POLICY ISSUE
(Notation Vote)

April 14, 1997

SECY-97-083

FOR: The Commissioners

FROM: L. Joseph Callan
Executive Director for Operations

SUBJECT: CLASSIFICATION OF HANFORD LOW-ACTIVITY TANK WASTE FRACTION AS INCIDENTAL

PURPOSE:

To transmit to the Commission, for review and approval, the attached draft letter (Attachment 1) from C. Paperiello, U.S. Nuclear Regulatory Commission, to J. Kinzer, U.S. Department of Energy (DOE), at Hanford. The draft letter provides the results of the staff evaluation of the letter request dated November 7, 1996 (Attachment 2), from J. Kinzer, to C. Paperiello, asking Commission agreement that the Hanford tank waste planned for removal from the tanks and disposal on-site is incidental waste [i.e., not high-level waste (HLW)] and, therefore, would not be subject to NRC licensing authority. Incidental waste classification is related to DOE's plans for the treatment of HLW in the Hanford site single-shell tanks (SSTs) and double-shell tanks (DSTs), segregation of the waste into HLW and low-activity waste (LAW) fractions, and ultimate disposition of these wastes.

SUMMARY:

The November 7, 1996, letter from J. Kinzer, DOE, to C. Paperiello, NRC, requested NRC agreement that Hanford tank waste planned for removal from the tanks and disposal on-site is incidental waste (i.e., not HLW) and, therefore, would not be subject to NRC licensing authority. In a March 1993 letter to DOE, NRC specified criteria for classification of waste as "incidental."

DOE is currently in the early planning stages of waste treatment selection and facility design, and the information provided by DOE supporting the incidental waste classification for the low-activity fraction of wastes removed from SSTs and DSTs is somewhat preliminary, particularly with respect to performance assessment (PA). Staff concludes that the preliminary information provided by DOE supports the assertion that the LAW portion of the Hanford tank waste

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planned for removal from the tanks and disposal on-site is incidental waste in accordance with the criteria listed in the March 1993 letter; however, there is insufficient information to make an absolute determination. A draft letter response to DOE has been prepared.

BACKGROUND:

On June 9, 1988, staffs from NRC and DOE met to discuss DOE's plans to remove, stabilize and dispose of wastes contained in 28 DSTs at the Hanford site and to discuss NRC concerns with respect to the classification of those wastes (i.e., as "high-level" or "low-level waste") for ultimate disposal. (DST wastes were the focus of discussions at that time.) The NRC definition of HLW in Appendix F of 10 CFR Part 50 is source-based; therefore, the bulk of the tank waste could theoretically be classified as HLW because the waste in the tanks is a mixture from various sources, including reprocessing. However, when the Atomic Energy Commission promulgated the Appendix F definition, it specifically noted that the definition did not include "incidental" waste resulting from fuel reprocessing plant operations, such as ion-exchange beds, sludges, contaminated laboratory items, clothing, tools, radioactive hulls, and other irradiated and contaminated fuel structure hardware (34 FR 8712, June 3, 1969; 35 FR 17530, November 14, 1970).

In subsequent correspondence and further meetings, spanning a period from June 1988 to September 1989 (detailed in the "Chronology," Attachment 3), DOE proposed an approach to classifying DST wastes that included use of an overall material balance of tank waste at the Hanford site to demonstrate that the largest practical amount ($\geq$ 90 percent) of total site activity attributable to "first-cycle solvent extraction" would be segregated so that only the residuals would be grouted. The staff agreed that the DST waste planned for disposal by grouting in near-surface vaults was not HLW, and that NRC licensing would not be required (September 25, 1989, letter from R. Bernero, NRC, to A.J. Rizzo, DOE).

Following the staff's letter of agreement, NRC received a petition for rulemaking from the States of Washington and Oregon requesting that the Commission revise the definition of HLW so as to establish a procedural framework and substantive standards by which the Commission would determine whether reprocessing waste is HLW and, therefore, subject to the Commission's licensing authority [July 27, 1990, Petition for Rulemaking (PRM) from the States of Washington and Oregon (PRM-60-4)]. NRC denied the petition in February 1993 and later informed DOE that it would regard the residual fraction of the separated wastes removed from the DSTs as "incidental" provided "...that the waste (1) has been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical; (2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR Part 61; and (3) will be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied" (March 2, 1993, letter from R. Bernero, NRC, to J. Lytle, DOE, Attachment 4).

In August 1996, DOE and the Washington State Department of Ecology issued a "Final Environmental Impact Statement for the Tank Waste Remediation System" (TWRS), which describes their plans for treatment and ultimate disposition of the HLW currently stored in both SSTs and DSTs. The preferred option for tank waste remediation is the Phased Implementation Alternative, which consists of an initial demonstration phase followed by process scale-up. The tank wastes will be removed from the tanks, and separated by activity, into a high-activity portion to be vitrified, then disposed of as HLW, and a low-activity portion (i.e., LAW) currently slated for immobilization followed by disposal on-site. The current DOE projected immobilization method is vitrification although molten metal processing is also being considered. DOE intends the waste separation and classification of the LAW to meet the incidental waste criteria described in the March 1993 letter. Disposal of incidental waste would not be subject to NRC licensing authority.

DISCUSSION:

In Attachment 2, DOE requested NRC's agreement by April 1997 that the Hanford tank waste planned for removal from the tanks and disposal on-site is incidental. In response, NRC and contractor staff [Center for Nuclear Waste Regulatory Analyses (CNWRA)] performed an expedited review of the "Technical Basis for Classification of Low-Activity Waste Fraction from Hanford Site Tanks" (Technical Basis report) and supporting documents, including the "Hanford Low-Level Tank Waste Interim Performance Assessment" (Interim PA), to determine whether there is reasonable assurance that the tank waste fraction slated for disposal as LAW meets the three incidental waste classification criteria specified in the March 1993 letter.

The information provided by DOE in support of Hanford TWRS incidental waste classification is preliminary in relation to selection of specific treatment alternatives and design of treatment facilities, etc. Although DOE's waste management plans are still being developed, the available information was evaluated in regard to the criteria listed above to determine whether there is reasonable assurance that the LAW fraction can be classified as incidental. A draft letter response to DOE incorporating the conclusions of this review has been prepared. The review is summarized below.

Criterion One:

Criterion One from the March 1993 letter specifies that "...wastes have been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical." The Hanford site tank waste inventory contains approximately 3.4×10^{18} Bq (91.6 MCi) of activity that will be processed for disposal as HLW or LAW. Approximately 99.9 percent of this activity is cesium-137 and strontium-90.

Available separation technologies were identified for each of the main radionuclides of interest [cesium-137, strontium-90, transuranics (TRU), technetium-99, selenium-79, carbon-14, iodine-129, hydrogen-3, and uranium

isotopes] and individually evaluated to determine the status of the technology and the radionuclide removal efficiency. Many of the available separation technologies have only been used on a laboratory scale and were, therefore, not considered to be technically practical. Separation processes that were determined to be technically practical were then examined for economic practicality based on cost per curie (3.70×10^{10} becquerel) removed. Three separation technologies were deemed both technically and economically practical. At the present time it is expected that all three will be used. Initially, a simple solids-liquids separation will be performed on the waste to yield a low-activity liquid fraction containing the bulk of the non-radioactive materials (including about 3 percent solids carryover) and a high-activity fraction containing most of the solids. The solids-liquids separation process is expected to be relatively simple to complete and will remove approximately 2.1×10^{18} Bq (55.6 MCi) of activity, consisting primarily of strontium-90 and TRU. Additional removal of TRU wastes from selected tanks and single-cycle ion exchange removal of cesium-137 from certain wastes will leave approximately 3.1×10^{17} Bq (8.5 MCi) of activity in the LAW; or approximately 2 percent of the estimated 15.6×10^{18} Bq (422 MCi) generated at the Hanford site (based on a December 31, 1999, decay date). No further separation processes were deemed both technically and economically practical.

It is considered that Criterion One for classifying the Hanford site LAW fraction as incidental waste will be met if the waste management plan presented in the Technical Basis report is followed. Note that if actual radionuclide inventories, either in the tanks or following separation, are significantly higher than those projected, compliance with this criterion will require re-evaluation.

Criterion Two:

Compliance with Criterion Two, "...wastes will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C [low-level waste] as set out in 10 CFR Part 61," was determined using the estimated total vitrified waste volume (158,000 m^3)(42,000,000 gallons) in conjunction with projected radionuclide activities. From these calculations, which NRC staff verified, the vitrified waste form is expected to meet the limits for Class C or less, as specified. Note that molten metal processing is also being considered for the LAW form. This method would considerably decrease the total waste form volume such that the waste classification could be affected. If the radionuclide inventories in the LAW are significantly higher than those projected in the Technical Basis report, or if the waste form type or total volume is altered, re-evaluation of conformance with this criterion will be necessary.

Criterion Three:

To evaluate Criterion Three, "...wastes are to be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C are satisfied," an Interim PA

was prepared. The DOE PA was performed to the requirements of DOE Order 5820.2A, "Radioactive Waste Management," September 26, 1988. This order is similar with respect to the 10 CFR Part 61 performance objectives.

The Interim PA is the first of three PAs planned and is somewhat preliminary; it was conducted before selection of a disposal facility site and design, specific treatment alternatives, or LAW form. Our review identified a number of specific issues and concerns associated with the Interim PA, documented in the February 6, 1997, Request for Additional Information (RAI) (Attachment 5) from M. Bell, NRC, to D. Wodrich, DOE, and discussed in the CNWRA report enclosed in Attachment 1. DOE's responses to the RAI constitute Appendix B to the CNWRA report. Many of the RAI comments cannot be fully resolved until the site, facility design, and solidification process are selected. It is expected that uncertainties and concerns identified with respect to the Interim PA can be satisfactorily addressed in the subsequent PAs.

Although the Interim PA is very limited, it indicates that the performance objectives of Part 61 will be met. Consistent with the preliminary nature of this Interim PA, the staff's preliminary finding is that Criterion Three appears to be satisfied. As the disposal facility site is chosen, the disposal facility design is completed, treatment alternatives are selected, and the LAW form is determined, the various assumptions and input parameters are likely to be further refined. In the draft letter, staff has requested that subsequent PAs be submitted as supplements to the Technical Basis report so that they can be reviewed to confirm the current analysis and resolve any outstanding issues.

Incidental Waste Classification:

Based on the preliminary information provided in the DOE Technical Basis report and the Interim PA, the staff's preliminary finding is a provisional agreement that the LAW portion of the Hanford tank waste planned for removal from the tanks and disposal on-site is incidental waste and is, therefore, not subject to NRC licensing authority. Staff considers that the information presented is not sufficient to make an absolute determination at this time. Note that if the Hanford tank waste is not managed using a program comparable to that set forth in the Technical Basis report, the incidental waste classification must be revisited by DOE, and NRC consulted. As a fundamental element of the incidental waste classification, DOE must ensure that the contractors that perform LAW separation and disposal do so in accordance with the criteria set forth in the March 1993 letter and the approved Technical Basis report.

Staff requests in the draft letter that subsequent PAs be submitted as supplements to the Technical Basis report so that they can be reviewed to confirm the current analysis and resolve any outstanding issues. Other specific changes that would necessitate DOE re-evaluation and further consultation with NRC include, but are not limited to, the following:

1) Continuing characterization of tank waste results in a determination that the radionuclide inventory in the HLW tanks is higher than that used to develop the Technical Basis report and the Interim PA. This would affect the resolution of all three criteria.

2) The LAW fraction of the Hanford tank waste is not vitrified, or the final volume of the waste form is significantly different from that projected in the Technical Basis report. The waste form is a determining factor in classification of waste as Class A, B, or C (Criterion Two), and would also impact PA (Criterion Three).

3) Final selection of the LAW disposal site, or changes to site characterization parameters will affect the resolution of Criterion Three.

COORDINATION:

This paper has been coordinated with the Office of the General Counsel, and it has no legal objection. There are no resource impacts nor information management implications nor impacts associated with this paper.

CONCLUSION AND RECOMMENDATIONS:

Based on the preliminary nature of the information provided by DOE in the Technical Basis report and Interim PA, staff's preliminary finding is a provisional agreement that the LAW portion of the Hanford tank waste planned for removal from the tanks and disposal on-site is likely to be incidental waste in accordance with the criteria listed in the March 1993 letter and will, therefore, not be subject to NRC licensing authority. This finding is conditional on the NRC staff's review of subsequent PAs and other stipulations described in this paper. As such, it is recommended that the Commission approve the attached letter response to DOE stating provisional agreement with the incidental waste classification for LAW at the Hanford site.

L. Joseph Callan
Executive Director
for Operations

Attachments:
1. Draft ltr response to DOE
2. Ltr dtd 11/7/96 fm J. Kinzer/DOE to C. Paperiello/NRC (w/o att)
3. Chronology of Hanford Incidental Waste Classification Issue
4. Ltr dtd 3/2/93 fm R. Bernero/NRC to J. Lytle/DOE
5. Ltr dtd 2/6/97 fm M. Bell/NRC to D. Wodrich/DOE

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Tuesday, April 29, 1997.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT April 22, 1997, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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ATTACHMENT 1

DRAFT LETTER RESPONSE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

Mr. Jackson Kinzer, Assistant Manager
Office of Tank Waste Remediation System
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, WA 99352

SUBJECT: CLASSIFICATION OF HANFORD LOW-ACTIVITY TANK WASTE FRACTION

Dear Mr. Kinzer:

The U.S. Nuclear Regulatory Commission has received your letter dated November 7, 1996, requesting NRC agreement that the Hanford tank waste planned for removal from the tanks and disposal on-site is incidental waste [i.e., not high-level waste (HLW)] and, therefore, would not be subject to NRC licensing authority. In response to your request, NRC and contractor staff [Center for Nuclear Waste Regulatory Analyses (CNWRA)] have reviewed the "Technical Basis for Classification of Low-Activity Waste Fraction from Hanford Site Tanks" (Technical Basis report) and supporting documents, including the "Hanford Low-Level Tank Waste Interim Performance Assessment" (Interim Performance Assessment (PA)], to determine whether there is reasonable assurance that the tank waste slated for disposal as low-activity waste (LAW) meets the incidental waste classification criteria specified in the March 2, 1993, letter from R. Bernero, NRC, to J. Lytle, U.S. Department of Energy (DOE).

Criterion One from the March 1993 letter specifies that "...wastes have been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical." To comply with this criterion, available separation technologies were identified for each of the main radionuclides of interest and individually evaluated to determine the status of the technology and the radionuclide removal efficiency. Three separation technologies were deemed both technically and economically practical. Currently, it is expected that all three will be used. The three technologies include a simple solids-liquids separation, removal of transuranics wastes from selected tanks, and single-cycle ion exchange removal of cesium-137 from certain wastes. Approximately 3.1×10^{17} Bq (8.5 MCi) of activity will remain in the LAW, which corresponds to about 2 percent of the estimated 15.6×10^{18} Bq (422 MCi) generated at the Hanford site (based on a December 31, 1999, decay date).

NRC staff concludes that available separation processes have been extensively examined to determine those that are both technically and economically practical, and that the residual 2 percent of the activity generated at the Hanford site represents the maximum amount of separation currently technically and economically practical for this case. It is considered that Criterion One for classifying the Hanford site LAW fraction as incidental waste will be met if the waste management plan presented in the Technical Basis report is followed. Note that if actual radionuclide inventories, either in the tanks or following separation, are significantly higher than those projected, compliance with this criterion will require re-evaluation by NRC.

Compliance with Criterion Two, "...wastes will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C [low-level waste] as set out in 10 CFR Part 61," was determined using the estimated total vitrified waste volume (158,000 m^3)(42,000,000 gallons) in conjunction with projected radionuclide activities. From these calculations, which NRC staff verified, the vitrified waste form is expected to meet the limits for Class C or less, as specified. Note that molten metal processing is also being considered for the LAW form. This method would considerably decrease the total waste form volume such that the waste classification could be affected. If the radionuclide inventories in the LAW are significantly higher than those projected in the Technical Basis report, or if the waste form type or total volume are altered, re-evaluation of conformance with this criterion will be necessary.

To evaluate Criterion Three, "...wastes are to be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C are satisfied," an Interim PA was prepared. The DOE PA was performed to the requirements of DOE Order 5820.2A, "Radioactive Waste Management," September 26, 1988. This order is similar with respect to the 10 CFR Part 61 performance objectives.

The Interim PA is the first of three PAs planned and is somewhat preliminary; it was conducted before selection of a disposal facility site and design, specific treatment alternatives, or LAW form. Our review identified a number of specific issues and concerns associated with the Interim PA, documented in the February 6, 1997, Request for Additional Information (RAI) from M. Bell, NRC, to D. Wodrich, DOE, and discussed in the enclosed CNWRA report. DOE's responses to the RAI constitute Appendix B to the CNWRA report. Many of the RAI comments cannot be fully resolved until the site, facility design, and solidification process are selected. It is expected that uncertainties and concerns identified with respect to the Interim PA can be satisfactorily addressed in the subsequent PAs.

Although the Interim PA is preliminary, it indicates that the performance objectives of Part 61 will be met. Consistent with the preliminary nature of this Interim PA, the staff's preliminary finding is that Criterion Three appears to be satisfied. As the disposal facility site is chosen, the disposal facility design is completed, treatment alternatives are selected, and the LAW form is determined, the various assumptions and input parameters are likely to be further refined. Please submit future PAs as supplements to the Technical Basis report so that they can be reviewed to confirm the current analysis and resolve any outstanding issues.

Based on the preliminary information provided in the DOE Technical Basis report and the Interim PA, the staff's preliminary finding is a provisional agreement that the LAW portion of the Hanford tank waste planned for removal from the tanks and disposal on-site is incidental waste and is, therefore, not subject to NRC licensing authority. Staff considers that the information presented is not sufficient to make an absolute determination at this time. Note that if the Hanford tank waste is not managed using a program comparable to that set forth in the Technical Basis report, the incidental waste

classification must be revisited by DOE, and the NRC consulted. As a fundamental element of the incidental waste classification, DOE must ensure the contractors that perform LAW separation and disposal do so in accordance with the criteria set forth in the March 1993 letter and the approved Technical Basis report.

Successive PAs should be submitted as supplements to the Technical Basis report so that they can be reviewed to confirm the current analysis and resolve any outstanding issues. Other specific changes that would necessitate DOE re-evaluation and further consultation with NRC include, but are not limited to, the following:

1) Continuing characterization of tank waste results in a determination that the radionuclide inventory in the HLW tanks is higher than that used to develop the Technical Basis report and the Interim PA. This would affect the resolution of all three criteria.

2) The LAW fraction of the Hanford tank waste is not vitrified, or the final volume of the waste form is significantly different from that projected in the Technical Basis report. The waste form is a determining factor in classification of waste as Class A, B, or C (Criterion Two), and would also impact PA (Criterion Three).

3) Final selection of the LAW disposal site, or changes to site characterization parameters will affect the resolution of Criterion Three.

If you have any questions about the details of this letter, please contact Michael Bell of my staff at (301) 415-7286.

