



Department of Energy
Washington, DC 20585

June 27, 1996

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DNF SAFETY BOARD

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W.
Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

Enclosed is a memorandum of acceptance and a compliance evaluation of the Hanford Site "Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds." Site completion and Headquarters review and action for this performance assessment is a deliverable pursuant to the commitment in Task Initiative VII.B.5.b.1 identified in the Department of Energy's (DOE's) Implementation Plan, Revision 1, for the Defense Nuclear Facilities Safety Board Recommendation 94-2.

The assessment evaluates the performance of the Hanford 200 West Area burial grounds relative to the low-level waste performance objectives contained in DOE Order 5820.2A. The Headquarters review found that, with conditions, the assessment is technically acceptable and it provides a reasonable expectation of meeting the DOE 5820.2A performance objectives. This assessment is the first step in the process to complete an evaluation of projected impacts to the public and to issue a disposal authorization statement for the 200 West Area burial grounds.

The Department has completed the actions for the Hanford 200 West Area performance assessment identified under this commitment and proposes that this part of the commitment be considered complete.

Sincerely,

A handwritten signature in cursive script, appearing to read "S. Cowan".

Stephen P. Cowan
Deputy Assistant Secretary
for Waste Management
Environmental Management

Enclosure

memorandum

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DATE: June 27, 1996

REPLY TO
ATTN OF: EM-35

SUBJECT: Conditional Acceptance of the Hanford 200 West Area Burial Ground
Performance Assessment

TO: Charles Hansen, Richland Operations Office

Headquarters (HQ) has conducted a review of the "Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds," November 1994 for compliance with DOE Order 5820.2A. In the course of this review, the Office of Waste Management (EM-30) requested a review of the performance assessment by the Peer Review Panel (PRP). Based on input from the PRP and the evaluation by HQ staff, the performance assessment is conditionally accepted. A compliance evaluation of the performance assessment is included as an attachment to this memorandum. By complying with the conditions below, you are authorized for interim operations of the 200 West Area Burial Grounds until issuance of a disposal authorization statement.

Consistent with the "Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-2 Implementation Plan, Revision 1," (April 1996) full approval of the performance assessment will not be possible until the completion of a composite analysis which evaluates the potential offsite radiological impacts of the 200 West Area burial grounds in conjunction with other radioactive sources that will remain at the Hanford Site. Upon satisfactory completion of the composite analysis and approval by HQ, the performance assessment will be approved and a disposal authorization statement issued.

The subject performance assessment is hereby conditionally accepted by EM-30. The conditions that must be met are:

1. The Richland Operations Office is to submit a composite analysis which includes the 200 West Area Burial Grounds by December 31, 1997, as committed to in the DNFSB Recommendation 94-2 Implementation Plan, Revision 1.
2. Hanford must implement the controls documented in the memorandum June M. Hennig to J. A. Turi, "Submittal of Additional Information on the 200 West Area Burial Ground Performance Assessment," January 19, 1995, response 1.c. to ensure that the conditions evaluated in the performance assessment are met. The Richland Operations Office is to assure that these controls are in place by December 31, 1996.
3. The site is to address the requirement for an ALARA analysis as required in the latter part of DOE Order 5820.2A, Chapter III, 3.a.(2). The

detail of this analysis should be commensurate with the calculated doses.

4. The site is to document the rationale that was provided to reviewers during the course of the review for assuming intrusion into the Category 3 facility occurs at 500 years rather than 100 years as is assumed for the Category 1 facility.
5. The site is to discuss consistency of the performance assessment results with the requirements in the "Hanford Site Ground Water Protection Plan" and the "Hanford Site Ground Water Remediation Strategy."
6. An addendum to the performance assessment is to be issued by December 31, 1996. The addendum is to include the additional information developed by the site in response to numbers 3, 4, and 5 above and the information requests from the PRP. The addendum must be distributed to all known holders of the performance assessment. The purpose of this condition is to ensure that the documentation that was the basis for HQs' acceptance is readily available to any party interested in the performance assessment.

