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Evaluation of Proposed New LLW Disposal Activity
Disposal of LLW in a Engineered Trench rather than in Slit Trenches

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Revision History

Following issuance of the original document (i.e., rev. 0), it was discovered that an error was made in stating the dimensions and volume of the Engineered Trench and the incorrect volume was used in calculating the concentration limits (i.e. the inventory limit divided by the volumetric waste capacity of the unit) in the tables. The terminology of calling the average concentrations "limits" proved problematic in managing the inventory limits through the deviation process. Since the average concentration values presented in the UDQ serve no essential purpose (Waste Acceptance Criteria are derived from the inventory limits), they were removed from the tables. Also, the name of the disposal unit was changed from the MegaTrench to the Engineered Trench. For clarification, a statement was added that differences in dimensions of disposal units of less than about 10% are inconsequential from a PA perspective.

Summary

The effect of disposing of low-level waste in a much larger trench than the slit trenches analyzed in the revised performance assessment for the E-Area low-level waste facility is evaluated. The conclusion of the evaluation is that such disposal is bounded by the performance assessment **if** two restrictions are imposed. These restrictions are:

1. The radionuclide inventory limits for slit trench disposal derived from the revised performance assessment, rather than the radionuclide concentration or package guidelines, are applied to the larger trench (i.e., average radionuclide concentration or package guidelines for the Engineered Trench must be derived by dividing the radionuclide inventory limits for the set of five slit trenches by the volumetric waste capacity of the entire Engineered Trench).

2. For stabilized waste (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste), radionuclide concentration or package guidelines derived from the inventory limits for these wasteforms calculated in the performance assessment and the volumetric waste capacity of the entire Engineered Trench may be used **if** this waste fills a large-enough segment of the trench to provide structural support for the closure cap, as assumed in the performance assessment (the minimum trench segment necessary to provide closure cap stability is judged to be nominally 20 feet long by 20 feet wide, based on the 20 feet width of the slit trench analyzed in the performance assessment) **and** the stabilized waste is segregated from the unstabilized waste by emplacing the stabilized waste along the edge of the trench and separating the stabilized waste from the unstabilized waste by a minimum of two feet of soil or other material with similar hydraulic properties (the minimum thickness of the soil separator is based on detailed modeling studies conducted in support of the PA revision).

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 low-level waste (LLW) in a single, but much larger, trench rather than in slit trenches and co-disposing stabilized and unstabilized waste) 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.

For the disposal of waste in slit trenches, the PA analyzed a set of five trenches. Each trench was assumed to be 200 meters long by 6 meters deep by 6 meters wide. It was also assumed that the set of five trenches was 48 meters wide. Thus, there are 4.5 meters of undisturbed ground between each trench in the set (Figure 2.2-4 in the PA).

One element of the proposed action is to dispose of unstabilized (i.e., very-low-activity) LLW in a single large trench (called an Engineered Trench) that occupies approximately the same land area as the set of five trenches (i.e., approximately 48 m by 200 m). The other element of the proposed activity is to dispose of stabilized (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste) waste in the Engineered Trench. Initially, it was thought that the entire Engineered Trench would be excavated before emplacing waste. Now, however, it is expected that the Engineered Trench will be excavated in stages along the length of the trench. Nonetheless, to ensure conservatism in this evaluation, the total projected size of the Engineered Trench (i.e., approximately 200 m long by 48 m wide by 6 m deep, of which 4.8 m would contain waste) must be considered.

There will be some design features of the Engineered Trench that differ from the slit trench concept for operational reasons. The floor of the Engineered Trench will be slightly sloped to a sump and covered with a gravel layer, to facilitate vehicle traffic, on top of a porous geotextile fabric, to prevent the gravel from being pressed into the underlying material. Before closure the sump will be filled in and the void spaces in the gravel will have been become filled with backfill. The final configuration will be very much like that modeled in the PA. Thus, these design changes will have no effect on the long term performance of the disposal facility.