Sincerely,

Carl J. Paperiello, Director
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

REPORT ON
DOE HANFORD TANK WASTE CLASSIFICATION

Prepared for

Nuclear Regulatory Commission
Contract NRC-02-93-005

Prepared by

Patrick Mackin
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Center for Nuclear Waste Regulatory Analyses
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February 1997

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EXECUTIVE SUMMARY

Introduction and Background

Hanford Site tank radioactive and hazardous chemical wastes were produced from 1944 through 1988 by reprocessing irradiated nuclear fuel. Aqueous wastes resulting from these reprocessing operations were stored in underground double-shell (DST) and single-shell tanks (SST). The wastes have been treated to reduce volume and to remove some of the radionuclides. The Nuclear Regulatory Commission (NRC) has regulatory responsibility for disposal of high-level radioactive waste (HLW) generated at Hanford, but does not have authority for regulating disposal of U.S. Department of Energy (DOE) low-level radioactive waste (LLW) from that site.

The DOE has requested NRC to concur in a Hanford Site tank waste management plan presented in Technical Basis for Classification of Low-Activity Waste Fraction from Hanford Site Tanks for the Tank Waste Remediation System (hereafter referred to as the TBR) that would classify certain wastes as incidental. These incidental wastes would be disposed onsite in a LLW facility.

The NRC has applied three criteria to classification of Hanford Site tank wastes as incidental:

- Criterion One: Wastes have been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical

- Criterion Two: Wastes will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C LLW as set out in 10 CFR Part 61

- Criterion Three: Wastes are to be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C are satisfied.

This report provides a Center for Nuclear Waste Regulatory Analyses (CNWRA) assessment of the DOE TBR with respect to whether the waste management plan described therein would result in a low-activity waste (LAW) fraction that could be classified as incidental waste. It also includes an assessment of the DOE Hanford Site tank waste characterization.

Evaluation of the Characterization of the Hanford Site Tank Wastes

The Hanford Site liquid radioactive and hazardous chemical wastes from several different waste streams were subjected to a variety of treatment processes. The wastes have also been concentrated to reduce volume and have been mixed in 177 DSTs and SSTs. Available records do not accurately trace the sources, quantities, and current locations of the radionuclides. Consequently, there is uncertainty in the characterization of the constituents and quantities of the wastes in each of the tanks. However, the DOE is confident that the quantities of radionuclides used to support the TBR represent an upper bound. The following assumptions were used in the CNWRA assessment.

- Hanford Site tank waste inventories used for the material balance in the TBR are representative of the upper bound of these inventories, given the uncertainties in existing records of tank contents.

- If continuing characterization of tank wastes results in a determination that radionuclide inventory values should be significantly increased, classification of the wastes will be re-evaluated.

- If waste classification must be reevaluated in response to increases in the estimated inventory, privatization contract specifications for the waste form will continue to require that all solidified waste be classified as Class C or less as defined in 10 CFR Part 61.

- Any re-evaluation of waste classification in response to increased estimates of tank inventories will be conducted using the three criteria currently defined or other criteria concurred in by the NRC staff.

In conclusion, the material balance used for the TBR is consistent with available records and models of tank waste radionuclide inventories.

Evaluation of Compliance with Criterion One

The DOE waste management plan for the Hanford Site tanks proposes the use of processes that will remove all but 8.5 MCi of the key radionuclides (approximately 2–5 percent of the total site inventory). This 8.5 MCi would be the waste considered to be incidental. CNWRA reviewers evaluated DOE analyses of the technical and economic practicality of methods available for radionuclide removal, considering NRC guidance to DOE on requirements for classifying waste as incidental. To some extent, the evaluation was constrained by availability of references and the subjectivity of the analyses. The following assumptions were used in this evaluation.

- Results of the DOE assessments of the technical and economic practicalities of radionuclide removal processes for the Hanford Site tank wastes represent a reasonable effort to perform such assessments considering inherent subjectivity.

- Privatization contract specifications provide flexibility in the use of radionuclide removal processes consistent with producing a waste form that would be classified as Class C or less.

- A LAW fraction from processing both DST and SST wastes that results in a lower waste volume and total waste activity at the lower end of the range than previously expected considering only the DSTs, supports a determination that radionuclide removal would be completed to the extent technically and economically practical, consistent with the same determination made by the NRC in 1989 for the DST wastes.

In conclusion, Criterion One for classifying the Hanford Site LAW fraction as incidental waste will be met if a waste management plan similar to the one presented in the TBR is placed in effect and if privatization contractors meet the contract waste form specifications.

Evaluation of Compliance with Criterion Two

In section 2 of this report, CNWRA reviewers conclude that the DOE characterization of the key radionuclides and their quantities represents a realistic estimate. Using this waste characterization data, CNWRA reviewers assessed the DOE estimates of key radionuclide concentrations in the probable solidified waste form. This assessment included an examination of the contract specifications for the privatization contractors. Privatization contract specifications require that the radionuclide concentration in the waste form be less than Class C limits. The following assumptions were used in this assessment.

- The radionuclide inventory has been adequately characterized in the TBR. If the inventory is found to be significantly larger, the NRC will re-evaluate its determination of waste classification.

- Privatization contractors will be able to produce a waste form complying with contract specifications that require that the solidified product meets the limits for Class C waste or less as defined in 10 CFR Part 61. If privatization contractors are unable to meet waste form contract specifications, the NRC will re-evaluate its determination of waste form classification.

In conclusion, Criterion Two for classifying the Hanford Site LAW fraction as incidental waste will be met if privatization contractors meet the contract waste form specifications.

Evaluation of Compliance with Criterion Three

The CNWRA reviewers conducted an independent assessment of the comparability of performance objectives from DOE Order 5820.2A and Subpart C of 10 CFR Part 61. The primary differences between the NRC and DOE performance objectives that would be applicable to the Hanford Site disposal facility are (i) lack of a technical requirement for waste classification in the DOE system (compensated by a specific performance objective dose limit for intruder protection), (ii) lack of a stability performance objective in the DOE framework (addressed through system performance assessments), (iii) absence of a specific performance objective for protection of individuals during operations (addressed by a required safety analysis report), and (iv) absence of an NRC groundwater protection performance objective (compensated by a requirement in 10 CFR 61.41).

In addition, to meet Criterion Three a performance assessment must demonstrate that the disposal facility will meet the performance objectives. In reviewing the TBR, the CNWRA considered the results of an interim performance assessment (IPA) for the disposal facility conducted by Westinghouse Hanford Company. This interim performance assessment is the first of three required and was conducted prior to selection of a disposal facility site, completion of a disposal facility design, or selection of a LAW fraction solidification process. However, the interim performance assessment incorporates the requirements of the three criteria for incidental waste classification.

The following assumptions were used in this assessment.

- The absence of a DOE waste classification system is compensated by a performance objective dose limit for intruder protection.

- The lack of a DOE performance objective for site stability can be addressed through system performance assessments that incorporate processes affecting the site.

- Absence of a DOE performance objective for protection of individuals during operations can be mitigated through the completion of the required site safety analysis report.

- Although NRC has no specific performance objective for protection of groundwater, DOE and NRC application of "as low as reasonably achievable" (ALARA) requirements will provide protection of groundwater resources.

- Proposed changes to DOE site performance objectives will not result in significant inconsistencies with NRC performance objectives.

- Uncertainties and concerns identified with respect to the interim performance assessment can be satisfactorily addressed in the subsequent preliminary and final performance assessments required by DOE Order 5820.2A. Many of these concerns result from lack of specificity because a site, design, or solidification process have not yet been selected.

In conclusion, for Criterion Three, performance objectives from DOE Order 5280.2A are comparable to those contained in 10 CFR Part 61, and disposal of the LAW fraction as proposed in the TBR will meet applicable performance objectives.

Summary

The results of the CNWRA review of the TBR and a number of associated references support the conclusion that if Hanford Site tank wastes are managed using a program compatible with the one presented in the TBR, the NRC can consider the resulting solidified LAW fraction to be incidental waste. Such waste could then be disposed onsite in near-surface vaults not subject to NRC regulatory control. If the management plan presented in the TBR changes significantly, NRC may find it necessary to re-examine waste classification.

The CNWRA review identified a number of uncertainties and concerns that should be addressed by the DOE through its continuing implementation of the tank waste remediation system (TWRS) program. Specifically, the CNWRA reviewers found that assessing compliance with Criterion Three identified several areas of significant uncertainty and technical concern. To some extent, these uncertainties and concerns may be resolved as site, design, and process selection are completed. Some of the concepts used in the IPA for assessing disposal system performance may need to be refined. These items have been identified in this report. Continuing concurrence in the DOE incidental waste classification for the Hanford Site tank wastes requires that these issues be adequately resolved in the preliminary and final performance assessments. The NRC has the responsibility and authority to conduct any such re-evaluation under its existing statutory and regulatory roles.

1 INTRODUCTION AND BACKGROUND

Hanford Site tank radioactive and hazardous chemical wastes were produced from 1944 through 1988 by reprocessing irradiated nuclear fuel. Aqueous wastes resulting from these reprocessing operations were stored in underground double-shell (DST) and single-shell tanks (SST). The wastes have been treated to reduce volume and to remove some of the radionuclides (Westinghouse Hanford Company, 1996a, pp. ES-i and 1-1). In managing Hanford Site tank wastes, high-level radioactive waste (HLW) is considered to be "...those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel" (Nuclear Regulatory Commission, 1956). The Nuclear Regulatory Commission (NRC) has regulatory responsibility for disposal of HLW generated at Hanford, but does not have authority for regulating disposal of U.S. Department of Energy (DOE) low-level radioactive waste (LLW) from that site (Westinghouse Hanford Company, 1996a, p. 2-1).

In September 1988, the DOE proposed a management plan for the Hanford DST wastes during a meeting with NRC staff. This plan incorporated the preferred alternative in the Environmental Impact Statement for the Disposal of Hanford Defense, High-Level, Transuranic, and Tank Wastes (U.S. Department of Energy, 1987). The plan addressed only the waste in the DSTs, and required removal of ^{137}Cs from neutralized current acid waste and complexant concentration waste supernatants. Transuranic wastes (TRU) were also to be removed from the neutralized cladding removal waste and from the plutonium finishing plant sludges. The wastes from liquid remaining after removal of these radionuclides were to be solidified as a grout for disposal in near-surface vaults. SST wastes were not addressed in this 1988 plan, since the DOE required further study on appropriate means for their disposal (Westinghouse Hanford Company, 1996a, p. ES-i). The plan also proposed developing a DOE/NRC consensus on a source-based approach to classification of the wastes (Bell, 1988).

In response to the 1988 DOE plan for management of DST wastes, the NRC provided general concurrence and offered comments intended to improve the Hanford Site tank waste management and classification. These comments (i) recommended disregarding specific individual waste streams based on radionuclide activity rather than on volume as had been recommended by the DOE, (ii) provided improved criteria for classification of waste as incidental, (iii) requested an opportunity to review the characteristics of specific tank wastes prior to grouting, and (iv) rejected a DOE suggestion to establish a DOE/NRC task force to develop a risk-based definition for HLW. Concerned that the proposed DOE plan would require a tank-by-tank waste classification effort, the NRC staff suggested an alternative approach using a material balance of the tank wastes at Hanford Site and the existing source-based definition of HLW. With this approach, if the DOE could demonstrate that at least 90 percent (the largest practical amount) of the first cycle solvent extraction wastes had been removed, the NRC would concur that the residual small fraction of moderately radioactive material would not be subject to NRC licensing and could be disposed by the DOE onsite in near-surface vaults. The NRC response also included criteria for classifying decontaminated salts as incidental wastes (Bell, 1988).

In March 1989, the DOE completed the material balance recommended by the NRC and reported the results. The material balance indicated that only 3–5 percent of the key radionuclides estimated to be in the DST wastes would be incorporated in the grouted waste. According to the DOE analysis, all of these wastes would be Class C or less as defined in 10 CFR Part 61 (Nuclear Regulatory Commission, 1982a). The DOE also proposed removing additional ^{137}Cs to reduce the grouted portion of the key radionuclides to 2–3 percent of the DST radioactive wastes. In response to an NRC concern that the grouted vaults would contain more Class C waste than other similar facilities, the DOE noted that multiple barriers and the well-established institutional controls at the Hanford Site would provide mitigation of the effects of

the large waste quantity. In conclusion, the DOE stated that the material balance demonstrated that residual radionuclides were not HLW and therefore not subject to NRC licensing (Rizzo, 1989). In September 1989, the NRC concurred that the low-activity waste (LAW) fraction resulting from processing the DST wastes as proposed in the DOE waste management plan could be considered incidental LLW and could be disposed in a grout facility not subject to NRC licensing (Bernero, 1989).

Subsequent to these activities, Washington State and others petitioned for a rulemaking that would establish a procedural framework for determining classification of Hanford Site tank wastes (Husseman, 1990). This petition was ultimately denied (Nuclear Regulatory Commission, 1993). The discussion of the standard for waste classification in the denial includes the NRC conclusion that "any radioactive material from the DSTs that is deposited in the grout facility would not be high-level waste subject to NRC licensing jurisdiction." These wastes would be "...'incidental' wastes because of DOE assurances that they: (1) have been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical; (2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low level waste as set out in 10 CFR Part 61; and (3) are to be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied" (Nuclear Regulatory Commission, 1993). These three criteria were transmitted by letter to the DOE with the direction that they be considered in any re-evaluation of tank waste remediation options by the DOE (Bernero, 1993).

Subsequent to development of the plan for processing DST wastes, DOE determined that it is possible to process SST waste in the same manner (Washington State Department of Ecology et al., 1994). Concerns about the suitability of grout as a waste form have resulted in decision to use a vitrification or solidification process (Westinghouse Hanford Company, 1996a, p. 2-4). More recently, DOE has decided that the waste treatment and immobilization will be privatized, and the selected private contractors will define the processes for waste treatment and immobilization in their proposals. The associated facilities will be contractor owned and operated (Kinzer, 1996). Contract specifications for these private contractors (U.S. Department of Energy, 1996a,b) require that radionuclide separation processes and the immobilized waste form be consistent with the technical basis provided in Revision 2 to Technical Basis for Classification of Low-Activity Waste Fraction from Hanford Site Tanks for the Tank Waste Remediation System (Westinghouse Hanford Company, 1996a); hereafter referred to as the Technical Basis Report (TBR). The DOE notes that the radioactivity remaining in the LAW fraction from all 177 SSTs and DSTs (if the contractors can meet the specifications) will be less than that initially proposed for the LAW fraction from the DSTs (Kinzer, 1996). In consideration of this activity level, and noting that the NRC previously concurred in classifying the DST LAW fraction as incidental waste, the DOE has requested that the NRC concur that the combined DST and SST LAW fractions be considered incidental waste. The DOE also has requested that this waste be disposed onsite in a solidified form not subject to NRC licensing authority (Kinzer, 1996).

This report provides a Center for Nuclear Waste Regulatory Analyses (CNWRA) assessment of the DOE TBR. It includes the assumptions that must be met for the NRC to accept the DOE proposal for classification of DST and SST LAW fractions as incidental waste. Section 2 evaluates the DOE characterization of the Hanford Site tank wastes provided in the TBR, considering other published data on tank wastes. Sections 3, 4, and 5 assess compliance with the three NRC-specified criteria for classification of the LAW fraction as incidental waste. Section 6 summarizes conclusions, and section 7 provides references. Uncertainties regarding the Hanford tank waste inventory are outlined in Appendix A.

2 EVALUATION OF THE CHARACTERIZATION OF THE HANFORD SITE TANK WASTES

2.1 DISCUSSION

Processing of irradiated nuclear fuel at the Hanford Site began in 1944. The resulting liquid radioactive and hazardous chemical wastes from several different waste streams were subjected to a variety of treatment processes. Also, the wastes have been concentrated to reduce volume and have been mixed in 177 DSTs and SSTs. Available records do not accurately trace the sources, quantities, and current locations of the radionuclides (Westinghouse Hanford Company, 1996a, pp. 1-1; Rizzo, 1989, enclosure 1, p. 4). Consequently, there is uncertainty in the characterization of the constituents and quantities of the wastes in each of the tanks. However, the DOE is confident that the quantities of radionuclides used to support the TBR represent an upper bound.[1] Specific evaluations of individual radionuclide uncertainties are provided in appendix A (reproduced from the TBR).

Figure 2-1, reproduced from the TBR (Westinghouse Hanford Company, 1996a, p. 3-2, figure 3-1), provides the estimated material balance for the Hanford Site tank waste radionuclide inventory. Figure 2-1 indicates that 243 MCi of the original tank waste radionuclide content of 422 MCi will have decayed by the year 1999. This value reflects the relatively short half lives of ^{137}Cs and ^{90}Sr. The material balance also indicates that approximately 87 MCi are accounted for as (i) leaks or deliberate discharges, (ii) encapsulation of ^{137}Cs and ^{90}Sr, (iii) other offsite shipments, or (iv) residual tank inventories. The remaining 91.6 MCi consists of 55.6 MCi insoluble waste to be disposed in a geologic repository as HLW and 36 MCi that comprises the soluble radionuclides that will be further treated to produce what DOE proposes to classify as incidental waste. This 36 MCi contains most of the ^{137}Cs and ^{99}Tc and almost all of the ^{79}Se, ^{129}I, ^{14}C, and ^{3}H (Westinghouse Hanford Company, 1996a, p. 4-1). After further treatment, 8.5 MCi will remain as incidental waste with 27.5 MCi being added to the HLW stream.

The tank waste inventory for selected radionuclides (decayed to December 31, 1999) that formed the basis for the material balance used data from the Integrated Data Base Report—1994 (U.S. Department of Energy, 1994a). In table 2-1, values of total tank waste inventory are compared for ^{90}Sr, ^{137}Cs, ^{99}Tc, and TRU taken from the TBR (Westinghouse Hanford Company, 1996a, p. 3-3, Table 3-1), from Shelton (1995), and from Goldberg and Guberski (1995). Values from the different references are consistent, except for the TRU inventory. The TRU inventory value in the TBR is lower by 63 percent when compared to Shelton (1995) and to Goldberg and Guberski (1995)—most likely because ^{241}Am was not included in the TRU inventory listed in the TBR. However, the difference in the total radionuclide inventory is within the uncertainties recorded in the reported values. The effect of a larger value for the TRU inventory will be addressed in section 4. This comparison indicates that various sources of tank waste inventory data are consistent. All inventories used for the comparison were compiled by DOE contractors. No non-DOE sources of Hanford Site tank waste inventory are known to be available.

[1] During briefings to the NRC and CNWRA staffs at the DOE facilities in Richland, Washington, January 15, 1997, Mr. D. Wodrich noted that although individual tank inventories may be uncertain, the total radionuclide inventory in the material balance used to develop the TBR is considered to adequately represent the upper bound.

