RECEIVED
APR 23 1997
OSTI

BHI-00844
Rev. 1
Volume 2

Application for Approval of Derived Authorized Limits for the Release of the 190-C Trenches and 105-C Process Water Tunnels at the Hanford Site: Volume 2 - Source Term Development

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.
Richland, Washington

MASTER

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.
Available in paper copy and microfiche.

Available to the U.S. Department of Energy
and its contractors from
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831
(615) 576-8401

Available to the public from the U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

Printed in the United States of America

DISCLM-5.CHP (8-91)

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
in electronic image products. Images are
produced from the best available original
document.**

APPROVAL PAGE

Title of Document: APPLICATION FOR APPROVAL OF DERIVED AUTHORIZED LIMITS FOR
THE RELEASE OF THE 190-C TRENCHES AND 105-C PROCESS WATER
TUNNELS AT THE HANFORD SITE:
VOLUME 2 - SOURCE TERM DEVELOPMENT

Author: D. H. Denham, BHI
S. L. Winslow, THI
W. E. Kennedy, Jr., Dade Moeller & Associates
M. P. Moeller, Dade Moeller & Associates

Approval: J. J. McGuire, Project Manager, D&D Projects

Signature

Date

The approval signatures on this page indicate that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

BHI-DIS

3/28/97 MAH

CONCURRENCE PAGE

N. C. Little, Lead Engineer
D&D Projects

3-26-97

DATE

A. A. Freitag, Project Engineer
D&D Projects

3-27-97

DATE

M. A. Mihalic, Task Lead
D&D Projects

3-26-97

DATE

S. L. Winslow, Lead RadCon Engineer
RadCon Operations

3-27-97

DATE

BHI-00844

Rev. 1

Volume 2

Application for Approval of Derived Authorized Limits for the Release of the 190-C Trenches and 105-C Process Water Tunnels at the Hanford Site: Volume 2 - Source Term Development

Author

D. H. Denham, BHI

S. L. Winslow, THI

W. E. Kennedy, Jr., Dade Moeller & Associates

M. P. Moeller, Dade Moeller & Associates

Date Published

March 1997

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.

Richland, Washington

MASTER

HH
DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED

EXECUTIVE SUMMARY

As part of environmental restoration activities at the Hanford Site, Bechtel Hanford, Inc. (BHI) is conducting a series of evaluations to determine appropriate release conditions for specific facilities following the completion of decontamination and decommissioning (D&D) projects. The release conditions, with respect to the residual volumetric radioactive contamination, are termed *authorized limits*. The U.S. Department of Energy (DOE), Richland Operations Office (RL) has the authority (under current DOE Order 5400.5 and potentially under 10 CFR 834) to approve authorized limits specific to D&D projects at the Hanford Site. This two volume report provides the necessary evaluations for the 190-C trenches and 105-C process water tunnels, serves as the technical basis for a request for approval of authorized limits of residual radioactive contamination levels associated with these facilities, and documents our response (Appendix A, Volume 1) to the comments received from RL following issuance of Rev. 0 on January 20, 1997.

Volume 1 of this report contains the Dose Assessment and Results and this volume (Volume 2) contains the Source Term Development. This volume contains the radiological characterization data, spreadsheet analyses, and radiological source terms. The source terms characterize the radionuclides and activity concentration levels for the facilities, and serves as input to the various radiation exposure pathways and scenarios used to estimate the individual annual radiation doses that could result from release of these facilities. Based on the results of these evaluations, it is determined that the application of the proposed authorized limits for the 190-C trenches and the 105-C process water tunnels represents a safe and cost-effective approach to their final disposition.

CONTENTS

1.0	INTRODUCTION	1
2.0	FACILITY DESCRIPTION/CONTAMINATION HISTORY	1
2.1	190-C MAIN PUMPHOUSE	2
2.2	105-C PROCESS WATER TUNNELS	4
3.0	RADIOLOGICAL SURVEY RESULTS	4
3.1	190-C MAIN PUMPHOUSE TRENCHES	6
3.2	105-C PROCESS WATER TUNNELS	6
3.3	117-N HIGH-EFFICIENCY PARTICULATE AIR FILTER CONTAMINATION	7
4.0	SOURCE TERM EVALUATIONS	7
4.1	RESRAD-BUILD SOURCE TERM	7
4.2	NUCLEAR REGULATORY COMMISSION DECOMMISSIONING RESIDENTIAL SCENARIO SOURCE TERM	9
5.0	CONCLUSIONS	10
6.0	REFERENCES	10

APPENDICES

A - RADIOLOGICAL SURVEY RECORDS FOR THE 190-C TRENCHES AND THE 105-C TUNNELS	A-1
B - GAMMA RAY ENERGY ANALYSIS REPORTS	B-1
C - MICROSOFT EXCEL® SPREADSHEET RESULTS	C-1

FIGURES

1. Basement Level Layout for the 190-C Pumphouse	3
2. Layout of the 105-C Process Water Tunnels	5

TABLES

1. RESRAD-BUILD Source Term for the 190-C Trenches	8
2. RESRAD-BUILD Source Term for the 105-C Process Water Tunnels	8
3. Residential Scenario Source Term for the 190-C Trenches and the 105-C Process Water Tunnels	9

1.0 INTRODUCTION

Chapters II and IV of the U.S. Department of Energy (DOE) Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990) contain the DOE requirements for control and release of property containing residual radioactive material. In addition, the Department issued guidance (DOE 1995a) to address release of non-real property and structures. This guidance states:

It is the responsibility of DOE field and, as appropriate, program offices to review and, where appropriate, approve measurement procedures and methodology and authorized limits for soil (lands) which meet DOE requirements for restricted or unrestricted use as specified in the Order and associated guidance.

It is anticipated that this guidance will also be consistent with the final version of 10 CFR 834, *Radiation Protection of the Public and the Environment*, once it becomes final.

Bechtel Hanford, Inc. (BHI) is in the process of conducting environmental restoration activities at the Hanford Site. As part of these activities, BHI is documenting a series of evaluations to determine appropriate release conditions for specific facilities following the completion of decontamination and decommissioning (D&D) projects. This report presents the summary of the supporting information and the final application for approval of derived authorized limits for the release of the 190-C trenches and the 105-C process water tunnels. The information in this report has been developed to follow the DOE guidance and addresses the significant concerns and issues necessary to gain approval of this application for authorized limits for the 190-C trenches and the 105-C process water tunnels.