Background

In the revised E-Area PA[3], only very general characteristics of the unstabilized waste were incorporated into the analysis; thus, any waste that meets the radionuclide concentration or package guidelines for trench burial of unstabilized (i.e., very-low-activity) waste based on the revised PA 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). For stabilized waste (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste) the presence of cement grout was taken into consideration in assigning radionuclide distribution factors (K_d) that affect the migration of radionuclides from the waste. Also, for stabilized waste, the filling of the trench with this waste was assumed to provide stability for the closure cap for a period of 300 years.

The only trench configuration considered in the PA was slit trenches (i.e., 6 meters wide by 6 meters deep). For convenience in interpreting the results of the analysis, the set of five trenches was assumed to occupy the same land area as a Low Activity Waste (LAW) vault (i.e., 200 meters long by 48 meters wide). Since the top of each trench was assumed to be 6 m wide, the spacing between trenches was assumed to be 4.5 m.

The trenches were assumed to be 6 m deep, with 4.8 m of waste and the top 1.2 m of each trench was assumed to be filled with non-contaminated backfill. Thus the disposal capacity of each of the five trenches in a set is 5,760 m^3 and the disposal capacity of the set of five trenches is 28,800 m^3.

The aspects of the trenches that are significant to this evaluation are:

- The amount of land containing waste in proportion to the total amount of land in a group of trenches. This determines the "geometrical reduction factor" in the inadvertent intruder analysis. In the PA, given the dimensions of the slit trenches, the spacing between trenches and the assumption that a set of five trenches comprises a disposal unit, the geometrical reduction factor is 0.6 (i.e., the surface area of the five trenches divided by the surface area of the set of five trenches).

- The thickness of waste within the trench. This is related to the concentration of radionuclides in water migrating to the groundwater table. In the PA, the thickness of the waste in the slit trenches was 4.8 m (i.e., 16 feet).

- The land surface area of the trenches. This is significant in the simulation of radionuclide migration to the water table. The surface area of each trench is 1,200 m^2 and the trench surface area for the set of five trenches is 6,000 m^2 (not counting the land between each trench).

- The waste volume in the disposal unit. In the PA, some radionuclide limits are derived by simulating radionuclide migration from the disposed waste to a hypothetical groundwater well. Limits derived from the groundwater pathway are based on the total amount of the radionuclide in the disposal unit. Limits for other radionuclides are derived from the intruder pathways. These limits are derived from the average concentration of the radionuclide in the disposal unit. Limits derived from the air pathway are based on the total inventory of radionuclides in the disposal unit. In the PA, all of the limits are expressed as total inventory limits (Tables 7.1-3, 7.1-5, and 7.1-6 of the PA[3]).

- The distance from the bottom of the trench to the water table. The PA assumed a nominal distance of 7.6 m. This is significant for transport of radionuclides to the water table.

- For disposal of unstabilized waste, a prior analysis[9] determined the effect of co-disposing wood products (i.e., cellulosic material) in the slit trenches on radionuclide limits. Revised radionuclide limits for a set of five slit trenches were developed and presented in Table 1 of reference 9. Application of these limits requires that wood products be homogeneously mixed with other wastes and do not exceed 40% by weight of other wastes disposed in the active disposal area of the slit trenches. The 40% restriction on the fraction of wood products was imposed because the tests in the studies that form the basis for reference 9 were done with no more than 40% wood products.

  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 must be included in WAC derived from the revised PA. Additional research[10, 11] 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.

- For stabilized waste (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste), the PA assumed that the stabilized wasteforms would prevent subsidence and consequent closure cap failure for a period of 300 years. Additionally, the PA assigned a much lower hydraulic conductivity to the stabilized waste compared to the unstabilized waste during the first 300 years.