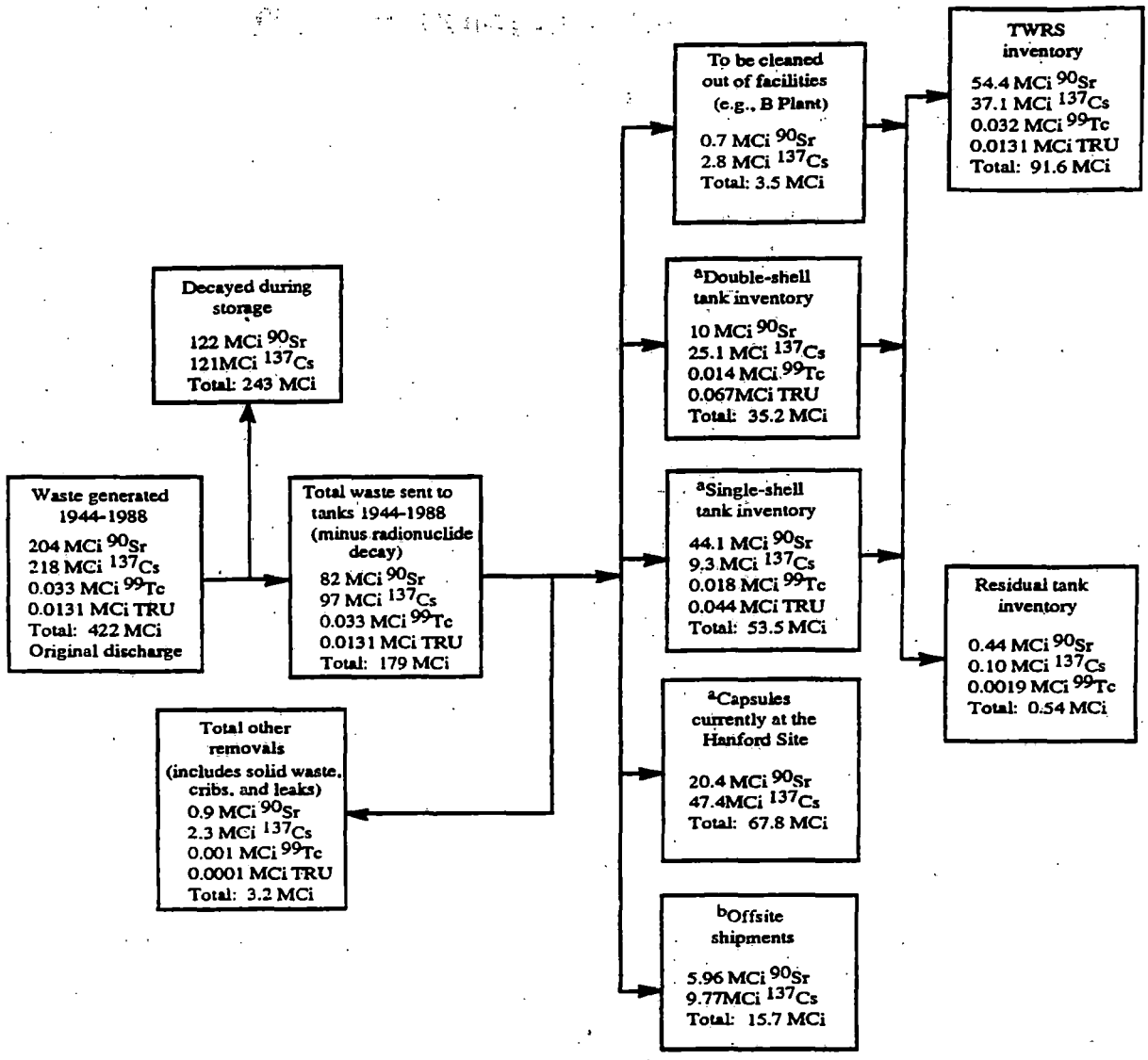

Figure 2-1. Estimate Hanford Site Tank Waste Radionuclide Inventory[c,d]

[a]Curie values are based on the Integrated Data Base Report—1994, rev. 11, table 2.11 decayed to December 31, 1999.

[b]The "offsite shipments" inventory is not expected to return to the Hanford Site for treatment.

[c]Decay products are not listed. Some radionuclides, such as ^{137}Cs and ^{90}Sr, have daughters with relatively short half-lives and are present in concentrations associated with the normal decay chain of the radionuclide.

[d]Inventories of other key radionuclides (i.e., ^{3}H, ^{129}I, ^{14}C, ^{79}Se, uranium isotopes, and ^{126}Sn) are not shown on the material balance. These radionuclides have small inventories that do not significantly affect the total curies in the material balance.

Table 2-1. Comparison of Hanford Site tank waste radionuclide inventory data

Radionuclide	Total (Double- and Single-Shell) Tank Waste Inventory, MCi (decayed to December 31, 1999)		
	Technical Basis Report	Shelton, 1995	Goldberg and Guberski, 1995
^{90}Sr	54.1	53.6	53.7
^{137}Cs	34.4	34.9	34.9
^{99}Tc	0.0321	0.0321	0.0321
TRU	0.131	0.214	0.213
TOTAL	88.66	88.75	88.85

2.2 ASSUMPTIONS

Following are the assumptions made in assessing the TBR waste characterization.

- Hanford Site tank waste inventories used for the material balance in the TBR are representative of the upper bound of these inventories, given the uncertainties in existing records of tank contents.
- If continuing characterization of tank wastes results in a determination that radionuclide inventory values should be significantly increased, classification of the wastes will be re-evaluated.
- If waste classification must be re-evaluated in response to increases in the estimated inventory, privatization contract specifications for the waste form will continue to require that all solidified waste be classified as Class C or less as defined in 10 CFR Part 61.
- Any re-evaluation of waste classification in response to increased estimates of tank inventories will be conducted using the three criteria currently defined or other criteria concurred in by the NRC staff.

2.3 CONCLUSION

The material balance used for the TBR is consistent with available records and models of tank waste radionuclide inventories.

3 EVALUATION OF COMPLIANCE WITH CRITERION ONE

WASTES HAVE BEEN PROCESSED (OR WILL BE FURTHER PROCESSED) TO THE MAXIMUM EXTENT THAT IS TECHNICALLY AND ECONOMICALLY PRACTICAL

3.1 DISCUSSION

The NRC provided initial guidance to the DOE on classification and disposal of incidental waste from DSTs in a letter from M.J. Bell to R.E. Gerton (1988). This guidance stated "...we suggest that DOE attempt an overall material balance of HLW at the Hanford Site using the source-based meaning of HLW. ...Under this approach, if DOE could demonstrate that the largest practical amount of the total site activity attributable to 'first-cycle solvent extraction' wastes has been segregated for disposal as HLW, then the NRC would view the residual as a non-HLW. We would anticipate that at least 90 percent of the activity would have been separated in this way. Thus, if it can be shown that DOE has processed the waste with the intent to dispose of the HLW in a repository or other appropriate licensed facility, leaving behind only a small fraction of only moderately radioactive material, then the goals stated in 10 CFR Part 50 appendix F and incorporated in the Energy Reorganization Act would have been satisfied; and the disposal of the residual would accordingly not be subject to NRC licensing (Bell, 1988)."

In response to this cited NRC 1988 guidance, DOE conducted a radionuclide balance and concluded that 3–5 percent of the key radionuclides that entered the tanks would be disposed as LLW in near-surface vaults. DOE proposed additional radionuclide removal that would reduce this value to 2–3 percent of the key radionuclides. The classification of this waste would be Class C or less (Rizzo, 1989). The NRC concurred that if the DOE processed the waste in this manner, the low-activity fraction would not be considered HLW. In forwarding this concurrence, the NRC noted similar evaluations made for incidental wastes at the West Valley Demonstration Project and the Savannah River Site, and acknowledged the complications resulting from mixing various waste sources at the Hanford Site. The NRC also noted that the Hanford Site waste material balance was based on estimates from computer models and that actual samples taken prior to solidification would be used to confirm waste inventories (Bernero, 1989).

In forwarding to the DOE its denial of a rulemaking petition from Washington and Oregon on the subject of radioactive waste classification, the NRC stated that key radionuclide removal must be completed to the maximum extent technically and economically practical (Bernero, 1993). In so doing, the NRC did not rescind its concurrence in the DOE plan for onsite disposal of the LAW fraction for DST wastes.

As shown in figure 2-1 of this report, 91.6 MCi comprises the Hanford Site tank waste inventory that will be processed for disposal as HLW or LLW. Approximately 99.9 percent of this waste is ^{137}Cs or ^{90}Sr. Initially, a simple solids-liquids separation will be performed on this waste to yield a low-activity liquid fraction containing the bulk of the nonradioactive materials, including about 3 percent solids carryover, and a high-activity fraction containing most of the solids. This solids-liquids separation process is expected to be relatively simple to complete and will remove approximately 55.6 MCi, consisting primarily of ^{90}Sr and TRU radionuclides (Westinghouse Hanford Company, 1996a, pp 3-2, 4-1, 4-2). Chapter 5 of the TBR concludes that, with the additional selective removal of transuranic wastes from three complexant concentrate tanks, and single-cycle ion exchange removal of ^{137}Cs from certain wastes,

the waste concentrations presented in the Supernatant Inventory after Pretreatment column of table 3-1 (reproduced from the TBR) (Westinghouse Hanford Company, 1996a, p. 5-2, table 5-2), are those to be incorporated in the incidental waste.[1] The evaluation of the DOE assessment of economic and technical practicality for radionuclide removal processes was made using available references and considering the subjectivity of the analyses in the TBR.[2]

Table 3-1. Solidified waste radionuclide concentrations after supernatant separations versus 10 CFR Part 61 limits

Radionuclide	Supernatant Inventory after Pretreatment[a] (Ci/m^3)	Average Concentration in Low-Activity Waste Glass (Ci/m^3)[b,c]	Class A Limit (Ci/m^3)	Class B Limit (Ci/m^3)	Class C Limit (Ci/m^3)
^{137}Cs	5	32	1	44	4,600
^{90}Sr	3.4	22	0.04	150	7,000
^{99}Tc	0.32	0.2	0.3	–	3.0
^{79}Se	0.00103	<0.006	NLE	NLE	NLE
^{14}C	0.0053	<0.03	0.8	NLE	8.0
^{129}I	0.000051	<0.0003	0.008	NLE	0.08
^{3}H	0.01	0.06	40	NLE	NLE
^{126}Sn	0.0016	<0.01	N/A	N/A	N/A
Uranium	0.001	<0.006	NLE	NLE	NLE
Transuranics	0.01nCi/g	25 nCi/g	10 nCi/g	NLE	100 nCi/g

NLE=No limit established.
[a]To be conservative, it is assumed that 100 percent of the ^{99}Tc, ^{79}Se, ^{14}C, ^{3}H, ^{129}I, and ^{126}Sn inventories (soluble and insoluble fractions) are incorporated into the immobilized low-activity waste.
[b]The sum of the fractions rule for mixtures of radionuclides has been applied.
[c]The low-activity waste volume is estimated to be 158,000 m^3 of glass.

[1] The column titled Supernatant Inventory after Pretreatment includes dissolved species in existing tank supernatant, dissolved salt cake, and liquids from treatment of sludge (Westinghouse Hanford Company, 1996a, p. 3-1)

[2] During briefings to the NRC and CNWRA staffs at the DOE facilities in Richland, Washington, January 15, 1997, Mr. D. Wodrich, in response to a comment that relevant reference materials had not yet been obtained by the reviewers, noted that the assessments of economic and technical practicality were somewhat subjective.

The TBR states that "economic practicality is determined by the total life-cycle cost per curie removed" and that "the economically practical limit is selected...as the point where additional removal costs increase significantly" (Westinghouse Hanford Company, 1996a, p. 2-9). However, the TBR examines only one of the key radionuclides, ^{137}Cs, with respect to these criteria: a cost per curie removed curve is provided only for ^{137}Cs (Westinghouse Hanford Company, 1996a, p. 4-7). The TBR examined the economic practicality of radionuclide removal processes only if they were determined to be technically practical. Processes were determined to be technically practical only if they had been tested on a plant scale or exhibited a high probability of success (Westinghouse Hanford Company, 1996a, pp. 2-7, 2-9).

The TBR did not consider duplicative costs. Chapter 4 of the TBR examines removal of ^{137}Cs, ^{99}Tc, and ^{79}Se through volatilization as an intrinsic part of the vitrification process. In each case, the TBR concludes that such volatilization is technically impractical because the process has not been demonstrated at a plant scale [this is consistent with the definition of technical practicality used in the TBR (Westinghouse Hanford Company, 1996a, p. 2-7)]. Consequently, no economic analysis is provided for this process. However, section B5.0 of the report assesses the cost of ^{79}Se removal through volatilization as $1.00 per Ci. Considering this low cost compared to other radionuclide removal processes, further examination of volatilization as a radionuclide removal technique might be appropriate, and the costs could be distributed among relevant radionuclides.

Table 3-2 has been reproduced in part from the TBR (Westinghouse Hanford Company, 1996a, p. 4-26, table 4-4). An examination of the cost per curie column from table 3-2 indicates that some removal options considered not economically practical have costs very close to others deemed economically practical. For example, costs for hydroxide precipitation for TRU and ^{90}Sr, evaluated as being economically practical, are higher than those for one category of single-cycle cation ion exchange, which is viewed as being economically impractical. No criteria are provided for evaluating these economic practicality judgments or costs, other than for ^{137}Cs.

There was limited reference material available for assessing DOE evaluations of economic and technical practicality. However, the DOE is allowing the privatization contractors flexibility in selection of radionuclide removal and treatment processes so long as solidified product specifications and performance objectives are met.[3] These contract specifications (U.S. Department of Energy, 1996a,b) require that the solidified product radionuclide concentrations meet Class C or less requirements as defined in 10 CFR Part 61 (Nuclear Regulatory Commission, 1982a) and as described in the Branch Technical Position on Concentration Averaging and Encapsulation (Nuclear Regulatory Commission, 1995).[4,5]

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[3] During briefings to the NRC and CNWRA staffs at the DOE facilities in Richland, Washington, January 15, 1997, the DOE staff stated that the Tank Waste Remediation System privatization contractors had the option to select radionuclide removal and treatment procedures so long as the solidified product met the contract specifications.

[4] Contract specification 2, Immobilized Low-Activity Waste (ILAW), Product Requirement 2.2.2.8 for both privatization contracts states "The radionuclide concentration of the ILAW form shall be less than Class C limits as defined in 10 CFR 61.55 and as described in *Branch Technical Position on Concentration Averaging and Encapsulation*. In addition, the average concentrations of $^{137}Cesium$ (^{137}Cs), $^{90}Strontium$ (^{90}Sr), and ^{99}Tc shall be limited as follows: $^{137}Cs < 3$ Ci/m^3, $^{90}Sr < 20$ Ci/m^3, and $^{99}Tc < 0.3$ Ci/m^3. The average concentrations shall be calculated by adding the inventories of each of the above radionuclides in the packages that have been presented to date for acceptance and dividing by the total volume of waste in these packages."

[5] Contract specifications 4, 5, and 6 (^{137}Cs, ^{99}Tc, and ^{90}Sr and TRU) state that for these specific radionuclides: "The contractor shall determine the degree of...removal required to comply with the requirements of specification 2, *Immobilized Low-Activity Waste*" as discussed in footnote 3.

Table 3-2. Summary of costs for technically practical radionuclide removal technology options

Technically Practical Technology Option	Economically Practical	Cost $/Ci
Single-Cycle Cation Ion Exchange, Selective Removal (^{137}Cs concentrations >0.05 Ci/L)	Yes	25
Single Cycle Cation Ion Exchange, Selective Removal (^{137}Cs concentrations <0.05 Ci/L)	No	65
Single Cycle Cation Ion Exchange	No	30
Second Cycle Cation Ion Exchange	No	420
Hydroxide Precipitation for TRU and ^{90}Sr, Selective Treatment	Yes	63–128
Ferric Hydroxide Precipitation for TRU and ^{90}Sr, Selective Treatment	No	140–570
Solvent Extraction, TRUEX, PUREX	No	800,000

The CNWRA reviewers examined the radionuclide removal processes discussion in chapter 4 of the TBR in conjunction with the Tank Waste Remediation Process Flowsheet (Orme, 1995). This examination supports the conclusion that the TBR presents a reasonable assessment of the types of processes available to conduct radionuclide removal. The radionuclide removal processes examined in the TBR, in conjunction with the process flowsheet and the requirements of the privatization contract provide a substantial framework for economical, technically practical radionuclide removal.

Both DST and SST wastes are considered in the TBR waste management plan. Table 3-3 [taken from the TBR (Westinghouse Hanford Company, 1996a, p. 5-4, table 5-3)] reflects that the DOE plan to process both SST and DST wastes, including additional radionuclide removal after pretreatment, will result in a smaller waste volume with a total Curie content near the low end of the range previously proposed for only the DST wastes. This revised Curie content (8.5 MCi) represents approximately 2 percent of the estimated activity generated at the Hanford Site (8.5 MCi/422 MCi × 100% = 2.01%). If the original total waste inventory is decayed until the 1999, the 8.5 MCi represents approximately 5 percent of the

remaining inventory (8.5 MCi/179 MCi × 100% = 4.74%). This value is consistent with the NRC requirement that at least 90 percent of the activity be removed (Bell, 1988).

Table 3-3. Comparison of previous and proposed determinations of Hanford Site tank waste classification[b,c]

Parameter	Previous NRC Determination[a]	Proposed NRC Determination[b]
Scope, Number of waste tanks	28 DSTs	28 DSTs and 149 SSTs
LAW form	Grout	Glass
LAW volume, m^3	233,000	158,000
Radionuclides in LAW (MCi)		
^{137}Cs	6 to 7	5
^{90}Sr	1 to 8	3.4
Transuranics	0.002 to 0.01	0.01
^{99}Tc	0.016 to 0.028	<0.03[c]
^{79}Se	—	<0.001
^{14}C	0.0027	<0.0053
^{129}I	0.000033	<.000051
^{3}H	—	<0.01
^{126}Sn	—	<0.0016[c]
Uranium	—	<0.001[c]
Total (without daughters)	7 to 15	8.5

— = No value established
[a]Decay date December 31, 1995
[b]Decay date December 31, 1999
[c]And as required by the performance assessment

3.2 ASSUMPTIONS

The following assumptions were made in assessing compliance with Criterion One.

- Results of the DOE assessments of the technical and economic practicalities of radionuclide removal processes for the Hanford Site tank wastes represent a reasonable effort to perform such assessments, considering inherent subjectivity.

- Privatization contract specifications provide flexibility in use of radionuclide removal processes consistent with producing a waste form that would be classified as Class C or less.

- A LAW fraction from processing both DST and SST wastes that results in a lower waste volume and total waste activity at the lower end of the range previously expected considering only the DSTs, supports a determination that radionuclide removal would be completed to the extent technically and economically practical, consistent with the same determination made by the NRC in 1989 for the DST wastes.

3.3 CONCLUSION

Criterion One for classifying the Hanford Site LAW fraction as incidental waste will be met if a waste management plan similar to the one presented in the TBR is placed in effect and if privatization contractors meet the contract waste form specifications.

4 EVALUATION OF COMPLIANCE WITH CRITERION TWO

WASTES WILL BE INCORPORATED IN A SOLID PHYSICAL FORM AT A CONCENTRATION THAT DOES NOT EXCEED THE APPLICABLE LIMITS FOR CLASS C LOW-LEVEL WASTE AS SET OUT IN 10 CFR PART 61

4.1 DISCUSSION

Table 3-1 supports the analysis for this criterion. Assuming that the DOE assessment of the waste inventory is correct, table 3-1 indicates that the waste form will comply with 10 CFR Part 61 requirements for Class C waste or less.