The information that comprises this application is organized into two volumes: Volume 1 - Dose Assessment and Results, and Volume 2 - Source Term Development. This volume (Volume 2) contains the radiological characterization data, spreadsheet analyses, and radiological source terms. The source terms characterize the radionuclides and activity concentration levels for the facilities, and serve as input to the various radiation exposure pathways and scenarios used to estimate the individual radiation doses that could result from release of these facilities

2.0 FACILITY DESCRIPTION/CONTAMINATION HISTORY

The 100 Area of the Hanford Site served as the location of the nine nuclear reactors used to produce plutonium for national defense. These nuclear production reactors were all graphite-moderated, and water-cooled, with a once-through coolant water design dependent on the

use of water from the nearby Columbia River. The following sections describe the 190-C Main Pumphouse and the 105-C process water tunnels and their contamination histories.

2.1 190-C MAIN PUMPHOUSE

Associated with the C Reactor, the 190-C Main Pumphouse served as the pumphouse for process water to be used for once-through cooling. The C Reactor was closed in 1969 and is the subject of environmental restoration activities. Figure 1 shows the relative dimensions of the 190-C pumphouse and includes the 105-C water tunnel connections. The 190-C Facility pumped water to the C Reactor after the water was treated/filtered in the 183-C filter building/pumproom. The water was chemically treated with sodium dichromate and stored in outside tanks located between the 190-C and 183-C facilities.

The 190-C Facility is approximately 49 by 60 by 10 m (160 by 196 by 32 ft), constructed above ground, on a reinforced concrete foundation, with a full basement. Located on the main floor are ten pumping stations, electrical switchgear room, control room, survey room, lunchroom, change room, bathroom, shop area, and filter storage area. The basement contains cooling water systems, compressed air and steam piping, fluid coupling heat exchanger, solids injection system, valve pits and the entrances to the 105-C process water tunnels. Each tunnel contains the piping used to supply water and steam to the C Reactor.

After the 190-C Facility was shutdown, the floor space was used for storage of miscellaneous items such as boxes of insulation, pallets of scrap metal, crates of pump parts, and surplus piping. The facility was also used as a work area to replace the radiologically contaminated filters from the 117-N high-efficiency particulate air (HEPA) filter banks. Limited quantities of particulate contamination from the filter frames escaped into the facility. The potential for contamination from this source was considered as a potential part of the source term, as described later in this volume. The stored insulation, scrap metal, and various pieces of stored equipment have been removed from the building. Because of the potential for particulate contamination, all items removed were surveyed prior to radiological release.

The 190-C Facility was initially characterized for both hazardous and radiological contaminants, as reported in BHI-00523, *Characterization Report on the 190-C Main Pump House Facility* (Harris 1995). The characterization report identifies the areas containing radioactive and hazardous materials, their constituents and recommended methods of disposal. During subsequent decontamination activities, mercury was discovered in the basement trenches. The visible mercury beads and other debris, including radioactive contamination, were vacuumed from the trenches. Additionally, the facility was radiologically decontaminated and the surfaces of the trenches were painted to "fix" any remaining residual radioactive contamination. The contamination surveys provided in this report were taken after the trenches were vacuumed, but before the fixative was applied. At a later date, the facility

Figure 1. Basement Level Layout for the 190-C Pumphouse.

NOTE: The trenches are 2.5' wide by 2.0' deep.

will be demolished to a level about 1 m (3 ft) below grade. The basement structure, located deeper than 1 m (3 ft) below grade, will remain and be filled with demolition debris. All below grade areas will be filled to eliminate future subsidence.

2.2 105-C PROCESS WATER TUNNELS

Two underground tunnels, which contained pipes that carried the coolant water, connected the 190-C Main Pumphouse to the 105-C Reactor Building. These tunnels were designated as the 105-C process water tunnels. The length of each tunnel was slightly greater than 152 m (500 feet). Figure 2 shows the approximate layout of the 105-C process water tunnels, with the connections to the far ends of the 190-C Main Pumphouse.

The 105-C water tunnels are constructed of reinforced concrete floors, walls, and roofs. The tunnels vary in width and height but average about 3.0 m by 3.7 m (10 ft by 12 ft). Each tunnel contains three, 0.6 m (24 in) water lines and one, 0.2 m (8 in) steam line.

The tunnels were sloped toward the 190-C Building to allow any water leaks from the piping to flow to the main sump. The floor elevation of the tunnels drop about 3.7 m (12 ft) from the reactor to the basement of the 190-C Building.

The only decontamination activity that was determined to be necessary for the 105-C tunnels was the removal of asbestos insulation on the tunnel piping. The residual levels of radioactive contamination were determined to be low enough as to not warrant further decontamination, pending approval of this application for authorized limits.

Both the 190-C main pumphouse and the 105-C process water tunnels were considered to be radiologically uncontaminated (clean) facilities for most of their operation because they were on the intake (not discharge) side of the water coolant system. However, during the operation of the C Reactor, reactor coolant water occasionally entered the tunnels from the 105-C Facility and deposited radioactive contamination on the floors of the tunnels and trenches of the 190-C basement. These trenches (shown in Figure 2) were about 0.7 m (2.5 feet) wide and 0.6 m (2 feet) deep, and were used to channel water away from the pump station foundations and other floor areas.

3.0 RADIOLOGICAL SURVEY RESULTS

Following decontamination operations for the 190-C trenches and 105-C tunnels, radiological survey information was collected. The following sections describe the collected data.

Figure 2. Layout of the 105-C Process Water Tunnels.

NOTE: Tunnels are 10' wide by 12' high on the average

(Not to Scale)

3.1 190-C MAIN PUMPHOUSE TRENCHES

Following decontamination of the 190-C trenches, a detailed radiological survey was conducted and the results were recorded as Survey Number 190C-952 (BHI 1996a). This report is included in Appendix A. The survey was conducted using standard Geiger-Mueller (GM) field survey instruments, equipped with a P-11 probe with surface area of 15.5 cm². As shown in the survey report in Appendix A, only a limited area of the basement level of the 190-C Main Pumphouse was determined to contain residual radioactive contamination. The detailed map of this limited area indicates that the typical direct beta-gamma readings for the 190-C trenches were low, in the 1,000 to 2,000 dpm/probe area (15.5 cm²) range, with limited maximum readings in the 10,000 to 20,000 dpm/probe area range.

