Hanford Environmental Dose Reconstruction Project

Monthly Report

August 1989

Prepared for the Technical Steering Panel

DISCLAIMER

This report was prepared under the direction of the HANFORD ENVIRONMENTAL DOSE RECONSTRUCTION PROJECT Technical Steering Panel by Battelle Memorial Institute's Pacific Northwest Laboratories operating the Pacific Northwest Laboratory for the U.S. Department of Energy (DOE). While funding for the work was provided by DOE, the work is not under DOE direction or control. The views and opinions of the authors expressed in this document do not necessarily reflect those of the United States Government or any agency thereof. 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 U.S. Government or any agency thereof, nor by Battelle Memorial Institute.

*Printed in the United States of America
Available from
National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161*

*NTIS Price Codes
Microfiche A01*

Printed Copy

Pages	Price Codes
001-025	A02
026-050	A03
051-075	A04
076-100	A05
101-125	A06
126-150	A07
151-175	A08
176-200	A09
201-225	A10
226-250	A11
251-275	A12
276-300	A13

HANFORD ENVIRONMENTAL DOSE
RECONSTRUCTION PROJECT

Monthly Report

August 1989

Prepared for the Technical Steering Panel

Pacific Northwest Laboratory
Richland, Washington 99352

HANFORD ENVIRONMENTAL DOSE RECONSTRUCTION PROJECT

Compiled by: B. S. Dennis
B. S. Dennis, Project Coordinator
Hanford Environmental Dose Reconstruction Project

Approved By: H. A. Haerer
H. A. Haerer, Project Manager
Hanford Environmental Dose Reconstruction Project

Approved By: W. L. Templeton
W. L. Templeton, Manager
Office of Hanford Environment

OFFICE OF HAWAIIAN ENVIRONMENTAL

MANAGEMENT

DATE

[Signature]

OFFICE OF HAWAIIAN ENVIRONMENTAL

MANAGEMENT

DATE

[Signature]

OFFICE OF HAWAIIAN ENVIRONMENTAL

MANAGEMENT

DATE

[Signature]

HAWAIIAN ENVIRONMENTAL DOSE RECONSTRUCTION PROJECT

CC-101

ENV-100-83 10/10

PREFACE

This monthly report summarizes the technical progress and project status for the Hanford Environmental Dose Reconstruction (HEDR) Project (structure shown in Figure 1) being conducted at Pacific Northwest Laboratory (PNL) under the direction of a Technical Steering Panel (TSP). The TSP is composed of experts in numerous technical fields related to this project and represents the interests of the public. The U.S. Department of Energy (DOE) funds the project.

Figure 1. Hanford Environmental Dose Reconstruction Project Organization Structure

EXECUTIVE SUMMARY*

The objective of the Hanford Environmental Dose Reconstruction Project is to estimate the radiation doses that populations could have received from nuclear operations at Hanford since 1944. The project is being managed and conducted by Pacific Northwest Laboratory under the direction of an independent Technical Steering Panel.

The Technical Steering Panel consists of experts in environmental pathways, epidemiology, surface-water transport, ground-water transport, statistics, demography, agriculture, meteorology, nuclear engineering, radiation dosimetry, and cultural anthropology. Included among the members are appointed technical members representing the States of Oregon and Washington, cultural and technical experts nominated by the Indian tribes in the region, and an individual representing the public.

---

* This Executive Summary was approved by the Technical Steering Panel in September 1988.

The project is divided into the following technical tasks. These tasks address each of the primary steps in the path from radioactive releases to dose estimates:

- source terms
- environmental transport
- environmental monitoring data
- demographics, agriculture, and food habits
- environmental pathways and dose estimates.

The source terms task will develop estimates of radioactive emissions from Hanford facilities since 1944. These estimates will be based on historical measurements and production information.

The environmental transport task will reconstruct the movement of radioactive materials from the areas of release to populations. Movement via the atmosphere, surface water (Columbia River), and ground water will be studied.

The environmental monitoring task will assemble, evaluate, and report historical environmental monitoring data. A major effort of this task is to separate Hanford as a source of radionuclide concentrations in the environment from concentrations due to natural sources and nuclear testing fallout.

The demographics, agriculture, and food habits task will develop the data needed to determine the populations that could have been affected by the releases. Population and demographic information will be developed for the general population within the study area. This information will also be developed for several special population groups including the Native American Tribes in the study area, Army personnel stationed at Hanford, Hanford construction workers, and migrant farm workers.

In addition to population and demographic data, the food and water consumption patterns and sources of food and water for these populations must be estimated since these provide a primary pathway for the intake of radionuclides.

Historical dairy farming practices and milk distribution systems will be studied because milk is a significant pathway for iodine-131 to enter the human body. Cows could have eaten vegetation contaminated with this radionuclide.

The environmental pathways and dose estimates task will use the information produced by the other tasks to estimate the radiation doses populations could have received from Hanford.

Project reports, which have been approved by the Technical Steering Panel, and references used in the reports will be made available to the public in a public reading room. Project progress will be documented in monthly reports, which are available to the public.

... to the ...
... of the ...
... of the ...
... of the ...

... of the ...
... of the ...
... of the ...
... of the ...

... of the ...
... of the ...
... of the ...
... of the ...

MANAGEMENT SUMMARY

PROGRESS

In August 1989, HEDR staff accomplished the following activities:

- completed the following scheduled milestones:*
- 0402-B *Monthly Average Air Concentrations/Surface Contamination by Location and Radionuclide Computer Files-Units*
- 0403-B *River Water Radionuclide Concentrations at Defined Locations; Sediment Concentrations*
- 0503-B *Final River and Sediment Monitoring Data*
- 0602-A *Demographic Information for 1944-1947 by Age Group, Urbanization Category, and Subpopulation by Year*
- 0603-A *Preliminary Food Consumption Parameters 1944-1947 for Each Food Type by Age, Sex, Urbanization, Category, Subpopulation*
- 0603-B *Preliminary Food Consumption Parameters 1964-1966 kg/mo Consumed for Each Food Type by Age, Sex, Urbanization Category, Subpopulation*
- 0604-A *Preliminary Agricultural Production/Distribution for Non-Milk Products by Grid Cell*
- 0604-B *Preliminary Milk Production/Distribution/Consumption for 1944-1947 for Each Grid Cell*
- 0604-C *Demographic Information for 1964-1966 Number and Age/Urbanization/Subgroup for River Recreation, Drinking River Water*
- 0605-B *Preliminary Native American Traditional Diet Description-River Pathway*
- 0702-B *Soil-to-Plant Model*
- 0704-A *Bioassay Data-Tabulate Thyroid Data*
- 0704-B *Initiate Investigation of Potential Uses of Bioassay Data*
- held a Native American workshop on August 8 and 9 in Richland, Washington. Seven tribes participated in the workshop, which included an overview of the HEDR Project and discussions on potential data sources, preliminary diet estimates, and indefinite quantity contracts.
- provided Environmental Pathways and Dose Estimates Task staff with input needed to calculate Phase I dose estimates. This information included data on meteorology, surface-water transport, air concentrations, milk production/distribution/consumption, food consumption distribution, and population estimates.

