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May 2, 2002

FH-0201994
CONTRACT NUMBER DE-AC06-96RL13200

Mr. Peter M. Knollmeyer
Assistant Manager for the Central Plateau
U.S. Department of Energy A5-11
Richland Operations Office
Post Office Box 550
Richland, Washington 99352

RECEIVED
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Dear Mr. Knollmeyer:

HISTORY OF THE LOW-LEVEL WASTE BURIAL GROUNDS (LLBG) PERFORMANCE ASSESSMENTS

References: (1) DOE, 1999, DOE O 435.1, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.

(2) DOE, 2000, *Low-Level Waste Disposal Facility Federal Review Group Program Management Plan*, U.S. Department of Energy, Washington, D.C.

(3) Wood M.I., R. Khaleel, P.D. Rittmann, A.H. Lu, S.H. Finfrock, R.J. Serve, K.J. Cantrell, and T.H. De Lorenzo, 1995, *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*, WHC-EP-0645, Westinghouse Hanford Company, Richland, Washington.

(4) Wood M.I., R. Khaleel, P.D. Rittmann, A.H. Lu, S.H. Finfrock, T.H. De Lorenzo, and D.Y. Garbrick, 1996, *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*, WHC-SD-WM-TI-730, Westinghouse Hanford Company, Richland, Washington.

(5) Wood, M.I., 1998, *1996-1997 Review of the 200 West and 200 East Area Performance Assessments*, HNF-1561, Rev. 0, Waste Management Federal Services of Hanford, Inc., Richland, Washington.

RL has requested a review of performance assessment-based dose/flux estimates for radioactive low level waste disposed in the Low Level Burial Ground (LLBG). This review is provided in the attachment to this letter.

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Dose and flux estimates from inventory disposed in the LLBG were first generated in the performance assessment (PA) analyses for the 200 West and 200 East Area LLBG (Wood, et. al. 1995 and Wood, et. al. 1996, respectively). Subsequently, beginning in 1997 (Wood 1998), annual dose/flux estimates were provided in annual reviews of the PA analyses to account for newly disposed waste inventory. These estimates are generated to compare with performance objective limits specified in DOE Order 435.1 that must be satisfied for the LLBG operations to be compliant with the Order. Department of Energy (DOE)-approved PA analyses are subject to additional review by the Low-Level Waste Disposal Facility Federal Review Group (LFRG) if review thresholds are triggered (DOE 2000). One threshold is an increase in dose/flux estimates in the values provided in the approved PA analyses by more than 25% or an exceedence of the performance objective values.

In this review, comparison of current dose/flux estimates with original PA analyses values shows that some of the current values have exceeded the 25% trigger value. The review concludes that calculated increases by more than 25% are due entirely to the increase in inventory disposed in the LLBG. Such increases are inevitable when the initial inventory is small relative to the growing inventory in an active disposal facility and associated dose/flux estimates are small relative to performance objectives. Other aspects of the PA assumptions and analysis methodology are fundamentally unchanged.

For Hanford LLBG waste disposal and associated dose/flux estimates, the 25% trigger value provides no indication of disposal facility performance relative to the DOE 435.1 performance objectives. Rigorous compliance with performance objectives is maintained by implementation of PA-derived waste acceptance criteria and is regularly monitored using the waste acceptance process. Currently, all estimates are well below the performance objective limits, and there is no indication that these limits are likely to be exceeded. In the event that specific waste stream disposal could greatly increase dose/flux estimates to levels approaching performance objective values, the waste acceptance process ensures that disposal options are thoroughly evaluated by the LLBG contractor and DOE before disposal. DOE approval of the selected disposal option is required before disposal can proceed. If no adequate disposal option can be found, the waste will not be disposed in the LLBG.

Very truly yours,

[redacted]

[redacted] Vice President
Waste Management Project
Fluor Hanford

Attachment

[redacted] [redacted]

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Richland, Washington 99352

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APR 14 2005

FH-0501152
CONTRACT NO. DE-AC06-96RL13200

Mr. Keith A. Klein, Manager
U.S. Department of Energy
Richland Operations Office A7-50
Post Office Box 550
Richland, Washington 99352

Dear Mr. Klein:

PERFORMANCE ASSESSMENT REVIEW REPORT, 2003-2004 ANNUAL REVIEW OF THE 200 WEST AND 200 EAST AREA PERFORMANCE ASSESSMENTS

The attached letter report, *2003-2004 Annual Review of the 200 West and 200 East Area Performance Assessments*, has been completed to satisfy the DOE requirement for submittal of annual evaluations of performance assessment (PA) analyses completed for the Low-Level Waste Burial Grounds (LLBG) in accordance with PHMC Section J.C.2.2, CRD O 435.1, Chg. 1 (Supp Rev. 0).