The site is responsible for maintaining this performance assessment in accordance with the memorandum, "Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal" (July 21, 1995). This involves the conduct of field data gathering needed to improve confidence in the analyses.

If your staff has any questions regarding the conditional acceptance of this performance assessment and the process for getting full approval, they should contact Virgil Lowery of my staff on (301) 903-7142.



Stephen P. Cowan
Deputy Assistant Secretary
for Waste Management
Environmental Management

Attachment

**Compliance Evaluation of the
"Performance Assessment for the Disposal of Low-Level Waste
in the 200 West Area Burial Grounds,"
WHC-EP-0645, November 1994.**

1.0 Summary

The Office of Planning and Analysis (EM-35) concludes from its review of the "Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds" (PA), additional information provided by Hanford Site personnel after the PA was submitted, and the Performance Assessment Peer Review Panel report that there is a reasonable expectation that the Order DOE 5820.2A low-level waste performance objectives will be met. The base case analysis results in the following calculated doses relative to the performance objectives:

- 0.23 mrem/yr and 0.47 mrem/yr all-pathways doses for Category 1 and Category 3 disposal configurations, respectively, versus a performance objective of 25 mrem/yr. Sensitivity/uncertainty analyses were conducted by identifying the modeling parameters to which the results were most sensitive, and individually evaluating the impacts of using higher and lower input values than those used for the base case. For each of the parameters evaluated, the least conservative parameter value would yield results that are lower than the performance objective.
- 1.1×10^{-6} mrem/yr and 0.012 mrem/yr doses via the air pathway for a Category 1 and Category 3 disposal configurations, respectively, versus a performance objective of 10 mrem/yr.
- 44 mrem/yr and 0.7 mrem/yr intruder doses from chronic exposure for Category 1 (at 100 years) and Category 3 (at 500 years) disposal configurations, respectively, versus a performance objective of 100 mrem/yr. Annual doses from acute exposure are expected to be less than those for chronic exposure so will meet the 500 mrem/yr performance objective.
- 0.13 mrem/yr and 0.35 mrem/yr doses via the groundwater pathway for Category 1 and Category 3 disposal configurations, respectively, versus an assumed performance target of 4 mrem/yr for all radionuclides migrating from the disposal facility. Sensitivity/uncertainty analyses were conducted by identifying the modeling parameters to which the results were most sensitive, and individually evaluating the impacts of using higher and lower input values than those used for the base case. For each of the parameters evaluated except 1, the least conservative parameter value would yield results that are lower than the 4 mrem/year performance target. In the case of solubility-controlled release

of uranium, the upper bound parameter input could yield results of about 6 mrem/yr.¹ This result of a conservative sensitivity/uncertainty calculation is judged to be consistent with a reasonable expectation that the performance target for protecting groundwater will be met.

Sensitivity/uncertainty analyses show that the values of parameters used in the base case, and the results of the base case are in the conservative portions of their respective ranges. This supports the premise that the analyses are conservative and that the performance objectives can reasonably be expected to be met.

2.0 Performance Measures

2.1 Performance Objectives

This evaluation is developed in relation to the requirement in Order DOE 5820.2A, Chapter III, 3.b.(1), which states, "Field organizations with disposal sites shall prepare and maintain a site specific radiological performance assessment for the disposal of waste for the purpose of demonstrating compliance with the performance objectives stated in paragraph 3a." The performance objectives for low-level waste management (III.3.a) are:

- (1) Protect public health and safety in accordance with standards specified in applicable EH Orders and other DOE Orders.
- (2) Assure that external exposure to the waste and concentrations of radioactive material which may be released into surface water, ground water, soil, plants and animals results in an effective dose equivalent that does not exceed 25 mrem/yr to any member of the public. Release to the atmosphere shall meet the requirements of 40 CFR 61. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as reasonably achievable.
- (3) Assure that the committed effective dose equivalents received by individuals who inadvertently may intrude into the facility after the loss of active institutional control (100 years) will not exceed 100 mrem/yr for continuous exposure or 500 mrem for a single acute exposure.
- (4) Protect ground water resources, consistent with Federal, State and local requirements.