In addition to the direct survey results, a visible "hot particle" of contamination was obtained from the trench and analyzed by IT Hanford Co. to determine the gamma-ray spectrum associated with the residual radioactive contamination. Limited radionuclide-specific analyses (for strontium-90 and plutonium-239) were also conducted. These results are shown in Appendix B for the 190-C Main Pumphouse. As shown in Appendix B, the dominant radionuclides by activity concentration are strontium-90 and cesium-137, with only minor contributions from other radionuclides. Even though not detected in this sample, both cobalt-60 and europium-152 have been identified in historical source term data for 105-C Reactor (Dorian and Richards 1978). Today these nuclides represent a very small portion of the nuclide distribution, but were included to depict a more representative distribution based on historical data.

3.2 105-C PROCESS WATER TUNNELS

Following the asbestos removal operations for the 105-C tunnels, a detailed radiological survey was conducted to characterize the levels of residual radioactive contamination. The survey was conducted for both the north and south tunnels, and the results are included in Appendix A. These surveys were recorded as Survey Number PS-190C-438 (BHI 1996b) for the north tunnel, and Survey Number PS-190C-437 (BHI 1996c) for the south tunnel. Again, low levels of residual radioactive contamination were encountered, with typical direct readings below 20,000 dpm/probe area, as shown in the detailed survey maps.

Consistent with the evaluation of the 190-C trenches, smear samples were obtained and analyzed in a laboratory (again by IT Hanford Co.) to determine the gamma-ray spectrum associated with the residual radioactive contamination. Since no radionuclide-specific analyses (for strontium-90 and plutonium-239) were conducted and the process water tunnels provided the pathway for the trenches to become contaminated, the same nuclide distribution was assumed to be representative for the tunnels. These results are shown in Appendix B for both the north and south 105-C process water tunnels.

3.3 117-N HIGH-EFFICIENCY PARTICULATE AIR FILTER CONTAMINATION

As discussed in Section 2, part of the 190-C facility was used as a work space to replace the radiologically-contaminated filters from the 117-N filter banks. Limited quantities of particulate contamination from this source were distributed in the 190-C Main Pumphouse as a result of these activities. To evaluate if this source could have significantly modified the source term for the 190-C trenches, additional smear samples were taken of the HEPA filter area and analyzed by IT Hanford Co. The results of these analyses, included in Appendix B, indicate that the radionuclide distribution for the HEPA filter contamination was a different mixture of radionuclides, not consistent with the radionuclide mixture found for the 190-C trenches or the 105-C tunnels. The HEPA filter contamination was mostly cobalt-60, europium-154, and europium-155, with some strontium-90, while the contamination on the samples from the 190-C trenches was mostly cesium-137 and strontium-90. This result indicates that the contamination from the 117-N HEPA filter operations did not contribute to the radionuclide mixture found associated with the 190-C trenches and 105-C tunnels. Additionally, this northwest area of the main floor in 190-C was subsequently decontaminated, surveyed, and released from radiological controls per the project-specific release plan.

4.0 SOURCE TERM EVALUATIONS

Two different source terms were determined for the 190-C trenches and the 105-C tunnels. The first was designed to serve as input to the RESRAD-BUILD recreationist scenario, and provided the average surface activity levels, in units of $\text{pCi}/100 \text{ cm}^2$. The second source term was designed as input to the residential scenario developed to support the revised U.S. Nuclear Regulatory Commission (NRC) policy on decommissioning (Kennedy and Strenge 1992). The following sections describe the source terms that were developed for the 190-C trenches and the 105-C tunnels.

4.1 RESRAD-BUILD SOURCE TERM

The source term needed to conduct a scenario analysis using RESRAD-BUILD was developed for the 190-C trenches and the 105-C tunnels using the results of fixed (direct) and removable (smear) contamination surveys. The smear samples were subjected to gamma-ray energy analysis and limited radionuclide-specific analyses (for strontium-90 and plutonium-239). The RESRAD-BUILD scenario uses surface contamination readings, consistent with the contamination levels measured during the site characterization measurements, without further radioactive decay.

For the 190-C trenches and 105-C tunnels, the results of the *in situ* field measurements were evaluated by first summing the fixed and removable contamination levels (in units of dpm/100 cm²), as determined through smear sample analysis. By summing the fixed and removable values, a conservative maximum surface contamination level was determined to represent the total contamination present. Next, the average of these measurements was calculated, converted to pCi/cm², and then multiplied by the fractional contribution of each radionuclide to the total mixture that was determined from the gamma-ray and specific radionuclide analyses. These calculations were performed using Microsoft Excel® spreadsheets. A copy of the spreadsheets and the results obtained is included in Appendix C for both the 190-C trenches and the 105-C tunnels. The resulting radionuclide distributions are shown in Table 1 for the 190-C trenches and in Table 2 for the 105-C tunnels. For both source terms, it is noted that the dominant radionuclides by activity concentration are strontium-90 and cesium-137, with only minor contributions from other radionuclides.

Table 1. RESRAD-BUILD Source Term for the 190-C Trenches.

Radionuclide	Percent Distribution	Total (Fixed plus Removable) Surface Activity (pCi/100 cm ²)
cobalt-60	0.42	41
strontium-90	53	5,195
cesium-137	46	4,509
europium-152	0.21	21
plutonium-239	0.3	29
americium-241	0.03	2.9

Table 2. RESRAD-BUILD Source Term for the 105-C Process Water Tunnels.