Other aspects of the slit trenches are not significant to this evaluation. For example, the location proposed for the Engineered Trench within the E-Area Low-Level Waste Facility differs from that assumed in the PA. In the PA, the slit trenches were assumed to be adjacent to the Intermediate Level Vaults (see Figure 2.2-1 of the PA) while the proposed location of the Engineered Trench is adjacent to the LAW vaults. Because of the methodology employed to model the E-Area disposal units, the specific location of each unit will have little or no effect on the modeling results.

<u>Options for use of Trenches for LLW Disposal</u>

Options for the use of trenches for LLW disposal that are bounded by the current PA analyses are discussed below. The options consider variations on trench size and construction.

1. The options analyzed in the PA (i.e., each trench being a slit trench and a set of five such trenches occupying the same land area as a LAW vault) and segregating the types of waste (i.e., very-low-activity waste, intimately-mixed cement-stabilized waste, and cement-stabilized encapsulated waste are each disposed in a set of five slit trenches containing only one type of waste) are clearly within the bounds of the PA.

2. The option being evaluated here, namely the use of a single large trench instead of a set of five slit trenches, is within the bounds of the PA **if** the radionuclide concentration or

package guidelines for the large trench are derived by dividing the radionuclide inventory limits (i.e., total curies of each radionuclide in the set of five trenches for each waste type – Tables 7.1-3, 7.1-5, and 7.1-6 of the revised PA[3]) derived from the PA for the slit trenches by the total waste volumetric capacity of the entire Engineered Trench **and**, for stabilized waste (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste), **if** this waste fills a large-enough segment of the trench to provide structural support for the closure cap, as assumed in the performance assessment (the minimum trench segment necessary to provide closure cap stability is judged to be nominally 20 feet long by 20 feet wide, based on the 20 feet width of the slit trench analyzed in the performance assessment) **and** the stabilized waste is segregated from the unstabilized waste by emplacing the stabilized waste along the edge of the trench and separating the stabilized waste from the unstabilized waste by a minimum of two feet of soil or other material with similar hydraulic properties, to ensure that water diverted by the stabilized waste does not flow through the unstabilized waste (the minimum thickness of the soil separator is based on detailed modeling studies conducted in support of the PA revision).

The limits for stabilized (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste) and unstabilized waste derived above would be applied to the respective wastes. In essence, to facilitate record keeping and limit tracking, each radionuclide would have a limit for each of the three wasteforms. For example, ^{99}Tc would have three limits: $^{99}Tc_{unstab}$ for unstabilized waste, $^{99}Tc_{ash}$ for intimately-mixed cement-stabilized waste (e.g., ashcrete), and $^{99}Tc_{comp}$ for cement-stabilized encapsulated waste (i.e., components in grout). Each of the "forms" of technetium would be tracked versus its respective limit in the sum-of-fractions for the trench. The radionuclide concentration or package guidelines, as stated above, would be derived by dividing the inventory limits for each waste type in the PA by the entire volume of the Engineered Trench.

Alternatively, the Engineered Trench could be divided into segments so that each segment would contain a particular type of waste (i.e., components in grout, ashcrete, general waste). In this case, radionuclide concentration guidelines could be derived for each trench segment and the sum-of-fractions maintained less than one for each segment. However, it must be kept in mind that, for this evaluation, the radionuclide concentration guidelines for each segment must be derived in the same way as stated above. In other words, the radionuclide concentration guidelines may not be derived using the waste volume for a segment; the waste volume for the entire Engineered Trench must be used.

Supporting Analysis

The Engineered Trench differs from the slit trenches in three ways that may be significant with respect to PA-derived radionuclide limits for both the stabilized (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste) and unstabilized wastes. These are the lack of land not containing waste within the bounds of the Engineered Trench, the land surface area of the Engineered Trench, and the waste volume contained by the Engineered Trench. For the stabilized wastes, the placement of the stabilized waste within the Engineered Trench is also significant. Each of these factors is discussed below.