Consequently, the PA is reviewed and evaluated primarily to determine whether it provides a reasonable expectation that the above-listed performance objectives will be met. The determination involves comparison of the results

¹ Hanford plans on conducting studies to refine the understanding of uranium solubility.

of a base case with the performance objectives. The sensitivity/uncertainty analyses are evaluated to ensure that the base case is reasonably conservative (i.e., the values of the parameters selected for the base case are in the conservative portion of the range of applicable values and results of the base case are in the upper range of results from the sensitivity/uncertainty analyses, but are not at the highest end of the range). Also, the results of the sensitivity/uncertainty analyses, taken together, should indicate that it is likely that the performance objectives will not be exceeded (i.e., results of the sensitivity/uncertainty analyses lie below as well as above the base case).

2.2 Interpretation and Other Criteria

This section addresses how some of the performance objectives are interpreted and applied in the evaluation of the performance assessment and also other criteria that are used in the evaluation. Certain criteria, assumptions or practices used in the preparation of the 200 West Area PA were based on best judgment of the analyst and recommendations of the DOE Performance Assessment Task Team due to the lack of specific policies or guidance (e.g., time of compliance, intruder analyses). Most of the subjects are now being addressed by DOE. The judgment and guidance used at the time the PA was prepared was consistent with or tended to be more conservative than the policy and guidance now being contemplated.

The Order DOE 5820.2A is silent on the time of analysis and time of compliance. Consistent with DOE's documented position (e.g., letter, T. O'Toole (EH-1) to Mary Nichols (EPA), June 13, 1995), this compliance evaluation has focused on compliance for times not to exceed 1000 years for the all pathways and groundwater protection analysis. In the absence of specific guidance, the PA analysis conservatively extended these analyses to 10,000 years. This compliance evaluation considers the analyses beyond 1000 years as support to the reasonableness of the modeling.

Evaluation of dose via the air pathway is to be in accordance with 40 CFR 61, Clean Air Act regulations. These regulation specifically exclude radon from the dose evaluation. This practice is used in the air pathway analysis and extended to the all-pathways analysis. Radon is evaluated separately using the a ground surface flux limit borrowed from the Uranium Mill Tailings regulations. Acceptable limits for disposal or evolution of radon in the disposal facility are based on a flux limit of 20 pCi/m²/s at the ground surface.

For intruder analyses, in this evaluation it is assumed that a hypothetical, temporary intrusion into the waste site occurs shortly after 100 years, the time of active institutional control in Order DOE 5820.2A. The time of intrusion can be extended based on passive controls such as disposal system design or land use controls.

In this evaluation, the reasonableness of intruder analyses is based on current DOE thinking which places much less emphasis on intruder analyses because of the intent to maintain active institutional control of contaminated

lands. Instead the focus is on selecting reasonable scenarios and reasonably conservative parameter values. Thus, although in the 200 West Area performance assessment sensitivity/uncertainty analyses were performed on the parameter values, they were not needed to assess compliance with intruder performance objectives.

In this evaluation of the intruder analyses, doses to the intruder are assumed to come from the exposure, ingestion, and inhalation of material exhumed from the site. This may occur via a variety of pathways, but the analysis is not expected to include consumption of contaminated groundwater. The impacts of groundwater contamination are evaluated with respect to the all-pathways and groundwater protection performance objectives.

A tiered approach is used in determining compliance with the groundwater protection performance objective. The first tier is compliance with applicable federal, state, or local regulations for groundwater protection from the low-level waste disposal facility. The second tier is compliance with negotiated agreements. The final tier of the groundwater protection protocol is for sites to be consistent with their groundwater protection plan as developed under Order DOE 5400.1. The PA predates the development of the tiered groundwater protection guidance.