In section 2, the CNWRA reviewers examined the validity of the waste inventory as presented in the TBR. This examination indicated that the TBR may have underestimated the quantity of TRU radionuclides by a factor of about 63 percent compared to other assessments of the radionuclide inventory. Assuming that the waste form would contain 63 percent more TRU than indicated in table 3-1, the average TRU concentration in LAW glass would increase to approximately 41 nCi/g (1.63 × 25 nCI/g), at least a factor of two less than the Class C limit.

Privatization contract specifications require that the radionuclide concentration in the ILAW form be less than Class C limits (Kinzer, 1996; U.S. Department of Energy, 1996a,b).[1] If the quantities of the radionuclides in the inventory are within reasonable bounds of those estimated in the TBR, and if the privatization contractors can meet the contract specifications, then Criterion Two will be met.

4.2 ASSUMPTIONS

The following assumptions were made in assessing compliance with Criterion Two.

- The radionuclide inventory has been adequately characterized in the TBR (this issue was evaluated in section 2.1). If the inventory is found to be significantly larger, the NRC will re-evaluate its determination of waste classification.

- Privatization contractors will be able to produce a waste form complying with contract specifications that require that the solidified product meets the limits for Class C waste or less as defined in 10 CFR Part 61. If privatization contractors are unable to meet waste form contract specifications, the NRC will re-evaluate its determination of waste form classification.

[1] Contract specification 2, Immobilized Low-Activity Waste (ILAW), Product Requirement 2.2.2.8 for both privatization contracts states "The radionuclide concentration of the ILAW form shall be less than Class C limits as defined in 10 CFR 61.55 and as described in *Branch Technical Position on Concentration Averaging and Encapsulation*. In addition, the average concentrations of ^{137}Cesium (^{137}Cs), ^{90}Strontium (^{90}Sr), and ^{99}Tc shall be limited as follows: ^{137}Cs < 3 Ci/m^3, ^{90}Sr < 20 Ci/m^3, and ^{99}Tc < 0.3 Ci/m^3. The average concentrations shall be calculated by adding the inventories of each of the above radionuclides in the packages that have been presented to date for acceptance and dividing by the total volume of waste in these packages."

4.3 CONCLUSIONS

Criterion Two for classifying the Hanford Site LAW fraction as incidental waste will be met if waste inventory estimates are reasonably accurate and if privatization contractors meet the contract waste form specifications.

5 EVALUATION OF COMPLIANCE WITH CRITERION THREE

WASTES ARE TO BE MANAGED, PURSUANT TO THE ATOMIC ENERGY ACT, SO THAT SAFETY REQUIREMENTS COMPARABLE TO THE PERFORMANCE OBJECTIVES SET OUT IN 10 CFR PART 61 ARE SATISFIED

5.1 DISCUSSION

The DOE requirements for LLW disposal are presented in DOE Order 5820.2A Radioactive Waste Management, chapter III, section 3.a (U.S. Department of Energy, 1988). The NRC performance objectives in 10 CFR Part 61 are at §61.40 through §61.44 (Nuclear Regulatory Commission, 1982a).

Appendix D of the TBR contains a DOE comparison of the performance requirements from DOE Order 5820.2A and 10 CFR Part 61. This comparison also incorporates the results of Hanford Low-Level Tank Waste Interim Performance Assessment (IPA) (Westinghouse Hanford Company, 1996b) and Performance Objectives of the Tank Waste Remediation System Low-Level Waste Disposal Program (Westinghouse Hanford Company, 1996c). In the latter document, DOE assesses LLW disposal facility performance objectives from DOE, the U.S. Environmental Protection Agency, NRC, and Washington State regulations. This assessment indicates that the performance objectives contained in DOE Order 5820.2A are comparable to the requirements of these other agencies. The TBR notes that the performance objectives from DOE Order 5820.2A were sent to members of the Hanford Advisory Board and that the resulting comments required no changes to the performance objectives. (Westinghouse Hanford Company, 1996a, appendix D). CNWRA reviewers conducted an independent assessment of the comparability of performance objectives from DOE Order 5820.2A and 10 CFR Part 61. This assessment is described in the following subsection.

5.1.1 Assessment of the Comparability of Nuclear Regulatory Commission and U.S. Department of Energy Low-Level Waste Disposal Site Performance Objectives

In addition to the performance objectives at §61.40 through §61.44, 10 CFR Part 61 includes several prescriptive technical requirements that are intended to help ensure that the performance objectives are met. These technical requirements are specified in Subpart D of 10 CFR Part 61 and include requirements for (i) disposal site design, §61.51; (ii) waste classification, §61.55; and (iii) institutional ownership and control, §61.59.

Taken together, the technical requirements establish a system that is intended to provide long-term disposal with reasonable assurance of meeting the performance objectives of Subpart C. No single element of the system is assumed to be sufficient to provide assurance that the performance objectives are realized for near surface land disposal facilities, and it is unlikely that the performance objectives can be met if the facility is significantly deficient with respect to any one element of the technical requirements. In the 10 CFR Part 61 framework for LLW disposal, it is the combination of technical requirements that reasonably assures that the performance objectives will be met.

DOE performance objectives and technical requirements for LLW disposal contained in chapter III of DOE Order 5820.2A include requirements for (i) protection of public health and safety in

accordance with standards specified in applicable EH Orders and other DOE orders, (ii) protection of the public from releases of radioactive material, (iii) protection of inadvertent intruders, and (iv) protection of groundwater resources. DOE Order 5820.2A chapter III also contains various supporting technical requirements addressing factors such as (i) waste form requirements, 3.i.(5); (ii) site selection criteria, 3.i.(7); (iii) facility and site design, 3.i.(8); (iv) operations, 3.i.(9); (v) closure and post closure operations, 3.i.(j); and (vi) environmental monitoring, 3.i.(k).

10 CFR Part 61 is primarily a performance-based regulation, and the technical requirements of Subpart D contribute to establish an integrated system that addresses all parameters that can affect facility performance. The DOE LLW disposal requirements are not as explicitly integrated, and DOE Order 5820.2A covers other aspects of LLW management in addition to disposal. The DOE system relies on the results of performance assessments to determine the factors requiring adjustment to meet the performance objectives. These factors can include waste forms, waste classification, and facility design. Although the NRC framework provides the ability to make similar adjustments based on results of performance assessments, the requirements of Subpart D of 10 CFR Part 61 independently provide some degree of assurance that the facility will meet the performance objectives of Subpart C.

Following are comparisons and evaluations of performance objectives and requirements from 10 CFR Part 61 with corresponding requirements from DOE Order 5820.2A.

(1) **10 CFR 61.40** "General Requirement. Land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives in §§ 61.41 through 61.44."

DOE 5820.2A, III.3.a.(1). "Protect health and safety in accordance with standards specified in applicable EH Orders and other DOE orders."

Comparison

The NRC statement is more prescriptive in requiring that specific facility lifecycle parameters be examined to provide reasonable assurance that performance objectives will be met. However, both documents require conformity with standards to protect public health and safety.

Evaluation

These requirements are comparable.

(2) **10 CFR 61.41** "Protection of the general population from releases of radioactivity. Concentrations of radioactive material which may be released to the general environment in groundwater, surface water, air soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 mrems to the whole body, 75 mrems to the thyroid, and 25 mrems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as reasonably achievable."

The 25 mrem/yr limit applies throughout the operating and post-closure periods of a disposal facility. The other radiological control limits of 10 CFR Part 20 (Nuclear Regulatory Commission, 1991) apply during facility operation, except for the 25 mrem limit from the pathways defined above.

DOE 5820.2A, III.3.a.(2). "Assure that external exposure to the waste and concentrations of radioactive material which may be released into surface water, groundwater, soil, plants and animals results in an effective dose equivalent that does not exceed 25 mrem/yr to any member of the public. Releases 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 is reasonably achievable."

Comparison

10 CFR 61.41 requirements for protection of the public from releases to the general environment and DOE performance objective 5280.2A III.3.a.(2) are essentially equivalent for most release pathways. However, the DOE requirement is stated in more current dose measurement standards of effective dose equivalent rather than whole body dose.

10 CFR 61.41 does not specify meeting National Emission Standards for Hazardous Air Pollutants (NESHAPS) atmospheric release limits promulgated by EPA in 40 CFR Part 61 (U.S. Environmental Protection Agency, 1989). NRC has a "constraint level" of 10 mrem/yr for air emissions from NRC licensed facilities in 10 CFR Part 20. The constraint level is viewed as a means of implementing as low as reasonably achievable (ALARA) requirements.

Both DOE and NRC impose ALARA requirements.

Evaluation

Considering that the release limit objectives of the two agencies are essentially equivalent for most pathways, and that the air emissions limit in the DOE objective is consistent with NRC constraints for operating facilities, these performance objectives are comparable.

(3) **10 CFR 61.42** "Protection of individuals from inadvertent intrusion. Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed."

Although a particular dose limit is not specified in this performance objective, compliance with the technical requirements of 10 CFR Part 61 and, in particular, with the classification system of 10 CFR 61.55, is considered to provide adequate protection to intruders at a near surface land disposal facility. In the draft environmental impact statement for the 10 CFR Part 61 rulemaking (Nuclear Regulatory Commission, 1981), NRC used a 500 mrem/yr dose limit to an inadvertent intruder to establish the concentration limits and other aspects of the waste classification system. In addition, 10 CFR Part 61 does not specify a time limit for institutional controls in the performance objectives, but does require in 10 CFR 61.59(b) that "...institutional controls may not be

relied upon for more than 100 years following transfer of control of the disposal site to the owner."

DOE 5820.2A, III.3.a.(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."

Comparison

The requirements for intruder protection are similar. Although the NRC classification system is based on a 500 mrem/yr intruder exposure limit, the corresponding 10 CFR Part 61 performance objective does not specify a dose limit.

The DOE performance objective explicitly states a 100 mrem/yr limit for continuous exposure and a 500 mrem limit for a single acute exposure. These limits are consistent with and more conservative than the intent of 10 CFR Part 61. The DOE limits for intruders are also consistent with current NRC radiation protection standards in 10 CFR 20.1301 for dose limits to individual members of the public (Nuclear Regulatory Commission, 1991).

Evaluation

The DOE acute exposure limit of 500 mrem to an intruder is more conservative than the basis for 10 CFR Part 61.

DOE Order 5820.2A does not incorporate a waste classification system such as that in 10 CFR 61.55. However, the specification of intruder dose limits in the DOE performance objectives would likely cause the activity concentration limits of any waste classification system derived from a site specific performance assessment to be controlled to levels similar to those contained in NRC regulations.

(4) **10 CFR 61.43** "Protection of individuals during operations. Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in Part 20 of this chapter, except for releases of radioactivity in effluents from the land disposal facility, which shall be governed by §61.41 of this part. Every reasonable effort shall be made to maintain radiation exposures as low as reasonably achievable."

This performance objective applies to both the public and to LLW disposal facility workers. No performance objective is specified in DOE Order 5820.2A that corresponds to this NRC performance objective with respect to protection of workers (Westinghouse Hanford Company, 1996a, p. D-6).

Comparison

DOE Order 5820.2A performance objectives do not explicitly establish requirements for protection of workers and the general public during facility operations. NRC invokes the

radiation protection standards of 10 CFR Part 20 (Nuclear Regulatory Commission, 1991) (except that the more restrictive 25 mrem/yr limit of 10 CFR Part 61 applies for radionuclide releases) as an explicit disposal facility performance objective.

DOE 5820.2A provides in III.3.i.(9) that, "Field organizations shall develop and implement operating procedures for low-level waste disposal facilities that protect the environment, health and safety of the public."

Requirements for LLW disposal should make clear the distinction between operating and post-operating phases. Radiation exposures during operations (handling, processing, emplacement of waste, skyshine, etc.) could be significantly higher than for post-operating conditions when the waste will be covered. Radiation protection standards applicable to the public and radiation workers should be specified for the disposal facility operations that are consistent with radiation protection standards that apply for other operating facilities that impose similar risks. In general, these should be consistent with 10 CFR Part 20 and with corresponding DOE Orders. A draft revision to DOE 5820.2A, (DOE 5820.2B [Department of Energy, 1994b]) proposes that these DOE orders be incorporated into the performance objectives for LLW disposal (Westinghouse Hanford Company, 1996c, pp. A-2, A-3). DOE should consider amending performance objectives in DOE Order 5820.2A to explicitly incorporate radiation protection standards. The DOE plans to address worker protection through the safety analysis report that will be prepared for the disposal system (Westinghouse Hanford Company, 1996b, p. 1-11; 1996c, p. 3).

Evaluation

Although DOE performance objectives are not explicit with respect to protection of individuals during operations, the requirement for a disposal facility safety analysis report should assure adequate worker protection and the performance objective can be considered comparable.

(5) **10 CFR 61.44** "Stability of the disposal site after closure. Disposal facilities must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

The stability performance objective is consistent with a major premise of 10 CFR Part 61 that the facility must be sited, designed, used, operated, and closed with the intention of providing permanent disposal. A disposal facility should not require long-term maintenance and care. Stability is particularly important considering the requirements in 10 CFR 61.59(b) that "...institutional controls must not be relied upon for more than 100 years following transfer of control of the disposal site to the owner."

No DOE performance objective corresponds to this NRC performance objective.

Comparison

DOE performance objectives do not include a requirement for long-term facility stability as specified in 10 CFR 61.44. However, DOE has included some waste stability requirements in 5820.2A,III.3.i.(5) and site stability considerations in 5820.2A,III.3.i.(7)(d), respectively.

NRC notes that long-term stability is important to meeting performance objectives in several ways, including reducing (i) water infiltration and the potential for migration, (ii) uncertainty and the need for long-term maintenance and care costs, (iii) likelihood and results of inadvertent intrusion, and (iv) occupational exposures and potential off-site releases in the event of an accident (Nuclear Regulatory Commission, 1982b).

The stability performance objective is supported by a number of specific technical requirements for near-surface disposal in 10 CFR 61.50. These include stability criteria for avoiding site locations (i) that are susceptible to flooding [10 CFR 61.50(a)(5)]; (ii) that have areas where upstream drainage could cause erosion or inundation of disposal units [10 CFR 61.50(a)(6)]; (iii) that are susceptible to tectonic processes such as faulting, folding, seismic activity, or volcanism [10 CFR 61.50(a)(9)]; and (iv) where there is significant potential for surface geologic processes such as mass wasting, erosion, slumping, landslides, or weathering [10 CFR 61.50(a)(10)].

DOE Order 5820.2A, while referencing site suitability factors, does not provide these same constraints and detailed guidance on site selection and suitability [DOE, 1988, section III.3.1(7)].

NRC Regulatory Guide 4.19 (Nuclear Regulatory Commission, 1988) states that, "...NRC staff considers the long-term contribution of the natural conditions of the site essential in protecting the general population against releases of radioactive material. The effectiveness of other measures such as design features, waste form, waste packaging, and institutional controls is assumed to decrease with time after site closure."

Evaluation

Although a stability requirement is different in nature from other performance objectives that relate directly to protection of health and safety, stability is nonetheless important to site performance. Assessments of performance need to incorporate site stability evaluations. So long as DOE performance assessments for the LLW disposal facility adequately evaluate processes affecting site stability, there is no need for DOE to explicitly define a site stability performance objective.

(6) **Groundwater Protection**

NRC does not have a performance objective for groundwater protection, although 10 CFR 61.41 provides protection for groundwater resources.

DOE 5820.2A, III.3.a.(4). "Protect groundwater resources, consistent with Federal, State and local requirements."

Comparison

NRC has considered that the release limits of 10 CFR Part 61.41 adequately protect the public and environment. EPA plans to promulgate a groundwater protection standard for LLW disposal sites in its proposed regulation, 40 CFR Part 193 (Environmental Protection Agency, 1994). NRC (Bernero, 1990) and DOE (Pelletier, 1991) have opposed the issuance of a groundwater protection standard. However, the DOE performance objective is consistent with the proposed 40 CFR Part 193.

There is not a consensus among DOE, NRC, and the Environmental Protection Agency on groundwater protection requirements. However, NRC (10 CFR 61.41) and DOE [5820.2A, III.3.a.(2)] both prescribe application of ALARA requirements to releases of radioactivity in effluents to the general environment, including groundwater.

Evaluation

Although NRC has no specific performance objective for protection of groundwater, DOE and NRC application of ALARA requirements regarding radioactive effluents will provide protection of groundwater resources.

Summary of Evaluations

10 CFR Part 61 presents a performance-based regulatory framework combined with several prescriptive requirements considered important to providing reasonable assurance that the performance objectives can be achieved. DOE Order 5820.2A, Chapter III prescribes a more loosely structured performance-based framework for LLW management and disposal at DOE facilities.

DOE Order 5820.2A provides performance criteria for protecting the health and safety of the public (environmental release limits and intruder protection) and for environmental protection (groundwater resource protection). Various technical criteria address waste characterization, waste form, treatment, and disposal to help ensure compliance with performance and other health and safety objectives.

While the NRC requirements for LLW disposal comprise a system of well defined elements that are integrated to ensure that performance objectives will be attained, the DOE requirements allow greater flexibility in attaining performance objectives. This difference in approach may account for the specific differences in the performance objectives. The primary differences are (i) lack of a technical requirement for waste classification in the DOE system (compensated by a specific performance objective dose limit for intruder protection), (ii) lack of a stability performance objective in the DOE framework (addressed through system performance assessments), (iii) absence of a DOE specific performance objective for protecting individuals during operations (addressed by required safety analysis report), and (iv) absence of an NRC groundwater protection performance objective (compensated by requirements at 10 CFR 61.41).

Proposed Changes to DOE Performance Objectives

DOE has proposed changes to the performance objectives for the LLW disposal facility so that "the Hanford stakeholders can help determine the performance objectives to be used in the assessment of long-term impact of the disposal of low-level waste from the Hanford tanks (Westinghouse Hanford

Company 1996c, p. iii)." The proposed performance objectives in that document include (i) a 25 mrem/yr effective dose equivalent exposure limit from all pathways for protection of the general public, (ii) the same limit for workers as for the general public, (iii) a 500 mrem one-time and 100 mrem/yr continuous exposure limit for inadvertent intruders, (iv) National Primary Drinking Water Regulation limits for groundwater (4 mrem/yr), (v) 1.0 mrem/yr surface water dose limits, and (vi) a 10 mrem/yr limit from airborne emissions.

DOE has also proposed a revision to DOE Order 5820.2A (i.e., 5820.2B) and issuance of a directive from the Richland Operations Office (RL-5820.2A), both of which contain performance objectives different from those in DOE Order 5820.2A (Westinghouse Hanford Company, 1996c, pp. A-2 to A-4). The CNWRA reviewers did not conduct a detailed review of these proposed documents. However, the summaries of their content provided in Performance Objectives of the Tank Waste Remediation Systems Low-Level Waste Disposal Program (Westinghouse Hanford Company, 1996c) indicated that these documents may not contain the same set of four performance objectives that are specified in 10 CFR Part 61, and may not be mutually consistent.