Land not containing waste

As stated above, the trench disposal unit analyzed in the PA is a set of five slit trenches with 4.5 meters of undisturbed ground between each trench in the set. This configuration is assessed in the inadvertent intruder analysis as a "geometrical reduction factor" which accounts for the probability of the intruder striking uncontaminated land instead of waste. The geometrical reduction factor is the ratio of the land surface area containing waste to total land surface area of the disposal unit. In the PA this ratio is 0.6. Therefore, in the PA, the doses calculated in the intruder analysis are multiplied by 0.6 to represent the reduced probability of the intruder encountering waste.

The Engineered Trench occupies the same land area as the set of five slit trenches. However, all of the land within the Engineered Trench contains waste. Therefore, the geometrical reduction factor for the Engineered Trench would be unity. Thus, the doses calculated in the intruder analysis would not be reduced by the geometrical reduction factor and the radionuclide limits for the Engineered Trench (if only this factor is considered) would be lower than those for the slit trench. However, as noted below, the increased volume of waste in the Engineered Trench compensates for this factor, if the radionuclide inventory limits derived for the slit trenches in the PA are applied to all of the waste in the Engineered Trench (i.e., the radionuclide inventory limits for the slit trench are "diluted" by the larger volume of the Engineered Trench).

Land surface area of the Engineered Trench

The land surface area of the Engineered Trench is larger than that of the five slit trenches. As originally conceived, the land surface area of the Engineered Trench was to be 8,580 m^2 (the proposed dimensions of the Engineered Trench were 195 m long by 44 m wide[12]). Initially, it was thought that the entire Engineered Trench would be excavated before emplacing waste. Now, however, it is expected that the Engineered Trench will be excavated in stages along the length of the trench. Nonetheless, to ensure conservatism in this evaluation, the maximum projected size of the Engineered Trench must be considered.

The land surface area of the five slit trenches is 6,000 m^2. The land surface area of the disposal unit determines the amount of infiltrating water that passes through the unit in a given time. The effect of the land surface area, however, is also related to the quantity of radionuclides disposed. If the land surface area of the disposal unit is increased and the quantity of radionuclides disposed in the unit is held constant, the calculated concentration of radionuclides in the groundwater will decrease.

Volume of waste emplaced in the Engineered Trench

The Engineered Trench will contain considerably more waste volume than the set of five slit trenches. The volume of the set of five slit trenches available for waste emplacement is 28,800 cubic meters. The proposed dimensions of the portion of the Engineered Trench that will contain waste are 195 m long by 44 m wide by 4.8-m deep[12]. Therefore, the waste disposal capacity of the Engineered Trench will be about 41,200 cubic meters. The disposal capacity of the Engineered Trench will be about 1.4 times that of the set of five slit trenches. However, to ensure conservatism in this evaluation, it will be assumed that the entire Engineered Trench will occupy the same land area as the set of five trenches (i.e., 200 m by 48 m). Thus, for the purposes of this evaluation, the volumetric waste capacity of the Engineered Trench will be 46,080 m^3. This volume is 1.6 times greater than the volumetric waste capacity of the set of five slit trenches. The difference in dimensions between the design dimensions of the Engineered Trench and the area of the set of five slit trenches analyzed in the PA is less than about 10%, which is judged to be inconsequential in maintaining controls derived from the PA.

If the total quantity (i.e., curies) of radionuclides disposed in the Engineered Trench was restricted to the radionuclide inventory limits derived from the PA for the slit trenches (Tables 7.1-3, 7.1-5, and 7.1-6 in the PA), the average concentration of radionuclides in the Engineered Trench would be about 60% of that analyzed for the slit trenches in the PA. Thus, the dose calculated in the intruder pathway for the Engineered Trench would be essentially the same as that calculated in the PA. Thus, the larger disposal volume in the Engineered Trench mitigates the lack of uncontaminated ground discussed above if the radionuclide inventory limits derived for the slit trenches (Tables 7.1-3, 7.1-5, and 7.1-6 in the PA) are applied to the Engineered Trench.

