0057022

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

02-ERD-0056

MAR 19 2002

Mr. Randy Acselrod
State of Washington
Department of Health
2839 West Kennewick Ave.
Box 385
Kennewick, Washington 99336

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APR 30 2002
EDMC

Mr. Michael L. Goldstein
Acting Hanford Project Manager
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, Washington 99352

Addressees:

AIR MONITORING PLAN FOR THE ENVIRONMENTAL RESTORATION DISPOSAL FACILITY (ERDF)

Attached is the approved Air Monitoring Plan for the ERDF.

This document is for your use. The aforementioned plan was approved in February 2002, and provides the required radiological air quality documentation to proceed with the tasks.

If you should have any questions, please contact Owen Robertson, of my staff, on (509) 373-6295.

Sincerely,

Matt McCormick, Director
Environmental Restoration Division

ERD:OCR

Attachment

cc w/attach:
D. R. Einan, EPA
Administrative Record (ERDF)

cc w/o attach:
J. G. Woolard, BHI

AIR MONITORING PLAN FOR THE ENVIRONMENTAL RESTORATION DISPOSAL FACILITY

097361

1.0 INTRODUCTION

Operation of the Environmental Restoration Disposal Facility (ERDF) has the potential-to-emit radioactive particulates. The ERDF is authorized to operate under a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) Record of Decision (EPA 1995). Quantification of radioactive emissions, implementing best available radionuclide control technology, and air monitoring have been identified as substantive requirements (i.e., applicable or relevant and appropriate requirements) for operation of the ERDF. Best available radionuclide control technology compliance demonstration is determined by the regulatory agency on a case-by-case basis. These substantive requirements are according to *Washington Administrative Code* (WAC) 246-247. This plan presents compliance with those requirements[1].

1.1 OPERATIONAL ACTIVITIES

The selected ERDF site covers a maximum of 4.1 km^2 (1,013 acres) approximately in the center of the Hanford Site, southeast of the 200 West Area and southwest of the 200 East Area. The ERDF is the receiving and disposal facility for waste generated from response actions where disposal is the selected cleanup remedy. Only remediation waste that originates on the Hanford Site will be placed in the ERDF. Waste is transported to ERDF in covered containers, the containers are staged, and the waste is then unloaded into the currently operational disposal cell. Clean soil is placed over the waste pending final closure of the cell. Some treatment activities may also take place at the ERDF as required to meet the ERDF waste acceptance criteria, as identified in the applicable CERCLA decision document that applies to the remedial action.

The ERDF site will include a staging area (approximately 0.012 km^2 [3 acres] in size) that will be located in the northeast corner of the ERDF facility near the boundary fence line. The staging area will consist of a level compacted area. It will be operated as a Corrective Action Management Unit, allowing waste to be staged while it awaits treatment prior to disposal. Drums from the 618-4 and 618-5 Burial Grounds will be staged in this location along with contaminated material from other remedial action sites as necessary. Treatment of the staged drums containing uranium-bearing wastes excavated from the 618-4 and 618-5 Burial Grounds is not within the scope of this air-monitoring plan.

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[1] This Air Monitoring Plan replaces the *Air Monitoring Plan for the Environmental Restoration Disposal Facility*, BHI-01402, Rev. 0

2.0 AIRBORNE SOURCE INFORMATION

There is a potential for particulate radioactive airborne emissions to result from the operation of ERDF. The principal waste received at the ERDF is in the form of bulk contaminated soil and constitutes the major source for potential offsite emissions. Other wastes (such as miscellaneous debris, contaminated equipment/components, resins) are received at the ERDF. These materials are transported to ERDF in approved waste shipping containers.

On occasion, containers or contaminated material require grouting at the ERDF prior to disposal to eliminate void space. Containers may be opened to grout the contents of the container or grout may be injected through a port in the container. If an injection port is used, air will be vented through a second port in the container, which is equipped with a high efficiency particulate air (HEPA) filter.

In addition, some materials, such as lead bricks or resins, may require stabilization (e.g., grouting) or encapsulation at ERDF prior to disposal at ERDF to meet the waste acceptance criteria.

2.1 INVENTORY

2.1.1 Bulk Disposal Inventory

Soil contaminant information forms the basis for developing the radionuclide inventory and emission estimates for bulk disposal at ERDF. Soil information is used because waste received at ERDF that is highly radioactive is packaged or encapsulated. Nonsoil waste that is not encapsulated or sealed contains similarly low radionuclide inventories as the soils. Such nonsoil waste is usually in a nondispersible form (e.g., concrete or rubble).

The average concentration of each radioisotope is identified in Appendix A and is based on laboratory data and the ERDF database through 1997. The waste received through 1997 is anticipated to be representative of the overall waste inventory expected over the life of the facility. The total inventory per year and the potential inventory released in curies/year are provided in Appendix A.

The total inventory per year was calculated by determining the total soil mass and multiplying this number by the average radionuclide inventory concentration. The assumptions for the total soil mass are as follows: (1) 50,000 ft^2/day potentially exposed to wind blown erosion, (2) 242 days/year operation, and (3) 0.01 m of erosion. The release fraction of 1E-03 for particulates and a release fraction of 1.0 for tritium (WAC 246-247-030) was applied to the total inventory per year to determine the potential inventory released.