---

* All milestones are internal unless otherwise indicated. All internal milestones contribute to the Phase I summary report.

- began planning activities and milestones for FY 1990
- initiated work on Phase I summary report
- began a series of investigations to determine the important parameters for the Native American diet sensitivity studies
- displayed posters in the Richland Federal Building that summarize available information for the Columbia River between Priest Rapids Dam and McNary Dam
- continued internal PNL clearance on several draft reports, which will become part of the Phase I summary report
- continued declassifying early-day, Hanford-originated documents of potential interest/use in the HEDR Project
- continued development of the strategy and detailed procedures necessary to estimate doses and their uncertainties.

MAJOR ISSUES AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for subsequent months includes the following:**

- complete the following milestones in September:

01   *Phase I Report*
 0402-D *Status Report of Meteorological Data Base Development*
 0502   *I-131 Sample Vegetation Data*
 0602-B *Preliminary Lifestyle Information for Each Age, Urbanization/
 Subpopulation Hours/Month Outdoors vs. Indoors*
 0703-A *Recommendation for Computer System Requirements*
 0703-B *GIS and Data Base System Recommendation*
 0706-A *Inhalation Doses, Vegetation Concentrations, Fallout Dose Rates*
 0706-B *Preliminary Dose Estimates, Air Pathway 1944-1947*
 0706-C *Food Product Consumption Doses*
 0706-D *Milk Ingestion Doses for 1944-1947*
 0706-E *External Dose Rate Calculations by Population Group for 1944-1947*
 0706-F *Dose Calculations for 1964-1966 River Pathway*

** All milestones are internal unless otherwise indicated. All internal milestones contribute to the Phase I summary report.

12-B *Native American Diet Sensitivity Study-River Pathway*
 12-D *List Dominant Radionuclides (to TSP)*
 12-G *Native American Diet Sensitivity Study-Air Pathway*
 12-I *Recommended Areas for Experimental Verification*

- provide input to the Phase I summary report, including continuing to prepare and internally clear various preliminary draft reports that will be appended to the Phase I report
- continue planning preliminary FY 1990 activities
- continue to add input to numerical data base
- complete preparation of vegetation data file and summary for 1945-1946, uncertainty estimates, and external review of the draft vegetation biases report for 1945-1947
- continue contract negotiations with tribes
- continue to assess the use of historical bioassay data
- continue to declassify reports that address activities from reactor startup to about mid-year 1945
- continue to identify and collect documents and/or data of potential interest/use to the HEDR Project that address activities during the years from reactor startup through 1949
- issue remaining HEDR procedures: HEDR-TP-3, *HEDR Documentation of Critical Decisions* and HEDR-TP-4, *HEDR Data Quality Objectives*
- plan for and participate in internal PNL QA audit
- continue developing the strategy and procedures for dose estimation and uncertainty analyses for Phase I.

BUDGET STATUS

Projected expenditures through August 1989 \$ 3102K

Actual expenditures through August 1989 \$ 2971K

VARIANCE EXPLANATION

None. Four internal milestones were rescheduled for completion in September 1989. They are Milestone 0403-A, *Development of Conceptual Model of Radionuclide*

Transport in the Columbia River/Phase I, which will be covered in detail in the Phase I Summary Report, 0502; *I-131 Sample Vegetation Data*, which was impacted by the unavailability of certain interviewees; 12-B, *Native American Diet Sensitivity Study-River Pathway*, and 12-G, *Native American Diet Sensitivity Study-Air Pathway*, which were delayed pending the acquisition of additional information.

CAPITAL STATUS

No FY 1989 capital budget.

PROJECT SUMMARY REPORT

1. IDENTIFICATION NUMBER: DE-AC076RLO 1830		2. PROGRAM/PROJECT TITLE: HANFORD ENVIRONMENTAL DOSE RECONSTRUCTION						3. REPORTING PERIOD: AUGUST 1989			
4a. PARTICIPANT NAME AND ADDRESS: PACIFIC NORTHWEST LABORATORY P. O. BOX 999 RICHLAND, WA 99352		4b. CLIENT NAME AND ADDRESS: DOE/RL RICHLAND WA 99352						5. START DATE: OCTOBER 1988			
								6. COMPLETION DATE: SEPTEMBER 1989			

7. FY 89	8. MONTHS	O	N	D	J	F	M	A	M	J	J	A	S	FY90

9. COST STATUS:														
a. \$ EXPRESSED IN THOUSANDS	4500													
b. BUDGET & REPORTING NO./SUB. ACCT NO. 12578 GEO2210110	4000													
c. FIN. NO.	3500													
d. ACTUAL COSTS PRIOR YEARS 3016	2500													
e. FY BUDGET 3509*	2000													
f. TOTAL BUDGET	1500													
g. FY FUNDS AUTH 3509*	1000													
h. TOTAL FUNDS AUTH 5829	500													

COSTS	I. PLANNED	203	162	312	253	212	260	300	260	320	280	320	400
	J. ACTUAL	193	178	275	180	398	241	362	290	221	316	310	
	K. VARIANCE	10	-16	37	73	-186	19	-62	-30	99	-36	10	
	L. CUM PLANNED	203	365	677	930	1142	1402	1702	1962	2282	2562	3102	3502
	M. CUM ACTUAL	193	371	646	834	1231	1472	1834	2124	2345	2661	2971	
	N. CUM VARIANCE	10	-6	31	96	-89	-70	-132	-162	-63	-99	131	

10. LEGEND: PLANNED ----- ACTUAL ----- PROJECTED ----- FUNDS AUTH. ----- 90% FUNDS SPENT

* Additional \$220K is in subaccount 16027

11. MILESTONES	O	N	D	J	F	M	A	M	J	J	A	S	FY90
01 Phase I Report													
0302-B Description of Major Hanford Site Operations and Facilities, 1944-1972													
0303-A Radionuclide Source Terms from Fuel Processing 1944-1947													
0303-B Dissolution Dates for PUREX 1984-1986													
0303-C Radionuclide List/Decay Schemes													
03 Radionuclide Source Locations/Stacks/Stack Parameters													
0303-D Radionuclide Release Fractions by Major Facility as Function of Time for Gases, Particulates, Volatiles													