In this report, two primary topics have been addressed. First, the impact of additional radionuclide inventory disposal in the LLBG from August 1, 2003 through October 31, 2004, on LLBG dose estimates has been calculated. Estimated doses due to potential release of radionuclides from the LLBG are well below performance objectives defined in DOE Order 435.1. Most cumulative estimates have increased slightly from the last annual report. We have, therefore, concluded that the LLBG operations are in compliance with the Order. Second, new information pertinent to key PA assumptions has been summarized, including identification of uranium precipitates in grout formulations representative of materials used in disposal operations. Characterization of laboratory samples identified a suite of uranium-bearing phases that likely will precipitate because of the chemical environment imposed by grout-water interactions.

Technical questions in regard to this matter should be directed to Ms. L. L. Fritz on 373-9206. Contractual questions should be directed to Ms. L. J. Hunter on 376-6986.

Very truly yours,

[redacted]

President and
Chief Executive Officer

Attachment

[redacted]

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ATTACHMENT

History of the Low-Level Waste Burial Grounds (LLBG) Performance Assessments

Consisting of 10 pages,
including cover page

History of the Low-Level Waste Burial Grounds (LLBG) Performance Assessments

Marc Wood

Summary

A summary of dose and flux estimates from low-level and mixed low-level waste (LLW and MLLW) disposal in the Low-Level Waste Burial Grounds (LLBG) is provided below over three different time periods. Changes in dose and flux estimates with time are compared and explained. Generally, dose and flux estimates have increased over time, as additional inventory has been disposed in the LLBG. Currently, all dose and flux estimates are well below performance objectives specified in DOE Order 435.1. In some cases, dose estimates have increased by more than 25% of the initial PA analyses estimates, a value identified by the Low-Level Waste Disposal Facility Review Group (DOE 2000) as a trigger for considering a detailed review of approved performance assessment (PA) analyses. For the Hanford LLBG, as an active disposal facility, the relative increases in excess of 25% of initial PA estimates are expected. These relative increases provide no indication of life cycle compliance with the performance objectives nor do they indicate a substantive change in PA analyses assumptions and performance estimating methodology.

Background

In 1988, the Department of Energy (DOE) implemented DOE Order 5820.2A, *Radioactive Waste Management*, to regulate the management of DOE-derived radioactive wastes, including LLW and MLLW being disposed at various DOE sites. To ensure that LLW and MLLW disposal would be conducted per a risk-based standard, DOE Order 5820.2A specified a set of quantitative dose- and flux-based performance objectives and required completion of a facility-specific performance assessment analysis to demonstrate facility compliance with the performance objectives for all wastes disposed after September 26, 1988. A revision of DOE Order 5820.2A (DOE Order 435.1) was completed and implemented in July 1999. This Order revision did not substantively change the performance objectives or the PA process.

At the Hanford site, two PA analyses were completed one each for active burial grounds in the 200 West Area (Wood et al 1995) and 200 East Area (Wood, et. al. 1996). These PA analyses were peer reviewed by the DOE and conditionally accepted (Cowan 1996; Frei 1997). A Disposal Authorization Statement was issued permitting the LLBG operations to continue. Following approval, a PA maintenance activity was instituted in which the initial PA analyses are reviewed annually and documented in an annual report to DOE. A key goal of these reviews is to evaluate the effects of additional inventory disposed in the LLBG in the previous year on dose and flux estimates corresponding to the performance objectives. These reviews provided timely indications of disposal practice acceptability relative to DOE Order 435.1.

Review of Dose and Flux Estimates for the LLBG

Dose and flux estimates for five different performance objectives at three different times are summarized in Table 1. The performance objectives address different radionuclide release

scenarios. The first two performance objectives (25 mrem/yr all pathways, and 4 mrem/yr drinking water) address radionuclide leaching from the facility, subsequent travel through the vadose zone to the unconfined aquifer and use by man of contaminated groundwater. The third performance objective (100 mrem/yr) addresses inadvertent intrusion and exposure to man initiated by exhumation of waste from the disposal facility. The last two performance objectives, 20 pCi/m^2/s and 10 mrem/yr, address exposure due to atmospheric release of radon and other radionuclides, respectively (in this case, ^{14}C and tritium).