3.0 Technical Adequacy Review

One of the functions performed by the DOE Low-Level Waste Performance Assessment Peer Review Panel (PRP) is a preliminary review of a performance assessment while it is in draft form. The PRP reviewed the subject PA and provided comments for consideration. In finalizing the PA the site considered and responded to these comments. The resolution of the comments is addressed in Appendix H of the PA.

Upon submittal of the current version of the PA, Headquarters requested that the PRP conduct a review of the PA for consistency and technical quality. Over the course of 6 months, the PRP completed its review. The PRP reported the results of its review in the letter, Elmer L. Wilhite to J.A Turi, "Performance Assessment Peer Review Panel Recommendation on the Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds, WHC-EP-0645, November, 1994," SRT-WED-95-0071, April 24, 1995. In the course of its review, the PRP requested additional information or analyses from the Hanford Site personnel. Three supplements of information were provided in response to these requests and constitute part of the basis for the PRP's finding that the PA is technically acceptable. As discussed in a paragraph below, there was an issue raised for Headquarters' consideration based on information received from the site in this supplemental information.

4.0 Disposal Facility Performance

Disposal facility performance relative to the performance objectives is discussed below. An abbreviated restatement of the performance objectives is given in italics. These correspond to the performance objectives listed under paragraph 1 of Performance Measures.

The disposal facility addressed by this PA comprises those trenches in the 200 West Area burial grounds that have been or will be used for low-level waste disposal from 1988 to 2022. The PA includes evaluation of the radioactive component of mixed low-level waste disposed of in 200 West Area trenches.

There are a number of features worth noting about the approach taken by Hanford Site personnel in developing the PA. A "base case" was established using a set of reasonably conservative parameters. This is opposed to a "best case" that would employ a set of parameters that are judged to be most likely to occur. Then, a number of different parameter sets are analyzed to determine their effects on the results. By evaluating the assumptions and results of the base case, the other cases analyzed, or both, a conclusion can be drawn regarding a reasonable expectation that the performance objectives will be met.

Another feature of the Hanford 200 West PA is that unit factors (either concentration or quantity) were used in the initial analyses. The results can then be scaled based on disposal trench dimensions and performance objectives to arrive at waste acceptance limits for the various radionuclides. In the final analysis, the site used projected waste volumes and radionuclide inventories to compare to the performance objectives of the order. The PA describes Hanford 200 West Area burial ground disposal operations and expected waste receipts in Sections 2.3 and 2.5, as amended by the errata provided in Attachment 2, page 1 of the memorandum from June Hennig to J.A. Turi, "Submittal of Additional Information on the 200 West Area Burial Ground Performance Assessment," 95-SWT-033, January 19, 1995.

Acceptance of the following results is predicated on technically valid analyses having been performed. The PRP has reviewed the PA, and supplemental analyses, and determined that they were technically acceptable. Further, the controls cited in response 1.c of the memorandum, June M. Hennig to J.A. Turi, "Submittal of Additional Information on the 200 West Area Burial Ground Performance Assessment," 95-SWT-033, January 19, 1995, are necessary to ensure that the conditions of radionuclide distribution in the burial grounds are met.

4.1. *Protect public health in accordance with applicable DOE Orders.*

Compliance with Order DOE 5400.5 is not a required part of this evaluation. Regardless, from the standpoint of planning, it is useful to consider the results of the Hanford 200 West Area PA in relationship to the public radiation protection standards of 100 mrem in a year via all pathways and 10 mrem in a year via the air pathway as contained in

Order DOE 5400.5. A comparison of PA results with these public protection standards provides confidence that corrective actions will not be needed in the future to ensure that doses to the public will be maintained at low levels. As discussed below, the PA projects no difficulties in meeting the standards in the future.

The PA shows peak doses occurring in the intermediate to long term. It is assumed that at the time that the peak doses are projected to occur, the only contributors to dose will be the closed facilities that remain at the site. These will include waste that has been disposed of (e.g., DOE disposal facilities, commercial disposal facilities) and residual radioactivity disposed of in place. Order DOE 5820.2A establishes an all-pathways effective dose equivalent limit of 25 mrem/yr to a member of the public. Therefore, projected compliance with the Order DOE 5820.2A shows that the 100 mrem/yr limit will easily be met for the burial grounds by themselves.