LEGEND: SCHEDULED TO TSP TIME LINE DEVIATION TIME NOW:

COMPLETED DEVIATION PROGRESS

12. NAME/SIGNATURE OF PARTICIPANTS PROG/PROJ MANAGER & DATE
H A Haerer

PROJECT SUMMARY REPORT

PROJECT SUMMARY REPORT

PROJECT SUMMARY REPORT

CONTENTS

PREFACE	v
EXECUTIVE SUMMARY	vii
MANAGEMENT SUMMARY	xi
SOURCE TERMS	1
ENVIRONMENTAL TRANSPORT	5
ENVIRONMENTAL MONITORING DATA	9
DEMOGRAPHICS, AGRICULTURE, FOOD HABITS	11
ENVIRONMENTAL PATHWAYS AND DOSE ESTIMATES	15
INFORMATION RESOURCES	19
RECORDS MANAGEMENT	21
QUALITY ASSURANCE	22
STATISTICS	25
PROJECT TECHNICAL COORDINATION	27
APPENDIX A - COMMUNICATIONS LOG	A.1

FIGURES

Hanford Environmental Dose Reconstruction Project Organization Structure	vi

CONTENTS	1
FOREWORD	1
ACKNOWLEDGMENTS	1
ABBREVIATIONS	1
LIST OF FIGURES	1
LIST OF TABLES	1
1. INTRODUCTION	1
2. MATERIALS AND METHODS	1
3. RESULTS	1
4. DISCUSSION	1
5. CONCLUSIONS	1
6. REFERENCES	1
7. APPENDICES	1
8. INDEX	1
9. GLOSSARY	1
10. BIBLIOGRAPHY	1
11. CURRICULUM VITAE	1
12. RESUME	1
13. CERTIFICATE OF PUBLICATION	1
14. DECLARATION OF INTEREST	1
15. STATEMENT OF WORKING DUTY	1
16. STATEMENT OF FINANCIAL INTEREST	1
17. STATEMENT OF ETHICS	1
18. STATEMENT OF COMPLIANCE	1
19. STATEMENT OF AWARENESS	1
20. STATEMENT OF UNDERSTANDING	1
21. STATEMENT OF AGREEMENT	1
22. STATEMENT OF CONSENT	1
23. STATEMENT OF ASSENT	1
24. STATEMENT OF REFUSAL	1
25. STATEMENT OF WITHDRAWAL	1
26. STATEMENT OF RECONCILIATION	1
27. STATEMENT OF RESOLUTION	1
28. STATEMENT OF REPAIR	1
29. STATEMENT OF RESTORATION	1
30. STATEMENT OF REDEMPTION	1
31. STATEMENT OF REFORMATION	1
32. STATEMENT OF REGENERATION	1
33. STATEMENT OF REPRODUCTION	1
34. STATEMENT OF REPRODUCTION	1
35. STATEMENT OF REPRODUCTION	1
36. STATEMENT OF REPRODUCTION	1
37. STATEMENT OF REPRODUCTION	1
38. STATEMENT OF REPRODUCTION	1
39. STATEMENT OF REPRODUCTION	1
40. STATEMENT OF REPRODUCTION	1
41. STATEMENT OF REPRODUCTION	1
42. STATEMENT OF REPRODUCTION	1
43. STATEMENT OF REPRODUCTION	1
44. STATEMENT OF REPRODUCTION	1
45. STATEMENT OF REPRODUCTION	1
46. STATEMENT OF REPRODUCTION	1
47. STATEMENT OF REPRODUCTION	1
48. STATEMENT OF REPRODUCTION	1
49. STATEMENT OF REPRODUCTION	1
50. STATEMENT OF REPRODUCTION	1
51. STATEMENT OF REPRODUCTION	1
52. STATEMENT OF REPRODUCTION	1
53. STATEMENT OF REPRODUCTION	1
54. STATEMENT OF REPRODUCTION	1
55. STATEMENT OF REPRODUCTION	1
56. STATEMENT OF REPRODUCTION	1
57. STATEMENT OF REPRODUCTION	1
58. STATEMENT OF REPRODUCTION	1
59. STATEMENT OF REPRODUCTION	1
60. STATEMENT OF REPRODUCTION	1
61. STATEMENT OF REPRODUCTION	1
62. STATEMENT OF REPRODUCTION	1
63. STATEMENT OF REPRODUCTION	1
64. STATEMENT OF REPRODUCTION	1
65. STATEMENT OF REPRODUCTION	1
66. STATEMENT OF REPRODUCTION	1
67. STATEMENT OF REPRODUCTION	1
68. STATEMENT OF REPRODUCTION	1
69. STATEMENT OF REPRODUCTION	1
70. STATEMENT OF REPRODUCTION	1
71. STATEMENT OF REPRODUCTION	1
72. STATEMENT OF REPRODUCTION	1
73. STATEMENT OF REPRODUCTION	1
74. STATEMENT OF REPRODUCTION	1
75. STATEMENT OF REPRODUCTION	1
76. STATEMENT OF REPRODUCTION	1
77. STATEMENT OF REPRODUCTION	1
78. STATEMENT OF REPRODUCTION	1
79. STATEMENT OF REPRODUCTION	1
80. STATEMENT OF REPRODUCTION	1
81. STATEMENT OF REPRODUCTION	1
82. STATEMENT OF REPRODUCTION	1
83. STATEMENT OF REPRODUCTION	1
84. STATEMENT OF REPRODUCTION	1
85. STATEMENT OF REPRODUCTION	1
86. STATEMENT OF REPRODUCTION	1
87. STATEMENT OF REPRODUCTION	1
88. STATEMENT OF REPRODUCTION	1
89. STATEMENT OF REPRODUCTION	1
90. STATEMENT OF REPRODUCTION	1
91. STATEMENT OF REPRODUCTION	1
92. STATEMENT OF REPRODUCTION	1
93. STATEMENT OF REPRODUCTION	1
94. STATEMENT OF REPRODUCTION	1
95. STATEMENT OF REPRODUCTION	1
96. STATEMENT OF REPRODUCTION	1
97. STATEMENT OF REPRODUCTION	1
98. STATEMENT OF REPRODUCTION	1
99. STATEMENT OF REPRODUCTION	1
100. STATEMENT OF REPRODUCTION	1

Source Terms

OBJECTIVE

Source terms are the amount and type of radioactive materials released to the environment. Members of the Source Terms Task will develop estimates of radioactive emissions since 1944 from Hanford facilities based on historical measurements and production information. Source term estimates will be used by Environmental Transport Task members to reconstruct the concentrations of radionuclides in the environment.