Note that it is the PA-derived inventory limits that should be applied, not the Waste Acceptance Criteria that will be derived from the PA for the slit trenches. The WAC for the slit trenches are expressed as a concentration or amount of radionuclide allowed in a container with a specific volume. These WAC are derived from the PA inventory limits by dividing the inventory limit by the available volume for the slit trenches. If these concentration or container guidelines are applied to all the waste disposed in the Engineered Trench, the projected dose in the intruder analysis and the projected radionuclide concentrations in groundwater would exceed the PA performance measures. Thus, for the purposes of this evaluation, WAC for the Engineered Trench must be derived from the PA inventory limits developed in the PA[3] for the slit trenches and the available volume of the Engineered Trench.

Emplacement of stabilized waste in the Engineered Trench

In the PA analysis, the trenches containing unstabilized waste were separated from the trenches containing stabilized waste (i.e., intimately-mixed cement-stabilized waste and cement-stabilized encapsulated waste). The hydraulic properties of the unstabilized waste are different than those of the stabilized waste (i.e., the stabilized waste will allow less water to pass through the waste than will the unstabilized waste). To ensure that water shed by the stabilized waste does not flow through the unstabilized waste, the two types of waste must be separated by a minimum of 2 feet of soil (i.e., clean soil or suspect soil) or other equivalent material (e.g., CLSM) (the minimum thickness of the soil separator is based on detailed modeling studies conducted in support of the PA revision).

In the PA analysis for the stabilized wastes, it was also assumed that the stabilized waste completely fills each of the slit trenches. This assumption allowed the PA to assume that subsidence and consequent failure of the closure cap could be extended to 300 years. To apply this phenomenon in the Engineered Trench, the stabilized wastes must be emplaced so they fill a segment of the trench, rather than being randomly emplaced throughout the trench. The minimum trench segment necessary to provide closure cap stability is judged to be 20 feet long by 20 feet wide, based on the 20 feet width of the slit trench analyzed in the performance assessment. To ensure conditions similar to those analyzed in the PA, the stabilized waste must also be placed along the edge of the trench, rather than in the midst of the unstabilized waste (This will ensure that the effect of closure cap degradation over the unstabilized waste will be similar to that assumed in the PA).

Tables 1, 2, and 3 provide radionuclide inventory limits appropriate for the Engineered Trench.

Evaluation

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

   No, per the analysis above, so long as WAC for the Engineered Trench are derived from the PA radionuclide inventory limits (Tables 7.1-3, 7.1-5, and 7.1-6 of the PA) and the waste volume of the Engineered Trench and stabilized wastes fill segments of the Engineered Trench (the minimum segment size is 20 feet long by 20 feet wide).

2. Does the proposed activity involve a:

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

      No. Trench disposal was envisioned in the PA. The proposed activity is merely a change in the configuration of the trench and the co-disposal of several types of waste in a single trench.

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

      No. The analyses and radionuclide inventory limits derived in the PA do not change. However, new concentration guidelines for the proposed activity must be derived from the PA radionuclide inventory limits for the slit trenches and the volume of the Engineered Trench; these inventory limits are presented in Tables 1, 2, and 3.

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

      No. The proposed activity, if WAC derived from the PA radionuclide inventory limits for the slit trenches and the volume of the Engineered Trench are applied to the waste disposed in the Engineered Trench and stabilized wastes fill segments of the Engineered Trench, 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. By applying the PA-derived radionuclide inventory limits for the slit trenches to the volume of waste in the entire Engineered Trench and ensuring that stabilized wastes fill segments of the Engineered Trench, the resulting impacts (e.g., groundwater concentrations or intruder doses) will be essentially the same as those calculated in the PA.