The draft of the revised DOE Order 5820.2B adds specific requirements for (i) protection of public health and safety in accordance with DOE Order 5400.5, (ii) protection of worker safety in accordance with DOE Order 5480.11 and other applicable regulations, (iii) protection of the environment in accordance with DOE Order 5400.1, (iv) restrictions on atmospheric emissions to be in compliance with 40 CFR Part 61, and (v) application of ALARA requirements (Westinghouse Hanford Company, 1996c, pp. A-2, A-3). However, this proposed revision to DOE Order 5820.2A appears to contain no provision for protection of inadvertent intruders.

The proposed Richland Operations Office supplement to 5820.2A (RL 5820.2A) would provide for (i) protection of the public from releases from all exposure pathways, (ii) groundwater protection, (iii) application of ALARA requirements, (iv) intruder protection, and (v) mixed waste regulation (Westinghouse Hanford Company, 1996c, pp. A-3, A-4).

NRC should monitor the development of these documents to ensure that DOE performance objectives for LLW disposal remain comparable to 10 CFR Part 61 performance objectives.

5.1.2 Assessment of the U.S. Department of Energy Interim Performance Assessment for the Hanford Site Tank Wastes

Assuring that performance objectives applicable to the Hanford Site LLW disposal facility are comparable to those in 10 CFR Part 61 is not sufficient for compliance with Criterion Three. A performance assessment must also demonstrate that the disposal facility will meet the performance objectives. In reviewing the TBR, the CNWRA considered the results of the DOE IPA (Westinghouse Hanford Company, 1996b).

The IPA is the first of three performance assessments required by DOE Order 5820.2A (Westinghouse Hanford Company, 1996b, p. iv). The IPA has been conducted prior to selection of a disposal facility site, completion of a disposal facility design, or selection of a LAW solidification process. However, the IPA incorporates the requirements of the three criteria for incidental waste classification (Westinghouse Hanford Company, 1996b, p. 2-44).

The following ten items are observations and concerns from the CNWRA review of the IPA.

- The IPA provides a value of an initial fractional radionuclide release rate of 4.4×10^{-6} for all radionuclides except ^{99}Tc which has a rate of 8.8×10^{-7} (Westinghouse Hanford Company, 1996, pp. iv and 3-32). These values for the fractional radionuclide release rate may be unrealistically low for the disposal facility. The IPA assumes that the fractional radionuclide release rates are limited by the fractional bulk dissolution rate of the glass. It is not clear how the fractional release rate for ^{99}Tc, a highly soluble nuclide, could be much smaller than those for the other isotopes in the glass. These values should be justified. For example, Kerrisk (1984) presents a detailed model for calculating fractional radionuclide release rates for vitrified pressurized water reactor HLW for ten important radionuclides expected in the waste based on nuclide solubilities, recharge rates, background concentrations of silica, and other factors. A similar evaluation would be appropriate for the Hanford Site tank wastes. Additionally, the bulk dissolution rate for glass does not necessarily determine the dissolution rate for high solubility fission products in the glass (such as ^{99}Tc and ^{129}I), because many of these nuclides may have the ability to diffuse out of the glass, therefore having higher release rates. These processes are not included in the IPA.

- The K_d value for ^{129}I (Westinghouse Hanford Company, 1996b, p. 3-27, table 3-5) appears to be non-conservative. As standard practice, ^{129}I is generally considered to be unretarded, that is, $K_d=0$ (Sheppard and Thibault, 1990). The value presented in the IPA (3 L/kg) is higher. This difference is expected to significantly affect the results. The value should be altered or justified.

- Some of the all-pathways dose conversion factors (DCF) in the IPA (Westinghouse Hanford Company, 1996b, p. B-56, table B-3) appear to be low compared with DCFs for other arid sites (LaPlante et al., 1995). The IPA should include a more detailed technical justification for selection of DCFs, because evaluations of disposal facility performance are expected to be very sensitive to the values selected.

- The derivation of the relative radionuclide release rate (Westinghouse Hanford Company, 1996b, pp. 3-33 and 3-34) may require modification. The equation in the center of page 3-33 describes the absolute radionuclide release rate (in Ci/yr) for the waste form as

$$RRR(t) = C * S(t) * I(t)/V(t) \tag{5-1}$$

where

$RRR(t)$ = the radionuclide release rate (Ci/unit time)
C = the constant corrosion rate (L/unit time)
$S(t)$ = the surface area of the waste as a function of time (L^2)
$I(t)$ = the radionuclide inventory as a function of time (Ci)
$V(t)$ = the volume of the waste as a function of time (L^3).

Assuming that this equation is correct, the relative (or fractional) radionuclide release rate $FRRR(t)$, that is, the fraction of radionuclide inventory release rate per unit of time, would be given by

$$FRRR(t) = RRP(t)/I(t) = C * S(t)/V(t) \quad (5\text{-}2)$$

The waste area to volume ratio is expected to increase with time due to corrosion of the waste form and cracking due to formation of corrosion products. Since $FRRR(t)$ is directly proportional to the waste area to volume ratio, this quantity would be expected to increase with time. In contrast, on page 3-34 there is an expression for $FRRR(t)$ that decreases with time. These considerations should be included in the IPA, because performance is likely to be highly sensitive to radionuclide release rate.

- The IPA methodology is deterministic and single values (sometimes best values) of parameters are used in the analysis. The reviewers are concerned that if the range of measured parameter values were to be incorporated into the IPA, some performance limits might be exceeded. Uncertainty analyses are required in addition to the sensitivity analyses presented in the IPA.

- There is insufficient justification for the assumption that the capillary barrier will be intact for 1,000 yr. The performance of this barrier will degrade with time. Similarly, the IPA assumes that the concrete vaults will be intact for 500 yr. This assumption seems to be based on an NRC branch technical position that specifies that the maximum credit that can be allowed for concrete structures is 500 yr. A site specific justification must be provided for this assumption, since occurrence of earthquakes and other natural events must be considered.

- The infiltration rate of 0.5 mm/yr for the first 1,000 yr and 3 mm/yr thereafter has not been adequately justified. These values may be unrealistically low, and contribution from lateral subsurface flow during storms has been neglected.

- The release rate calculation appears unrealistic in that the dissolution time for the entire inventory is based on dissolution in still water. In flowing water, waste dissolution will be faster because the fresh water will provide for continuous attack on the waste form. The IPA acknowledges that performance results are dependent on release rate (Westinghouse Hanford Company, 1996b, pp. 3-32 and 3-35). The dissolution time calculations should be justified or altered.

- The IPA uses an equation that appears to consider that the quantity of radionuclides transported to the base of the vadose zone is dissolved in a volume of water equal to the annual recharge (Westinghouse Hanford Company, 1996b, p. 3-61). This would be unrealistic and non-conservative, particularly for the second design option in which the vaults are interspersed by soil. The volume of water will be the portion of annual recharge that actually flows over the waste. The concentration calculated by the flow and transport code would appear to be more justifiable.

- Flow and transport modeling neglects heterogeneity within layers, thereby omitting consideration of spatially distributed flow.

Preliminary DOE responses to these comments on the IPA are included as Appendix B. These preliminary responses provide a basis for further discussion and interaction between NRC and DOE on the results of the IPA.

5.2 ASSUMPTIONS

The following assumptions were made in assessing compliance with Criterion Three.

- The absence of a DOE waste classification system is compensated by a performance objective dose limit for intruder protection.
- The lack of a DOE performance objective for site stability can be addressed through system performance assessments that incorporate processes affecting the site.
- Absence of a DOE performance objective for protection of individuals during operations can be mitigated through the completion of the required site safety analysis report.
- Although NRC has no specific performance objective for protection of groundwater, DOE and NRC application of ALARA requirements will provide protection of groundwater resources.
- Proposed changes to DOE site performance objectives will not result in significant inconsistencies with NRC performance objectives.
- Uncertainties and concerns identified with respect to the IPA can be satisfactorily addressed in the subsequent preliminary and final performance assessment required by DOE Order 5820.2A. Many of these concerns result from lack of specificity because a site, design, or solidification process have not yet been selected.

5.3 CONCLUSIONS

The following conclusions were reached in assessing compliance with Criterion Three.

- Performance objectives from DOE Order 5280.2A are comparable to those contained in 10 CFR Part 61.
- Disposal of the LAW fraction as proposed in TBR will meet applicable performance objectives.

6 SUMMARY OF CONCLUSIONS

The results of the CNWRA review of the TBR and a number of associated references support the conclusion that if Hanford Site tank wastes are managed using a program compatible with the one presented in the TBR, the NRC can consider the resulting solidified LAW fraction to be incidental waste. Such waste could then be disposed onsite in near-surface vaults not subject to NRC regulatory control. If the management plan presented in the TBR changes significantly, NRC may find it necessary to re-examine waste classification.

The CNWRA review identified a number of uncertainties and concerns that should be addressed by the DOE through its continuing implementation of the TWRS program. Specifically, the CNWRA reviewers found that assessing compliance with Criterion Three identified several areas of significant uncertainty and technical concern. To some extent, these uncertainties and concerns may be resolved as site, design, and process selection are completed. Classification of wastes as incidental will require that privatization contractors meet waste form specifications. Proposed changes to site performance objectives must not result in incompatibility with NRC performance objectives in Subpart C of 10 CFR Part 61. Some of the concepts used in the IPA for assessing disposal system performance may need to be refined. These items have been identified in this report. Continuing concurrence in the DOE incidental waste classification for the Hanford Site tank wastes requires that these issues be adequately resolved in the preliminary and final PAs. The NRC has the responsibility and authority to conduct any such reevaluation under its existing statutory and regulatory roles.

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APPENDIX A

HANFORD SITE TANK WASTE INVENTORY UNCERTAINTIES

HANFORD SITE TANK WASTE INVENTORY UNCERTAINTIES

This appendix has been abstracted from the Technical Basis Report (TBR) (Westinghouse Hanford Company, 1996, pp. 3-3, 3-4) to document the U.S. Department of Energy (DOE) assessment of uncertainties associated with the quantities of key radionuclides contained in the Hanford Site double-shell (DSTs) and single-shell tanks (SSTs). The Center for Nuclear Waste Regulatory Analyses (CNWRA) considers these uncertainty assessments to be adequate considering the available technical data on the characterization of the tank wastes. Specifically, Shelton (1995) and Goldberg and Guberski (1995) corroborate the TBR assessment of radionuclide inventories.

Cesium and Strontium Inventories: The reported inventories for ^{137}Cs and ^{90}Sr are expected to have small uncertainties (less than 10 percent).

Transuranics (includes ^{239}Pu, ^{240}Pu, ^{241}Am, and ^{237}Np) Inventory: The inventory uncertainty for transuranics is primarily associated with the quantities in the insoluble fraction. This uncertainty does not affect an analysis of removal from the soluble fraction. The tank waste processing inventory of transuranics used for this analysis is consistent with the Integrated Data Base Report, Rev. 11. (U.S. Department of Energy, 1994).

Technetium Inventory: The ^{99}Tc inventories are based on the assumption there will be no removal of ^{99}Tc by previous processing. Previous ^{99}Tc removals include cribbing as supernatants from the tanks, cribbing of process wastes during B Plant ^{90}Sr and ^{137}Cs recovery campaigns, ^{99}Tc recovery demonstration and shipment offsite, and removal from the Hanford Site as a contaminant in shipments of uranium oxide product. These previous removals may reduce the ^{99}Tc tank inventory by 25–50 percent (Colby and Petersen, 1995). Analysis of the ^{99}Tc inventory is ongoing.

Selenium Inventory: The ^{79}Se inventories assume no removal of ^{79}Se by previous processing. Previous ^{79}Se removals include cribbing as supernatants from the tanks and cribbing or process wastes during B Plant ^{90}Sr and ^{137}Cs recovery campaigns. These previous removals may reduce the ^{79}Se tank inventory by up to a factor of two. Analysis of previous ^{79}Se removals is in progress.

Carbon Inventory: Because of the poorly known chemistry of ^{14}C in the fuel reprocessing operations that generated the Hanford Site tank wastes, the assumed inventory is conservative and the actual inventory may be a factor of 2–10 lower. The assumed inventory is 0.0053 MCi, representing 120 kg of ^{14}C diluted by approximately 1,800,000 kg of natural carbon. The chemistry of carbon results in its distribution in the supernatants and solids of all tanks. If no ^{14}C is removed, offgas during the vitrification process will result in a maximum offsite 50-yr dose of less than 7 mrem/yr (Westinghouse Hanford Company, 1996, p. 4-21).

Tritium Inventory: Tritium (^{3}H) contained in the tank wastes is estimated to be 10,000 Ci (Colby, 1994). ^{3}H will be discharged to a state-approved disposal site from the pretreatment and waste vitrification facilities in the process condensates as tritiated water. Analysis of the ^{3}H inventory is ongoing.

Tin Inventory: Some ^{126}Sn is expected to be solubilized in the alkaline solutions, but inventory values have not yet been specified. No significant quantity of ^{126}Sn is expected in the low-activity waste that would affect the waste classification. Therefore, ^{126}Sn is not considered for additional radionuclide removal. For performance assessment studies, incorporation of some ^{126}Sn in the low-level radioactive waste (LAW) fraction is assumed to ensure continued consideration of ^{126}Sn for intruder dose consequences.

Uranium Inventory: The reactor discharges of the major uranium isotope, ^{238}U, are well established using the ORIGEN2 model. The production estimates of higher actinides, including other uranium and plutonium isotopes, are more difficult to calculate. Further analysis is needed to refine the values for ^{234}U, ^{236}U, and ^{241}Am.

Other-Sodium Inventory: The impact of a potential reduction in the tank sodium inventory was not quantitatively determined in this study. Qualitatively, the costs for ^{137}Cs ion exchange will not change significantly with a reduction in the sodium inventory. Agnew (1995) indicates that the total sodium inventory in the tank wastes may be approximately 60 percent of the current reported values. This would decrease the predicted volume of the immobilized LAW form since sodium is the major constituent in the LAW, but will not affect Class C concentration limits.

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APPENDIX B

PRELIMINARY U.S. DEPARTMENT OF ENERGY RESPONSES TO COMMENTS ON HANFORD LOW-LEVEL TANK WASTE INTERIM PERFORMANCE ASSESSMENT

PRELIMINARY U.S. DEPARTMENT OF ENERGY RESPONSES TO COMMENTS ON HANFORD LOW-LEVEL TANK WASTE INTERIM PERFORMANCE ASSESSMENT

The U.S. Department of Energy (DOE) provided the following responses to an informal Nuclear Regulatory Commission (NRC) request for additional information (RAI) regarding the Hanford Low-Level Tank Waste Interim Performance Assessment (IPA) (Westinghouse Hanford Company, 1996b). The RAI forwarded the IPA comments documented in section 5.1.2 of this report. These DOE responses provide a basis for further discussion and interaction between NRC and DOE on the results of the IPA.

REFERENCES

Westinghouse Hanford Company. 1996b. *Hanford Low-Level Tank Waste Interim Performance Assessment.* WHC-EP-0884, Revision 0, prepared for the U.S. Department of Energy. Richland, WA: Westinghouse Hanford Company.

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

FEB 1 8 1997

97-TWR-003

Michael J. Bell, Chief
Engineering and Geosciences Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Bell:

REQUEST FOR ADDITIONAL INFORMATION - HANFORD INCIDENTAL WASTE CLASSIFICATION

Reference: NRC letter from Michael J. Bell, to Donald D. Wodrich, RL, "Request for Additional Information - Hanford Incidental Waste Classification," dated February 6, 1997.

As requested in the above reference, attached is our response to your review comments of the "Hanford Low-Level Tank Waste Interim Performance Assessment," WHC-EP-0884, Revision 0, dated September 16, 1996. On February 12, 1997, copies of the document referenced in the attached responses, "Data Package for the Hanford Low-Level Tank Waste Interim Performance Assessment," WHC-SD-WM-RPT-166, Revision 0, dated August 1995, were transmitted.

It is my understanding that this information meets your needs and that a meeting on this subject is not needed at this time. If you have any questions or need additional information, please contact me on (509) 376-6550.

Sincerely,

DDWodrich

Don Wodrich, Senior Technical Advisor
Office of Tank Waste Remediation System

TWR:DDW

Attachment

cc w/attach:
C. Peterson, NHC

Response to Specific Comments from the Review of the
"Hanford Low-Level Tank Waste Interim Performance Assessment,"
WHC-EP-0884, Revision 0
(Comments contained in the letter from Michael J. Bell, NRC)

1a. *The comments suggest that the initial fractional release rate of $4.4x10^{-6}$ for all radionuclides except ^{99}Tc, which has a rate of $8.8x10^{-7}$ may be unrealistically low.* The actual waste form to be disposed is undergoing negotiation between the Department of Energy and two private vendors selected for phase 1 immobilization. Since the waste form is unknown, the base case of the interim performance assessment used the specifications that were included in the request for proposal [RFP] (and now included in the contracts). Please note that for the base case, the release rate for Tc is taken as $4.4x10^{-6}$.

Although this release rate is very low, experiments at the Argonne and Pacific Northwest National Laboratories have shown for a variety of low-level radioactive glass waste forms, this rate can be achieved for the temperatures and pHs expected in the disposal facility.

The initial rate will be determined by a 7-day PCT test and hence should be indicative of the forward rate of glass dissolution. Multi-year experiments at Argonne and Pacific Northwest Laboratories on LD6-5413, a typical low-level waste glass, show that the initial rate is indeed conservative for both Stage II and III of the glass dissolution process.

In addition, to using the release rate specifications, computer simulations based on experimental data for LD6-5412 were performed. These calculations show that the predicted release rate is much lower than required in the RFP.

1b. *The comments state that the release rate for Tc may not be lower than for other components.* For the base case of the interim performance assessment, the release rate for Tc was assumed to be the same as for other elements. The lower rate for Tc release in the RFP could be met in a variety of ways. The most likely way is to separate the Tc from the waste to be immobilized, as the specifications require the release rate calculated relative to the amount of material supplied to the vendor and not to the amount in the waste form. However, from the perspective of a performance assessment, the effect is the same as shown by the sensitivity cases.

1c. *The comments suggest that bulk glass dissolution does not necessarily determine the dissolution rate for high-solubility nuclides, which may be released at much higher rates by diffusion.* The only element that has been observed in experiments at Argonne and Pacific Northwest National Laboratories to be released faster than bulk dissolution is sodium. Experiments with actual vendor glasses are planned to determine whether the fission product nuclides are also subject to this release mechanism. Recent experiments at Argonne National Laboratory suggest that Tc may be bound in some of the secondary phases that are formed from dissolution of LD6-5412 and FLLW-1.

2. *The comments note that the Kd for iodine is usually taken to be 0 and that the interim performance assessment used 3 L/kg.* Kd values for the important elements are based on experiments using Hanford soils (see "Distribution Coefficient Values Describing Iodine, Neptunium, Selenium, Technetium, and Uranium Sorption to Hanford Sediments" by D.I. Kaplan and R.J. Serne, PNL-10379, Sup. 1 - March 1995. This document as well as others forming the data base for the interim performance assessment are contained in "Data Packages for the Hanford Low-Level Tank Waste Interim Performance Assessment," WHC-SD-WM-RPT-166, Rev. 0 - August 1995). Subsequent measurements and reanalysis confirmed that a non-zero Kd is appropriate for Hanford soils, although the value of 3 may be a bit too high.