Uncertainty in calculated and measured data can result from many factors. Uncertainties in measured emissions may result from early measurement techniques; for calculated emissions, from the differences in the published variables that are used to perform calculations. By comparing the uncertainty in the available data, task staff will determine the most accurate method for developing source terms. For time periods where measured values do not exist, source terms must be calculated from available information. The proposed methods and results of this task will be reviewed, evaluated, and approved by the TSP.

PROGRESS

Activities for this reporting period included the following:

Milestone 0303-F, *Recommendation Regarding Development of Libraries Specific to Hanford Reactors for ORIGEN Code*, due March 1989 and complete:

- continued internal PNL clearance of the draft report originally completed in March 1989 and revised to incorporate the informal review comments received from the TSP's Source Terms Subcommittee during the March working session.

Milestone 0303-C, *Radionuclide List/Decay Schemes*, due March 1989 and complete:

- continued internal PNL clearance of the draft report originally completed in April 1989.

Milestone 0303-A, *Radionuclide Source Terms from Fuel Processing, 1944-1947*, due May 1989 and complete:

- completed a final draft report of atmospheric emissions of iodine-131 from fuel processing, 1944-1947; these values are all derived from reported emissions. The report will be submitted for internal PNL clearance.

Milestone 0303-G, *Description of Chemical Form and Atmospheric Chemistry of Iodine Emissions*, due May 1989 and complete:

- completed a final draft report describing the chemical form and atmospheric chemistry of iodine emissions at the Hanford Site. The report will be submitted for internal PNL clearance.

Milestone 0303-H, *Best Estimate of Iodine-131 Contained in Irradiated Fuel at Time of Dissolution, 1944-1945*, due May 1989 and complete:

- completed a final draft of the calculated estimates of iodine-131 contained in irradiated fuel at the time of its dissolution, 1944 - 1945.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for subsequent months includes the following:

- document fuel dissolution dates at the PUREX Plant, 1984-1986, from identified records
- continue to prepare various draft reports for inclusion in the draft Phase I report and initiate internal PNL clearance of the reports

- continue acquiring and documenting information regarding radioactive emissions to the atmosphere from fuel processing, 1944-1947
- continue data input to task numerical data base.

Copyright 1994 by the American Psychological Association

0893-3200/94 \$12.00 DOI: 10.1037/0893-3200.14.4.444

Published by the American Psychological Association, 750 First Street, N.E., Washington, DC 20002-4242

Environmental Transport

OBJECTIVE

Members of the Environmental Transport Task will reconstruct the movement of radioactive materials (the source term information) from the areas of release to the accessible environment. Movement via the atmosphere, Columbia River, and ground water will be studied.

To track the releases to the atmosphere from the Hanford Site, meteorological data are needed including wind speed, wind direction, and other data that affect the dispersion of the releases. Mathematical models will be applied to these meteorological data and the source term data to calculate concentrations of radionuclides in the air and on the ground. The TSP will review, evaluate, and provide direction concerning the proposed models.

Reconstruction of the transport of radionuclides in the Columbia River will be based primarily on historical studies of the Columbia River and its tributaries. Computer models will be used to reconstruct radionuclide concentrations in the river for time periods when data were limited or unavailable.

The movement of radionuclides in the ground water will be initially reconstructed by using ground-water monitoring data to estimate the contribution to the surface-water pathway. As in the case of the surface-water pathway, some modeling might be required where data are lacking.

PROGRESS

Activities for this reporting period included the following:

Milestone 0403-A, *Development of Conceptual Model of Radionuclide Transport in the Columbia River/Phase I*, due August 1989 and rescheduled for September 1989:

- provided a description of the calculations completed to estimate radionuclide concentrations in Columbia River water and sediments for Phase I to the Environmental Pathways and Dose Estimates Task. Along with the description of the calculations, major assumptions for the Phase I calculations were summarized. This description of the Phase I calculations and assumptions will be included in the Phase I report. The detailed description of the conceptual model of radionuclide transport in the Columbia River will be completed early in FY 1990.

Milestone 0403-B, *River Water Radionuclide Concentrations at Defined Locations; Sediment Concentrations*, due August 1989 and complete:

- provided the Environmental Pathways and Dose Estimates Task with estimates of radionuclide concentrations in the water column and bed sediments for the Columbia River from the Hanford Site to McNary Dam. The calculations involved routing radionuclide concentrations to locations where water from the Columbia River was used.

Milestone 0402-D, *Status Report on Meteorological Data Base Development*, due September, 1989:

- completed in July the entry of meteorological data for 1983 through 1987 into the meteorological data base for the Phase I calculations. A brief status report on the meteorological data base development will be completed in September.

Milestone 0402-B, *Monthly Average Air Concentrations/Surface Contamination by Location and Radionuclide*, due August, 1989 and complete:

- provided estimates of the monthly-average air concentrations, month-end surface contamination, and monthly-average deposition rates by census division to the Environmental Pathways and Dose Estimates Task. These calculations were based on average meteorological conditions for 1983 through 1987.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

WORK PLANNED FOR SUBSEQUENT MONTHS

Work planned for subsequent weeks includes the following:

- provide input to the Phase I report
- participate in planning for FY 1990.

DECLASSIFIED BY SP-1000/1000 10/15/00

DECLASSIFIED BY SP-1000/1000 10/15/00

DECLASSIFIED BY SP-1000/1000 10/15/00

DECLASSIFIED BY SP-1000/1000 10/15/00

DECLASSIFIED BY SP-1000/1000 10/15/00

DECLASSIFIED BY SP-1000/1000 10/15/00

Environmental Monitoring Data

OBJECTIVE

Members of the Environmental Monitoring Data Task will assemble, evaluate, and summarize key historical measurements of the concentrations of radionuclides in the environment around Hanford. Radionuclide concentrations have been measured at various times in such media as air, drinking water, foods, fish, the Columbia River, soil and in other sample materials. These measurements will be evaluated to estimate their accuracies and then used by Environmental Pathways and Dose Estimates Task staff to estimate radiation doses and by Environmental Transport Task staff to calibrate computer models. Methods to attain this objective will be proposed to the TSP for review, evaluation, and approval.

PROGRESS

Activities for this reporting period included the following:

Milestone 0502, *I-131 Sample Vegetation Data*, due August 1989 and rescheduled for September 1989:

- obtained data on the dimensions of the vegetation samples and the magnitude of the variability in these dimensions. These factors affect the magnitude of the measurement biases and uncertainties. Sage samples were collected and mounted on measurement cards following the procedures described in the historical documents. These were mailed to individuals involved in the historical sampling program to obtain input on the accuracy of the reconstruction, and measurements will be made of samples reconstructed based on those inputs. Work was delayed due to the unavailability of some of these individuals.