The first set of estimates in Table 1 was provided in the initial PA analyses (Wood, et. al. 1995, Wood, et. al. 1996). Inventory disposed in the LLBG between September 1988 and 1993-1994 was considered in these initial analyses. The PA analyses identified the critical site-specific parameters affecting environmental contamination. These included hydrogeologic properties, disposal facility characteristics, meteorological conditions and waste inventory. Of these conditions, effective infiltration rates and inventory of specific radionuclides turned out to be the most significant parameters influencing environmental contamination and associated dose/flux estimates. From these analyses quantitative estimates of dose were derived that were proportional to waste inventory or waste concentrations depending on the performance objective. Further, inventory and concentration limits were derived and have been implemented in the Hanford LLBG waste acceptance process.

The second set of estimates was provided in the first annual review of the PA analyses (Wood 1998) and considers inventory disposed from September 27, 1988 through July 31, 1997. Finally, the third set of estimates is provided in the most recent annual review that covers inventory disposed from September 27, 1988 through July 31, 2001 (Wood 2001). Dose/flux estimates in these subsequent reviews assumed the same inventory/concentration to dose and flux relationships provided in the initial PA analyses. Thus, changes in dose/flux estimates shown in Table 1 over time are strictly a function of changes in disposed inventory and waste volume as well as estimates of future waste inventory and waste volume. A more detailed discussion of these estimates and their variability is provided in sections below.

Groundwater Contamination Performance Objectives

Two performance objectives are considered. The first, the 25 mrem/yr all pathways objective, is specified directly in DOE Order 435.1 [Chapter IV, Section P (1)]. In the PA analyses a scenario was considered in which radionuclides disposed in the LLBG leached from the facility and contaminated groundwater which was then used by a nearby farmer (100 m downstream). The second, the 4 mrem/yr drinking water scenario, is LLBG specific and approximates the EPA drinking water standard and assumes only consumption of contaminated groundwater. This objective turns out to be more restrictive than the 25 mrem/yr objective relative to allowable disposable inventory and is being used at the LLBG to control waste acceptance.

The dose estimates for these performance objectives are divided into two parts; one estimate is based on disposed waste within the time period of compliance and the other estimate is based on future projected waste. The time period of compliance begins with the implementation of DOE Order 5820.2A, September 26, 1988 and ends shortly before the time at which any given annual

review is being completed. Future waste projections are then made by considering waste to be disposed after the current review until LLBG closure.

Initial inventory estimates in the PA analyses were crude and not particularly accurate for several reasons. First, although a formal data base (the Solid Waste Information Tracking System, SWITS) was evolving as the analysis was being completed, a straightforward listing of inventory was not easily obtainable and a certain amount of inventory approximation was used when estimating dose/flux values. Second, no formal system of future waste projections had been developed. Consequently, an estimate of future waste was derived by increasing the approximate inventory of waste already disposed by the ratio of time remaining for burial ground operations to the current time period of compliance. Not unexpectedly, the sum of these inventory estimates turned out to be highly inaccurate.

By the time the first annual review was completed in 1997, the SWITS database was essentially complete and more user friendly. Also, a formal system of future waste projections was in place in which known generators are annually queried for estimates of future waste inventories and volumes. While this approach is also highly uncertain relative to future waste disposal, it is the best that can be done and more closely approximates real waste stream inventories than the ratioing method used in the PA analyses. The 1997 inventory estimate is the most appropriate baseline for comparison with future disposals and incremental dose and flux changes because all subsequent and future inventory estimates are based on these same formalized sources of information.

A comparison of dose estimates for the three time periods for either the 25 mrem/yr or 4 mrem/yr performance objective reflects the evolution of inventory estimates. For disposed wastes, a substantial inventory (primarily uranium wastes) was disposed between the early 1990's and July 31, 1997. Also, complete implementation of PA-derived waste acceptance criteria did not occur until about 1996 after the PA analyses were approved and the 10-fold increase in all pathways dose (from 0.1 to 1.06 mrem/yr) during this time is largely due to disposal of ungrouted uranium. Grouting of uranium substantially reduces doses estimated from uranium leaching by minimizing elemental solubility. After 1996, more than 90 % of uranium mass has been grouted per PA requirements and the subsequent reduced increase in the all pathways dose estimate (from 1.06 mrem/yr in 1997 to 1.43 mrem/yr in 2001) reflects this change in disposal practice. Grouting practices are now standard.