The CAP-88 model was used to determine the potential unabated offsite dose to the maximally exposed individual. The potential inventory released (curies/year) was the input to the computer model. The distance to the maximally exposed individual used in the model was 13,750 m east southeast of the ERDF.

The assumptions, calculations and CAP-88 model summary and synopsis are presented in Bechtel Hanford, Inc. Calculation No. 0600X-CA-V0003, Rev. 1, (BHI 2002a). The calculated total potential unabated offsite dose from bulk disposal at ERDF is 3.85E-02 mrem/yr. A factor of 10 is applied to this number to account for potential short-term increases in radionuclide inventory received at ERDF, as agreed in meeting minutes dated April 23, 1998 (BHI 1998a). Thus, the reported unabated offsite dose for bulk material is 3.85E-01 mrem/yr.

2.1.2 Miscellaneous Waste Container Inventory

Some contaminated miscellaneous waste that is shipped to the ERDF requires grouting to fill void space or stabilization/encapsulation at ERDF prior to disposal. The activity of grouting/stabilization has the potential-to-emit radioactive emissions. The waste inventory for this activity was developed based on information from the Reactor Interim Safe Storage, K Basin, and the Ground Water Project. Data from these projects is assumed to be representative of what might be received at ERDF.

The radionuclide annual possession quantity, and subsequent potential emission calculations for these containers are summarized in Appendix B. To determine the annual possession quantity, the containers inventory was multiplied by a release fraction of 1E-03 for particulates and a release fraction of 1.0 for tritium (WAC-246-247-030).

The CAP-88 model was used to determine the potential unabated offsite dose to the maximally exposed individual. The potential inventory released (curies/year) was the input to the computer model. The distance to the maximally exposed individual used in the model was 13,750 m east southeast of the ERDF.

The assumptions, calculations and CAP-88 model summary and synopsis are presented in Bechtel Hanford, Inc. Calculation No. 0600X-CA-V0019, Rev. 0, (BHI 2002b). The calculated total potential unabated offsite dose from these activities at the ERDF is 2.84E-02 mrem/yr.

2.1.3 Staging Area Inventory

There is a potential for radioactive airborne emissions to result from drum venting and annual inspections while drums are located in the staging area. An estimated 1,922 drums will be received from the 300 Area and arranged in controlled areas at the ERDF staging area. The estimate includes the drums excavated to date at 618-4 Burial Ground and the drums to be excavated at the 618-4 and 618-5 Burial Grounds. There are two drummed waste streams expected, 1) depleted uranium chips immersed in oil, and 2) depleted uranium oxide powder (yellow and black oxide). It is assumed that of the 1922 drums, 393 drums (288 drums from 618-4, and 105 drums from 618-5) contain uranium oxide powder. These drums will have been overpacked and sealed. Therefore, there is no potential for emissions from these drums. The remaining drums (1,184 drums from 618-4 and 345 drums from 618-5) will be overpacked in the configuration presented in Table 1.

The drum inventory was developed based on sampling data obtained from the drums. Uranium is the primary isotope of interest, with cesium-137, cobalt-60 and strontium-90 also identified. However, it is expected that the isotopic concentrations listed in Appendix C represent the upper

bound of what is in the drums. The radionuclide annual possession quantity and subsequent potential emission calculations for the drums are summarized in Appendix C.

To determine the annual possession quantities for drum venting and the annual inspections, the drum inventory was multiplied by the number of drums, then by the appropriate release fraction, as outlined in Table 1. An annual inspection assumes that the drums containing oil coated metal tailings, fines, and sludges are opened for inspection one day per year. The inspection consists of opening the B-25 boxes and the 85-gallon overpack to evaluate the inner drum integrity.

The CAP-88 model was used to determine the potential unabated offsite dose to the maximally exposed individual. The potential inventory released (curies/year) was the input to the computer model. The distance to the maximally exposed individual used in the model was 13,750 m east southeast of the ERDF.

The assumptions, calculations and CAP-88 model summary and synopsis are presented in Bechtel Hanford, Inc. Calculation No. 0600X-CA-V0018, Rev. 0, (BHI 2002c). The calculated total potential unabated offsite dose from the venting and inspecting the drums at the ERDF staging area is 4.10E-07 mrem/yr.

As noted in Section 1.1 contaminated material from other remedial action sites may be placed in the staging area. It is anticipated that this will be an insignificant volume of the total waste disposed at ERDF and any potential emission is captured within the total estimated dose for ERDF (see Section 2.1.4).

Table 1. Drum Configuration.