Radionuclide	Percent Distribution	Total (Fixed Plus Removable) Surface Activity (pCi/100 cm ²)
cobalt-60	0.42	300
strontium-90	53	38,400
cesium-137	46	33,300
europium-152	0.21	150
plutonium-239	0.3	220
americium-241	0.03	22

4.2 NUCLEAR REGULATORY COMMISSION DECOMMISSIONING RESIDENTIAL SCENARIO SOURCE TERM

Input to the residential scenario (developed to support NRC decommissioning activities and documented in NUREG/CR-5512, *Residual Radioactive Contamination from Decommissioning: Volume 1, Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent* [Kennedy and Streng 1992]), requires an estimate of the source term in units of pCi/g of each radionuclide in the mixture. As a first step in the evaluation, the total activity present in both the 190-C trenches and the 105-C tunnels is estimated by multiplying the average contamination levels for these facilities (by radionuclide) by the total area contaminated. About 244 m² of contamination are found in the 190-C trenches, and about 972 m² are found in the 105-C tunnels. The average concentration in the top 0.5 m of soil is next determined by assuming that this summed activity is homogeneously distributed over an area of 1 hectare, consistent with the NRC residential scenario assumptions. The density of the soil is assumed to be 1.6 g/cm³. The summary of this source term and the resulting soil concentrations are shown in Table 3.

Table 3. Residential Scenario Source Term for the 190-C Trenches and the 105-C Process Water Tunnels.

Radionuclides	190-C Trenches Total Activity (pCi)	105-C Tunnels Total Activity (pCi)	Combined Total Activity (pCi)	Concentration in Top 0.5 m of Soil over an area of 1 ha (pCi/g)
cobalt-60	1.00E+6	2.92E+7	3.02E+7	3.78E-3
strontium-90	1.27E+8	3.73E+9	3.86E+9	4.82E-1
cesium-137	1.10E+8	3.24E+9	3.35E+9	4.19E-1
europium-152	5.12E+5	1.45E+7	1.51E+7	1.89E-3
plutonium-239	7.08E+5	2.14E+7	2.21E+7	2.76E-3
americium-241	7.08E+4	2.14E+6	2.21E+6	2.76E-4

5.0 CONCLUSIONS

In conclusion, the following points are noted:

- The measured residual radioactive contamination levels in the 190-C trenches and the 105-C tunnels are dominated by strontium-90 and cesium-137.
- Three separate source terms were determined to be the following:
 - 1) 190-C Trenches
 - 2) 105-C Process Water Tunnels
 - 3) Combined activity from the trenches and tunnels spread out on the ground surface (to a depth of 0.5 m) over 1 hectare.
- The source terms derived for this analysis are conservative estimates of the contamination levels and radionuclide mixtures because: the source terms are derived using the "as measured" data without background subtraction, and represent the sum of fixed plus removable contamination, not just total contamination as measured *in situ*.
- Contamination from the 117-N HEPA filter replacement activities that were conducted in the 190-C Main Pumphouse after operations at the C Reactor ceased did not contribute to the source term based on the gamma-ray spectra results obtained during the characterization, and this area of the building was surveyed and released from radiological controls prior to the characterization surveys used to estimate the source terms for the basement-level trenches.

6.0 REFERENCES

- 10 CFR 834, 1995, "Radiation Protection of the Public and the Environment," *Code of Federal Regulations*, Draft, as amended.
- BHI, 1996a, *Radiological Survey Record, 190-C Main Pumphouse*, RWP # PS-190C-004, Rev. 2, Survey Number PS-190C-952, Bechtel Hanford, Inc., Richland, Washington.
- BHI, 1996b, *Radiological Survey Record, 190-C North Tunnel*, RWP # PS-190C-004, Rev. 0, Survey Number PS-190C-438, Bechtel Hanford, Inc., Richland, Washington.
- BHI, 1996c, *Radiological Survey Record, 190-C South Tunnel*, RWP # PS-190C-004, Rev. 0, Survey Number PS-190C-437, Bechtel Hanford, Inc., Richland, Washington.
-

DOE, 1990, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, U.S. Department of Energy, Washington, D.C.

DOE, 1995, *Memorandum: Application of DOE 5400.5 Requirements for Release and Control of Property Containing Residual Radioactive Material*, dated November 17, 1995, from Raymond F. Pelletier, Director, U.S. Department of Energy, Office of Environmental Policy and Assistance, Washington, D.C.

Dorian, J. J. and V. R. Richards, 1978, *Radiological Characterization of the Retired 100 Areas*, UNI-946, United Nuclear Industries, Inc., Richland, Washington.

Harris, R. A., 1995, *Characterization Report on the 190-C Main Pump House Facility*, BHI-00523, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Kennedy, W. E., Jr., and D. L. Strenge, 1992, *Residual Radioactive Contamination From Decommissioning: Volume 1, Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent*, NUREG/CR-5512, Pacific Northwest Laboratory, Richland, Washington.

Yu, C., D. J. LePoire, C. O. Loureiro, L. G. Jones, and S. Y. Chen, 1994, *RESRAD-BUILD: A Computer Model for Analyzing the Radiological Doses Resulting from the Remediation and Occupancy of Buildings Contaminated with Radioactive Material*, ANL/EAD/LD-3, Argonne National Laboratory, Argonne, Illinois.

APPENDIX A

RADIOLOGICAL SURVEY RECORDS FOR THE 190-C TRENCHES AND THE 105-C TUNNELS

ERC Radiological Survey Record

Page 1

Survey & Counting Instruments			Survey Number:	Location:	(Check One)	RWP Number:
Model	Serial Number	Response			☐ Release ☐ Routine ☒ Work Progress ☐ Shipment	PS-AOC-004 REV 2
Gm/P-11	1655/0477	4	190C-952	190C Trenches		
Gm/P-11	1895/04161		Date:	Time:		
Gm/P-11	0936/0697	PS	8.5.96	1520		
Gm/P-11	1996/0611	PS				

Contamination Survey Information

No.	Description of item or location surveyed	Removable		Direct		No.	Description of item or location surveyed	Removable		Direct	
		Alpha	Beta-Gamma	Alpha	Beta-Gamma			Alpha	Beta-Gamma	Alpha	Beta-Gamma
	For Levels Found See										
	Attached Survey Map.										