Future waste inventories estimates are based on better information via input from the generators. However, they remain highly uncertain and little credence can be placed on the associated dose estimates. The ~60 % increase in all pathways dose estimates in the PA analysis versus the 1997 review (0.37 versus 0.58 mrem/yr) reflects the change in inventory estimating method from the ratio approach to generator estimates. The larger increases in dose estimate in the 1997 versus the 2001 estimate (0.58 versus 1.9 mrem/yr) is due to the recent and very large ^{99}Tc and ^{129}I inventory estimates in secondary wastes from the tank vitrification project.

Inadvertent Intruder Performance Evaluation

DOE Order 435.1 [Section P (2)(b)] requires that an evaluation of the dose effects of inadvertent intrusion into the disposal facility be completed to estimate dose and establish waste acceptance criteria. Both chronic and acute exposure were considered in the PA analyses and it was determined that for the same initial inventory and disposal conditions, higher dose estimates were calculated for chronic exposure. Consequently, waste acceptance criteria (i.e., radionuclide-specific waste concentrations) were established to satisfy the chronic exposure performance objective of 100 mrem/yr.

In the LLBG PA analyses the inadvertent intruder exhumes waste, mixed waste with garden soil, planted crops and received exposure from inhalation, ingestion and direct exposure. Exhumation occurs either by basement excavation or well drilling. To estimate dose, basement excavation occurs in Category 1 facilities with a minimal cover (< 5 m thick) and well drilling occurs in Category 3 facilities with a thicker cover (≥5 m). Because more waste is removed by basement excavation, higher doses are calculated for the same initial waste concentrations. Dose estimates are proportional to waste concentrations, which are calculated as total radionuclide inventory divided by total disposed waste volume. In the wastes routinely disposed at the LLBG, the primary radionuclides contributing to dose are ^{137}Cs, ^{90}Sr and uranium.

In the 200 West PA analysis, wastes inventories were divided into Category 1 and Category 3 groups and inadvertent intruder doses were calculated for each group. The 44-mrem/yr value shown in Table 1 is the dose estimate for the Category 1 waste group. Doses are estimated by assuming average waste concentrations (total disposed inventory divided by total waste volume). In the 200 East PA all trenches contained Category 3 waste so an assumption was made that there would be no final Category 1 disposal facilities. The listed dose estimates are much smaller because of the assumption of Category 3 disposal conditions and the much smaller waste inventory in the 200 East Area LLBG. No estimates of future waste contributions to intruder dose were calculated.

In the subsequent analyses, the inadvertent intruder doses decrease with time. In the 200 West PA versus the 1997 dose estimates the drop in dose (1.6 versus 44 mrem/yr) is largely attributable to the assumption of Category 3 versus Category 1 conditions. All other dose estimates shown in Table 1 assume Category 3 disposal conditions. Category 1 disposal estimates have been discontinued because Category 3 wastes are ubiquitous in the LLBG and final cover characteristics are expected to be required to satisfy RCRA cover closure requirements. These requirements will ensure that the Category 3 characteristics are also satisfied (cover thickness of ≥ 5 m and infiltration control of ≤ 0.5 cm/yr). In the 1997 versus the 2001 dose estimates, dose estimates decrease in all burial grounds. These decreases over time reflect drops in averaged radionuclide concentrations in disposed waste. Estimates from future waste projections have not been calculated because these projections (both inventory and waste volume) are highly uncertain and dose estimates are extremely low relative to the 100 mrem/yr performance objective. Chances of exceeding this performance objective are negligible.

Radon Flux and Air Contamination Performance Objectives

The final two performance objectives consider air contamination. Both the 20 pCi/m^2/s radon flux and 10 mrem/yr air contamination objective are specified in DOE Order 435.1 [Chapter IV, Section P (1)]. In the PA analyses, an individual is exposed to gaseous radionuclides that are initially present in the disposed waste and diffuse upward through the cover. Radionuclide flux is calculated using a simple analytical one-dimensional solution, in which flux is directly proportional to initial waste concentration. Air contamination doses are calculation assuming gaseous ^{14}C and tritium releases.