The Department has committed to preparing a composite analysis that evaluates the impacts of the other sources that add to the dose resulting from low-level waste disposal facilities. The Hanford Site is scheduled to complete a Composite Analysis which considers the effects of the 200 West Area burial grounds and other facilities on an offsite hypothetical member of the public (see the DNFSB 94-2 Implementation Plan, Revision 1, April 1996). That analysis is to be reviewed and approved by Headquarters prior to issuing a disposal authorization statement for the 200 West Burial Grounds.

Compliance with the air pathway limit of 10 mrem/yr is also included in the performance objectives of Order DOE 5820.2A, Chapter III and will be addressed below.

4.2 *Dose to a member of the public to be less than 25 mrem in a year. Dose via the air pathway to comply with 40 CFR 61. Reasonable effort to maintain doses as low as reasonably achievable.*

Based on the analyses in the performance assessment and supplemental material, there is a reasonable expectation that the dose limit of 25 mrem in a year via all pathways, and the PA-imposed target of 4 mrem/yr through the drinking water pathway, will be met. This conclusion is based on accepting the premise that the 5 cm/yr and 0.5 cm/yr infiltration rates for Category 1 and Category 3 facilities, respectively, are maxima expected for the cover systems assumed. The performance assessment did not evaluate higher infiltration rates because those used in the base case are relatively conservative.

There is also a reasonable expectation that the doses to an offsite member of the public via the air pathway will be far below the limits of 40 CFR 61, that is, 10 mrem/yr exclusive of doses from radon.

Although there is not an established standard for radon from low-level waste disposal facilities, this PA includes an evaluation of the

projected flux of radon from the waste through the ground surface and compares it to the uranium mill tailings standard of 20 pCi/m²/s. The PA projects compliance with this flux limit.

The analysis implies that the groundwater pathway will be the dominant means of exposing an offsite member of the public. The point of exposure is assumed to be at a point 100 meters down-gradient of the edge of the burial ground.

In evaluating the all-pathways and groundwater dose, a couple of different scenarios were considered. In the all-pathways analysis, it is assumed that groundwater is drawn from a well and used for drinking (730 L/yr), watering crops, and watering livestock. Because of the amount of water drawn to support non-drinking needs, clean water is drawn through the well in addition to the contaminated water. In the drinking water-only analysis, it is assumed that there is no dilution of the contaminated groundwater with clean water. The analyses found that the drinking water pathway was the more limiting of the two scenarios because of the more restrictive dose target of 4 mrem/yr imposed in the PA, and therefore, was the basis for establishing waste acceptance criteria via the groundwater.

In the base case, the infiltration rate for the Category 1 facility was assumed to be 5 cm/yr. For the Category 3 facility, which has a cover system that is more effective at recycling moisture back to the atmosphere, the infiltration rate is assumed to be 0.5 cm/yr. The analysis also assumes that the mixed waste portion of the facility will perform similar to the rest of the facility, i.e., the cover will have the same infiltration rate and the liner and leachate collection system neither enhance nor detract from facility performance.

In evaluating the groundwater pathway, the analysts were able to show that many radionuclides would not result in significant doses through the groundwater pathway. Therefore, the focus was on a reasonably small set of mobile nuclides (that are not held up in the Hanford soils) and three less mobile nuclides in Category 1-type disposal. The mobile nuclides that were limited by the concentration in the groundwater were H-3, C-14, Cl-36, Se-79, Mo-93, Tc-99, I-129, Re-187, and uranium. The three less mobile nuclides that were limited by the groundwater pathway were Po-209, Pa-231, and Np-237.