No. of Drums	Drum Configuration	Applicable Release Fraction
618-4 Burial Ground		
276	30-gallon drum containing black uranium oxide powder overpacked in 55-gallon drum (sealed), and overpacked in 85-gallon steel drum (sealed)	No potential to emit
12	30-gallon drum containing yellow uranium oxide powder overpacked in 55-gallon drum (sealed), and overpacked in 85-gallon steel drum (sealed)	No potential to emit
1034	30-gallon drum containing metals/oil overpacked in 55-gallon drum (vented with filter), and overpacked in 85-gallon steel drum (vented without filter)	2.00E-09[1]
150	30-gallon drum containing metals/oil overpacked in 95-gallon poly (vented without filter), and overpacked in B-25 boxes (vented with filter)	For metals - 4.73E-09[2] For oil – 2.74E-06[2]
618-5 Burial Ground		
100	30-gallon drum containing black uranium oxide powder overpacked in 55-gallon drum (sealed), and overpacked in 85-gallon steel drum (sealed)	No potential to emit
5	30-gallon drum containing yellow uranium oxide powder overpacked in 55-gallon drum (sealed), and overpacked in 85-gallon steel drum (sealed)	No potential to emit
345	30-gallon drum containing metals/oils overpacked in 55-gallon drum (vented with filter), and overpacked in 85-gallon steel drum (vented without filter)	2.00E-09

[1] Release fraction of 2E-09 approved by Washington State Department of Health for use in calculating release potential from venting of drums (Conklin 1999).

[2] The release fractions for the B-25 boxes are a weighted average of the release fractions used when the boxes are open for inspection and when they are staged and emitting through the use of the Nucfil® filters or equivalent.

Release fraction used for B-25 boxes = ((release fraction for vented container) x (number of days box vents in a year).
..+ (Release fraction for radionuclides released as particulates or solids) x (Number of days box is open in a year)).
../ (Number of days in a year)

Release Fraction used for B-25 Boxes (metals) = ((2.0E-09) x (364 days) + (1.0E-06) x (1 day)) / (365 days) = 4.73E-09

Release Fraction used for B-25 Boxes (oil) = ((2.0E-09) (364 days) + (1.0E-03) x (1 day)) / (365 days) = 2.74E-06

Where: Particulates = 1.0E-03 release fraction
Solids = 1.0E-06 release fraction

®Nucfil is a registered trademark of Nuclear Filter Technology Incorporated, 5161 Ward Rd., Wheat Ridge, CO 80033.

2.1.4 Total Inventory Summary

The total potential unabated offsite dose for all activities at the ERDF is 4.13E-01 mrem/yr. This offsite dose is the sum of 1) bulk disposal at 3.85E-01 mrem/yr (including the factor of 10 [Section 2.1]), 2) miscellaneous waste containers at 2.84E-02 mrem/yr, and 3) the staging area at 4.10E-07 mrem/yr.

3.0 BEST AVAILABLE RADIONUCLIDE CONTROL TECHNOLOGY

3.1 DUST CONTROL

Water or fixant will be applied to active waste facility areas to control dust emissions. In-pit dust control will be accomplished by using water sprays, including recycled leachate, during placement and compaction operations. Additionally, the waste soil arrives at the ERDF with substantial residual moisture from dust suppression activities at the remediation sites. At the end of each day of operations, a fixative will be applied to active areas of the landfill. At the 35-ft and 70-ft levels, waste will be covered with clean fill whenever the waste reaches a finished gradient configuration. The clean fill is required to maintain operating surfaces. The combination of this cover and use of dust suppression techniques will prevent wind erosion and resulting resuspension of contaminated soils.

3.2 OPEN WORKING FACE

The maximum annual average open working face will be limited to 50,000 ft^2. The maximum average open working face will be estimated and documented on a weekly basis and will be available in the ERDF project file.

3.3 FILTERS

HEPA filters will be utilized to control radioactive air emissions during the grouting of the closed waste containers. HEPA filters are considered best available radionuclide control technology for radioactive emissions at the Hanford Site.

Nucfil® or equivalent filters will be utilized on some of the 300 Area drums to control the potential for radioactive air emissions from the drums. These filters may also be used if other vented containers are staged at ERDF. Nucfil or equivalent filters are considered best available radionuclide control technology for radioactive emissions at the Hanford Site.

® Nucfil is a registered trademark of Nuclear Filter Technology Incorporated, 5161 Ward Rd., Wheat Ridge, CO 80033.

4.0 MONITORING

Three project specific monitors will be located downwind to monitor emissions from the ERDF. Data from two stations operated and established for other Hanford Site programs provide upwind air monitoring information; Pacific Northwest National Laboratory Station #11 (200 West SE) and the near-facility air monitoring station N963.

Figure 1 identifies the existing air monitors N482, N517, and N518. These stations are currently being utilized to monitor the disposal activities that are being conducted.

As agreed in the meeting minutes dated May 20, 1998 (BHI 1998b), the previous monitor N483 was relocated/renumbered to the now N517 and the N484 monitor was relocated/renumbered to the existing N518. These relocations occurred to support the expansion of disposal activities into cells 3 and 4. Additionally, three thermoluminescent dosimeters (TLDs), ERDF 1, ERDF-2, and ERDF-3 are located at the existing air monitoring stations. These TLDs were relocated with the air monitors, as agreed in the meeting minutes dated May 20, 1998 (BHI 1998b). An annual soil deposition sample will also be taken at ERDF air monitoring station N482.

Downtime of the air monitoring stations will be minimized. If one down-wind near-facility air monitor is shut down for more than 48 hours during normal operations, the regulatory agencies will be notified. If more than one down-wind near-facility air monitor is shut down for more than 48 hours during normal work operations, contaminated material-handling operations will be suspended until at least one of the monitors is returned to service. Excluded from normal work operations are weekends and contractor-designated holidays.