Circled values in removable
B-G column denotes mrad/hr betaUnless noted, removable contamination is
<1,000 dpm/100 cm² Beta-gamma. Direct readings are
<1,000 dpm/probe Beta-gamma. Alpha is <20 dpmReadings taken at 3/4 max. dimension
of object: CF (CP) = 3, CF (RO-2) = 4
Readings beyond that distance, CF = 1

O = Removable # = Direct M = LAW = Gamma, mR/hr □ = Beta, mrad/hr Δ = Micro-R/hr * = Contact Rdg. N = Neutrons, nrem/hr [AS] = air sample

-C- Contaminated Area	-H- High Contamination Area	-R- Radiologically Buffer Area	-RC- Radiologically Controlled Area	-RM- Radioactive Materials Storage Area	-R- Radiation Area	-HR- High Radiation Area
-----------------------	-----------------------------	--------------------------------	-------------------------------------	---	--------------------	--------------------------

See Attached
Survey Map

COPY

(Both Print & Sign)
S. K. K. / L. Metzger / R. Spence 8.6.96
RCT Signature/Date / L. Metzger / R. Spence 8.6.96
RC Supervisor Signature/Date J. Butler / 8/6/96

Remarks: Note, Levels listed on page 3 map are
B.V. levels direct/probe area in DPM. &
levels listed on sides are below water
mark on walls. & Approx 54' of trench was
characterized. &

ERC Radiological Survey

Survey No. 190C-952

Page 2 of 2

Additional Information (drawing, map, etc.)

Basement level

COPY

Page 3 of 3

EMI-TIA-PCCSC (2:55)

ERC Radiological Survey Record

Page 1 of 2

Survey & Counting Instruments			Survey Number:		Location:		(Check One)		RWP Number:	
Model	Serial Number	Response	PS-190C-438		190C		☐ Release ☐ Routine ☒ Work Progress ☐ Shipment		PS-190C-004	
12m P-11	8916/814	1m	Date:	Time:	North				2WD	
12m P-11	481231	1SK	3/6/96	1100	Turne					
12m P-11	11244/32	1m								
12m P-11	1446/398	1m								
2m P-11	2979	1m								

Contamination Survey Information

No.	Description of item or location surveyed	Removable		Direct		No.	Description of item or location surveyed	Removable		Direct	
		Alpha	Beta-Gamma	Alpha	Beta-Gamma			Alpha	Beta-Gamma	Alpha	Beta-Gamma
1	Floor of Tunnel	<20	2.5K	<20	30K	6	Floor of Tunnel	<20	2.1K	<20	30K
2		<20	2K	<20	30K	7		<20	1.5K	<20	30K
3		<20	2K	<20	30K	8		<20	2K	<20	20K
4		<20	4.5K	<20	30K	9		<20	5.6K	<20	20.5K
5	✓	<20	3.5K	<20	30K	10	↓	<20	2.4K	<20	20K

Circled values in removable B-G column denotes mrad/hr beta

Unless noted, removable contamination is <1,000 dpm/100 cm² Beta-gamma. Direct readings are <1,000 dpm/probe Beta-gamma. Alpha is <20 dpm

Readings taken at 3/4 max. dimension of object: CF (CP) = 3, CF (RO-2) = 4
Readings beyond that distance, CF = 1

○ = Removable	# = Direct	M = LAW	□ = Gamma, mR/hr	□ = Beta, mrad/hr	△ = Micro-R/hr	◊ = Contact Adj.	N = Neutrons, nram/hr	[AS] = air sample
-C- Contaminated Area	-H- High Contamination Area	-R- Radiologically Buffer Area	-RC- Radiologically Controlled Area	-RM- Radioactive Materials Storage Area	-R- Radiation Area	-HR- High Radiation Area		

See attached
Survey map

COPY

(Both Print & Sign) 3/6/96 RCT Signature/Date RC Supervisor Signature/Date S.R. REED		Remarks: please note smearable levels are taken with LAW's, due to contaminant will not cling to tech smears. no dose rates were found. Contamination was concentrated closest to pipes and under pipes.
--	--	--

ERC Radiological Survey Record -- Continuation

Survey No. PS-19DC-43B

Page 2 c

Contamination Survey Information

No.	Description of item or location surveyed	Removable		Direct		No.	Description of item or location surveyed	Removable		Direct	
		Alpha	Beta-Gamma	Alpha	Beta-Gamma			Alpha	Beta-Gamma	Alpha	Beta-Gamma
11	Floor of Tunnel	420	2.2K	420	20K						
12		420	3K	420	20K						
13		420	3K	420	20K						
14		420	2.4K	420	20.5K						
15		420	2K	420	10.5K						
16				420	10.5K						
17				420	10.5K						
18	1st 1" dia - pipe	420	2K								
19		420	2K								
20		420	1.5K								
21		420	1K								
22		420	1K								
24		420	2K								
25		420	1.5K								
26		420	1K								
28		420	1K								
29		420	1.5K								
30		420	1K								
31		420	1K								
33	2nd upper pipe	420	1K								
37		420	1.2K								
38		420	1.4K								
39		420	1.6K								
40		420	1.2K								
41		420	1K								
42		420	1K								

ЕН-ТМ-РОДЕБ (2/35)

ERC Radiological Survey Record -- Continuation

Survey No. PS-19DC-438

Page 3 of 3

↓ Additional Information (drawing, map, etc.) ↓

NORTH TUNNEL

COPY

BHI-TM-R006c (2/95)

ENTER

ERC Radiological Survey Record

Page 1 of 3

Survey & Counting Instruments			Survey Number:		Location:		(Check One)		RWP Number:		
Model	Serial Number	Response									
GMIP-11	19961814	K	PS. 190C.437		190C South Tunnel		☐ Release ☐ Routine ☒ Work Progress ☐ Shipment		PS. 190C.004 Rev 0		
PAM	2979	↓	Date:		Time:						
CP	6364	↓	3.6.96		1000						
GMIP-11	481231	MS									
GMIP-11	1644155	↓									
GMIP-11	14461399	↓									

Contamination Survey Information											
No.	Description of Item or location surveyed	Removable		Direct		No.	Description of Item or location surveyed	Removable		Direct	
		Alpha	Beta-Gamma	Alpha	Beta-Gamma			Alpha	Beta-Gamma	Alpha	Beta-Gamma
1	Floor of tunnel	420	1500	420	15K	6	Floor of Tunnel	420	2K	420	20K
2			1500		20K	7			2K		15K
3			1500		10K	8			1500		20K
4			2500		150K	9			1K		10K
5			2000		25K	10			1500		15K

Circled values in removable B-G column denotes mrad/hr beta

Unless noted, removable contamination is <1,000 dpm/100 cm² Beta-gamma. Direct readings are <1,000 dpm/probe Beta-gamma, Alpha is <20 dpm

Readings taken at 3/4 max. dimension of object: CF (CP) = 3, CF (RO-2) = . Readings beyond that distance, CF = .