   Argonne National Laboratory is measuring Tc release from LD6-5412 glass this year. Both Argonne and Pacific Northwest National Laboratories will measure release rates of actual vendor glasses made using actual Hanford tank waste starting next year.

3. *The comments state that dose conversion factors in the interim performance assessment appear to be low compared to other arid sites and should be documented.* The dose conversion factors are documented in "Data and Assumptions for Estimates of Radiation Doses for the Glass Low-Level Waste Interim Performance Assessment, P.D. Roadman, WHC-SD-WM-TI-707 - June 1995. This document as well as others forming the data base for the interim performance assessment are contained in "Data Packages for the Hanford Low-Level Tank Waste Interim Performance Assessment," WHC-SD-WM-RPT-166, Rev. 0 - August 1995). The values used are consistent with the values used in other Hanford risk assessments. Both the values and methods used were reviewed by the Hanford Environmental Dose Oversight Panel.

4. *The comments note that the surface area to volume of the waste form should increase with time due to corrosion and cracking.* As noted in the performance assessment, the simple assumption of uniform decrease in dimensions were used. As more is known about the waste form and its processing, cracking and other events will be included into the performance assessments.

5. *The comments note that interim performance assessment used point values and provided sensitivity studies. The comments suggest that an uncertainty analysis be performed.* The interim performance assessment was produced into order to provide confidence that the disposal of Hanford low-activity tank waste could be performed. Because it was produced so early in the project, many items (waste form, disposal facility location and design) were not known. Reasonable assumptions based on other projects were used for the estimation of values for the base case. Sensitivity cases were defined to determine the impact of these assumptions. For the performance assessments to be submitted for regulatory review, uncertainty analyses will be done.

6. *The comments note that the surface barrier is assumed to be intact for 1,000 years and that the concrete structure for 500 years.* Neither the surface barrier nor the concrete structures have been designed. The results from sensitivity studies assuming no credit for

such structures are very little different from the base case where credit for such structures is taken. The parameters (including design life) for the surface barrier come from work on the Hanford barrier ("Prototype Hanford Surface Barrier: Design Basis Document," D.R. Myers and D.A. Duranceau, BHI-0007 - November 1994). Research on the Hanford surface barrier is continuing. As the design of the disposal facility progresses, analyses to determine the degradation of the structure will occur. However, until design does start, assumptions based on other projects were thought suitable for the interim performance assessment.

7. *The comments suggest that the infiltration rates are not adequately justified. The effect of lateral subsurface flow during storms has been neglected.* The rates were taken from "Estimate of the Natural Ground Water Recharge for the Performance Assessment of a Low-Level Waste Disposal Facility at the Hanford Site" by M.L. Rockhold, M.J. Fayer, C.T. Kincaid, and G.W. Gee, PNL-10508, March 1995. (This document as well as others forming the data base for the interim performance assessment are contained in "Data Packages for the Hanford Low-Level Tank Waste Interim Performance Assessment," WHC-SD-WM-RPT-166, Rev. 0 - August 1995). The value for the first 1,000 years is based on the design specifications of the Hanford surface barrier. Testing of this surface barrier is continuing at Hanford and so far is meeting its specifications (even under precipitation rates of three times normal). The long-term infiltration rates are based on an extensive program at Hanford which has been very favorable reviewed by outside groups. The results of a program including long-term tracer measurements, lysimeter measurements, and computer simulations will be used in the performance assessments created for regulatory review.

   The cause of infiltration at the Hanford Site has been extensively studied. Lateral flow is seen at Hanford but its cause is suspected to be from geologic and hydraulic phenomena (non-horizontal layers, anisotropic hydraulic tensors) rather than storm related events. Since a disposal site is selected, characteristic of vadose zone properties will allow a better answer to these concerns.

8. *The comments indicate that the release calculations are unrealistic because they are based on dissolution is still water.* Because of the low infiltration rates, the waste if not in still water is in an environment in which the water hardly moves. The base analysis case assumes the forward rate of glass dissolution provides the maximum rate since it is based on distilled water. Moreover, the simulations of glass dissolution do assume flowing water but at rates consistent with water infiltration. These calculations show that the system is diffusion dominated with a very small advective component.

9. *The comments note that the contaminants are assumed to be diluted using the area of the disposal facility, not of the waste packages.* The computer model used in the base analysis case was a full facility model. The results of these simulations clearly show that the water and contaminants do spread laterally enough to cover the gaps between vaults in the alternate layout design. In fact, the calculations are conservative, since the lateral dispersion will extend beyond the area of the disposal facility.

10. *The comments note that the vadose zone modeling neglects heterogeneity within layers.* This is true. The site of the disposal action not yet been determined. Once the site(s) have been determined, then site characterization will be performed. The effect of any preferred flow paths will be determined.

ATTACHMENT 2

LETTER REQUEST

(without attachment)

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

NOV 07 1996

96-TWR-020

Mr. Carl Paperiello, Director
Office of Nuclear Materials Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Paperiello:

CLASSIFICATION OF HANFORD LOW-ACTIVITY TANK WASTE FRACTION

References:
1. Letter from A. J. Rizzo, RL, to Robert M. Bernero, NRC, (No Subject Given) dated March 6, 1989.
2. NRC letter from Robert M. Bernero, to A. J. Rizzo, RL, (No Subject Given) dated September 26, 1989.
3. Federal Register, Volume 58, 12342 dated March 4, 1993.
4. NRC letter from Robert M. Bernero, to Jill Lytle, HQ, (No Subject Given) dated March 2, 1993.

The purpose of this letter is to request your agreement that the Hanford tank waste planned for disposal on-site is incidental waste (i.e., not High-Level Waste [HLW]) that would not be subject to Nuclear Regulatory Commission (NRC) licensing authority.

BACKGROUND

Reference 1 requested NRC's concurrence on classification and disposal of Double-Shell Tank (DST) Waste in grout facilities as Low Level Waste (LLW) instead of HLW, therefore, not requiring NRC licensing authority. Reference 2 provided NRC's agreement that the criteria used by the U.S. Department of Energy (DOE) to classify the Hanford DST wastes, planned for disposal by grouting in near surface vaults as LLW were appropriate; and therefore the grout facility for disposal of this waste would not be subject to NRC licensing authority. In 1990, the States of Washington and Oregon filed a petition for a formal rulemaking which was denied in 1993 (Reference 3). The NRC informed DOE of the petition denial, restated the NRC criteria for determining non HLW, and noted that DOE must communicate with the NRC if any waste may be subject to NRC licensing (Reference 4).

Single-Shell Tank (SST) waste was not included in the previous agreement as its disposition had not then been decided. DOE recently issued a Tank Waste Remediation System Final Environmental Impact Statement with the preferred alternative to dispose of the SST waste in the same manner as the DST waste. A Record of Decision is expected shortly. The plan for treating (processing) and immobilizing the DST waste has also changed since 1989;

therefore, this request seeks NRC's agreement on DOE's proposed waste classification of the low-activity fraction from both the SST and DST waste.

It does not request agreement on classification of any residual waste that may remain in the tanks following waste retrieval. That waste will be addressed in a future request.

DISCUSSION

DOE plans to divide the Hanford tank waste into two fractions, a HLW fraction that will be disposed off-site in a NRC licensed geologic repository and a low-activity waste fraction that will be disposed on-site as LLW. This low-activity fraction will be processed (radionuclides removed), immobilized, and disposed in a manner that meets the NRC's criteria for determining it to be incidental waste. Those criteria (as listed in Reference 4) are:

> "DOE will assure that the waste: (1) has been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical; (2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low level waste as set out in 10 CFR Part 61; and (3) will be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied".

DOE has completed an evaluation of its plans for processing and immobilizing the low-activity waste fraction against the NRC criteria and believes the information in "Technical Basis for Classification of Low-Activity Waste Fraction from Hanford Site Tanks, WHC-SD-WM-TI-699, Rev. 2," dated September 18, 1996, (Attachment) demonstrates that this waste is not HLW subject to NRC licensing authority.

As DOE is planning to privatize tank waste treatment and immobilization, the selection of processes to remove radionuclides from the waste fraction destined to be low-activity waste will be by private companies who will also own and operate the facilities. These facilities will be built on Federal land at Hanford. The radionuclide removal processes have not yet been selected but the processes considered and evaluated in the attachment are believed to be typical of those that will be used; and therefore the determination of technically and economically practical is reasonable. This determination results in less radioactivity remaining in the low-activity fraction from all 177 tanks (i.e., greater separation) than remained from just the 28 DSTs in the 1989 determination. This comparison is shown in Table 5-3 of the Attachment.

The low-activity waste fraction will be incorporated in a solid physical form and will not exceed the applicable concentration limits for Class C LLW as set out in 10 Code of Federal Regulations (CFR) Part 61. The baseline is a vitrified waste form although other waste forms would be acceptable if they

meet the same performance requirements. The radionuclide concentrations in the final waste form are well below class C limits as shown in Table 5-2 of the Attachment

The waste will be disposed on the Hanford Site and managed so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied. DOE requirements for LLW disposal are in DOE Order 5820.2A and are comparable to 10 CFR Part 61. A performance assessment of the waste disposal site is required by DOE Order 5820.2A and an interim one has been completed (Hanford Low-Level Tank Waste Interim Performance Assessment, WHC-EP-0884, dated September 1996) which indicates 10 CFR Part 61 requirements will be met. The compliance time period used in our interim performance assessment is 10,000 years and we assume this period will continue to be a requirement. The low activity waste will be disposed (in a retrievable manner) on the 200 Area Plateau, and as an additional measure of safety, DOE expects to maintain institutional control of this area for the foreseeable future.

Members of our staffs met earlier this year to discuss the classification of the Hanford tank waste. Your agreement is now requested that the low-activity tank waste fraction planned for disposal on the Hanford Site is not HLW subject to NRC licensing. We would appreciate receiving your agreement by April 1997.

If you have questions or need additional information, please contact me on (509) 376-7591 or Don Wodrich of my staff on (509) 376-6550.

Sincerely,

Jackson Kinzer

Jackson Kinzer, Assistant Manager
Office of Tank Waste Remediation System

TWR:DDW

Attachment

cc: w/attach:
S. Dahl, Ecology
R. Stanley, Ecology
L. Hall, LMHC
R. Murkowski, LMHC
C. Peterson, NHC
R. Weller, NRC

ATTACHMENT 3

CHRONOLOGY

CHRONOLOGY OF THE HANFORD INCIDENTAL WASTE CLASSIFICATION ISSUE

I. July 11, 1988, letter from Hugh Thompson, U.S. Nuclear Regulatory Commission, to Michael Lawrence, U.S. Department of Energy (DOE), regarding the June 9, 1988, meeting between NRC and DOE staffs.

Key Issues:

(1) contents of two low-level radioactive waste double-shell tanks (DSTs) to be grouted and disposed of on-site via shallow land burial

(2) contents of two high-level radioactive waste (HLW) DSTs to be vitrified and eventually sent to the geologic repository

(3) further meetings to be held regarding classification of 24 additional DSTs -

(a) single-shell tanks (SSTs) not addressed
(b) need a consensus on the definition of HLW - NRC's definition (10 CFR Part 50) is purely source-based; DOE's definition combines source and activity.

II. November 29, 1988, letter from Ronald Gerton, DOE, to Michael Bell, NRC, requesting concurrence that the DST waste planned for disposal by grouting in near-surface vaults is not HLW, and that NRC licensing is not required.

Proposed approach to classifying DST wastes: use an overall material balance of tank waste at the Hanford site to demonstrate that the largest practical amount ($\geq$ 90 percent) of total site activity attributable to "first-cycle solvent extraction" has been segregated so that only the residuals will be grouted.

III. March 6, 1989, letter from A.J. Rizzo, DOE, to Robert Bernero, NRC, stating that the DST waste planned for disposal in near-surface vaults is not HLW, and that NRC licensing is not required. The letter requested NRC concurrence on the stated position.

IV. SECY-89-164, "Classification and Disposal of the Hanford Tank Wastes," dated May 30, 1989, requesting that the Commission approve the transmittal of an enclosed letter dated September 25, 1989, which is summarized below.

V. August 11, 1989, letter from Michael Bell, NRC, to Ronald Gerton, DOE, enclosing the minutes for the August 8, 1989, meeting on classification and disposal of Hanford DST wastes.

Key discussion points:

(1) The States of Washington and Oregon, and the Yakima Indian Nation raised the following concerns:

(a) NRC should maintain an ongoing role over the clean-up operation at the Hanford site to verify that the largest practical amount of total site activity from HLW is isolated for disposal in a deep geologic repository.
(b) The public should have an opportunity to comment on the proposed approach for classifying the Hanford DST wastes.

(2) The staff presentation addressed NRC statutory authority, the classification of HLW, and NRC's views on the concept of incidental waste. The process for determining that residual wastes can be considered incidental waste is as follows:

(a) perform an overall material balance for HLW at the Hanford site;
(b) demonstrate that the largest practical amount ($\geq$ 90 percent) of total site activity attributable to HLW has been isolated for disposal in a deep geologic repository; and
(c) any residual waste should be only moderately radioactive.

VI. September 25, 1989, letter from Robert Bernero, NRC, to A.J. Rizzo, DOE, regarding the March 3, 1989, letter request for concurrence.

"NRC agrees that the criteria used for classification of the grout feed as LLW are appropriate."

This letter also endorses DOE's plans to sample and analyze the grout feeds before disposal and notes that NRC intends "...to defer judgment on the classification of SST waste until after DOE has completed its program of characterizing that waste."

VII. January 2, 1990, petition (revised and resubmitted on July 27, 1990) from the States of Washington and Oregon requesting that "...the Commission revise the definition of HLW so as to establish a procedural framework and substantive standards by which the Commission would determine whether reprocessing waste...is HLW and, therefore, subject to the Commission's licensing authority."

VIII. Petition was denied on February 26, 1993 (States of Washington and Oregon: Denial of Petition for Rulemaking [7590-01-P]).

"The petition is being denied because the NRC concludes that the principles for waste classification are well established and can be applied on a case-by-case basis without revision to the regulation."

IX. March 2, 1993, letter from Robert Bernero, NRC, to Jill Lytle, DOE, stating that NRC would regard the residual fraction of the separated DST wastes as "incidental," provided "that the waste:

(1) has been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical;

(2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR Part 61; and

(3) will be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied."

The letter also enclosed a copy of the petition denial.

X. July 23, 1996, meeting between members of the Division of Waste Management and DOE representatives to discuss the Hanford Tank Waste Remediation System, a plan for treatment and ultimate disposition of the HLW currently stored in both SSTs and DSTs. DOE intends to retrieve the tank waste and separate it into a HLW portion, to be vitrified, and into a low-activity portion, also to be vitrified. The low-activity waste is intended to be classified as "incidental," based on the three criteria in the March 1993 letter from Bernero to Lytle.

XI. November 7, 1996, letter from Jackson Kinzer, DOE, to Carl Paperiello, NRC, requesting agreement that the Hanford tank waste planned for disposal on-site is incidental waste that would not be subject to NRC licensing authority.

XII. February 6, 1977, letter from Michael Bell, NRC to Donald Wodrich, DOE, Request for Additional Information.

XIII. February 18, 1977, letter from Don Wodrich, DOE, to Michael Bell, NRC, responding to Request for Additional Information.

ATTACHMENT 4

LETTER FROM R. BERNERO TO J. LYTLE

OMMISSION
555

MAR 0 2 1993

Ms. Jill Lytle
Deputy Assistant Secretary for Waste Operations
Office of Waste Management
Environmental Restoration
and Waste Management
U.S. Department of Energy
Washington, D.C. 20585

Dear Ms. Lytle:

Members of the Nuclear Regulatory Commission staff appreciated the opportunity to meet with the Department of Energy (DOE) staff, DOE contractors, and other parties on July 16, 1992, to review new waste characterization data and current DOE plans for management of radioactive tank waste at Hanford. The purpose of this letter is to provide DOE with the staff's assessment of that information as it relates to DOE's program to classify, process, and dispose of Hanford tank wastes. We are also taking this opportunity to respond to the related November 4, 1992, letter from Leo P. Duffy to Chairman Ivan Selin.

During the meeting, DOE presented revised tank waste inventory estimates, based on current characterization data. The information indicated that the double-shell tank activity that would be grouted in near-surface vaults is within earlier range estimates. The NRC staff is concerned, however, that Cs-137 quantities are now near the upper end of the range, rather than at the lower end, as previously believed, especially given that DOE indicated that uncertainties associated with the activity estimates remain because of the limited sampling and analysis that has been conducted to date. Consequently, we encourage DOE to examine available mechanisms for achieving greater radionuclide separation.

In presenting its current plans for waste management, DOE outlined its intention to complete, by March 1993, a broad reevaluation of various treatment options for both single and double-shell tanks. These options include a new facility to be used to separate radionuclides for repository disposal of high-level radioactive waste (HLW).

As you recall, NRC indicated to DOE, in 1989, its agreement that the criteria DOE used for classification of grout feed as low-level waste were appropriate, and, consequently, that the grout facility for disposal of double-shell tank

waste would not be subject to our licensing authority (R. Bernero, NRC letter to A. Rizzo, DOE, September 25, 1989). This agreement was predicated on our understanding that DOE would segregate the largest practical amount of the total site activity attributable to "first-cycle solvent extraction, or equivalent" for disposal as HLW, leaving behind only a small fraction of moderately radioactive material.

The Commission has recently completed its review of a rulemaking petition from the States of Washington and Oregon on the subject of the double-shell tank wastes and has indicated, in the enclosed petition denial, that it would regard the residual fraction as "incidental" waste, based on the Commission's understanding that DOE will assure that the waste: (1) has been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical; (2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR Part 61; and (3) will be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied.

It is therefore essential, in the light of this position, that DOE's present reevaluation of tank waste remediation options, and subsequent periodic evaluations as may be conducted, include the application of these principles. We recognize that there may be significant economic, programmatic, and safety factors affecting the remediation program, but the consideration of such factors as they may relate to the possible jurisdiction of NRC should be made clear.

If during your periodic evaluations, it becomes apparent to you that any wastes may be subject to NRC licensing, it will be necessary for you to communicate that concern to NRC. It will then be necessary to determine what form of pre-licensing interactions, analogous to repository site characterization, would be needed to define the appropriate disposition of these wastes. We expect that DOE will document the results of the analyses supporting its conclusions and that this documentation will be adequate for an NRC review, should that be appropriate. We believe it would be prudent for any such documentation to be developed with good record-keeping and under an adequate quality assurance process.

I trust that this letter and the enclosed petition denial provide the information requested in Leo P. Duffy's November 4, 1992, letter to Chairman Ivan Selin, regarding NRC's intended response to the rulemaking petition by

the States of Washington and Oregon. If you have any further questions, please feel free to contact me, at 301-504-3352, or B.J. Youngblood, Director of the Division of High-Level Waste Management, at 301-504-3404.

Sincerely,

Robert M. Bernero, Director
Office of Nuclear Material Safety
and Safeguards

Enclosure
Petition Denial

cc: J. Tseng, DOE-EM-36
J. Anttonen, DOE
L. Barrett, DOE-RW-1
P. Grimm, DOE-EM-1
D. Duncan, EPA
R. Stanley, Washington State
J. Franco, Oregon State
R. Jim, YIN

[7590-01-P]

NUCLEAR REGULATORY COMMISSION

10 CFR Part 60

Docket No. PRM-60-4

States of Washington and Oregon: Denial of Petition for Rulemaking

AGENCY: Nuclear Regulatory Commission.