Milestone 0503-A, *Final River Water and Sediment Monitoring Data*, due August 1989 and complete:

- completed data base, data verification, and data summary.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTH

Work planned for subsequent months includes the following:

- complete preparation of vegetation data file and summary for 1945-1946, uncertainty estimates, and external review of the draft report on vegetation biases for 1945-1947
- submit river water and sediment data file and summary for 1964-1966 to members of the Environmental Transport and Environmental Pathways and Dose Estimates tasks for model calibration and for direct model input for estimating doses
- prepare first draft of Phase I report contribution.

Demographics, Agriculture, Food Habits

OBJECTIVE

Task members will develop the demographic, food consumption, and food production information needed to estimate doses.

Demographic information will be developed for the general population and for several special population groups that are not adequately represented by the U.S. Census, including Native American tribes, Army personnel stationed at Hanford, some Hanford construction workers, and migrant workers.

In addition to demographic data, the sources and quantities of food and water consumed must be estimated, because food and water provide pathways for the intake of radionuclides.

Airborne radionuclides from the plant stacks may have been deposited on fruits and vegetables. Consumption of these foods provided a pathway for radionuclide transport to humans. The pathways will be studied. In addition, milk produced from cows represents a significant food pathway for iodine-131 if the cows were fed vegetation contaminated with radionuclides. Dairy farming practices and milk distribution systems will be studied to locate the populations that may have consumed potentially contaminated milk.

Consumption of contaminated fish and shellfish is also a food pathway for exposure to radioactive materials. Estimates of the amount of potentially contaminated fish and shellfish consumed from the Columbia River and ocean bays will be developed through an extensive review of numerous past studies.

Treated Columbia River water was used by some community members downstream from Hanford. Drinking this water provided a pathway for exposure to

radioactive materials. To estimate the doses from this pathway, it is necessary to know the communities using the water, the amount of water withdrawn, the treatment process, the travel time through the system, and the amount of water consumed. Irrigation water usage downstream from Hanford will also be studied because the radioactive materials in the river water could have been deposited on crops consumed by people or animals. Recreational users of the river could also have been exposed to radiation from the river and shoreline. Food and lifestyle habits of Native Americans that differentiate them from the general population will also be considered. Methods to collect data and to estimate population densities and food consumption have been proposed to the TSP for review, evaluation, and approval.

PROGRESS

Activities for this reporting period included the following:

- conducted a HEDR Native American Workshop on August 8-9, 1989 in Richland, Washington, with 22 participants from seven tribes (Colville, Kalispel, Nez Perce, Spokane, Umatilla, Warm Springs, and Yakima). The workshop included an overview of the HEDR Project and discussions of potential data sources, preliminary diet estimates, and the indefinite quantity contracts.
- signed an indefinite quantity contract with the Yakima Nation; now awaiting approval from the Yakima Tribal Council
- presented an overview of the HEDR Project to the Coeur d'Alene Tribal Council on August 24, 1989
- discussed the Request for Proposal with technical staff of the Umatilla Tribe on August 25, 1989
- received preliminary diet estimates for all age categories for the 1944-1947 and 1964-1966 time periods from the Colville Tribe
- received a proposal in response to our RFP from the Kalispel Tribe.

Milestone 0605-B, *Native American Traditional Diet Description (River Pathway)*, due August 1989 and complete:

- received traditional diet estimates for the air and water pathways from Dr. Eugene Hunn, Anthropologist at the University of Washington. These estimates were used as a baseline in discussing the diet with the tribes.

- delivered initial Native American food estimates to HEDR technical coordinator for use in estimating Phase I preliminary dose data.

Milestone 0602-A, *Demographic Information for 1944-1947 by Age Group, Urbanization Category, and Subpopulation by Year* and Milestone 0604-C, *Demographic Information for 1964-1966, Number and Age/Urbanization/Subgroup for River Recreation, Drinking River Water*, due August 1989 and complete:

- received ten-county population estimates done by race, sex, and single-year of age
- delivered population estimates broken down by race, sex, and age to HEDR technical coordinator for use in estimating Phase I preliminary dose data
- received report detailing age, race, and sex information for Phase I area from the Demographics Laboratory.

Milestone 0604-B, *Milk Production/Distribution/Consumption for 1944-1947 for Each Grid Cell*, due August 1989 and complete:

- delivered initial cow feeding and milk production and distribution estimates to HEDR technical coordinator for use in estimating Phase I preliminary dose data
- transmitted preliminary data on the milk pathway to Environmental Pathways and Dose Estimates Task staff for use in sensitivity analyses of variables in models of iodine-131 contamination.

Milestone 0603-A, *Preliminary Food Consumption Parameters 1944-1947 for Each Food Type by Age, Sex, Urbanization, Category, Subpopulation*, and Milestone 0603-B, *Preliminary Food Consumption Parameters 1964-1966 Kg/Mo Consumed for Each Food Type by Age, Sex, Urbanization Category, Subpopulation*, due August 1989 and complete:

- completed estimating the food consumption distributions and delivered results to HEDR technical coordinator for use in estimating Phase I preliminary dose data.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for subsequent months includes the following:

- continue contract negotiations with the five tribes who do not have contracts with PNL. Expect to receive proposals from the Colville, Warm Springs, and Umatilla Tribes soon.
- negotiate a work order with the tribes who have contracts that will define the work order(s) for Phase I research. This will include an assessment of available data and a method for collecting that data.
- contact Walla Walla area producers and continue gathering milk model data
- submit final county population estimates report to TSP
- submit draft report on milk production, processing, and distribution to TSP.

Environmental Pathways and Dose Estimates

OBJECTIVE

Task members will use calculated and measured concentrations of radionuclides provided by members of the Environmental Transport Task and the Environmental Monitoring Data Task to calculate doses to populations, typical individuals, and specific individuals. These calculations will include doses via direct transfer of radionuclides from concentrations in air and water to people (via breathing, drinking, immersion, etc.). The calculations will also include doses via radionuclide concentrations in air and water transferred through environmental pathways, such as soil, plants, animals, and fish, to people. All significant decisions on exposure models and input parameters will be presented to the TSP for review, evaluation, and approval.

PROGRESS

Activities for this reporting period included the following:

Milestone 0702-B, *Soil-to-Plant Model*, due August 1989 and complete:

- selected the concentration factor method for use in Phase I for the soil-to-plant model. Concentration ratios were prepared; extreme values for the distribution were obtained from the literature, and a central estimate for Hanford was selected on the basis of expert judgement. This model has been written into the code development specifications.

Milestone 0703-B, *GIS and Data Base System Recommendation*, due September 1989:

- received most of the data required for the Phase I calculations. The data are being studied for incorporation into an ORACLE data base. A wide range of ease of machine-readability was encountered - some data were hand-written, some were generated with a word processor, and some were provided as formatted disk files. Programs were prepared to read the data into arrays more suitable for model calculations.