○ = Removable # = Direct M = LAW — = Gamma, mR/hr □ = Beta, mrad/hr Δ = Micro-R/hr * = Contact Adj. N = Neutrons, mm/hr [AS] = air sample

—C— Contaminated Area —H— High Contamination Area — Radiological Buffer Area —RC— Radiologically Controlled Area —RM— Radioactive Materials Storage Area —R— Radiation Area —HR— High Radiation Area

See attached
Survey Map

COPY

(Both Print & Sign)		Remarks: Please note smearable levels are taken with laws, due to contamination will not cling to tech smears. No dose rates were found. Contamination was concentrated closest to pipes and under pipes.	
RCT Signature/Date	S. Klekar 3.6.96		
RC Supervisor Signature/Date	S.R. HEED 3/7/96		

MULTI-DMA (8/85)

ERC Radiological Survey Record -- Continued..

Survey No. PS. 1900. 437

Page 2 of:

Contamination Survey Information

[illegible]

COPY

ERC Radiological Survey Record -- Continuation

Survey No. PS-1901-437

Page 3 of 3

Additional Information (drawing, map, etc.)

BHI-TM-R0086 (8/95)

APPENDIX B

GAMMA RAY ENERGY ANALYSIS REPORTS

Trenches

	A	B	C	D	E	F	G
1	GAMMA-RAY ENERGY ANALYSIS REPORT				190-C Trenches		
2	Radiometric Laboratory						
3	Environmental Analytical Laboratory						
4	IT Hanford Co.						
5							
6							
7	Customer ID Number:			190C Hot Particle			
8	EAL ID Number:			EAL02418			
9							
10	Isotope		Activity, pCi on 17 April, 1996				
11	-----						
12	Be7	<	809.10				
13	K40	<	182.00				
14	Co57	<	353.50				
15	Co60	<	22.59				
16	RuRh106	<	977.00				
17	Sb125	<	263.10				
18	I129	<	12060.00				
19	Cs134	<	36.93				
20	Cs137		36800.00	+/-	6354.00		
21	Ce144	<	338.80				
22	Eu152	<	84.39				
23	Eu154	<	83.26				
24	Eu155	<	187.10				
25	Th32dau	<	106.20				
26	U235	<	84.00				
27	U238	<	4974.00				
28	U238dau	<	158.70				
29	Np237	<	147.50				
30	Pu239	<	602900.00				
31	Pu240	<	9435000.00				
32	Am241		421.40	+/-	291.10		
33						Alpha activities	
34	Sr-90		43400.00			Am241	23.86
35	Gross Alpha		1304.00			Pu239	235.50
36	Gross Beta		53000.00			Th232	202.00
37	AEA		1304.00			Others	
38							
39	Definitions:						
40	All errors reported at 2 standard deviations						
41							

*Direct
reading
400K
unshielded

150K
shielded
in place*

	A	B	C	D	E	F	G
1	GAMMA-RAY ENERGY ANALYSIS REPORT				105-C North Tunnel		
2	Radiometric Laboratory						
3	Environmental Analytical Laboratory						
4	IT Hanford Co.						
5							
6							
7	Customer ID Number:			190C North Tunnel (maslin)			
8	EAL ID Number:			EAL02047			
9			pg/100cm ²				
10	Isotope		Activity, pCi/g on 22 March, 1996				
11	-----						
12	Be7	<	13.90				
13	K40	<	576.70				
14	Co57	<	908.00				
15	Co60		182.00	+/-	37.60		
16	RuRh106	<	1096.00				
17	Sb125	<	495.80				
18	I129	<	30190.00				
19	Cs134	<	25.45				
20	Cs137		20120.00	+/-	7150.00		
21	Ce144	<	879.30				
22	Eu152	<	163.40				
23	Eu154	<	244.90				
24	Eu155	<	508.40				
25	Th32dau	<	91.37				
26	U235	<	914.00				
27	U238	<	6405.00				
28	U238dau	<	252.90				
29	Np237	<	299.00				
30	Pu239	<	1590000.00				
31	Pu240	<	21980000.00				
32	Am241	<	1050.00				
33							Alpha activities
34	Sr-90	Not Completed yet					
35	Gross Alpha	N/R					
36	Gross Beta	N/R					
37	AEA	N/R					
38							
39	Definitions:						
40	All errors reported at 2 standard deviations						
41							

Direct read.
15k

	A	B	C	D	E	F	G
42	For soils and natural samples, the following applies:						
43	The analysis of U238 is based on the activity of Pa234m						
44							
45	The analysis of Np237 is based on the activity of Pa233						
46							
47	U238dau is the activity of Pb214 and Bi214, short lived daughter products						
48	products of U238. Equilibrium between parent and daughter products probably						
49	does not exist in disturbed materials.						
50							
51	Th32dau is the activity of Ac228, Pb212, and Tl208, short lived daughter products						
52	products of Th232. Equilibrium between parent and daughter products may						
53	not exist in disturbed materials.						
54							
55	Other samples, not containing natural materials, may have inapplicable results						
56	for the Th, U, transuranics and daughter products. The results must then be						
57	balanced against the gross alpha analysis.						
58							
59	N/R means no result or analysis not requested.						
60							
61							
62							
63	Radiological analyst				Date		Albert I. Davi
64							Radiological