The downwind air monitors are used to verify that emissions from the operation of ERDF are low. The operation of these air monitors/TLDs, sample collection, and analysis will follow the protocol and procedures established for the existing near-facility environmental monitoring program for the Hanford Site. The air samples are collected every two weeks and are analyzed for total alpha and total beta. The samples are then composited every six months for further analysis. The composite air and soil deposition samples are analyzed for strontium-90, isotopic plutonium, isotopic uranium, and gamma energy analysis.

Downwind total alpha, total beta, or composite sample analytical results that exceed more than 3 sigma above each air sampler's respective running historical mean will be investigated. The U.S. Environmental Protection Agency will be informally notified of air sample results that are above 3 sigma.

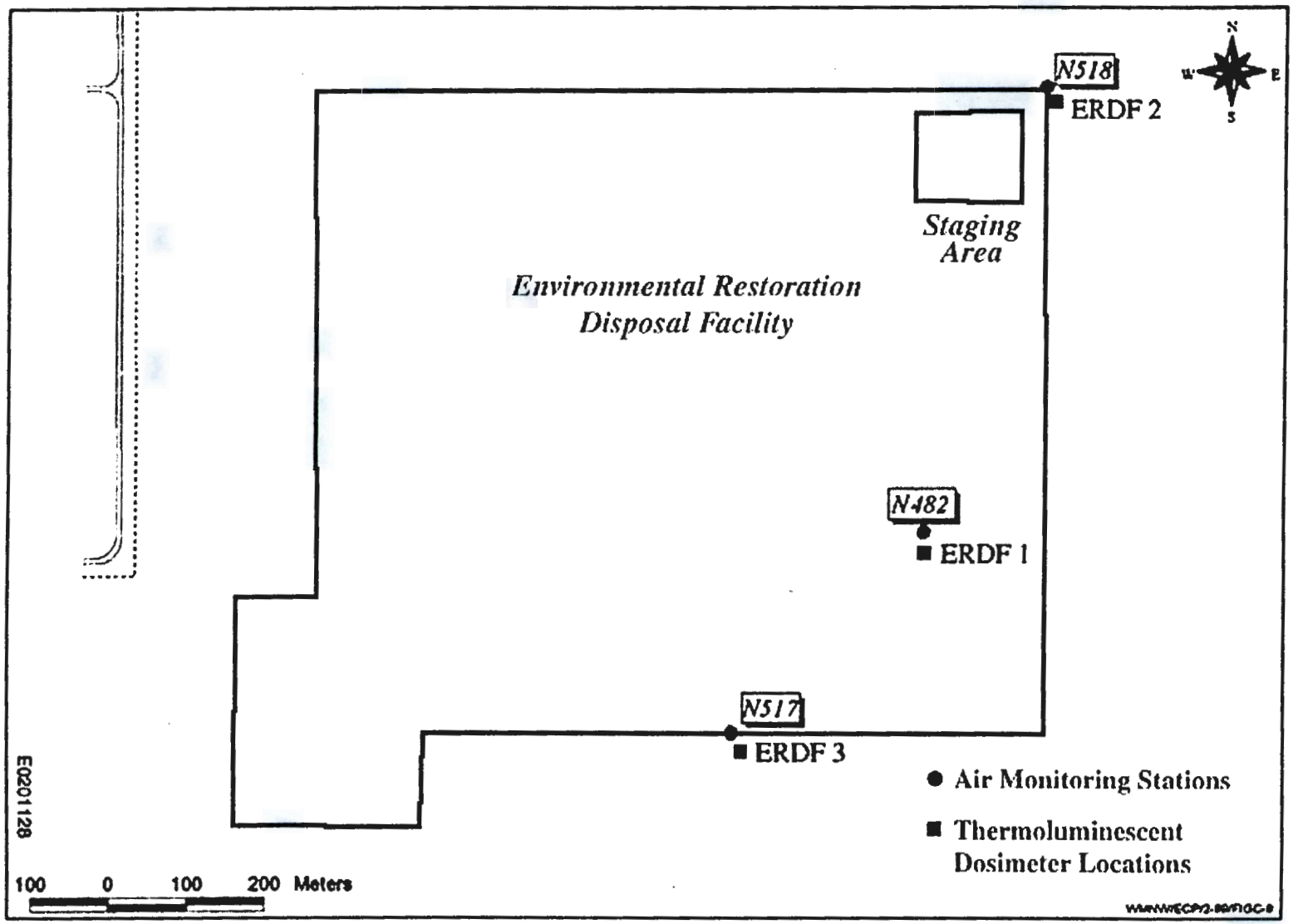

Figure 1. Air Monitoring Stations.

5.0 REFERENCES

BHI, 1998a, *Closure of Notice of Violation for ERDF Air Monitoring,* ERC Meeting Minutes, CCN 058280, dated April 23, 1998, Bechtel Hanford Inc., Richland Washington.

BHI, 1998b, *Relocation of ERDF Air Monitor Station,* ERC Meeting Minutes, CCN 058970, dated May 20, 1998, Bechtel Hanford Inc., Richland, Washington.

BHI, 2002a, *Calculation of Estimated Air Emissions from 1998 ERDF Activities*, BHI Calculation No. 0600X-CA-V0003, Rev. 1, Bechtel Hanford Inc., Richland, Washington.