Sensitivity analyses were conducted to determine which parameters most affected the transport of radionuclides from the disposal facility, through the vadose zone and affect the concentration in the groundwater at the well. These include:

- the mechanism by which radionuclides are released from waste material and become available to infiltrating water;
- effects of increased infiltration around the disposal facility caused by irrigating;

- changes in the hydraulic gradient;
- increase in the permeability of the saturated sediments;
- effects of soil moisture content - permeability relationships in the vadose zone;
- the presence of clastic dikes;
- the impacts of packages with higher concentrations of radionuclides than is assumed as average in the trench;
- impacts of the dimension of the trench parallel to the direction of groundwater flow; and
- the effects of pumping which dilutes the concentration of radionuclides by drawing in more clean water.

The uncertainty analysis focused on those factors which were shown to be most significant via the sensitivity analysis. The factors and the uncertainty analysis are summarized as follows:

- for those factors affecting transport of radionuclides, separate from their solubility, the uncertainty analysis indicates that peak concentrations could be up to 7.6 times higher or 400 to 800 times lower;
- the infiltration rates of 5 and 0.5 cm/yr for Category 1 and Category 3 disposal configurations are considered the maximum for the corresponding cover conditions. These infiltration rates were reduced to 1 and 0.1 cm/yr for the Category 1 and 3 configurations, respectively. The analysts conclude that such a reduction will result in a corresponding reduction in peak concentration by a factor of 4;
- saturated hydraulic conductivity was decreased by a factor of 5 and increased by a factor of 100 relative to the base case value of 46 ft/d. The resulting groundwater concentration peaks are 5 times higher and 100 times less, respectively;
- effects of increased vadose zone permeability and a lower hydraulic gradient would each increase the peak groundwater concentration by less than a factor of 0.25;
- the sorption of radionuclides, represented by K_d values is inversely proportional to the peak concentration. Two of the three sorbing radionuclides (Po-209 and Pa-231) were not analyzed from the standpoint of uncertainty due to the lack of alternate data, and because they are expected to be a very small and inconsequential part of the inventory. For the third nuclide, Np-237, a site-specific measured K_d value is twice that used in the

analysis, so the peak concentration of Np in the groundwater could be expected to be half of that calculated in the base case.

- uranium is the only nuclide whose release was considered to be solubility controlled. Considering the variability in uranium solubility and other factors affecting the peak groundwater concentration, the bounds on peak concentration are calculated to be 18 times higher to 2000 times lower relative to the base case.
- for those mobile radionuclides for which a waste form may be needed if they are present in sufficient quantities, diffusion control provided by a grout waste form is projected to be effective. An assumed 5-fold increase and 10-fold decrease in diffusivity result in an 8-fold increase and 15-fold decrease in peak groundwater concentrations, respectively.

For the air pathway, performance is evaluated against 10 mrem/yr for H-3 and C-14, two radionuclides which can become available through vapor diffusion to the ground surface. The other scenarios for migration of these nuclides to a receptor were found to be more limiting than the air pathway and formed the basis for establishing waste acceptance limits.

The performance of radon in the disposal system was compared against a flux rate of 20 pCi/m²/s. This is not a limit explicitly called out in the Order DOE 5820.2A or in 40 CFR 61. It is the limit used in the uranium mill tailings program and is generally accepted as a surrogate limit for LLW disposal facilities. Radon will evolve from certain uranium decay chain isotopes. The analysis found that the limits established for those isotopes would not be further constrained by the radon limit.

In the PA, the radionuclide concentration and mix over the four years from 1989 to 1992 were extrapolated to the year 2022 and modified based on a recognition of specific, unique disposals. The calculated doses for the base case conditions are shown in the following table. These doses are projected to occur prior to the 1000-year time of compliance.

Performance Measure*	Results Category 1 Disposal	Results Category 3 disposal
All-pathways (25 mrem in a year)	0.23 mrem/yr	0.47 mrem/yr
Drinking water (4 mrem in a year)	0.13 mrem/yr	0.35 mrem/yr
Air pathway (10 mrem in a year)	1.1×10^{-6} mrem/yr	0.012 mrem/yr
Radon emission (20 pCi/m ² /s)	0.017 pCi/m ² /s	0.15 pCi/m ² /s

- * The first and third performance measures are performance objectives directly from Order DOE 5820.2A. The second performance measure was self-imposed by the site to evaluate the groundwater pathway. The fourth performance measure is used in this review for radon emission.