ACTION: Denial of petition for rulemaking.

SUMMARY: The Nuclear Regulatory Commission (NRC) is denying a petition for rulemaking (PRM-60-4), submitted by the States of Washington and Oregon, which deals with the process and criteria for classifying radioactive waste materials at defense facilities as high-level radioactive waste (HLW) or as non-HLW. (As noted in the petition, certain facilities for the storage of HLW are subject to NRC licensing authority.) The petition is being denied because the NRC concludes that the principles for waste classification are well established and can be applied on a case-by-case basis without revision to the regulations.

ADDRESSES: Copies of the petition for rulemaking, the public comments received, and the NRC's letter to the petitioner are available for public inspection or copying in the NRC Public Document Room, 2120 L Street, NW. (Lower Level), Washington, DC.

FOR FURTHER INFORMATION CONTACT: Naiem S. Tanious, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 492-3878.

SUPPLEMENTARY INFORMATION:

I. The Petition

The States of Washington and Oregon, and the Yakima Indian Nation, initially submitted a petition for rulemaking on this subject on January 2, 1990. On February 7, 1990, the NRC staff conferred with the petitioners as contemplated by Paragraph (b) of 10 CFR 2.802. In response to suggestions by the NRC staff, the petition was clarified and resubmitted (by the States of Washington and Oregon) on July 27, 1990.

On December 17, 1990, the Nuclear Regulatory Commission published a notice of receipt of the petition for rulemaking (55 FR 51732). The petition requested that the Commission revise the definition of "high-level radioactive waste" (HLW) so as to establish a procedural framework and substantive standards by which the Commission will determine whether reprocessing waste, including in particular certain waste stored at the U.S. Department of Energy's (DOE) site at Hanford, Washington, is HLW and, therefore, subject to the Commission's licensing authority.

The petitioners request that the Commission amend 10 CFR 60.2 to clarify the definition of HLW and the definition of "HLW facility." The petitioners specifically request that the Commission:

1. Establish a process to evaluate the treatment of defense reprocessing wastes in tanks so that such wastes will not be considered HLW if, prior to disposal, each tank is treated to remove the largest technically achievable amount of radioactivity; and

2. Require that the heat produced by residual radionuclides, together with the heat of reaction during grout processing (if employed as a treatment technology), will be within limits established to ensure that grout meets temperature requirements for long-term stability for low-level waste forms.

The petitioners state that the petition for rulemaking is based, in part, on Section 202 of the Energy Reorganization Act of 1974 (ERA), which provides for the Commission to exercise licensing and related regulatory authority over "facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive wastes generated by [DOE] which are not used for, or are part of, research and development activities."

According to the petitioners, the legislative history of the ERA reveals that Congress intended the Commission to license defense reprocessing tank wastes at the point of long-term storage or disposal. The petitioners note that "low-fraction wastes" resulting from pretreatment of tank wastes are scheduled to be grouted and disposed of in land-based grout vaults on the Hanford site in accordance with regulations developed under the Resource Conservation and Recovery Act (RCRA). The petitioners believe that if these wastes are HLW, they clearly fall under the Commission's licensing jurisdiction under Section 202(4) of the Energy Reorganization Act of 1974 (42 USC 5842(4)).

The petitioners acknowledge that the present definition of HLW in the Commission's regulations is based upon the source of the waste, and that

"incidental waste" generated in the course of reprocessing is not HLW. (The latter point is evident from the proposal to amend 10 CFR 60.2 to provide that a residual fraction would be "considered an incidental waste and, therefore, not HLW.") The petitioners claim, however, that wastes stored in tanks at Hanford cannot practicably be classified as incidental waste (as opposed to HLW) because the tanks contain a mixture of wastes from a number of sources, including reprocessing of reactor fuel. Moreover, the petitioners state that radionuclide inventories are estimates subject to substantial uncertainty, owing to lack of accurate records. Further, the petitioners assert that neither DOE, the Commission, nor the petitioners have adequate information regarding the source and composition of the tank waste. Hence, the petitioners believe that the Commission needs to establish both a procedure and a standard for making an evaluation as to whether wastes are HLW on a tank-by-tank basis.

The petitioners assert that the proposed amendment is essential to provide protection of the future health and safety of the citizens of the Pacific Northwest.

II. Classification of DOE Reprocessing Wastes

At Hanford and other sites, questions have arisen regarding the classification of reprocessing wastes for which DOE must provide disposal. In the long-standing view of the Commission, these questions must be resolved by examining the source of the wastes in question. The reason for this is that when Congress assigned to NRC the licensing authority over certain DOE facilities for "high-level radioactive wastes," the Congress was referring to

those materials encompassed within the meaning of the term "high-level radioactive waste" in Appendix F of 10 CFR Part 50. (For a full statement of this position, see the discussion presented in the Commission's advance notice of proposed rulemaking, "Definition of High-Level Radioactive Waste" (52 FR 5993, February 27, 1987).) Accordingly, any facility to be used for the disposal of "those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent ..." as HLW is defined in Appendix F to Part 50, must be licensed by the NRC. Most of the waste storage tanks at Savannah River (South Carolina), West Valley (New York), and Hanford contain wastes that meet this definition, and the facilities to be used for disposal of these wastes are, therefore, potentially subject to NRC licensing jurisdiction.

However, when the Appendix F definition was promulgated, the Atomic Energy Commission specifically noted that the term HLW did not include "incidental" waste resulting from reprocessing plant operations, such as ion exchange beds, sludges, and contaminated laboratory items, such as clothing, tools, and equipment. Neither were radioactive hulls and other irradiated and contaminated fuel structural hardware encompassed by the Appendix F definition. Under the same reasoning, as the Commission has previously indicated, incidental wastes generated in further treatment of HLW (e.g., salt residues or miscellaneous trash from waste glass processing) would be outside the Appendix F definition.

In the cases of Savannah River and West Valley wastes, DOE plans to retrieve the wastes from their storage tanks and to separate essentially all of the radioactive materials for eventual disposal in a deep-geologic HLW

repository.[1] Accordingly, the projected recovery of HLW from the wastes in tank storage at those sites will be sufficiently complete that the decontaminated salts and other residual wastes are classified as "incidental" (i.e., non-HLW). The NRC will have no regulatory authority, under Section 202 of the Energy Reorganization Act, over DOE's facilities to be used for processing and disposal of the incidental waste.

At Hanford, DOE plans to process the wastes presently stored in double-shell tanks in a manner similar to that planned for the wastes at Savannah River and West Valley. Such processing would separate most of the radioactive constituents of the wastes for eventual deep-geologic repository disposal and, the residual salts would be disposed of onsite in a shallow, near-surface concrete-like grout facility. (Plans for processing of single-shell tank wastes have been deferred.) However, classification of the Hanford double-shell tank wastes has proven more difficult than classification of Savannah River and West Valley wastes. At Hanford, many of the primary reprocessing wastes were generated using older separation technologies, which resulted in substantial dilution of those wastes with nonradioactive materials. In addition, many of the tanks at Hanford contain mixtures of wastes from both reprocessing sources and other sources. Finally, recordkeeping at Hanford was not always thorough enough to allow precise determinations of the origins of the wastes now present in specific tanks at

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[1]See 52 FR 5992, February 27, 1987 (definition of "high-level waste"), n. 1, where the Commission characterizes as "incidental waste," the decontaminated salt with residual activities on the order of 1,500 nCi/g Cs-137, 30 nCi/g Sr-90, 2nCi/g Pu, as described in the Department of Energy's FEIS on long-term management of defense HLW at the Savannah River Plant, DOE/EIS-0023, 1979. Although an EIS has not yet been published for the West Valley Demonstration Project, preliminary estimates indicate the likelihood of an equivalent degree of separation.

Hanford. For these reasons, some of the Hanford tank wastes cannot be readily classified as either HLW or incidental wastes using only the definitions and concepts discussed above.

Taking into account these uncertainties and their implications with respect to NRC jurisdiction, the NRC and DOE staff held several meetings to explore the situation in detail. A principal objective of these meetings was to ascertain, to the extent practicable, whether some or all of the wastes should be regarded as HLW and whether, on the other hand, some or all of the wastes should be classified as non-HLW. Several things became clear as a result of these meetings.

First, management records were adequate for DOE to determine that two double-shell waste tanks do not contain wastes from reprocessing of reactor fuels. Therefore, these wastes clearly do not contain HLW within the Appendix F definition. The NRC agreed with DOE that any disposal facility intended exclusively for these wastes would not be subject to NRC licensing authority.

Second, DOE has carried out a "material balance" analysis of waste management activities at Hanford. This analysis estimated the total amount of "first cycle reprocessing wastes" generated at Hanford and, to the extent practical, the current location of those wastes. The DOE proposed onsite grout disposal of the residual waste from the double-shell tank waste processing would be only a small fraction of the reprocessing wastes originally generated at the site.

Finally, DOE studied possible technologies for additional waste processing, and agreed to remove the largest practical amount of radioactive material from double-shell tank wastes prior to disposal in onsite grout

facilities. This commitment by DOE, coupled with the material-balance study indicating that most of the originally-generated radioactive material would be recovered, led the NRC staff to conclude that the residual waste material should be classified as incidental waste, since they are wastes incidental to the process of recovering HLW. With this classification, DOE could proceed with onsite disposal of such incidental wastes in a grout facility without licensing by the NRC. It should be noted that if the DOE processing operations go as planned, the residual activity of these incidental wastes would be below the concentration limits for Class C wastes under the waste classification criteria of 10 CFR Part 61.

Following its review, the NRC staff, by letter dated September 25, 1989, from R. M. Bernero, Director, Office of Nuclear Material Safety and Safeguards, NRC, to A. J. Rizzo, Assistant Manager for Operations, Richland Operations Office, DOE, endorsed DOE's plans to sample and analyze the grout feeds before disposal in an effort to control the final composition of the grout feed. However, the staff indicated that if DOE were to find, in the course of conducting the sampling program, that the inventories of key radionuclides entering the grout facility are significantly higher than previously estimated, DOE should notify the NRC and other affected parties in a timely manner.

It should be noted that the appropriate classification of some Hanford wastes remains to be determined -- specifically, any single-shell tank wastes, and any empty but still contaminated waste tanks DOE might dispose of in-place. For both types of wastes, a case-by-case determination of the appropriate waste classification might be necessary.

III. Discussion

The petition for rulemaking presents two basic issues. The question is not whether "high-level waste" should be interpreted by reference to the source-based concepts derived from Appendix F to 10 CFR Part 50. The petitioners agree that this is proper. Nor is there any fundamental challenge to the concept that "incidental wastes" are excluded from the definition of "high-level waste." The issues are much narrower ones. The first issue is a substantive one -- the criteria to be applied in differentiating incidental waste from high-level waste. The second issue is a procedural one -- the process that should be employed by the Commission in arriving at a judgment whether or not it has jurisdiction over particular facilities. These will be addressed in turn.

A. The Standard for Classification

We first address the standard that should be employed in distinguishing high-level waste from incidental waste. In doing so, we strive to apply the policies that underlie the adoption of Appendix F to 10 CFR Part 50 (and, hence, Section 202 of the Energy Reorganization Act).

The petitioners suggest that the proper standard, to be applied on a tank-by-tank basis, is to consider all processing streams to be high-level waste unless they have been treated, prior to disposal, "to remove the largest technically achievable amount of radioactivity." Adoption of such a criterion would certainly serve the goal, which had been contemplated by the Commission, of removing the hazardous process streams to a geologic repository for

permanent storage. It is not the only standard, however, that would suffice for this purpose, particularly when it is viewed in a broader regulatory context.

The clearest expression of the overall regulatory objectives is the Atomic Energy Commission's (AEC's) explanatory statement when it promulgated Appendix F -- namely, "that the public interest requires that a high degree of decontamination capability be included in such facilities and that any residual radioactive contamination after decommissioning be sufficiently low as not to represent a hazard to the public health and safety." 35 FR 17530, November 14, 1970. As we read the AEC's intent, the reference to "a high degree of decontamination capability" leaves a substantial degree of discretion. It certainly does not rule out consideration of economic factors as well as technical ones. It was the AEC's contemporaneous practice to consider financial impacts as, for example, in controlling releases of radioactive materials from licensed facilities to the lowest levels "technically and economically practical." AEC Manual Chapter 0511. When the AEC spoke of a "high degree" of decontamination capability, we believe that it was guided by similar considerations. Moreover, from a policy standpoint, this makes good sense, for so long as there is adequate protection of public health and safety, it would not be prudent to expend potentially vast sums without a commensurate expectation of benefit to health and the environment.

Achieving a "high degree of decontamination capability" implies, then, that the facility should separate for disposal as much of the radioactivity as possible, using processes that are technically and economically practical. In addition, however, as the AEC's statement indicates, the residual radioactive

contamination should be sufficiently low as not to endanger public health and safety.

These principles -- high decontamination capability and protection of health and safety -- are the essential benchmarks that have influenced the development of NRC's position vis-a-vis DOE on the question of the proper classification of the tank wastes and grout at Hanford.

When the question regarding classification of wastes was first raised, the NRC staff identified to DOE some approaches that might be used in distinguishing HLW from incidental waste. One approach was expressed as follows:[2]

> As an alternative approach, we suggest that DOE attempt an overall material balance for HLW at the Hanford site, using the source-based meaning of HLW. It is hoped that this approach might provide a more efficient means of identifying those wastes subject to licensing by NRC under terms of the 1974 Energy Reorganization Act. Under this approach, if DOE could demonstrate that the largest practical amount of the total site activity attributable to "first-cycle solvent extraction" wastes has been segregated for disposal as HLW, then NRC would view the residual as a non-HLW. We would anticipate that at least 90 percent of the activity would have been separated in this way. Thus, if it can be shown that DOE has processed the waste with the intent to dispose of the HLW in a repository or other appropriate licensed facility, leaving

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[2]Letter from Michael J. Bell, Chief, Regulatory Branch, Division of Low-Level Waste Management and Decommissioning, Office of Nuclear Material Safety and Safeguards, NRC, to Ronald E. Gerton, Director, Waste Management Division, Richland Operations Office, DOE, November 29, 1988. The letter included some "suggested criteria" involving a "good faith" effort to achieve isolation of HLW from nonradioactive salts, such an effort to be judged, as a practical matter, by considering (among other things) alternative separation processes.

behind only a small fraction of only moderately radioactive material, then the goals stated in 10 CFR Part 50 Appendix F and incorporated in the Energy Reorganization Act would have been satisfied; and the disposal of the residual would accordingly not be subject to NRC licensing.

In response, DOE considered the practicality of various waste processing alternatives and presented the results of its study by letter dated March 6, 1989.[3] The results were also presented at a meeting among interested parties, including the petitioners, held on August 4, 1989. (Minutes of the meeting are available for public inspection in the NRC Public Document Room) DOE's "baseline" disposal plans would have recovered all but about 12-13 million curies of cesium-137, together with lesser activities of strontium-90, transuranics, and other radionuclides.[4] DOE's study indicated the practicality of removing an additional 6 million curies of cesium-137 for repository disposal. DOE proposed to remove this additional 6 million curies of cesium-137. DOE also identified additional treatment alternatives, with their associated costs, which it viewed as not being economically practical. DOE's material balance showed that, after the residue from the double-shell tank wastes is grouted, 2 to 3 percent of the key radionuclides which originally entered all Hanford tanks would be disposed of as LLW in near-surface vaults. The concentrations of radionuclides in the grout would be

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[3]Letter from A. J. Rizzo, Assistant Manager for Operations, Richland Operations Office, DOE, to Robert M. Bernero, Director, Office of Nuclear Materials Safety and Safeguards, NRC, March 6, 1989.

[4]DOE noted in the March 6, 1989 letter from Rizzo to Bernero that, based on limited available analytical data, the total cesium-137 could be as much as 20 million curies versus the 12-13 million estimate.

comparable to Class C for cesium and transuranic wastes, and to Class A or B for the remainder.[5] DOE also noted certain engineering and institutional factors that might compensate, especially as to potential intrusion hazards, for the possibility that the total amount of waste that would be grouted would be greater than the amount of Class C waste that might be contained in a typical commercial burial ground.

Based on its review of DOE's March 6, 1989 submission, the NRC staff concluded that DOE's proposed processing would remove the largest practical amount of total site activity, attributable to HLW, for disposal in a deep geologic repository. This finding was based on (1) past and planned treatment of the tank wastes; (2) radionuclide concentration and material balance; and (3) cost-effectiveness of additional radionuclide removal. These conclusions reflected DOE's undertakings both to achieve a high degree of separation and to provide protection of public health and safety. As a result, the staff concluded that the expected residual waste would not be high-level waste and would thus not be subject to NRC licensing authority. The staff thereupon advised DOE that NRC agreed that the criteria used by DOE for classification of the grout feed are appropriate and that the grout facility for the disposal

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[5] NRC understood this statement to connote that cesium-137 and transuranic radionuclides in the residual waste would be less than the concentration limits for Class C low-level waste, as defined in NRC's requirements in 10 CFR Part 61, and that the concentration of other radionuclides would be less than the concentration limits for Class A or B low-level waste.

of the double-shell tank waste would not be subject to NRC licensing authority.[6]

At a meeting in Richland, Washington on July 16, 1992, DOE staff presented more detailed double-shell tank waste processing options and, based on recent analyses, summarized available information on the characteristics of waste within the tanks. DOE's current estimate of the total amount of radioactivity proposed for disposal in grout in near-surface vaults is within earlier range estimates but is now believed to be nearer the upper end of the range. DOE also clarified its intention to apply criteria comparable to the Performance Objectives set out in 10 CFR Part 61. Among other things, these performance objectives include numerical radiation exposure limits for protection of the general population from releases of radioactivity and requires a design to achieve long-term stability of the disposal site.

DOE intends to complete a reassessment of the tank waste processing options by March 1993. This reassessment, the NRC staff understands, will include a reexamination of the practicality of achieving higher degrees of separation, particularly with respect to those tanks that contain substantial quantities of key radionuclides.

Assuming implementation of DOE's plans as described above, the Commission concludes that any radioactive material from the double shell tanks that is deposited in the grout facility would not be high-level radioactive

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[6]Letter from Robert M. Bernero, Director, Office of Nuclear Material Safety and Safeguards, NRC, to A. J. Rizzo, Assistant Manager for Operations, Richland Operations Office, DOE, September 25, 1989. The letter also called upon DOE to advise NRC periodically of the analytical results of samples of key radionuclides entering the grout facility, so that the classification of the waste might be reconsidered if the inventories were significantly higher than DOE had estimated.

waste subject to NRC's licensing jurisdiction. The responsibility for safely managing those wastes rests with the Department of Energy. The basis for the Commission's conclusion is that the reprocessing wastes disposed of in the grout facility would be "incidental" wastes because of DOE's assurances that they: (1) have been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical; (2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR Part 61; and (3) are to be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61 are satisfied.