Milestone 0704-A, *Bioassay Data - Tabulate Thyroid Data*, due August 1989 and complete:

- entered 3330 records into a dBase IV data base, providing input to Milestone 0704-B, *Initiate Investigation of Potential Uses of Bioassay Data*

Milestone 0704-B, *Initiate Investigation of Potential Uses of Bioassay Data*, due August 1989 and complete:

- briefly evaluated the current database. Some of the characteristics of the 3330 records are:
  - records entered to date cover a 27-month period from October 1944 through December 1946
  - the majority of the records are from the 14-month period from July 1945 through August 1946 (only 75 records are dated prior to July 1945 and only 15 are dated post August 1946)
  - the thyroid total net counts (sum of left and right measurements) range from 0 to 132 counts per minute (CPM); over 1200 of the records show 0 net CPM, and over 2500 records show fewer than 10 net CPM
  - the highest total net count rates were evaluated using an arbitrary cutoff value of 38 CPM. Sixty-two records have net count rates of greater to or equal than 38 CPM; 60 of these highest records fall within the 7-month period of July 1945 through January 1946, with one each in February and March 1946.
- made several recommendations concerning additional investigations of this data, including additional review to identify temporal trends.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for the subsequent months includes the following:

- continue defining the overall structure of the needed HEDR data base and the type of data processing equipment needed for smooth project integration
- complete the preliminary code design and implementation
- provide initial estimates of dose for a limited subset of cases.

Information Resources

OBJECTIVE

Members of the Information Resources Task will work with the other task members to meet information needs, including ensuring that all data referenced in the reports are publicly available and establishing a microcomputer-based tracking system for ready retrieval of historical information.

PROGRESS

Activities for this reporting period included the following:

- declassified 10 early-day, Hanford-originated documents of potential interest/use in the HEDR Project and provided them to appropriate task leaders and the public domain
- provided the DOE-RL Public Reading Room with 70 Hanford-Site originated documents of potential interest/use in the HEDR Project. The DOE-RL Reading Room now has copies of all documents identified on the listing generated on 11/28/88.
- continued to search for documents that address silver reactor capabilities, performance, and incidents
- continued to search for documents containing pertinent information of stack filter samples and scrubber samples during 1946 through 1949
- added new citations to the tracking system
- identified and provided the Project Office with selected articles that address communicating risk to lay audiences
- identified the first open literature publication by a Hanford-Site author that positively recognizes milk as a pathway for iodine-131. Other selected publications dated later were also included.
- verified citations scheduled for inclusion in a forthcoming HEDR report.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Planned work for subsequent months includes the following:

- continue to add input to the information resources tracking data base
- continue to provide documents to the DOE-RL Public Reading Room in an orderly, timely fashion
- develop a list of Hanford-originated raw data logs/notes of potential interest/use to the HEDR Project
- declassify, with or without deletions, duPont operating history volumes that address activities from startup to about mid-year 1946
- identify and collect significant documents that address silver reactor capabilities, performance, and incidents, especially at the Redox Plant
- continue to identify and collect documents and/or data of potential interest/use to the HEDR Project that address activities during the years from reactor startup through 1949
- identify documents that present information on stack filter samples and scrubber samples for 1946 through 1949
- watch for information that may explain in detail, and support data in, "green run" document HW-17381 DEL
- develop a chronology addressing stack gas disposal as reported in selective issues of technical progress letters
- develop a listing of selected citations addressing the "hot particle" problem
- develop a listing of citations addressing the radioactivity of reactor effluent and the impact of fuel failures on the radioactivity
- create an updated listing of Hanford-originated documents of potential interest/use for the HEDR Project that are publicly available and in the DOE-RL Reading Room. Update the listing of classified documents and those currently being processed for public availability.

Records Management

OBJECTIVE

Members of the Records Management Task provide storage and control of completed project records, maintain an automated inventory of all project documentation, and provide a reference service to project staff and the TSP.

PROGRESS

Activities for this reporting period included the following:

- received and processed project records.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for subsequent months includes the following:

- continue processing incoming project records
- continue transferring processed project records to the DOE-RL Public Reading Room.

1. **Introduction**

The purpose of this report is to provide a summary of the work done during the period from 1 January to 31 December 1964.

2. **Summary of Work Done**

The work done during the period from 1 January to 31 December 1964 is summarized in the following table:

3. **Conclusions**

4. **References**

5. **Appendix**

6. **Tables**

7. **Figures**

8. **Notes**

9. **References**

10. **Appendix**

11. **Tables**

12. **Figures**

13. **References**

14. **Appendix**

Quality Assurance

OBJECTIVE

The objective of this task is to ensure continuous quality assurance (QA) support and coordination with all project tasks. This objective is met through the identification and documentation of QA requirements in the form of a QA Plan and periodic monitoring of project activities during the life of the project to ensure compliance with these requirements.

PROGRESS

Activities for this reporting period included the following:

- performed surveillances on the atmospheric transport code that will be used to perform transport, diffusion, and deposition calculations for Phasel. Computer software requirements checked included code verification, configuration management, and application of the code. The overall surveillance results indicate that effective control is being exercised in the atmospheric transport code documentation reviewed for compliance to the applicable software QA requirements.
- submitted the latest draft version of procedure HEDR-TP-3, *HEDR Documentation of Critical Decisions*, to technical task leaders for review and comment.

MAJOR PROBLEM AREAS AND ACTIONS TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for subsequent months includes the following:

- assist in implementing QA program requirements for HEDR staff training and software control requirement identification

- perform surveillance of software control requirements and records control
- issue remaining HEDR procedures: HEDR-TP-3, *HEDR Documentation of Critical Decisions* and HEDR-TP-4, *HEDR Data Quality Objectives*
- plan for and participate in internal PNL QA audit.

Statistics

OBJECTIVE

Task members will provide statistical support to members of technical tasks and will develop and apply sensitivity and uncertainty analyses. Sensitivity analyses will be used to identify parameters with the greatest influence on dose estimates. Using sensitivity analyses results, project staff can focus resources where the benefit in terms of accurate dose estimates is greatest. Uncertainty analyses enable task leaders to determine the extent to which the accuracy and precision of the dose estimates are influenced by accuracy and precision in the input parameters.