Radon is generated by radioactive decay of disposed ^{226}Ra, ^{238}U and ^{234}U. Over time, radon flux will decrease from the ^{226}Ra source and will increase from the uranium isotope sources because of daughter product ingrowth. To calculate radon flux from ^{226}Ra, immediate secular equilibrium is assumed and radon waste concentrations are calculated as total ^{226}Ra inventory over total waste volume. In the 200 West PA analysis an approximate ^{226}Ra waste concentration was used to estimate the 0.15 pCi/m^2/s flux shown in Table 1. Contribution to flux from uranium isotopes was significantly less. To calculate radon flux from uranium isotopes, averaged uranium concentrations were estimated and a proportional radon concentration was derived assumed activity ratios between the parent and daughter at 10,000 years postclosure. The radon derived from ^{234}U provides significantly greater inventory than ^{238}U, so the ^{234}U decay is used as the uranium source.

In subsequent analyses, the radon flux was calculated using the ^{234}U concentrations because large quantities of uranium were being disposed in the burial grounds and the average ^{226}Ra concentrations have dropped by more than a factor of 4 in 2001 compared to the approximate concentration assumed in the 200 West PA. This occurs because ^{226}Ra wastes are rare and overall disposed waste volumes continue to increase substantially. Also, by using the 10,000-year parent/daughter decay ratio, maximum radon concentrations are assumed; by comparison, the radon to ^{234}U ratio is 40 times smaller at 1,000 years, DOE Order 435.1 time of compliance. Thus, bounding radon flux estimates are generated. Comparison of the 1997 versus the 2001 flux estimates shows relatively large increases in value. Estimates from future waste projections have not been calculated because these projections (both inventory and waste volume) are highly uncertain and current dose estimates are extremely low relative to the 20 pCi/m^2/s performance objective. Chances of exceeding this performance objective are negligible.

Dose from inhaled air contaminated by ^{14}C and tritium was calculated assuming gaseous release of the total inventory 500 years postclosure over a 1 year period from a Category 3 facility. This scenario provides the dose estimate described in the 200 West PA analysis. This dose calculation has not been repeated since in the 200 East PA analysis or the annual reviews because of the unreasonable physical model required to generate a > 0 mrem/yr dose estimate. The model requires that ^{14}C and tritium remain trapped in the disposal facility for 500 years and then are released rapidly into the atmosphere over the period of a year. No plausible mechanism for this sequence of events exists. For comparison with the performance objective, sample values are provided in Table 1 for the 1997 and 2001 annual review inventories.

Expectations For Future Dose/Flux Estimates

Changes in dose/flux estimates may increase or decrease depending on waste inventory estimates and the linear dependence of the estimate on waste inventory versus waste concentration. In the case of the groundwater contamination performance objective doses, 25 mrem/yr all pathways and 4 mrem/yr drinking water, doses are proportional to disposed waste inventory of groundwater mobile radionuclides. Therefore, the dose estimate value associated with buried waste will increase over time, as additional mobile radionuclide waste, primarily ^{99}Tc and uranium, is disposed.

The groundwater contamination doses associated with future disposed waste are highly uncertain. The estimated doses could increase or decrease over time, depending on generator inventory forecasts and waste form performance assumptions. Currently, the largest and dominating contributor to future mobile radionuclide inventory estimates is the tank waste vitrification project, which is estimating waste inventory from secondary waste streams generated by the vitrification process. Inventory values (^{99}Tc and ^{129}I) are highly uncertain to the point that waste form performance may or may not be required to dispose of the waste. Thus, the dose estimates provided in Table 1 only represent a crude approximation given the information at hand and could increase or decrease over time. Because the future projected doses are such a large fraction of the total dose projection (over half), total dose estimates could actually decrease in the future.

Intruder/air contamination dose and radon flux estimates are linearly proportional to averaged specific radionuclide concentrations. These are calculated as the ratio of the relevant specific radionuclide to total waste volume. As wastes are disposed in the LLBG, these concentrations change. During the course of dose/flux estimates over the last 7-8 years, averaged concentrations have decreased relative to the intruder dose and increased relative to the radon flux. In the fictitious calculation for air contamination, the averaged ^{14}C to waste volume number has also increased.

Given the dependence of dose/flux estimates on waste inventory, and the uncertainty associated with future inventory estimates and eventual reliance on waste form performance, future relative changes in value on a short-term (yearly) basis cannot be predicted reliably. Furthermore, they provide no indication of life cycle compliance with the performance objectives. In the case of intruder/air contamination and radon flux estimates, the historical record established so far (7-8 years) shows that dose/flux estimates are very small relative to the performance objectives (< 1%). Because the estimates are so small, relatively high increases or decreases in estimated values can occur easily. However, an extraordinary increase in disposed inventory (primarily ^{137}Cs, ^{90}Sr and uranium wastes) would be required to create dose estimates as much as 10 % of the performance objectives. Calculated relative changes in dose/flux estimates are inconsequential compared to the performance objective values.