	A	B	C	D	E	F	G
1	GAMMA-RAY ENERGY ANALYSIS REPORT				105-C South Tunnel		
2	Radiometric Laboratory						
3	Environmental Analytical Laboratory						
4	IT Hanford Co.						
5							
6							
7	Customer ID Number:		190C South Tunnel (maslin)				
8	EAL ID Number:		EAL02048				
9			PC/100cm ²				
10	Isotope		Activity, pCi/g on 22 March, 1996				
11							
12	Be7	<	353.10				
13	K40	<	546.30				
14	Co57	<	833.70				
15	Co60	<	75.15				
16	RuRh106	<	1054.00				
17	Sb125	<	451.40				
18	I129	<	42070.00				
19	Cs134	<	100.80				
20	Cs137		14470.00	+/-	5146.00		
21	Ce144	<	803.90				
22	Eu152	<	153.80				
23	Eu154	<	137.90				
24	Eu155	<	105.90				
25	Th32dau	<	264.60				
26	U235	<	104.00				
27	U238	<	67.77				
28	U238dau	<	265.80				
29	Np237	<	277.90				
30	Pu239	<	1444000.00				
31	Pu240	<	18370000.00				
32	Am241	<	1041.00				
33					Alpha activities		
34	Sr-90		Not Completed yet				
35	Gross Alpha		N/R				
36	Gross Beta		N/R				
37	AEA		N/R				
38							
39	Definitions:						
40	All errors reported at 2 standard deviations						
41							

*Direct area.
7K*

	A	B	C	D	E	F	G
42	For soils and natural samples, the following applies:						
43	The analysis of U238 is based on the activity of Pa234m						
44							
45	The analysis of Np237 is based on the activity of Pa233						
46							
47	U238dau is the activity of Pb214 and Bi214, short lived daughter products						
48	products of U238. Equilibrium between parent and daughter products probably						
49	does not exist in disturbed materials.						
50							
51	Th32dau is the activity of Ac228, Pb212, and Tl208, short lived daughter products						
52	products of Th232. Equilibrium between parent and daughter products may						
53	not exist in disturbed materials.						
54							
55	Other samples, not containing natural materials, may have inapplicable results						
56	for the Th, U, transuranics and daughter products. The results must then be						
57	balanced against the gross alpha analysis.						
58							
59	N/R means no result or analysis not requested.						
60							
61							
62							
63	Radiological analyst		Date			Albert I. Davi	
64						Radiological	

GAMMA-RAY ENERGY ANALYSIS SCREENING REPORT 117-N HEPA Filters

Radiometric Laboratory

Environmental Analytical Laboratory

IT Hanford Co.

Customer ID Number: 190C Smear # 2

EAL ID Number: EAL01802

Isotope XXXXXXXXXX Ci/g on 30 January, 1996

Be7	<	7.3e+01	
K40	<	8.3e+01	
Co57	<	4.1e+01	
Co60		6.5e+01 +/-	1.6e+01
RuRh106	<	8.4e+01	
Sb125	<	2.1e+01	
I129	<	4.2e+03	
Cs134	<	1.3e+01	
Cs137	<	1.3e+01	
Ce144	<	3.9e+01	
Eu152	<	4.6e+01	
Eu154		7.0e+02 +/-	2.8e+02
Eu155		1.5e+02 +/-	3.5e+01
Th32dau	<	3.8e+01	
U235	<	3.9e+01	
U238	<	2.1e+04	
U238dau	<	1.5e+01	
Np237	<	1.5e+01	
Pu239	<	6.9e+04	
Pu240	<	9.5e+05	
Am241	<	3.2e+01	

Alpha activities

Sr-90	2.5e+01 +/-	1.7e+00
Gross Alpha	N/R	
Gross Beta	N/R	
AEA	N/R	

Definitions:

All errors reported at 2 standard deviations

For soils and natural samples, the following applies:

The analysis of U238 is based on the activity of Pu234m

The analysis of Np237 is based on the activity of Pu233

U238dau is the activity of Pb214 and Bi214, short lived daughter products
products of U238. Equilibrium between parent and daughter products probably
does not exist in disturbed materials.

Th32dau is the activity of Ac228, Pb212, and Tl208, short lived daughter products
products of Th232. Equilibrium between parent and daughter products may
not exist in disturbed materials.

Other samples not containing natural materials, may have inapplicable results
for the Th, U transuranics and daughter products. The results must then be
balanced against the gross alpha analysis.

N/R means no result or analysis not requested.

GAMMA-RAY ENERGY ANALYSIS SCREENING REPORT				117-N HEPA Filters	
Radiometric Laboratory					
Environmental Analytical Laboratory					
IT Hanford Co.					
Customer ID Number: 190C Smear # 1					
EAL ID Number: EAU01801					
Isotope: XXXXXXXXXX B/g on 30 January, 1996					
Be7	<	6.7e+01			
K40	<	6.2e+01			
Co57	<	3.4e+01			
Co60		1.0e+02 +/-	2.4e+01		
RuRh106	<	7.3e+01			
Sb125	<	1.7e+01			
I129	<	1.9e+03			
Cs134	<	1.1e+01			
Cs137	<	7.4e+00			
Ce144	<	3.4e+01			
Eu152	<	3.3e+01			
Eu154		1.3e+03 +/-	2.8e+02		
Eu155		3.0e+02 +/-	3.5e+01		
Th32dau	<	3.3e+01			
U235	<	3.2e+01			
U238	<	3.9e+04			
U238dau	<	1.2e+01			
Np237	<	1.2e+01			
Pu239	<	5.9e+04			
Pu240	<	7.5e+05			
Am241	<	2.4e+01			
Alpha activities					
Sr-90		8.7e+01 +/-	6.7e+00		
Gross Alpha		N/R			
Gross Beta		N/R			
AEA		N/R			
Definitions:					
All errors reported at 2 standard deviations					
For soils and natural samples, the following applies:					
The analysis of U238 is based on the activity of Pa234m					
The analysis of Np237 is based on the activity of Pa233					
U238dau is the activity of Pb214 and Bi214, short lived daughter products					
products of U238. Equilibrium between parent and daughter products probably					
does not exist in disturbed materials.					
Th32dau is the activity of Ac228, Pb212, and Tl208, short lived daughter products					
products of Th232. Equilibrium between parent and daughter products may					
not exist in disturbed materials.					
Other samples not containing natural materials, may have inapplicable results					
for the Th, U transuranics and daughter products. The results must then be					
balanced against the gross alpha analysis.					
N/R means no result or analysis not requested.					