BHI, 2002b, *Total Effective Dose Equivalent Calculation for ERDF Disposal Activities*, BHI Calculation No. 0600X-CA-V0019, Rev. 0, Bechtel Hanford Inc., Richland, Washington.

BHI, 2002c, *Total Effective Dose Equivalent Calculation for ERDF Staging Area*, BHI Calculation No. 0600X-CA-V0018, Rev. 0, Bechtel Hanford Inc., Richland, Washington.

Conklin, 1999, Letter dated October 18, 1999, from A. W. Conklin, Washington State Department of Health, Olympia, Washington, to J. E. Rasmussen, Director, U.S. Department of Energy, Environmental Assurance, Permits and Policy Division, Richland Operations Office, Richland, Washington.

EPA, 1995, *ERDF Record of Decision*, U.S. Environmental Protection Agency, Washington, D.C.

WAC 246-247, "Radiation Protection -- Air Emissions," *Washington Administrative Code*, as amended.

Concurrences:

R. S. Acselrod Washington State Department Health	2/20/2002 Date	D. Einan U.S. Environmental Protection of Agency	2/25/2002 Date

O. C. Robertson U.S. Department of Energy, Richland Operations Office	2/20/02 Date

APPENDIX A

ENVIRONMENTAL RESTORATION DISPOSAL FACILITY BULK DISPOSAL INVENTORY

Figure A-1. Environmental Restoration Disposal Facility Bulk Disposal Inventory (Based on 1997 Data).

Radionuclide	Average Radionuclide Inventory (pCi/g)	Average Radionuclide Inventory (Ci/kg)	Total Soil Mass (kg/yr)	Annual Possession Quantity (Ci/yr)	Release Fraction	Potential-to-Emit (Ci/yr)	Unabated Offsite Dose (mrem/yr)
Americium-241	1.50E+01	1.50E-08	1.87E+07	2.80E-01	1.00E-03	2.80E-04	5.66E-03
Americium-243	3.70E-03	3.70E-12	1.87E+07	6.91E-05	1.00E-03	6.91E-08	1.40E-06
Carbon-14	6.30E+01	6.30E-08	1.87E+07	1.18E+00	1.00E-03	1.18E-03	4.29E-06
Cobalt-60	4.10E+01	4.10E-08	1.87E+07	7.65E-01	1.00E-03	7.65E-04	1.72E-04
Cesium-137	2.10E+02	2.10E-07	1.87E+07	3.92E+00	1.00E-03	3.92E-03	2.11E-04
Barium 137m	1.99E+02	1.99E-07	1.87E+07	3.71E+00	1.00E-03	3.71E-03	7.04E-04
Europium-152	4.20E+02	4.20E-07	1.87E+07	7.84E+00	1.00E-03	7.84E-03	1.69E-03
Europium-154	9.50E+01	9.50E-08	1.87E+07	1.77E+00	1.00E-03	1.77E-03	3.09E-04
Europium-155	3.10E+01	3.10E-08	1.87E+07	5.79E-01	1.00E-03	5.79E-04	4.49E-06
Tritium	3.00E+02	3.00E-07	1.87E+07	5.60E+00	1.00E+00	5.60E+00	3.68E-04
Nickel-63	2.00E+02	2.00E-07	1.87E+07	3.73E+00	1.00E-03	3.73E-03	1.73E-06
Plutonium-238	4.90E+00	4.90E-09	1.87E+07	9.15E-02	1.00E-03	9.15E-05	1.11E-03
Plutonium-239	1.90E+01	1.90E-08	1.87E+07	3.55E-01	1.00E-03	3.55E-04	4.67E-03
Plutonium-240	1.10E+01	1.10E-08	1.87E+07	2.05E-01	1.00E-03	2.05E-04	2.69E-03
Plutonium-241	2.80E+02	2.80E-07	1.87E+07	2.05E-01	1.00E-03	2.05E-04	4.22E-05
Plutonium-242	1.90E-07	1.90E-16	1.87E+07	3.55E-09	1.00E-03	3.55E-12	4.44E-11
Radium-226	2.00E-02	2.00E-11	1.87E+07	3.73E-04	1.00E-03	3.73E-07	2.67E-07
Radium-228	7.00E-05	7.00E-14	1.87E+07	1.31E-06	1.00E-03	1.31E-09	3.83E-10
Strontium-90	2.70E+02	2.70E-07	1.87E+07	5.04E+00	1.00E-03	5.04E-03	7.67E-04
Yttrium-90	2.70E+02	2.70E-07	1.87E+07	5.04E+00	1.00E-03	5.04E-03	1.72E-06
Technetium-99	2.20E+01	2.20E-08	1.87E+07	4.11E-01	1.00E-03	4.11E-04	1.31E-05
Thorium-228	9.50E-02	9.50E-11	1.87E+07	1.77E-03	1.00E-03	1.77E-06	1.59E-05
Thorium-232	3.40E-05	3.40E-14	1.87E+07	6.35E-07	1.00E-03	6.35E-10	8.14E-09
Uranium-233/234	1.09E+02	1.09E-07	1.87E+07	2.03E+00	1.00E-03	2.03E-03	1.02E-02
Uranium-235	1.00E+01	1.00E-08	1.87E+07	1.87E-01	1.00E-03	1.87E-04	8.78E-04
Uranium-238	1.09E+02	1.09E-07	1.87E+07	2.03E+00	1.00E-03	2.03E-03	8.96E-04
Total							**3.85E-02**