In the case of all pathways and groundwater drinking dose estimates, the historical record indicates the largest increases in dose estimates for buried waste have been calculated between completion/approval of the PA analyses (1995,1996) and the first annual review (1997). This relatively large change reflects an increase in the accuracy of disposed waste inventory values

and the incomplete implementation of PA-derived waste acceptance criteria in this time period. Since the time of the first annual review and later, waste acceptance criteria have been fully implemented and the rate of dose estimate increases has diminished, primarily because of routine grouting of higher inventory uranium waste streams. To date, the largest increase in future dose estimates is due to the tank waste vitrification secondary waste stream estimates. Other future generators and waste streams are not entirely predictable. Consequently, short-term relative changes in dose estimates using future waste estimates can provide only a qualitative indication of future 'problem wastes' that may require extended evaluation and waste form development.

The large uncertainties with future waste identification, treatment and disposal make estimates of compliance with performance objectives uncertain as well. Therefore, strong reliance is placed on the waste acceptance process to ensure that LLBG operations continue to be compliant with DOE Order 435.1. In this process real waste containing moderate to high levels of mobile radionuclides are identified prior to acceptance, evaluated for potential dose projection, and then disposed properly, using waste form performance as needed. This process ensures that no waste stream will provide a significant portion of total allowable dose per the performance objective. If disposal of a real waste stream is proposed that provides a significant dose relative to the performance objective value despite best available waste form performance, then an extensive DOE review is needed. The review process is available in the DOE PA maintenance program. Such a waste stream has not yet been encountered at the LLBG.

Table 1. Summary of Dose/Flux Estimates for LLW and MLLW disposed in the LLBG over several time periods.

Performance Objectives	Exposure Pathways	PA dose/flux estimates for waste disposed between approximately 1988 and 1993/94					First Annual Report Dose/flux estimates for waste disposed between 9/88 and 8/97					Latest Annual Report Dose/Flux estimates for Waste Disposed between 9/88 and 8/01				
		West Area			E-10	E-12B	West Area			E-10	E-12B	West Area			E-10	E-12B
		Inventory Source					Inventory Source					Inventory Source				
		buried	[a]future	total			buried	[a]future	total			buried	[a]future	total		
25 mrem/yr	groundwater, all pathways	0.1	0.37	0.47	0.02	0.009	1.06	0.58	1.64	0.016	0.0034	1.43	1.9	3.33	0.0184	0.0077
4 mrem/yr	groundwater, drinking	0.08	0.27	0.35	0.02	0.008	0.36	0.32	0.68	0.0056	0.002	0.49	0.88	1.37	0.0069	0.0042
100 mrem/yr (500 yr)	post-drilling intruder	[b]44	[c]nc	[b]44	0.02	0.00005	1.6	[c]nc	1.6	0.008	0.0009	0.83	[c]nc	0.83	0.0056	0.0005
20 pCi/m^2/s	radon emission	0.15	[c]nc	0.15	0	0.009	0.03	[c]nc	0.03	3E-05	5E-05	0.062	[c]nc	0.056	0.0013	1E-04
[d]10 mrem/yr	air contamination	nil (0.012)	nil [c]nc	nil (0.012)	nil (<.0002	nil [e](<.0002	nil (0.012)	nil [c]nc	nil (0.012)	nil (0)	nil (0)	nil (0.0048)	nil [c]nc	nil (0.0048)	nil (0)	nil (0)

[a]For calculation purposes, all future wastes are assumed to be disposed in the 200 West Area LLBG.

[b]Intruder dose estimates provided in the 200 West PA analysis assumes Category 1 disposal conditions

[c]nc = not calculated

[d]No realistic dose is expected due to the unreasonable physical model needed to calculate positive dose. Numbers derived from this model. are provided in parentheses for comparison with the performance objective.

[e]Numbers are provided in the Disposal Authorization Statement, but 0 is reported in the 200 East PA because no ^{14}C or tritium was disposed in these burial grounds.

References

Cowan, S.P., 1996, *Conditional Acceptance of the Hanford 200 West Area Burial Ground Performance Assessment*, memorandum (EM-30) to C. Hansen, U.S. Department of Energy, Richland Operations Office, dated June 27, 1996, U.S. Department of Energy, Washington, D.C.

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