PROGRESS

Activities this reporting period included the following:

- began developing a strategy for using the multiplicative lognormal method for conducting uncertainty analyses to compare with uncertainty analyses conducted using monte carlo computer simulations
- continued to write the strategy for conducting uncertainty analyses. This strategy document will appear in the Phase I HEDR summary report.
- attended a meeting on August 3 and 4 of the National Cancer Institute (NCI) Task Group on Exposure of American People to Iodine-131 from Nevada Test Site Fallout. The purpose of the meeting was to review the latest draft of the final report to NCI and to provide technical direction. Important discussions took place concerning uncertainty analyses that were germane to the HEDR project.
- prepared an abstract of a proposed paper that would be presented at the Workshop, Statistics of Human Exposure to Ionizing Radiation, Oxford, UK April 2-4, 1990. The abstract is titled, "Statistical Aspects of Reconstructing the 131-I Dose to the Thyroid of Individuals Living Near the Hanford Site in the Mid-1940s".

- continued to collect references that discuss how to communicate statistical and scientific concepts to lay (public) audiences. This effort supports TSP Directive 89-7, "Presentation of Technical Material to the Public".
- began planning a workshop to be held early in 1990 that would review the uncertainty analyses conducted in Phase I.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for subsequent months includes the following:

- continue to help develop the strategy and detailed procedures for dose estimation and uncertainty analyses for Phase I and Phase II
- conduct uncertainty analyses to approximate the uncertainty in correction factors being developed to obtain corrected iodine-131 measurements of vegetation for 1945-1947
- plan the workshop to be held in early 1990 to review the uncertainty analyses conducted in Phase I
- help the Demographics, Agriculture, Food Habits Task fulfill TSP Directive 89-7, "Presentation of Technical Material to the Public."

Project Technical Coordination

OBJECTIVE

The objective of the Project Technical Coordination Task is to provide a general technical overview of the project to ensure that appropriate information is generated from the technical tasks for performing the final dose calculations.

PROGRESS

Activities this reporting period included the following:

Milestone 12-B, *Native American Diet Sensitivity Study - River Pathway*, due August 1989 and rescheduled for September 1989:

- began a series of investigations to determine the important parameters for this pathway/exposure combination. It was found that the controlling parameters are Columbia River concentration and fish concentration ratio or measured fish concentration, and quantity of fish consumed; other exposure pathways were secondary in importance. Important radionuclides are Np-239, P-32, and Zn-65, in approximately equivalent fractions.

Milestone 12-G, *Native American Diet Sensitivity Study - Air Pathway*, due August 1989 and rescheduled for September 1989:

- began a series of investigations to determine the important parameters for this pathway/exposure combination. The issue of milk consumption was found to be very important. For the traditional diets without milk, consumption of traditional plants controls the dose. For non-traditional diets without milk, consumption of both conventional and traditional plant species are important. For diets with milk, iodine-131 is of greatest importance; for diets without milk, iodine-131 and ruthenium-106 are of approximately equal importance.

Milestone 12-1, *Recommendation for Experimental Procedures re:Deposition Velocity/Interception/Retention Model*, due September 1989:

- redefined this milestone as *Recommended Areas for Experimental Verification*. This will allow a broader application of the work being performed.

MAJOR PROBLEM AREAS AND ACTION TAKEN

None.

PLANNED WORK FOR SUBSEQUENT MONTHS

Work planned for the subsequent months includes:

- continue defining the overall structure of the needed HEDR data base and the type of data needed for smooth project integration
- complete the dominant radionuclides report and issue for TSP review.

APPENDIX A

Communications Log

COMMUNICATIONS LOG - AUGUST 1989

<u>INITIATED BY</u>	<u>CONTACT</u>	<u>AFFILIATION</u>	<u>TYPE</u>	<u>SUBJECT</u>
PNL/W. Haerer	John Till	TSP, Chairman	Telephone	Ongoing discussions re:HEDR Project
PNL/W. Haerer	Bernard Shleien	TSP, Executive Secretary	Telephone	Ongoing discussions re:HEDR Project
JS Stohr/T. Jetton	Bonnie Dennis	PNL	Telephone	Ongoing discussions re: meeting planning
PNL/L. Morgan	Maurice Robkin	TSP	Telephone	Independent corroboration of I-131 data for Phase I
TSP/ M. Robkin	Cal Heeb	PNL	Telephone	Power profile in Hanford solid slug
PNL/C. Heeb	Maurice Robkin	TSP	Telephone	Response to inquiry re:power profile in solid slug
PNL/R. Hanf	Herman Paas	Former Hanford Employee	Telephone	Vegetation pellets
PNL/R. Hanf	Jack Healy	Former Hanford Employee	Telephone	'45 & early '46 hand-formed vegetation pellets
PNL/B. Dennis	Bernard Shleien	TSP	Telephone	Release of MESOILT code
TSP/V. Nguyen	JV Ramdsell	PNL	Telephone	Request for MESOILT code
PNL/R. Hanf	Lou Turner	Former Hanford Employee	Telephone	Vegetation pellets in 1945 and 1946
PNL/R. Hanf	Robert C. Thorburn	Former Hanford Employee	Telephone	Sagebrush & cheatgrass counting pellets
PNL/E. Mart	Walt Singlevich		Telephone	Support for Env. Monitoring Task

DISTRIBUTION**No. of
Copies****No. of
Copies****OFFSITE**

D. S. Barth
University of Nevada
4505 Maryland Parkway
Las Vegas, NV 89154

W. A. Bishop
2503 Wedgewood Court SE
Olympia, WA 98501

M. L. Blazek
Oregon Department of Energy
625 Marion Street N.E.
Salem, OR 97303

G. G. Caldwell
Deputy Director
Arizona Dept of Health Services
1740 W. Adams St.
Phoenix, AZ 95007

S. N. Davis
Dept of Hydrology &
Water Resources Bldg 11
University of Arizona
Tucson, AZ 85721

N. J. Germond
224 Iron Mountain Blvd.
Lake Oswego, OR 97034

P. C. Klingeman
College of Engineering
Merryfield Hall 100
Oregon State University
Corvallis, OR 97331-2410

K. J. Kopecky
Fred Hutchinson Cancer
Research Center
1124 Columbia Street
Seattle, WA 98104

R. L. Morrill
Dept of Geography
DP-10
University of Washington
Seattle, WA 98195

A. H. Murphy
Depts of Atmospheric Sciences
and Statistics
Strand Agricultural Hall Rm 331
Oregon State University
Corvallis, OR 97331