NOTE: Radionuclides with a half-live less than 3 years (i.e., cesium-134 and sodium-22) have not been included. The following radionuclides are not included in the above dose estimate because their potential contribution is expected to be insignificant and is easily captured in the overall total dose (which is 10 times the calculated dose as described in 2.1.1). Americium-242m, Cesium-133, Curium-242, Curium-243, Curium-244, Curium-245, Curium-246, Curium-247, Curium-248, Cesium-134, Manganese-54, Neptunium-237, Polonium-210, Praseodymium-144, Plutonium-244, Uranium-232, Uranium-236, Zinc-65 Cobalt-58, and Niobium NB-94.

APPENDIX B

MISCELLANEOUS WASTE CONTAINER INVENTORY

Table B-1. Annual Possession Quantities and Release Fractions. (2 pages)

Isotope	Annual Possession[1] Quantity (Ci/yr)	Release Fraction	Potential to Emit (Ci/yr)
Conex Boxes from 100-F Area			
Am-241	5.30E-02	1.00E-03	5.30E-05
C-14	2.19E+00	1.00E-03	2.19E-03
Co-60	2.23E+00	1.00E-03	2.23E-03
Cs-137	5.63E+00	1.00E-03	5.63E-03
Ba-137m	5.33E+00	1.00E-03	5.33E-03
Eu-152	2.25E+01	1.00E-03	2.25E-02
Eu-154	3.19E+00	1.00E-03	3.19E-03
Eu-155	6.40E-01	1.00E-03	6.40E-04
H-3	1.58E+00	1.00E+00	1.58E+00
Ni-63	2.53E+01	1.00E-03	2.53E-02
Pu-238	5.00E-03	1.00E-03	5.00E-06
Pu-239	8.00E-02	1.00E-03	8.00E-05
Pu-241	3.90E-01	1.00E-03	3.90E-04
Pu-242	4.30E-08	1.00E-03	4.30E-11
Sr-90	5.40E-01	1.00E-03	5.40E-04
Y-90	5.40E-01	1.00E-03	5.40E-04
Tc-99	8.70E-04	1.00E-03	8.70E-07
U-233	1.40E-03	1.00E-03	1.40E-06
U-238	1.50E-03	1.00E-03	1.50E-06
4 x 4 x 8 Boxes from 100-K Area			
Am-241	5.38E-02	1.00E-03	5.38E-05
Cm-244	4.18E-05	1.00E-03	4.18E-08
Cs-137	3.23E-01	1.00E-03	3.23E-04
Ba-137m	3.05E+02	1.00E-03	3.05E-01
Co-60	3.10E-03	1.00E-03	3.10E-06
Eu-152	1.93E-04	1.00E-03	1.93E-07
Eu-154	4.60E-03	1.00E-03	4.60E-06
Eu-155	1.45E-03	1.00E-03	1.45E-06
H-3	2.90E-04	1.00E+00	2.90E-04
Ni-63	1.10E-03	1.00E-03	1.10E-06
Pm-147	7.45E-03	1.00E-03	7.45E-06
Pu-238	6.68E-03	1.00E-03	6.68E-06
Pu-239	4.25E-02	1.00E-03	4.25E-05
Pu-240	1.63E-02	1.00E-03	1.63E-05
Pu-241	6.35E-01	1.00E-03	6.35E-04
Sb-125	5.15E-04	1.00E-03	5.15E-07
Sm-151	4.50E-03	1.00E-03	4.50E-06
Sr-90	3.38E-01	1.00E-03	3.38E-04
Y-90	3.38E-01	1.00E-03	3.38E-04

Table B-1. Annual Possession Quantities and Release Fractions. (2 pages)

Isotope	Annual Possession[1] Quantity (Ci/yr)	Release Fraction	Potential to Emit (Ci/yr)
U-234	8.70E-05	1.00E-03	8.70E-08
U-235	1.48E-05	1.00E-03	1.48E-08
U-238	6.90E-05	1.00E-03	6.90E-08
4 x 4 x 4 Boxes from 100-K Area			
Am-241	3.10E-01	1.00E-03	3.10E-04
Cm-244	9.34E-04	1.00E-03	9.34E-07
Cs-137	1.17E+01	1.00E-03	1.17E-02
Ba-137m	1.10E+01	1.00E-03	1.10E-02
Co-60	2.93E-03	1.00E-03	2.93E-06
Eu-152	8.18E-04	1.00E-03	8.18E-07
Eu-154	8.46E-02	1.00E-03	8.46E-05
Eu-155	1.49E-02	1.00E-03	1.49E-05
H-3	3.04E-02	1.00E+00	3.04E-02
Ni-63	3.97E-03	1.00E-03	3.97E-06
Pm-147	2.35E-01	1.00E-03	2.35E-04
Pu-238	9.25E-02	1.00E-03	9.25E-05
Pu-239	1.86E-01	1.00E-03	1.86E-04
Pu-240	1.02E-01	1.00E-03	1.02E-04
Pu-241	5.46E+00	1.00E-03	5.46E-03
Sb-125	1.87E-02	1.00E-03	1.87E-05
Sm-151	1.58E-01	1.00E-03	1.58E-04
Sr-90	9.07E+00	1.00E-03	9.07E-03
Y-90	9.07E+00	1.00E-03	9.07E-03
U-234	7.47E-04	1.00E-03	7.47E-07
U-235	3.50E-05	1.00E-03	3.50E-08
U-238	5.84E-04	1.00E-03	5.84E-07
Resin from 100-HR-3 OU			
H-3	5.25E-04	1.00E+00	5.25E-04
Tc-99	1.61E-02	1.00E-03	1.61E-05
U-232	4.93E-08	1.00E-03	4.93E-11
U-233	6.61E-04	1.00E-03	6.61E-07
U-235	7.32E-05	1.00E-03	7.32E-08
U-236	8.53E-05	1.00E-03	8.53E-08
U-238	5.24E-04	1.00E-03	5.24E-07

