs-135	3.9E+02
Cs-137 +d	2.1E+04
Sm-151	6.1E+06
Eu-154	8.1E+06
Th-228	5.5E+19
Th-232 +d	1.3E+00
U-232 +d	1.4E+01
U-233 +d	2.4E+00
U-234 +d	8.5E+00
U-235 +d	4.9E+00
U-236	9.6E-02
Np-237 +d	4.8E-02
U-238 +d	2.4E-01
Pu-238 +d	2.8E+02
Pu-239 +d	9.6E-01
Pu-240 +d	1.2E+00
Am-241 +d	2.4E+02
Pu-241 +d	7.2E+03
Pu-242 +d	1.7E-02
Am-242m +d	8.1E+02
Am-243 +d	9.0E-01
Pu-244+d	1.8E-02
Cm-242 +d	1.8E+05
Cm-243	1.8E+04
Cm-244 +d	4.3E+02
Cm-245+d	3.7E+01
Cm-246	1.4E+02
Cm-247 +d	7.1E-01
Cm-248 +d	3.6E+01
Bk-249 +d	2.8E+04
Cf-249 +d	6.9E+01
Cf-250 +d	4.8E+04
Cf-251	5.2E+01
Cf-252 +d	4.5E+06

[a] "+d" indicates potentially-significant short- and long-lived daughters are accounted for in the limit.
[b] From Table 7.1-3 of the PA (WSRC-RP-94-218, Rev. 1).