The petitioners also requested that the Commission exercise oversight to assure that the grout meets temperature requirements for low-level waste forms. They acknowledge that DOE's vault design is protective of human health and the environment if heat produced by residual radioactivity, together with heat generated from reactions during the grout process, is kept within defined limits. They present no technical data to suggest that achievement of these temperature controls presents any unusual engineering challenge. In any event, inasmuch as the Commission does not consider the grout produced in accordance with DOE's plans to be high-level waste, it does not have the authority to carry out this oversight function.

B. Procedural Issues

1. Whether Rulemaking Is Necessary and Desirable

The petitioners urge that the Commission initiate rulemaking procedures that would result in the establishment of substantive criteria for determining whether particular radioactive wastes either are or are not high-level waste. Generally, a decision whether to proceed by rulemaking (as requested) or to make determinations in individual, ad hoc litigation lies within the informed discretion of the cognizant administrative agency. Rulemaking is most appropriate where an agency seeks to establish a general principle, having prospective effect, to be applied in a wide variety of factual contexts. Where the issue before an agency involves the application of law to a very specific existing fact situation, especially where that situation is not representative of other matters that may need to be decided by the agency, then it is clearly more efficient and more to the point to decide by a process of adjudication (i.e., on a case-by-case basis).

Applying these principles to the petition at hand, the Commission has little difficulty in concluding that rulemaking is neither necessary nor desirable. Reprocessing wastes are located at only four principal locations in the United States. The Commission has previously determined that the residual contamination anticipated from proposed operations at Savannah River should be characterized as incidental waste and not high-level waste (see 52 FR 5993, Feb. 27, 1987, cited above, at footnote 1.) Wastes generated at the Idaho Chemical Processing Plant are markedly different from those at Hanford and Savannah. Therefore, if questions about classification of the

Idaho wastes should arise, precedents established at Savannah River and Hanford might be difficult to apply. Any wastes at the Western New York Nuclear Service Center will require treatment in accordance with the applicable provisions of the West Valley Demonstration Project Act.

The limited practical effect of the decision -- i.e., restricted to the Hanford tanks -- is reason enough to proceed by way of adjudication instead of rulemaking. The Commission is persuaded further by the need to avoid making premature decisions with respect to the wastes stored at Hanford in single-shell tanks that are not the subject of pending treatment plans. If the Commission were to establish rules to apply to the wastes remaining in those tanks, our inquiry would have to be greatly broadened; and it might become necessary to consider a wide range of situations that might or might not ever come to pass in the future.

2. Whether the Commission Is Adequately Informed

Petitioners suggest that their proposed procedures, which include detailed tank-by-tank assessments, are necessary to ensure confidence in the treatment process employed by DOE and to build confidence that the treatment standard is being met.

The issue to be decided by the Commission is a much narrower one: it is merely to determine whether the activities being undertaken by the Department of Energy fall within the NRC's statutory jurisdiction. As in the case of other persons whose activities may fall within our regulatory sphere, the Commission may from time to time demand information so as to be able to determine whether or not to initiate an enforcement action. The NRC staff has

acted in this manner in its inquiries to DOE. It has obtained and evaluated information that is relevant and material to a determination whether or not the proposed activities of the DOE are subject to NRC licensing jurisdiction. All the information obtained and evaluated has been made available contemporaneously to the public.

Moreover, as a practical matter, NRC recognized the uncertainties associated with the projected radionuclide inventories in the tank wastes and endorsed DOE plans for sampling and analyzing the grout feeds before disposal. The objective of these efforts is to control the final composition of the grout wastes. If DOE finds that it can no longer assure that these wastes will be managed in accordance with the criteria previously discussed, DOE should notify NRC.

If a standard of "largest technically achievable amount .... will be isolated" were to be applied, then the facts submitted by DOE might not be sufficient to conclude that NRC lacked jurisdiction. However, the proper standard includes considerations of economical practicality as well. As indicated in an earlier part of this decision, the Commission has obtained information that is sufficient for this purpose.

3. Future Adjudications

The petitioners contemplate that if a rule were to be adopted in accordance with their proposal, particular determinations of how specific wastes would be characterized would be "left to individual adjudicative proceedings." The NRC infers that the "proceedings" contemplated by petitioners are licensing activities of the kinds specified in Section 189 of

the Atomic Energy Act, as amended, 42 USC 2239. Adjudications in this type of proceeding are in some cases to be conducted in accordance with the hearing provisions of Subpart L of 10 CFR Part 2.

These procedures are often appropriate with respect to activities that are subject to NRC regulatory and licensing authority. However, the NRC is reluctant to employ them in the context that is proposed -- to determine whether NRC has jurisdiction in the first place. To do so would entail the conduct of an adjudicatory proceeding in order to see whether another adjudicatory licensing proceeding must be held. More importantly, the Commission considers that the existing record contains all the factual information needed for a decision and that no unresolved material factual issues remain that would require further proceedings.

4. Other Considerations

While both NRC and DOE have focused their attention upon the meaning of the statutory term "high-level waste" and its application to the materials in storage at Hanford, other considerations might come into play in determining whether or not DOE activities are subject to licensing. In particular, it should be recalled that NRC exercises licensing authority under Section 202(4) only as to "facilities authorized for the express purpose of subsequent long-term storage of [DOE-generated] high-level waste." The content of individual waste tanks is by no means dispositive of the question whether the facilities for storage of the treated waste are subject to licensing. A number of other factors may be relevant and material as well: (1) what are the limits, geographically and functionally, of "facilities"; (2) have those facilities

been "authorized" (and by whom is such authorization required); and (3) have those facilities been authorized "for the express purpose of subsequent long-term storage of high-level waste" where those who may authorize the facility make no express mention of high-level waste? It is not necessary for the Commission to address these questions at length in order to dispose of the pending petition.

IV. Public Comments on the Petition

The NRC received letters from 12 commenters. Two letters were from other Federal agencies, two were from public interest groups, one was from a nuclear industry corporation, and seven were from private individuals. Most comments were opposed to the petition.

A. Process and Standards Proposed in Petition

Several comments expressed concern that granting the petition would have an adverse effect on the timely disposal of radioactive waste at Hanford. This was a concern because many of the Hanford waste tanks were seen as nearing or exceeding their design life. The provisions of the rulemaking proposed in the petition were viewed as limiting DOE's flexibility in selecting the most effective processes for waste treatment and disposal. The petitioner's request that "best available technology" be used in removing HLW material from the tank wastes was seen as ignoring costs of disposal, exposures to workers, and environmental impacts.

Some comments disputed the petitioner's claim that the rulemaking proposed in the petition would offer a better process for classification and disposal of the Hanford tank wastes. These commenters did not see any advantage in the proposed process over the process for classification and disposal currently in use. One comment suggested that the Commission's rulemaking requiring disposal of Greater-than-Class C waste in a geologic repository or Commission-approved alternative (53 FR 17710, May 19, 1989) might force DOE to allocate resources to handle the hazards, rather than to waste further time fruitlessly searching for ways to remove more and more activity from one part of the waste. The action proposed by the petitioners was viewed as not increasing the safety of disposal of the waste.

The Commission believes that adherence to the standard of technical and economic practicality generally reflects agreement with these comments.

B. Creation of a Risk-Based Classification System

Several comments, while noting that the rulemaking proposed by the petition would not do so, favored creation of a risk-based system of radioactive waste classification.

The Commission has previously addressed the costs and benefits of creating a new system of radioactive waste classification. Its rationale for not doing so is outlined in the statement of considerations to the proposed Part 61 rulemaking on disposal of Greater-than Class C waste (53 FR 17709, May 18, 1988). Further consideration of these issues is beyond the scope of this proposed rulemaking action.

C. NRC Licensing Authority

Some comments focused on the licensing authority of NRC over the Hanford tank wastes. DOE stated that the rulemaking suggested in the petition would involve NRC in regulation of DOE's predisposal waste treatment and processing activities, which would be inconsistent with NRC authority to license specific DOE facilities under the Energy Reorganization Act of 1974. Another commenter stated that the proposed rulemaking was inconsistent with the statutory responsibilities of DOE and NRC. These arguments have already been discussed, and require no further response. It may be emphasized, however, that even if the Commission were found to have jurisdiction over the disposal facilities, it would not regulate either the tanks themselves or the facilities being used to process the wastes in these tanks; and there is reason for concern that implementation of the petitioner's proposal might draw the Commission improperly into regulation of those facilities.

A commenter concluded that DOE was currently in violation of 10 CFR Part 30 requirements for a license because various near-surface waste disposal facilities at Hanford are being used for "long-term storage" of high-level radioactive waste. The issue is not pertinent to the subject matter of the petition. However, in any case, the comment does not take into consideration the judicial interpretation of the term in Natural Resources Defense Council, Inc. v. U.S. Nuclear Regulatory Commission, 606 F.2d 1261 (D.C. Cir., 1979). The D.C. Circuit Court of Appeals ruled in this case in support of NRC's position that the tanks have not been authorized for use as

long-term storage or disposal and are, therefore, not subject to NRC licensing.

D. Public Input

A number of comments stressed the importance of adequate public input into decision making regarding disposal of the Hanford tank wastes. Some called for public hearings on this subject to be held in the Pacific Northwest. One commenter noted that the EIS which was done for Hanford provided the opportunity for public comment. Another commenter believed that the Commission's rulemaking procedures did not offer the public a better opportunity for input than does the current licensing procedure.

As indicated in the Discussion above, the NRC's review of the situation with respect to the double-walled tanks has been carried out publicly from the start. Meetings with DOE have been open, and at least one of the petitioners (the State of Washington) has been provided advance notice and an opportunity to attend. Documents have been placed in the Public Document Room and have been made available for public inspection. It appears to the Commission that the essence of the issue concerns the appropriate standard for evaluating whether certain wastes should be regarded as high-level waste or not. Sufficient factual information is available to carry out these evaluations. Also, the petition for rulemaking has afforded an opportunity for views to be expressed with respect to the appropriateness of the standard.

A decision that NRC lacks licensing jurisdiction does not mean that opportunities for public input will be denied. As DOE undertakes its waste

management activities, it will afford opportunities for public participation to the extent required by its own enabling statutes, regulations, and orders.

E. Other Comments

One commenter took exception to the petitioner's claim that the radioactive inventory of the Hanford tank wastes was inadequately known. The commenter believed that the contents of the tanks can be bounded well enough to judge the relative safety of various disposal options.

The Commission considers the available information to be sufficiently bounded to enable it to conclude that DOE's proposed operations (with respect to the material stored in the double-shell tanks) can result in the removal from the Hanford double-shell tanks of as much of the radioactive waste as may be technically and economically practical, and that the applicable regulatory objectives have been satisfied. Once these judgments are made, it is not the NRC's role to judge the relative safety of various disposal options, and we decline to do so.

One comment stated that while the petition was aimed solely at the Hanford tank wastes, its provisions could potentially affect all radioactive wastes from reprocessing, including those at Savannah River, West Valley, and the Idaho National Engineering Laboratory. As the waste management programs at these other sites are in different stages of implementation, the impacts of the provisions would vary from site to site. As indicated above, the Commission is sensitive to this consideration yet believes that the specific case at hand only needs to be addressed at this time.

Some comments urged the Commission not to change the present definition of HLW. The Commission is not changing the present definition.

V. Conclusion

For the reasons presented in this document, the petition for rulemaking is denied.

Dated at Rockville, Maryland this 26th day of February, 1993.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,
Secretary of the Commission.

ATTACHMENT 5

LETTER FROM M. BELL TO D. WODRICH

February 6, 1997

Mr. Donald D. Wodrich
Office of Tank Waste Remediation System
U.S. Department of Energy
Richland Operations Office
P.O. Box 550 MSIN S7-50
Richland, WA 99352

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - HANFORD INCIDENTAL WASTE CLASSIFICATION

Dear Mr. Wodrich:

U.S. Nuclear Regulatory Commission staff along with our contractor, the Center for Nuclear Waste Regulatory Analyses, are in the process of reviewing the "Technical Basis for Classification of Low-Activity Waste Fraction from Hanford Site Tanks" (Technical Basis), WHC-SD-WM-TI-699, Rev. 2, as requested in the November 7, 1996, letter from J. Kinzer, U.S. Department of Energy (DOE), to C. Paperiello, U.S. Nuclear Regulatory Commission. In the process of reviewing the Technical Basis, we have also examined several of the supporting references, including the "Hanford Low-Level Tank Waste Interim Performance Assessment" (Interim PA), WHC-EP-0884, dated September 16, 1996. With respect to the Interim PA, we have identified several issues that need to be resolved before NRC staff can fully evaluate your request for agreement that the Hanford tank waste planned for disposal on-site is incidental waste that would not be subject to NRC licensing authority. These comments address the effects of certain assumptions, models, or parameters on dose calculations with respect to meeting the third of the incidental waste classification criteria set forth in the March 2, 1993, letter from R. Bernero, NRC, to J. Lytle, DOE. The comments are listed in the Enclosure.

In order to facilitate the expedited review schedule requested in the November 7 letter, we would like to attempt to resolve these issues in a meeting (face-to-face, or through telecon or videocon) with you and with the PA staff that authored the Interim PA document. Please contact either Jennifer Davis at (301) 415-5874, or Richard Weller at (301) 415-7287 to set up a meeting. We would appreciate it if the meeting could be held very soon, as we are working to meet your scheduled completion date of April 1997.

Sincerely,

/S/

Michael J. Bell, Chief
Engineering and Geosciences Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated
cc: J. Kinzer (w/encl)

SPECIFIC COMMENTS FROM REVIEW OF THE
"HANFORD LOW-LEVEL TANK WASTE INTERIM PERFORMANCE
ASSESSMENT," WHC-EP-0884, REVISION 0

1. The Interim PA provides a value of an initial fractional radionuclide release rate of 4.4×10^{-6} for all radionuclides except ^{99}Tc, which has a rate of 8.8×10^{-7} (pp. iv and 3-32). These values for the fractional radionuclide release rate may be unrealistically low for the disposal facility. The Interim PA assumes that the fractional radionuclide release rates are limited by the fractional bulk dissolution rate of the glass. However, it is not clear how the fractional release rates for ^{99}Tc, a highly soluble nuclide, could be much smaller than the other isotopes in the glass. These values should be justified. For example, Kerrisk (1984) presents a detailed model for calculating fractional radionuclide release rates for vitrified pressurized water reactor high-level waste for 10 important radionuclides expected in the waste, based on nuclide solubilities, recharge rates, background concentrations of silica, and other factors. A similar evaluation would be appropriate for the Tank Waste Remediation System waste.

   Additionally, the bulk dissolution rate for glass does not necessarily determine the dissolution rate for high-solubility fission products in the glass (such as ^{99}Tc and ^{129}I), because many of these nuclides may have the ability to diffuse out of the glass, and may, therefore, have high release rates. These processes are not included in the Interim PA.

2. The K_d value for I (p. 3-27, Table 3-5) appears to be nonconservative. As standard practice, I is generally considered to be unretarded, i.e., K_d = 1 L/kg. (See also Sheppard and Thibault, 1990.) The value presented in the Interim PA, K_d = 3 L/kg is somewhat higher. This difference is expected to significantly affect the results. The value used should be altered or justified.

3. Some of the all-pathways dose conversion factors (DCFs) in the Interim PA (p. B-56, Table B-3) appear to be low compared with DCFs for other arid sites (LaPlante, et al., 1995). The Interim PA should include a more detailed technical justification for the selection of the DCFs, because evaluations of disposal facility performance are expected to be very sensitive to the values selected.

Enclosure

4. The derivation of the relative radionuclide release rate (pp. 3-33 and 3-34) may require modification. The equation in the center of page 3-33 describes the absolute radionuclide release rate (in Ci/yr) for the waste form as:

$$RRR(t) = C * S(t) * I(t)/V(t)$$

Where:

RRR(t)	=	the radionuclide release rate (Ci/t)
t	=	the time
C	=	the constant corrosion rate ($1/t$)
S(t)	=	the surface area of the waste form as a function of time (1^2)
I(t)	=	the radionuclide inventory in the waste form as a function of time (Ci)
V(t)	=	the volume of the waste form as a function of time (1^3)

Assuming that this equation is correct, the relative (or fractional) radionuclide release rate, FRRR(t), i.e., the fraction of radionuclide inventory release rate per unit time would be given by:

$$FRRR(t) = RRR(t)/I(t) = C * S(t)/V(t)$$

The waste area to volume ratio is expected to increase with time due to corrosion of the waste form and cracking due to formation of corrosion products. Because FRRR(t) is directly proportional to the waste area to volume ratio, this quantity would be expected to increase with time. On page 3-34, there is an expression for FRRR(t) that decreases with time. These considerations should be included in the Interim PA, because performance is likely to be highly sensitive to radionuclide release rate.

5. The Interim PA methodology is deterministic, and single values (sometimes best values) of parameters are used. The reviewers are concerned that if the range of measured parameter values were incorporated into the Interim PA, some performance limits might be exceeded. Uncertainty analyses should be performed in addition to the sensitivity analyses presented in the Interim PA.

6. There is insufficient justification for the assumption that the capillary barrier will be intact for 1000 years. The performance of this barrier will degrade with time. Similarly, the Interim PA assumes that the concrete vaults will be intact for 500 years. This assumption seems to be based on a U.S. Nuclear Regulatory Commission Branch Technical Position which specifies that the maximum credit that can be allowed for concrete structures is 500 years. A site-specific justification should be provided for this assumption, since occurrence of earthquakes and other natural events must be accounted for.

7. The infiltration rate of 0.5 mm/yr for the first 1000 years and 3mm/yr thereafter has not been adequately justified. These values may be unrealistically low, and contribution from lateral subsurface flow during storms has been neglected.

8. The release rate calculation appears unrealistic in that the dissolution time for the entire inventory is based on dissolution in still water. In flowing water, waste dissolution will be faster because the fresh water will provide for continuous attack on the waste form. The Interim PA acknowledges that performance results are dependent upon the release rate (pp. 3-32 and 3-35). The dissolution time calculations should be justified or altered.

9. The Interim PA uses an equation which appears to consider that the quantity of radionuclides transported to the base of the vadose zone is dissolved in a volume of water equal to the annual recharge (p. 3-61). This would be unrealistic and nonconservative, particularly for the second design option in which the vaults are interspersed by soil. The volume of water will be the portion of annual recharge that actually flows over the waste. The concentration calculated by the flow and transport code would appear to be more justifiable.

10. Flow and transport modeling neglects heterogeneity within layers, thereby omitting consideration of spatially distributed flow.

REFERENCES

Kerrisk, J.F., "Solubility Limits on Radionuclide Dissolution at a Yucca Mountain Repository," LA-9995-MS, Los Alamos National Laboratory, Los Alamos, NM, 1984.

LaPlante, P.A., S.J. Maheras, and M.S. Jarzemba, "Initial Analysis of Selected Site Specific Dose Assessment Parameters and Exposure Pathways Applicable to the Groundwater Release Scenario at Yucca Mountain," CNWRA 95-018, Center for Nuclear Waste Regulatory Analyses, San Antonio, TX, 1995.

Sheppard, M.I., and D.H. Thibault, "Default Soil/Solid Liquid Partition Coefficients, K_d, for Four Major Soil Types: A Compendium," Health Physics, Vol. 59, No. 4, pp. 471-482, 1990.