[1] Radionuclide annual possession quantities are presented in Calculation Brief 0600X-CA-V0019, Rev. 0, *Total Effective Dose Equivalent for ERDF Disposal Activities,* January 2002.

Table B-2. Summary of the Potential-to-Emit Values and Unabated Offsite Dose. (Potential-to-Emit Values from Table B-1.)

Isotope	100-F Conex Boxes (Ci/yr)	100-K 4'x4'x8' Boxes (Ci/yr)	100-K 4'x4'x4' Boxes (Ci/yr)	100-HR-3 Resin (Ci/yr)	Total (Ci/yr)	Unabated Offsite Dose[1] (mrem/yr)
Am-241	5.30E-05	5.38E-05	3.10E-04	NA	4.17E-04	8.44E-03
C-14	2.19E-03	NA	NA	NA	2.19E-03	7.96E-06
Cm-244	NA	4.18E-08	9.34E-07	NA	9.76E-07	1.04E-05
Cs-137	5.63E-03	3.23E-04	1.17E-02	NA	1.76E-02	9.49E-04
Ba-137m	5.33E-03	3.05E-01	1.10E-02	NA	3.21E-01	3.16E-03
Co-60	2.23E-03	3.10E-06	2.93E-06	NA	2.24E-03	5.05E-04
Eu-152	2.25E-02	1.93E-07	8.18E-07	NA	2.25E-02	4.86E-03
Eu-154	3.19E-03	4.60E-06	8.46E-05	NA	3.28E-03	5.72E-04
Eu-155	6.40E-04	1.45E-06	1.49E-05	NA	6.56E-04	5.09E-06
H-3	1.58E+00	2.90E-04	3.04E-02	5.25E-04	1.61E+00	1.06E-04
Ni-63	2.53E-02	1.10E-06	3.97E-06	NA	2.53E-02	1.17E-05
Pm-147	NA	7.45E-06	2.35E-04	NA	2.43E-04	4.30E-07
Pu-238	5.00E-06	6.68E-06	9.25E-05	NA	1.04E-04	1.27E-03
Pu-239	8.00E-05	4.25E-05	1.86E-04	NA	3.08E-04	4.05E-03
Pu-240	NA	1.63E-05	1.02E-04	NA	1.18E-04	1.55E-03
Pu-241	3.90E-04	6.35E-04	5.46E-03	NA	6.48E-03	1.33E-03
Pu-242	4.30E-11	NA	NA	NA	4.30E-11	5.37E-10
Sb-125	NA	5.15E-07	1.87E-05	NA	1.92E-05	4.36E-07
Sm-151	NA	4.50E-06	1.58E-04	NA	1.62E-04	1.98E-07
Sr-90	5.40E-04	3.38E-04	9.07E-03	NA	9.95E-03	1.51E-03
Y-90	5.40E-04	3.38E-04	9.07E-03	NA	9.95E-03	3.40E-06
Tc-99	8.70E-07	NA	NA	1.61E-05	1.69E-05	5.40E-07
U-232	NA	N	NA	4.93E-11	4.93E-11	8.73E-10
U-233	1.40E-06	NA	NA	6.61E-07	2.06E-06	1.03E-05
U-234	NA	8.70E-08	7.47E-07	NA	8.34E-07	4.14E-06
U-235	NA	1.48E-08	3.50E-08	7.32E-08	1.23E-07	5.77E-07
U-236	NA	NA	NA	8.53E-08	8.53E-08	4.00E-07
U-238	1.50E-06	6.90E-08	5.84E-07	5.24E-07	2.68E-06	1.18E-05
Total						**2.84E-02**

[1] The annual unabated dose was determined using the CAP88-PC, Version 2 model. The potential-to-emit total (Ci/yr) was input to the model, and the model generated the annual unabated dose. The distance to the MEI for the ERDF is 13,750 m east southeast. The CAP88-PC model summary and synopsis are presented in ERC Calculation 0600X-CA-V0019, Rev. 0, *Total Effective Dose Equivalent Calculation for ERDF Disposal Activities*, January 2002.