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

      No. By applying the PA-derived radionuclide inventory limits for the slit trenches to the volume of waste in the entire Engineered Trench and ensuring that stabilized wastes fill segments of the Engineered Trench, the resulting impacts (e.g., groundwater concentrations or intruder doses) will be essentially the same as than those calculated in the PA.

f. change in 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 LLW in a single Engineered Trench rather than a set of five slit trenches and co-disposing of unstabilized and stabilized waste in the same trench) is bounded by the PA[3]; provided the radionuclide concentration guidelines developed from the radionuclide inventory limits developed in the PA for the slit trenches use the assumed volume of the Engineered Trench of 46,080 cubic meters and the stabilized waste is segregated from the unstabilized waste by emplacing the stabilized waste along the edge of the trench and separating the stabilized waste from the unstabilized waste by a minimum of two feet of soil or other material with similar hydraulic properties (the minimum thickness of the soil separator is based on detailed modeling studies conducted in support of the PA revision).

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Table 1 Engineered Trench Radionuclide Inventory Limits for Very Low Activity Waste

Radionuclide	Inventory limit[a] Ci/5 trenches or Ci/Engineered Trench
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] From Table 7.1-3 of the PA (WSRC-RP-94-218, Rev. 1).

Table 2. Radionuclide Inventory Limits for Cement-Stabilized Encapsulated Waste Disposal

Radionuclide	Inventory limit Ci/5 trenches[a] or Ci/Engineered Trench
H-3	3.2E+05
Ni-59	4.4E+03
Co-60	2.1E+09
Ni-63	1.3E+06
Se-79	7.7E+01
Sr-90+d	2.6E+05
Zr-93+d	1.6E+01
Tc-99	3.0E-01
Pd-107	1.7E+01
Sn-126+d	5.2E+00
I-129	2.2E-04
Cs-135	2.0E+01
Cs-137+d	2.2E+06
Sm-151	3.1E+07
Eu-154	3.6E+07
U-232+d	1.7E+03
U-233+d	6.6E+01
U-234+d	9.8E+00
U-235+d	2.6E+01
U-236	4.6E+02
U-238+d	1.2E+02
Pu-238+d	1.4E+04
Pu-239+d	1.3E+02
Pu-240+d	1.3E+02
Am-241+d	2.7E+02
Pu-241+d	8.0E+03
Pu-242+d	1.3E+02

[a] From Table 7.1-6 of the PA (WSRC-RP-94-218, Rev. 1).

Table 3. Radionuclide Inventory Limits for Intimately-Mixed Cement-Stabilized Waste Disposal

Radionuclide	Inventory limit Ci/5 trenches[a] or Ci/Engineered Trench
H-3	3.2E+05
C-14	2.7E+00
Ni-59	4.7E+02
Co-60	2.1E+09
Ni-63	1.3E+06
Se-79	1.8E+01
Rb-87	3.4E-01
Sr-90 +d	2.6E+05
Zr-93	1.7E+03
Nb-94	2.1E+00
Tc-99	3.9E-01
Pd-107	9.9E+01
Sn-126 +d	1.9E+00
I-129	4.1E-04
Cs-135	2.0E+01
Cs-137 +d	2.2E+06
Sm-151	3.1E+07
Eu-152	2.0E+10
Eu-154	3.6E+07
Th-232 +d	1.4E+00
U-232 +d	1.7E+03
U-233 +d	1.3E+02
U-234 +d	9.8E+00
U-235 +d	2.6E+01
U-236	4.6E+02
Np-237 +d	9.4E+00
U-238 +d	1.2E+02
Pu-238 +d	1.4E+04
Pu-239 +d	1.3E+02
Pu-240 +d	1.3E+02
Am-241 +d	2.7E+02
Pu-241 +d	8.0E+03
Pu-242 +d	1.3E+02
Am-243 +d	2.1E+01
Pu-244+d	9.7E+00
Cm-244 +d	4.8E+04
Cm-245 +d	3.4E+01
Cm-246	1.3E+02
Cm-247 +d	9.2E+00
Cm-248 +d	3.4E+01
Cf-249 +d	4.0E+01
Cf-250 +d	4.8E+04
Cf-251	5.2E+01
Cf-252 +d	4.5E+06

[a] From Table 7.1-5 of the PA (WSRC-RP-94-218, Rev. 1).