An ALARA analysis has not been included in the PA. The doses projected in the PA imply that such an ALARA analysis would not result in changes to site waste management practices; however, it is necessary for the site to document and report the conclusion of the analysis.

- 4.3 *Dose to intruder to be less than 100 mrem in a year for chronic exposure. Dose to intruder to be less than 500 mrem in a year for an acute exposure.*

Based on the analyses in the performance assessment and supplemental material, there is a reasonable expectation that the dose limits of 100 mrem in a year from chronic exposure of a hypothetical intruder and 500 mrem/yr from an acute exposure of an intruder will not be exceeded. A number of intruder scenarios were considered in the PA. Based on other work (reference section 3.1.1), two of the scenarios were selected for analysis because they are expected to result in the most significant doses. The scenarios selected were gardening scenarios following excavation to build a house and following the drilling of a well. Recognizing DOE's intent to control the land on which low-level waste is buried as long as the waste remains dangerous, these scenarios are considered to be extremely conservative. These two chronic exposure scenarios are expected to result in greater doses to the hypothetical intruder than any of the acute exposure scenarios considered, so compliance with the acute exposure limit can be assumed if the chronic exposure limits are met.

The garden size over which the exhumed waste materials was distributed is 2500 m², or about a half acre. Although this seems quite large, it

is consistent with the assumption that 25% of the hypothetical intruder's food comes from the garden.

The exposure pathways considered for the intruder are direct external exposure, inhalation, and ingestion of food matter and some amount of soil. Consistent with DOE PA practice, consumption of water was not considered one of the exposure pathways for the intruder. Evaluation of contaminants in the groundwater is adequately addressed in the dose analysis for the member of the public via all-pathways and the drinking water pathway.

The intruder analysis considered a very large set of radionuclides with half-lives greater than 5 years. The PA preparers consider it implausible that nuclides with half-lives less than 5 years would be present in sufficient quantity that the million-fold reduction in inventory that occurs during the assumed 100 years of active control would leave enough of the nuclide to be significant to an intruder evaluation.²

Intrusion was assumed to occur at three different times: 100, 300 and 500 years. The analysts note that for radionuclides with half-lives less than thirty years that the differences in dose affected by the time of intrusion is an order of magnitude or greater. For nuclides with half-lives greater than 100 years, there is an insignificant difference in the dose as a function of time of intrusion. The Order DOE 5820.2A allows analysts to assume that active institutional control will be maintained over a disposal site for 100 years. In the current PA, the analyst further assumes that passive controls will prevent an intruder from drilling a well for an additional 400 years. Although not expressed in the PA, the analyst has indicated that this is based on Category 3 sites being more recognizable because of their cover construction. This rationale needs to be documented in the PA.

The analyses were carried out assuming a 1 Ci/m³ initial concentration. The results can then be scaled to allow direct comparison with the performance objectives. In conducting sensitivity analyses, it is noted that certain parameters are important to certain radionuclides, principally because there is a dominant pathway by which the intruder is exposed, i.e., inhalation is dominant for one radionuclide while ingestion is dominant for another.

Since DOE will control the land where the 200 West Area burial grounds are located, an inadvertent intruder is an unlikely event that would occur for only a short period of time. The scenarios and parameters selected are considered adequate for concluding that there is a

²

The one exception to not considering radionuclides with half-lives less than 5 years in PA-derived waste acceptance criteria (WAC) development is curium-242. This nuclide has a specified limit in 10 CFR 61 which is adopted in the Hanford burial ground WAC.

reasonable expectation of meeting the performance objectives. The PA presents sensitivity/uncertainty analyses of various parameters used. However, these analyses were not used in making a determination of compliance. The analyses showed that using more conservative values for individual parameters could increase doses 2 to 3 times and using more conservative values for all of the parameters considered would increase doses about 20 times.