V. Nguyen
EWA, Inc.
133 1st Ave. N.
Minneapolis, MN 55401

D. W. Price
Agricultural Economics
Hulbert Hall Room 211
Washington State University
Pullman, WA 99163

M. A. Robkin
Radiological Sciences SB-75
University of Washington
Seattle, WA 98195

G. S. Roessler
202 Nuclear Sciences Center
University of Florida
Gainesville, Florida 32611

B. Shleien
2421 Homestead Drive
Silver Springs, MD 20902

A. P. Slickpoo Sr.
P. O. Box 331
809 Nez Perce Lane
Kamiah, ID 83536

No. of
CopiesNo. of
Copies

	J. E. Till Rt. 2 Box 122 Neeses, South Carolina 29107		D. E. Walker Jr. P. O. Box 4147 Boulder, CO 80306
	J. V. Flett Spokane Business Council P. O. Box 100 Wellpinit, WA 99040		A. V. Pinkham, Chairman Nez Perce Tribal Exec Committee P. O. Box 305 Lapwai, ID 83540
	Z. Jackson, Chairman Tribal Council Confederated Tribes of the Warm Springs Reservation P. O. Box C Warm Springs, OR 97761		M. Sampson, Chairman Tribal Council Confederated Tribes and Bands of the Yakima Indian Nation P. O. Box 151 Toppenish, WA 98948
	G. Nenema, Chairman Kalispel Business Council P. O. Box 39 Usk, WA 99180		E. Stensgar, Chairman Coeur d'Alene Tribal Council Plummer, ID 83851
	E. H. Patawa, Chairman Board of Trustees Confederated Tribes of the Umatilla Indian Reservation P. O. Box 638 Pendleton, OR 97801		M. Tonasket, Chairman Colville Business Council P. O. Box 150 Nespelem, WA 99165
3	DOE Office of Scientific and Technical Information Technical Information Center P. O. Box 62 Oak Ridge, TN 37830		R. R. Mooney Washington State Dept of Social & Health Services LE-13 Olympia, WA 98504-0095
10	J. S. Stohr Office of Nuclear Waste Mgmt Department of Ecology Mail Stop PV-11 Olympia, WA 98504		D. Oliver, R.S., M.P.A. Hazardous Waste Coordinator Toxic Substances Section Dept of Social & Health Services LD-11 Olympia, WA 98504
	J. Ruttenber Centers for Disease Control 2858 Woodcock Blvd Koger Center F-28 Atlanta, GA 30341		S. Simon Dept of Environmental Science, CB7400 University of North Carolina Chapel Hill, NC 27599

No. of
CopiesNo. of
Copies

A. P. Hull
Safety & Environmental
Protection Division
Bldg 535A
Brookhaven National Laboratory
Upton, NY 11973

T. D'Arcy McGee
Counsellor (Energy)
Canadian Embassy
1746 Massachusetts Ave NW
Washington, DC 20036

J. D. Mulder
Public Health Liaison to EPA
U.S. EPA
1200 Sixth Ave.
Seattle, WA 98101

L. Duffy, S-1
Department of Energy
Forrestal Bldg Room 7B-118
1000 Independence Ave.
Washington, DC 20585

R. Geiger, EH-231
Department of Energy
Forrestal Bldg Room 3G-089
1000 Independence Ave.
Washington, DC 20585

C. Morris, DP-3
Department of Energy
Forrestal Bldg Room 4A-045
1000 Independence Ave.
Washington, DC 20585

C. Bastin, NE-471
Department of Energy
Room F-416
Germantown, MD 20545

F. R. Dixon
Chief of Bureau of Preventive
Medicine Dept of Health & Welfare
State House
Boise, ID 83720

W. J. Roberds
Golder Associates
4104 148th N.E.
Redmond, WA 98052

E. Magione, Director
Division of Disease Control
& Environmental Epidemiology
Colorado Dept of Health
4210 E. 11th Ave.
Denver, CO 80220

S. Convis, MA-295
Department of Energy
Forrestal Bldg Room 7E-054
1000 Independence Ave.
Washington, DC 20585

A. Fingeret, GC-22
Department of Energy
Forrestal Bldg Room 6H-087
1000 Independence Ave.
Washington, DC 20585

M. Leifer, EH-232
Department of Energy
Forrestal Bldg Room 3G-089
1000 Independence Ave.
Washington, DC 20585

J. Tseng, EH-20
Department of Energy
Forrestal Bldg Room 4A-045
1000 Independence Ave.
Washington, DC 20585

No. of
CopiesNo. of
Copies

D. Nelson, EH-33
Department of Energy
Room G-144
Germantown, MD 20545

B. Goldsmith, ER-73
Department of Energy
Room E-222
Germantown, MD 20545

V. Trice, DP-122
Department of Energy
Room A-222
Germantown, MD 20545

G. Sherwood, NE-12
Department of Energy
Room E-478
Germantown, MD 20545

L. Waldo, DP-122
Department of Energy
Room A-222
Germantown, MD 20545

R. Mathias, ER-70
Department of Energy
Room F-208
Germantown, MD 20545

ONSITE1 Hanford Environmental Health
Foundation

S. E. Dietert H1-03

2 Westinghouse Hanford Company

G. D. Carpenter H4-15
D. E. Wood H4-51

15 DOE Richland Operations

J. H. Anttonen, AMR A5-10
R. F. Brich, SED (2) A5-55
R. A. Holten, SED A5-55
J. R. Hunter, OPD A6-55
J. J. Keating, AMS A6-54
M. J. Lawrence, MGR A7-50
E. E. Pride, OCC A4-52
A. J. Rizzo, AMO A6-53
R. M. Rosselli, AMA A7-70
R. R. Tibbatts, FRD A7-88
M. W. Tiernan, SED (2) A5-55
K. J. Wheelless, COM A7-75
M. J. Zamorski, OPD A6-55

46 Pacific Northwest Laboratory

D. L. Alamia K3-70
G. L. Andrews P7-80
W. F. Bair K4-14
J.W. Brothers K1-86
D. S. Broussard K1-67
D. B. Cearlock K1-42
T. D. Chikalla K1-74
T. T. Claudson K1-45
R. Cuello P7-50
G. H. Cunningham K1-59
J. W. Falco K6-78
M. D. Freshley K6-96
R. O. Gilbert K1-85
S. P. Gydesen P8-55
H. A. Haerer K6-89
M. S. Hanson K1-51
J. Johnson K3-53
W. E. Kennedy K3-54
R. C. Liikala K1-57
A. H. McMakin K6-86
L. G. Morgan K2-35
B. A. Napier K3-54
T. A. Nelson K1-55
R. E. Rhoads K6-64
J. T. A. Roberts K1-40

**No. of
Copies**Pacific Northwest Laboratory, contd.

R. L. Skaggs		K6-77
R. G. Stevens		K6-45
J. A. Stottlemire		K6-94
W. L. Templeton		K1-30
W. R. Wiley		K1-46
R. K. Woodruff	(2)	K5-09
H.E. Wyer		K1-11
Project Office Files	(5)	K6-89
Records Center		K3-70
Technical Library	(2)	
Public Reading Room	(5)	A1-65