APPENDIX C

STAGING AREA INVENTORY

Table C-1. Annual Possession Quantity and Potential-to-Emit Values. (2 pages)

Drum Type	Isotopes	Number of Drums	Annual Possession Quantity (Ci/yr)	Release Fraction	Potential-to-Emit (Ci/yr)	Grand total for each Isotope (Ci/yr)
618-4 Drums						
30-gal Drum Containing Black Uranium Powder	U-234	276	3.88E+00	0.00E+00	0.00E+00	
30-gal Drum Containing Yellow Uranium Powder	U-234	12	2.75E-02	0.00E+00	0.00E+00	
Metals portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-234	1034	1.38E+00	2.00E-09	2.75E-09	
Oil portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-234	1034	2.13E-02	2.00E-09	4.25E-11	
Metals portion of a 30-gal Drum Containing Metal/Oil in Poly Overpack	U-234	150	2.00E-01	4.73E-09	9.44E-10	
Oil portion of a 30-gal Drum Containing Metal/Oil in Poly Overpack	U-234	150	3.09E-03	2.74E-06	8.45E-09	**1.22E-08**
30-gal Drum Containing Black Uranium Powder	U-235	276	1.55E-01	0.00E+00	0.00E+00	
30-gal Drum Containing Yellow Uranium Powder	U-235	12	1.23E-03	0.00E+00	0.00E+00	
Metals portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-235	1034	9.26E-02	2.00E-09	1.85E-10	
Oil portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-235	1034	1.50E-03	2.00E-09	3.00E-12	
Metals portion of a 30-gal Drum Containing Metal/Oil in Poly Overpack	U-235	150	1.34E-02	4.73E-09	6.36E-11	
Oil portion of a 30-gal Drum Containing Metal/Oil in Poly Overpack	U-235	150	2.18E-04	2.74E-06	5.97E-10	**8.49E-10**
30-gal Drum Containing Black Uranium Powder	U-238	276	2.28E+01	0.00E+00	0.00E+00	
30-gal Drum Containing Yellow Uranium Powder	U-238	12	1.62E-01	0.00E+00	0.00E+00	
Metals portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-238	1034	8.11E+00	2.00E-09	1.62E-08	
Oil portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-238	1034	1.25E-01	2.00E-09	2.50E-10	

Table C-1. Annual Possession Quantity and Potential-to-Emit Values. (2 pages)

Drum Type	Isotopes	Number of Drums	Annual Possession Quantity (Ci/yr)	Release Fraction	Potential-to-Emit (Ci/yr)	Grand total for each Isotope (Ci/yr)
Metals portion of a 30-gal Drum Containing Metal/Oil in Poly Overpack	U-238	150	1.18E+00	4.73E-09	5.56E-09	
Oil portion of a 30-gal Drum Containing Metal/Oil in Poly Overpack	U-238	150	1.82E-02	2.74E-06	4.97E-08	**7.18E-08**
618-5 Drums						
30-gal Drum Containing Black Uranium Powder	U-234	100	1.40E+00	0.00E+00	0.00E+00	
30-gal Drum Containing Yellow Uranium Powder	U-234	5	1.14E-02	0.00E+00	0.00E+00	
Metals portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-234	345	4.59E-01	2.00E-09	9.18E-10	
Oil portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-234	345	7.10E-03	2.00E-09	1.42E-11	**9.32E-10**
30-gal Drum Containing Black Uranium Powder	U-235	100	5.61E-02	0.00E+00	0.00E+00	
30-gal Drum Containing Yellow Uranium Powder	U-235	5	5.13E-04	0.00E+00	0.00E+00	
Metals portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-235	345	3.09E-02	2.00E-09	6.18E-11	
Oil portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-235	345	5.01E-04	2.00E-09	1.00E-12	**6.28E-11**
30-gal Drum Containing Black Uranium Powder	U-238	100	8.28E+00	0.00E+00	0.00E+00	
30-gal Drum Containing Yellow Uranium Powder	U-238	5	6.75E-02	0.00E+00	0.00E+00	
Metals portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-238	345	2.70E+00	2.00E-09	5.41E-09	
Oil portion of a 30-gal Drum Containing Metal/Oil in 55-gal Steel Overpack	U-238	345	4.17E-02	2.00E-09	8.35E-11	**5.49E-09**

Table C-2. Summary of the Potential-to-Emit Values and Unabated Offsite Dose. (Potential-to-Emit Values from Table C-1.)

Isotope	Potential-to-Emit Values (Ci/yr)			Unabated Offsite Dose (mrem/yr)[1]
	618-4 Drums	618-5 Drums	Total	
U-234	1.22E-08	9.32E-10	1.31E-08	6.50E-08
U-235	8.49E-10	6.28E-11	9.11E-10	4.28E-09
U-238	7.18E-08	5.49E-09	7.72E-08	3.41E-07
Total				**4.10E-07**

[1] The annual unabated dose was determined using the CAP88-PC, Version 2 model. The potential-to-emit total (Ci/yr) was input to the model, and the model generated the annual unabated dose. The distance to the MEI for the ERDF is 13,750 m east southeast. The CAP88-PC model summary and synopsis are presented in ERC Calculation 0600X-CA-V0018, Rev. 0, *Total Effective Dose Equivalent for ERDF Staging Area,* January 2002.