There is one additional analysis to consider relative to the long-lived isotopes with daughters that grow in over long time periods. The PRP requested an additional analysis of the intruder dose at 10,000 years when the daughter product contributions to dose have increased. The results were provided in the memorandum, T.K. Teynor to J.A. Turi, "Additional Information Submitted to the Peer Review Panel (PRP) on the 200 West Burial Ground Performance Assessment, Supplement 3," 95-SWT-232, April 11, 1995. Resulting doses, on a unit basis, exceeded those that were used for establishing the waste acceptance limits. Site personnel have argued that the limits should not be changed because only a small number of waste packages actually approach the established limits and disposal of a few packages exceeding the 10,000 year-based limit will not be a problem once the activity is averaged over the trench or burial ground. This compliance evaluation concludes that a change to the waste acceptance criteria is not necessary. Compliance with the intruder performance objective at 10,000 years is inconsistent with DOE's stated position that compliance analyses should not exceed 1000 years.

Doses to an inadvertent intruder were calculated based on a projection to 2022 of the waste receipts from the years 1989 to 1992. The resulting doses relative to the performance objectives are shown below:

Performance Objective	Estimated dose (at 100 years) Category 1 disposal	Estimated dose (at 500 years) Category 3 disposal
100 mrem/yr chronic exposure	44 mrem/yr	0.7 mrem/yr
500 mrem/yr acute exposure	less than the chronic exposure (see p 3-2)	less than the chronic exposure (see p 3-2)

4.4 Protect groundwater.

There is a reasonable expectation that the groundwater at the Hanford Site will be protected because the projected dose to an offsite member of the public through the groundwater pathway is well below 4 mrem/yr as discussed in number 4.2 above. There are no applicable Federal, State or local regulations and releases to the groundwater from low-level waste burial grounds has not been addressed in the Hanford Tri-Party Agreement. The 4 mrem/yr dose limit used in the PA analysis is not

counter to the site's groundwater protection plan which does not explicitly address future releases from disposal facilities.

The Department is establishing a tiered protocol for determining compliance with the groundwater protection performance objective. The first tier is whether there are applicable federal, state, or local regulations for groundwater protection from the low-level waste disposal facility. There are currently no applicable Federal regulations addressing protection of the groundwater from LLW disposal facilities. The Richland Operations Office's position is that DOE, rather than the State, has the authority and responsibility to regulate Atomic Energy Act materials. Therefore, there are no applicable state or local regulations.

The second tier of the groundwater protection protocol is that the site must comply with negotiated agreements. Richland Operations Office personnel confirm that there are no agreements (e.g., Tri-Party Agreement, 216 discharge agreement) that are applicable to the subject of groundwater protection as it relates to low-level waste disposal.

The final tier of the groundwater protection protocol is for sites to be consistent with their groundwater protection plan as developed under Order DOE 5400.1. The Richland Operations Office has issued a "Hanford Site Ground Water Protection Management Plan," DOE/RL-89-12, Revision 2 and a "Hanford Site Ground Water Remediation Strategy," DOE/RL-94-95. These plans do not expressly address radionuclide limits for groundwater protection from low-level waste disposal facilities as addressed in the PA. However, the Strategy states that a key element of the strategy is to "(c)ontrol the migration of plumes that threaten or continue to further degrade ground water quality beyond the boundaries of the Central Plateau [where the 200 West Area is located]. In conducting the analysis of projected future waste receipts versus a 4 mrem/yr dose limit as discussed in 4.2 above, it is the conclusion of this evaluation that the PA has shown that there is a reasonable expectation that groundwater will be protected consistent with the site groundwater protection program. This conclusion is based on the PA-imposed target of 4 mrem/yr being a reasonable surrogate in lieu of specific limits being provided in the "Hanford Site Ground Water Protection Management Plan" plus a recognition that additional attenuation will occur between the PA drinking water point of compliance (100 m from the edge of the burial ground) and a future boundary around the Central Plateau.

Confirmed: _____

Date: _____