Ave
Co60 82.5

Eu154 1E3
Eu155 2.2 E2

Sr90 56.0

1.47 times more Co60
than Sr90

APPENDIX C

MICROSOFT EXCEL® SPREADSHEET RESULTS

RESRAD-BUILD Spreadsheet Source Term Analysis for the 190-C Trenches.
(sheet 1 of 3)

	Removable dpm/100cm2	Direct dpm/15.5 cm2	Direct dpm/100 cm2	Total Contamination dpm/100cm2	
	1500	1500	9750	11250	
	1500	1500	9750	11250	
	1500	1000	6500	8000	
	2500	2000	13000	15500	
	2000	1000	6500	8500	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	1500	1000	6500	8000	
	1000	1000	6500	7500	
	1500	2000	13000	14500	
	3000	1000	6500	9500	
	1500	2000	13000	14500	
	2000	1000	6500	8500	
	3000	2000	13000	16000	
	1500	1000	6500	8000	
	2000	1000	6500	8500	
	2500	1000	6500	9000	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	4500	1500	9750	14250	
	3500	1000	6500	10000	
	2100	1500	9750	11850	
	1500	1000	6500	8000	
	2000	1500	9750	11750	
	5600	1500	9750	15350	
	2400	1000	6500	8900	
	2200	1500	9750	11950	
	3000	1500	9750	12750	
	3000	1000	6500	9500	
	2400	3000	19500	21900	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	1500	9750	11750	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	2000	13000	15000	
	2000	2500	16250	18250	
	2000	4500	29250	31250	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	

RESRAD-BUILD Spreadsheet Source Term Analysis for the 190-C Trenches.
(sheet 2 of 3)

2000	1000	6500	8500
2000	2000	13000	15000
2000	2000	13000	15000
2000	4000	26000	28000
2000	2500	16250	18250
2000	1000	6500	8500
2000	1000	6500	8500
2000	1500	9750	11750
2000	4000	26000	28000
2000	2000	13000	15000
2000	3000	19500	21500
2000	4000	26000	28000
2000	2000	13000	15000
2000	3500	22750	24750
2000	2000	13000	15000
2000	3000	19500	21500
2000	2000	13000	15000
2000	2000	13000	15000
2000	1000	6500	8500
2000	2000	13000	15000
2000	1000	6500	8500
2000	2000	13000	15000
2000	2000	13000	15000
2000	3000	19500	21500
2000	2000	13000	15000
2000	4000	26000	28000
2000	3000	19500	21500
2000	1000	6500	8500
2000	2000	13000	15000
2000	1000	6500	8500
2000	2000	13000	15000
2000	1000	6500	8500
2000	2000	13000	15000
2000	3000	19500	21500
2000	2000	13000	15000
2000	2500	16250	18250
2000	2000	13000	15000
2000	3000	19500	21500
2000	1500	9750	11750
2000	1000	6500	8500
2000	1000	6500	8500
2000	1000	6500	8500
2000	1500	9750	11750
2000	1000	6500	8500
2000	1000	6500	8500
2000	1000	6500	8500
2000	1000	6500	8500
2000	1500	9750	11750
2000	1000	6500	8500

RESRAD-BUILD Spreadsheet Source Term Analysis for the 190-C Trenches.
(sheet 3 of 3)

	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	1500	9750	11750	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
	2000	15000	97500	99500	
	2000	20000	130000	132000	
	2000	2000	13000	15000	
	2000	6000	39000	41000	
	2000	2000	13000	15000	
	2000	4000	26000	28000	
	2000	10000	65000	67000	
	2000	20000	130000	132000	
	2000	2000	13000	15000	
	2000	4000	26000	28000	
	2000	2000	13000	15000	
	2000	6000	39000	41000	
	2000	1000	6500	8500	
	2000	2000	13000	15000	
Sum	270700		1927250	2197950	
Average Total Contamination				21761.88119	9803
					pCi/100cm2
Removable Release Fraction				0.123160217	
Nuclide	% Distribution		Activity (pCi/100cm2)		
Co60	0.42		41.17112657		
Cs137	46		4509.218625		
Eu152	0.21		20.58556329		
Sr90	53		5195.404067		
Am241	0.03		2.940794755		
Pu239	0.3		29.40794755		

RESRAD-BUILD Spreadsheet Source Term Analysis for the 105-C Tunnels.
(sheet 1 of 1)

	Removable	Direct	Total Contamination		
	dpm/100cm2	dpm/100 cm2	dpm/100cm2		
	1500	97500	99000		
	1500	130000	131500		
	1500	65000	66500		
	2500	975000	977500		
	2000	162500	164500		
	2000	130000	132000		
	2000	97500	99500		
	1500	130000	131500		
	1000	65000	66000		
	1500	97500	99000		
	3000	97500	100500		
	1500	130000	131500		
	2000	97500	99500		
	3000	97500	100500		
	1500	130000	131500		
	2000	65000	67000		
	2500	195000	197500		
	2000	195000	197000		
	2000	195000	197000		
	4500	195000	199500		
	3500	195000	198500		
	2100	195000	197100		
	1500	195000	196500		
	2000	130000	132000		
	5600	133250	138850		
	2400	130000	132400		
	2200	130000	132200		
	3000	130000	133000		
	3000	130000	133000		
	2400	133250	135650		
	2000	68250	70250		
Sum	70700	4917250	4987950		
Average Total Contamination			160901.6129	72478.2040 pCi/100cm2	
Removable Release Fraction			0.01417416		
Nuclide	% Distribution		Activity (pCi/100cm2)		
Co60	0.42		304.4085		
Cs137	46		33339.9738		
Eu152	0.21		152.2042		
Sr90	53		38413.4481		
Am241	0.03		21.7435		
Pu239	0.3		217.4346		

DISTRIBUTION**ONSITE (20 copies)****U.S. Department of Energy**
Richland Operations Office

R. F. Brich	H0-12
J. M. Bruggeman	H0-12
D. C. Smith	H0-12
DOE/RL Public Reading Room	H2-53

ERC Team

D. H. Denham (2)	X0-23
J. H. Dunkirk	H0-13
A. A. Freitag	H0-18
D. E. Gergely	X0-34
N. C. Little	X5-53
J. J. McGuire	X5-53
M. A. Mihalic	X5-53
J. E. Rugg	X5-53
S. L. Winslow	X0-23
D&D Project Files	X5-53
Document and Information Services (4)	H0-09
PNNL Technical Library	P8-55